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NSC

New heights at Coventry

Vol 26 No 10 Nov/Dec 2018

City of London's tallest tower

Economic design boost for Bradford

University of Warwick sports legacy

Five steel schools for North East


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Cover Image
Twentytwo, 22 Bishopsgate, London
Main client: AXA IM – Real Assets
and Lipton Rogers Developments
Architect: PLP Architecture
Main contractor: Multiplex
Structural Engineer: WSP
Steelwork contractor: Severfield
Steel tonnage: 17,000t

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Steel construction quality stands out

Nick Barrett - Editor

The entire construction team on the steel-framed Bloomberg European headquarters building in the City will be delighted to have received further recognition of their achievement in the shape of the 2018 RIBA Stirling Prize for Architecture on top of their earlier Structural Steel Design Awards success (NSC October 2018).

The Stirling Prize is one of the most coveted in world architecture, and is given only to projects that demonstrate outstanding achievement on a broad range of criteria, including design vision, innovation and originality, sustainability and client satisfaction. Chairman of the judges Sir David Adaye called the building, whose BREEAM 'Outstanding' rating led to it being hailed as the world's most sustainable office building, an 'astounding commitment to quality architecture' (see News).

It is high praise for a project that shows steel construction at its best, one in which steelwork contractor William Hare can take great pride. Superlatives like those of Sir David are not used lightly, but they can in fact be justifiably applied fairly routinely to a wide range of steel-framed buildings and structures, and often are by grateful construction teams who clearly understand and value the virtues inherent in steel construction, including speed of construction, offsite manufacture, and just-in-time delivery of sections to congested sites.

In this issue of NSC we can find ringing endorsements for steel as a modern method of construction delivering outstanding benefits. At the University of Warwick 'cutting edge' sports facilities are being created for use by students and the wider community, a project described by the contractor as a 'fantastic project' to be part of. Using steel meant cost savings for the client and a frame erected five weeks ahead of schedule.

Speed of construction from a well tried and tested steel construction approach is also impressing at a batch of five secondary schools in the North East, where the construction programme had to be mindful of working hard up against pupils taking examinations in adjacent school buildings. The contractor had been pleased with steel's capabilities on earlier projects and has developed a standardised steel-framed school design approach.

Steel has earned new admirers at Bishopsgate where the City of London's tallest building, second in height only to the Shard in Western Europe, is under construction. Steel allowed engineers to design foundations around the pre-existing foundations of a cancelled project, saving time and cost.

The speed of steel construction is also impressing in Coventry, where what will be the City's tallest two buildings are under construction. The project at Fairfax Street involves four blocks designed to accommodate 1,192 students in studio apartments.

The steel construction sector has been delivering this sort of outstanding performance for many years, but some may be worried about the potential impact of Brexit negotiations. BCSA President Tim Outteridge explains in his President's Column why even a no-deal Brexit is in fact unlikely to cause any upset to the manufacture or availability of structural steelwork in the UK.

Bloomberg European HQ wins 2018 Stirling Prize

Having won a Structural Steel Design Award, Bloomberg's pioneering new European headquarters in the City of London has also collected the 2018 RIBA Stirling Prize.

The award-winning steel-framed project is credited as the world's most sustainable office and achieved a BREEAM 'Outstanding' rating, which is the highest design-stage score ever achieved by any major commercial development in the UK.

Six buildings were shortlisted for this year's coveted RIBA Stirling Prize for the UK's best new building.

The award is judged against a range of criteria including design vision, innovation and originality, capacity to stimulate, engage and delight occupants and visitors, accessibility and sustainability, how fit the building is for its purpose and the level of client satisfaction.

Sir David Adjaye, who chaired the Stirling Prize jury, said: "This groundbreaking project demonstrates what is possible through close collaboration between highly skilled, imaginative architects and a deadly sophisticated, civic-minded client. Bloomberg is an astounding commitment to quality architecture."

Working on behalf of Sir Robert McAlpine, William Hare fabricated, supplied and erected the steelwork.

Contractor named for TK Maxx's steel-framed HQ

ISG has been awarded the contract to build a landmark steel-framed headquarters building for high street retailer TK Maxx opposite Watford Junction station.

The focal point for the development is a new 15,000m² building that appears as a series of interlocking glass volumes, which sits next to two existing buildings that will be refurbished.

According to project designers Sheppard Robson, the architectural identity of the main building is shaped around its immediate townscape context. The highest part of the building aligns to Clarendon Road with volumes stepping down around the curved frontage opposite the station to acknowledge the smaller scale residential buildings on that side of the development.

As well as creating an engaging architectural form that reduces the mass of the building, this stepping of the volumes also creates the opportunity for several garden terraces and staff amenity spaces.

Sheppard Robson's interior design group have been carrying out extensive consultation with the client to shape their future work patterns, driving efficient and creative use of the internal spaces.

The office space will be arranged around the perimeter to maximise natural daylight, with circulation atria positioned on the inside of the buildings, showcasing the inner workings of the interior spaces.

Steelwork completes for Burton Gateway phase two

Located just south of Burton-upon-Trent, developer St. Modwen has completed phase two of its Burton Gateway distribution park.

Phase two consists of three distribution centres, two of which are combined within one large structure, totalling more than 11,000m² of space.

Main contractor GMI started on-site in Spring 2018 and ASA Steel Structures fabricated, supplied and erected the steelwork.

The site is said to be one of the largest warehouse developments in the Midlands and is a key employment site for East Staffordshire. It is already home to Hellmann Worldwide Logistics, who last year took a 10-year lease on a speculatively developed 8,000m² building on the site.

Rob Richardson, Senior Development Manager at St. Modwen, said: "This latest phase of speculative development is a mark of St. Modwen's intention to meet the growing need for high-quality and well connected space at a number of its key development sites. St. Modwen is committed to providing the Midlands with quality places to work, allowing regional and national businesses to thrive."

In order to develop the 280-acre site, St. Modwen carried out extensive highway works to support the regeneration of the area and, in turn, unlock the potential of a key location for commercial and residential development, having worked with the local authority and stakeholders.

St. Modwen has also recently secured planning consent for the third phase of construction at Burton Gateway, totalling a further 9,600m² of distribution space.

Steel for Life to host practical guidance seminar

Steel for Life will host a Steel Essentials free half-day seminar in Westminster on 20th November, presenting practical guidance on key aspects from preliminary scheme development to optimising in-service performance for designers considering the use of structural steelwork.

The seminar is aimed primarily at engineers, but has been structured to concentrate on good practice in steel construction rather than focus on design calculations.

It will provide helpful guidance relevant to other disciplines such as quantity surveyors, main contractors and architectural technicians engaged in the delivery of steel-framed structures.

For those attending the seminar, familiarity with steel construction would be helpful but not essential as none of the topics covered will assume prior knowledge.

The seminars topics will include steel construction options, efficient steel design, design performance, steel specification, budget costing and a review of the free resources available from Steel for Life and the wider steel construction sector.

Steel for Life was launched in 2016 and is a wholly-owned subsidiary of the British Constructional Steelwork Association. Its key purpose is to communicate and disseminate the advantages that steel offers to the construction sector which make it the material of choice for a wide range of buildings, bridges and other structures.

To book a place at the seminar contact Christina Gulvanessian, email: *Christina.gulvanessian@steelconstruction.org* or Tel: 0207 747 8139

Accommodation boost for Aberdeen students

Aberdeen's burgeoning student population is set to receive more accommodation options once the prestigious Triple Kirks scheme completes in late 2019.

Being developed by Dandara, the project comprises three interlinked steel-framed blocks (11, 12 and 13-storeys high), offering 337 en-suite accommodation units and ancillary facilities, that occupy a constrained site with a Grade A listed church spire dating from the 1840s.

Alongside the construction programme, restoration and refurbishment work is also being undertaken to the spire so that it will become a feature element within the completed development.

Dandara Engineering Director Greg Kerwick said: "On a tight and constrained site like this steel has the advantage of being fabricated offsite. This results in far less material on the footprint as it is brought to site and erected immediately. It is also quick to erect which is something we like."

Fabricated, supplied and erected by EvadX, the steel frame totals 600t with an extremely high piece count. This is because there are no long spans and the grid pattern is very irregular as it has to encompass three different room sizes, all of which are present on each floor.

Typically, the design has a central corridor with accommodation units

situated either side. Blocks one and two sit to the north of the spire and block three is positioned to the south. Two and three are linked via a narrow corridor structure that wraps behind the spire.

Work continues apace on Midland's inland port

Covering 700 acres, a game-changing distribution hub (inland port) is under construction in Leicestershire.

Known as the SEGRO Logistics Park East Midlands Gateway, the scheme combines links to the M1 and East Midlands Airport with a major new rail freight terminal.

Main contractor Winvic is undertaking a huge earthmoving operation to prepare the ground for the planned distribution structures. This involves a plant fleet of 65 vehicles moving approximately 105,000m³ of earth every week.

Four of the site's planned steel-framed distribution centres are currently under construction. Severfield is fabricating, supplying and erecting three plots, while a fourth is being constructed by Caunton Engineering.

The three plots being erected by Severfield are all large portal-framed structures with their own office blocks. Plot One (pictured), being built for an online retailer requires 2,000t of structural steelwork for the main frame and a further 4,500t for the building's two internal mezzanine levels.

Plot Two is the highest of the structures, reaching a maximum height of 35m for approximately one third of its overall length. The remainder of this building is 19m-high.

The third plot is the smallest of three Severfield distribution centres (46,451m²) and will be occupied by another online retailer.

Working on a design and build contract, Caunton Engineering has fabricated, supplied and erected 900t of hot and cold rolled steelwork for Plot 4. Measuring 244m × 69m and reaching a height of 12m, the unit will offer just over 11,000m² of floor space. This portal-framed structure will be occupied by Swiss-based transport and logistics company Kuehne + Nagel.

NEWS IN BRIEF

London's Science Museum was the venue for the **UK Steel Innovation Day 2018**, where representatives gathered to demonstrate the crucial role a modern and vibrant steel industry has to play in society. Showcasing the high level of technical innovation taking place in the steel industry and the opportunities the sector represents throughout the supply chain, the event was an opportunity to hear the leading innovators from the sector discuss how R&D can unlock the potential for a sustainable steel industry.

Ardmore has been appointed by developer Knight Dragon to deliver the Design District, a cluster of 16 artistically-inspired commercial buildings devised by a collection of eight separate design practices offering 13,000m² of workspace for creative industries and 6,000m² of education facilities and retail space. It sits at the heart of the Greenwich Peninsula master plan, situated between The O2 Dome, North Greenwich Underground Station and the new Upper Riverside residential neighbourhood.

Premier League football club **Leicester City**'s plans to create a new football training ground have been given the go-ahead. The club has secured planning permission to turn a 185-acre golf and fishing complex off the A46, eight miles north of Leicester, into a £100M complex where the first team squad will practice.

The regeneration of **Gainsborough** town centre has moved a step closer following the exchange of contracts between West Lindsey District Council and partner, Muse Developments. The first phase of development will focus on the town's historic centre, where the team will look to develop a cinema with restaurant outlets, a new public square, along with extensive public realm improvements to the riverfront.

The London Legacy Development Corporation has approved plans for a new commercial building at **International Quarter London** (IQL), the £2.4 billion joint venture development between Lendlease and LCR, in Stratford, east London. The building will provide 32,500m² of new workspace across 22 storeys and will be positioned at the gateway to the Queen Elizabeth Olympic Park.

PRESIDENT'S COLUMN

Although we had all hoped that October would bring some much-needed clarity to the Brexit process, this has not been the case. Because of this, the structural steelwork sector has asked itself what the risks of a no-deal Brexit are to the UK's structural steelwork supply.

The answer to this question is that the risk of a no-deal Brexit to the supply of structural steelwork in the UK is low.

So how do we know? BCSA and its member companies undertook a risk analysis that looked at the supply of materials and products, the structure of the workforce, stocking trends and tariffs under WTO rules.

Importantly, 98% of the UK's structural steelwork is fabricated in the UK, which means a no-deal Brexit poses no risk to structural steelwork manufacturing. The key input to this process is of course steel, and the risk to the availability and delivery of hot rolled structural sections is low. This is largely due to a joined-up supply chain that includes a UK producer, European producers, and a well established network of distributors and stockholders who hold sufficient levels of stock to support just-in-time deliveries to steelwork contractors.

UK steelmakers currently source their raw materials outside the EU and purchase forward due to long shipping times. A no deal would have no effect on this trade and any customs delays could be easily absorbed. And if UK – EU trade moved to WTO rules under a no deal scenario, import duties on raw steel would remain at 0%

There is very little risk to labour availability. On average only 7% of employees working for UK steelwork contractors are from the EU. In contrast to subcontractors that work mainly on-site, structural steelwork is fabricated offsite in manufacturing facilities that have a permanent, stable and full-time workforce.

