

NSC



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Cover Image

Sheffield Moor retail development
 Main client: Aberdeen Property Trust
 Architect: Leslie Jones Architecture
 Main contractor: Bowmer & Kirkland
 Structural engineer:
 Sanderson Watts Associates
 Steelwork contractor: Hambleton Steel


TATA STEEL


February 2016 Vol 24 No 2

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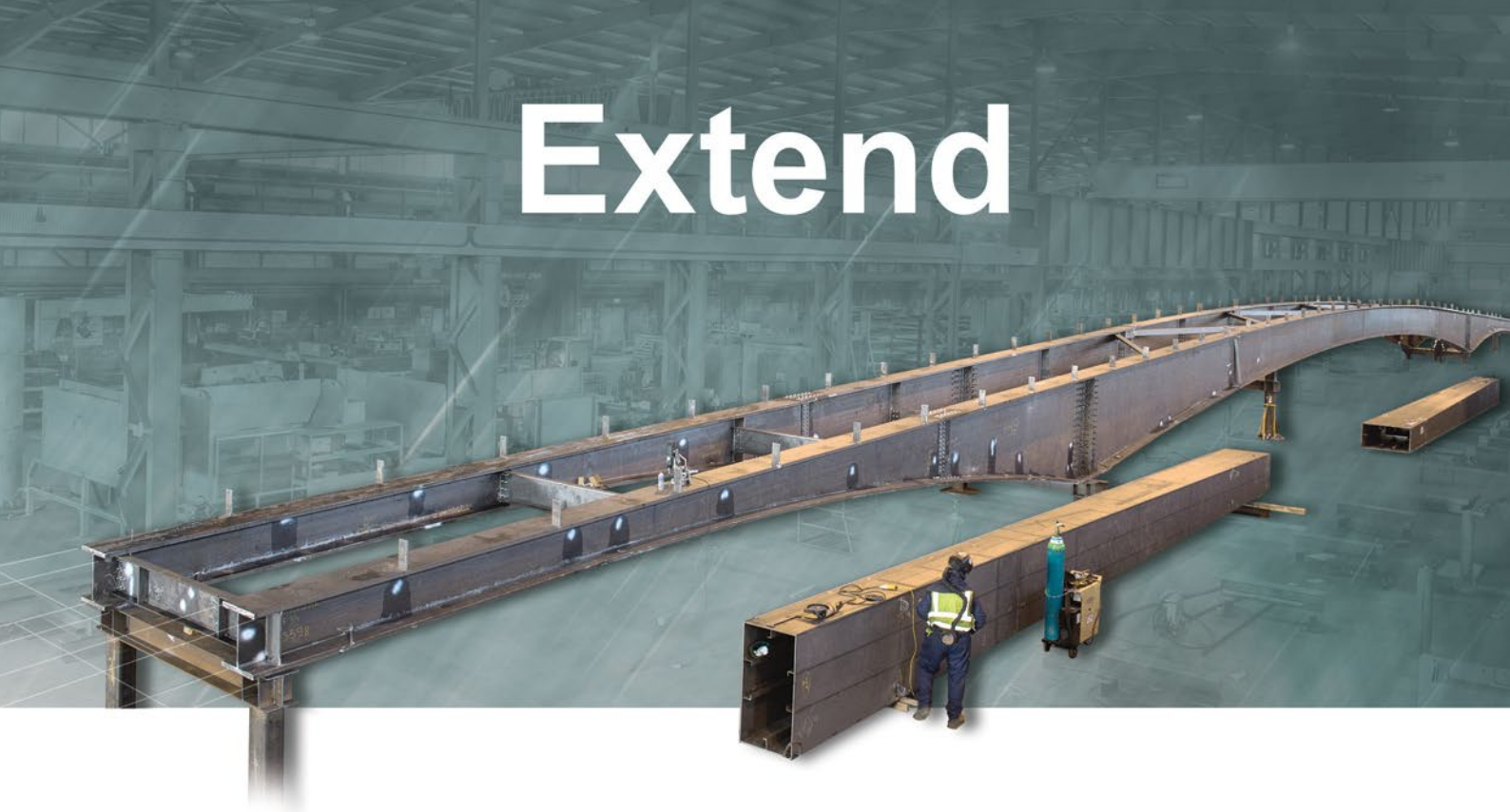
BCSA Members

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Register of Qualified Steelwork Contractors for Bridgeworks

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

Extend



We have the capacity

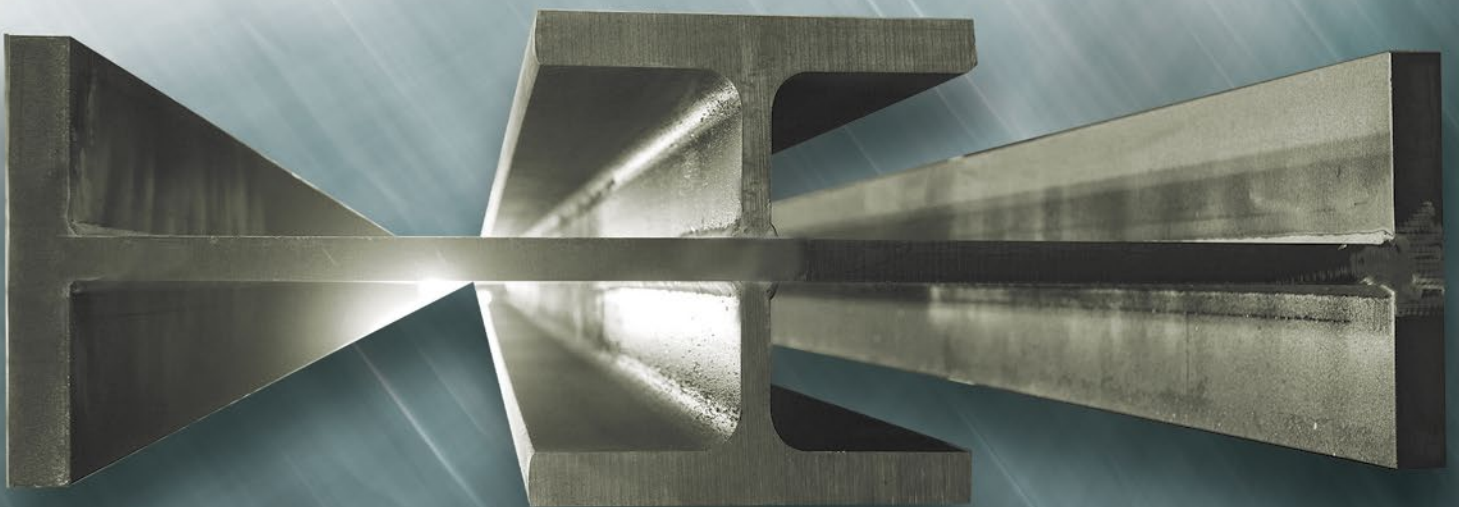
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Innovate

Fresh life for steel



Nick Barrett - Editor

Structural steelwork has been confirmed again as the leading market choice for building frames, as you can read in News this month. In the key multi-storey offices market steel has reconfirmed the dominant position it has held for most of the past 30 years or more, with a 68% share of the market.

