www.newsteelconstruction.com

NSC

Heathrow terminal expands

Nov/Dec 2012
Vol 20 No.9

Rail upgrade at Reading

New Place at London Bridge

www.steelconstruction.info launched

New focus for Tata Steel

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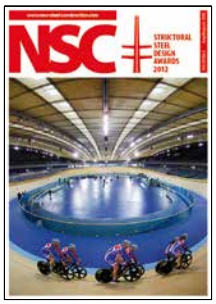
New Steel Construction keeps designers and contractors abreast of all major steel construction related developments and provides detailed technical information on key issues such as the introduction of the Eurocodes. NSC will be the first place most people hear about advances made by the extensive research 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 four 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'.

NSC is available free of charge every two months to subscribers living in the UK or Ireland by contacting us by email at *admin@new-steel-construction.com*, or filling in the form below and faxing it to 020 7747 8199.



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Cover Image
Reading station redevelopment
Client: Network Rail
Architect: Grimshaw
Steelwork contractors:
Bourne Group, Cleveland Bridge
Steel tonnage: 3,000t

NSC
Nov/Dec 2012 Vol 20 No 9

These and other steelwork articles can be downloaded from the New Steel Construction Website at *www.newsteelconstruction.com*

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Helicopter base - Model courtesy of Stahlbau Ziemann GmbH

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First port of call for steel advice

Nick Barrett - Editor

The steel sector, already renowned for providing a wealth of information, guidance and other advice, has launched a new website that brings together all the technical and cost information previously available across a number of steel sector sources, into one easy to use location. The new website, *www.steelconstruction.info* went live on 1 October and is already proving popular with architects and engineers as the new go-to source for information.

A recent survey showed that there was already a wealth of design guidance available, but spread across a number of different sites it wasn't always easy to find. The solution has now been provided in the shape of a new online steel 'encyclopaedia' that can be easily accessed and is straightforward to use. The site has been developed over the last two years by the British Constructional Steelwork Association (BCSA), Tata Steel and the Steel Construction Institute.

It can be described as a 'wikipedia' for steel construction and can be easily found via a Google search thanks to search engine optimisation strategies. It can be accessed via any device like smart phones, iPads or computers. The information will be developed as new material such as design guidance becomes available and old advice is updated, although it is fairly complete as it stands today.

The hope is that the earliest users will tell their colleagues about it and it will quickly become the go-to source for steel construction related information - there is already clear evidence that this is happening and that architects and engineers are finding the new site a useful resource.

The steel sector wants people to let it know what they need; this information will guide future market development activity so take a look at *www.steelconstruction.info* and let us know what you think.

An encouraging reception has also been given to the new NSC website which went live on 1 September, at *www.newsteelconstruction.com*, As well as featuring current issues and having its own search function, the new site contained searchable digital magazine versions of NSC for the past five years at launch; this has now been extended to seven years and will soon be eight years. Just like the new *steelconstruction.info* website, the NSC website and the digital magazines can be viewed with full functionality on virtually any device, including smart phones, iPads and laptops. The old NSC site remains linked from the new one, keeping the older archive available.

NSC

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The role of the Editorial Advisory Board is to advise on the overall style and content of the magazine.

Steel erectors should get a PAL

The British Constructional Steelwork Association is encouraging its membership to ensure steel erectors hold an IPAF (International Power Access Federation) PAL+ qualification.

PAL+ is an optional, additional one day of category specific training for mobile elevating work platform (MEWP) operators working in higher risk or challenging environments.

The training course focuses on practical training and includes a short, compact theory session. It is intended to be more advanced, challenging and extensive than the PAL operator course, which meets all requirements for basic operator training.

The UK Contractors Group (UKCG) recently stated that it would encourage steel erectors and net riggers working on UKCG sites to hold an IPAF PAL+ qualification from 1 January 2013.

Trusses create covered town hall courtyard

Phase one of the redevelopment of Wiltshire County Hall in Trowbridge was officially opened in early November.

The work included creating a new internal courtyard by roofing over a previously underused outdoor area between the two County Hall office blocks.

A series of nine 30m long tubular trusses support a lightweight ETFE roof, creating a new main entrance and reception area, a café and a new indoor link between the site's buildings.

Tubecon, a division of Billington Structures, supplied and erected the trusses. They arrived on site in three pieces and were lifted into place by a mobile tower crane.

Surrounding the new covered courtyard, steel construction has also been utilised to renovate a 1970s built block and create a new library and modern open plan offices.

Phase two of the project has now started and this part of the job involves the refurbishment of the main County Hall structure.

Main contractor for the project is Kier Western, and architect Stride Treglown has carried out the design.

More turbines installed for north east

Steelwork contractor and wind turbine tower manufacturer Mabey Bridge has installed five wind turbines at Seamer wind farm in Teesside.

The manufacturer makes wind turbine towers at its base in Chepstow and transports them to sites across the UK.

In addition to manufacturing five 80m high towers for client REpower, Mabey Bridge also installed them, along with nacelles, rotor hubs and blades.

Using a 1,200t main crane and 300t tailing crane, each tower took 10 erectors two days to assemble.

Seamer wind farm lies across the administrative boundaries of Hambleton and Stockton-on-Tees. The site is on arable farmland between the villages of Seamer and Hilton.

The site was developed by Banks and has recently been acquired by Infinis, one of the UK's leading generators of renewable power.

When operational, the 2MW turbines are expected to generate enough electricity to meet the average annual electricity demands of 6,400 local households.

The turbines are supplied by REpower UK whose Managing Director, Rick Eggleston, commented that using Mabey Bridge for the Seamer installation made perfect sense.

He said: "REpower has worked closely with the company since its move into the wind industry, and we have developed an extremely positive relationship. Considering their heritage we had no hesitation in choosing Mabey Bridge for this job.

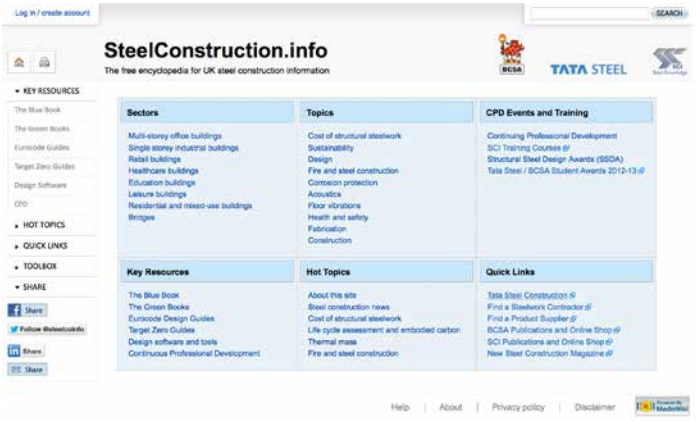
"The fact that Mabey Bridge now offers the expertise to install wind turbines can only be a positive for the UK renewables sector."

Go-to advice source

The steel sector's new website – *www.steelconstruction.info* – bringing all the steel construction sector's guidance on detailed design and other topics together in a single easily searchable location - has been successfully launched.

Architects and engineers have been enthusiastic users of the new site since its launch on 1 October, and it is fulfilling its promise to be the first stop for technical guidance on steel construction. The site, the result of a two year development programme by the BCSA, Tata Steel and the SCI, can be seen as an online 'encyclopaedia', or 'Wikipedia' for steel construction. At its core are over 100 Wikipedia style articles, written by the steel sector's own experts and external consultants, covering best practice in the use of steel across the construction sector.

The site was well stocked with vital information at launch and new and updated guidance is being added as it becomes available. Popular sections with engineers so far have included those covering eurocode guidance and the Green Books on connection design, while architects are finding the schematics summarising the most cost effective ways to achieve the required BREEAM rating for five common sectors of particular interest. Guidance on thermal mass passive cooling strategies in steel framed buildings has been popular with both architects and engineers.



Chris Dolling, BCSA Manager, Technical Development, said: "The site contains material written by industry experts, bringing together all steel related advice and information into one easily accessible place. It is the go-to source for steel construction, easy to navigate and designed with construction professionals in mind."

Cellular beams create Airbus headquarters

ASD Westok has worked closely with consulting engineers Ramboll to successfully deliver 500t of cellular beams for the Airbus Office project in Bristol.

The £27m project will consolidate more than 2,500 of the company's 4,000 engineering, design, customer support and other employees onto one new modern site.

The four-storey office building incorporates four atria and a roof level plant room. The structural grid was set out at 15m × 7.5m, and both the client and architect were keen to employ an exposed structural solution.

Westok floor beams were chosen as the most economic means of achieving the required long clear spans.

Iconic crystal leads the way in green design

The Crystal, a unique structure designed for Siemens to showcase sustainability has officially opened in London.

Located on the waterfront at the western end of the Royal Victoria Docks, the 6,300m² Crystal will serve as a conference centre, technology and innovation venue and a hub for dialogue on sustainable living and development.

The building will be home to Siemens' global 'Center of Competence Cities', a team of urban experts who aim to encourage the growth of sustainable cities through partnerships, research and expert collaboration on solutions.

Speaking at the launch, Chief Executive of Siemens, Peter Löscher said: "Cities are the engines of the world economy and also have the greatest impact on the environment. The development of our planet will stand or fall with the development of cities. Looking ahead to the urban future, the Crystal showcases a wide variety of opportunities and solutions."

The 800t of steelwork for the complex frame was fabricated, supplied and erected by Rowecord Engineering working on behalf of ISG.

NEWS IN BRIEF

Barrett Steel has launched Barrett Offshore Tubes to provide a dedicated and focused service to the offshore market for oil, gas and renewable energy. As part of the company's strategy the service centre at Scunthorpe has been earmarked for development.

ADS Westok is hosting a seminar on 'An Integrated Approach to Fire Design' to be held at the Wellcome Collection Conference Centre, Euston Road, London on 12 December 2012. For more information email: *info@asdwestok.co.uk*

BW Industries has purchased a new production line from FICEP UK. The new machine is said to have increased throughput by as much as 74% for the company's range of sections and channels.

Metsec SFS lightweight steel framing system has been used to create a multi million pound library and joint services centre in Whitley Bay. Due to open next spring, the centre is expected to become a hub of the community.

A new patented guardrail system, known as Formarail, from **Barrett Steel** has been introduced. It is designed for rapid installation and is said to be suitable for roof edge protection, handrails, steps and ramps, trackside guardrails, pedestrian segregation and protection, mezzanine floors and gantries.

Tata Steel RoofDek D100 structural roof decking has been installed as part of an innovative green convex and concave curved roof construction at the new Maplefields School in Corby. Main contractor for the project was Graham Construction working for Northamptonshire County Council, while the steelwork package was completed by Walter Watson.

AROUND THE PRESS

Construction News
13 September 2012
Steely approach for grammar school
[Kirkwall Grammar School] - As at the Papdale Hall of Residence, the team settled on the use of structural steel as a framing material thanks to its speed of erection and reduced likelihood of the construction timetable being wind affected.

Construction News
11 October 2012
Landmark council HQ gets modern refurb
[Derby Council House] – Under the scheme, a new steel frame has been built within the original central courtyard of the building that connects to the existing frame. This new frame provides a central atrium and new council chamber.

Building Design
2 November 2012
Meeting the student deadline
"Most of our schemes are built in steel," says Rusell Worthington, development director of developer Worthington Properties, "Concrete is far too slow. Steel frame is all to do with speed."

New Civil Engineer
8 November 2012
Phoenix from the floods
[Northside Bridge, Workington] "Steel offered us a number of benefits, one of which was speed of construction," says Capita Symonds project manager Alan Webb.

The Structural Engineer
November 2012
Major steel website launches
www.steelconstruction.info is described as a free encyclopaedia for UK steel construction… Chris Dolling, BCSA Manager, Technical Development said: "This is one of the most significant developments in making steel related advice available to designers since the internet started."

Members' Day informs steel community

The SCI annual Members' Day took place on Wednesday 24 October at the National Motorcycle Museum in Solihull.

Starting up the event, guest speaker Fergus McCormick of Buro Happold delivered a presentation on the Olympic Stadium. He demonstrated the originality of the design and the teamwork involved in the project that enabled the stadium to be safely and successfully completed almost a year ahead of the opening ceremony.

The main focus for the event was the provision and access of technical information within the steel community.

SCI's Michael Sansom demonstrated the new *www.steelconstruction.info* website, which provides a "Wiki" style encyclopedia of information.

Steelbiz, SCI's online technical resource site, to be relaunched in 2013, was demonstrated and explained by Dorota Koschmidder of the SCI.

Graham Couchman, SCI CEO, introduced the final topic on Steelbiz Direct, which is a further development of Steelbiz, to deliver relevant resources based on an intelligent matching of search criteria and resource content, given in an appropriate way to the end user.

The future directions for all of these information resources should reflect the end user's requirements, says the SCI. It is important that their development reflects how designers access information and how that information is used and so the SCI would like to receive input to help develop the strategy.

It has two surveys at *http://www.steel-sci.com* From the responses, one individual will be selected at random and sent an iPad to acknowledge their contribution.

Steel forms new London public realm

More than 550t of structural steelwork is being erected by Fisher Engineering to form St Pancras Square, a new public realm that will include cafes, restaurants and a terraced water feature.

Also known as Zone B, St Pancras Square is part of the 67 acre Kings Cross development that will ultimately deliver up to 1,900 new homes, more than 300,000m^2 of office space, 46,000m^2 of retail space, 20 new streets and 10 public spaces.

Seven new buildings, all with their own basements, but also sharing a common basement created by the steel podium, will surround St Pancras Square.

The steel podium, measuring 110m × 55m and covering approximately 3,500m^2, will initially be used to provide construction vehicle access to the adjacent construction sites before being converted into the realm.

Atrium links academic centre

Steel construction has played an integral role in the building of St Peter's Academy in Stoke-on-Trent.

Knitting the project's four educational wings together, and providing the academy with an open and clear span focal point, is a steel framed atrium.

Working on behalf of main contractor Thomas Vale, Atlasco Constructional Engineers has designed, supplied and erected 70t of steel for this feature element.

Four steel walkways link the school's first and second floors by spanning the atrium; these steel structures are all hung from the roof rafters.

"To accommodate the walkways we've had to erect a series of 1m deep cellular beams," explained Anthony Gilbert, Atlasco Project Engineer. "Some of these 20m long members are up to 4t in weight."