Plant and equipment are a high-value, long-term purchase with orders for new plant and machinery made many months in advance. Machinery supplies are expected to be unaffected by a no-deal Brexit.

Structural fasteners and bolts used by steelwork contractors in the UK are sourced globally and UK suppliers already have to hold a sufficient stock of product in their UK warehouses. The risk to supply is low.

Currency fluctuations would impact on both input and output pricing, but this is only one of many factors that has an impact on steel pricing models at any one point in time.

The full risk analysis can be found in Latest News on *www.steelconstruction.org*

Tim Outteridge
BCSA President & Sales Director Cleveland Bridge

Two bridges installed in 11 hours on A14 upgrade scheme

Forming part of Highways England's A14 Huntingdon to Cambridge Improvement Scheme, Cleveland Bridge installed two 1,050t bridges in just 11 hours.

Known as the Bar Hill Junction bridges, each of the two composite decks measured 44m-long and contained 330t of steel and 720t of concrete.

A total of 12 girders were fabricated at the company's facility in Darlington, County Durham, before being transported by road over two weeks during the summer.

The girders were then braced together on-site and handed over to the A14 Integrated Delivery Team (IDT), the joint venture comprising Costain, Skanska, Balfour Beatty and designers Atkins/CH2M, before the reinforced concrete deck slab was added.

Once the concrete was cured, the decks were lifted from a series of trestles onto self-propelled modular transporters (SPMTs). They were then manoeuvred slowly into position before being lowered onto the newly-constructed abutments.

The A14 was closed to traffic at 9pm on a Friday evening to allow sections of the existing A14 carriageway to be infilled and regraded at the Bar Hill site to accommodate the SPMTs. The bridges were then installed and the road re-opened by noon on Sunday – 18 hours ahead of schedule.

Galvanizing success at Glasgow Airport

Scottish Galvanizers (part of the Wedge Group) has helped to lay the foundations for the growth of one of Britain's busiest airports.

The plant was called upon by structural steelwork contractor BHC to process more than 334t of hot-rolled steel consisting of approximately 924 separate pieces, used as part of the multimillion pound development at Glasgow Airport. The steelwork has been used to construct new pick-up and drop-off points, as well as a newly-extended car park.

BHCGeneral Manager Bryan Cathcart said: "We're pleased to see the completed works helping to ease congestion at the airport and providing a better experience for everyone who uses it.

"Hot-dip galvanizing is one of the best steel finishes we can use on structural builds as all surfaces of the steel are immersed in molten zinc, giving it thorough and long-lasting protection which can withstand the elements and prevent corrosion.

Scottish Galvanizers Commercial Manager Paul Tait added: "While the volume of steel was an average amount, the challenging part of this project was the number of components required for the works, totaling almost 1,000 separate pieces of galvanized steel.

"We're delighted that the project was a success and look forward to working together with the BHC team again in the future."

Steel frames complete at Trafford Park

Two steel frames with a combined tonnage of 800t have been erected for a flagship Williams Group retail centre for new and approved used vehicles.

Situated on a 14-acre site adjacent to the Trafford Centre, the project includes a striking three-storey contemporary glass fronted showroom for BMW, alongside separate Jaguar Land Rover and Mini showrooms and workshops.

Working on behalf of main contractor Caddick Construction, Border Steelwork Structures has fabricated, supplied and erected the project's steelwork, and is now installing the cladding.

A further steel-framed structure is due to be erected on-site. Located behind the two showrooms, this 78m-long × 30m-wide portal-framed building will house car wash bays and vehicle valeting areas.

Steel milestone reached at Rochdale town centre

Rochdale's Riverside development has reached a significant milestone as the steel frame for the project's centerpiece cinema block has been completed.

Representatives from Rochdale Borough Council and contractor, Willmott Dixon, gathered on-site to mark the completion of the steel frame for the 6-screen cinema building.

According to Willmott Dixon, rapid progress has been made over the last few months, with major jobs like preparing the site foundations now complete. Willmott Dixon has also been busy diverting services, while Hambleton Steel has been erecting the steel.

The completion of the steelwork is another big step forward for the project, which was given a major boost earlier this month when high street giant Marks and Spencer re-affirmed its commitment to the scheme after announcing it wanted to pull out in December last year.

Next, Boots, JD Sports and River Island will also be part of the scheme, which is expected to open to the public in summer 2020.

Councilor Allen Brett said: "There's been a lot going on at the Rochdale Riverside site and I'm pleased to see they're making really good progress and are well on schedule. Now we can see huge structures going up, the excitement is really building.

"This development will change the face of Rochdale by creating a first-class retail and leisure experience, which will bring major high street names and create a fantastic early evening offer to complement the many new bars and restaurants which have recently opened in the town centre."

Metal decking app launched by SMD

Structural Metal Decks (SMD) has developed a new mobile phone app for architects, designers and engineers.

Called SMD Elements® Span Check, the free-to-download app is a calculation tool enabling users run simple span checks on its range of floor deck profiles.

Said to be easy-to-use, the company believes this app to be the only one of its kind on the market. It helps users to understand the options available for each product and what can be achieved with different types of specification.

Downloadable for Android and Apple devices, the app has been designed by SMD's Marketing and Brand Manager Pete Watkins and created by Bournemouth digital agency Adido.

The app benefits from a simple menu along the bottom of the screen allowing users to navigate through the app easily and quickly.

Mr Watkins said: "The idea to create a multi-feature application for internal company and external client use is very much part of SMD's ongoing development programme as we strive to offer the best possible service.

"It complements our long-established and well-used SMD Elements® Design software which is downloadable from the SMD website for Windows desktop use which enables more in-depth calculations.

As well as the main 'Span Check' tool for determining maximum deck spans, the new app features written technical help, a form for submitting queries, links to downloadable PDFs, website literature and FAQs.

The app is downloadable now from any app store.

Work starts on Chorley retail and leisure scheme

Eric Wright Group is set to start work on a £12M development to extend the Market Walk shopping centre in Chorley, Lancashire.

The eight-unit development will see a number of steel-framed units including an M&S Foodhall, six-screen Reel Cinema, restaurants and other new businesses come to the growing market town.

John Wilson of Eric Wright Construction, said: "As a local contractor we are extremely proud to be delivering this scheme with Chorley Council and look forward to getting the main build under way.

"It offers a modern two-storey extension to the existing shopping centre which will become a major feature within the town.

"The scheme complements a lot of other work taking place to improve the appearance of Chorley town centre, such as the Primrose Gardens retirement village we are also constructing on Fleet Street.

"Chorley Council is working hard to provide a long-term future for the town and we are pleased to be a part of it."

Diary

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

Tuesday 13 November 2018
Designing in Stainless Steel
This webinar gives an introduction to the use of stainless steel in structural applications. Topics covered include grade selection and design of members and connections in accordance with Eurocode 3.

Tuesday 20 November 2018
Steel for Life - Steel Essentials Seminar
See lead story on p7.
Half-day seminar.
Westminster.
Contact *christina.gulvanessian@steelconstruction.org* or tel 0207 747 8139

Tuesday 20 November 2018
Light Gauge Steel Design Course
This course introduces the uses and applications of light gauge steel in construction, before explaining in detail the methods employed by Eurocode 3 for designing light gauge steel members in bending. Leeds

Tuesday 4 December 2018
Steel Building Design to EC3
The course will deliver a sense of reassurance that design to EC3 will become straightforward in time, and indeed has advantages in some areas. Reading.

Tuesday 11 December 2018
Double Skin Composites - Webinar

Tuesday 22 January 2019
Essential Steelwork Design 2 day course
This course introduces the concepts and principles of steel building design, before explaining in detail the methods employed by Eurocode 3 for designing members in bending, compression and tension. Birmingham

An introduction to preloaded bolting

NSC reports on bolted connections, and the regulations, standards and current practice for preloaded bolting.

A typical preloaded bolted assembly

Bolted connections in structural steel can be separated into two categories. Where a small amount of joint slip has no consequence for the structure, non-preloaded bolting is satisfactory. However, if connections are subject to vibration, load reversal, fatigue or where slip must be avoided, preloaded bolting assemblies should be used.

Standards

Preloaded bolting assemblies are covered by the BS EN 14399 series European standard which comprises 10 parts; of particular note are:

Part 1: General requirements (this is the harmonised or CE Marking standard)
Part 2: Suitability test for preloading
Part 3: System HR – Hexagon bolt and nut assemblies
Part 4: System HV – Hexagon bolt and nut assemblies
Part 7: System HR – Countersunk head bolt and nut assemblies
Part 9: System HR or HV – Direct tension indicators for bolt and nut assemblies
Part 10: System HRC – Bolt and nut assemblies with calibrated preload

Direct Tension Indicators (DTI) are also known as 'load indicating washers' and system HRC is the same as Tension Control Bolts (TCBs)

Current practice

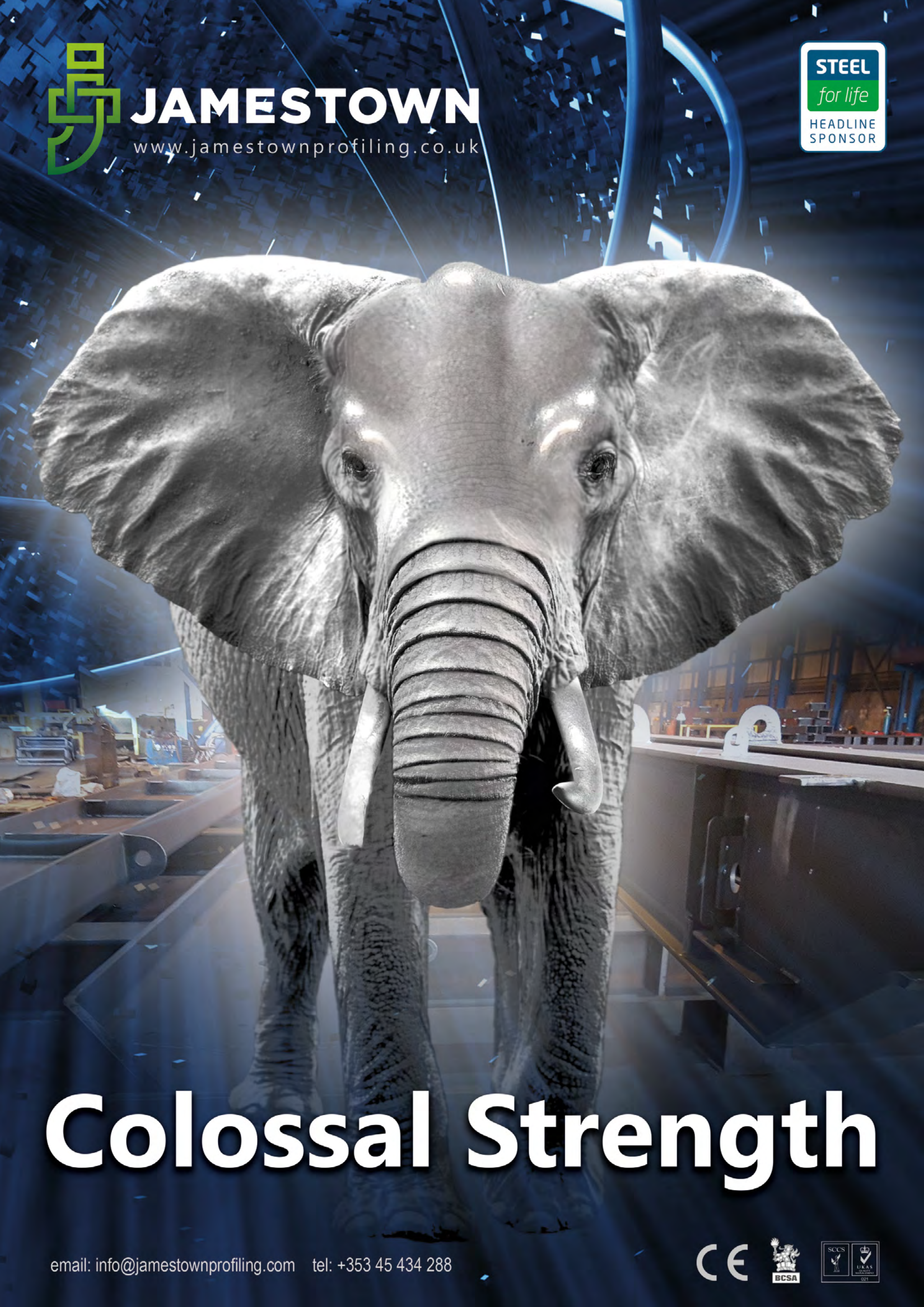
Currently only system HR (High Resistance) and HRC (High Resistance Calibrated) assemblies are used in the UK. System HV (Hochfest Vorgespannte Verbindung) assemblies have a short bolt thread and use a thinner nut to obtain ductility by plastic deformation of the threads within the nut. Both HR and HRC assemblies achieve the necessary ductility primarily by plastic deformation of the bolt threads. These systems of bolting are less susceptible to overtightening during preloading. However, if these assemblies are overtightened, the ductile failure mode is by yielding and eventually fracture of the bolt. This type of failure is easily detectable. The use of both HR/HRC and HV systems on the same site should always be avoided because of the risk of confusion and misuse.

