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NSC

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Vol 24 No 8 September 2016

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New shed delivered for Amazon

Steel blooms at New Covent Garden

New use for old skills at Kings Cross

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Cover Image
One Angel Court, London
Main client: Stanhope/Mitsui Fudosan UK
Architect: Fletcher Priest Architects
Construction manager: Mace
Structural engineer: Waterman Structures
Steelwork contractor: Severfield
Steel tonnage: 3,900t

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

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Tomas Twomey, General Manager of IPW Fabricators
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Courtney Bell , Finance Director of AJN
"The Endeavour proved to be the ultimate solution for drilling and we have now purchased 3 of these impressive machines."

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The strong chain that links steel

Nick Barrett - Editor

Steelwork contractors are widely acknowledged for their key role in the construction supply chain, but what is less widely appreciated perhaps is steel construction's own supply chain, which is highly integrated and able to provide the full range of services to deliver the complete building or structure.

There is plenty of evidence of that in this issue of NSC. Many of the commercial and leisure developments of the last 20 years or more would be undeniably less interesting and innovative - both architecturally and structurally - without the ability to bend steel. Curved sections adorn many key developments and many designs couldn't be delivered without the advances that have been made in bending, as you can read in our feature on bending developments.

Higher strength steels are coming into more common use, and until recently it might not have been possible or economically viable to bend these steels. Tighter and more intricate bends are now possible because of advances made by the specialist companies involved, thanks to investment that has been made in increasingly sophisticated equipment and research and development.

Lightweight cold formed steel products are another important feature of steel construction projects and we take a look at the close relationships that have developed between suppliers in this sector and steelwork contractors. This includes just in time manufacturing methods which ensure the short lead-in times that many projects demand.

Steel construction's more traditional advantages are seen to great effect in our article on the Tate Modern extension, particularly in providing the 18 metre spans needed for the new galleries in a building that has been hailed as signalling a new era for modern and contemporary art in the UK.

Easily achieved long spans might be a traditional steel construction benefit, but it is being capitalised on by leading edge clients in the most modern industries, as we see in our report on the Amazon distribution centre. Not long ago a 250,000 sq ft warehouse was remarkable but Amazon's latest 'shed' is a striking one million square feet, with spans up to 35 metres.

The useful part of steel's life cycle doesn't end when a building or other structure is completed - steel's ability to be reused and recycled has been developed thanks to the efforts of many members of the supply chain. We can see this feature being taken advantage of by the 'state-of-the-art' design to provide temporary accommodation for London's New Covent Garden Market.

The building will be needed for six years while a permanent home for the world famous fruit, vegetable and flower market is being provided nearby. During that time the large clear spans that only steel can so easily provide will create an efficient and attractive, modern environment for one of the world's busiest flower markets. The building will then be dismantled for possible re-use or recycling, thanks to the skills honed by specialists in steel's ever strengthening supply chain.

BCSA Eurocode publication updated

The British Constructional Steelwork Association (BCSA) has updated '*Eurocode Load Combinations for Steel Structures*'.

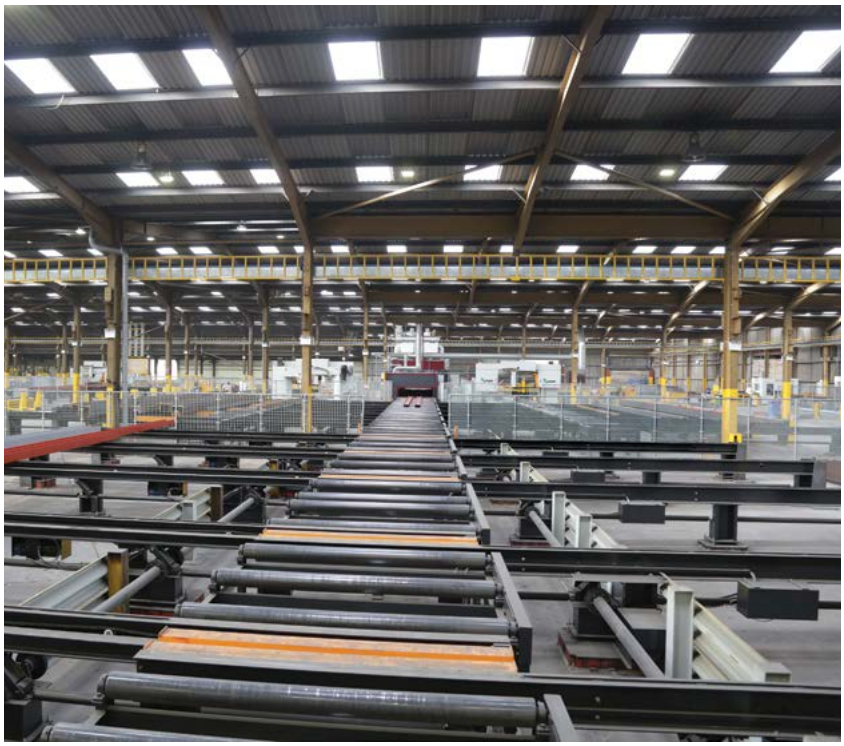
The guide provides straightforward guidance on the Eurocode loading and load combinations for both serviceability and ultimate limit states for multi-storey buildings – simple construction; multi-storey buildings – continuous construction; portal frames without cranes, and portal frames with cranes.

Copies of the publication can be obtained from the BCSA online bookshop at *www.steelconstruction.org/shop/*

It is priced at £15 + VAT for BCSA members and £20 + VAT for non BCSA members.

To receive a 25% discount members must login to the members' only area of the website before purchasing the publication.

£5M processing equipment investment made by steel stockholder



AJN Steelstock has made a multi-million pound investment at its new 17-acre depot in Somerset, which includes £5M of steel processing machinery supplied by FICEP.

The new site's production total is said to be growing rapidly month by month, with the goal to achieve 500t per day within five years by increasing shift patterns from one to three in order to fully exploit the potential of the FICEP steel processing machinery.

The eight new FICEP machines in operation at AJN include an Endeavour - a multi-spindle drilling line, the Gemini - the gantry drilling, milling and thermal cutting system for plates, several Katana - high speed bandsaws, a Rapid - high speed drilling line for angles and flats, and a shot blasting machine.

The order with FICEP also included another Endeavour machine that was purchased for AJN's Kentford facility.

AJN has conducted a detailed time study analysis that determined a 48-minute job on its old machinery now takes under five minutes on the Endeavour and is four times faster when drilling only, while productivity is said to have been further enhanced by the Gemini.

AJN Finance Director Courtney Bell said: "When we decided to expand into a new site, FICEP were the ones who offered us the best solutions after a considerable review of existing and new suppliers.

"The Endeavour proved to be the right solution for drilling and sawing. On top of this, the Rapid 25 we purchased allowed us to secure a large amount of new business."

Steel bending creates purpose-built motorway advertising arch

Metal fabrication and bending specialist Barnshaws Section Benders has contributed to the construction of what is said to be the UK's first purpose-built digital advertising arch.

The Salford Arch was financed by UK outdoor advertising business JCDecaux, and features precision rolled steel tube from Barnshaws Section Benders.

Located on the M602 gateway across six lanes as the motorway meets Regent Road, the double-sided Salford Arch is visible to the tens of thousands of vehicles that travel the highway on a daily basis.

Barnshaws were contracted to roll the required tubing that now spans 37m across the motorway. The high potential risk of the structure demanded that the work had to be carried out within stringent radii tolerances.

Barnshaws' Commercial Director Greg North said: "The scale of the project demanded a large cold bending capacity, which was a capability Barnshaws was able to provide.

"We can cold bend sections from 6mm to 660mm diameter in a very tight radii due to our focus on research, development and investing in modern machinery on site."

The Salford Arch is expected to generate £5M for Salford City Council over ten years, with local government hailing the new structure as a 'landmark' for the area.

UKAS delivers steel sector scheme

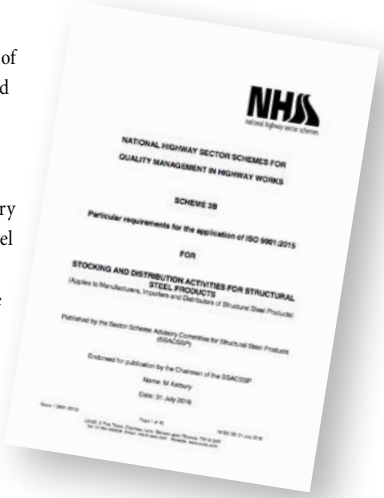
The United Kingdom Accreditation Service (UKAS) has published National Highways Sector Scheme 3B – Stocking and Distribution activities for Structural Steel Products (NHSS3B).

NHSS3B will apply to steel manufacturers, steel traders and steel stockholders that stock and distribute structural steel products and supply them for Highways England projects.

In relation to BS EN ISO 9001:2015, NHSS3B describes the quality management system for the stocking and distribution of structural steel products. It also includes the legal obligations placed on importers and distributors of structural steel products by the Construction Products Regulation as the vast majority of these products are covered by harmonised standards.

The sector scheme will be included in Highways England's 1800 series specification and will become a mandatory requirement for companies supplying steel products to Highways England projects from 15 September 2018. Before this date the scheme is voluntary.

Copies of NHSS3B can be downloaded from the UKAS website at: *www.ukas.com/technical-services/publications/publications-relating-to-certification-body-accreditation-3/*


NHSS

NATIONAL HIGHWAY SECTOR SCHEMES FOR QUALITY MANAGEMENT IN HIGHWAY WORKS

SCHEME 3B

Particular requirements for the application of ISO 9001:2015

FOR

STOCKING AND DISTRIBUTION ACTIVITIES FOR STRUCTURAL STEEL PRODUCTS

Galvanizing Awards 2016 highlight industrial innovation

Five projects, including the Suffolk Energy from Waste facility, were winners at this year's Galvanizing Awards ceremony held at London's Royal Aeronautical Society.

The steel-framed Suffolk Energy from Waste facility, designed by TSP with steelwork erected by Severfield, was said to meet exceptionally high standards in all aspects from operation, performance and emissions. The building also provides facilities for the local community to enhance education and understanding of the role of waste management.

The long design life and corrosive atmosphere within the plant dictated a protection system for the steel that would match these high demands. Additional issues of complex access areas and keeping down time to a minimum were important considerations within the decision making process.

Hot-dip galvanizing was chosen to provide the required protection including that for the 38m span trusses in the boiler hall.

The other winning projects were the Sutherland Hussey Harris' Edinburgh Sculpture Workshop, Creative Labs; Hudson Architects' folded galvanized sheet staircase at Norwich University; DunnettCravens' architectural canopies in Almere, The Netherlands; and the Coffee Ground by Kiwi & Pom, a new artisan café concept for Wyevale Garden Centres.

Former gas works site reborn with steel

A seven-storey steel-framed office and retail building is the latest structure to take shape at the First Street Development in central Manchester.

Located on the site of the former Gaythorn Gas Works, near Oxford Road railway station, the First Street scheme includes a mix of commercial office, retail, residential and cultural buildings.

Working on behalf of main contractor Carillion, Elland Steel Structures is fabricating, supplying and erecting approximately 1,750t of steel for the building, which will provide 14,600m² of Grade A office accommodation.

It will also include 1,300m² of retail space at ground floor, with associated entrance lobby, loading/ service bay and undercroft parking.

A striking feature of the building is the elevational treatment, with two-storey high punched windows projecting forward from a contemporary architectural mesh that wraps into the entrance lobby and key internal spaces.

Setting the office development apart from other projects in Manchester is a series of six two-storey high winter gardens that will provide recreational and break-out space for the building occupants.

Erected around a centrally positioned core, the steel frame features Westok cellular beams throughout and is based around a 6m × 13m grid pattern.

Completion of the building is set for September 2017.

NEWS IN BRIEF

Cellular beam specialist **Kloeckner Metals UK | Westok** has upgraded its Cellbeam software package with the launch of Version 10.2. The software is typically used by steel construction engineers and designers to analyse and design Westok cellbeams and ultra shallow floor beams (USFBs) for single and multi-storey construction projects. Cellbeam and all of Kloeckner Westok's software is free to download from *www.kloecknerwestok.com*

Two major arenas, the Future Arena and Youth Arena, used for the recent Olympic Games in Rio De Janeiro were built with the help of building information modelling (BIM) software provider **Trimble's** 'Tekla' solutions. The software allowed the steelwork contractor to accurately model the structures quicker, with a smoother fabrication process and reduced time and costs.

Structural steel manufacturer **voestalpine Metsec** has gained Building Information Modelling [BIM] Level 2 accreditation; becoming one of the first cold roll steel forming companies to be certified and one of the first Tier 2 designer and manufacturers to achieve the standard for design and construction in the UK. BIM Level 2 is characterised by the ability to work collaboratively across the supply chain.

Plans have been submitted for a second large office block in the New Bailey regeneration area of Salford. **Two New Bailey** will be 11-storeys high and built with red steel and glass, according to the plans submitted to Salford City Council. Designed by architects AHMM, the building will offer 17,500m² of office space, nearly double the size of its sister building, the eight-storey One New Bailey, which was completed in May this year.

Locally-based developer **Urbo** has submitted plans for a £175M mixed-use regeneration scheme in Sheffield city centre. The project, to be known as West Bar Square, has been developed in partnership with Sheffield City Council as a new extension of a regenerated central shopping and business district.

AROUND THE PRESS

New Civil Engineer
September 2016
Spanning the ages
… But cast iron bridges died out from about 1875, with the introduction of the more ductile wrought iron and steel. Structural steel, with a safe working strength 20% greater than wrought iron, came into general use about 1890 and in less than five years became the only metal used in bridges.