Atlasco has also erected a further 74t of structural steelwork to construct the academy's sports hall. A series of 29m long Westok cellular beams create the necessary open area. These were brought to site in three pieces, spliced together on the ground and then lifted into position as one long rafter.

St Peter's Academy is scheduled to open in September 2013.

Steel completes greenest public building

Having received a BREEAM 'Outstanding' rating the Brent Civic Centre has the distinction of being the greenest pubic office building in the UK and the fourth greenest in the world.

Working on behalf of main contractor Skanska, Bourne Steel has recently completed the steel erection for the project. A total of 1,000t of the material has been utilised to form a full height glass fronted atrium, that connects a concrete framed council office block to a nine-storey steel framed drum shaped civic building.

Five 30m long steel plate girders support the 31m high atrium roof and these are supported at their ends by columns on the interior face of the office block and civic drum.

At 950mm deep and 350mm wide, the girders and their associated steelwork create a 7.5m grid that is in-filled by ETFE pillows.

Steel members were designed to arrive on site in their longest possible lengths to reduce the amount of time spent on site splicing sections together, as well as to reduce the risk of working at height.

The girders each arrived in 15m long sections and were lifted using tower cranes, which were designed specifically for the weight and reach required to install the members.

Halls of residence for outlying islanders

Part of a multi million pound schools investment programme for the Orkney Islands, a new halls of residence is under construction at Kirkwall Grammar School.

"Pupils from the outlying and northern islands of Orkney cannot travel to and from school in one day," explains Alan Moar, Orkney Islands Council Project Director. "They will generally arrive on a Monday morning and stay at the halls until Friday."

The halls comprise of two three-storey blocks linked by a ground level passageway and entrance. Together they provide 70 en suite bedrooms, mostly singles but there are also a few twins as well as four disability rooms.

BHC has erected 180t of structural steelwork to complete the blocks in just three weeks. All of the steel was brought to site in 25t loads, travelling from BHC's facility to Aberdeen by road, then via ship to Kirkwall.

"The speed of steel construction was one of the main reasons for choosing the material," says Ronnie Bruce, Morrison Construction Project Director. "We looked at all options and even if we'd have had to stop erecting steel for a period due to windy conditions, it was still the best and most cost efficient framing option."

Edinburgh University's wave and tidal test facility framed in steel

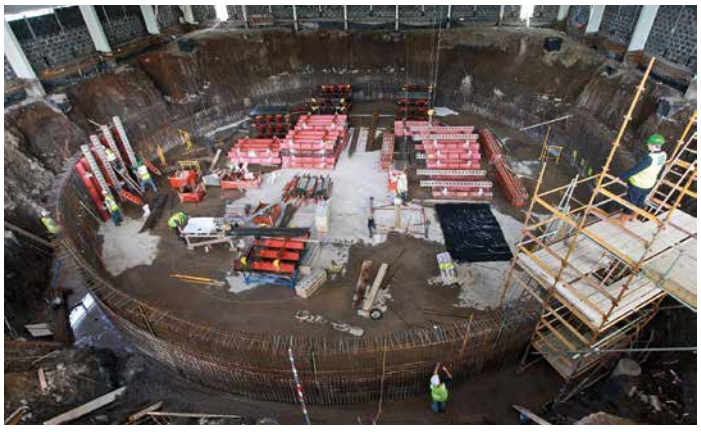
The new state-of-the-art wave and current test facility being built by Graham Construction at the University of Edinburgh has reached a milestone as the outer steel frame has been erected.

Once completed, the facility will be able to simulate at scale combinations of waves of up to 28m high and currents up to 12 knots – ideal conditions for developers of cutting-edge marine energy technologies.

The circular 25m pool is specifically designed to mimic the normal and extreme conditions of coastlines around the UK and Europe, and will also be suitable for testing of submersible devices, remotely operated vehicles and offshore wind installation and service vessels.

Graham started on the £9.5M national facility in February following demolition of redundant buildings at the King's Buildings campus within the University of Edinburgh.

Since then, the company has driven the piles and excavated, reinforced and poured the base of the 5.4m deep pool, as well as overseeing the erection of steelwork by contractor Alex Morton Contracts.



Diary

For SCI events contact Jane Burrell, tel: 01344 636500 email: *education@steel-sci.com*

15 Nov 2012
Steel Building Design to EC3
Manchester

21 & 22 Nov 2012
Essential Steelwork Design (2 Day)
London

20 Nov 2012
Portal Frame Design - Design of Members
1 hour webinar

27 Nov, 4 & 13 Dec 2012
On-line Steel Building Design to EC3 - Part 1
On line delivery (1 day course)

12 Dec 2012
Portal Frame Design - Connection Design and Detailing
1 hour webinar

15 Jan 2012
EC4 Composite Design (Part 1)
1 hour webinar

Making the difference

Tata Steel has reorganised its sales and marketing organisation with the previous product led approach being replaced by sector focused teams. Sales and Marketing Director for the Construction Structures sector, Ian Beveridge, talks to Nick Barrett about the benefits this will bring to customers and the rest of the construction supply chain.

Ian Beveridge says the steel construction sector deserves more recognition

Tata Steel has a long history of supporting the UK construction supply chain, which is widely acknowledged as the most sophisticated and developed in the world. This didn't happen by accident, but was the result of consistent effort and investment over many years, by the UK's leading steel producer, going back to the days of British Steel, through Corus and now Tata Steel, and its partners in the British Constructional Steelwork Association and the Steel Construction Institute.

Ian Beveridge says he is keen for the contribution of Tata Steel and its customers in this success story to continue and he would also like to see them get rightful recognition. "UK construction has benefited greatly from the improvements made in the steel construction supply chain. The delivery of the major venues for the London 2012 Olympics is a fantastic example of UK construction at its best, and steel played a big part in that. We need to shout louder about the key role steel plays in many major construction projects and the genuinely world class capability of the steel supply chain in the UK, from outstanding designers through product manufacturing and distribution and then on to fabrication and erection on site.

"As the Construction Structures Sector within Tata Steel in Europe we now need to improve our product and service offerings as well as expand our customer base or we will always be vulnerable to changing market circumstances. We still need to maintain and improve our traditional relationships with our key steelwork contractor customers, which have been built up over many years, but we also need to develop new ways of working together and sharing joint strategies and objectives."

The new customer focus in Tata Steel is all about 'Together we make the Difference'. This is supported by the new sector based organisation that puts Mr Beveridge at the head of structural sections, tubes and plate sales to the construction sector. Tata Steel is the only European steel producer to have aligned itself in this way, where production and supply chain activities are aligned to respond to the requirements of specific market sectors.

Dedicated market sector teams now give customers single point access to all of the company's products as well as its technical and research and development resources. "Our vision is to use the strength and depth of our product and service offering to make Tata Steel a brand that is recognised as good to do business with. We know we do a lot of things right but we accept that we can do

Ian Beveridge has managed two of the biggest distribution businesses in the UK

East of Scotland born Ian Beveridge is a committed steel man but admits that he came into the industry by accident: "I have always had metal in my veins. I joined the steel sector by accident initially working for a small local stockholder for ten years, which is where I learned the trading dynamics of the steel business. We had little cash, minimal stock and only a few customers to start with and built a very successful business from the ground up."

His next move was to the steel distribution group ASD, running its Edinburgh depot and eventually, following various regional appointments, becoming Managing Director. ASD had a substantial UK position, as did the Corus Distribution business where again after several key positions he became Managing Director, which means he has managed two of the biggest distribution businesses in the UK. "I joined Corus in 2004, so I had a good insight into the customer view of the company. I also knew that customers highly value both the continuity and reliability of supply provided by Corus, and now Tata Steel in Europe."

Mr Beveridge greatly admires the achievements of the UK construction industry and is proud of the contribution made by Tata Steel and its customers on leading projects throughout the UK like the London Olympics. "There is huge value in these projects of national significance, and a host of others over the years, but there seems to be little recognition of the part the steel construction supply chain plays. The value is there but it is concealed. It is our own fault perhaps for allowing that to happen, but we do need to address it, urgently and quickly."

more, and that means we have to make some changes.

"We want to help to develop our customer's businesses as well if we can and we have a strong desire to ensure that our success also leads to further success for our key customers. Mutually advantageous relationships are what we need to foster."

The refocused Tata Steel aims to be agile and close to its customers. Trust and cooperation is the best way to describe how various parts of the company such as production, distribution and sales and marketing are now working together for the benefit of the company as well as its customers.

Understandably, Mr Beveridge does have some concerns about the levels of steel imports now penetrating the UK market at prices any domestic producer would struggle to match. Price is always going to be a key factor in the buying decision but he feels the service elements of what Tata Steel has to offer are sometimes under valued. "We need to recover the cost of the services we provide such as added value processing, exact timed multi-product deliveries as well as the ongoing investment we make in product quality and market development," Mr Beveridge said, "These can often make the difference in terms of a project being successfully delivered or not."

Customer surveys already reveal the level of service provided as a key element in decisions to do business with Tata Steel. A recent survey showed good results on a range of key indicators such as product quality, health and safety performance, delivery, lead times, ease of doing business with, help with problem solving and provision of technical support and advisory services.

Relationships with the BCSA and its members are close, as can be seen in the ongoing joint market development strategy that has a number of staff seconded from Tata Steel to BCSA to work together on some of the key issues for the sector such as sustainability and Eurocode developments. The strategy is now half way through its initial five-year period, and is working well despite the difficult circumstances in the construction market.

The new Tata Steel strategy and organisation has been explained at various industry forums and is now being discussed with customers on an individual basis. Mr Beveridge concludes: "The message is that we want to focus on how we are going to succeed and grow together. If we collectively get it right, then when the economy is back to full health there will be great opportunities for the whole steel construction supply chain."

New steel site is class-leader

The new steel sector website – *www.steelconstruction.info* – is fulfilling its promise of being the first stop for architects and engineers looking for technical advice and information on steel construction, with thousands of visitors already benefiting from its user friendly design.

The new site represents one of the most significant developments in making steel related advice available to designers since the start of the internet era, bringing together in one place for the first time all the technical and cost information previously available across a variety of steel sector sources.

The site can be looked at as the free encyclopaedia for UK steel construction, designed to be as easy to use and as comprehensive as possible - a first stop for technical guidance on steel construction. Wikipedia was chosen as the platform for the site because many already know how to find their way around Wikipedia pages, and its navigability is easy to pick up for those not already familiar with it.

The site is the product of a two-year development programme by Tata Steel, the British Constructional Steelwork Association and the Steel Construction Institute. Chris Dolling, BCSA Manager, Technical Development, explained: "A survey confirmed that the internet has become the first port of call for architects and engineers looking for design guidance and other information, so the steel sector decided to provide a world-leading internet based source for steel construction. It has already proven to be a great success with designers, which is no surprise as all the guidance they need can be found there and it couldn't be more straightforward and simple to use."

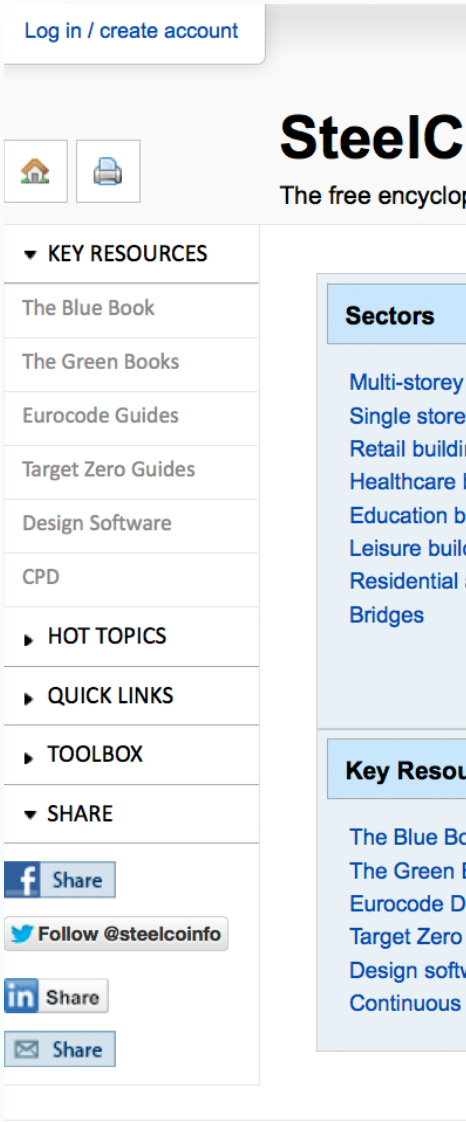
Popular sections with engineers since the site was launched on 1 October have included those covering eurocode guidance and Green Books on connection design. Architects are finding the Target Zero schematics of the most cost effective ways to achieve the required BREEAM rating for five common sectors of particular interest, and guidance on thermal mass passive cooling strategies in steel framed buildings has been popular with both architects and engineers.

At the heart of the site is a series of over 100 interlinked technical articles written by steel sector experts and external consultants covering best practice in the use of steel. Topics covered include fire engineering, cost, sustainability and health and safety, all downloadable as pdf's and containing multiple links to other information sources. These core articles act as a roadmap to each topic using links to more detailed information available from the sector and other external sources.

Online CPD presentations enable users to take tests and download certificates for their records.

The steel sector has an ongoing pipeline of research and development, continuously updating its guidance in line with changes in legislation, standards and industry practice, and the already comprehensive site will be continuously updated as new information and guidance becomes available.