System HR assemblies are available in M12 to M36 diameter in property class 8.8 or 10.9, whilst HRC (or TCBs) are available from M12 to M36 in property class 10.9 only. Both HR and HRC are usually supplied in the UK as *k*-class K0 only (no specific *k* factor or torque value required).

Countersunk head preloaded bolts are available as system HR and HRC (or TCBs) and are used where a flush finish is essential for functional reasons.

Weathering grade bolting assemblies are not specifically covered in the BS EN 14399 series. The execution standard EN 1090-2 section 5.6.6 gives advice in regard to suitable fasteners, but there is limited availability of such bolting assemblies in the UK. System HR weathering grade assemblies are available in property class 8.8, M24 diameter only. System HRC (or TCBs) are available in property class 10.9, M24 and M30 diameter; availability of any stock should always be sought from suppliers.

Installation and tightening of bolts is a major site activity and the designer should always consider the access for operatives and equipment. If insufficient care is taken, the result can be components that cannot be fitted or bolts that cannot be tightened with standard equipment. CAD blocks for both bolting assemblies and associated tooling (e.g. shear wrenches to install TCBs) for use in modelling are available from most reputable suppliers/manufacturers.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BCSA

Yorkshire gets fitness boost

An economically-designed steel-framed leisure centre is set to provide the local community in Bradford with modern sporting facilities.

FACT FILE
Sedbergh Sports and Leisure Facility, Bradford
Main Client: City of Bradford Metropolitan District Council
Architect: DarntonB3
Main contractor: ISG
Structural engineer: Furness Partnership
Steelwork contractor: Billington Structures
Steel tonnage: 450t

One of the more active construction sectors over the past decade or so has been leisure, spurred on by the fact that numerous local authorities are either upgrading their current facilities or building new state-of-the-art swimming and sports complexes.

Examples of this work recently covered in New Steel Construction include new pools in Coventry (NSC March 2018) and Rhyl (NSC April 2018) as well as a leisure complex in Littlehampton (NSC May 2018).

These projects are usually built using a steel-framed solution, as economically-constructed long, clear spans are needed to accommodate facilities such as swimming pools and indoor sports halls.

Constructional steelwork also offers a relatively quick construction programme, while flexibility can also be built into the frame, whereby partition walls can be removed to allow reconfiguration of rooms and halls.

Another recent example from this sector is the Sedbergh Sports and Leisure Facility in Bradford, where Billington Structures, working on behalf of ISG, has recently completed the steel frame.

The scheme is part of an ongoing investment programme by the council to replace outdated and inefficient leisure facilities, with modern, purpose-built amenities that better serve local communities and encourage greater participation in sports.

The new high-specification two-storey leisure centre includes a 25m swimming pool, 12.5m learner pool with moveable floor, eight-court sports hall, 80-station fitness suite, two dance studios, staff facilities and café as well as outdoor pitches for both football and rugby.

The rectangular-shaped building is arranged with the two long span areas – sports hall and pool hall - at either end. These two zones are both single-storey elements, reaching the full height of the structure, and are separated by a two-storey spine that also extends along the front elevation.

The two-storey area accommodates wet and dry changing facilities, with the gym and dance studios on the upper floor.

In front of the two-storey zone, the building has a full-height reception area that runs the full length of the building. Beyond this, a series of feature 219mm-diameter CHS columns supports an exterior canopy, which creates a covered pedestrian walkway.

Overall, the steel frame is based around an irregular grid pattern (varying between 4.7m and 5.7m spacings) as there are a multitude of uses to be accommodated, all of which require rooms and areas of differing sizes. Cross bracing, located in the building's corners and within interior partitions, provides the stability.

"Most of the bracing is out-of-view in the completed scheme, however, we do have some feature Macalloy cross bracing which sits inside the gym's large glazed wall that overlooks the site's sports pitches," says ISG Project Manager James Fryer.

Prior to the steelwork programme commencing, ISG had already begun its extensive groundworks, which included digging up 50,000m^3 of earth and then distributing it around the site.

The plot was previously used as sports fields that were poorly drained, and frequently waterlogged. ISG is installing a new drainage system throughout the site

A covered walkway will extend along the front elevation

A series of 45m-long trusses spans the sports hall

and altering the terrain in order to create flat sports pitches on an area that previously sloped up to 8m from one end of the site to the other.

The site has been lowered by approximately 6.5m to accommodate the leisure centre. All of the excavated material has remained on site and much of it has been relocated to the opposite end of the site to raise the plot's lowest level.

Having installed pad foundations for the steel frame and dug out and concrete-lined the swimming pools, ISG was ready for the steelwork programme to kick-off.

"The steelwork was completed on time and this has allowed us to get all of the follow-on trades started on time," says Mr Fryer. "However, this is only part of the story as our earthmoving and groundworks programme have both carried on during this time and beyond."

Billington used a number of mobile cranes, up to 70t-capacity, for the steel erection. The largest steel elements were the 45m-long trusses that span the sports hall. Brought to site in three sections, the trusses were bolted into two parts on the ground (one third and two thirds) before being lifted into place by two cranes. Once they were bolted on to their respective columns, the central splice was completed while the cranes were holding the truss sections in place.

Designed to complement its surroundings on the Sedbergh Playing Fields site, the 5,100m² building features a large expanse of glazing to its façade, with solar shading panels and timber cladding elements, as well as a striking aluminium roof design that wraps around the structure. The project is scheduled for completion in summer 2019.

Summing up, ISG Regional Director Tim Harvey said: "This latest investment in community leisure facilities underscores the importance Bradford District Council places on fitness and well-being across the region. Increasing participation in sporting activities is a key aim of the new centre, as well as creating a hub that becomes a focal point for the local community, and as a Bradford-based contractor this is a great aspiration for this influential project".

The completed learner pool

Value for money

The initial steel design for the Sedbergh Leisure Centre was engineered by Furness Partnership, but ISG wanted its subcontracted steelwork contractor, Billington Structures, to do a design and build on the scheme, in order to achieve a more cost-effective programme.

Working with the original designs, Billington conducted some value engineering, whereby all of the column locations, beam depths and spans were all fine-tuned, making the steelwork more cost-effective.

"By rationalising the steel tonnage, there were less crane lifts to undertake and consequently the overall programme was quicker," explains ISG Project Manager James Fryer.

Billington also supplied and installed the project's metal decking, two precast staircases, a feature steel staircase and easi-edge protection barriers. All of its on-site work was completed ahead of schedule.

Steel creates sporting legacy

A covered terrace sits adjacent to the cafe

A value-engineered and highly efficient steel-framed sports hub will help the University of Warwick achieve its ambitious physical activity targets.

Due to complete in March 2019, the University of Warwick's new sports hub will create one of the foremost sports facilities at a UK university – including what is claimed to be the country's largest gym facility in the higher education sector.

The project aligns with the University's ambition to be the "most physically active campus community in the UK by 2020".

Replacing the current sports centre on the campus, the hub will feature a 16-court sports hall, a 25m-long swimming pool with a moveable floor, fitness suites, climbing and bouldering walls and flexible studio spaces, as well as squash courts, outdoor 3G sports pitches and netball courts. It will also be the official training ground of Coventry's Wasps Netball Superleague team.

Cost is always a major factor in any construction scheme and this project is no different. Early in the design phase, Willmott Dixon engaged with the steelwork contractor Hambleton Steel to help with a value engineering exercise.

The project's original design envisaged a steel frame supporting precast planks to form the building's upper floors. Hambleton suggested changing this to a more cost-effective metal decking solution.

"We changed all the floors to metal decking with the exception the wet changing rooms and areas near to the pool because of chlorine corrosion concerns," says Willmott Dixon Construction Manager Nick Preedy.

"This meant we had to add extra beams to support the decking as it couldn't span as far as the planks, but overall we used less steel tonnage as a lighter frame was needed, which ultimately saved the client money."

Another benefit resulting from this design change was a quicker steel erection programme. Including the metal decking installation and the remaining precast planks, the work was completed in 13 weeks instead of the previously estimated 18 weeks.

Overall the sports hub is one large steel frame, which gains its stability from strategically-placed cross bracing, and offers 14,000m^2 of floor space.

Two large open-plan areas dominate the building and are placed at either end of the 200m-long structure. At the northern end of the structure the 16-court sports hall is a large column-free space reaching the full-height of the building. The hall is formed with a series of 11 spliced 40m-long × 2m-deep trusses, which weighed 8t each.

The trusses are supported at one end by tubular raking columns that form the architectural feature façade for a viewing gallery.

"These raking columns are the middle

FACT FILE
University of Warwick sports hub
Main Client: University of Warwick
Architect: Space & Place
Main contractor: Willmott Dixon
Structural engineer: Arup
Steelwork contractor: Hambleton Steel
Steel tonnage: 900t

The sports hub will allow the University to achieve its lofty sporting ambitions

Architectural raking columns adorn the sports hall's viewing gallery

portion of a longer spliced column," explains Hambleton Steel Design Engineer Andrew Dobson. At basement level the column is a vertical UC section, it then changes to a raking section for the ground floor and then reverts back to a vertical member higher up."

Another design innovation from Hambleton is a series of beams that cantilever out from the top of the sports hall's roof and over the lower roof of the adjoining areas. Willmott Dixon supported the scaffold for the cladding installation on these sacrificial beams, which will be removed once the cladding is complete.

"This helped speed up the installation of the scaffolding as it would have ordinarily been supported from ground level. By using the beams the scaffold was erected more rapidly, which allowed us to get started on the cladding earlier, and meant we got the sports hall watertight earlier," says Mr Preedy.

At the southern end of the hub there is an 8m-high swimming pool hall, which is another large open column-free space. This zone is formed by a series of 30m-long glulam beams supported on steel columns.

The columns in the pool area will be left exposed in the completed building, as will most of the sports hub's steel frame. To this end, all of the project's steelwork has been painted with a high-spec protective coating to prevent any corrosion from the potentially humid and chlorinated conditions.

The sports hub's other facilities occupy the large area between these two column-free zones, as well as running along the entire eastern elevation. In these parts, the hub has three floors, a basement – mainly accommodating changing rooms and offices, a ground floor with the main entrance, climbing wall and squash courts, wet changing facilities and a café, and a first floor containing a 330-station gym and multi-purpose studios.

Steel starts at basement level, where a large concrete retaining wall forms this partially subterranean level. Early in the construction programme Willmott Dixon completed a cut and fill operation, removing 20,000m^3 of overburden to level the previously sloping site.

As well as internal exposed steelwork, some of the hub's exterior steel will also be remain visible as architectural features.

Adjacent to the pool hall a large cantilevering canopy, partially supported by raking CHS columns, creates an outdoor terrace for the hub's café.

At the opposite end of the hub, a similar canopy forms the roof for the facility's main entrance, again supported by raking columns.

These raking 273mm-diameter columns also extend along the exterior of the eastern elevation, joining the two canopies with a series of large Ws, which obviously stand for Warwick.

Most of these raking columns are not structural, but purely architectural. They are attached to the elevation's cantilevering roof and will be installed once the cladding is complete.

Summing up, Willmott Dixon Managing Director in the Midlands Peter Owen says: "This is a fantastic project to be part of, creating cutting edge sporting facilities for the community at University of Warwick, which will really benefit its users."

Steel construction was chosen for its speed of erection

FACT FILE
English Martyrs School, Hartlepool
Main client: Education and Skills Funding Agency [ESFA]
Architect: Ryder
Main contractor: BAM Construction
Structural engineer: BAM Design
Steelwork contractor: Harry Marsh [Engineers]
Steel tonnage: 552t

Lessons learnt in steel

A standardised steel-framed design is helping a school project in the North East of England to quickly take shape. Martin Cooper reports from Hartlepool.

Part of a nationwide programme, five new schools are to be constructed in the North East of England.

The Education and Skills Funding Agency [ESFA] has appointed BAM Construction for this Capital Framework North East Batch A of priority schools.

Four of the projects are steel-framed secondary schools, replacing existing and out-of-date premises. The fifth project, a primary school, has a modular light steel design.

The batch consists of two schools in Hartlepool, and one each in Durham, Houghton Le Spring, and Whickham, Newcastle.