Building Magazine
29 July 2016
Bond Street, Essex
Mark Kraut, Lead Architect with WCEC, explains: "Large open-plan retail spaces require maximum flexibility in the floor plans, which is obviously easier with steel."

Building Magazine
29 July 2016
The Moor, Sheffield
"We created an opening for a temporary infill in the structure, which will allow the tenant to install the escalator during the fit out work. It demonstrates the flexibility of structural steel," Bowmer & Kirkland Contracts Manager Keith Hogger.

Building Magazine
29 July 2016
2012 forever
The clever flexibility of Make Architects' original design for the [steel-framed] handball arena meant it avoided some of the more expensive conversions elsewhere in the park, and it too has been turned into a public gym, sports and conference centre.

Construction News
15 July 2016
Moral drive on Morrison build
[Highland Hospice] - "Originally there was no steel, it was a fully timber frame, but the construction engineers had to introduce steel to make it work," says Morrison Construction Project Manager Alison Muirhead.

Advice on curved steel sections issued by Kent County Council

Kent County Council (KCC) has issued Primary Authority assured advice in relation to the CE Marking of curved steel sections that are manufactured using an industrial process.

The advice relates, in particular, to the definition of series production and whether or not the exclusion given in Article 5a of the Construction Products Regulation applies to the manufacturing of curved steel sections.

Article 5 provides three exclusions from the requirement to CE Mark a construction product. These are:

a) Where the product has been individually manufactured or custom made in a non-series process in response to a specific order.
b) Where the product has been manufactured on site.
c) Where the product has been manufactured using traditional methods.

The Council reviewed the processes used to manufacture curved steel sections and the European Commission's guidance on the interpretation of series and non-series production given in CPR 07/07/1 – Explanation of Article 5a of the CPR and Guidance Paper M.

KCC concluded: "Due to the nature of the industrial processes commonly used in their manufacture, curved steel sections are a construction product whose method of production falls within the definition of series production."

British Constructional Steelwork Association (BCSA) Director of Engineering Dr David Moore said: "In simple terms this means that curved steel sections manufactured using an industrial process must be CE Marked in accordance with BS EN 1090-1."

Primary Authority assured advice drives greater consistency and certainty and once issued must then be taken into account by other local authorities when dealing with that regulation.

Working with KCC's trading standards, the BCSA is able to seek clarification on the requirements of BS EN1090 and CE marking as it has a direct partnership with the Council's Trading Standards Service via a primary authority agreement.

Lincoln transport hub approved

A new bus station and 1,000-space multi-storey car park is to be built in Lincoln after the Government released funding.

The £29M transport hub scheme is designed to improve city centre journeys for people living in, working in or visiting the city.

Main contractor Willmott Dixon has confirmed that structural steelwork will play a significant role in the project as the bus station will be steel-framed and the car park will have a composite design with steel supporting precast planks.

The scheme will also include a new bridge, which is curved in plan and designed as a steel Vierendeel truss.

The scheme is expected to create up to 200 jobs in the city, and could deliver an economic boost worth £9M a year.

The Department for Transport is providing £11M towards the project, with the City of Lincoln Council providing £16M and the Greater Lincolnshire Local Enterprise Partnership contributing £2M.

The city's MP Karl McCartney said: "I am delighted that the Government continues to back Lincoln with its support for funding vital transport projects and the Transport Hub is no exception.

"The construction of the Transport Hub is another important step forward in making Lincoln the most vibrant, successful and modern City in the whole of the East Midlands. Lincoln is rapidly becoming the place to live, work, visit and study."

The project is expected to start within weeks.

Nene Valley tourist site rises up with steelwork

Structural steelwork is under way on the Rushden Lakes leisure, retail and tourism development in the Nene Valley, Northamptonshire.

Covering an area of 244 acres, the £55M development will include three main steel-framed retail buildings, requiring nearly 2,000t of steel and currently being erected by Caunton Engineering.

In consultation with the Wildlife Trust and Natural England, project architect HPW has designed the buildings to include extensive renewable energy systems.

The three blocks consist of a House of Fraser store, another block accommodating Marks and Spencer and Primark, and one further retail structure.

Working on behalf of main contractor Winvic Construction, Caunton will also be supplying and erecting the steel for three further smaller buildings to house restaurants overlooking the site's lake.

The first retail units on the site are scheduled to open in early 2017.

Bristol to get first BREEAM 2014 Outstanding offices

Willmott Dixon has been awarded the £17.5M contract to construct Bristol's first commercial office space to be BREEAM 2014 'Outstanding'.

Known as the Aurora Office Development, the project will form part of the Finzels Reach development, a £250M mixed-use regeneration scheme in central Bristol close to Temple Meads railway station and Cabot Circus shopping centre.

Aurora will provide 8,800m² of Grade A office space at a prime city centre location.

Cubex Land Director Gavin Bridge said: "I'm delighted that with our solid financial backing we are pressing ahead with this speculative development encouraged by the fact that Bristol has a shortage of Grade A office space which has already resulted in rental growth.

"Aurora will be the first new development to be completed in a number of years and will deliver the very best office space Bristol has to offer in a vibrant, mixed-used location."

Neal Stephens, Managing Director of Willmott Dixon in Bristol said: "With a local office in Bristol, we're delighted to have the opportunity to build such an important office for the city's economy, one that will attract new investment and set the standard for BREEAM 'Outstanding' in a city that was 2015's European Green Capital."

The seven-storey Aurora building will include a glass atrium, basement car and bicycle parking and a link to the adjacent Grade II listed Generator Building.

Steel-framed office block completed at London's Pancras Square

The penultimate building on the prestigious Pancras Square scheme, which forms an integral part of the Kings Cross development in north London, has been completed.

One of four buildings around the scheme to feature steelwork elements, Three Pancras Square is an 11-storey 15,230m² building offering office floorplates of 1,700m² over the 10 upper levels, while the ground floor houses a double-height reception area.

Sitting atop a two-level reinforced concrete basement that connects into a shared podium, the building measures approximately 58m x 36m and 46m high to fit into the overall height scheme of the Square.

Steel starts at ground floor level and columns are generally spaced at 6m centres around the perimeter, with splices occurring on every second floor.

Fabsec cellular beams have been used throughout the project and span up to 13.5m, creating a near column-free internal space on every office floor.

Working on behalf of main contractor BAM Construction, Severfield fabricated, supplied and erected 1,900t of structural steelwork for the project.

Next door, the same construction team members are currently building Four Pancras Square which features a steel exoskeleton. It will be the final building on Pancras Square and is due to be completed early next year.

Described as a new piece of London and boasting a brand new postcode - London N1C - the development will eventually include 50 new buildings, 2,000 new homes, 20 new streets and 10 new public squares spread over 67 acres.

London Royal Mint scheme gets go ahead

Plans to transform the historic 5.2 acre central London former Royal Mint site into a campus of up to five buildings, providing modern flexible office accommodation with significant public realm and retail facilities, has been approved.

The 55,700m² development near the Tower of London will see two listed buildings that previously housed the Royal Mint for 150 years renovated for new uses.

Three modern buildings on the site will be partially demolished and remodelled to make room for office buildings.

Overall the scheme will incorporate five buildings, providing contemporary office space and shops, cafes and restaurants, together with 1.8 acres of landscaped public realm.

The designs have been drawn-up by architectural practice Sheppard Robson, with architects Morrow + Lorraine appointed to sympathetically reinvigorate the historic buildings.

The flexible floorplates of the offices are designed to appeal to a wide spectrum of potential occupiers, delivering both large open-plan spaces as well as smaller, more dynamic floor spaces for the creative and start-up industries.

Designed to achieve an 'Excellent' BREEAM rating, the sustainable development incorporates in excess of 1,000 bike spaces. The landscaped public courtyards will also provide flexibility for a large number of possible uses, such as retail pop-ups and seasonal events for tenants and the local community.

Diary

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

Tuesday 20 September 2016
Portal Frame Design - Part 2
The second presentation in this three-part series covers member verification to BS EN 1993-1-1. One hour webinar free to BCSA and SCI Members

Tuersday 27 September 2016
Supporting Economic and Innovative Steel Design in the UK
A series of presentations and case studies on how steel can be used economically and innovatively. London

Wednesday-Thursday 5-6 October 2016
Essential Steelwork Design -2 days
This course introduces the concepts and principles of steel building design to EC3. Leeds.

Tuesday 18 October 2016
Portal Frame Design - Part 3
This webinar covers the major connections in a portal frame – eaves, apex, base and bracing. One hour webinar free to BCSA and SCI Members

Wednesday 9 November 2016
SCI Annual Event
3D Printing - the future of design and manufacture.
London.

Stronger steels in high demand

ArcelorMittal reports increasing use of high strength steels offering weight and cost savings across the worldwide markets that it operates in, as Neil Tilley tells Nick Barrett.

Steel manufacturer ArcelorMittal can lay claim to a near 100 year history of experience supplying the UK and Ireland markets. The company is now active in 60 countries worldwide and has an industrial footprint involving mining or manufacturing in 19 of those.

It is acknowledged as a world leading producer of structural steel shapes and is a leading supplier of quality steel products in major markets across the construction, automotive, household appliances and packaging sectors.

The company maintains a global research and development effort and a worldwide network of operations like dedicated sales and market support teams.

ArcelorMittal says it can provide whatever steel solution is needed, rolling all the standard sizes required in the UK and also some unique products of its own. Neil Tilley, Senior Technical Sales Engineer & Business Development at ArcelorMittal Europe – Long Products, says: "The company has been active in the UK for many years and is increasing its commitment to the market in several ways. For example, we are Headline sponsors of the Steel for Life marketing initiative and are offering support to designers.

"We offer a full range of sections and other steel products as well as having some innovative specialist products in the range, like our high strength and low alloy steels. We can offer the bigger sections that many projects now depend on.

"There is a very high commitment to sustainability at ArcelorMittal. We have recently adopted a Sustainable Development Framework that drives and shapes a consistent approach to sustainability in all the countries we operate in."

High strength and low alloy steel grades

ArcelorMittal says it is seeing an increasing use of high strength steels around the world as engineering designers and steelwork contractors capitalise on their advantages. One of these is that weight and cost savings of as much as 20% can be achieved by using high strength steels.

Another type of steel seeing increasing interest is low alloy content steels such as those in ArcelorMittal's HISTAR range. HISTAR steels are structural grades with a low alloy content, combining high strength, good toughness and superior weldability, available with minimum yield strengths of 355 or 460 N/mm^2.

They are said to feature improved guaranteed mechanical characteristics over the whole range of product thicknesses.

ArcelorMittal's Neil Tilley said: "We offer a wide range of high strength steel grades, which are finding an increasingly wide range of applications. As well as our conventional S355 steel and high strength S460M steel, we are seeing growing use of steel capable of exceeding the standard requirements, such as our HISTAR 355 and HISTAR 460 steels.

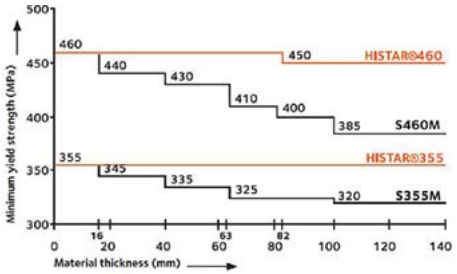
"An outstanding feature of these high strength steels is their low carbon equivalent values, which allows easier processing by steelwork contractors, which means preheating before welding can usually be avoided, allowing substantial time and cost savings.

"Engineers around the world are taking advantage of HISTAR steel in gravity columns of high-rise buildings, axially loaded members in long-span trusses and in seismic design."

In order to best suit the different applications, HISTAR grades are available with guaranteed toughness to -20° C and -50° C. They are delivered in the thermomechanically rolled condition in accordance with the European Technical Approval ETA-10/0156.

They comply with the requirements of the European standards EN 10025-4:2004 for weldable fine grain structural steels and EN 10225:2009 for weldable structural steels for fixed offshore structures. They also comply with other national standards including ASTM A 913-11 and JIS G 3106:2008.

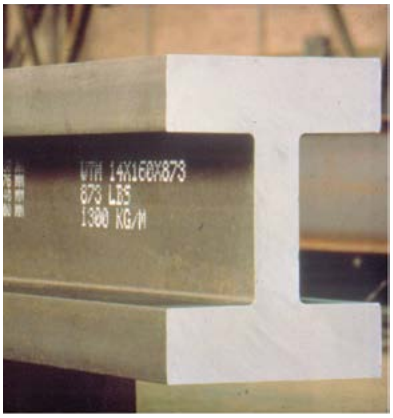
The figure below shows a comparison, based on yield strength, between HISTAR and other standard structural steel grades. HISTAR grades are compatible with the requirements of the Eurocodes for the design of steel structures and composite steel-concrete structures.



Super Jumbo Sections

Super Jumbo Sections are proving to be a popular addition to the designer's arsenal where low carbon equivalent values remove the need to pre-heat thick sections prior to welding, leading to additional cost and programme savings.

Super Jumbo Sections are very heavy rolled wide flange sections, with up to 140 mm flange thickness and weighing up to 1377 kg/m. They are available in ASTM A913 grades 485, 450 and 345 MPa, Histar 460, S460M and normal S355. An outstanding feature of Super Jumbo sections is their low CEV, allowing easier processing.



Environmental focus

ArcelorMittal reports an ever increasing focus on the sustainability of the products used in industries including construction, which is working to the advantage of steel over alternative products like concrete for building frames and bridges. Along with a host of other sustainability advantages that arise from selecting steel, developers and designers are eager to capitalize on the fact that steel has such a high recycled content.