The site is optimised for use with smartphones such as iPhones and Android devices as well as desktop computers



The home page of the user friendly www. steelconstruction.info site

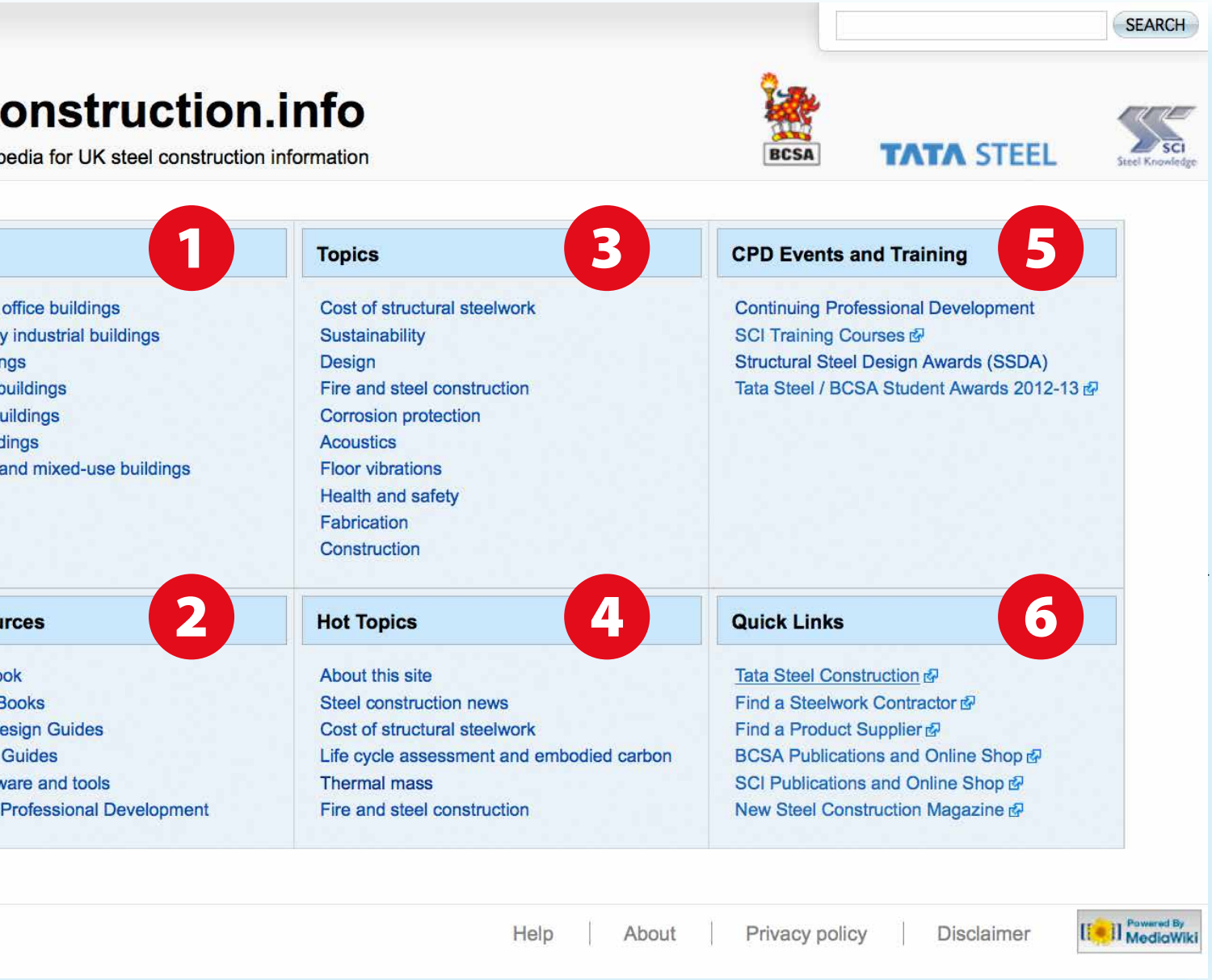
The site has almost identical functionality to Wikipedia so couldn't be more straightforward to use and navigate. On the front page of the new website you will find several main headings:

1 Sectors

Links are provided here to other relevant parts of the site where you can find information on steel structures such as multi storey commercial buildings, industrial buildings and bridges. More invaluable information is available via links to external sources within the articles.

2 Key Resources

There is a wealth of informative steel sector produced guides and they



are all easily accessible here. This includes the Blue and Green Books, Target Zero (the steel sector low carbon buildings research initiative), Eurocode Design Guides, structural design software as well as Continuing Professional Development presentations.

3 Topics

The steel sector has invested a lot of time and effort to produce extensively researched and detailed advice on subjects such as fire engineering, acoustics, floor vibrations and costs of structural steelwork, all of which can be linked from here. External sources of information are also included here, for example the cost of structural steelwork link takes you to a Gardiner & Theobald written report on the key cost drivers for steel frames for various types of buildings.

4 Hot Topics

From here you can find sections on thermal mass, life cycle assessment and embodied carbon, while links will also direct you to various sources of industry news provided by New Steel Construction magazine and steel special supplements that have appeared in other publications. This area of the site also has a section devoted to explaining how the site actually works as well as an overview of the contents.

5 CPD Events and Training

All of the steel sector provided training courses and Continuing Professional Development initiatives can be learned about here, as well as information about the Structural Steel Design Awards, the Tata Steel/BCSA Student Awards and SCI Training Courses.

The section provides access to free technical seminars that can be provided online or in-house in the UK by Tata Steel's team of Regional Technical Managers. Topics include Sustainability, Introduction to EC3, Worked Examples to EC3, Design for Fire, Portal Frames, Acoustics, and Weathering Steel Bridges.

6 Quick Links

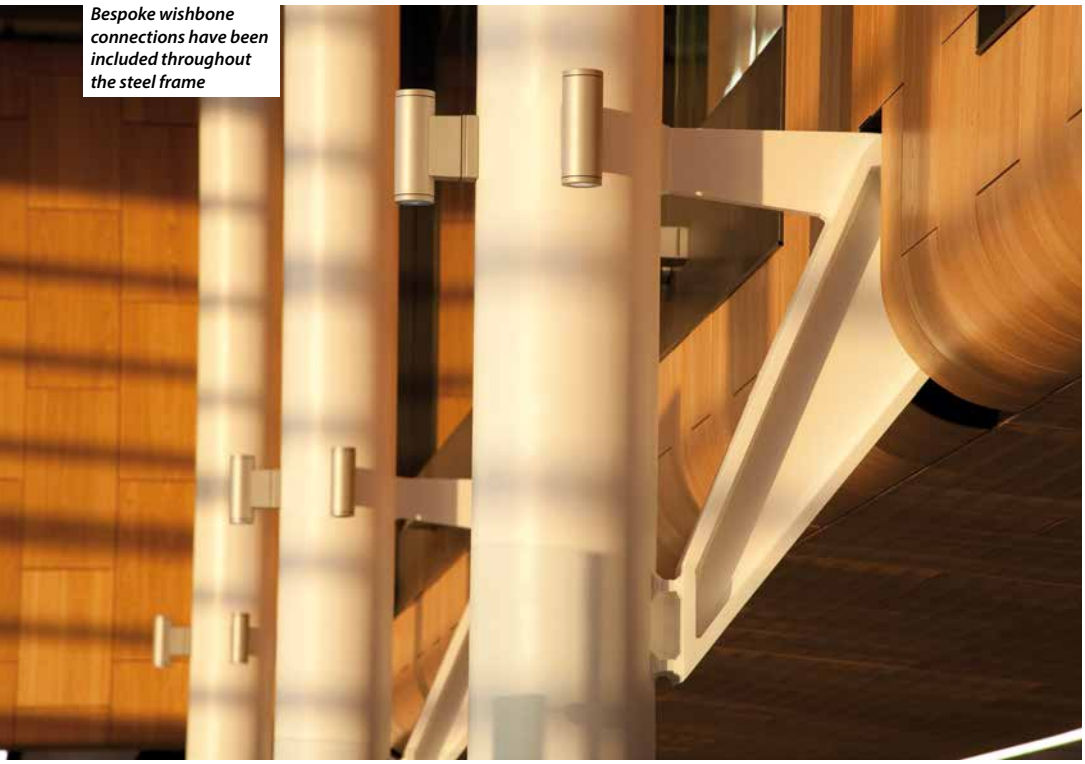
Need to find a steelwork contractor? From here you can quickly access the information about selecting a BCSA member steelwork contractor (for which there is new a free searchable app available). There are also links to the Tata Steel construction website, the BCSA and SCI online shops and New Steel Construction magazine.

Terminal checks in with steel

Steel construction has come to the fore, above and below ground, during the building of a satellite pier at Heathrow Airport. Martin Cooper reports.

FACT FILE
Heathrow Terminal 2B (Satellite pier)
Main client: BAA
Architect: Grimshaw
Main contractor: Balfour Beatty
Structural engineer: Mott MacDonald
Steelwork contractor: Watson Steel Structures
Steel tonnage: 7,000t
Project Value: £490M

Phase one of the programme opened in 2010



Bespoke wishbone connections have been included throughout the steel frame

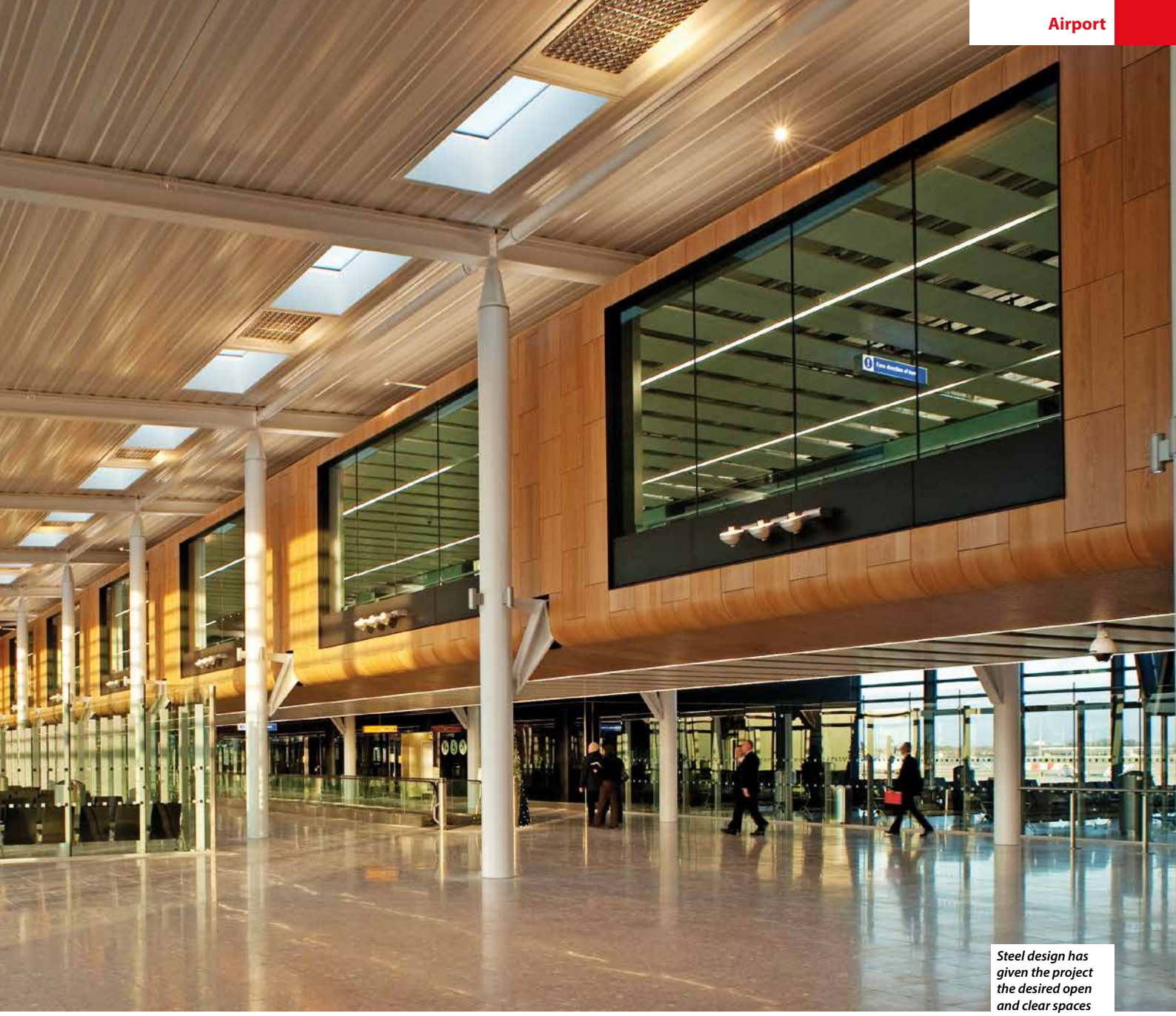
The construction of satellite pier Terminal 2B (T2B) forms part of a multi-billion pound investment programme under way at Heathrow Airport.

The overall scheme will radically improve and alter the layout of Britain's busiest airport and includes the construction of the new Terminal 2A and a multi-storey car park.

Balfour Beatty is managing the design and also constructing Satellite T2B, which is 522m long and set to fully open in 2014. It will have 16 long haul stands, 10 of which are sized for the new double decker A380s.

The T2B project is being delivered in two phases in order to ensure the airport's operation is not interrupted. Phase I opened in 2010 and delivered six new stands, the more complex Phase 2 – currently under construction – will open at the same time as the main Terminal 2A in two years time.

"The plan was to have the six stands of Phase 1 delivered well ahead of the Olympics," explains Rohit Patel, Balfour Beatty Engineering and Design Director.



Steel design has given the project the desired open and clear spaces

At the moment, the functioning stands are connected to the existing Terminal 1 via a footbridge. Once the scheme is completed, this structure will be demolished and satellite pier T2B linked to Terminal 2A initially via a passenger tunnel, and then a track transit system.

Phase 2 construction work was begun by main contractor Balfour Beatty during October 2010. Work on this part of the pier was then split into three phases, with the north and south portions of the building being constructed with a top-down method which allowed for an early start on the superstructure.

The central part of the pier is being built from the bottom up, providing for the earliest completion of the critical path subsurface plant rooms located in the basement.

The basement is large and measures 360m long, 60m wide and 15m deep. As well as providing space for plant and communications rooms for the pier, it will connect into the passenger tunnel and provide access into the pier.

Steelwork has played a key role beneath the surface as well as forming the pier's superstructure main frame. For the top-down process, 160 plunge columns have been installed, all fabricated from recycled steel. The columns are 20m long sections, and each member is supporting up to 20MN.