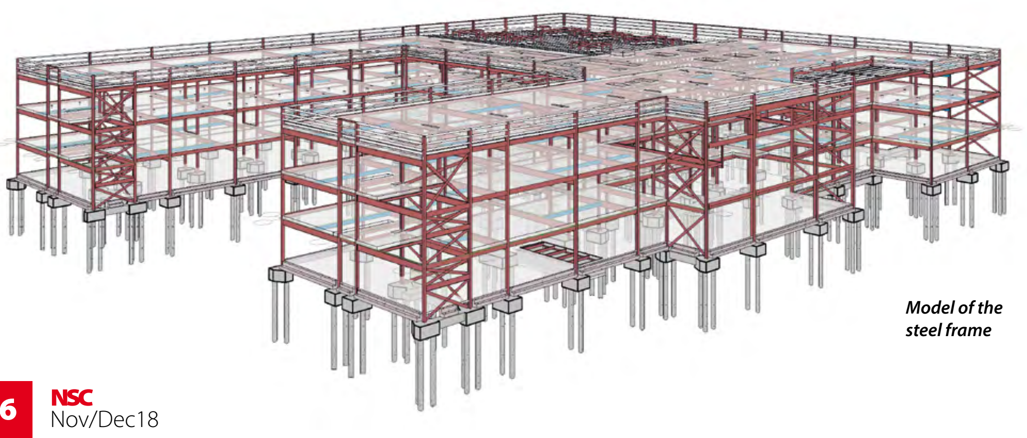
The first of the two Hartlepool projects to get started is the English Martyrs School, located on the western fringes of the town.

BAM Construction started on this site during April this year and is scheduled to complete the project in May 2020.

As well as building the new school, BAM will also demolish most of the existing buildings, once the students and staff have decamped, and convert that plot into new sports fields.

However, two buildings on the site will not be demolished and will remain as part of the new school; the stand-alone sixth form college and a music block. The retention of the latter building has necessitated BAM to enlarge an adjacent toilet block.

The new school building is one large U-shaped steel frame, partially enclosing a landscaped garden. The steelwork gains its stability from cross bracing, either located in stairwells or in partition walls.



Model of the steel frame

Overall the structure and its two outer wings are 81m-long, with the back of the U-shape building having a width of 69m.

"Many ESFA schools are built using a steel-framed solution, as it's viewed as a quick form of construction," says BAM Construction Project Manager Jason Kelly.

"It's also a tried and tested form of construction for BAM, as we've done a number of similar schemes."

BAM Design Associate Engineer Stuart Hinde agrees and adds: "We have designed a lot of secondary schools over the years and they are predominantly steel-framed."

"We now have a default design method for these projects, which gives us our starting point, although we do fine tune and constantly review each scheme."

BAM's standardised design method allows each project to get an early start and work to a regular kit of components. All of this helps with procurement of materials and the speed of the overall programme.

This design methodology also lends itself to secondary school projects as they are invariably similar, although the layout of certain facilities will always change depending on the location and the architectural intent.

"Our classroom layout of the English Martyrs School is typical of our standardised design, with each wing containing two rows of classes separated by a centrally-positioned corridor," adds Mr Hinde.

"Our design fine tuning has led to us using a 7.2 × 7.86m grid pattern which we now consider to be the most efficient position for column spacings."

Each classroom space has enough room for all of its intended components but, if a larger space is needed in the future, the steel design has in-built flexibility as partition walls can be removed without having to remove a column.

The school's steelwork supports precast planks to form its floors and roof. This method is considered by BAM to offer a quick final product, even though a concrete screed topping must always be added.

The underside of the planks are left exposed within the ceilings of the completed classrooms, and the few services that do run through the rooms are also exposed and hung beneath the steel beams.

Most of the steel frame incorporates two storeys, apart from three large open-plan areas; a sports hall and two multi-functional halls next to the main entrance.

In these areas, precast planks have not been used as a lightweight metal decked roof has been installed, which is considered to be a more efficient method when dealing with longer spans.

In the open-plan areas, which rise uninterruptedly to the building's full height and are mostly grouped towards the back of the U-shape, Westok cellular beams have been used to form the spans.

The spans in the sports hall are 18.5m long, while the other two halls feature even longer spans of 21m.

The project is on schedule and has escaped any major hiccups, although working next to a functioning school can throw up a few challenges.

"When we began our works the school was just starting its exam process and the sports hall where most are held is right next to our site," says Mr Kelly.

"We had to be mindful of their exam times and, consequently, when we could operate plant equipment such as the piling rigs."

The new school building is founded on a series of CFA piles which have been installed to a depth of 17m.

Once the site, which was previously occupied by sports fields, had been piled, the steelwork erection programme was able to begin in June, with the majority of this work completed during the school summer holidays.

Steelwork contractor for the English Martyrs School project was Harry Marsh [Engineers] and it is now working with BAM on the second school in Hartlepool, High Tunstall College of Science.

The school is scheduled to complete in May 2020

The steelwork supports precast planks to form the floors

Stability for the frame is derived from cross bracing

City's tallest tower

Known as Twentytwo, the City of London's latest signature commercial building will be head and shoulders above all others in the square mile. Martin Cooper reports on the challenges that have been overcome.

Topping out at 62-storeys and 278m-tall, Twentytwo located at 22 Bishopsgate will on completion be the City of London's highest building, and second only to the Shard in western Europe.

Being built on the plot of the previously stalled Pinnacle scheme, the new development incorporates the below-ground elements of its predecessor, including three floors of basement and a raft slab supported on piled foundations.

From ground level upwards it is a steel-framed structure surrounding a large central core, with minimal internal columns ensuring long clear spans of up to 17m. Twentytwo will eventually offer an impressive 118,000m^2 of flexible workspace for all sizes of businesses.

The building will be the first of its kind to house a food market, brimming with fresh tastes and open kitchens, while other amenities will include an innovation hub, gym, well-being retreat and spa, a restaurant and London's highest free public viewing gallery.

Constructing one of Europe's tallest structures on the site of a previous scheme was always going to throw up a few snags.

"Reusing the foundations was the project's biggest challenge," says WSP Project Engineer Diego Padilla Philipps. "In the end, we re-used 100% of the existing piles, although some are not in the most convenient positions for the new structure."

In order to remedy this pile position challenge, transfer structures have been introduced at basement level and level two to support columns that do not have a pile directly below them.

The basement level transfer structure supports one column that extends up to the full height of the building. The transfer structure is a 15m-long plate girder weighing approximately 97t.

Meanwhile, the level two transfer structure is another giant steel member that also transfers loads from perimeter columns. This

FACT FILE
Twentytwo, 22 Bishopsgate, London
Main client: AXA IM – Real Assets and Lipton Rogers Developments
Architect: PLP Architecture
Main contractor: Multiplex
Structural engineer: WSP
Steelwork contractor: Severfield
Steel tonnage: 17,000t

The steel frame will top out by the end of the year plate girder weighs in excess of 100t and is 14m-long.

An existing access route to the basement loading bay necessitated steelwork contractor Severfield to design, fabricate and erect a structure dubbed the 'Rhino' truss because of its shape.

"This is circa 150t in weight and was erected using two tower cranes. We had to get a special dispensation from the manufacturer to uprate the cranes for the erection of this truss," explains Severfield Project Manager Kyle Fletcher.

"It is made up of site bolted booms, nodes and diagonals, with the heaviest node weighing approximately 20t."

In order to maximise the building's floor space and help the remainder of the perimeter columns locate on existing pile positions, the structure's lower columns, up to level 7, are mainly inclined.

As the columns are raking outwards there are some large structural reactions and transfer forces. To counteract this, the floor beams are slightly larger on these levels and installed in a diagonal orientation, as opposed to being perpendicular to the core.

Like most UK high-rise commercial buildings, the superstructure comprises a composite design of cellular beams supporting metal decking and a concrete slab.

This provides a diaphragm action restraint to the perimeter columns.

A centrally-positioned core contains 35 lifts, providing direct access from the entrance lobby to all levels. Squeezing so many lifts into one core, without intruding on any of the valuable floor space, meant a long slender core design was chosen.

Consequently, the core cannot provide the necessary structural stability to the superstructure's steel frame during high winds. This has required the installation of two giant outrigger stability systems positioned on two intermediate floors, adding some stiffness to the building and controlling sway and acceleration.

Mr Padilla Philipps uses a skiing analogy to describe the work the outriggers perform. "If a skier has his arms straight down by his sides, there is very little stability. However, by introducing poles with arms outstretched one can maximise stability."

Positioned at levels 25 and 41, both of which are double-height floors containing plant equipment, the outriggers are large floor-to-ceiling V-shaped trusses that link the core to the perimeter columns and provide bracing.

There are three sets of outrigger trusses on both floors, all of which extend from the building's east elevation, through the core and then connect to the west perimeter columns.

They were fabricated and erected in sections to form a truss. These were typically made up of a top and bottom boom, plus ▶20

Managing windy conditions

Working on a building that will ultimately reach a height of 278m and with three tower cranes looking down on the structure from an even loftier position, it is not surprising that Severfield has had to manage the effect of high winds and gusty conditions on steel erection.

Wind is the one weather element that can occasionally delay a steel erection programme that relies on craneage, and wind speeds generally increase with height so it has more of an effect on tall buildings. However, what is surprising about this scheme is that the high winds that have occasionally suspended crane duties have mostly been encountered at low levels along the main Bishopsgate thoroughfare.

"The street is like a wind tunnel at times as gusts speed along the road between the numerous high-rise buildings," says Severfield Senior Site Manager Micky Reilly.

"This stops us picking up steel from our delivery point and lifting it up to the erectors who are working further up the building. Strangely at these times the conditions have been mostly alright for working and lifting steel on the top parts of the structure."

To guard against such wind stoppages and mitigate any potential delays to the programme, Severfield's erection team is working on a 24-hour basis, with a night-time shift – wind permitting – delivering and placing as much steelwork as possible in readiness for the daytime shift to erect.

Outrigger systems have been installed on two levels

▶19

internal diagonals.

The internal diagonals are installed with the bolts pinned in oversized holes to allow movement in the truss when the building deflects with axial shortening under gravity loads during construction. These do not become 'active' until the building is fully loaded, at which point they will be tightened.

The trusses vary in size depending on their locations, with the largest fully assembled truss measuring approximately 15m × 7.6m.

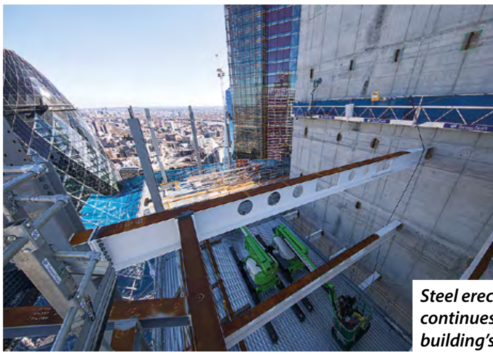
"The booms were brought to site with complex, offset and heavy node connections on transport frames. They were designed and fabricated by ourselves to be lifted straight in to their as-built position from the back of the trailer," says Mr Fletcher.

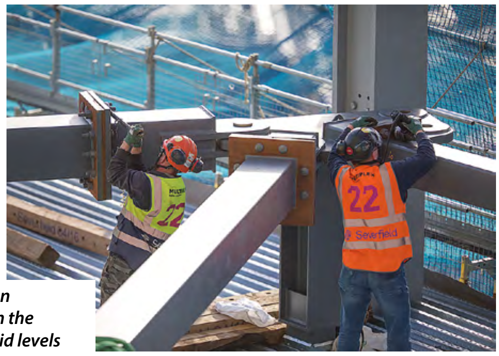
As there are outrigger sections embedded within the concrete core, steelwork contractor Severfield had to design, fabricate and deliver these elements well in advance of the main steelwork.

Once the steelwork and floors were installed up to levels 25 and then 41, the V-shaped trusses were installed either side of the core and connected to plates left exposed from the elements inside the concrete core.

Twentytwo is due to complete by the end of 2019.

Outrigger truss positioned on Level 41





Steel erection continues on the building's mid levels

Outriggers

The lateral stiffness of 22 Bishopsgate is increased in the direction of the narrow dimension of the concrete core by mobilising the perimeter columns. Richard Henderson of the SCI discusses some of the issues.

The lateral stiffness of a building with a narrow core can be increased by connecting the core to the perimeter columns by means of stiff beams known as outriggers. In 22 Bishopsgate these are provided at two levels and are double storey-height trusses. Under lateral load, the bending moment in the building core increases rapidly with distance from the top of the building. The effect of the outriggers is to apply a bending moment of the opposite sense to the core using the steel perimeter columns (see the figure).

The magnitude of the moment transferred depends on the bending stiffnesses of the core and outrigger and the axial stiffness of the columns. The intended result is that the overall stiffness of the building is increased and the maximum deflection at the top significantly reduced.