Steel's commanding position in the single storey buildings market, which is everything from sheds for the logistics sector to new factories like those that house the booming export market for UK produced cars, is also of long-standing and steel now accounts for over 90% of that market.

Other good news from the independently produced market share survey is that the market has been fairly buoyant, with the total market for structural frames up 7.2% in 2015. Further market growth is expected this year.

Why does steel enjoy such dominance? Designers consistently speak of steel's cost-effectiveness compared to concrete or other alternatives, its flexibility, the potential for accepting late design changes in a fast moving development market, a host of sustainability benefits, and the fast construction programmes made possible only because of offsite fabrication, and quick, safe, erection. Many projects on congested inner city sites are barely conceivable these days without using steel as the framing solution.

There is no sign of this market preference changing. Steel manufacturing has been buffeted by global economic forces but the UK's structural steel supply chain remains in good shape to continue its world-leading service to the construction market.

The construction industry is no place for resting on laurels, and also in News you can read about the progress of Steel for Life, a constructional steelwork supply chain initiative to ensure that architects, engineers and quantity surveyors continue to find designing in steel as straightforward as it can be by having all the design and cost advice they need, and have become used to, within easy reach.

Steel for Life will be an exemplar of how an integrated supply chain can work together to deliver the technical development, education and design and cost information that specifiers need.

Steel for Life is being funded by supply chain sponsors and the BCSA, and will be managed by BCSA staff. It has an Advisory Board that will meet three times a year, ensuring that in changing markets Steel for Life is providing the right sort of support for specifiers. It can only be money well spent – try imagining life in construction without steel.



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Steel for Life gathers pace

The first sponsors have signed up to the constructional steelwork supply chain's new market development programme, Steel for Life, which has been established to ensure that steel maintains its position as the preferred framing solution for key construction markets.

To ensure construction industry specifiers have all they need to make designing in steel straightforward and **cost-effective**, Steel for Life will draw on the resources of the integrated steel supply chain.

Sponsors from across the supply chain fund Steel for Life along with the British Constructional Steelwork Association and there are four separate sponsorship levels, Headline, Gold, Silver and Bronze. The first sponsors are:

Headline: ArcelorMittal Commercial UK; Barrett Steel; Jamestown; Trimble Solutions (UK).

Gold: AJN Steelstock; Ficep UK; National Tube Stockholders and Cleveland Steel & Tubes; Wedge Group Galvanizing

Silver: Hadley Group, Building Products Division; Jack Tighe

Bronze: BAPP Group of Companies;

Barnshaw Section Benders; Hempel; Joseph Ash Galvanizing; Kaltenbach; Tension Control Bolts.

"Jamestown is delighted to be involved with Steel for Life. It is of vital importance that the use of steel is promoted, publicised, marketed and given maximum exposure, so that our sector remains strong," said Jamestown Cladding and Profiling General Manager Fiacre Creegan.

"As an industry we must work to firstly maintain, but ultimately grow our presence among the range of competing construction materials. Jamestown obviously seeks to grow, in line with overall sector growth, which Steel for Life will bring. We are committed to Steel for Life and delighted to be such a significant part of this project."

Barrett Steel Group Managing Director James Barrett commented: "We are delighted to be the headline sponsor for the distribution and stockholding sector of Steel for Life.

"Throughout our 150 year history Barrett has remained at the forefront of the sector by continuing to improve our added value service to our customer base. We

look forward to working closely with Steel for Life in the coming years to promote the constructional steel sector, and helping to deliver a successful and sustainable future for all members of the steel supply chain."

Trimble Solutions (UK) Managing Director Andrew Bellerby said: "Trimble decided to join the Steel for Life initiative to help promote and advance the use of BIM (Building Information Modelling) and technology in construction, an area where steel is ahead of most of the industry."

Roy Eshelby, Managing Director ArcelorMittal Commercial UK said: "ArcelorMittal, as a leading supplier of sections and merchant bars to the UK's construction industry, enthusiastically supports Steel for Life as a headline sponsor.

"We aim to strengthen our commitment to the long-term relationships we have with UK customers while information made available to the whole supply chain will make the advantages of steel offered to the construction sector even more visible and transparent."



An independent Advisory Board, comprising BCSA members, staff and Headline sponsors oversees the Steel for Life initiative to ensure a tailored and collaborative offering.

The Advisory Board meets three times a year to discuss ongoing strategy, priorities and programme activity.

In addition to the continuation of existing activities including New Steel Construction magazine and SteelConstruction.info, Steel for Life is keen to work closely with specifiers to provide what they need to help them deliver successful steel construction projects for their clients.

If you are a specifier and keen to provide feedback on steel resources please contact Christina Gulvanessian: Christina.Gulvanessian@steelconstruction.org



Annual Review highlights the best of New Steel Construction

The best and most innovative project reports of the year, plus technical articles explaining the current issues affecting the steel construction sector are all contained within the latest *New Steel Construction (NSC) Annual Review* which can be viewed online at www.steelconstruction.info

NSC Annual Review includes a digest of the most important news items to appear in the magazine over the last 12

months. This is followed by a review of last year's prestigious *Structural Steel Design Awards* that were held at One Great George Street in London.

All of the major construction sectors in which structural steelwork is used are represented within the *Annual Review*.

Project features include a new grandstand at Cheltenham Racecourse and a new all-weather maintenance and manufacturing facility for the Royal National Lifeboat Institution give an insight into steel construction's versatility.

More than 90% of the UK's **distribution**

centres are constructed with a **steel frame** and the *Annual Review* highlights a huge 58,000m² structure built near Doncaster for retailer Next.

Project features on **commercial schemes** in Hammersmith and the City of London, a university campus in Belfast, a **shopping centre** in Newport, and **footbridges** for a Scottish rail scheme display steel's broad appeal throughout the construction industry.

Technical articles on **CE Marking** and guidance on **cost** are included, as well as an article explaining why structural steelwork is **the right choice** and another piece highlighting the updates and new content that have been added to www.steelconstruction.info

Upgrade for Welsh town centre relies on steel

More than 750t of structural steelwork has been galvanized for the **construction** of a 600-space **multi-storey car park** and a 2,200m² retail unit, as part of the redevelopment of Neath's shopping district.

Workshop Galvanizing partnered its long-standing client and project steelwork contractor Cauntion Engineering to **galvanize** the steel.

The project, which is being overseen by main contractor Kier Construction, saw Workshop Galvanizing process structural

steel including beams and columns to construct the new structures.

Funded by the Regeneration Investment Fund for Wales (RIFW), the project is central to attracting more people to the town, and create a vibrant place to live, work, and socialise.

The use of galvanized steel was a specific request of the contractor as it will ensure the framework and beams are protected against rust and **corrosion** for years to come."



Steel shows growth in key markets

Structural steelwork has been confirmed as the preferred market choice as a framing solution in the 2015 Market Share survey, which confirms the upward trend of demand for steel in key markets.