Neil says: "Thanks to steel's ability to recover its original properties without loss of quality after melting, steel is the most recycled material in the world.

"In the built environment, 99% of the hot-rolled steel sections can be re-used or recycled at their end of life. Being flexible and adaptable, the functional life of steel sections can be extended in refurbished and new constructions.

"As 100% of the recovered scrap will be used as a raw material in the steel industry, recycling contributes to resources savings and a better environment."

Blue Book extension

An example of the support that ArcelorMittal offers to designers and steelwork contractors is the recent cooperation with the Steel Construction Institute aimed at helping them utilise the advantages of S460 steel. This resulted in a welcome extension to the Blue Book. Following the familiar Blue Book format, member capacities can be used for BS4 sections including the ArcelorMittal range of Jumbo Sections right up to 356 × 406 × 1299.

Sustainable sourcing

ArcelorMittall Europe – Long Products has been certified under the BRE Environmental & Sustainability Standard BES 6001, demonstrating the company's commitment to sustainable sourcing. This certification covers the entire portfolio of the Long Products division's product range including angles, channels, merchant bars, rails, sections, sheet piles, rebar, construction bar and wire.

The certification is awarded following third party independent assessment that scrutinises organisational governance and supply chain management as well as environmental and social issues. Manufacturers also have to demonstrate the sustainable operations of raw materials suppliers.

ArcelorMittal is a headline sponsor of Steel for Life

Shape of things to come

The use of curved steel bent into shape by UK specialist steel bending companies is helping designers create elaborate landmark structures.

Manchester Victoria Station

Bending steel sections to help create stunning architectural designs not only allows steelwork to show its flexibility in construction, the process is also very economical.

Section bending is a cost-effective way of changing the shape of a structure, as it is relatively inexpensive when compared to manufacturing a multi-faceted member.

There are two main types of bending used in construction: roller bending and induction bending.

The majority of curved sections used in buildings will be cold roller bent as this is the most cost-effective method of forming.

Companies have developed methods over the years to achieve tighter and more intricate bends, especially in closed sections, to enable architects to express themselves.

However, there may be sections that would deform locally because of the radius required. This is where induction bending is used. The section is heated up to around 1000°C and combined with a pivoted radial arm and pushing unit, tighter radii can be achieved.

Over the last 10 years, bending technology has advanced significantly, alongside fabrication techniques and machinery.

Tougher demands from customers have led to the introduction of more accurate and stronger machines.

Investment in machinery has meant that large sections can now be bent into shape by the UK's leading specialist bending firms, steel sections that would have been too large a short time ago.

Buildings are being designed using higher strength steels which are harder to bend as bending requires the material to be taken beyond the yield strength.

The use of S460 steel means that bending companies need to exert up to 40% more bending power to create curves than they did 10-15 years ago.

This means that today most specialist steel bending companies have the capability to bend all sections from the smallest angle to the largest beam.

This gives engineers and architects the opportunity to use the most appropriate sections for their projects. The limiting factor is usually the radii, but using different bending methods can usually overcome this issue.

There has also been an increase in the use of closed sections (tubes, RHS, SHS etc) over recent years because of their relative strength-to-weight ratio.

"In order to create a sinuous and aesthetically pleasing structure, bent steel sections are an integral element of a project," comments Simon Roberts, Architect at Wilkinson Eyre. "The complex designs that are so common today would not be possible without the bending process."

The use of curved and bent steelwork is today highly visible, as over the last decade or so many of the most well-known buildings and structures have utilised steel bending in one form or another. For instance, all of the main London 2012 Olympic structures featured curved steel.

Wimbledon Centre Court has benefitted from curved steel with its retractable roof and this project was so successful that Court Number One will soon be under a similar steel roof, that will also utilise bending.

Another sporting showcase for the use of curved steel was last year's Structural Steel Design Awards winner, Derby Arena, which includes a curved steel roof spanning up to 85m.

Airports throughout the world have curve appeal with bent steelwork clearly visible at Gatwick, Heathrow, Dublin, Dubai and Hong Kong.

In fact, curved steel is in more buildings than you might think. For example, cambered beams are used in floors for multi-storey buildings to allow for deflection of loading.

From design to reality

Greenwich Reach Footbridge (UK)

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Light solutions

Lightweight cold-formed steel products are a vital component for the majority of steel construction projects. NSC takes a look at the light gauge steel framing sector.

The light gauge steel framing sector is supported by a number of specialist and expert UK-based manufacturers. These companies have traditionally had a very close working relationship with steelwork contractors as they generally sell their products directly to them. This is because purlins, rails and other cold-formed items are part and parcel of a steelwork contractors' erection programme.

Because of this close working relationship light gauge steel framing manufacturers know what the market wants and have consequently worked proactively to refine their products.

Cost is always an important issue on construction projects and value engineering is now practiced on a regular basis as a way of saving money. In response to this trend the light gauge sector's manufacturing processes have become more efficient and streamlined, ready and able to respond to market variations.

But what are the benefits of using light gauge steel framing instead of concrete?

Phil Jasper, Business Unit Director at Kingspan Insulated Panels says: "The benefits of light gauge steel framing over concrete solutions are demonstrated by the shorter overall on site construction periods provided.

"The main contractor will get significantly reduced on site periods because whilst our structures are installed in relatively similar time periods to a concrete host structure, when our light gauge frame is handed over it is complete with external walls, sheathed and insulated with helping hand systems factory fitted. In addition, most of the internal metal-framed partitions are also installed."

William Worthington (voestalpine Metsec) Metframe Sales Manager agrees and adds: "Offsite constructed light steel structural frames give many advantages over in-situ concrete structural frames when looking at mid-rise construction.

"Foundation load reductions of up to 30% can be realised, as well as possible overall site programme reductions of up to 20%."

Steelwork contractors may sub-contract out the erection process, but cold-formed steelwork is invariably part of their overall erection package, as it is with all the heavier structural steel members. Consequently it is the steelwork contractors that influence this market sector as they dictate what products are needed and when.

Repeat business is also widely seen as one of the most important aspects of the sector. Every manufacturer will ensure that every order is on time and consists of the correct sizes and product quantity.

Light gauge framing producers also thrive on and are geared up to supply large quantities of repetitious products, used typically in the hotel, student accommodation and medium rise residential sectors, projects where a building's floors are usually identical.

This enables the designers to reduce lead in periods for large schemes to acceptable durations by utilising 'just in time' manufacturing methods, typically a lead in period for a 10-storey hotel could be 10-14 weeks.

The UK steel construction industry is highly developed in the use of computer aided design and detailing methods. Drawings and details are increasingly transferred electronically between the steelwork contractor and the light gauge manufacturing site. The specific details of each component part of a structure is created through the use of CAD systems and fed through to the production line. This is a very fast and accurate system in an industry that is persistently looking for ways of reducing the build programme.

STEEL for life

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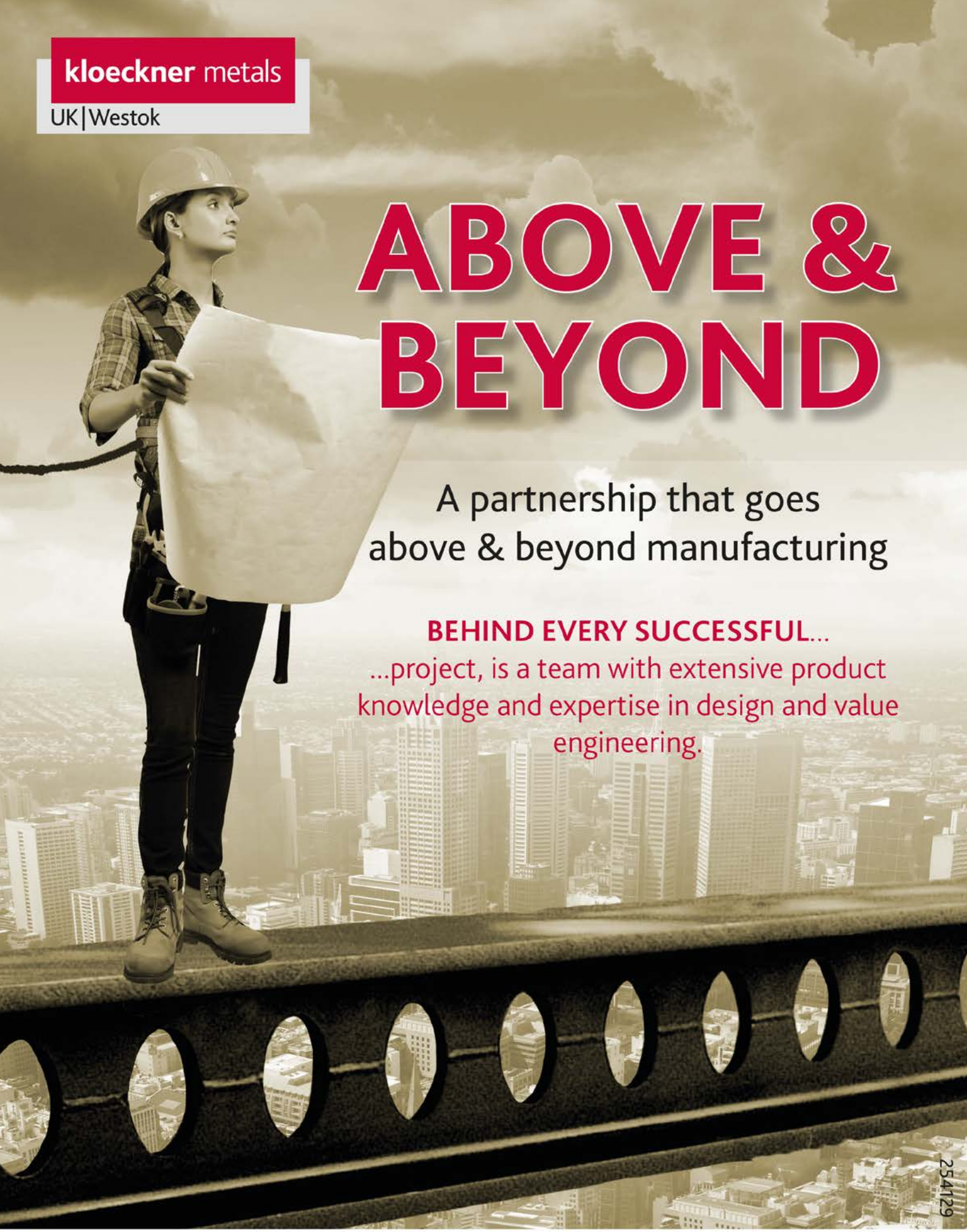

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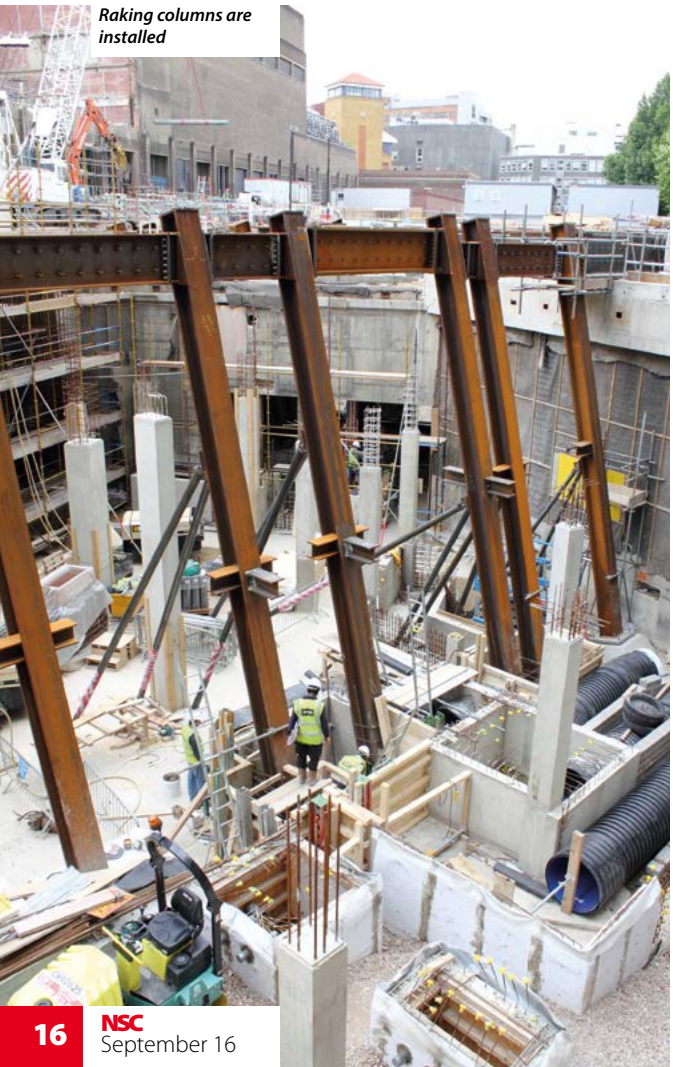
FACT FILE
Tate Modern, London
Main client: Trustees of Tate Modern
Architect: Herzog & de Meuron
Main contractor: Mace
Structural engineer: Ramboll
Steelwork contractors: Severfield, Bourne Steel
Steel tonnage: 1,000t

Contemporary art extension switched on

The extension tower sits behind the existing Tate Modern building

Structural steelwork has exhibited its long span qualities in creating the large gallery spaces for the recently opened Tate Modern extension.



Raking columns are installed

Proclaimed as the most important cultural building to open in the UK for almost 20 years, the Tate Modern extension, known as the Switch House, has thrown open its doors to the public.

Designed by architects Herzog & de Meuron, who also designed the original conversion of the Bankside Power Station in 2000 into the original Tate Modern, the new structure has added 60% more space to the museum.