The deflection of a building is made up of the sum of shear deflection and bending deflection. The outriggers reduce the contribution of the bending deflection to the total but do not affect the shear deflection. This is because the slope of the core at the relevant level results in a vertical deflection at the ends of the outrigger which is resisted by axial forces in the perimeter columns. Under the shear deformation, the outriggers remain horizontal and no axial forces develop in the columns.

Some of these effects can be explored at concept design stage by considering the deflection of a cantilever under lateral load with a discrete moment applied at the appropriate position. For example, the maximum bending deflection δ of a vertical cantilever of height H under a uniform load with an opposing applied moment M at mid height is given by:

$$\delta = \frac{H^2}{8E_c I}(WH - 3M)$$

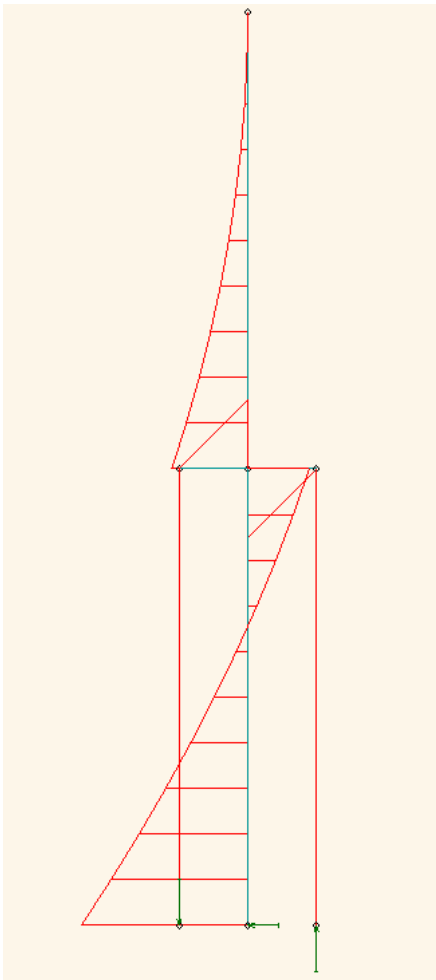
if W is the total lateral load on the cantilever. The perimeter columns extend and shorten by an amount equal to the deflection of the end of the outrigger. If the outrigger is at mid height and is assumed to be rigid, the building width is b and the outriggers are $b/2$ long, the vertical deflection of the outrigger ends can be calculated from the slope of the cantilever at mid height due to the lateral load and applied moment. The vertical deflection is given by

$$x = \pm \frac{bH}{96E_c I}(7WH - 24M)$$

and is equal to $FH/(2AE_s)$ (either lengthening or shortening) where A is the column area. Using these expressions, the force F in the column is given by:

$$F = \frac{7WbHm}{24I}\left(\frac{AI}{2I + mb^2A}\right)$$

where m is the modular ratio. The moment and the deflection can then be estimated. A similar expression can be developed which takes account of the deflection of the outrigger.

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Reaching new heights in the Midlands

Topping out at 23-storeys high, a student accommodation project will be Coventry's tallest building. Martin Cooper reports.

Steel has provided the required speed of construction

Car manufacturing, including the famous London black cab, and the invention of the bicycle, Coventry is famous for many things, but until recently high-rise buildings was not one of them.

That perception may be about to change, as a new landmark 23-storey student accommodation scheme has claimed the accolade for Coventry's tallest building, excluding the nearby cathedral spire.

Towering over the city centre, the Fairfax Street scheme for specialist student accommodation developer CODE Students will deliver 1,192 self-contained studios. All will feature a fully-equipped kitchen, deluxe shower room, a double bed, 200mb broadband and a secure CCTV and fob entrance system.

The scheme consists of four interlinked steel-framed blocks, ranging in height from the eight-storey Block C to the tallest element, the 23-storey high Block B. Meanwhile, Block A has 14-storeys and Block D tops out at 21-storeys, technically making it Coventry's second tallest tower.

"This is the highest project main contractor Winvic has ever built," explains Project Manager Martin Overfield. "The company is well-known for constructing distribution centres, but we are now diversifying and recently completed a similar job for the client in Leicester, although that was low-rise compared to this scheme as it only had eight-storeys."

Winvic started work on site during October 2017, and began by installing piled foundations in readiness for the steel erection to begin. The plot had previously been used as a surface car park and the client had already remediated the site before Winvic arrived.

The choice of a steel-framed solution for the scheme was made solely for the material's speed of construction.

"Getting the accommodation completed as quickly and efficiently as possible was upmost in our initial discussions with the client," says Mr Overfield. "Consequently, we went for a steel frame construction with metal decking as it is the fastest method."

This design decision has proven to be the correct one as after only 11 months on site 315 bedrooms were already completed. Block A and a portion of the adjacent Block B were handed-over in September, just in time for the new University term.

By the following month (October), steelwork contractor Caunton Engineering had competed the majority of its programme, having erected Blocks A, B and D, and then completing Block C.

"For logistical reasons Block C was erected last as it's situated in the middle of the scheme on what was our delivery area," explains Caunton Engineering Deputy ▶24


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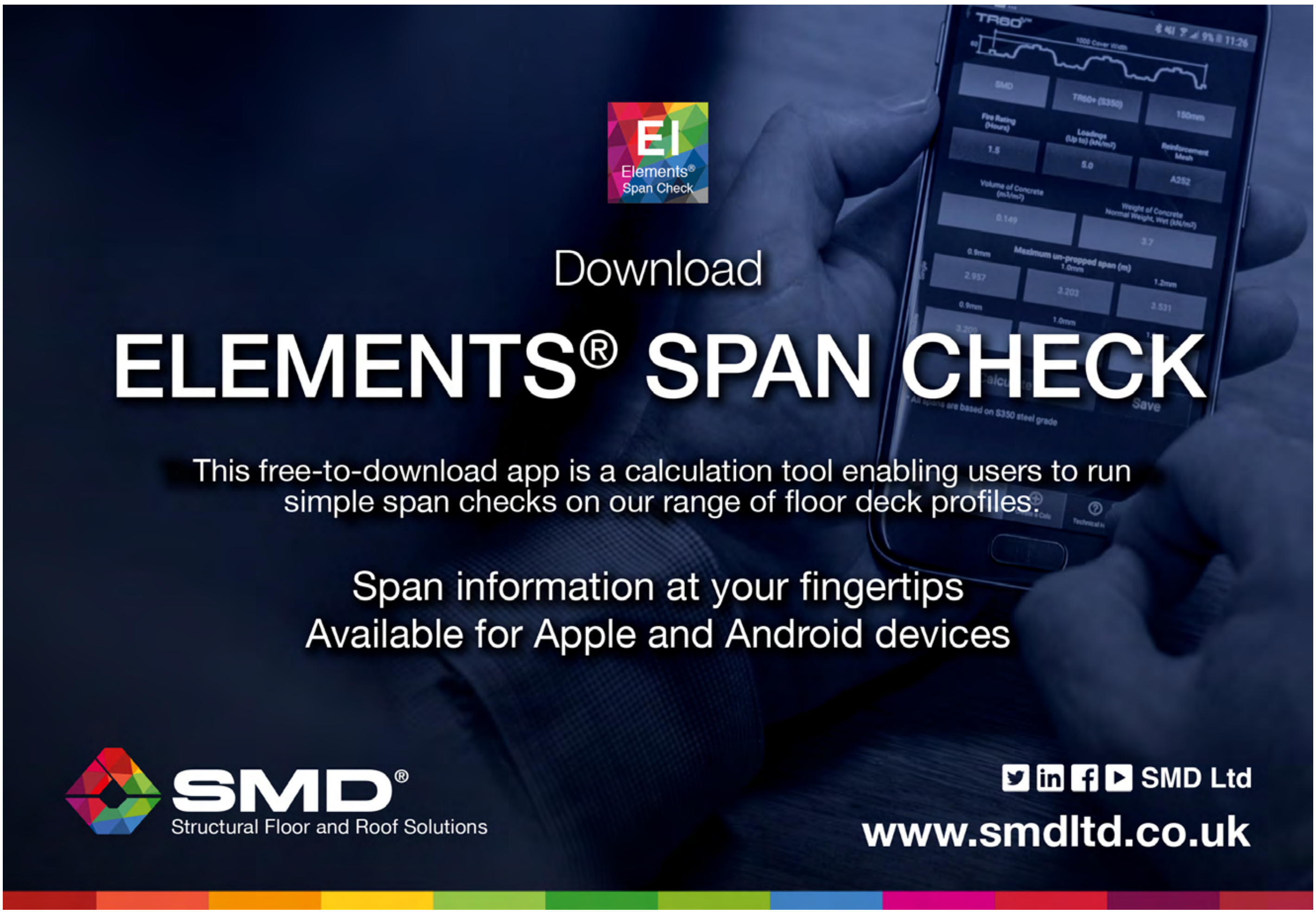
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▶22 Erection Department Manager Richard Patterson.

A final piece of the steelwork jigsaw will be completed in February when Caunton will return to site to erect 26t of steel that forms a single-storey podium deck situated in front of Block C. This will accommodate ground floor retail units and a landscaped private garden on the first floor.

Caunton Engineering has been employed on a design and build contract for the scheme. The company's Senior Structural Engineer Colin Winter says: "Although there are four blocks and a podium, much of the steelwork is fairly straightforward and repetitive as each of the accommodation blocks have identical floor plans."

The four accommodation blocks have widths between 13m and 15m, with only one internal column line. These members are offset from a central line, allowing them to be positioned one side of the corridor that separates two rows of bedrooms on each of the block's floors.

Meanwhile, perimeter columns are generally set at 6m or 7m intervals, with stability for the frames derived from full height vertical bracing systems.

The bracing forms steel cores around stairs and lifts, which are located in the two tallest towers, Blocks B and D.

"The entire scheme is essentially two large steel frames, separated by a movement joint between Block C and B," explains Mr Winter.

The regimented tower block grid lines even include non-bedroom areas such as the ground and first floor areas which will accommodate retail and student communal areas.

Some of these areas will be subjected to higher loadings and so larger beams, measuring 350mm × 300mm, have been installed at first floor level in Block A where a student gym will be located.

The majority of Fairfax Street Student Accommodation will be handed over to the client in August 2019.

FACT FILE
Fairfax Street Student Accommodation, Coventry
Main client: CODE Students
Architect: RG+P
Main contractor: Winvic Construction
Structural engineer: PRP
Steelwork contractor: Caunton Engineering
Steel tonnage: 1,800t


Artist's impression of the finished scheme

Towering construction

As the steel frame of this project began to rise, the cranes used to lift the steelwork had to be changed.

"All of the steelwork up to level nine was done using mobile cranes, positioned in the building's footprints and on the plot where Block C now sits," explains Caunton Engineering Deputy Erection Department Manager Richard Patterson.

"Once we reached floor 10, it was more cost-effective to use tower cranes so Winvic installed two units, which were then predominantly used for the steel erection."

The site's two cranes are 75m and 85m tall respectively, and are the largest tower cranes ever managed by Winvic.

Due to the height of the cranes, Winvic says it has had to inform the Aviation Authority of the position and height of these cranes as they are a potential hazard to low flying aircraft. At night both cranes display red warning lights to help identify them to aircraft, as units this high are unusual in Coventry.

For the erection programme, Caunton used MEWPs positioned on the ground floor to work in conjunction with the cranes. However, once the erection sequence progressed beyond level 14, the MEWPs did not have the required reach.

"You can get MEWPs with a longer reach but they are expensive to hire and use, and as the floors were yet to be concreted we used a bespoke platform system that supports the MEWPs on the already erected steel frame," says Mr Patterson.

As the steel frame progressed upwards, two floors at a time, the tower cranes would then lift the frames to their next position and then place the MEWPs, in readiness for the next stage of steel erection.

Composite beam design at elevated temperature: comparisons between different temperature distributions in the concrete flange

Several resources give guidance on the temperature profile through composite slabs; BS 5950-8, EN 1994-1-2 and NCCI PN005C-GB. Ricardo Pimentel of the SCI discusses the impact of these alternative profiles on the design of composite beams at elevated temperature.

Composite beams are one of the most common structural elements in the UK construction market. Steel and concrete are connected by mechanical devices (shear connection – usually studs), allowing the two materials to work together. Composite beams are usually simply supported elements, allowing the steel to be mainly in tension and the concrete in compression.

The fire design of composite beams is often required, which demands an assessment of resistance of the concrete, steel and studs at elevated temperature. The main topic of this article is to evaluate the impact of alternative temperature distributions in the slab to obtain the critical temperature or the allowable fire exposure period of composite beams. For a composite beam design at elevated temperature, there are three possible ways to model the temperature distribution in the slab in the UK: (i) EN 1994-1-2 Annex D Table D.5; (ii) BS 5950-8 Table 12; (iii) NCCI PN005C-GB. However, note that the UK National Annex to EN 1994-1-2 states that Annex D should not be used, recommending the use of non-contradictory complementary information (NCCI).