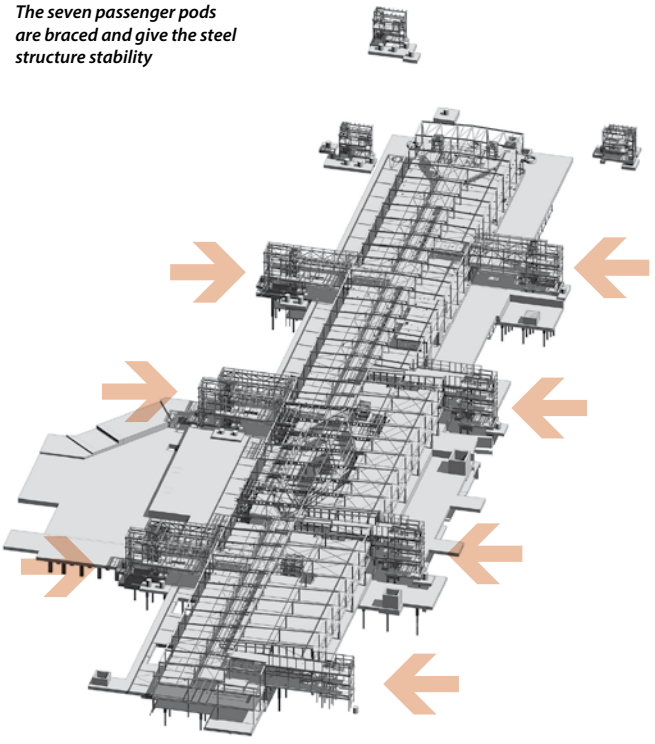
"By installing plunge columns the basement excavation could proceed, in two areas, simultaneously with the steelwork erection above," adds Mr Patel.

Co-ordination between trades, excavation, concreting and steel erection, has been a key issue on the project.

"When the groundworks team were constrained by various airport workings, steel frame fabrication was sufficiently advanced to enable the erection sequence to be reversed, which allowed the worksto progress§," says Andy Luter, Watson Steel Structures Project Manager.

The steelwork frame of the pier consists of three basement levels and four levels above ground topped with a steel roof.

The seven passenger pods are braced and give the steel structure stability



The pier will be connected to Terminal 2 via an underground walkway

"This speeded the job up and meant we'd completed the three phases – totalling 5,000t of steel – in nine months."

Above ground a lot of design work has gone into producing a light and airy structure, one that is welcoming to passengers and to this end steelwork has played a crucial role.

"We've worked hard with the architect to refine the steelwork details to form sculptural shapes and to reduce the visual impact of the building," says Eric Li, Mott MacDonald Project Structural Engineer.

The most striking and noticeable architectural steel features are the series of internal CHS columns with bespoke connections that form the Departures and Arrivals halls.

The columns stand the full height of the building and have a pencil point connection at the top and a wishbone shaped connection further down that supports the pier's second floor.

"The wishbone connection creates the impression the arrivals corridor is floating above the departures floor, and the column pencil point connection removes any bulk from the structural intersection," says Mr Luter. "The connections enhance the internal lightness of the frame."

The steel main frame is based around a regular 12m by 9m grid, which incorporates two lines of internal CHS columns. Cellular beams have also been used within the structure, not to carry services, but again to aid the desired airy ambiance.

Stability for the steel superstructure is entirely derived from bracing, some of which would usually be located along the façades.

However, as the design of a light filled structure incorporates glazing along most of the elevations, alternative locations for bracing had to be found, locations where it would not intrude on the glasswork.

The solution, as Hani Salaytah, Balfour Beatty Structural Steelwork Area Manager explains, was to use the aircraft boarding pods located along the structure's elevations.

"There are seven of these structures and they are heavily braced, acting like cores and supplementing the bracing within the main part of the building. and we had to use a large amount of temporary bracing until they were complete."

Future-proofing is also playing a key role in this construction scheme. The underground walkway will eventually be kitted out with an underground railway which, as a well as linking 2A with pier 2B, will also then connect to future Terminal 2C. Groundwork is already being prepared for this next steel framed project as part of Balfour Beatty's T2B works.

Working airside

Construction work on a functioning and busy international airport brings a host of unique challenges. Security is obviously an important issue and all workers and goods are routinely checked in and out of the Terminal 2B site.

On the flip side of the coin, one of the site's advantages is the lack of restrictions on night time work and consequently a 24-hour working cycle is possible. Most of the steelwork erection has been carried out at night, following on behind the groundwork and concrete slab teams which work during the day.

Surrounded by Heathrow Airport's busy activity, the site is very constrained and space for materials storage is at a premium. Off site construction has been used on this project to ease congestion. One of the large off site elements, a steel framed plant room for the pier, was fully assembled on the edge of the airport and then transported to the site during an 18-hour procedure.

The plant module weighed 100t (200t including the temporary works) and was moved across the airfield using multi-axle transporters that jacked the unit into place when it reached its final position.

The pier has a total of eight 12m high steel services risers, all of which arrive on site fully kitted out and ready for immediate installation, again saving time and lessening the need of on site work and space.

The project team has made use of steel with innovative and safe working methods for this complex terminal structure.

Stability solutions for Heathrow Terminal 2B Satellite Pier

Ed Yandzio (SCI)
and Eric Li (Mott MacDonald)

In the UK, the lateral stability of a large proportion of low to medium rise buildings is provided by either concrete cores or steel bracing systems. These bracing systems allow the use of 'simple' construction techniques, where connections between beams and columns are nominally pinned. This type of construction is typical for many commercial buildings.

For airport pier buildings, owing to the open plan nature of the building interior and the extensive use of glazed façades, there is less opportunity for these traditional types of vertical stabilising elements to be easily integrated within the building. More unusual solutions to provide stability have to be considered.

For the first phase of the Heathrow Terminal 2B development, the building design and construction philosophy was to use a mixture of diagonal bracing up to first floor level and steel frames with moment resisting connections above. The transverse stability of the terminal building (across its 34m width) was achieved by portal frame action at the mid column height within each bay of the main building frame. However, the high stresses on the tubular steel sections required the use of thick walled, special order sections to accommodate the connection forces and provide the required lateral stiffness.

For the second phase, which quadrupled the length of the pier, Mott MacDonald, who undertook the civil, structural and infrastructure engineering services, adopted an alternative scheme to laterally stabilise the pier superstructure, utilising the lift cores within the external pier gate extensions, known as the Vertical Circulation Cores (VCC's) to provide the transverse lateral stability. The VCC's protrude from the main body of the terminal building at approximately 90m intervals along both sides of the pier; they allow the boarding and disembarkation of aircraft passengers. The VCCs are connected to the main building by steel trusses and composite floor slabs. In conjunction with a series of braced bays at roof level and the diaphragm action of the composite floor slab at first floor level, the VCCs provide lateral stability across the width of the pier, between movement joints which occur at 90m centres. The use of the alternative stability system allowed the internal columns to be fabricated from standard hot rolled sections and significantly increased the piers structural efficiency.

Longitudinal stability is provided by diagonal bracing, situated around the building perimeter, hidden behind solid façade panels for the small service risers on either side of the VCCs. This bracing typically consists of tubular steel members arranged in a K configuration.

To enable construction of the building to progress efficiently, VCC construction usually lagged behind that of the main pier body. To stabilise the building structure during construction, temporary internal, storey high, steel props were used. These props were only removed upon the completion of the VCC's and their connection to the building.

Temporary Macalloy bars held floors in place until the structure was complete up to level 12

Balancing act

A steel frame has proven to be the right choice for a commercial project being constructed above an array of London Underground assets. Martin Cooper reports from The Place.

The South Bank area around London Bridge has changed out of all recognition over the last few years. Smart new steel framed office blocks and restaurants along the Thames waterfront have replaced dark Victorian warehouses, while adjacent to London Bridge Station developments have radically altered outdated rail infrastructure and the station environs.

The most eye-catching development is known as London Bridge Quarter (LBQ) which incorporates The Shard (the EU's tallest building), improvements to the railway and bus stations, a new landscaped public realm, and last, but not least, The Place.

Designed by renowned architect Renzo Piano, The Place is an innovative steel framed headquarters building which will provide 40,000m^2 of efficient office space within a 17-storey structure (the building has plant levels on floors 18 and 19).

Located in the heart of the LBQ and spanning three lanes of the new bus station, the structure has posed the construction team a number of unique challenges.

Below ground the building's foundations are constrained by a host of London Underground assets, and this has demanded some innovative engineering solutions as pile locations are limited.

Meanwhile above ground, maximising the lettable office space, the building's steel framed floorplates expand outwards at level 3, with the aid of cantilevering spans of 14m.

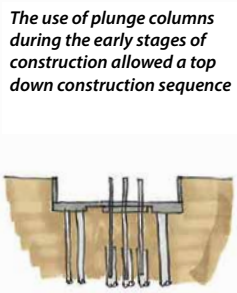
The spans are not regular, they are longer on the east elevation than on the west, and this means the building is out of balance. In the north-south direction it is out of balance as well, because of the limited columns. To stop the structure from tipping, the cores provide the lateral stability, resisting the gravity loads from the cantilevers.

This balancing act has been one of the biggest challenges, as the structure was subject to movements during the construction which also had to be accommodated.

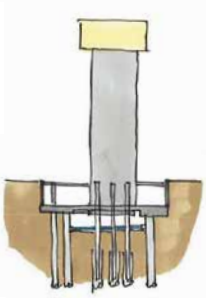
"Steelwork was the ideal material for constructing this project," says Flan McNamara, Sellar Project Managing Director. "It has given us the required efficient structure with long cantilevers, erected on a constrained site with minimal disruption to pedestrians and traffic. Below ground, steel plunge columns allowed us to conduct a top-down programme, while an on site archaeological dig was ongoing."

Unusually for a structure of this height, the basement is no more than 50 per cent of the overall footprint. This is because Northern and Jubilee Line underground tunnels, escalators, vent shafts and escape stairs as well as the main London Bridge underground ticket hall, are all within the

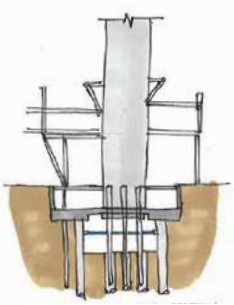
The use of plunge columns during the early stages of construction allowed a top down construction sequence



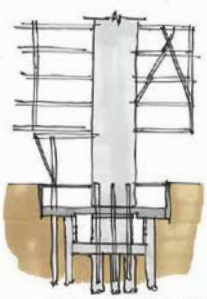
Install plunge columns, secant walls and bearing piles
Construct level 00 slab to prop secant wall



Commence slipform
Commence moling to +0.2m install props and walling at +0.5m



Commence steel erection
Moling to formation level



Steelwork completed to level 12 on both elevations and supported by the cores and temporary works

building's footprint, sometimes only a matter of feet away from the basement walls.

With so many subterranean obstructions, column and pile locations were extremely limited and had to be carefully planned. "Where we couldn't pile we have installed non load bearing columns, more architectural than structural, to give the building a symmetrical look," says Matt Massey, Mace Senior Project Manager. "In these areas the steelwork is all hung from the concrete cores."

The early part of the programme witnessed a rather busy and congested site. After the majority of the footprint was cleared and the basement was being excavated, a team of archaeologists from the Museum of London came on site. The investigation unearthed a host of interesting finds including medieval remains and the walls of two Roman villas.

However, work had to continue around the dig and the installation of a total of 56 fabricated steel plunge columns allowed main contractor Mace to progress the project.

The slipforming of the two cores was completed on time as they are supported on 40 of the plunge columns. A number of large diameter bored piles have also been installed, including what is believed to be the UK's biggest.

"This pile is up to 2.7m diameter and 58m long; it was installed during one 20 hour long operation," explains Mr Massey. "It supports one of the main and most loaded columns in the building and it has to deal with loads of up to 32 mega newtons."

With the cores complete steelwork erection was able to commence and one of the first tasks was to form the slab of level 0, which effectively made a bridge or crash deck above the museum workers, allowing them to continue working safely while The Place structure began to rise up in earnest.

Another early part of the steelwork programme was the erection of a temporary safety canopy around the elevations spanning the bus station. Safety is paramount, and this heavy duty system comprises 61t of steel and could withstand drop loads of up to 8t.

A phased steel erection programme was used, due to the complexity and the long cantilevers.

Steelwork was initially erected up to level 3 using temporary props, as very few of the columns (as previously mentioned) are load bearing. Above this, up to level 12 a temporary support system of Macalloy bars was used, holding the floors in place and allowing the props below level 3 to be removed.

The erection sequence involved Severfield-Reeve partially erecting the raking columns to level 8 and from these the Macalloy bars were suspended, holding each floor as it was completed.

A large steel safety canopy, able to take loads of up to 8t, was installed above adjacent bus lanes

"As each floor was completed we had to monitor and adjust the temporary Macalloy system," says Richard Tarren, Severfield-Reeve Project Manager. "We had to keep to some extremely tight tolerances, otherwise the cladding programme would have been affected."

The eastern side was initially erected to level 12 and then the western side followed. The remaining eight levels were then erected in a more traditional manner with the topping out being achieved last June.

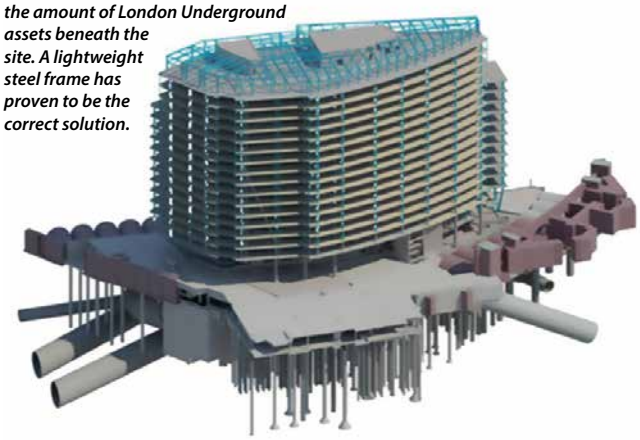
"Only when level 12 was complete with the permanent hangers in place, giving us the permanent load paths, could the temporary props be released," explains Jack Adams, WSP Technical Director.

The loads from level 12 and from the permanent hangers are applied to the core through steel beams which are fixed to the core with embedment plates.

One of the final steel elements to be erected was the winter gardens which stretch from level 3 to level 13 on the western elevation. This was simply bolted onto the already completed main frame in stages. The winter garden is supported on one Y-shaped column, positioned at ground level and brought to site in three pieces.

The Place is aiming for a BREEAM 'Outstanding' rating and is due for completion in mid 2013.

FACT FILE
The Place, London
Main client: Sellar Property Group
Architect: Renzo Piano
Main contractor: Mace
Structural engineer: WSP
Steelwork contractor: Severfield-Reeve Structures
Steel tonnage: 6,700t



Pile locations were limited due to the amount of London Underground assets beneath the site. A lightweight steel frame has proven to be the correct solution.