The survey is the latest in a series, by independent researchers Construction Markets, that has been carried out annually since 1980. Based on interviews with 750 architects, builders and designers, the survey is the biggest of its kind in the UK.

The total market for structural frames in 2015 was estimated to be 40.6 million square metres of floor area, up 7.2% from the previous year.

Steel continued to dominate the key market for **multi-storey office developments** where it enjoyed a market share of 68%, up almost 1% from 2014.

The **single storey industrial buildings** sector continued to be dominated by steel with the material's market share increasing slightly to 91.3%.

According to the survey, this market



has continued to see strong demand with growth in the non-industrial sheds market (up 0.8%), infrastructure buildings (up 4.3%), cold stores (up 5.8%) and farm buildings / agriculture (up 9.6%).

BCSA Director General Sarah McCann-Bartlett said: "The survey shows that steel is the preferred choice of the growing construction market across all the building

types analysed.

"The **cost-effectiveness** of steel, its **flexibility**, **speed of construction** and contribution to **sustainability** are all factors that continue to be valued by developers, contractors, designers and building users, so we are confident that future market share surveys will continue to illustrate the dominance of steel as a framing material."

BIM Level 2 certification for steelwork contractor

William Hare Group has announced that it is one of the first steelwork contractors to be certified to BIM Level 2, with Ocean Certification, ahead of the UK Government's 2016 deadline for BIM implementation.

The company has successfully completed the external audit to confirm that it has satisfied the requirements of BIM Level 2 and PAS 1192-2:2013.

Commenting on the certification, William Hare Group's CEO, David Hodgkiss OBE said: "As a business we have been utilising BIM for a number of years, so we are pleased to have been officially certified to Level 2.

"We are committed to being a world



leader in the use of BIM and using this approach to the maximum possible extent to ensure optimum project delivery for our clients."

The auditor, David Robinson from Ocean Certification commented: "The staff interviewed showed an understanding of BIM in practice - it was clear that there was

strong commitment to the principles of digital design and compliance with client information requirements."

William Hare says it is now able to use BIM to economically deliver schemes using lean **fabrication** and **erection** processes to achieve lead times and high **quality standards**.

Old baths refurbishment makes a splash



Work has been completed on the refurbishment of Ashton (old) Baths in Manchester, which has turned a building that has been derelict for 40 years into a £3M business hub.

The interior of the former swimming pool building now includes a free-standing **steel-framed** pod that contains three levels of contemporary office accommodation.

Working on behalf of main contractor HH Smith & Sons, BD Structures **fabricated**, supplied and **erected** approximately 65t of steel for the job, all of which had to be fed into the Grade II Listed building via a narrow existing doorway.

As well as transforming the Victorian

structure's interior, the works have also included repairs to the brick and masonry elevations, window and door repairs and a new timber roof, all of which have helped the project achieve a 'Very Good' **BREEAM rating**.

The project has been funded in part by Tameside Council and the English Regional Development Fund along with specialist developer PlaceFirst.

David Smith-Milne, managing director of PlaceFirst, said: "Ashton Old Baths is such an iconic building and we are thrilled to offer a unique working environment, providing the flexibility new businesses need."

NEWS IN BRIEF

Bernard Shuttleworth, BCSA President from 1986-88, died on 28 December. During his long career in the steelwork sector, Bernard was Managing Director of Robert Watson's Bristol branch, and Managing Director and Co-Owner of Tetbury Steel.

Bourne Construction Engineering has launched a scholarship to encourage young people to take their first step towards a career in engineering. The Scholarship has been launched in the name of former Bourne Chairman, David Sands and is available to one student every year within the School of Civil/Structural Engineering at Brunel University, commencing in September 2016.

Having previously launched the M12 and M16 Type AAF clamps, **Lindpater** has now delivered the M20 sized version for heavy-duty adjustable connections. The product is the latest addition to its High Slip Resistance (HSR) family of clamps designed for high load requirements including frictional, tensile and combined load applications.

A new publication entitled **Stadium and Arena Design** that provides guidance and detailed technical information on all aspects of the planning, design, operation and maintenance of **stadiums** is now available. It costs £95 and is available online from www.icebookshop.com or email: orders@icepublishing.com

Prime Place, the private residential arm of **Willmott Dixon**, and its development partner Brentford Football Club have secured detailed planning consent from Hounslow Borough Council to deliver a new 20,000 capacity football stadium, together with 648 new homes. The new steel-framed stadium and seven new **residential buildings** will be located on a 10-acre site on Lionel Road South, close to Kew Bridge in south west London.

AROUND THE PRESS

The Structural Engineer February 2016

The art of the possible

[Address by Institution of Structural Engineers President Alan Crossman] – The main output was highly engineered composite structural frames for the full spectrum of [industrial](#), [commercial](#) and [domestic](#) buildings. The system advantage was that it optimised the strength, weight and resistance properties of both concrete and steel.

Construction News 29 January 2016

Hammerson's intricate watermark

[West Quay, Southampton] – Gerry O'Brien, design director AKT11, says: "The structure consists of large [steel] [trusses](#) that occupy the wall zones between the [auditoria](#). We have used the height of the auditoria to maximise structural depth, which allows us to limit deflections and increase stiffness and [vibration performances](#)."

Construction News 22 January 2016

Bam lifts Airedale HQ from the ashes

The spans are massive. The steelwork sits on a 32m by 6m grid, meaning only three rows of columns run through the operational space inside the factory.

Construction News 15 January 2016

Bridging the gap in South Africa

The solution was to hang the deck on tie bars from five megatrusses, each weighing 34 tonnes. These were made up of shoring, steel soldier beams and steel bracing members, with steel beams forming the bottom and top of each megatruss.

The RIBA Journal January 2016

Raining Tetris blocks

[Rotterdam redevelopment] – In terms of [sustainability](#), except that half as much steel as the Eiffel Tower went into the building, the Timmerhuis sets a new standard as the most sustainable multifunctional building in the country, with a [BREEAM 'excellent' rating](#).

Steel completed for Metropolitan Police headquarters

Structural steelwork has topped out on the redevelopment of the former Metropolitan Police headquarters at Curtis Green Building on London's Victoria Embankment.

The Metropolitan Police will vacate its current New Scotland Yard premises once its former headquarters has been renovated. This work has required Bourne Steel to fabricate and erect 620t of steelwork.

The majority of the steel will form new floors, while the remainder has been used to refurbish the existing 1930s steel frame.

Working on a constrained site with complex logistics was challenging and demanding, as was the [welding](#) of new steelwork to the existing steel.

Metallurgy studies were undertaken on samples of steel removed from the existing steel, which revealed high levels



of impurities such as carbon and sulphur making it brittle.

A robust [welding procedure](#) was developed and onsite works were completed without a single failure.

A complex load transfer or jacking

process was also employed during the [erection](#) process to ensure the new steel floors did not overload the existing steelwork frame.

Main contractor for the project is BAM Construction.

Steel providing a safe design for petrochemical headquarters



A [steel frame](#) designed specifically to withstand a blast scenario is taking shape at the INEOS petrochemical facility at Grangemouth in Scotland.