The effect of different temperature profiles will be assessed based on two worked examples, comprising 6 m and 12 m span beams, both optimized for an adequate performance under Serviceability Limit States, Ultimate Limit States and Fire Design. The geometry and design conditions for the two worked examples are summarized in the data presented in Figure 1 and Table 1.

h_1 [mm]	70
h_2 [mm]	60
l_1 [mm]	175
l_2 [mm]	125
l_3 [mm]	125

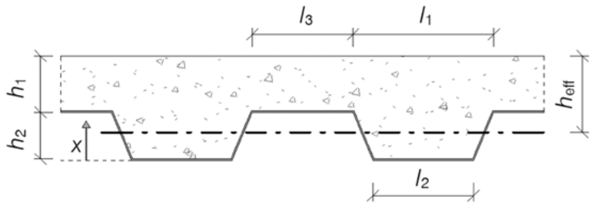


Figure 1 – Composite slab geometry.

Characteristic	Description/value
Steel section for the 6 m beam:	UB 203 x 133 x 25
Steel section for the 12 m beam:	UB 406 x 178 x 67
Effective slab breath to 12 m span:	3000 mm
Effective slab breath to 6 m span:	1500 mm
Floor usage:	Office
Beam spacing [m]	3.50
Slab weight [kN/m²]	2.65
Additional permanent loads [kN/m²]	2.00
Imposed Load [kN/m²]	2.70
Steel:	S355 JR
Concrete:	C30/37
Slab mesh:	A142
Ribs direction:	Perpendicular to the steel beam.
Fire protection:	Yes
Temperature gradient:	Uniform temperature in the steel profile.
Fire rating:	90 minutes
Steel Critical temperature – 6 m span:	620°C
Steel Critical temperature – 12 m span:	621°C
Miscellaneous:	Cambered beam; restrained by steel sheet in construction stage.

Table 1 – Design conditions

According to EN 1994-1-2, to take into account the ribs of a trapezoidal deck, an effective slab depth can be calculated (h_{eff} - Figure 1), allowing a more realistic uniform temperature distribution in the concrete flange. According to equations D.15a and D.15b of EN 1994-1-2, an effective depth of 100 mm can be obtained for the slab shown in Figure 1 (h_{eff} = 100 mm). Basically, this effective depth means that the temperature of the top concrete fibre is obtained assuming a depth of 100 mm in table D.5 of EN 1994-1-2.

There are no recommendations in the NCCI or BS 5950-8 for assessing an effective slab depth for composite floors. When estimating the resistance of the concrete flange at elevated temperature using NCCI, a weighted average between temperatures above ribs and between ribs can be considered (using l_2 and l_3 to calculate the weighted average). If BS 5950-8 is used, the approach of equations D.15a and D.15b of EN 1994-1-2 can be assumed to be valid. An alternative (and conservative) measure can be to disregard the ribs, i.e., assuming that $h_{eff} = h_1$ = 70 mm.

The temperature on the unexposed (top) side of the slab is required to be no more than approximately 140°C to fulfil insulation requirements[6]. A minimum slab thickness is imposed to fulfil this requirement. For the beam analysis, according to EN 1994-1-2, 4.3.4.2.2 (16), it may be assumed that for concrete temperatures below 250°C, no strength reduction is necessary. For these reasons, according to some references[7], assuming room temperature for assessing the sagging bending resistance of composite slabs and beams is suggested, as, in general, only a modest depth at the top of the slab will be necessary to obtain section equilibrium at elevated temperature. Thus, an example assuming room temperature in the slab will also be considered (note that if floor screed is considered for the minimum insulation thickness, the temperature in the top concrete fibre can be slightly higher).

For 90 minutes of fire exposure, the minimum insulation thickness according to EN 1994-1-2 Annex D would be $h_{eff} \geq$ 100 mm (note that the profile falls outside the scope of Annex D of EN 1994-1-2, which limits l_3 to 115 mm, compared to the actual value of 125 mm). According to the NCCI, a minimum thickness of $h_1 \geq$ 70 mm is imposed, while BS 5950-8 suggests $h_1 \geq$ 70 mm for

▶28

▶26

lightweight concrete and $h_1 \geq 80$ mm for normal weight concrete.

In Figure 2, for 90 minutes of fire exposure, the different temperature distributions in the concrete flange according to the three different UK resources can be found for normal weight concrete. Slab depth is measured from the face exposed to fire.

For 90 minutes of fire exposure, the temperatures in the top (Table 2) and the bottom (Table 3) fibres of the concrete flange above the steel sheet can be obtained (i.e. X = 130 mm, and X = 60 mm, respectively, according to Figure 1). Eight possible approaches are presented. Once the temperatures have been obtained, the respective concrete resistance reduction factors (K_c) according to Table 3.3 of EN 1994-1-2 can be obtained. In the top concrete fibres, according to EN 1994-1-2 and BS 5950-8 approaches, the top temperature is in fact close to 140°C (Cases 2 and 3). Even with conservative approaches (Cases 5, 6 and 7), the temperature in the top concrete fibre is generally below 250°C, so no concrete strength reduction would be needed for the top concrete fibres. On the other hand, for lower concrete fibres, the strength reduction can be up to 29 % for Cases 2 and 3 and 83 % for Case 6. Thus, depending of the depth of the concrete flange required for section equilibrium, the concrete resistance may have some significant reductions.

To evaluate the impact of different temperature distributions in the slab, the critical steel temperatures shown in Table 1 were assumed as fixed. The plastic bending resistance under fire, for each slab profiles temperatures (Cases 1 to 8) were then evaluated, and are presented in Table 4 and Table 5 for the two worked examples. The degree of shear connection (η) can vary between 0 and 1 in a composite beam. Results for different degrees of shear connection are presented in steps of 0.25 between those two extreme cases, obtained through a stress block analysis. Partial interaction curves are presented for both worked examples in Figure 3, for 6 m and 12 m worked examples.

Conclusions

1. The UK NCCI gives temperature profiles at/above ribs and between ribs for composite slabs; in the paper, a weighted average temperature is suggested to assess the sagging bending resistance of the composite beams design under fire.
2. The temperature distribution profile in the composite slab has generally minimal impact in the composite beam sagging plastic bending resistance because: (i) only the top concrete strips are usually needed to obtain section equilibrium, which are not significantly affected by the slab temperature; (ii) differences in the position of the plastic neutral axis are usually small between the approaches; (iii) as the concrete flange tends to be more resistant at elevated temperature than the steel, even if the slab temperature is actually higher than considered,

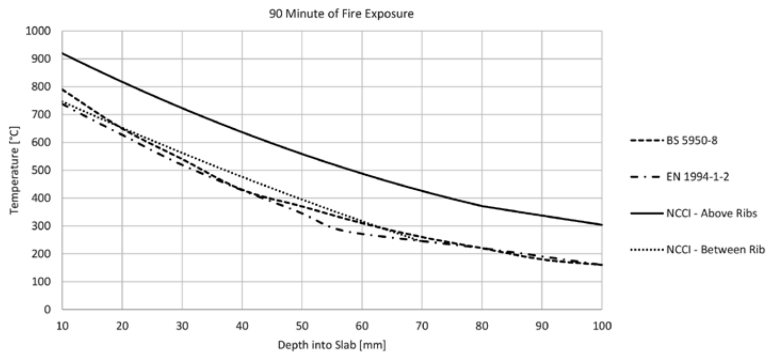


Figure 2 - Temperature distribution according to different UK resources.

Case	**Methodology** (90 minutes of fire exposure)	$\theta_{c,top}$	K_c
1	Room Temperature	20	1.00
2	EN 1994-1-2 Annex D (h_{eff} = 100 mm)	160	0.97
3	BS 5950-8 with EN 1994-1-2 Annex D ($h_{eff} \geq$ 100 mm)	160	0.97
4	Medium value according to NCCI (weighted average)	224	0.93
5	Ignoring Ribs According to EC (h_{eff} = 70 mm)	246	0.90
6	Ignoring Ribs According to BS 5950-8 (h_{eff} = 70 mm)	260	0.89
7	Ignoring Ribs According to NCCI (h_{eff} = 70 mm)	244	0.91
8	Assuming 40% of steel top flange temperature (θ_{top} flange = 620°C) EN 1994-1-2, 4.3.4.2.5 (2) – for shear studs resistance.	248	0.90

Table 2 – Top concrete fibre temperature according to different approaches (X = 130 mm).

Case	**Methodology** (90 minutes of fire exposure)	$\theta_{c,top}$	K_c
1	Room Temperature	20	1.00
2	EN 1994-1-2 Annex D (h_{eff} = 100 mm)	428	0.71
3	BS 5950-8 with EN 1994-1-2 Annex D ($h_{eff} \geq$ 100 mm)	430	0.71
4	Medium value according to NCCI (weighted average)	559	0.51
5	Ignoring Ribs According to EC (h_{eff} = 70 mm)	738	0.24
6	Ignoring Ribs According to BS 5950-8 (h_{eff} = 70 mm)	790	0.17
7	Ignoring Ribs According to NCCI (h_{eff} = 70 mm)	747	0.23
8	Assuming 40% of steel top flange temperature (θ_{top} flange = 620°C) EN 1994-1-2, 4.3.4.2.5 (2) – for shear studs resistance.	248	0.90

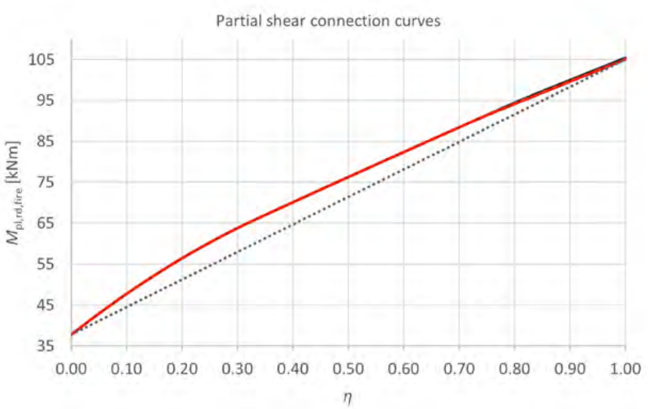
Table 3 – Bottom concrete fibre temperature according to different approaches (X = 60 mm).

$M_{pl,rd,fire}$ [kNm]	Slab temperature profile case							
η	1	2	3	4	5	6	7	8
0.00	37.71	37.71	37.71	37.71	37.71	37.71	37.71	37.71
0.25	60.22	60.22	60.22	60.22	60.22	60.22	60.22	60.22
0.50	76.24	76.24	76.24	76.24	76.24	76.24	76.24	76.24
0.75	91.41	91.41	91.41	91.41	91.35	91.30	91.36	91.34
1.00	105.37	105.25	105.25	105.08	105.00	104.95	105.01	104.99

Table 4 – Results for 6 m span beam: UB 203 x 133 x 25; Steel critical temperature: 621°C.

$M_{pl,rd,fire}$ [kNm]	Slab temperature profile case							
η	1	2	3	4	5	6	7	8
0.00	199.13	199.13	199.13	199.13	199.13	199.13	199.13	199.13
0.25	284.60	284.60	284.60	284.60	284.60	284.60	284.60	284.60
0.50	335.08	335.08	335.08	335.08	335.08	335.08	335.08	335.08
0.75	375.67	375.44	375.44	375.10	374.93	374.82	374.95	374.92
1.00	413.06	412.83	412.83	412.49	412.33	412.22	412.34	412.31

Table 5 – Results for 12 m span beam: UB 406 x 178 x 67; Steel critical temperature: 620°C



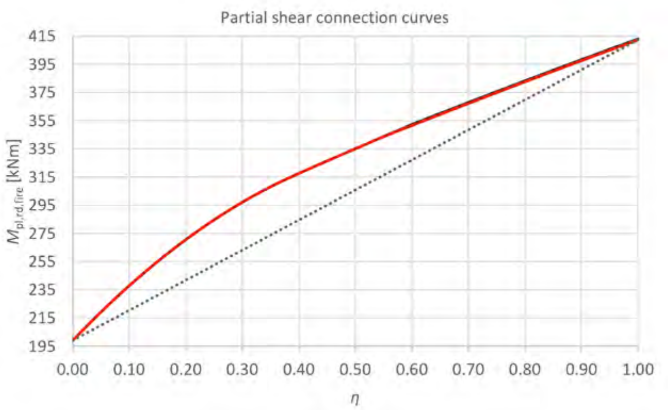


Figure 3 – Partial shear connection curves for the 6 m (left) and 12 m (right) worked examples.

only small changes in the neutral axis are expected, as a small increase in the assumed slab depth increases considerably the slab resistance.

3. For assessing the resistance of the slab, generally no reduction in strength is needed (ambient temperature may be assumed). An alternative often used, which is to assume the slab temperature is equal to 40% of the steel top flange temperature (a rule used to assess studs resistance under fire), can be seen as a conservative solution.