Shaken and stirred

During 2010 and 2011 a series of severe earthquakes shook New Zealand's South Island causing severe damage to a wide range of buildings. Dr Charles Clifton, Associate Professor of Civil Engineering and Structures at the University of Auckland, explains why steel framed structures fared better than concrete buildings.

New Zealand sits astride a major plate boundary in the Pacific Ocean and severe earthquakes are not uncommon. Between September 2010 and June 2011, the City of Christchurch on the country's South Island was hit by a series of six severe earthquakes.

The largest of these events was on 4 September 2010, with a Richter magnitude of 7.1, but the most intense was on 22 February 2011, with another intense earthquake on 13 June, both with a magnitude of 6.3.

New Zealand uses the Modified Mercalli (MM) Intensity scale, to classify an earthquake by examining its effects on people and the environment. This is measured from 1 (least severe) to 10 - 12 (most severe; the variation from 10 to 12 relates to varying degrees of ground instability).

It describes the impact at a given location and the figures that follow are for the Christchurch Central Business District (CBD).

The 4 September quake was rated at MM7, which is characterised by minor structural damage in modern buildings and general alarm, where some people may experience difficulty in standing and drivers may stop.

The 22 February event, easily the most severe, was rated at MM9-10 which results in significant structural damage to modern buildings, landslides and widespread liquefaction. It delivered the strongest peak ground accelerations recorded to date in a first world city.

The earthquakes caused extensive damage

Pacific Tower

Brace/beam/column connection showing out-of-plane yielding in endplate but no inelastic demand in gusset plate

and impacted on a range of buildings. These included steel framed buildings, from single storey structures to the tallest building in Christchurch at 22 storeys. Many of the multi-storey buildings used eccentrically braced framed seismic resisting systems (EBFs).

The EBF is a braced system where the braces intersect eccentrically with the beam, putting a short region of beam into high shear deformation in the event of overloading. This short region of beam is termed the "active link" and is designed to undergo shear yielding of the active link web in a severe earthquake.

The rest of the EBF system is designed to resist the overstrength actions from the yielding active links, so keeping inelastic demand within the active links in a severe earthquake. This earthquake series was the first time worldwide that these systems have been pushed into the inelastic range.

The number of steel structures is relatively low in the Christchurch area. However, the market share for steel framed structures nationally has increased considerably in the last few years and now exceeds that of reinforced/precast concrete structures. Consequently, most of the steel buildings in the Christchurch area are recent and designed to the latest seismic provisions.

Detailed analyses of the comprehensive set of strong motion data shows that the 4 September event was approximately 0.7 times the Ultimate Limit State (ULS) 500 year return period design level, specified by the New Zealand seismic loading standard over the period range of 0.5 to 4 seconds.

The 22 February event was 1.5 to 2 times the ULS and the most severe of the other earthquakes was 0.9 times ULS. While the strong shaking duration period of each earthquake was short (around 10 to 15 seconds) the cumulative duration of strong shaking over the earthquake series was greater than 60 seconds.

Two recently constructed multi story steel framed buildings have come in for special attention in the investigations that have followed the earthquakes: the 22 storey Pacific Residential Tower, completed in 2010, and the 12 storey Club Tower building, completed in 2009. Both had eccentrically braced frames as the principal part of their lateral load resisting system.

New Zealand uses a system of colour coding of buildings during the state of emergency conditions immediately following an earthquake. The guidelines for this, which have been developed by the New Zealand Society for Earthquake Engineering, draw heavily upon North American experience. A green sticker means the building has been inspected and there are no restrictions on use or entry.

Yellow means restricted use - parts may be off limits and people should enter only on urgent business and leave as soon as possible. Red means unsafe: do not enter. This regime remains in place until the state of emergency is lifted, after which the owners of buildings must get a full engineering evaluation undertaken to determine the actions to be taken long term.

Both the buildings were green-tagged following the earthquake, indicating that they were safe to occupy. However, both required some minor repairs. In these buildings, beyond the usual factors contributing to over strength in steel frames (for example, expected yield strength exceeding nominal values), a number of additional features can explain the better than expected performance.

These include the robustness of the composite floor slab action, mobilisation of the solid non structural wall concrete cladding adjacent to the staircase, the elastic stiffness of the gravity frame (especially the columns) and and the elastic rotational flexibility of the "fixed" column bases. Club Tower was reopened in July 2011.

The 22 storey Pacific Tower building was more severely impacted, with concentrated inelastic demand in the active links between levels 2 and 8, due principally to the non-structural configuration of the building. The building has open plan car parking over those levels, above which are hotels and apartments, with many non structural fire and acoustic rated walls which stiffened the upper building.

Of the 21 steel framed buildings identified as being constructed in the two decades prior to the earthquake, none were red tagged.

The building is scheduled to reopen in February 2013 in time for the phased reopening of the city centre. Prior to the earthquake this was one of six buildings of around 20 storeys in Christchurch; it is the only steel framed building of those six and will be the only one remaining after the demolitions are completed. Pacific Tower is near to a proposed new convention centre and it will become a principal source of accommodation for that centre. The redevelopment plan for Christchurch is for a medium rise CBD, so this is expected to be the only remaining high rise building in the new City.

In summary, a general assessment of the performance of different building types in the earthquake was published by the University of Canterbury in 2011. This report stated that of 21 steel framed buildings identified as having been constructed in the two decades prior to the earthquake, all had been tagged as either green (12) or yellow (9) following inspections subsequent to the events. None were red tagged.

For the 46 buildings identified as having a reinforced concrete frame, the equivalent figures were 26 green, 11 yellow and 9 red.

Detailed evaluation of these 67 buildings since the earthquakes have shown that the difference in damage between the steel and concrete buildings is appreciably greater than described in the 2011 report.

Club Tower, Christchurch

Multi storey mechanical garage stacker failed braces

On track for redevelopment

One of the UK's largest infrastructure projects is under way at Reading station. Reliant on steel construction, the work includes time saving modular offsite assembly and a new pedestrian footbridge which was launched across live rail tracks. Martin Cooper reports.

Once renowned for the three B's: brewing, bulbs and biscuits, Reading's economy has in recent times undergone a transformation, and today a host of global IT and electronics companies have based themselves in the Berkshire county town.

Less than 40 miles from London and with good links to the region's airports, the town's population and its attractiveness as a location for UK headquarters are both expected to increase.

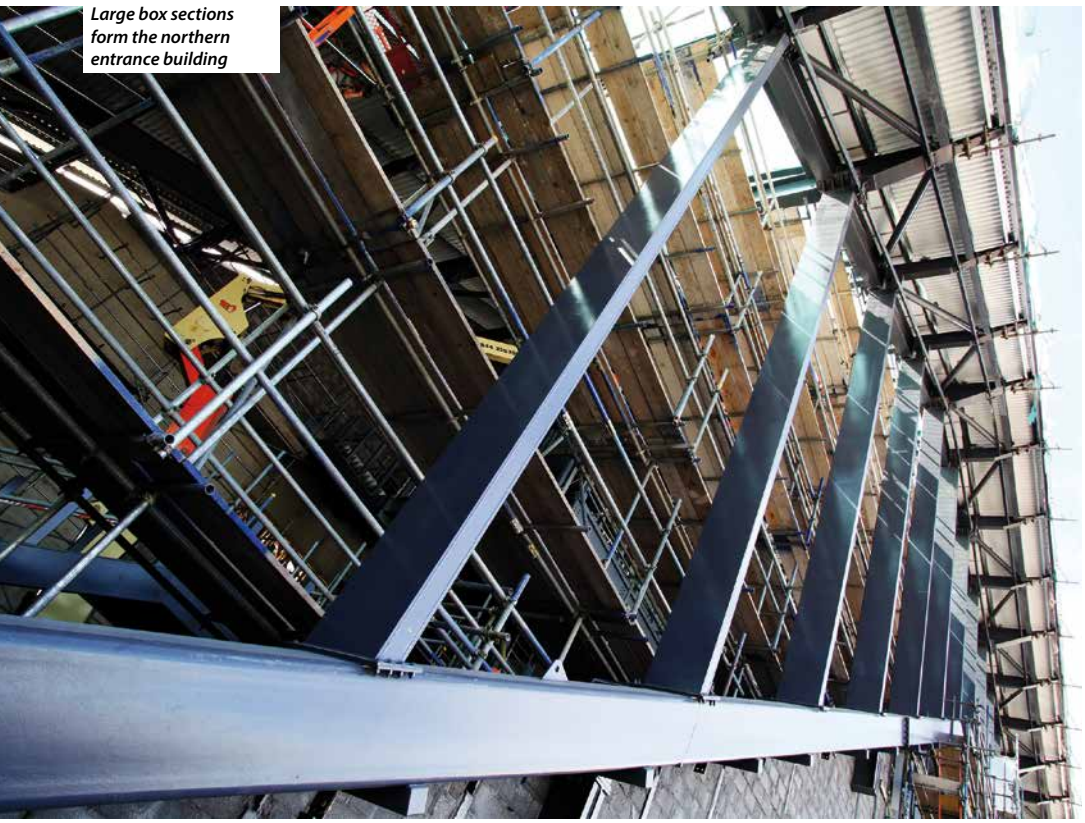
Reading is also one of the busiest parts of the UK's rail network, and an on-going multi million pound redevelopment of its station is seen as a vital stimulant for growth.

The project will ultimately increase capacity at the station and reduce delays through a new track layout, new platforms and entrances to ease congestion, as well as a new viaduct to the west of the station.

Network Rail as part of the overall scheme has awarded a number of contracts and one of the largest, for the rebuilding of the station, has been assigned to a Costain/Hochtief joint venture.

Bill Henry, Network Rail Project Director, explains: "Five new platforms at Reading will increase capacity, enable us to get more trains through and will mean better journeys for passengers. The new station will be more accessible, more modern, and improve the experience of the 14M people that travel through every year."

A large proportion of this contract is reliant on steel construction. Cleveland Bridge has fabricated, supplied and assembled a new footbridge, while the Bourne Group is erecting the new station structures at either end of the bridge. These are known as the new northern entrance and the western gateline. The company is also delivering and installing new modular canopy platform roofs, with the canopy system covering a distance of some 1.3km.



Large box sections form the northern entrance building

Buildings and platforms

The Bourne Group started work on site last March with the erection of the northern entrance, a structure that will give Reading station a new second entrance as well as housing staff offices.

The northern entrance building has four levels and consists of 3,500 individual pieces of steel, weighing in excess of 600t. According to Kevin Clarke, Bourne Group Divisional Manager, the structure involved some tight tolerance 500mm deep fabricated mullions, composite floors, the use of large SHS sections, escalator support steelwork, movement joints and a complex mixture of both hot and cold rolled sections throughout.

The steel braced frame of the building is based around a regular grid and incorporates cellular beams – for service integration – throughout.

Prior to steel erection starting on this

FACT FILE
Reading station redevelopment
Client: Network Rail
Architect: Grimshaw
Main contractor: Costain/Hochtief
Structural engineer: Tata Steel
Steelwork contractors: Bourne Group, Cleveland Bridge
Steel tonnage: 3,000t

Offices will also be accommodated on some of the floors in the north entrance

part of the project, the main contractor had already installed the ground floor slab. This aided the steel erection programme, as Bourne was able to use the level floor for its MEWPs (mobile elevating work platforms).

Bourne's package also included the installation of precast stairs and lift cores for this building.

The superstructure of both the northern entrance and western gateline buildings consists of a steel frame with metal decking, utilising a large quantity of secondary steel to support roof cladding, soffits, internal ceilings, masonry, gutters and vertical façades.

"Large fabricated box sections requiring close tolerances to suit the large glazed façades are also a feature of both structures," says Mr Clarke.

For the western gateline building Bourne erected a series of supporting V-shaped columns, each weighing 6t and fabricated from tapered plate girders.

The V-shaped columns were delivered to site in three sections and bolted up during installation. Designed as an architectural feature element of the project, there are ▶

Supporting V shaped columns are a feature element of the project

New canopies are being erected over existing and new platforms

three V's in the western gateline building and then a series across the platforms supporting the new modular canopies – on platforms 7 to 15 - creating a clear uniform design.

The main roof rafters consist of three 650 x 450 x 36 RHS jumbo sections, which were curved and then welded at Bourne's factory in Poole, Dorset, before being given an architectural finish and transported to site.

Each jumbo section, when assembled, weighs 31t and significantly contributes to the western gateline's overall 485t steel tonnage.

New modular canopies are being fitted not just to the existing station platforms but also over the five new platforms being constructed as part of the redevelopment. The canopies are supported by a column and spine beam configuration. Once complete, Bourne will have installed a total of 450 canopy modules, adding up to a total of 1,144t of steelwork.

Each canopy module is bespoke and Bourne has used its expertise in this form of construction from its previous work at Farringdon and Blackfriars stations.

In order to minimise disruption at this very busy railway station, offsite construction is being utilised for the canopies.

Once each canopy unit (most measure 8m x 3m) has been assembled it is then handed over to Lakesmere, the cladding contractor, before being sent to site ready to be installed.

Both companies are sharing Bourne's Poole facility for this integral work.

Prior to the canopy modules being erected the supporting column and beam steelwork is installed along the platform. This is generally done the previous day, but as Mr Clarke explains, the work can only be done during the night.

"Firstly, we have to wait until the platforms are ready and the old roofs have been removed from the existing platforms," he says. "Secondly, most of this work can only be carried out during short four hour night time possessions."

The project has also posed a number of other time restraints, such as the installation of canopies for platforms 5 and 6. These had to be completed before the Olympics, ensuring the Reading to Gatwick line was fully operational in the run up to the Games.

Logistics is playing a key role in the canopy installation, a process which will be ongoing into the New Year. For many of the platforms the process consists of an initial delivery of all canopies to Forbury, located a few miles down track from the site.

From here each unit is craned onto wagons, equipped with onboard cranes and delivered to site by rail for erection. Close coordination between the station's signalling staff and Bourne's project team has ensured disruption is being kept to the absolute minimum.

For the five new platforms the canopy installation is slightly easier as Bourne can get a mobile crane positioned onto the site. "There's more space on that side of the station," says Mr Clark. "So canopies are being lifted over the rails for installation, but again only at night."