More than 900t of structural steelwork is being [erected](#) to construct a three-storey £20M headquarters building for INEOS Olefins & Polymers UK, the country's largest privately-owned company and one of the world's largest chemical businesses.

"Because of the location, the design stage for this project was more onerous than would be expected for a job of this size," said BAM Construction Project Manager Gary Brown.

"Because the building is located within a major petrochemical complex the office HQ had to be designed to take this into account and so we employed a specialist blast engineer who had to review all of the

[initial designs](#), including the steel frame, secondary steel and cladding, to ensure everything was blast resistant."

Woolgar Hunter Senior Engineer Kenneth Irvine added: "We worked closely with Michael Laird Architects to develop a solution for the steel frame and [cladding](#), which addresses the loading issue but still provides an elegant and economic building.

"The structural design had to take into potential blast loadings and so the steel frame has to be flexible."

The requirement for the steel frame to be [ductile](#) in the event of a blast led the design team to choose [steel-framed cores](#) for the building instead of the more rigid concrete versions.

All of the cross bracing comprises 250mm x 12mm flat sections which were chosen as this steelwork offers more flexibility.

BHC is [fabricating](#), supplying and erecting the steelwork for the project, which is scheduled for an August 2016 completion.

Construction boost for Plymouth city centre

The £40M Drake Circus Leisure scheme has been granted planning consent by Plymouth City Council.

The 92,000m² [steel-framed](#) leisure scheme will include a 12-screen [cinema](#) operated by Cineworld, 13 restaurant units and 420 [car park](#) spaces. The site will be situated next to the existing Drake Circus Shopping Centre.

Construction work is expected to start on site this coming summer, following completion of Plymouth City Council's new



coach station, which is currently located on the site. The scheme is expected to open in Spring 2018.

British Land Retail Development Director David Pollock, said: "It is fantastic to have planning consent and continue the

scheme's exciting momentum.

Councillor Brian Vincent, Cabinet member for the Environment, added: "This scheme will transform this part of the city centre and create a major [leisure destination](#) that will bring visitors flocking."

Greg Lumley, Centre Director for Drake Circus Shopping Centre, said: "We look forward to Drake Circus and the new scheme helping make the city centre an even more vibrant leisure destination for the region."

Composite beam checking tool upgraded

The Composite Beam Checking Tool on www.steelconstruction.info has been upgraded to include the latest guidance in SCI-P405 *Minimum degree of shear connection rules for UK construction to Eurocode 4*, guidance that was produced with British Constructional Steelwork Association (BCSA) and Tata Steel funding.

"For many years [composite construction](#) has played a major role

in the commercial success of the steel construction sector in the UK. The rules incorporated into the upgraded [Composite Beam Checking tool](#) complement those given in Eurocode 4, and in so doing will enable valid designs to be produced for a broader range of beams," said SCI CEO Graham Couchman.

The software calculates design resistances for shear studs when used in

the presence of modern forms of [decking](#). It also determines the minimum number of studs that are needed on a range of beams (the minimum degree of shear connection).

In many cases this minimum is lower than would be required by EN 1994-1-1 (and BS 5950-3.1 prior to its amendment in 2010).

The combination of less onerous

requirements for minimum degree of shear connection, and lower stud resistances, allows many [composite beams](#) to be designed that would not satisfy the rules given in EN 1994-1-1.

As well as new minimum shear connection limits, the updated software also covers the effect of partial interaction on deflections and a total deflection check with an absolute limit of L/200.

Oxford technology park gets go ahead

Joint developers Hill Street Holdings and Bloombridge have secured planning permission for a £90M [steel-framed](#) technology park in Oxford.

The UMC-designed Oxford Technology Park will create 40,000m² of research and development space at Kidlington on the northern outskirts of the city.

The park will comprise two Grade A, three-storey buildings with office, research and development and innovation space, plus a range of two-storey research and development buildings.



According to UMC, all of the buildings have been designed as steel-framed structures for [speed of construction](#), [flexibility](#) and in order to create the [long spans](#) required in the research spaces.

Hill Street Holdings CEO Angus Bates said: "Oxford Technology Park will deliver top quality office and R&D space for businesses of all sizes, set within 20 acres of landscaped grounds.

"Each unit will be modelled as a bespoke unit and we are able to offer 'design and build' solutions to suit individual occupiers."

South entrance arrives at Leeds station

Thousands of commuters in Yorkshire are now enjoying quicker and easier journeys since the new £20M steel-framed [south entrance at Leeds station](#) was officially opened.

The new entrance provides a direct link to the city's growing south bank area – opening up access to South Bank Central, Holbeck Urban Village and Leeds Dock and Hinterland development areas. Passengers will no longer have to loop around the station to the existing northern entrance – cutting the time it takes to catch trains.

The entrance [design](#) is a striking addition to the cityscape south of the station, while additional customer information screens, ticket machines and automated ticket gates have reduced congestion and improved the experience for all passengers using the station.

The [portal-framed](#) entrance structure has been built over the River Aire and the construction programme posed a number of challenges.

Because of the location and a lack of access, steelwork contractor William Hare had to deliver all



of the steel using pontoons that transported the material from a delivery yard located downstream.

Main contractor for the project was Carillion, while the entrance was designed by architect AHR and structural engineer Mott MacDonald. Transport Minister Andrew

Jones said: "The stunning entrance will make journeys quicker and more convenient for thousands of passengers every day. This is a further example of the Northern Powerhouse in action, improving lives for people and businesses in Leeds."

Diary

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



Tuesday 9 February 2016 Simple Beam & Column Design to EC3

NEW – Four hour course containing minimum theory and maximum hands-on [member design](#) – focussing on practical design using the [Blue Book](#). The course is aimed at designers of orthodox structures where the resistance tables are the preferred way of selecting members. Leicester.



Wednesday 10 February 2016 Simple Beam & Column Design to EC3

NEW – see previous entry for description. Sheffield.



**Tuesday 23 February 2016
Design of Portal Elements**
1 hour lunchtime webinar free to BCSA and SCI members, considering design of portal elements. Webinar.



Wednesday 24 February 2016 Portal Frame Design

This course provide in-depth coverage of the major issues surrounding the analysis, design and detailing of [portal frames](#). Leeds.



Tuesday 8 March 2016 Essential Steelwork Design - 2 days

This course introduces the concepts and principles of steel building design to EC3. Birmingham.



Tuesday 22 March 2016 Steel Truss Design

1 hour lunchtime webinar Free to BCSA and SCI members, exploring steel [truss design](#).

West End steel

A number of logistical challenges have been overcome during the steelwork programme for a new office and retail development in the West End of London.

The London multi-storey sector was one of the few construction bright spots during the last economic downturn with developments large and small still being built while other sectors tailed off.

Now that better times have returned to the industry as a whole, the office sector in the capital is racing ahead and experiencing even more activity, especially in the commercial havens of the two cities – London and Westminster.