Tate Director Nicholas Serota says: "This is a landmark not only for Tate and London but also for the UK as a whole. The opening signals a new era for modern and contemporary art in the UK."

The Switch House arranges the museum's new spaces into a unique pyramid-shaped tower, standing 64.5m-high, with its outer structure folding into dramatic lines as it rises.

Said to be reinterpreting the power station's brickwork in a radical new way, it is clad in a perforated lattice of 336,000 bricks, partially supported on steelwork. This unique façade is said to allow light to filter in during the day and to glow out in the evening, transforming a solid, massive material into a veil that covers the skeleton of the new building.

Explaining the façade, Architect Jacques Herzog says: "Our aim was to create a building conglomerate which appears as one thing, not as a phase one and a phase two."

The resulting exterior creates both an iconic addition to the skyline and a unified Tate Modern. It also puts environmental sustainability at the heart of its design, with natural ventilation, solar panels and new green spaces.

The 10-storey Switch House has been designed as a hybrid structure with both steel and concrete-framed elements.

A total of 1,000t of structural steelwork was fabricated, supplied and erected for the project by Bourne Steel during phase one and then Severfield during phase two.

For Phase one the western oil tank steelwork was erected forming the footprint of the tower structure, including raking columns and ground floor transfer beams weighing 1,200kg/m. Also as part of the phase one works, Bourne Steel installed all of the steelwork to strengthen the existing ground slab within the original Switch House and new steelwork up to ground level.

Beginning at ground floor, Severfield began phase two by erecting and bridging over the basement spaces (known as The Tanks), with the main steel frame elements that comprise four levels that accommodate the entrance and shop, and above this three floors of galleries.

Steelwork was chosen for this part of the scheme as the material offered the best and most efficient way of creating the 18m spans required for the gallery spaces.

The steel element does not encompass the entire footprint of the Switch House extension, it shares the area with the adjacent concrete-framed tower. At fifth floor level, the steelwork actually supports the entire northern façade of the tower.

"The steel frame is formed with a series of large 1,200mm-deep fabricated beams spanning up to 18m," explains Ramboll Project Director Martin Burden. "The large beams were needed not just as transfer structures for the fourth floor roof which

New gallery spaces known as The Tanks

supports the façade, but also to support the gallery floors that will have some heavy exhibits to accommodate."

Working in the same way as cellular beams, all of the fabricated girders have large openings to accept services within their depth.

To support the sloping northern elevation of the tower, a 1.2m-deep steel spreader beam weighing 1,000kg/m was installed at level five. This beam distributes the loads from the perimeter structure and façade above into the level five roof beams, which, in turn, transfer the load to the core and northern Switch House columns.

In order to distribute the loads effectively, while minimizing the deflection of the north elevation, the spreader beam was supported on a series of 16 jacks. These were closely monitored during the construction of the north elevation, and jacking operations undertaken at strategic times to maintain the beam at a constant level and minimise impact on the construction above.

Once the final brick was installed, the jacks were grouted with maximum differential movement between jack locations having been limited to the required 2mm.

To achieve the tolerances required for installation of the glazing and brickwork it was essential that the deflection of the structural frame at the perimeter of the Switch House building was limited.

"Although complicated by the geometry of the tower and the various types of transfer structures, deflection limits of 1 in 1000 were achieved," adds Mr Burden.

Other notable structural steelwork elements include a storey-high truss that was required at the level two west elevation to span over UK Power Network's assets as well as long span transfer beams, which were installed to achieve the wide entrance openings needed for the delivery of art and installations.

Access between the Switch House and the original Tate Modern spaces, known as the Boiler House is via the Turbine Hall, which connects to the two structures.

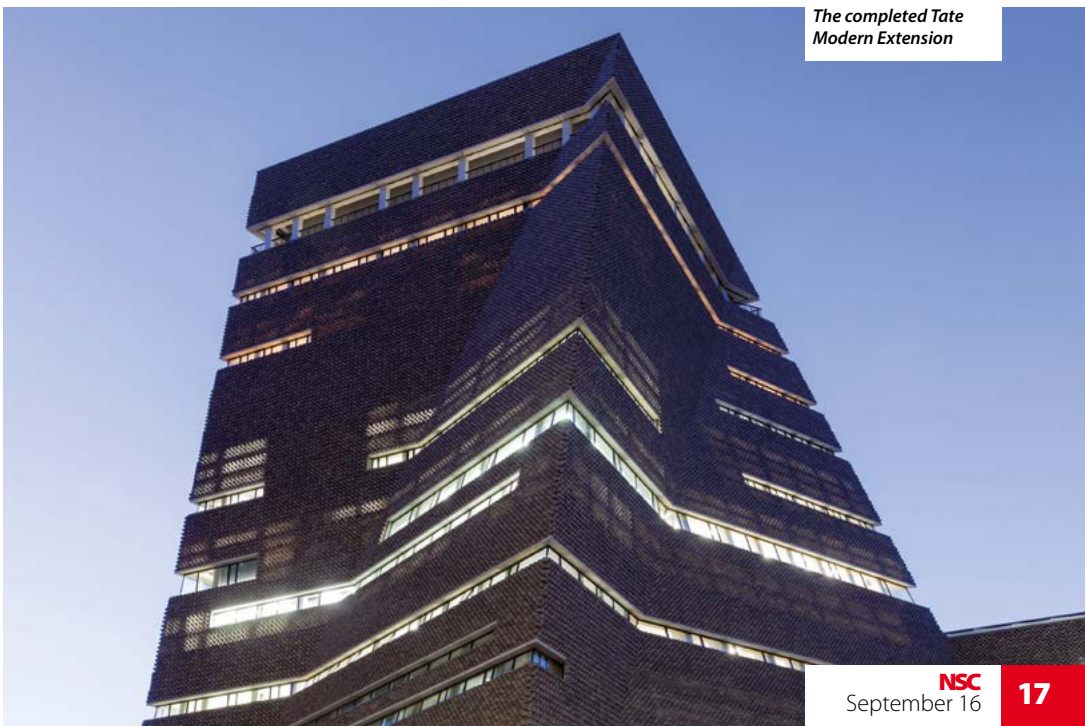
The two are also connected via a new footbridge that spans the Turbine Hall at fourth floor level.

In order to cause minimal disruption to visiting times and exhibitions in the Turbine Hall, the 20m-long steel link bridge was fully assembled and installed on site during a one week long procedure.

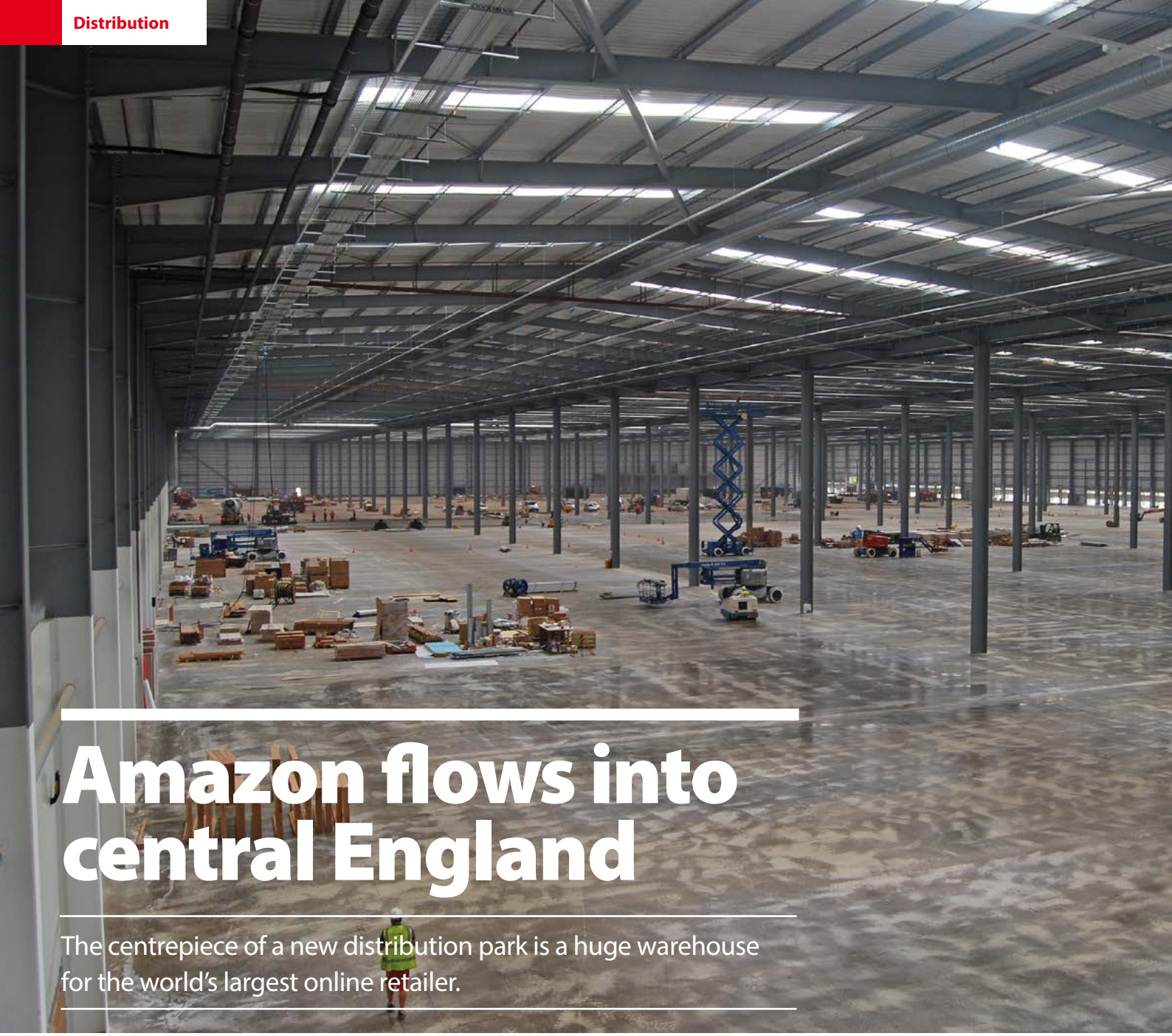
With no room or access for cranes the bridge was hung from the roof structure of the Turbine Hall and pulled across the void incrementally by a series of strand jacks.

Summing up, Mayor of London Sadiq Khan says: "I'm delighted that the Tate Modern's extraordinary new extension is now open. The Tate is an incredible success story, attracting millions of Londoners and visitors from all over the world and it is a shining example of the capital's status as a global leader in the arts."

The western transfer truss integrated with the concrete frame



The completed Tate Modern Extension



Amazon flows into central England

The centrepiece of a new distribution park is a huge warehouse for the world's largest online retailer.

FACT FILE
Unit one, Mountpark Bardon Distribution Park, Leicestershire
Main client: Mountpark Logistics
Architect: Michael Sparks Associates
Main contractor: Winvic Construction
Structural engineer: BWB Consulting
Steelwork contractor: Caunton Engineering
Steel tonnage: 2,750t

Distribution centres don't come much larger than the colossal shed being built for online retailer Amazon, which is currently nearing completion at the Mountpark Bardon site near Coalville, Leicestershire.

Known as unit one, and the first of three new centres to be built on the site, the structure measures 504m in length and has a width of 184m, offering just over one million square feet of floor space.

Main contractor Winvic started on this greenfield site, which is separated from Mountpark's existing distribution park by a main road, back in 2015.

Groundworks, drainage and some hard-standing surrounding the building's footprint was mostly completed prior to Caunton Engineering's steel erection programme starting.

Working on a design and build contract, Caunton completed its erection programme in just nine weeks, despite some inclement weather during May and June.

The structure is a large portal frame consisting of six spans. The two outer spans are 35m-wide, while the inner four spans measure 28.5m wide.

Perimeter columns are large 914 UB sections, set at 8.5m centres. Internally the columns are all bespoke columns fabricated from plate. Arranged in a hit-and-miss configuration throughout the structure, thereby creating more column-free space within the building, the columns measure 650mm deep × 400mm wide, with 25mm flanges.

"The perimeter columns are larger sections than we'd usually use as they were initially designed to support a mezzanine level, which was subsequently removed from the design," says Caunton Engineering Senior Structural Engineer Gavin Christie.

Using bespoke plated sections was deemed the best way of optimising inertia throughout the portal frame.

"The internal valley columns need to be stocky as they are unrestrained over their 16m height," adds Mr Christie.

For the erection programme Caunton used four 50t-capacity mobile cranes in conjunction with a variety of MEWPs.

"We worked in an arrow formation, erecting the two innermost spans first up to certain amount of bays, and then erecting the outer spans along with the perimeter columns. This process was repeated all through the length of the structure" explains Caunton Engineering Erection Manager Richard Patterson.

"In this way the central spans were stable once they were up and they then offered stability to the outer spans during erection."

All of the roof rafters were brought to site in two pieces, which were spliced on the ground to form either one 35m-long or 28m-long section and lifted into place as a single element.

However, as other trades were following on behind the steel erection, floor space was sometimes at a premium and on these

Large open spans were an important consideration for Amazon

occasions each half of a rafter was lifted into place individually and spliced together in the air.

Along one elevation the distribution centre has over 50 truck loading bays, while on the opposite side of the building there is an attached office block.

The single-storey structure is 220m-long and consists of two 11m-wide spans throughout its length. Topped with a gull-wing roof structure, a design where both sides of the roof pitch inwards, the office is surrounded by a 4m-high parapet that hides a plant deck.

The office structure gains its stability from the attached distribution centre main frame, as well as from strategically placed moment frames.