Passenger safety is of the highest priority and is being achieved through a combination of night time construction, the removal of any hazardous materials, as well as securing all working areas. Modular construction of the canopies has also helped lessen potential risks as it has reduced the amount of man hours on site by 80 per cent.

The first section of bridge is assembled before being launched into place over 'live' rail lines

Launching a station link

The project's longest roof canopies, at 17.5m, have been installed on the station's new footbridge, a structure which constitutes another steel construction aspect of the overall job and the part being delivered by Cleveland Bridge.

The 96m long x 30m wide pedestrian footbridge – which has an overall weight of 1,070t - will link the north entrance building to the western gateline, spanning and providing access to platforms 7 to 15.

Structurally, the bridge is formed by four lines of 1.4m deep plate girders running between the two new buildings, connected by 1m deep plate crossbeams forming the deck. The side and roof trusses of the footbridge are formed by 500mm x 500mm jumbo hollow sections.

Because of the structure's length and the fact that it spans a functioning and busy railway station, it was constructed in three separate stages, adjacent to the northern entrance building but also on its supporting piers.

"Erecting the bridge over the live railway lines was not an option so we devised a plan to build it in stages and then launch them into position," explains Ben Binden, Cleveland Bridge Site Agent.

Each of the first two stages, prior to being

Two bridge launches were successfully carried out by Cleveland Bridge

launched, were erected on the piers which span the five new platforms. Consequently, the steelwork erection was not being carried out over live railway lines.

Stage 1 and stage 2 were launched during July and August respectively. The launches were designed and carried out by Cleveland Bridge's sister company Dorman Long Technology. The method relied on a series of strand jacks moving the completed structures, with the bridge supported during the operation by PTFE pads, placed under the outer girders and on top of the piers.

The initial portion of the bridge to be erected (stage 1) measured 50m x 30m and consisted of 550t of steelwork. Prior to the launch, metal decking, modular roof canopies and shuttering were installed, adding a further 200t of weight.

"This cut down on the amount of work which needed to be done over the railway tracks," says Mr Binden.

Stage 1 was launched approximately 28m out over the railway lines, a procedure which took five night-time possessions to complete and had to be done before the Olympic embargo on works was enforced. While these possessions - 1am to 4am - were active, train services were still in operation on the adjacent lines.

This made the launch slightly more onerous as the very short possession window gave little actual launching time. However, things were different for the second launch.

"Network Rail was so impressed with the safety and the way we completed the first launch, it was happy for us to proceed with the second one, during the Olympic embargo and without having to stop when trains passed," adds Mr Binden.

Before the second launch took place during August, stage 2 of the footbridge was assembled. The structure was built over the new platforms, on the piers vacated by the first launch. Slightly smaller at 24m long, this section was connected to the first stage and the combined structures were then launched 18m to the final position adjoining the western gateline.

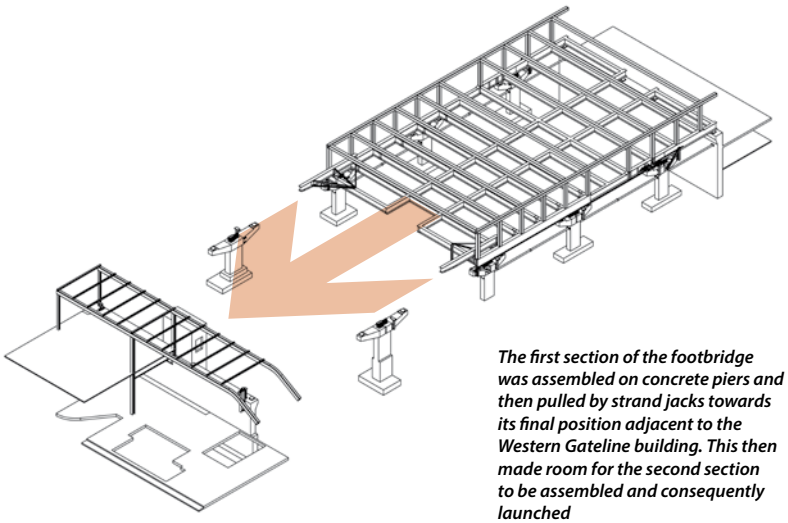
The second launch was completed during night-time posessions, after which the entire structure had to be de-jacked into its final position, a procedure which took a further three days work.

Stage 3 of the bridge construction has now been completed and this consisted of erecting the 23m long infill area between stage 2 and the northern entrance.

Commenting on the work so far completed, Brian Fisher, Costain/Hochtief Project Manager, said: "Everything we deliver has to be done around an operational railway which obviously brings its own demands.

"We've worked hard with Network Rail to minimise disruption to our customers throughout this project, and the team should be commended for completing the challenging bridge launches without impacting our services," adds Mark Hopwood, First Great Western Managing Director.

The Reading station redevelopment programme is scheduled for completion in 2015.



The first section of the footbridge was assembled on concrete piers and then pulled by strand jacks towards its final position adjacent to the Western Gateline building. This then made room for the second section to be assembled and consequently launched

Train care depot

Part of the overall scheme, Caunton Engineering was awarded the steelwork package by Volker Fitzpatrick for its £36M Reading train care depot implementation works contract for Network Rail.

Reading's existing train care depot will be demolished, as it is located in an area due to be redeveloped. The new facility will be capable of maintaining and servicing existing trains, as well as providing capacity for future rolling stock.

Caunton's steel package also required the erection of seven ancillary structures, but by far the largest building of the contract is the train care depot which is a portal framed structure measuring 210m long x 37m wide, with a height of 11.2m.

A total of 820t of structural steelwork was erected for the depot and this included overhead crane runway beams, which span the entire length of the building, plus a thousand rail support stools, which carry rail tracks through the building.

Construction of the train depot facilities began last January and work is scheduled to be completed by August 2013.

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MACS+ Membrane Action of Composite Structures in Case of Fire

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The purpose of this seminar is to inform construction professionals, particularly structural engineers, of the latest developments in structural fire engineering.

With speakers from: The University of Manchester, The University of Ulster, Arup and International Paints.

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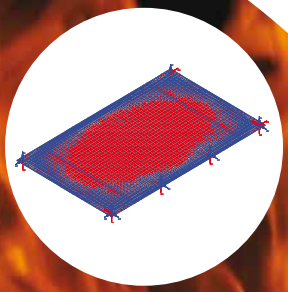

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Main project sponsor: European Commission, Research Fund for Coal and Steel

AD 1254 09/13 210x297

Weighing more than 300t the furnace's bustlemain is lifted into place

Furnace ready for blast off

Modular off line construction of large steel components is playing a central role in Tata Steel's multi million pound project at Port Talbot to rebuild a blast furnace. Martin Cooper reports.

Tata Steel is investing £185M to rebuild blast furnace No.4 at the Port Talbot steelworks. The project will not only safeguard the industry in South Wales, but it will also increase capacity as the new blast furnace will have a number of enhanced safety, efficiency and environmental features.

A blast furnace is the iconic structure that defines the steel industry. It is a vessel into which raw materials are charged with the furnace reaching temperatures of over 2,000 degrees celsius. From the furnace pure molten iron is conveyed to the steel making plant around the clock.

The furnace will be CE Marked and because of its location it is apt that steel construction should be taking the lead on this huge engineering project.

There have been a number of furnaces at Port Talbot in the past and the current units are known as No.4 and No.5, dating back to 1992 and 2002 respectively.

Furnaces nowadays have a campaign life of approximately 15-20 years and No.4's operating life has been carefully nurtured to extend it to 20 years. Initially it was planned to reline the furnace, but a few years ago the decision was taken to request investment to rebuild it completely.

Work on site began in earnest earlier this year with the shutting down and dismantling of the old No.4 furnace. The substructure and lower supporting columns were left in position and have subsequently been integrated into the new structure.

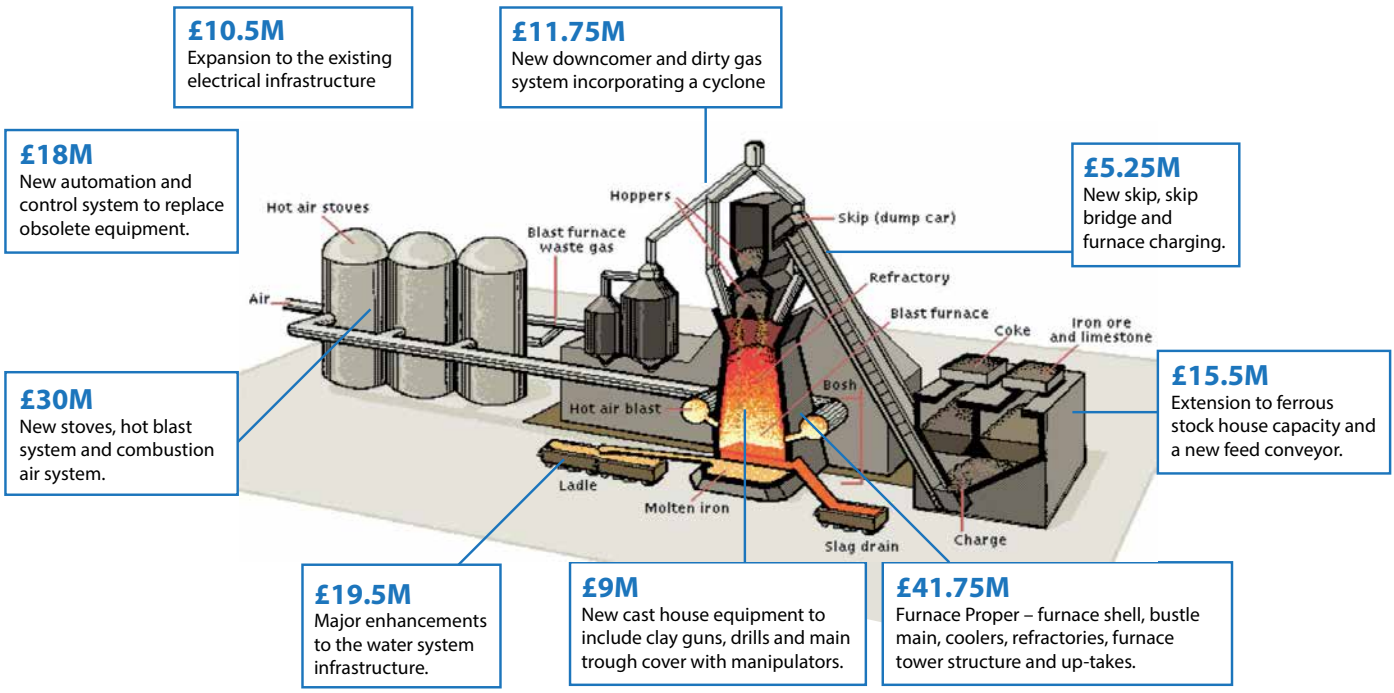
While this planned 130-day dismantling and construction programme is ongoing, Port Talbot steelworks has only one operational furnace. With 50% of the Works capacity shut down, getting the new blast furnace up and ready as quickly as possible is vital.

"The new furnace will not only restore our Works to full capacity, it will actually increase capacity by up to 500,000 tonnes a year due to its new design," explains Tony Thomas, Tata Steel Rebuild Manager.

Most of the project team for this job were in place for the previous furnace rebuilds in 1992 and 2002. A lot of experience has been gained from those projects as Mr Thomas adds: "We've refined our construction methodology and learnt important lessons from those jobs which has helped us immensely."

During July and August the dismantling of the old No.4 blast furnace was completed and the thousands of tonnes of steelwork from this structure are being recycled by going back into the steel making process.

Civil works on the retained furnace foundations were then carried out before



the steelwork for the new blast furnace shell and its surrounding and supporting tower structure could be installed.

All of the new blast furnace's steelwork has been assembled offsite into modules, which were then lifted into place in a series of heavy lifting operations.

"We used modular off line construction on the previous furnaces, but we have further developed and fine-tuned the procedure working closely with Siemens and Tata Steel," explains Ian Hoppé, Rowecord Engineering Contracts Director.

"The modular approach was chosen to provide a reduced build time, improve the quality of the work and to allow the follow on trades to complete their work off line."

The steelwork modules were being assembled and kitted out with ducting, pipework, cladding, electrics and other ancillary equipment while the dismantling process was being undertaken. This ensured they were ready to be installed as near complete units, almost immediately after the old furnace was gone.

The Port Talbot steelworks cover a vast site. However, because of the nature of the industry, the site is busy and there is very little unused space. This has meant the project's steel modules have had to be erected and assembled at a variety of locations all over the steelworks' site.

"Basically on any available space," says Mr Thomas. "Once temporary foundations were in place the modules were erected and then transported to their final position by self propelled mobile transporters (SPMTs)."

The longest distance any module was transported was three quarters of a mile. Moving each of the modules to site and then lifting them into place was usually completed in one day. The site is a 24 hour working environment and lifting and transporting could take place at any time. However, the project team always endeavoured to transport modules outside of the busy shift change times.

The furnace structure modules are typically based around 18.175m column centres, with the heaviest unit weighing in at more than 505t.

The modules all vary in height and weight, depending on their final position within the project and how much pipework and equipment was installed. Rowecord has fabricated much of the installed pipework from plate, as the diameters required are so large that no tubes of this size are readily available.

All connections between each module and the interconnecting pipework are welded onsite.

Because of the size of these units, a giant 1,600t capacity crawler crane was used for all of the project's heavy lifting operations. The crane was delivered in numerous truckloads and took several days to assemble.

The entire furnace structure consists of ten modular elements. This includes four main sections (with lift weights of 505t, 295t, 342t and 377t) and six ancillary pieces. These include the topmost part of the structure known as the 'Breeches & Candlesticks' and the skip bridge, a large sloping trackway leading to the furnace's top that allows carriages to tip raw materials into the furnace.

The 700t furnace shell, when complete, stands at 39m tall with a maximum diameter of 12.7m. It comprises of a top cone and 13 tiers of plate rings, varying in thickness from 25mm up to 90mm. Each ring was delivered

FACT FILE
Blast Furnace No.4 rebuild, Port Talbot steelworks
Main client: Tata Steel
Principal contractor: Tata Steel
Designer: Siemens
Steelwork and prime contractor: Rowecord Engineering
Steel tonnage: 2,500t

The new skip bridge is erected off line in readiness for lifting into place

Space is at a premium at Port Talbot so modular elements had to be assembled at numerous points around the site

The middle section of the furnace tower is lifted by the 1,600t capacity crane

to site in either six or eight segments, depending on diameter and weight. The steelwork at this part of the project was manufactured at Tata Steel's Workington facility.