A case in point is the City of Westminster's West End where a number of high-profile commercial developments are taking place. One of the more interesting is 11-12 Hanover Square, a project that will offer commercial office space as well as a retail frontage along one of London's prime shopping thoroughfares.

Situated on a plot previously occupied by four properties separated by an internal courtyard, the new 15m wide x 50m long eight-storey building fills in a space between Hanover Square and Oxford Street.

It will offer 4,500m² of office accommodation and 1,400m² of retail space. The basement, ground and first floor levels will be split in half, with the areas nearest Oxford Street dedicated to retail, and the other half of these floors, facing Hanover Square, occupied by a plant room (basement), a ground floor entrance lobby, and offices.

From second up to seventh floor level the

building is solely commercial office space, with the sixth floor benefiting from having a roof garden overlooking Oxford Street offering breakout space for tenants.

Main contractor McLaren began work on site in November 2014 with the demolition of the existing buildings. The basement was then deepened and a retaining wall installed along with piled foundations.

The new building has been constructed with a structural steel frame and composite concrete floors. Steelwork predominantly begins at ground floor, supported by the retaining wall and on concrete piers that extend upwards from the basement slab.

"There are quite a few steel to concrete interfaces at ground floor level that have required a lot of coordination between trades," says McLaren Construction Senior Project Manager Eike Schwartlander.

"Because of the excessive loads coming down the frame, four of the main steel columns are founded on the basement floor and then embedded in concrete up to the ground floor slab for extra stability."

Concreting these columns had to be left until the entire frame was completed in December, which has meant basement works having to be staggered.

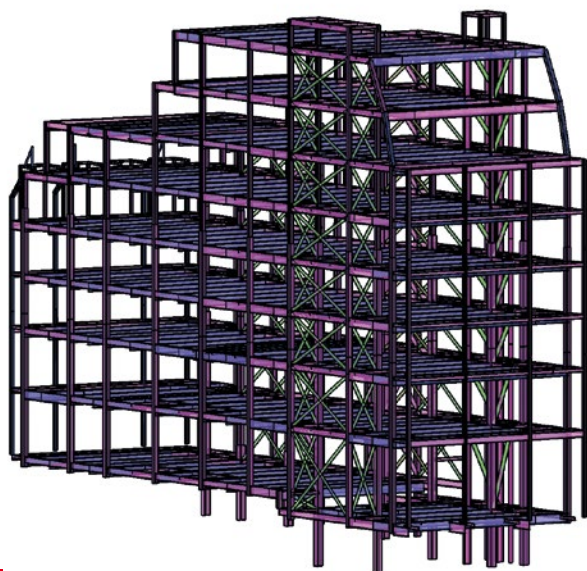
"However a steel frame has proven to be the most convenient material for this very confined site as deliveries are a challenge," adds Mr Schwartlander [see box].

As well as from bracing, the steel frame gets its stability from two steel-framed stair cores and two lift shafts.

Steel has been erected around a regular grid with the main columns predominantly positioned along the site's perimeters. These in turn support 15m-long cellular beams, which give the building its clear column-free spaces on each floor.

"By utilising a steel frame, the building's internal layout options are not restricted by intermediate columns thereby creating the desired large open plan office spaces," says Campbell Architects Project Lead David McEvoy.

"By using a steel composite solution we've also been able to design 'soft spots' into some of the lower retail floors where the future tenants can add stairs or even escalators if they choose," he adds.



The completed Oxford Street elevation



**FACT FILE**

11-12 Hanover Square, London

Main client: Aviva Life & Pensions

Architect: Campbell Architects

Main contractor: McLaren Construction

Structural engineer:

Waterman Structures

Steelwork contractor: BHC

Steel tonnage: 950t

The new Hanover Square façade



Temporary props support the adjacent buildings during construction



The sixth floor roof garden will overlook Oxford Street

Once steelwork is delivered to site BHC has erected the majority of the columns and beams with the on site **tower crane**. The only notable exception being a couple of second floor transfer girders, required because of the slight **grid pattern** change needed to accommodate the roof garden.

Weighing in at 20t the two 15m long beams were too heavy for the tower crane and so they were installed during a specially arranged weekend lifting operation.

The entire steelwork for this project, as well as the transfer girders, had to be lifted into place over three sets of temporary props that have been installed across the site in order to support the neighbouring buildings.

“Because of the height we had to reach in order to lift the beams over the props and then into the site’s footprint we had to use a 500t-capacity **mobile crane**,” says BHC Project Manager Bobby McCormick.

As the frame is erected BHC is also installing steel angles that connect the new steelwork to the façades of the four buildings that abut the new building on two sides.

“Although the building is structurally independent, the angles are a restraining element to mitigate against any potential movement,” explains Mr Schwartlander.

For the exterior, the Oxford Street façade will consist of precast panels with faience tiles and feature curved glazed

Logistics

Bringing materials to site on any central London project can be challenging, and this job is no exception. Not only is there no room for materials storage on site, as the new building covers the entire site’s footprint, the project’s two street frontages also have their restrictions.

Site cabins are positioned along the Oxford Street frontage blocking any potential vehicular access, although bringing deliveries along Oxford Street would have caused quite a few challenges.

Steel deliveries are unloaded from the Hanover Square side of the project and brought to site in a just-in-time basis. The site does have a cordoned off area for parking delivery wagons, but the project team does have to coordinate with the council and two other construction teams currently working on the Square.

Other works currently being undertaken in the vicinity include Crossrail, which is temporarily occupying the entire western side of the Square, and another commercial development directly opposite the McLaren job.

units, while the Hanover Square **façade** will consist of precast panels with a dark brick, Portland stone elements and bay windows. Flanking walls will be finished in a variety of brickworks in order to resemble the existing streetscape.

11-12 Hanover Square is due to be completed in August 2016.

Retaining a City streetscape

A modern steel-framed office and retail scheme in the City of London is being constructed behind two retained façades.

Set in the heart of the City of London's legal quarter, a new 9,300m² development in Chancery Lane will provide nine floors of modern office and retail accommodation behind two retained façades.

The four-storey façades of the previous building - Lonsdale Chambers - have been retained along the entire Chancery Lane elevation and a portion along the Breams Buildings thoroughfare.

Originally built in the 1870s, keeping these masonry walls and windows will add continuity to the surrounding streetscape. "Retaining the façades was one of the planning stipulations," explains Scott Brownrigg Associate Ian Wood. "They help make our new building less obtrusive, while

also maintaining the look of the street."

"Above the façades the new steel-framed floors are set-back which reduces the impact from street level along Chancery Lane."

Overall the new development comprises a basement, ground floor and seven upper storeys housed in a long span, steel-framed building with concrete floor slabs cast on metal decking. In order to maximise the floor-to-ceiling heights, the services have been incorporated into the structural steelwork zone by using Fabsec cellular beams throughout the frame.

The building's steel-framed core is offset and disconnected from the building floor plate due to vertical service risers. The building's stability is consequently provided by the structure acting as a sway frame to

remove the need to install cross bracing and compromise the architectural scheme.

A centrally positioned atrium extends upwards from basement to roof level, where it will be topped with glazing that will allow natural light to penetrate the inner areas of the building.