Speed is of the essence on all construction projects and this one is no exception. Having completed its steel package ahead of schedule, other trades were able to get a head start and so ensure the distribution centre meets its October completion date.

Second unit under way

On an adjoining site, with a similar project team containing main contractor Winvic and steelwork contractor Caunton Engineering, unit two of the development is under way.

This portal-framed structure has a similar design to its larger neighbour, although it is less than half the size of the Amazon warehouse offering 29,264 m^2 of warehouse and office space.

The speculative build structure measures 250m-long and consists of four 28m-wide spans, with perimeter columns spaced at 8m centres and valley columns again arranged in a hit-and-miss configuration. A total of 850t of structural steelwork was needed to complete this unit.

Valley columns are 356 U/C sections, perimeter columns 610 U/Cs, while gable end members are 457s.

Aiming for a BREEAM 'Very Good' rating, unit two is scheduled to be completed by the end of the year, by which time unit three, the smallest of the three distribution centres, should be under way.

Unit one under construction

The Bardon site takes shape with the Amazon warehouse

Artist's impression of the scheme

Rebuilding a City tower

Situated within the Bank of England Conservation Area, the 1970s-built One Angel Court is being rebuilt with a steel frame to create a standout City of London office scheme.

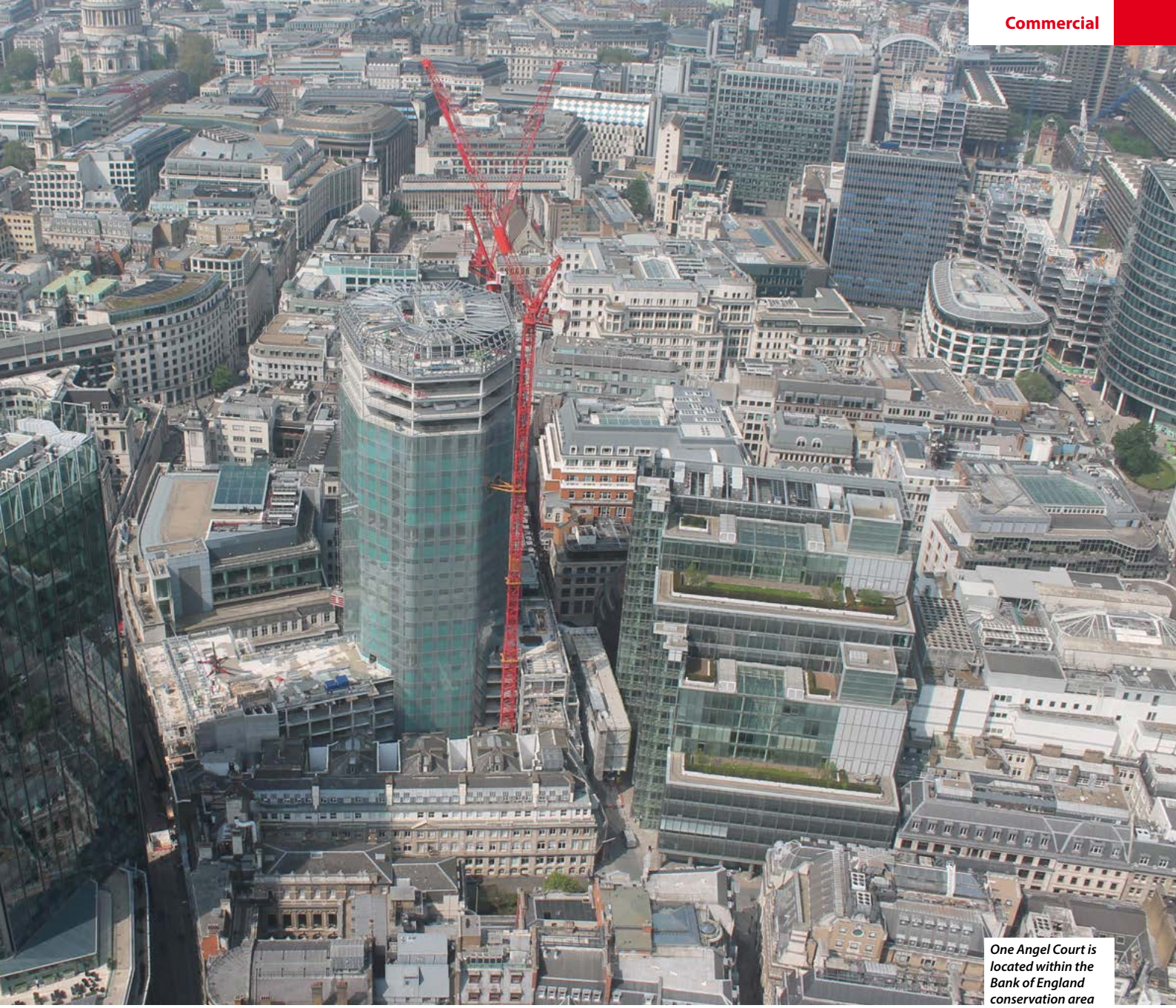
To help gain planning permission for a new office development within a City of London conservation area, a 24-storey concrete-framed building was demolished in 2014, with the exception of its centrally located core, which was retained so that a new structure could be built around it.

With the core refurbished and heightened, a new steel-framed office block has risen up on the same spot providing 32,500m² of floor space - 60% more than was previously available.

Replicating the original structure's octagonal shape, One Angel Court incorporates two podiums, north and south, both in the same positions as the previous building's podiums, but at seven storeys high these structures are higher.

According to Mace Project Manager for Structures, Marios Antoniades there are a number of reasons why the new tower and connecting podiums are steel-framed instead of concrete.

"Steel has helped us achieve longer spans,



One Angel Court is located within the Bank of England conservation area

have a quicker construction programme, add one additional floor and a double height plant enclosure to the top of the tower, while allowing us to re-use the existing core and foundations."

Once the demolition of the original concrete frame had been completed the initial steelwork erection programme began in April 2015 with the installation of basement members prior to the reinforced concrete ground floor slab being cast.

The double basement of the tower has been reused, as has the single-storey basement in the north podium. To add subterranean floor space and continuity to the scheme, Mace excavated and increased the depth of the south podium basement from one level to two levels.

"We started the main steel erection with the tower as this is on the project's critical path. Eventually we were working on three fronts once the podiums started," explains Severfield Senior Project Manager David Managh.

From ground floor up to seventh floor, the tower's columns are inclined, before straightening up for the upper floors. This means for the uppermost 17 levels, the tower is approximately three metres wider than the original building, thereby increasing its available floor space.

The tower features nine-metre clear spans from the centrally positioned core to the perimeter steelwork. Supporting composite metal decking the radial beams are 254UBs, while the perimeter members are slightly larger 525UBs.

Using a refurbished core within the tower presented a challenge for the steel erection.

"Each floor had to be thoroughly surveyed prior to the steelwork being installed as the fixing plates were in slightly varying positions on each level because it was important to miss the core's rebar when they were put in place," says Mr Managh. "So although the beams are in the same arrangement each floor is slightly different."

Topping the tower is a steel structure known as the 'birds' nest', which spans the roof plant deck at level 27. To allow construction of this roof and level 26, which is another plant deck, the core was heightened with the addition of a three-storey steel framework.

"The original concept for the roof enclosure would have involved a very high piece count, so to speed up the construction schedule the birds' nest was designed as a light and slender steel frame, stabilised by the core and, importantly, prefabricated offsite in large sections," says Waterman Regional Director Edwin Bergbaum.

Spanning around and over the roof of the tower, the birds' nest steelwork was prefabricated as a series of galvanized two dimensional trusses measuring three metres deep and up to 18m long.

Open-plan office space continues from the tower into the two adjoining podiums, which feature spans of up to 17m long. While the tower's beams are shallow UB sections installed to maximise the structure's floor-to-ceiling heights, the podiums have been formed with a series of Fabsec cellular members erected around slipformed

FACT FILE
One Angel Court, London
Main client: Stanhope/Mitsui Fudosan UK
Architect: Fletcher Priest Architects
Construction manager: Mace
Structural engineer: Waterman Structures
Steelwork contractor: Severfield
Steel tonnage: 3,900t

▶22

Clad and nearing completion

▶21 centrally-positioned cores.

"With the long spans we wanted to achieve in the podiums, cellular beams were chosen as UB sections of that length would have been too heavy," says Bergbaum. "As we are reusing the foundations, it was important to make the steel frame as light as possible."

To aid the construction programme, the podiums' perimeter beams and columns were all concrete-encased prior to arriving on site.

As the podiums reach a maximum of seven-storeys high, and in order to avert the need to splice the members, the perimeter columns were delivered and erected in lengths of up to 19m, weighing just under 10t each.

The most visually outstanding feature of the podium are the terraces, formed with steps in the steel frame at levels three, four and five, and the rooftop gardens.

A series of 11t 500mm-deep fabricated beams was installed throughout both of the podiums to form these terraces.

The main entrance for the scheme is via a double-height space set back along the western elevation. This faces Angel Court, a previously narrow and dark passageway linking Copthall Avenue with Throgmorton Street.

According to Fletcher Priest Architects, the development has added 30% to the public realm, turning Angel Court into an attractive pedestrian street lined with shops and restaurants which catch midday sun, rather than a dark alleyway reached through a hole in the wall.

Completion of the project's shell and core is scheduled for October, and the fit-out is then expected to be finished by the end of this year.

The rooftop birds' nest plant deck

The original core was retained during the demolition process

Richard Henderson of the SCI discusses

Some of the implications of inclined columns

The new One Angel Court structure retains the original building footprint but the perimeter columns over the first seven floors are inclined outwards leading to a floor plate that is 3m wider at this level. The next seventeen floors have the same floor plate so the columns above level seven are vertical.

The change in angle of the column at floor seven from inclined to vertical introduces a horizontal force at the intersection point which can be carried as an axial force in the floor beams assuming the intersection point occurs at floor level. The axial force includes permanent and variable components which are coincident with the vertical loads on the beams. The size of the axial forces depends on the slope of the inclined columns and a slope of 1.5m in 30m or 1 in 20 clearly results in a horizontal component which is 5% of the axial force in the column at this level. The axial force could be similar in magnitude to the shear force in the beam.

Tie forces are often specified as equal to the vertical shear force and therefore the axial force would also be similar to the tie force. The notable difference is that, unlike the tie force, the axial force and the shear force are present in the same load case. The normal rules set out in *SCI publication P358 Joints in steel construction: Simple joints to Eurocode 3* therefore do not apply to these beam to column joints. Where floor beams connect to the inclined columns on intermediate floors, a small axial component is also developed in the beams due to permanent and variables loads.

In a building with a footprint of a higher degree of rotational symmetry than four (e.g. a hexagon), the horizontal forces at the floor level where the columns become inclined can be resisted as a hoop tension in the perimeter beams with no forces transferred across the building. In a square or rectangular building, the horizontal forces are balanced across the building and would need to be passed through or around the core. If the inclined columns are present on one side of the building only (or if the loads in the columns are not the same on both sides of the building), a net shear force from permanent and variable loads is applied to the building's lateral load resisting system over the height where the columns are inclined. This shear force is conceptually similar to that resulting from sway imperfections dealt with in BS EN 1993-1-1 clause 5.3.2.

The presence of inclined columns introduces significant additional considerations which are not present in more conventional buildings.

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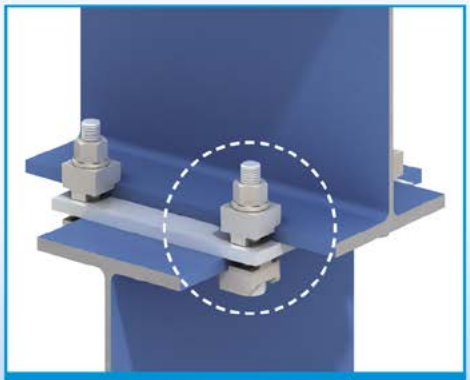
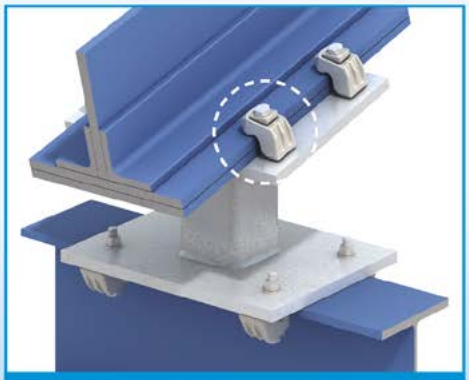


Beam-to-beam
(tensile loading)

Beam-to-column
(slip resistance)



Inclined beam-to-beam
(combined loading)

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Steel for the interim market goes up

Market trades in steel

Two steel-framed structures are spearheading the multi-million pound redevelopment of London's New Covent Garden Market. Martin Cooper reports.

FACT FILE
New Covent Garden Market redevelopment
Main Client: Vinci/St Modwen JV and Covent Garden Market Authority
Architect: BDP
Main contractor: Vinci Construction UK
Structural engineer: Aecom
Steelwork contractor: Hambleton Steel
Steel tonnage: 2,400t

One of the capital's largest regeneration schemes is taking place along the south bank of the River Thames at Nine Elms, a previously understated area that lies between Battersea and Vauxhall.

The area is being transformed and will become a much sought after place to live and work. As well as the creation of a new park to run parallel with the river, the redevelopment of the iconic Battersea Power Station, new embassies for the USA and the Netherlands, the area will also benefit from the extension of the Northern Line and the opening of two new underground stations.

Also taking place in the regeneration area is the redevelopment of the New Covent Garden Market site. The world-famous fruit, vegetable and flower market currently occupies a vast 57-acre site, which it moved into in the early 1970s after relocating from Covent Garden in central London.