On delivery, Rowecord welded the segments into tiers and assembled the tiers into three modules, giving lift weights of 402t, 143t and 161t. The modules were fitted out with safety decks and a gondola in the assembly area to allow for refractory bricking.

As well as the furnace itself, the project also includes a number of other connected parts, all of which have been completed with steelwork.

Rowecord has been responsible for dismantling the old gas cleaning plant and fabricating and erecting a new one. The new gas plant comprises a state-of-the-art vertical cyclone vessel, standing 24m tall with a diameter of 6.5m, and a scrubber vessel standing 32m tall with a diameter of 8m. Installation of the gas plant was carried out via nine module lifts, to complete this 1,500t element of the works.

A new stockhouse for raw materials has also been supplied and erected, a structure incorporating bunkers, hoppers, tipper cars and a conveyor system. This part of the project alone has required 1,650t of steelwork.

In addition, a new 43m high stove, with a diameter of 8.6m, has also been erected. "Due to the highly restricted footprint, the stove could not be erected conventionally with a crane, it was jacked up tier by tier," explains Mr Hoppé. "We have two more stoves to dismantle and replace over the next 18 months."

The new blast furnace is due to be up and running by the end of December, increasing the steelworks' capacity and competitiveness.

Summing up the project, Dr Karl Köhler, CEO of Tata Steel's European operations, says: "The investment will not only make this Welsh steelworks one of the most competitive steelmaking operations in the EU, but it will also provide a strong foundation for the whole of UK manufacturing through the supply chains this location serves."

Testament indeed to a project that has been heavily reliant on the UK's highly innovative steel construction industry.

Inside the furnace shell, which is comprised of three large steel sections made of 90mm thick plate

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Partial factors - obscure objects of desire?

In a two part article, Alastair Hughes, formerly of the SCI, delves into the UK's structural safety culture, remarks on an uncharacteristic permissiveness and questions 'what next?' Part One sets the scene.

Introduction

This is an article about load factors which are set by EN 1990 and its UK National Annex. They apply to all buildings, whatever they are made of.

Load factors ought not to be considered in isolation. They are only part of the overall safety margin – hence the name 'partial factor'. Resistance factors, by which the material strength is divided, provide the other part. Known as 'material' factors, they depend on the type of design situation as well as material and are given in EN 1992, 3, 4 etc and respective National Annexes.

γ-factors of both kinds are in the range 1 to 1.5 or thereabouts. Committees determine their values by juggling statistics, reliability theory and experience.

In principle the effect of the action multiplied by the load factor must not exceed the resistance divided by the resistance factor. The load factor allows for a degree of overload and the material factor for a degree of understrength and/or undersize. Both these degrees are sufficient to make the 'design' (factored) values highly improbable, though statistical improbability knows no bounds and a line has to be drawn, usually at the 95% level. If there is a 5% probability that each is beyond the line, there is a negligible probability that both will be.

Routinely, but unconservatively, neglected - some examples:

- Minor second order effects
- Minor dynamic magnification
- Sub-'significant' orography
- Underweight sections: ±4% rolling tolerance could lead to 6% shortfall in bending resistance

Typically these are taken into account only when above 10% or thereabouts. Below this threshold, our factors are expected to cover them.

But that's an oversimplification, because the overall safety factor has other things to account for: routine approximations (maybe shading into minor errors?) in design and execution, the possibility that the statistical edifice may not be quite as soundly based as is supposed, the ravages of time and a general feeling that something ought to be kept in reserve for the unforeseen. A case can therefore be made for a third factor, dedicated neither to load nor to resistance, and quantified solely from wise judgement and experience. Although EN 1990 provides a framework to allow this possibility (a 'model uncertainty factor') it is not widely adopted. In the UK the load and material factors together have to generate the margin of safety that is right for society. The balance between them does matter, because load factors act alone in non-strength-related situations such as overturning. This was the motive for abandoning the pre-1970 permissible stress approach, which was equivalent to a material factor alone.

The subsequently introduced load factors differentiate between live and dead load. Given the way we arrive at design loads for buildings, it is debatable whether that complication has added to the sum total of structural safety, but it is here to stay, having been retained and elaborated in EN 1990. (In fairness, it should be pointed out that Eurocodes are not just for buildings and anyone tasked with bridging the Strait of Messina would be very much in favour of differential load factors.)

Material factors vary greatly, for a variety of reasons – not all connected with variability of material, as a few examples can demonstrate. Steel is an interesting case because ostensibly its strength is unfactored, with γ_{M0} of 1.0. It might appear that the only safety factor is the load factor, which would be worrying, but in fact there is a concealed material factor, or margin, in that the yield strength is a 'guaranteed minimum' rather than a truly characteristic value. There is, in some situations, a further hidden reserve from strain hardening. Rebar attracts a γ_{M} of 1.15, which may reflect that it has been strain hardened in the manufacturing process.

Concrete is given a material factor of 1.5, seemingly generous even for an inherently variable material, but in reality part of it represents a conversion factor between the strength of a properly made cylinder (crushed after 28 days under water) and that of concrete in the actual structure (cast, compacted and cured under site conditions).

Bolts are factory products, precise in dimensions and relatively consistent in strength, yet they are given a γ_{M2} of 1.25, which might be to allow for unequal sharing of load between bolts in common jointing situations. Or might it be a reflection that these small but important components warrant an extra dose of safety on cost-benefit or consequences-of-failure grounds? Perhaps it doesn't help to probe; for one reason or another it just seems sensible.

So let us conclude this preamble with the observation that in reality overall safety factors probably, and rightly, owe as much to custom and common sense as to reliability theory and statistics. Indeed the statistical edifice can be undermined, e.g. by sheeting suppliers who deliberately, and legally, roll down to the lower end of the rather generous thickness tolerance allowed by their product standard. Design methods based on the nominal thickness lose their validity. That's not a bad example of the kind of unforeseen which our overall safety factors get called upon to cover. On the other hand, we routinely overdose on safety (or make prudent provision, if you prefer) when we declare a 'characteristic' office occupancy loading greater than the standard 2.5 kPa, itself a figure which only begins to approach the 95% level after it has been subject to 50% Live Load Reduction (LLR) in a column more than ten floors down.

What matters is that enough of an overall safety margin is there when it is needed. In that event, the manner in which it is built up, or broken down, seems pretty secondary.

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National differences

The Eurocode system allows individual nations to set their own partial factors, either because it was felt that some are more risk-averse than others or because they couldn't agree. Perhaps mainly the latter, in view of the intricate and arguably somewhat self-defeating subdivision of these factors, only part of which is touched upon above. What the Eurocode system does dictate is a format, and a nomenclature, within which the subdivision takes place. Partial factors are 'Nationally Determined Parameters' (NDPs), for each of which a 'Recommended Value' (RV) is given, but nations remain at liberty to substitute their own. In theory, NDPs allow for differences in climate or 'way of life'. The latter could, presumably, embrace structural safety culture and expectations of execution quality. The intention is that a time will come when the system will no longer tolerate such differences (other than the climatic ones) and standard values will apply from Aberdeen to Zagreb. The UK has a treaty obligation to progress towards this vision of harmony.

By and large current UK partial factors have been set by a process of 'calibration' designed to give outcomes similar to the previous British Standards. But it has to be conceded that in the limit calibration is antithetical to progress, and that if Eurocodes are more advanced, scientific and accurate, it is safe to trim the partial factors a little. That will reward users, clients and society at large for the extra design effort, and lubricate the changeover. In fact it is the load factors rather than the material factors that have been trimmed. Substituting 1.35 and 1.5 for the familiar 1.4 and 1.6 lowers the overall average factor by something in the order of 5%, and that's not the end of the story. This truly political decision is applicable to all buildings, regardless of material, and is communicated in NA.2.2 of the NA to BS EN 1990:2002.

In Part Two next issue: permutations and combinations in everyday strength verifications.

New and revised codes & standards

From BSI Updates September 2012

UPDATED BRITISH STANDARDS

PD 6695-2:2008+A1:2012
Recommendations for the design of bridges to BS EN 1993
AMENDMENT 1

PD6696-2:2007+A1:2012
Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2
AMENDMENT 1

NA+A1:2012 to BS EN 1993-2:2008
UK National Annex to Eurocode 3: Design of structures. Steel bridges
AMENDMENT 1

NA+A1:2012 to BS EN 1993-5:2007
UK National Annex to Eurocode 3: Design of steel structures. Piling
AMENDMENT 1

BRITISH STANDARDS PROPOSED FOR WITHDRAWAL

BS 4395-1:1969
Specification for high strength friction grip bolts and associated nuts and washers for structural engineering. General grade
This standard has been proposed for withdrawal as it is superseded by BS EN 14399-1:2005, BS EN 14399-2:2005, BS EN 14399-3:2005, BS EN 14399-4:2005, BS EN 14399-5:2005, BS EN 14399-6:2005, BS EN 14399-7:2007, BS EN 14399-8:2007 and BS EN 14399-10:2009

BS 4395-2:1969
Specification for high strength friction grip bolts and associated nuts and washers for structural engineering. Higher grade bolts and nuts and general grade washers
This standard has been proposed for withdrawal as it is superseded by BS EN 14399-1:2005, BS EN 14399-2:2005, BS EN 14399-3:2005, BS EN 14399-4:2005, BS EN 14399-5:2005, BS EN 14399-6:2005, BS EN 14399-7:2007, BS EN 14399-8:2007 and BS EN 14399-10:2009

BRITISH STANDARDS UNDER REVIEW

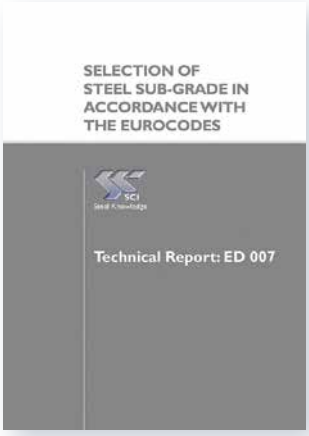
BS EN ISO 636:2008
Welding consumables. Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels. Classification

BS EN ISO 1071:2003
Welding consumables. Covered electrodes, wires, rods and tubular cored electrodes for fusion welding of cast iron. Classification

BS EN ISO 3581:2012
Welding consumables. Covered electrodes for manual metal arc welding of stainless and heat-resisting steels. Classification

BS EN ISO 17632:2008
Welding consumables. Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels. Classification

Selection of steel sub-grade in accordance with the Eurocodes



This technical document considers why and how brittle fractures may occur in steelwork and how it may be minimised by the specification of an appropriate steel quality or sub-grade.

It offers guidance on the selection of steel sub-grade, combining the best guidance from established approaches BS EN 1993-1-10, the associated UK National Annex and PD 6695-1-10 as well as other non-contradictory complementary information.

Additionally, it offers three worked examples that demonstrate the full procedure when selecting a steel sub-grade.

This document is only available as an electronic download.

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AD 371
Design of cold-formed steel trapezoidal sheeting

Load/span tables provided by manufacturers are often used for the design of cold-formed steel trapezoidal profile sheeting (commonly referred to as decking). One question that is frequently asked of the Advisory Desk, about such tables, is: ***"Why is the load carrying capacity of a single spanning system greater than that of a double or multi-spanning system? Intuitively, double or multi-span system should provide better structural performance."*** This Advisory Desk Note provides guidance to explain the reasons why this intuitive assumption is not always correct.

Cold-formed steel trapezoidal sheeting is commonly used in buildings for wall/roof cladding and floor decking. The sheeting provides resistance to transverse loading (wind loads and imposed loads) and is supported by secondary steelwork (rails/purlins or floor beams). Typically, the sheeting is supported as single spans, double spans or multiple spans, depending on the building dimensions and configuration of the main frame.

The evaluation of cold-formed steel trapezoidal sheeting is normally in accordance with BS EN 1993-1-3:2006 and includes assessment of:

- The bending resistance and shear resistance of the cross section at ULS
- The local resistance of the web of the profile at ULS (i.e. the resistance to crushing, crippling and buckling of the web).
- The combined effects of bending moment and shear at ULS
- The combined effects of bending moment and local transverse force at ULS
- Deflection (sometimes called "Inertia" in load/span tables) at SLS

For single spans, the governing design criterion is generally either the bending resistance of the cross section at ULS or the mid-span deflection at SLS. For longer spans, deflection is commonly the governing criterion.

For double and multi-span configurations, the governing criterion is usually the combination of effects at an internal support.

Since different failure modes govern, it is possible that under some loading conditions, a double or multi-spanning system does not necessarily offer an increased capacity compared to a single span system.