The basement of the building will accommodate some retail space towards the Chancery Lane end, with plant areas located to the rear in a deeper part of the floor zone. The ground floor will house more retail space, the main office entrance lobby and storage areas for the office tenants, such as bike sheds.

From the first floor upwards the new building will consist entirely of office space, with the first three levels (first, second and third) eventually tied into the retained façades [see box].

The fourth floor will feature a new mansard design (again mimicking the surrounding buildings) while above this the building steps back to accommodate a large fifth floor roof terrace and smaller terraces above. Because of these outdoor areas, the topmost office floors (5, 6 and 7) have significantly smaller floorplates than the lower floors.

"The set-back upper levels don't disturb the existing streetscape and they also create outdoor usable space for the new development," adds Mr Wood.

McLaren Construction began work on this project in August 2014 with the demolition of Lonsdale Chambers.

Early works included the demolition and stripping out of the original structure and installing associated temporary works to support the existing façades, basement retaining walls, pavement vaults and party walls of the adjacent properties.

Once the piling of the site, which required approximately 600 piles installed up to a depth of 22m, was completed the steelwork programme was able to begin.

Steelwork for the new frame begins at basement level and most of the 2,000t of steelwork Severfield has erected for this project was lifted into place using the site's two tower cranes.

"The only exceptions were a couple of 20t beams installed at ground and first floor levels which were too heavy for the tower cranes," says McLaren Construction Project

How the completed building will look along Chancery Lane (right) and Breams Buildings (left)



FACT FILE

25-32 Chancery Lane, London

Main client: Viridix Real Estate

Architect: Scott Brownrigg

Main contractor: McLaren Construction

Structural engineer: Campbell Reith

Steelwork contractor: Severfield

Steel tonnage: 2,000t

Manager Gavin Turnbull.

"As there is no room for a **mobile crane** we had to split one beam into three sections so the tower crane could lift the pieces, while the ground floor beam was installed using a forklift and a block and tackle."

These heavy beams form cantilevers; at ground floor where the frame has to avoid a subterranean obstruction and at first floor where a longer span is needed to accommodate the entrance.

Getting steel or any construction material to a site in central London is always a logistical challenge. On this project there is no space to store any material as the footprint of the site is taken up completely by the new building.

Steel was delivered on a just-in-time basis with at least two deliveries every working day.

"We had two offloading areas for the steel deliveries, one on Chancery Lane and the other within the site boundary adjacent to Breams Buildings, with each area serviced by one of the two tower cranes," explains Severfield Project Manager Richard Grey.

"For the erection we split the frame in half, with each of the two areas supplied by one of the offloading areas and with its own dedicated erection gang."

The steel frame is based around a fairly regular **grid pattern** offering column-free spans of up to 12m, all the way around the central atrium.

Aside from the first three levels of steelwork, the frame was erected two floors at a time, with Severfield also responsible for installing the **metal decking** which followed on behind.

Putting the finishing touches to the building, the cladding systems include fully **glazed façades** above the retained elements, while the remaining façade on Breams Building (excluding the retained portion) features curtain walling incorporating glazing and terracotta elements of blue, orange and white.

External works to the site include repaving footpaths to Breams Building and Little Whites Alley and high level soft and hard landscaping to the roof terraces from the fifth storey upwards.

25-32 Chancery Lane is scheduled to be completed in November 2016.



Retention systems

The **steelwork erection** was one of the key elements in keeping the project on schedule as a number of other vital trades and programmes were dependent on the steel completing on time.

The retained façades are supported by temporary propping systems around which the new steel frame was erected (pictured above). Once the

floor slabs up to level four were cast and cured the façades were then tied into the new steel frame via a series of angles.

After this the propping was removed as the façades were then supported by the steelwork.

Further down the building each corner of the site was temporarily propped, while the groundworks and then steelwork programme was progressing. Only after the ground floor slab was cast could the basement temporary works be removed.



The steel frame along Breams Buildings takes shape



Long span cellular beams have been used throughout

"For the erection we split the frame in half, with each of the two areas supplied by one of the offloading areas and with its own dedicated erection gang."



Straw power

One façade of the boiler house is left out to allow the installation of large equipment

Housing East Anglia's latest biomass renewable energy plant are a number of large steel-framed buildings.

FACT FILE

Snetterton Renewable Energy Centre, Norfolk

Main client:

Burmeister & Wain Scandinavian Contractor

Architect:

Ramboll

Principal contractor:

Burmeister & Wain Scandinavian Contractor

Contractor

Structural engineer:

Ramboll

Steelwork contractor:

Caunton Engineering

Steel tonnage:

1,500t

The latest straw powered biomass energy plant is under construction at Snetterton, Norfolk, close to the region's main trunk road the A11.

Once operational in 2017, the plant will have an electrical capacity of 44.2MW, fuelled annually by 250,000 tonnes of baled straw supplied by local farmers, as well as woodchips.

The plant is owned by a joint venture of Burmeister & Wain Scandinavian Contractor (BWSC) and a Danish infrastructure fund managed by Copenhagen Infrastructure Partners who together are investing around £160M in the project.

It will be operated for 15 years by Danish

company BWSC which is also managing the construction of the project

The biomass plant's operation is based on energy technology developed in Denmark. The main part of the power plant is a boiler from Burmeister & Wain Energy (BWE), which is said to be the world's largest water-cooled vibrating grate straw-fired boiler.

BWSC has in the last three years completed a similar project in Sleaford, Lincolnshire [see [NSC Sept/Oct 2013](#)], and it is currently constructing another biomass plant in the same county at Brigg [see [NSC June 2015](#)].

Construction work on the Snetterton project got under way in February 2015, with BWSC clearing the greenfield site, stabilising the ground and installing slab foundations.

A few months later Caunton Engineering was able to commence its steelwork erection programme, which includes constructing a boiler house, turbine hall with an attached office block, two straw barns, the roof of the woodchip barn and associated conveyor and chute supports, along with crane beams, stairs and platforms.

"Most of the access roads and slab foundations had already been completed when we started steel erection which made our work easier," comments Caunton Engineering Site Manager Robert Aitman.

"The roads allowed us to bring steel on to the site easily, while the slabs gave us a firm and flat surface for the cranes to be positioned on during the erection process."

Caunton erected a portion of the boiler

house first as this is a critical part of the overall scheme. By only erecting three sides of this large steel frame, a gap was left so that the boiler and all of its large ancillary equipment could be installed.

"Once the installation work was completed, we then erected the fourth elevation and completed the roof over the boiler," adds Mr Aitman.

The boiler house is 33m-high with the four elevations up to 35m-long. The building is a large braced frame with cross bracing inserted between the main columns, which are spaced at 5.7m intervals.

Because of their excessive length, all of the columns were delivered to site in three sections, which were then bolted together during the erection process.

The building's roof is formed by five 35m-long rafters, which arrived on site in 17.5m-long sections, each weighing 4t. Using two 50t-capacity mobile cranes, the roof rafters were lifted individually and bolted together in the air while being connected to the supporting columns.