The seven-year scheme will deliver over 46,500m² of new market facilities across 37-acres of the existing site, which will house the 200 market businesses currently employing around 2,500 people.

The remaining 20-acres within the New Covent Garden site area will be redeveloped to accommodate 3,000 new homes, 12,500m² of office space and 9,200m² of retail, leisure and community facilities, including shops, cafes and restaurants.

Parts of this grand scheme are now under way including two steel-framed projects, a recycling waste centre supporting rooftop five-a-side football pitches and an interim flower market.

The latter structure will temporarily house the wholesale flowers sector of the New Covent Garden business for approximately six years while the old premises are demolished and new buildings erected on that plot. This phased approach will keep the market operational throughout the construction programme, which is vital.

St. Modwen Construction Manager Neal Haywood says the design and delivery of the development made steel frames critical for the project.

"At New Covent Garden Market we're creating a brand new home for fresh produce and flowers.

"Although 'temporary' the interim flower market will be state-of-the-art in design terms and using steel in the construction means we can create the large, clear spans needed for modern market buildings.

"Steel also has the added advantage of being able to be re-cycled and re-used when the building is dismantled in six years' time. It also means that we can use light foundations, which in turn will benefit the re-use of the site itself in 2022."

Hambleton Steel has been contracted to fabricate, supply and erect the steelwork for both of these structures.

For the interim flower market the company will erect close to 1,000t of steelwork. The structure is being built on the site of the former entrance to the market.

Although temporary in name only, it will provide modern facilities for its brief lifespan, before the flower market relocates again to its new permanent home.

The market building measures approximately 200m-long × 70m-wide and

consists of the large ground floor market zone with a central two-storey zone running along the spine of the building.

The western elevation of the market building will incorporate a ramp leading to a first floor parking area for delivery vans that will be able to unload and load direct from the upper storey.

Founded on pad foundations, the structure is a braced frame with the steelwork based around a grid with perimeter columns spaced at 9m centres, and with internal spans of up to 15m.

Hambleton Steel Contracts Director Andy Fixter says the company erected the central two-storey element initially as this then provided the stability for the two outer single-storey parts of the market.

The steel programme for Hambleton began earlier this year with the recycling centre, which is being constructed directly to the south of the interim market.

Central to this structure are a pair of parallel 40m-long × 6m-deep trusses that create the open plan ground floor space for the recycling centre, while also providing the support for the rooftop football pitches.

Positioned 9m above ground level the trusses form the central spine of the structure. Consequently the trusses and their supporting columns were the first parts of the steelwork to be erected.

The six pitches are arranged in a double-deck formation, with three positioned within the trusses' depth – one between the trusses and two on either side - and the other three located on the rooftop.

A series of plate girders, positioned at 6m centres and supporting composite metal decking, span between the trusses and the outer perimeter columns to form the two decks for the pitches.

"A lot of dynamic loading analysis was required for the design of the two decks of sports pitches," says Aecom Project Director Alex Goulds. "Plate girders were then chosen as the most cost-efficient solution for the required 20m spans."

To erect the trusses Hambleton first had to install the columns at either end and temporarily prop them to provide stability.

All of the structure's perimeter columns are spliced 18.5m-high sections that extend beyond the height of the trusses to form a high-level parapet.

The company brought each truss to site in six pieces, three upper and three lower sections. These were then bolted together on site to form one large 75t truss, which was then tandem lifted into place using two 130t-capacity mobile cranes.

The interim market is due to be completed at the end of the year, by which time a number of other buildings, many of them steel-framed, within the New Covent Garden redevelopment will have begun.

Erecting the recycling centre's trusses

Two decks of football pitches span the recycling centre

Visualisation of how the interim flower market will look

A 'rocket launcher' prepares to lift and position a column

Cast iron petals still adorn the gasholders' beams

Ironwork erection under way

Cast iron challenge

A steelwork contractor's expertise has been used to re-erect three Listed Victorian cast iron gasholders. Martin Cooper reports

FACT FILE
The Triplets gasholders, Kings Cross, London
Main client:
Argent
Main contractor:
Carillion
Structural engineer:
Craddy Pitchers Davidson
Steelwork contractor:
Bourne Steel

Three cast iron Victorian gasholders are being re-erected as part of a prestigious residential scheme in Kings Cross, London. Standing independently, the Grade II Listed nineteenth century structures surround three new circular apartment blocks containing a total of 144 flats.

Known as the Triplets, because they are joined and share columns at three points, Gasholders 10, 11 and 12 were originally built in 1860 as part of the Pancras Gasworks that had more than 20 holders in total.

Apart from a few modifications, such as the installation of guidelines in the 1880s to allow telescopic lifting of the central storage unit to improve capacity, the gasholders remained unaltered for most of their lengthy lives.

However as the 20th Century drew to a close, the gasworks was closed down and the Triplets were dismantled in 2001 to make way for the enlargement of St Pancras Station. The columns and the rest of the cast iron framework lay dormant on site for almost ten years before being refurbished and rebuilt on a nearby site as part of a new development.

The three gasholder frames were sent to a specialist engineering company in Yorkshire for refurbishment and after a two-year programme they were ready to be delivered back to London for re-erection.

Bourne Steel was employed by the project's main contractor Carillion to undertake the erection process as it was decided a steelwork contractor would have the specialist knowledge for this job.

"Erecting the frames isn't a simple job or one to be rushed, the 150-year old cast iron is fragile and needs to be treated with care," explains Bourne Steel Contracts Manager Colin Hillier-Daines.

"The re-erection was made even more complex as the residential buildings were constructed first and so we had to work around them."

The iron frames surround the residential blocks but do not touch them at any point as they are self-supporting independent structures.

Each gasholder is a different size, number 10 is 42m in diameter, number 11 is the widest at 43.5m diameter, and 12 is only 31m in diameter.

In total there are 41 columns surrounding the three gasholders – including three shared columns where the frames touch – with each column divided into three sections.

The bottom sections of the columns are all 12.4m-long and weigh 12t each, while the middle and top sections are 10.2m-long and weigh 10t each.

"Considering the age of the ironwork it was all in a fairly good condition, with the exception of corrosion to the connections," explains Craddy Pitchers Davidson Director Colin Davidson. "Each of the column's three sections were originally made from smaller individual pieces bolted together. These bolts were corroded so we've added steel overbands to cover these connections for added strength."

Once the columns were delivered to site on flat bed trailers, the erection procedure involved some tricky manoeuvring so as not to damage the fragile ironwork.

The columns had to be carefully moved from a horizontal transport position to the vertical position for installation.

As well as the Triplets a fourth gasholder has been re-erected (in the foreground) to surround a new public realm

Specialist righting frames had to be developed specifically for this job. They had to be able to manoeuvre the columns without any load or strain being put onto the ironwork.

These righting frames, nicknamed 'rocket launchers' also incorporate the adaption for the different column lengths and diameters.

The columns were carefully lifted from the trailer stillage using a lifting beam to spread the load evenly. They were then set down and secured to the 'rocket launcher' for installation and testing.

Prior to the re-erection process each column was tested for integrity having been restored and bearing in mind the ironwork's age. This was carried out by inducing a three tonne compressive load between the column head and a cruciform lifting frame.

The column section and pivot frame were then lifted into a vertical position as one unit. Once vertical, the rigging was transferred from the pivot frame to the cruciform lifting frame.

A final test procedure involved placing the columns onto a weight table where 1.7t of steel plates were bolted to the base before being suspended for 20 minutes above the ground in order to test the integrity of the base.

Once the tests had been completed and the integrity of the column section had been guaranteed, they were lifted by tower crane into their final positions with the bases fixed using M60 x 1.5m-long holding down bolts.

"No temporary works were necessary as the first column section was stable once it was bolted into place and we were then able to erect each gasholder in a circular manner, one level – bottom, middle and top – in sequence, along with all the connecting beams and bracings," says Mr Hillier-Daines.

The Triplets had to be re-erected in their original assembly position. Once in position and surveyed to make sure the distance between columns was correct the inter-connecting lattice beams were tied in.

The distance between the columns slightly varies and so each lattice beam is bespoke and had to be installed in the correct location. The three rows of lattice beams are all between six and half metres and eight and a half metres long.

Revealing the extent of Victorian craftsmanship and their desire to give even industrial structures an aesthetic appearance, all of the lattice beams were once decorated with a series of cast iron petals.

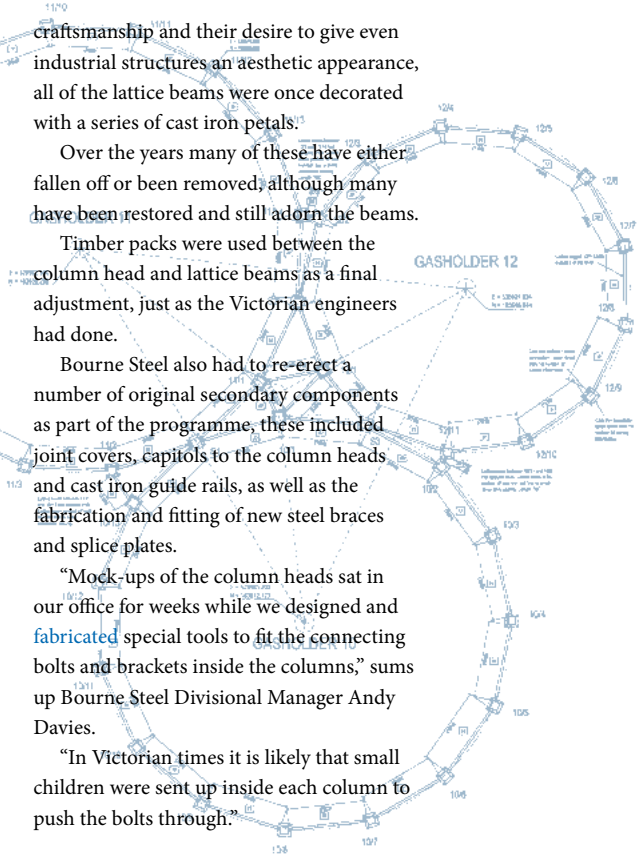
Over the years many of these have either fallen off or been removed, although many have been restored and still adorn the beams.

Timber packs were used between the column head and lattice beams as a final adjustment, just as the Victorian engineers had done.

Bourne Steel also had to re-erect a number of original secondary components as part of the programme, these included joint covers, capitols to the column heads and cast iron guide rails, as well as the fabrication and fitting of new steel braces and splice plates.

"Mock-ups of the column heads sat in our office for weeks while we designed and fabricated special tools to fit the connecting bolts and brackets inside the columns," sums up Bourne Steel Divisional Manager Andy Davies.

"In Victorian times it is likely that small children were sent up inside each column to push the bolts through."



Lateral torsional buckling – additional Eurocode provisions

David Brown of the SCI discusses the Eurocode rules when the effect of LTB may be ignored, and the simplified rules for buildings.

All designers will appreciate that there is a range of slenderness known as the 'plateau length', where there is no reduction for lateral torsional buckling – illustrated in Figure 1. In the Eurocode, the plateau length is given by $\bar{\lambda}_{LT,0}$ and has the value of 0.2 if using clause 6.3.2.2 and the value of 0.4 if using clause 6.3.2.3 and the UK National Annex.

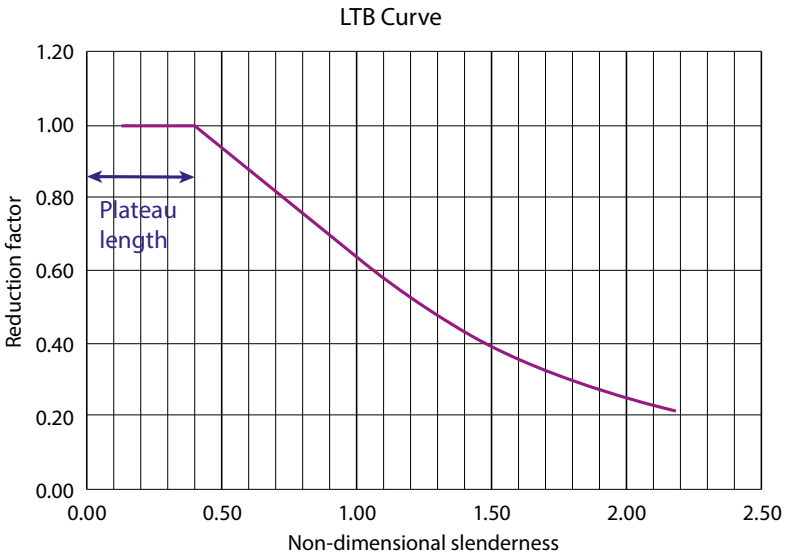


Figure 1: Typical LTB curve

If $\bar{\lambda}_{LT}$ is calculated, and found to be less than the plateau length, then there is no reduction for LTB. This (fairly obvious) point is confirmed in the first part of clause 6.3.2.2(4), which states that if $\bar{\lambda}_{LT} \le \bar{\lambda}_{LT,0}$ lateral torsional buckling checks may be ignored and only cross sectional checks apply.

There is some uncertainty which value of $\bar{\lambda}_{LT,0}$ was intended in this clause (0.2 or 0.4), so it is hoped that the forthcoming revision will provide some clarity.

The second part of clause 6.3.2.2(4) is rather more interesting, stating that LTB may be ignored if $\frac{M_{Ed}}{M_{cr}} < \bar{\lambda}_{LT,0}^2$. M_{Ed} is the design moment, and M_{cr} the elastic critical buckling moment.