References

[1] BS 5950-8:2003
Structural use of steelwork in building - Part 8: Code of practice for fire resistant design
BSI, 2003

[2] BS EN 1994-1-1:2004
Eurocode 4 - Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings
BSI, 2005

[3] BS EN 1994-1-2:2005+A1:2014
Eurocode 4 - Design of composite steel and concrete structures - Part 1-2: General rules - Structural fire design
BSI, 2005

[4] NA to BS EN 1994-1-2:2005
UK National Annex to Eurocode 4: Design of composite steel and concrete structures - Part 1-2: General rules - Structural fire design
BSI, 2008;

[5] PN005c-GB
NCCI: Fire resistance design of composite slabs
The Steel Construction Institute

[6] Steel and composite structures: behaviour and design for fire safety
Y. C. Wang, Spoon Press, 2005

[7] AS/NZ 2327.1
Composite Structures – Composite steel-concrete construction in buildings
Standards Australia/Standards New Zealand, 2017

BUILDING WITH STEEL

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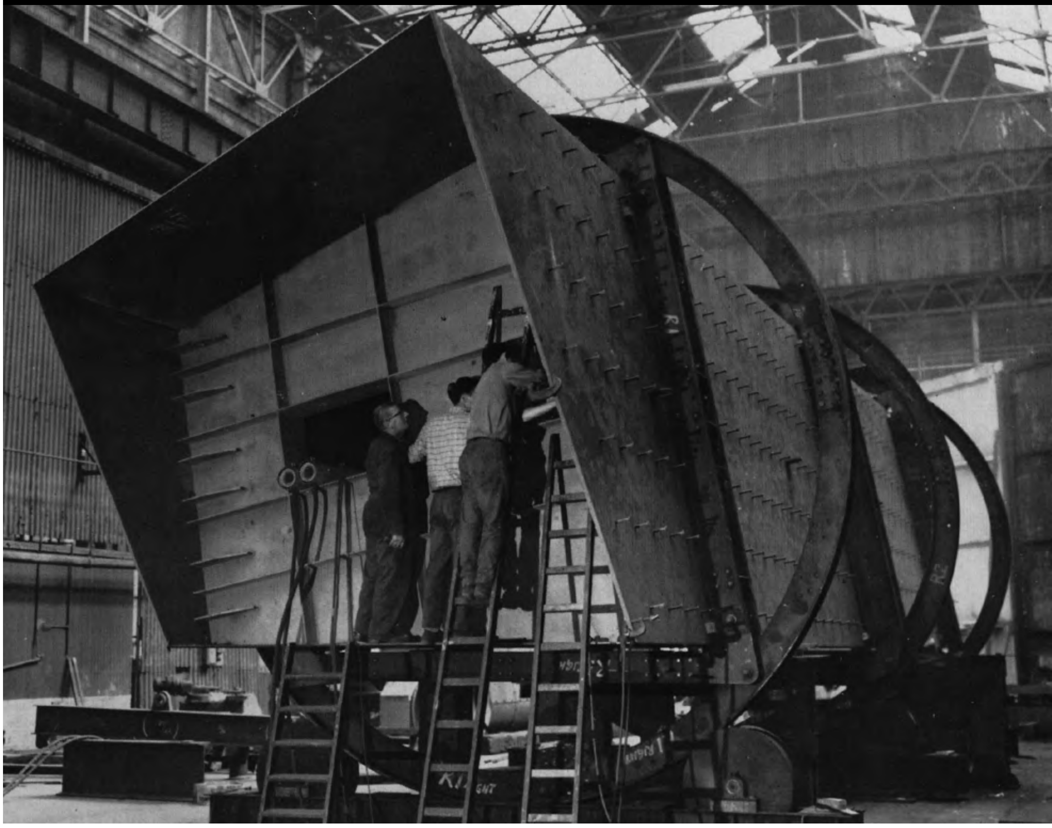


Fabricating the Irwell Valley Bridge

The Irwell Valley Bridge is a single span road bridge, over 200 ft long, comprising seven trapezoidal box girders. Each girder was fabricated at the works in four parts. This is a good example of steel prefabrication and the various processes involved in the shop fabrication are well illustrated in the accompanying photographs and drawings. Each girder was fabricated so that when finally positioned on site it had a camber of $2^{1}/_{8}$ in. The two middle sections of the girder are each 45 ft long and weigh 36½ tons, whilst the two outer sections with their skew ends are each 64 ft long and weigh 46 tons. The box girders are 10 ft 10 in deep, 12 ft wide at the top and 8 ft at the bottom. The web plates are ½ in thick throughout but the flange thicknesses vary as follows: the middle sections have top flanges 1 in thick and bottom flanges of 2 in plate; the corresponding thicknesses for the end sections are ¾ in and $1^{5}/_{8}$ in. The flanges for the end sections are made from two plates butt welded together but the middle section flanges are in single plates. The bottom flanges in all cases are of NDII steel to BS.2762.

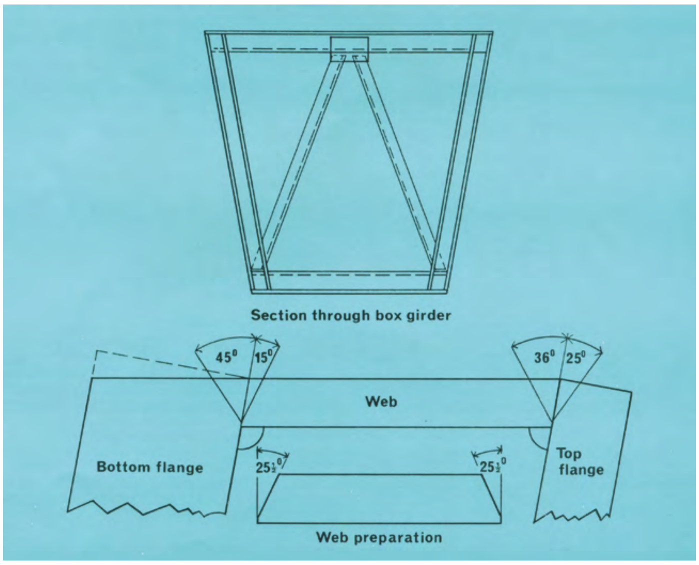
Material preparation and assembly

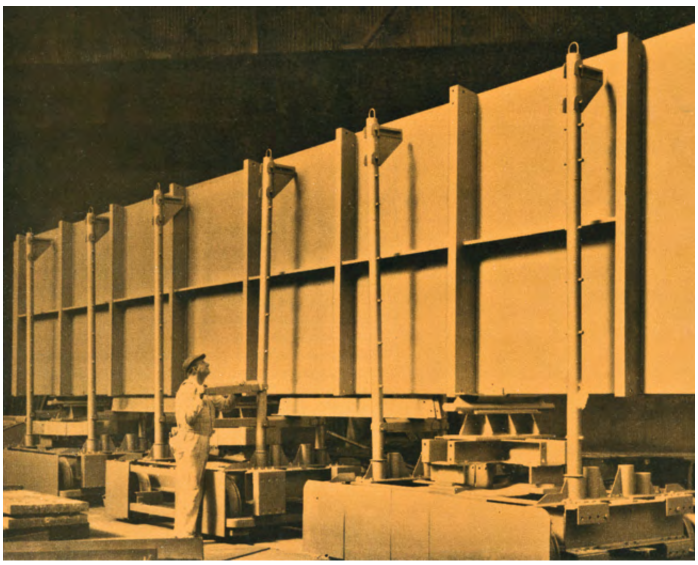
All web and flange plates were flame cut to width and bevelled as required, in one pass, on a specially constructed double-headed burning bench. Indicators were incorporated to enable the plates to be marked to length. Longitudinal and transverse stiffeners, 6 in bulb flats and 7 in by 3½ in by $^{7}/_{16}$ in angles respectively, were sub-assembled to webs and flanges in assembly jigs.

All flange stiffeners were welded in with $^{5}/_{16}$ in fillet welds on both sides and web stiffeners were similarly attached with $^{3}/_{16}$ in fillet welds. Two welders worked simultaneously, one on each side of a stiffener, working from the centre outwards, to ensure that all the welds were balanced and to avoid distortion. After sub-assembly, all parts were blast cleaned and given one coat of etch primer.

Final assembly

For the final assembly of each section, a former jig was used to keep the webs and flanges firmly in position and at the same time kept the ends in the correct relationship. As a further aid to assembly, holes were drilled in the transverse angle stiffeners so that the webs and flanges could be tack bolted together: the holes were filled with galvanized bolts before the inside of the box was painted. To ensure that on site the ends matched, an inside former frame was also used to maintain the correct shape and overall dimensions of the ends of the boxes. The assembled box was strongly tacked before being transferred to the manipulator jig for final welding. Weld details were modified at the corners of the boxes to give a more balanced weld and to allow the two corners to be welded whilst





the box was in one position, ie with the web horizontal, thus saving a part turn.

Additionally, the edges of the bottom flanges were bevelled in line with the web to avoid a shadow line on the bridge.

Non-destructive testing

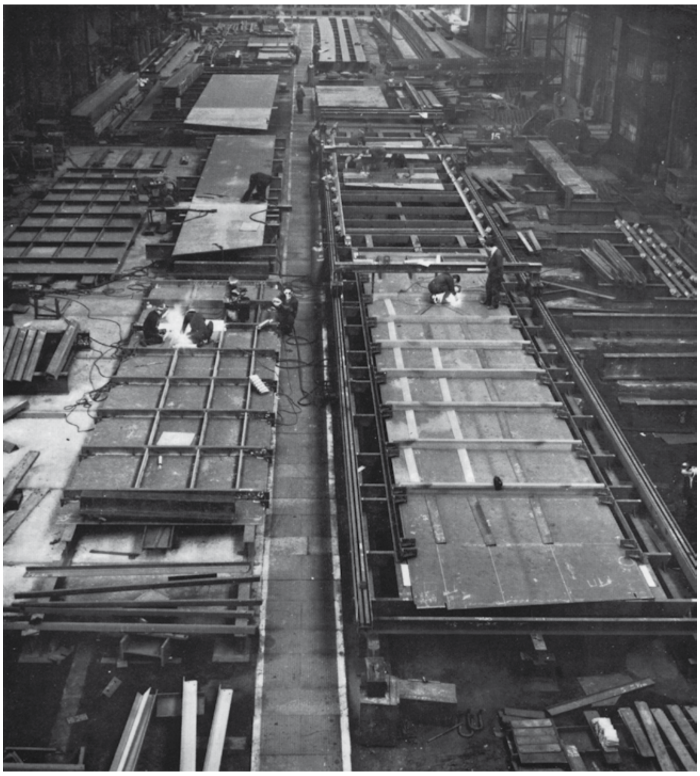
All plates were ultrasonically tested in the works and shop butt welds in both top and bottom flanges were subject to 100 per cent radiographic testing. In addition, coupon plates were provided for further testing of these butt welds, the tests being: one tensile, one normal bend, one reverse bend for each flange, with three charpy 'V'-notch tests for the tension flange. The latter were carried out, with the notch in the weld metal vertical to the plate surface at -15°C and the requirements for NDII steel to BS.2762 in this respect, ie average value of 20 ft lb for three specimens with no individual specimen breaking under less that 15 ft lb, were fully met. The other mechanical tests were conducted in accordance with BS.709.

All inside fillet welds on tension flanges were tested for cracks using K-07 Magnaflux simplified crack detector with Ardrox No 800-2 black magnetic particle inspection, kerosene based.

Tests for welding procedures

All welders were required to pass the appropriate tests specified in BS.2645 according to the degree of skill necessitated by the procedures, manual, semi-automatic, or automatic, on which they were to be employed.

The Irwell Valley Bridge was designed by Lancashire County Council and the contract was placed by the MoT North Western Road Construction Unit (Director, Mr James Drake, CBE).



AD 424: Shear stud length

SCI has been advised that shear studs which are shorter than usual have been placed on the market in the UK, and this AD warns against using them unless the length has been reflected in the design, and unless the studs meet the necessary material specification.

AD 380 indicates that a stud that starts with a manufactured length of 105 mm would typically have a length after welding (LAW) of 100 mm when welded directly to a beam flange and 95 mm when welded through decking. The studs are identified as nominally 100 mm studs. AD 380 also indicates that studs of diameter d = 19 mm and a nominal length of 100 mm may be deemed to satisfy the requirement that a stud extends at least 2d above the height of the decking, when that height is 60 mm. UK practice in composite construction for buildings generally involves the use of through deck welded shear studs. Tests have shown that through deck welded studs of 100 mm nominal length, with 60 mm decking, perform satisfactorily.