During the boiler house steel erection sequence, Caunton also erected the adjacent turbine hall and a connected three-storey office annex.

The turbine hall is a structurally independent building separated from the adjacent boiler house by a movement joint. Having the same width as the boiler house, albeit with a slightly lower roof, once clad the structures will look like one large building.

The turbine hall during the cladding process





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The straw barns sit end-to-end

►14 One of the larger steel elements within the turbine hall is a set of large crane beams. BWSC supplied all of the project's crane beams for Cauntton to erect, line and level, with the exception of the turbine hall's elements.

Cauntton fabricated these two beams, which are both 33m-long and weigh 8t each. They were brought to site in three pieces and lifted into place individually and then bolted together once insitu.

"While the boiler was being installed we began erecting the two conjoined straw

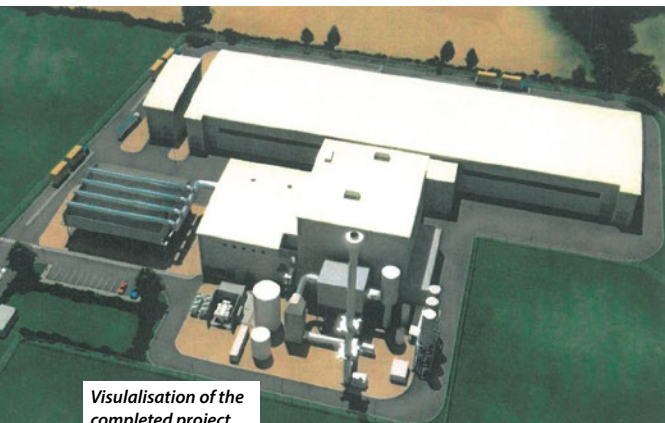
barns," explains Mr Aitman. "We had to work in coordination with the project's concrete team who were still installing parts of the slab."

The two straw barns sit end-to-end and are structurally independent frames, separated by a row of double columns and a masonry blast wall.

The barns will take delivery of and store the baled straw from the local suppliers. A conveyor system and feeder, all erected by Cauntton, will transport the straw into the adjacent boiler house.

Each of the identical 84m-long × 16m-high barns is a propped portal frame containing two 21m-wide spans. Again using a couple of 50t-capacity mobile cranes, the roof rafters were brought to site in three sections and spliced together during installation.

Summing up BWSC Director Christian Grundtvig said: "We are delighted with the acquisition of the Snetterton plant which adds a strong base to our portfolio in the UK and we are looking forward to making it a successful project."



Visualisation of the completed project

"Once the installation work was completed, we then erected the fourth elevation and completed the roof over the boiler."



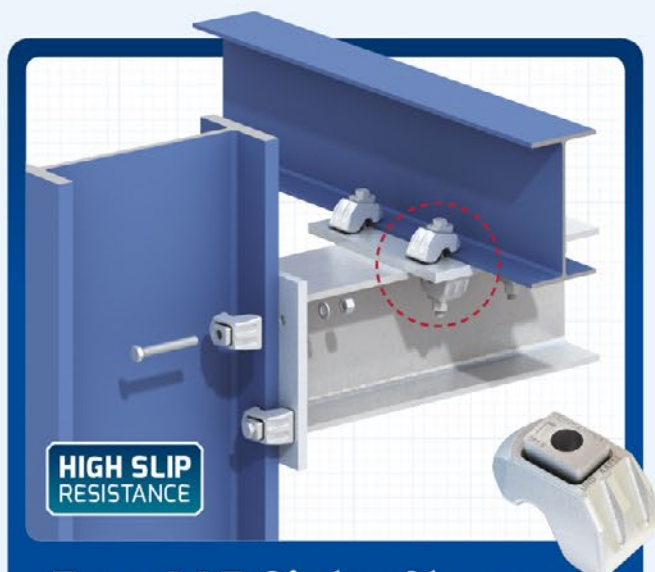


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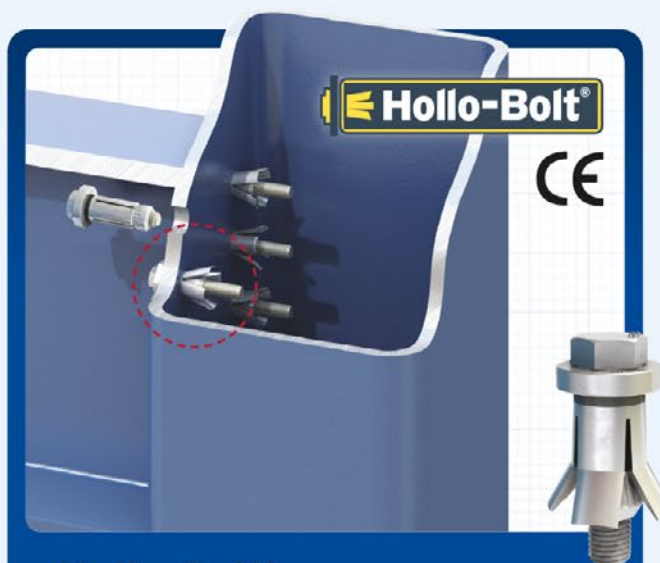
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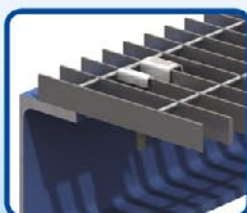
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The cinema structure begins to be erected

Retail buys into city centre revamp

The regeneration of Sheffield city centre's main shopping area is on going with steel construction playing a pivotal role.

current phase two – which kicked off in early 2015 – will deliver a three-level Primark store, a nine-screen cinema complex, restaurants and retail units all serviced by a large delivery yard.

Further phases are scheduled to begin later this year with more retail space in both new and refurbished buildings.

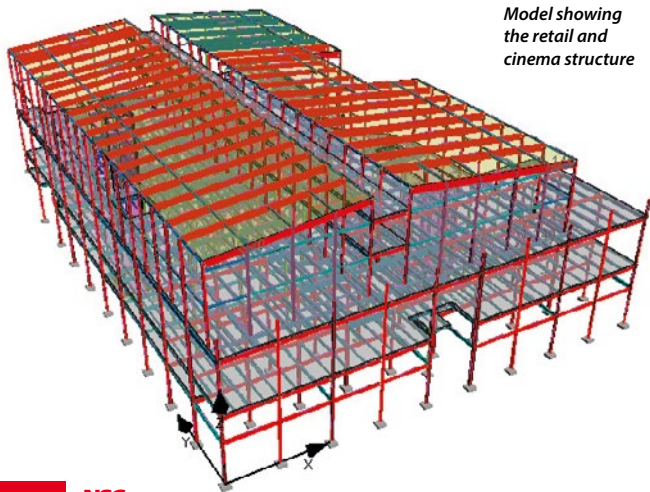
Phase two is essentially split into two structurally independent steel-framed buildings, separated by a 70mm wide movement joint. One building is a stand alone Primark store, while the other much larger structure accommodates the remainder of the scheme's amenities

Main contractor Bowmer & Kirkland started phase two last March (2015) and as the site had previously been cleared the first task was to install foundations.