The expression flows from the definition of $\bar{\lambda}_{LT}$, which is given as $\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}}$. The numerator $W_y f_y$ is the cross sectional resistance, $M_{c,Rd}$, so by simple substitution, $\bar{\lambda}_{LT} = \sqrt{\frac{M_{c,Rd}}{M_{cr}}}$ or $\bar{\lambda}_{LT}^2 = \frac{M_{c,Rd}}{M_{cr}}$. If $\bar{\lambda}_{LT} \le \bar{\lambda}_{LT,0}$ and it is recognised that the applied moment M_{Ed} must always be less than the moment capacity, the expression becomes $\bar{\lambda}_{LT,0}^2 \ge \frac{M_{Ed}}{M_{cr}}$, as given in the Standard.

This provision can have some interesting effects if the applied moment, M_{Ed} is low.

Example 1

533 × 210 × 92 UB, S355, 7 m long with a uniform bending moment. Using the tool for M_{cr} available from *steelconstruction.info*, M_{cr} = 362 kNm

Substituting the values into the expression, $0.4^2 \ge \frac{M_{Ed}}{362}$, or $M_{Ed} \le 58$ kNm. If the applied moment is less than this value, LTB effects may be ignored. The slightly unsettling feature of this result is revealed if the normal process of calculating the non-dimensional slenderness is followed.

$\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}} = \sqrt{\frac{838}{362}} = 1.52$ This value is much larger than the plateau length of 0.4, and one would naturally think there is a significant reduction in the LTB resistance. Completing the calculations, the reduction factor, $\chi = 0.38$ and the LTB resistance, $M_{b,Rd}$ = 319 kNm.

Considering this example, it is clear that clause 6.3.2.2(4) is not saying that there is no reduction due to LTB, just that if the expression is satisfied, the resistance is greater than the design moment. In this example, the design moment could be anything up to 319 kNm without a problem if the full procedure is followed, so perhaps the conservative limit of 58 kNm given by this clause is not very helpful.

Simplified assessment methods for beams with restraints in buildings

Many designers will conclude that the 'full' rules are easy enough, (especially if avoiding all calculations altogether by taking resistances directly from the Blue Book) so there is no value in simplified rules. The principles behind the simplified assessment in clause 6.3.2.4 are however of interest, and could be useful in unorthodox circumstances.

The basic approach is to consider only the compression part of a beam (the flange plus 1/3 of the compressed part of the web) and design this as a strut (Figure 2). This approach ignores the beneficial effects of the tension flange and the torsional rigidity of the beam.

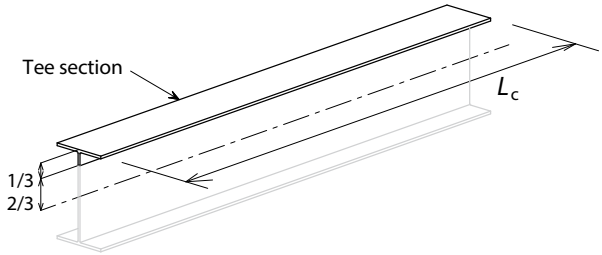


Figure 2: Simplified assessment concept

▶ Continued on p30

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Design software: and tools to aid designers with the efficient and economic design of steel-framed buildings and bridges, encompassing member design, connection design and carbon footprinting.

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▶28 The requirement is:

$$\bar{\lambda}_f = \frac{k_c L_c}{i_{f,z}\lambda_1} \le \bar{\lambda}_{c0}\frac{M_{c,Rd}}{M_{y,Ed}}$$

k_c depends on the shape of the bending moment diagram, from Table 6.6 or from $k_c = \frac{1}{\sqrt{C_1}}$ (from the National Annex).

L_c is the unrestrained length

$i_{f,z}$ is the radius of gyration of the compression flange plus 1/3 of the compressed depth of the web, in the minor axis

$$\lambda_1 = 93.9\varepsilon = 93.9\sqrt{\frac{235}{f_y}}$$

$\bar{\lambda}_{c0}$ is the length of the plateau – which is specified in the UK National Annex as 0.4 (not the value recommended in the Eurocode)

Comparing the above with clause 6.3.1.3, the term $\frac{L_c}{i_{f,z}\lambda_1}$ is simply the non-dimensional slenderness of a strut. The clause is indicating that if the slenderness of the strut is less than the plateau length, there is no reduction due to LTB. This relationship is modified by $\frac{\text{moment resistance}}{\text{applied moment}}$

Example 2

533 × 210 × 92 UB, S355, with a uniform moment and $M_{y,Ed} = M_{c,Rd}$. This would imply that there is no reduction in resistance due to LTB, so the limiting length, L_c at the end of the plateau may be back-calculated.

The relevant dimensions of the tee section are shown in Figure 3. The depth between flanges is 501.9 mm, so 1/3 of the compressed part is 83.7 mm.

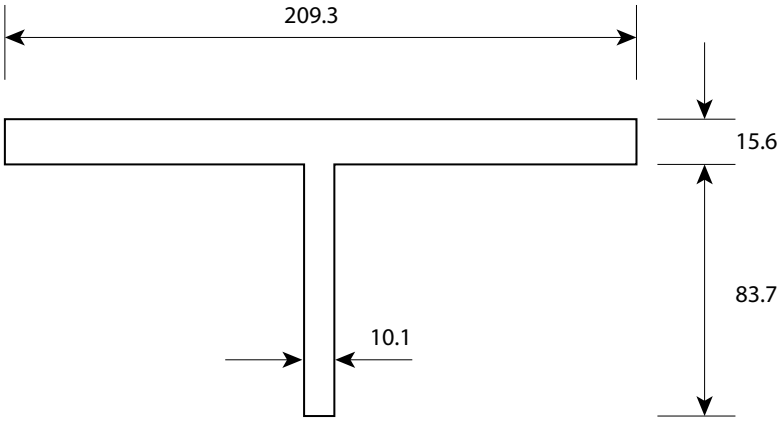

Figure 3: Tee dimensions

The radius of gyration, $i_{f,z} = 53.9$ mm.

Because the moment is uniform, $k_c = 1.0$.

$\lambda_1 = 93.9 \times 0.814 = 76.4$

Then $\frac{1.0 \times L_c}{53.9 \times 76.4} \le 0.4 \times 1.0$

Rearranging, $L_c \le 1647$ mm if there is to be no reduction for LTB.

This length can be compared with that determined from clause 6.3.2.2.

$$\lambda_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}} \text{ or } 0.4 = \sqrt{\frac{838}{M_{cr}}} \text{ or } M_{cr} = 5238 \text{ kNm}$$

The painful expression to back-calculate the length to give this value of M_{cr} is not repeated here, but the physical length at the end of the plateau is found to be 1581 mm. At lengths longer than 1581 mm, there is some reduction due to LTB so, in this example, the simplified method is not conservative (by a trivial amount, admittedly).

Example 3

533 × 210 × 92 UB, S355, with a uniform moment and 4 m between restraints. The maximum applied moment $M_{y,Ed}$ can then be determined at which the beam remains stable.

$$\frac{1.0 \times 4000}{53.9 \times 76.4} \le 0.4 \times \frac{838}{M_{y,Ed}} \text{ or } M_{y,Ed} < 345 \text{ kNm}$$

Looking in the Blue Book, for $C_1 = 1$ and a length of 4m, M_b = 557 kNm, so the simplified approach is (quite) conservative.

The language of clause 6.3.2.4(1) perhaps could be improved. The clause describes the situations where the member is "not susceptible" to LTB, which is a bit misleading. The member does experience a reduction due to LTB, but the buckling resistance is more than the applied moment.

Example 4

533 × 210 × 92 UB, S355, with a uniform moment of 450 kNm and 4 m between restraints. The conditions of 6.3.2.4(1) are not met:

$$\frac{1.0 \times 4000}{53.9 \times 76.4} > 0.4 \times \frac{838}{450} \text{ or } 0.971 > 0.745 ;$$

the clause requirement is not satisfied.

Clause 6.3.2.4(2) allows a design bending moment resistance to be calculated, again based on the resistance of the tee section.

The bending resistance is given as $M_{b,Rd} = k_{fl}\chi M_{c,Rd}$

k_{fl} is a modification factor to account for the conservatism of the equivalent compression flange method. The recommended value is 1.1, but the UK National Annex limits this to 1.0 for hot rolled members.

χ is the reduction factor for flexural buckling, based on $\bar{\lambda}_f$, as calculated above.

$\bar{\lambda}_f = 0.971$ (as above). According to clause 6.3.2.4(3), curve 'c' should be used. The imperfection factor α is therefore 0.49 and reduction factor χ is calculated as 0.56.

Therefore, $M_{b,Rd} = k_{fl}\chi M_{c,Rd} = 1.0 \times 0.56 \times 838 = 469$ kNm

According to this simplified approach, the buckling resistance exceeds the applied moment, so the beam is stable. In fact, as previously noted, the actual buckling resistance is 557 kNm, so the calculated resistance is satisfactorily conservative.

Conclusions

Designers are unlikely to make much use of these simplifications. The use of software and look-up tables means that the simplifications are generally not required. The principle of conservatively taking just the compression part of a beam, and verifying the Tee as a strut can be a useful approach in particular situations, for example when checking the stability of a portal frame haunch.

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- Simulation Driven Additive Manufacturing: New technology from SIMULIA-Abaqus – Auday Alrawe, Intrinsys
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AD 400: The degree of shear connection in composite beams and SCI P405

The stud resistances presented in both BS 5950-3.1 (as amended in 2010) and BS EN 1994-1-1 are lower than those given in the previous British Standard. This has resulted in many composite beam designs (that were previously satisfactory) becoming impossible to verify because the maximum number of studs that can be accommodated on a beam is often less than the number of studs needed to satisfy rules for minimum degree of shear connection.

The rules given in SCI P405[1] complement those given in BS EN 1994-1-1 by allowing the user to take into account more parameters (affecting the requirements for shear connection) than are explicitly covered by the Eurocode. This means that, in many cases, the problems encountered by designers in satisfying the minimum degree of shear connection requirements can be overcome.

P405 offers minimum degree of shear connection rules that are tailored to a range of cases:

- Both propped and unpropped construction.
- Both transverse and parallel decking cases are covered as the deck orientation can have a significant impact on the required degree of shear connection.
- Beams that are only part utilised in bending (because their design is governed by serviceability considerations).
- Beams that carry high levels of loading, as found in plant rooms.
- Cellular beams, i.e. beams with regularly spaced, large circular web openings.

The lower bound minimum degree of shear connection of 40% that is specified in BS EN 1994-1-1 and BS 5950-3.1 is modified in P405 accounting for the parameters indicated above. However, there remains a need for an absolute limit, to avoid the shear studs going beyond their elastic range under SLS loading. This is to prevent cumulative plastic deformation of the shear connection under repeated loading.

Because the rules for minimum degree of shear connection in P405 could result in the specification of significantly fewer studs than BS EN 1994-1-1 would otherwise require, the resulting composite beams may be less stiff. Rules for how to take this reduced stiffness into account when determining deflections are described in P405.

Reference

1 SCI P405 Minimum degree of shear connection rules for UK construction to Eurocode 4

Contact: **Eleftherios Aggelopoulos**
Tel: **01344636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates July & August 2016

BS EN PUBLICATIONS

BS EN ISO 4759-3:2016
Tolerances for fasteners. Washers for bolts, screws and nuts. Product grades A, C and F
Supersedes BS EN ISO 4759-3:2000

BS EN 10228-1:2016
Non-destructive testing of steel forgings. Magnetic particle inspection
Supersedes BS EN 10228-1:1999

BS EN 10228-2:2016
Non-destructive testing of steel forgings. Penetrant testing.
Supersedes BS EN 10228-2:1998

BS EN 10228-3:2016
Non-destructive testing of steel forgings. Ultrasonic testing of ferritic or martensitic steel forgings
Supersedes BS EN 10228-3:1998

BS EN 10228-4:2016
Non-destructive testing of steel forgings. Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings
Supersedes BS EN 10228-4:1999

BS EN 10314:2016
Method for the derivation of minimum values of proof strength of steel at elevated temperatures
Supersedes BS EN 10314:2002

NEW WORK STARTED

ISO 13918
Welding. Studs and ceramic ferrules for arc stud welding.
Will supersede BS EN ISO 13918:2008

ISO 14731
Welding coordination. Tasks and responsibilities
Will supersede BS EN ISO 14731:2006

ISO/TR 2597-3
Iron ores. Determination of total iron content. Calculation method

ISO/TR 20133
Iron ores. Determination of sodium content by X-ray fluorescence spectrometry

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – NATIONAL BRITISH STANDARDS

16/30338305 DC
BS 7668 Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
Comments for the above document were required by 24 August, 2016

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

16/30234880 DC
BS EN ISO 12944-5 Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 5. Protective paint systems
Comments for the above document were required by 18 July, 2016

16/30337293 DC
BS EN ISO 12944-9 Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 9. Protective paint systems and laboratory performance test methods for offshore and related structures
Comments for the above document were required by 18 July, 2016

16/30337296 DC
BS EN ISO 12944-4 Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 4. Types of surface and surface preparation
Comments for the above document were required by 18 July, 2016

16/30337299 DC
BS EN ISO 12944-8 Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 8. Development of specifications for new work and maintenance
Comments for the above document were required by 18 July, 2016

16/30340708 DC
BS EN 10348-2 Steel for the reinforcement of concrete. Galvanized reinforcing steel. Part 2. Galvanized reinforcing steel products
Comments for the above document were required by 25 July, 2016

ISO PUBLICATIONS

ISO 3581:2016
(Edition 3)
Welding consumables. Covered electrodes for manual metal arc welding of stainless and heat-resisting steels. Classification
Will be implemented as an identical British Standard

ISO 4759-3:2016
(Edition 4)
Tolerances for fasteners. Washers for bolts, screws and nuts. Product grades A, C and F
Will be implemented as an identical British Standard

ISO 6892-1:2016
(Edition 2)
Metallic materials. Tensile testing. Method of test at room temperature
Will be implemented as an identical British Standard

ISO 14171:2016
(Edition 3)
Welding consumables. Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels. Classification
Will be implemented as an identical British Standard

ISO 16878:2016
Iron ores. Determination of metallic iron content. Iron(III) chloride titrimetric method
Will be implemented as an identical British Standard

BUILDINGWITHSTEEL Reprinted from Volume 4 No. 3 August 1966

The new Coventry Swimming Baths

These splendid new swimming baths are now in full operation: a number of interesting design features are incorporated in the structure, one being the 'wish-bone' system which permits full deflection of the roof structure without transferring any load to the vertical glazing.