A complication is that studs identified as nominally 100 mm long have actual lengths "out of the box" which differ from manufacturer to manufacturer. It is understood that the shorter studs referred to in the opening paragraph are 90 mm before welding, so are likely to be less than 85 mm LAW when welded through decking. Clearly they should not simply be substituted for nominal 100 mm studs unless the design is verified with the shorter length.

All shear studs should conform to EN ISO 13918, as noted in the National Structural Steelwork Specification (NSSS). Composite beam design generally assumes a certain level of slip between the steel and concrete so the studs must be ductile, regardless of the fact that failure is normally in the concrete (at least for the grades of materials typically found in buildings). Annex B of BS EN 1994-1 describes the stud test arrangement to demonstrate ductility.

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New and revised codes & standards

From BSI Updates October 2018

BS EN PUBLICATIONS

BS EN ISO 15626:2018
Non-destructive testing of welds. Time-of-flight diffraction technique (TOFD). Acceptance levels
Supersedes BS EN ISO 15626:2013

BS IMPLEMENTATIONS

BS ISO 1835:2018
Round steel short link chains for lifting purposes. Medium tolerance sling chains. Grade 4, stainless steel
No current standard is superseded

PUBLISHED DOCUMENTS

PD CEN ISO/TR 20173:2018
Welding. Grouping systems for materials. American materials.
Supersedes PD CEN ISO/TR 20173:2009

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS EN ISO 19232-1:2013
Non-destructive testing. Image quality of radiographs. Determination of the image quality value using wire-type image quality indicators

BS ISO 14346:2013
Static design procedure for welded hollow-section joints. Recommendations

BRITISH STANDARDS WITHDRAWN

BS EN ISO 15626:2013
Non-destructive testing of welds. Time-of-flight diffraction technique (TOFD). Acceptance levels
Superseded by BS EN ISO 15626:2018

PD CEN ISO/TR 20173:2009
Welding. Grouping systems for materials. American materials
Superseded by PD CEN ISO/TR 20173:2018

Steelwork contractors for buildings

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Tel: 020 7747 8121 Email: *gillian.mitchell@steelconstruction.org*

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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			●	●					●	●			●	●		3			Up to £400,000
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					●				●	●			●	●	✔	4			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3	✔	Silver	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	Gold	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		Silver	Up to £3,000,000
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 £800,000
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				●	●	●	●		●	●			●	●	✔	4		Gold	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950				●	●	●	●		●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	Silver	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		Silver	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4			Up to £6,000,000
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Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		Silver	Up to £4,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	Gold	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●		●	●			●		●		●	✔	3		Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●		●	●	●			✔	4		Gold	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 £1,400,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £40,000
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	✔	Gold	Up to £6,000,000
ESL (GB) Ltd	01482 787986	●					●	●	●	●	●	●	●	●	●	✔	4			Up to £400,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●			●	✔	3		Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		Member	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000
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)

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)
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		● (green)	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		● (grey)	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				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●	●	✔	4		● (grey)	Up to £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●	●	●	●	●	●	●	●	●	●	●	●	✔	4		● (orange)	Up to £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		● (grey)	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		● (green)	Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●				●	✔	2			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £2,000,000
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			●	●	●	●				●						3			Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711									●				●	●	✔	4			Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●	●		●	●		●	●	✔	4		● (grey)	Up to £2,000,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		● (orange)	Up to £4,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		2			Up to £400,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			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			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●			●	●	✔	3			Up to £6,000,000
S H Structures Ltd	01977 681931	●			●		●	●	●	●	●	●			●	✔	4	✔	● (orange)	Up to £2,000,000
SAH Engineering Ltd	01582 584220			●	●	●				●	●			●	●		2			Up to £800,000
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		● (orange)	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 £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		2			Up to £1,400,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £800,000
Steel & Roofing Systems	00 353 56 444 1855			●	●	●	●				●	●		●	●	✔	4			Up to £3,000,000
Structural Fabrications Ltd	01332 747400	●							●	●						✔	3		● (grey)	Up to £1,400,000
Taunton Fabrications Ltd	01823 324266				●					●				●	●	✔	2		● (grey)	Up to £2,000,000
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			●	●	●	●	●	●		●			●	●	✔	3	✔	● (grey)	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2	✔		Up to £2,000,000
Underhill Engineering Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4	✔		Up to £3,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2			Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●	●	●	●	●	●	●				●	✔	4		● (green)	Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●	●				●					✔	4		● (orange)	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	● (orange)	Above £6,000,000
WT Fabrications (NE) Ltd	01642 691191			●	●	●	●				●			●	●		4			Up to £40,000
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)

Steelwork contractors for bridgeworks

RQSC — The Register of Qualified Steelwork Contractors Scheme

BCSA

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:

- **FB** Footbridges
- **CF** Complex footbridges
- **SG** 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	FB	CF	SG	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
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●	●	●	✓	4				Silver	Up to £3,000,000
Bourne Group Ltd	01202 746666	●			●	●				●	●	✓	4	✓		✓	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	✓	4			✓	Silver	Up to £4,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●				●	✓	3			✓	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	✓	3			✓	Silver	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●			●	●	●		●		●	✓	3					Up to £3,000,000
ESL (GB) Ltd	01428 787986									●	●	✓	4			✓		Up to £400,000
Four-Tees Engineers Ltd	01489 885899	●			●	●	●		●	●		✓	3			✓	Member	Up to £2,000,000
Had Fab Ltd	01875 611711									●	●	✓	4					Up to £3,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●				●				●	●	✓	4			✓	Gold	Up to £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●			●	✓	4			✓	Member	Up to £2,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●	●	●				●	✓	4			✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £4,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	Gold	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499									●	●	✓	3			✓		Up to £800,000
Structural Fabrications Ltd	01332 747400	●		●	●	●	●			●	●	✓	3				Silver	Up to £1,400,000
Taziker Industrial Ltd	01204 468080	●		●	●	●	●	●	●	●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●			●	●	●			●	●	✓	4	✓		✓		Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Non-BCSA member																		
Allerton Steel Ltd	01609 774471	●		●	●	●	●			●	●	✓	4			✓	Silver	Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	✓	4					Up to £2,000,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓		Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●	●	●	✓	4			✓	Member	Up to £1,400,000
Ekspan Ltd	0114 261 1126	●				●			●	●	●	✓	2					Up to £400,000
Francis & Lewis International Ltd	01452 722200									●	●	✓	4			✓	Gold	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
Harrisons Engineering (Lancashire) Ltd	01254 823993	●		●	●	●	●	●	●	●	●	✓	3		✓			Up to £1,400,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879									●	●	✓	3			✓		Up to £200,000
IHC Engineering (UK) Ltd	01773 861734	●									●	✓	3			✓		Up to £400,000
In-Spec Manufacturing Ltd	01642 210716									●	●	✓	4			✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500									●		✓	N/A					Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●		●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £2,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●		●		●				●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Silver	Above £6,000,000

Corporate Members

BCSA

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
Control Energy Costs Ltd	01737 556631
Gene Mathers	0115 974 7831
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Kier Construction Ltd	01767 640111
McGee Group (Holdings) Ltd	020 8998 1101
PTS (TQM) Ltd	01785 250706
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

Industry Members

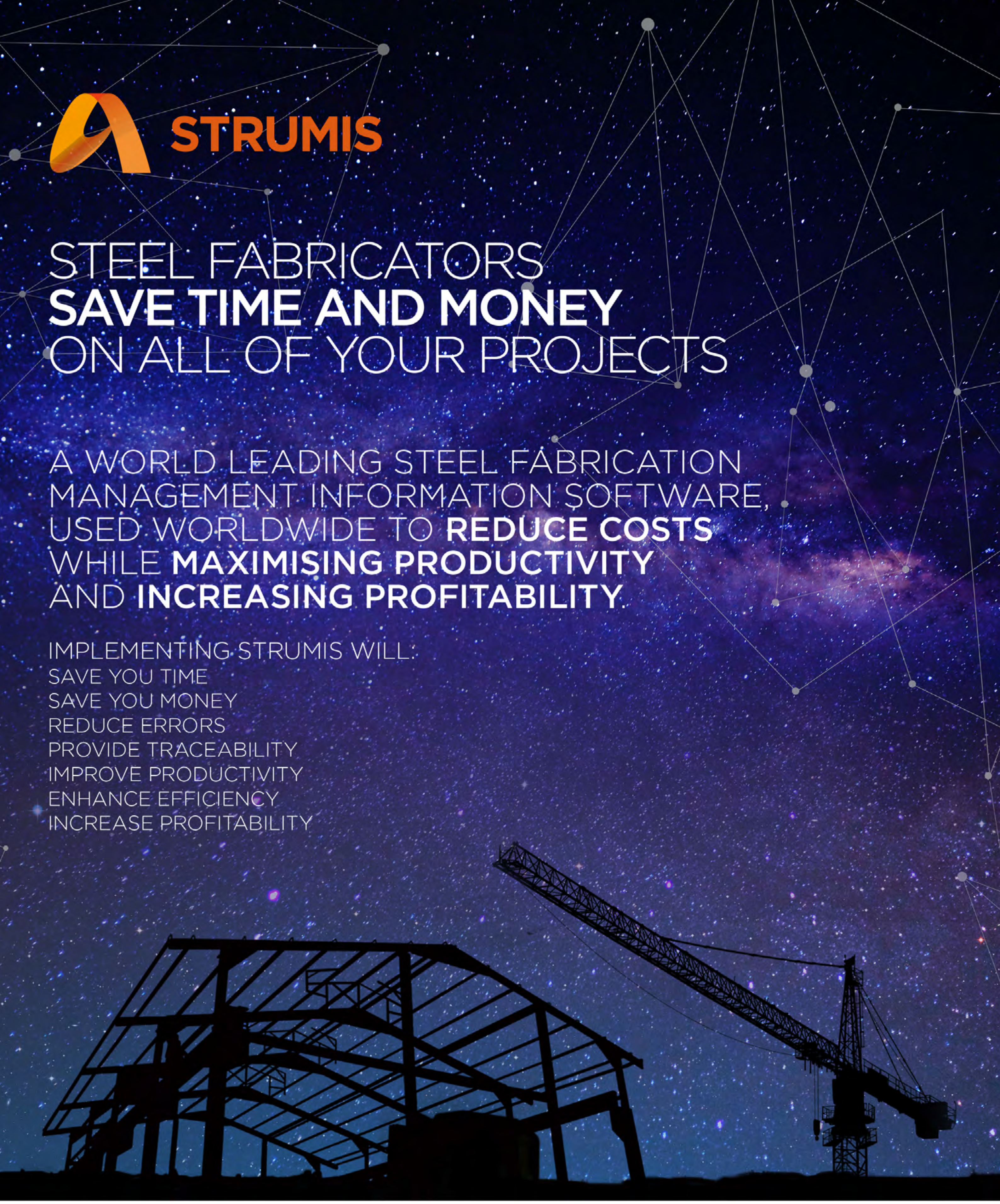
Industry Members are those principal companies involved in the direct supply to all or some Steelwork Contractor Members of components, materials or products. Industry member companies must have a registered office within the United Kingdom or Republic of Ireland.

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		
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 Ltd	01724 404040				●						M		
British Steel Distribution	01642 405040								●		D/I		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
Composite Metal Flooring Ltd	01495 761080	●									M		
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		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	Gold	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	Gold	
Forward Protective Coatings Ltd	01623 748323						●				N/A		
Hadley Industries Plc	0121 555 1342	●									M	Silver	
Hempel UK Ltd	01633 874024						●				N/A		
Highland Metals Ltd	01343 548855						●				N/A		
Hi-Span Ltd	01953 603081	●									M	Member	
International Paint Ltd	0191 469 6111						●				N/A	Gold	
Jack Tighe Ltd	01302 880360						●				N/A		
Jamestown Manufacturing Ltd	00 353 45 434288	●									M		
John Parker & Son 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	Gold	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lincoln Electric (UK) Ltd	0114 287 2401					●					N/A		
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 Architectural Coatings UK & Ireland	01924 354233						●				N/A		
Prodeck-Fixing Ltd	01278 780586	●									D/I		
Rainham Steel Co Ltd	01708 522311								●		D/I		
SDS/2 Ltd	07734 293573		●								N/A		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				N/A	Silver	
Structural Metal Decks Ltd	01202 718898	●									M		
StruMIS Ltd	01332 545800		●								N/A		
Stud-Deck Services Ltd	01335 390069	●									D/I		
Tata Steel – Tubes	01536 402121				●						M		
Tata Steel – ComFlor	01244 892199	●									M		
Tension Control Bolts Ltd	01948 667700						●			●	M		
Trimble Solutions (UK) Ltd	0113 887 9790		●								N/A		
voestalpine Metsec plc	0121 601 6000	●									M	Gold	
Wedge Group Galvanizing Ltd	01909 486384						●				N/A		
Yamazaki Mazak UK Ltd	01905 755755					●					N/A		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