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Tel: **01344 636525**
Email: **advisory@steel-sci.com**

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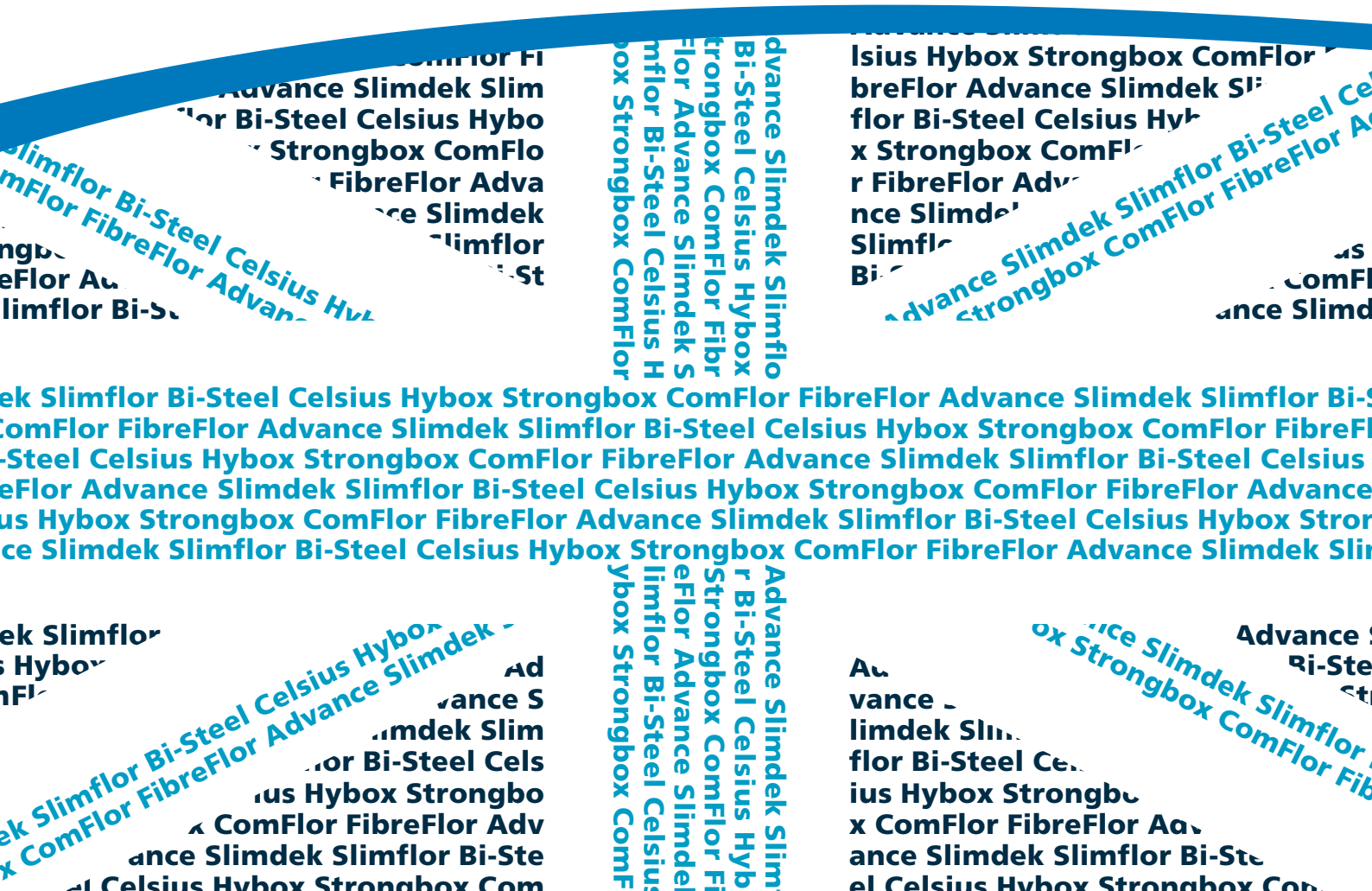
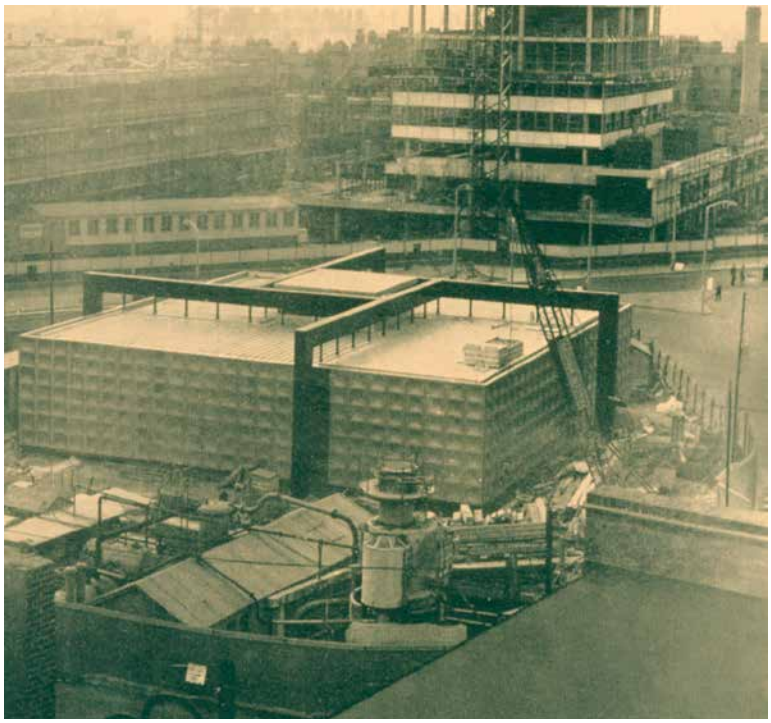
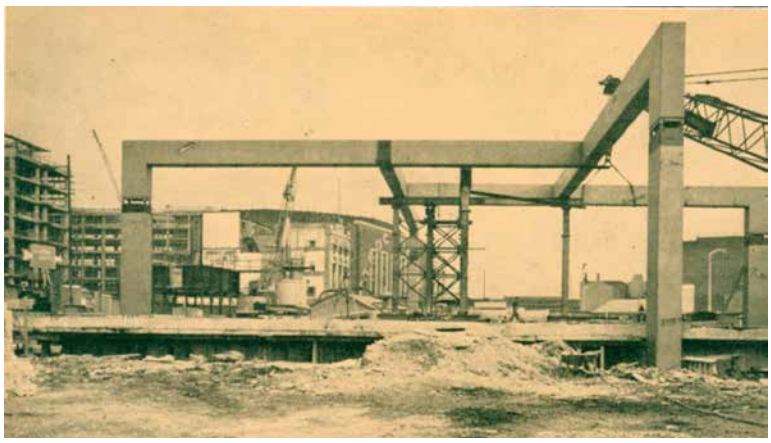
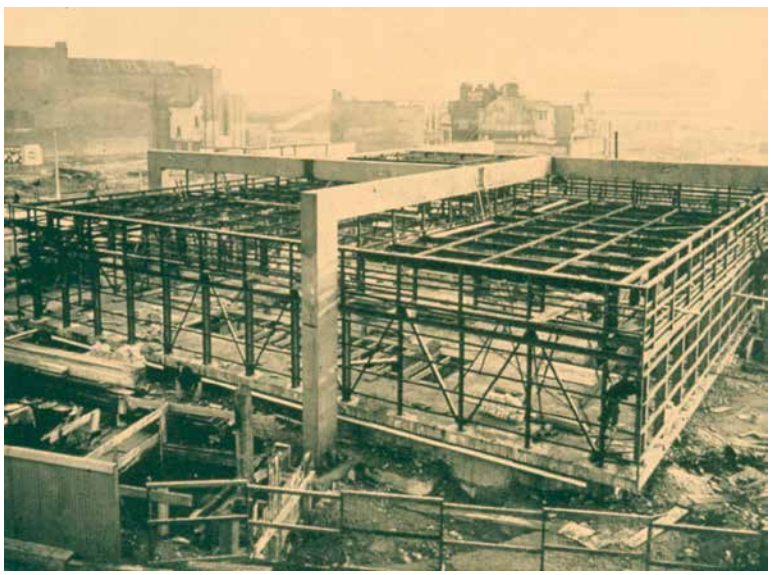


L.T.E. Substation, ELEPHANT & CASTLE

FROM BUILDING WITH STEEL AUGUST 1962







The comprehensive redevelopment of the Elephant and Castle is a part of the London County Council's plan for the County. Very broadly, the redevelopment consists of the reorganisation of the traffic at the junctions at six major roads and the development of seven sites - the whole area totalling about 31 acres.

The new road layout is in essence conceived as a major roundabout and a minor roundabout connected by a link road on the line of Newington Butts. The major roundabout is at the junctions of the five roads and is in the form of a pentagon. The new L.T.E. Sub-Station is on this roundabout and it replaces the existing sub-station which is being demolished to facilitate the redevelopment of the area.

It has been proposed that the new sub-station should be a memorial to Michael Faraday, who was born just up the road at Newington in Southwark in 1791. Faraday was one of the outstanding physicists and innovators of the nineteenth century, responsible for many ideas, including the theory of electro-magnetic induction, a theory which has a direct bearing on the function of this building.

This imaginative proposal was matched by a highly original architectural conception. This conception, of a composite glass and steel prismatic vertical enclosing and supporting structure with a steel space frame roof in the form of an inverted pyramid, unfortunately had to be abandoned. The architect's final design, which is now being constructed, features an all-welded structural steel framework wholly outside the building. The geometry of the main frames, from which are suspended the secondary steel frames supporting the roof, is perhaps unusual in that the horizontal members form a partially truncated orthogrid. These members are mutually self supporting internally and externally they are continuous with the four main stanchions. The overall span of the main frame is 87 ft. 3 in and it is approximately 25 ft. high

Because of the spatial arrangement of the structure and the eccentric nature of the supporting system there is a tendency for it to rotate in a horizontal plane about its centroid. The rotation gives rise to torsion in the main members which therefore must be given an appropriate and suitable shape. This leads to the use of the box section which not only has high torsional rigidity but also fits in with the architectural scheme.

The box sections for the main frames were all welded from mild steel plates which varied from ½ in to 1 in as the stress conditions demanded with constant overall dimensions of 36 in deep by 21 in wide. The maximum weight of unit fabricated in the shops was 8.0 tons. The main erection was carried out with a mobile crane with a capacity of 10 tons at 30 ft radius.

All site joints were welded and they were examined during the process of construction by means of either gamma ray or ultrasonic testing techniques.

A close watch by means of spot check radiography was also kept during fabrication.

The roof and walls of the building are supported on the secondary frames which consist of 10 in by 5 in R.S.J's. The secondary frames, which form a plan pattern of centre lines normal to the centre line of each main frame beam, are suspended at one end from the main frame by means of hangers.

The vertical columns of the secondary frames are supported on the cantilevered reinforced concrete slab forming the periphery of the floor. The shop joints of the secondary framing are welded but the side joints are made with high tension bolts.

The external cladding of the building consists of 2 ft. square dished stainless steel panels. There is also an internal cladding skin of expanded polystyrene panels faced with aluminium sheeting and plywood.

The roof construction included 2 in woolwood slabs supported on angle purlins and covered with aluminium. Consulting structural engineers: Ove Arup and Partners.

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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	Guide Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●											Up to £2,000,000
ACL Structures Ltd	01258 456051			●	●	●	●				●				●		●	Up to £2,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●		●	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●										✓		Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●			Up to £800,000
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
Arminhall Engineering Ltd	01799 524510	●			●					●	●			●	●			Up to £200,000
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 £800,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	●	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 D Structures Ltd	01942 817770			●	●	●	●				●	●		●				Up to £400,000
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		●	●	●	●	●	●	●	●	●	●		●		✓	●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●	●			●	●	✓	●	Up to £2,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✓	●	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
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✓		Up to £2,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	●	Up to £3,000,000
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	●	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		●	●	●	●	●	●	●	●	●	●		●		✓		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			●	●	●	●	●						●			●	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✓		Up to £2,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓		Up to £2,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●			●	✓		Up to £1,400,000
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
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**SCM**	**Guide Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Guide Contract Value (1)
Hills of Shoeburyness Ltd	01702 296321									●				●	●			Up to £1,400,000
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 £2,000,000
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									●					●			Up to £800,000
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●			Up to £1,400,000
REIDsteel	01202 483333		●	●	●	●	●	●	●	●	●	●		●				Up to £6,000,000
Remnant Plant Ltd	01594 841160				●		●	●	●	●	●				●	✓		Up to £400,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●			Up to £1,400,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	●	Above £6,000,000
S H Structures Ltd	01977 681931						●	●	●	●		●				✓	●	Up to £3,000,000
Severfield-Rowen Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	●	Above £6,000,000
Shipley Fabrications Ltd	01400 251480			●	●	●	●		●	●	●			●	●			Up to £1,400,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●	●		●	●				✓	●	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●		●		●	●		●		✓	●	Up to £2,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●			Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●			Up to £800,000
TEMA Engineering Ltd	029 2034 4556	●														✓		Up to £1,400,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●			●	●			Up to £200,000
Traditional Structures Ltd	01922 414172		●	●	●	●	●	●	●		●	●		●		✓	●	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●											Up to £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✓	●	Above £6,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●			Up to £3,000,000
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	Guide 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
Kier Construction Ltd	01767 640111

Company name	Tel
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								●		
ASD metal services	0113 254 0711								●		
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	●									

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Cellbeam Ltd	01937 840600	●									
Cellshield Ltd	01937 840600							●			
CMC (UK) Ltd	029 2089 5260								●		
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	●									●

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	Guide Contract Value (1)
Access Design & Engineering	01952 685162	●						●	●	✓				Up to £3,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓		✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓			●	Up to £2,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	✓		●	Above £6,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓		✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●	●	●	●			●	●	✓			●	Up to £800,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	✓	✓	✓	●	Above £6,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	✓	✓		Up to £4,000,000
Painter Brothers Ltd	01432 374400	●		●					●	✓			●	Up to £6,000,000
Remnant Plant Ltd	01594 841160	●	●	●					●	✓				Up to £400,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	✓	✓	✓	●	Above £6,000,000
S H Structures Ltd	01977 681931	●		●	●	●			●	✓		✓	●	Up to £3,000,000
SIAC Butlers Steel Ltd	00 353 57 862 3305	●	●	●	●	●		●	●	✓			●	Above £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	✓		✓	●	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	●	●	●		●	●		●	✓			●	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓		✓	●	Up to £1,400,000
Francis & Lewis International Ltd	01452 722200							●	●	✓			●	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 Construction Ltd	0121 344 4888							●	●	✓				Above £6,000,000*
Interserve Construction Ltd	020 8311 5500	●	●	●	●		●	●	●	✓				Above £6,000,000*
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	●	●	●	●	●	●	●	●	✓			●	Up to £2,000,000
Varley & Gulliver Ltd	0121 773 2441	●						●	●	✓		✓		Up to £4,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Forward Protective Coatings Ltd	01623 748323						●				
Goodwin Steel Castings Ltd	01782 220000	●									
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	●									●
Leighs Paints	01204 521771						●				●
Lindapter International	01274 521444								●		
Metsec plc	0121 601 6000	●									●
MSW	0115 946 2316	●									
National Tube Stockholders Ltd	01845 577440							●			

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Northern Steel Decking Ltd	01909 550054	●									
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				●						
Tata Steel UK Panels & Profiles	0845 308 8330	●									
Tekla (UK) Ltd	0113 307 1200		●								
Tension Control Bolts Ltd	01948 667700						●			●	
Wedge Group Galvanizing Ltd	01909 486384						●				

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Es.sen.tials *(noun)*

Something that is absolutely necessary

(dictionary definition)

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- Workflow advantages and increased productivity potential
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- Knowledge retention through process implementation
- Easy and user friendly to use

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