The new baths replace the ones destroyed by bombing in 1940 and have been designed to fit into the general pattern of the new modern City centre, which includes buildings of advanced design, the adjacent Lanchester College of Technology being a notable example. In addition to the normal function of a swimming bath this Centre provides a first-class social environment in which it differs drastically from earlier baths. For instance, gardens and sun bathing terraces are attractive features and amenities such as a restaurant, games room and spectators' galleries are included.

The building is in two parts, one housing the main swimming pool and adjoining, another containing two smaller pools, the restaurant and various rooms. Each has a steelwork superstructure and roof. A bed of rock some 6 feet below the site has been used to support the basement floor. The mass foundations under the stanchions supporting the roof structure over the main pool are also taken down to rock: elsewhere the building is supported on 17-in. diameter bored piles.

The Main Pool Section

The whole roof (165 ft by 196 ft) of the main pool section is supported on four stanchions on a 155-ft by 112-ft rectangular grid. Between each pair of stanchions 155-ft lattice girders straddle the pool, and trusses, generally at 16-ft centres, span the 112 feet between the lattice girders and cantilever out from the girders a further 42 feet at each end. The roof covering is supported at 8-ft centres on purlin frames between the trusses. Framing for roof lanterns and internal lay lights is made integral with the purlin frames and at both south and north ends, the purlin frames are extended beyond the end trusses to carry fascia framing.

The four stanchions, two lattice girders and two end trusses are designed as portal frames in two directions and constitute a highly indeterminate but rigid structure. When analysing the stresses of this structure the fabricator used a computer. The stanchions, each weighing about 22 tons, are compound sections composed of two 24 in by 9 in by 94 lb universal beams with two 34 in by $1^{7}/_{8}$ in flange plates riveted to them.

High Yield Stress Steel

In the case of the two 45-ton main lattice girders the top and bottom booms are of high yield stress steel and consist of one 20 in. by 7½ in by 89 lb rolled steel joist with two 14-in flange plates of varying thickness: the internal members are of mild steel. To facilitate erection they were delivered piece-small and framed up on the ground at site, in the vertical position, all site joints being made with high strength friction grip bolts.

The main trusses between the lattice girders were shop welded in halves and the centre splices then site welded. Each leaf truss is a parallel flanged lattice girder approximately 11 ft deep and 56 ft long in plan, set to give a slope of a little less than 1 in 2 to that part of the roof. Springing from the same show level as the main trusses are the 42-ft cantilever trusses. These are arranged so that the rafters slope inwards from the cantilever end at about 1 in 30 and then pass over the tops of the main lattice girders to meet the rafters of the main trusses about 14 ft beyond the lattice girders. Gutters 2 ft 6 in wide are formed at this junction. The roof structure is completely braced against the effects of wind loading.

Except for the seven stretches of wide lantern lights between the main trusses the roof is covered with aluminium decking on 1-in thick cork insulation and three layers of roofing felt. An acoustic ceiling is provided by perforated aluminium strip with a rock wool backing.

The window mullions to the south side are composed of $^{1}/_{16}$ in sheet steel formed into 18 in by 6 in box sections. The bases to the mullions are pinned and as mentioned earlier, the caps are hinged on a 'wish-bone' system.

The Small Pools Section

The roof steelwork for the small pools section consists of trusses 4 ft deep at the shoe, with rafters sloping at 1-in-24 from shoe to ridge so that surface water drains into the eaves and valley gutters. These trusses are 65 ft span over the small pools, 32 ft span over the games deck and 48 ft span over the entrance block and generally are at 16 ft centres. At the south side they cantilever 8 ft beyond the stanchion line to carry fascia frames. Purlin frames similar to those in the main pool section carry the roof decking. The underside of the roof steelwork is 28 ft 6 in above the poolside for both pools: interposed over the teaching pool is the restaurant floor which is carried on 33 in deep universal beams spanning 40 ft between two plate girders of 56-ft span.

On the east side (i.e. west side of main pool) the glass walls of the two sections are 3 ft apart and linked by a transverse glass panel set in 4 ft from the south elevation in which the glass walls to both blocks are in line. An expansion joint is incorporated into the details at the junction of the two blocks.

The baths were designed by the City Architect, Terence Gregory, A.R.I.B.A., A.R.I.C.S., A.M.T.P.I.: the structural design was carried out by the City Engineer, Granville Berry, M.I.C.E., M.I.Mun.E.

Steelwork contractors for buildings

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

FPC Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1 **2** – Execution Class 2
3 – Execution Class 3 **4** – Execution Class 4

BIM BIM Level 2 assessed
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	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		2			Up to £200,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●					●		●	●	●		●	●		✔	3			Up to £400,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	2			Up to £4,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●	✔	3		●	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2		●	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AIC Steel Ltd	01633 528400	●			●	●		●			●	●	●			✔	4			Up to £800,000*
AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4			Up to £2,000,000
AKD Contracts Ltd	01322 312203				●					●	●			●	●		2			Up to £100,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2			Up to £2,000,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £400,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●		●	●	●		●	●		2			Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	4			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	3		●	Up to £2,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●				●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●	✔	2			Up to £800,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●		✔	2			Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £2,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		●	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4			Up to £4,000,000
Builders Beams Ltd	01227 863770			●	●	●	●	●		●				●	●	✔	2	✔		Up to £1,400,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		●	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Up to £6,000,000
Cementation Fabrications	0300 105 0135	●			●			●			●		●		●	✔	3		●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4		●	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●			●	●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011				●					●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £800,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £100,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●		●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072		●	●	●	●	●	●	●		●	●			●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4		●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3		●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●					●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899												●		●	✔	3		●	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●				●		2			Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	**Guide Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		●	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		●	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●			●	✔	2			Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Intersteels Ltd	01322 337766				●	●	●	●					●			✔	3			Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		2			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●	●	✔	4			Up to £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Up to £3,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		●	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3			Up to £800,000
Luxtrade Ltd	01902 353182									●	●				●	✔	2			Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4			Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●	●				●	●				●	✔	2			Up to £800,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £1,400,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●		●	●	●	●			●	●	✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						2			Up to £3,000,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●		●	●	●	●				●				●	✔	4			Up to £1,400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✔	4			Up to £4,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		2			Up to £400,000
Painter Brothers Ltd	01432 374400								●		●			●	●	✔	2		●	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●	●	●	●	●		●			●	●	✔	2			Up to £2,000,000
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		2			Up to £1,400,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●		2			Up to £1,400,000
S H Structures Ltd	01977 681931	●			●		●	●	●	●	●	●				✔	4		●	Up to £2,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2			Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		●	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £800,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●	●			●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2			Up to £1,400,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		2			Up to £800,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £800,000
Taziker Industrial Ltd	01204 468080									●				●	●	✔	3			Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●			●	●	✔	2			Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	2	✔	●	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●		✔	2	✔		Up to £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✔	4		●	Above £6,000,000*
Underhill Engineering & Building Services Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4			Up to £3,000,000
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		4			Up to £2,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2			Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Up to £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●		●	●	●	●	●				●	✔	4			Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●			●		✔	4		●	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	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
A Lamb Associates Ltd	01772 316278
Balfour Beatty Utility Solutions Ltd	01332 661491
Bluefin Group	020 3040 6723
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Kier Construction Ltd	01767 640111

Company name	Tel
PTS (TQM) Ltd	01785 250706
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390
Welding Quality Management Services Ltd	00 353 87 295 5335

Steelwork contractors for bridgeworks

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
- **FPC** Factory Production Control certification to BS EN 1090-1
  1 – Execution Class 1 2 – Execution Class 2
  3 – Execution Class 3 4 – Execution Class 4
- **BIM** BIM Level 2 compliant
- **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	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●	●	●	●				●	✓	3					Up to £400,000
AIC Steel Ltd	01633 528400	●	●	●					●	✓	4		✓	✓		Up to £800,000*
Bourne Construction Engineering Ltd	01202 746666	●	●	●				●	●	✓	4	✓		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4			✓		Up to £4,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4			✓	●	Up to £3,000,000
Cementation Fabrications	0300 105 0135	●	●						●	✓	3				●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000*
D Hughes Welding & Fabrication Ltd	01248 421104	●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3			✓	●	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●	●	●	●		●		●	✓	3					Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3			✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4			✓	●	Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●	●	✓	4					Up to £800,000
Murphy International Ltd	00 353 45 431384	●	●	●	●				●	✓	4					Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	4		✓	✓		Up to £4,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4			✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4			✓	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499							●	●	✓	3					Up to £800,000
Taziker Industrial Ltd	01204 468080	●	●	●	●			●	●	✓	3		✓	✓		Above £6,000,000
Underhill Building & Engineering Services Ltd	01752 752483	●	●	●	●			●	●	✓	4			✓		Up to £3,000,000
Non-BCSA member																
Allerton Steel Ltd	01609 774471	●	●	●	●				●	✓	4			✓		Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●		●	●	●	✓	4					Up to £800,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●		●	✓	4				●	Up to £800,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	4			✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
HS Carlsteel Engineering Ltd	020 8312 1879	●	●					●	●	✓	3			✓		Up to £400,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3			✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500							●	●	✓	N/A					Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4		✓		●	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A					Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●						●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	✓	4				●	Above £6,000,000

Industry Members

Industry Members are those principal companies involved in the direct supply to all or some Steelwork Contractor Members of components, materials or products. Industry 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

CE
CE Marking compliant, where relevant:
M manufacturer (products CE Marked)
D/I distributor/importer (systems comply with the CPR)
N/A CPR not applicable

SCM
Steel Construction Sustainability Charter
● = Gold,
● = Silver,
● = Member

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
AJN Steelstock Ltd	01638 555500								●		M		
Albion Sections Ltd	0121 553 1877	●									M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I		
Autodesk Ltd	01252 456893		●										
AVEVA Solutions Ltd	01223 556655		●								N/A		
Ayrshire Metals Ltd	01327 300990	●									M		✓
BAPP Group Ltd	01226 383824									●	M		
Barrett Steel Services Limited	01274 682281								●		M		
Behringer Ltd	01296 668259					●					N/A		
British Steel	01724 404040				●						M		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cellshield Ltd	01937 840600							●			N/A		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
CMC (UK) Ltd	029 2089 5260								●		D/I		
Composite Profiles UK Ltd	01202 659237	●									D/I		
Cooper & Turner Ltd	0114 256 0057									●	M		
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A		
Daver Steels Ltd	0114 261 1999	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	●	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	●	
Forward Protective Coatings Ltd	01623 748323							●			N/A		
Goodwin Steel Castings Ltd	01782 220000	●									N/A		
Graitec UK Ltd	0844 543 8888		●								N/A		
Hadley Group Ltd	0121 555 1342	●									M	●	
Hempel UK Ltd	01633 874024							●			N/A		
Highland Metals Ltd	01343 548855							●			N/A		
Hilti (GB) Ltd	0800 886100									●	M		
Hi-Span Ltd	01953 603081	●									M	●	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
International Paint Ltd	0191 469 6111						●				N/A	●	
Jack Tighe Ltd	01302 880360						●				N/A		
Jamestown Cladding & Profiling Ltd	00 353 45 434288	●									M		
John Parker & Sons Ltd	01227 783200								●	●	D/I		
Joseph Ash Galvanizing	01246 854650						●				N/A		
Jotun Paints (Europe) Ltd	01724 400000						●				N/A		
Kaltenbach Ltd	01234 213201					●					N/A		
Kingspan Structural Products	01944 712000	●									M	●	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lindapter International	01274 521444									●	M		
MSW UK Ltd	0115 946 2316	●									D/I		
Murray Plate Group Ltd	0161 866 0266								●		D/I		
National Tube Stockholders Ltd	01845 577440								●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A		
PPG Performance Coatings UK Ltd	01773 814520						●				N/A		
Prodeck-Fixing Ltd	01278 780586	●									D/I		
Rainham Steel Co Ltd	01708 522311								●		D/I		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				M	●	
Sika Ltd	01707 384444						●				M		
Simpson Strong-Tie	01827 255600									●	M		
Structural Metal Decks Ltd	01202 718898	●									M	●	
StruMIS Ltd	01332 545800		●								N/A		
Tata Steel Distribution UK & Ireland	01902 484000								●		D/I		
Tata Steel Ireland Service Centre	028 9266 0747								●		D/I		
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		D/I		
Tata Steel Tubes	01536 402121				●						M		
Tata Steel UK Panels & Profiles	0845 3088330	●									M		
Tension Control Bolts Ltd	01948 667700						●			●	M		
Trimble Solutions (UK) Ltd	0113 887 9790		●								N/A		
voestalpine Metsec plc	0121 601 6000	●									M	●	
Wedge Group Galvanizing Ltd	01909 486384						●				N/A		
Yamazaki Mazak UK Ltd	01905 755755					●					N/A		

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- Planning and Scheduling
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- Revision and Change Control
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