"Ground conditions have been more challenging than we initially anticipated, so we've had to reschedule the steel programme accordingly," says Bowmer & Kirkland Project Manager Keith Birtwistle.

"It would have been easier, in terms of logistics and getting materials onto site, to erect the larger frame first and finish the steel erection with the Primark store," he adds.

Model showing the retail and cinema structure



The Moor has been Sheffield city centre's main shopping street since the end of the Second World War, but in recent years many of its customers have started frequenting newer and more up-to-date retail destinations.

In an effort to reverse this trend, Aberdeen Property Trust and Sheffield City Council have embarked on an ambitious programme of regeneration that will transform the area into one of the city's most desirable shopping areas.

Phase one of this programme centred around the completion of a new indoor Moor Market and nine retail units, while the

FACT FILE**Sheffield Moor retail development****Main client:** Aberdeen Property Trust**Architect:** Leslie Jones Architecture**Main contractor:** Bowmer & Kirkland**Structural engineer:** Sanderson Watts Associates**Steel contractor:** Hambleton Steel**Steel tonnage:** 2,200t

The Primark store was first to be erected



The new development's main elevation along the existing Moor shopping street



A series of 26m long trusses are installed to form the delivery yard

"It's a sway frame in two directions, as we wanted to avoid bracing."

"However, as groundworks were ongoing, we had to do the reverse and erect the Primark store first."

Since the Primark store has been erected site access for steelwork has been more challenging as the erected frame now blocks one of the previous entry points.

This means steelwork contractor Hambleton Steel has to make deliveries during early mornings and evenings, as these are the only times when the pedestrianised Moor shopping street can be closed. Meanwhile, larger steel elements are delivered via Debenhams' adjacent temporary service yard, which overlooks the site.

Debenhams has a vested interest in the project as the site's neighbour. Once the development is complete, it will be able to dispense with the temporary yard and once again use its main loading bays, which will be accessed via the delivery yard.

The three-level Primark store was constructed around a fairly typical retail sized **grid pattern** of 8m × 8m. There are a few slight variations to this pattern, most notably around **lift and stair cores**, and in order to accommodate the ground floor access ramp to the development's delivery yard.

"It's a **sway frame** in two directions, as we wanted to avoid bracing," explains Sanderson

Watts Associates Engineer Ryan McMullan.

"The building has glazed shop front elevations which aren't suitable for **bracing** as the client didn't want them in view, so we could only position supplementary cross bracings in discreet back-of-house locations."

The building's suspended floors and plant roof are designed to act **compositely** with the supporting steelwork beams, via shear studs, **welded** to the beam flanges.

One of the most challenging parts of the steel programme was the initial phase of the large mixed-use structure. A total of eleven 26m-long × 2.5m-deep **trusses** had to be installed to form the large column-free space of the delivery yard.

►19 To complete the yard's roof, there are a further seven shorter trusses positioned at a 45 degree angle to the larger members.

The **trusses** vary in weight considerably, with the lightest being only 7t and the heaviest coming in at 39t.

"Their weight depends on their position and the amount of column loadings they are going to absorb," explains Hambleton Steel Site Manager Andrew Aykroyd.

The loadings differ as the steel complexity increases above the service yard trusses. This is because, as well as forming the roof over the yard, the trusses also provide support to a host of columns forming the upper storey mall and the cinema.

The **cinema** steel frame superstructure (third floor and above) comprises two rows of mono-pitched **portal frames**, spanning over the screening rooms at approximately 4m centres.

In addition, a number of columns are offset to allow for clear access to a sloping

second floor pedestrian walkthrough mall. Therefore a series of **transfer beams** within the third floor structure have been utilised to support the cinema floor over the service yard.

Access to the cinema, restaurants and first floor shopping mall will be via an escalator link from The Moor.

Further trusses are located above the auditoria, including a 17t 24m-long truss that will be installed at roof level. Also at this level are a series of 30m-long rafters forming the mono-pitch roof.

For ease of **transportation**, these long sections, each weighing 2.5t each, will be brought to site in three pieces.

The service yard trusses, on the other hand, arrive on site in two pieces, which are then **bolted** together on the ground before being lifted into place using two **mobile cranes**.

The Moor phase two is due to be completed this October 2016.



The project forms a central element of Sheffield's wider regeneration plans



Primark's open plan interior

Truss design

by SCI Associate Director David Brown

Truss design always demands careful consideration – but especially so for the large span, heavily loaded trusses used in the Sheffield Moor retail development. Practical issues of joint design, transportation, erection and deflection may all have an influence on the design of the truss and selection of members. For heavily loaded transfer trusses, a 'Warren' or 'Pratt' truss are the likely solutions. At Sheffield a '**Pratt**' truss was adopted, which has the advantage of shorter compression internals (the verticals) but more internal members (and more joints) than a '**Warren**' truss. Trusses may be analysed assuming pinned joints (which would generally be recommended) or as an entirely rigid assembly. Rigid joints may help reduce deflection but can complicate joint design. A further solution is pinned internals and continuous chords. Analysis is usually based on centre lines meeting at nodes – though moving the intersection point to produce more appropriate joint details is always worth considering. The additional forces and moments that result from the eccentricity can be considered as part of the **initial design**. A key design consideration is **out of plane restraint** to the chords – generally the top chord has appropriate restraint, but reversal that causes compression in the bottom chord must be carefully considered and restraints provided.

Joint design is critical, which makes judicious choice of truss members essential, with a review of joint configuration part of the design process. **Open sections** have approximately 40% of the axial load concentrated in each



flange, so the transfer of these forces is likely to lead to heavily strengthened joints. The science of the joint designer is to consider how these forces are transferred between members, especially when at the joints the load-carrying elements (i.e. the flanges) are often perpendicular to each other.

Bolted joints are common in more lightly loaded trusses, but become increasingly complicated for heavily loaded joints between open sections. Connections with ordinary bolts also have the **potential of movement** as the clearance is taken up and bolts slip into bearing, leading to unwelcome deflection of the truss. If bolts are to be used at all, pre-loaded assemblies are strongly recommended. In the Sheffield Moor retail development, the trusses have **welded joints**. The necessary splices between sections of truss use **pre-loaded assemblies**, to ensure there is no slip.

The effect of deflection on the supported structure must be carefully considered; the supporting truss will undoubtedly deflect as steelwork is **erected** and load (such as floor slabs) added. In the Sheffield Moor retail development, the trusses were precambered, and the subsequent **construction** sequence carefully arranged to minimise movement of concrete floor slabs.

Resources:

- <http://www.steelconstruction.info/Trusses>
- NCCI: Design of roof trusses (SN027, available from <http://www.steelbiz.org>)
- SCI P148 Modelling of steel structures for computer analysis
- Steel Designers' Manual. 7th edition; Chapter 20
- http://www.steelconstruction.info/Preloaded_bolting

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FACT FILE

Holywell School, Flintshire

Main client: Flintshire County Council

Architect: Lovelock Mitchell

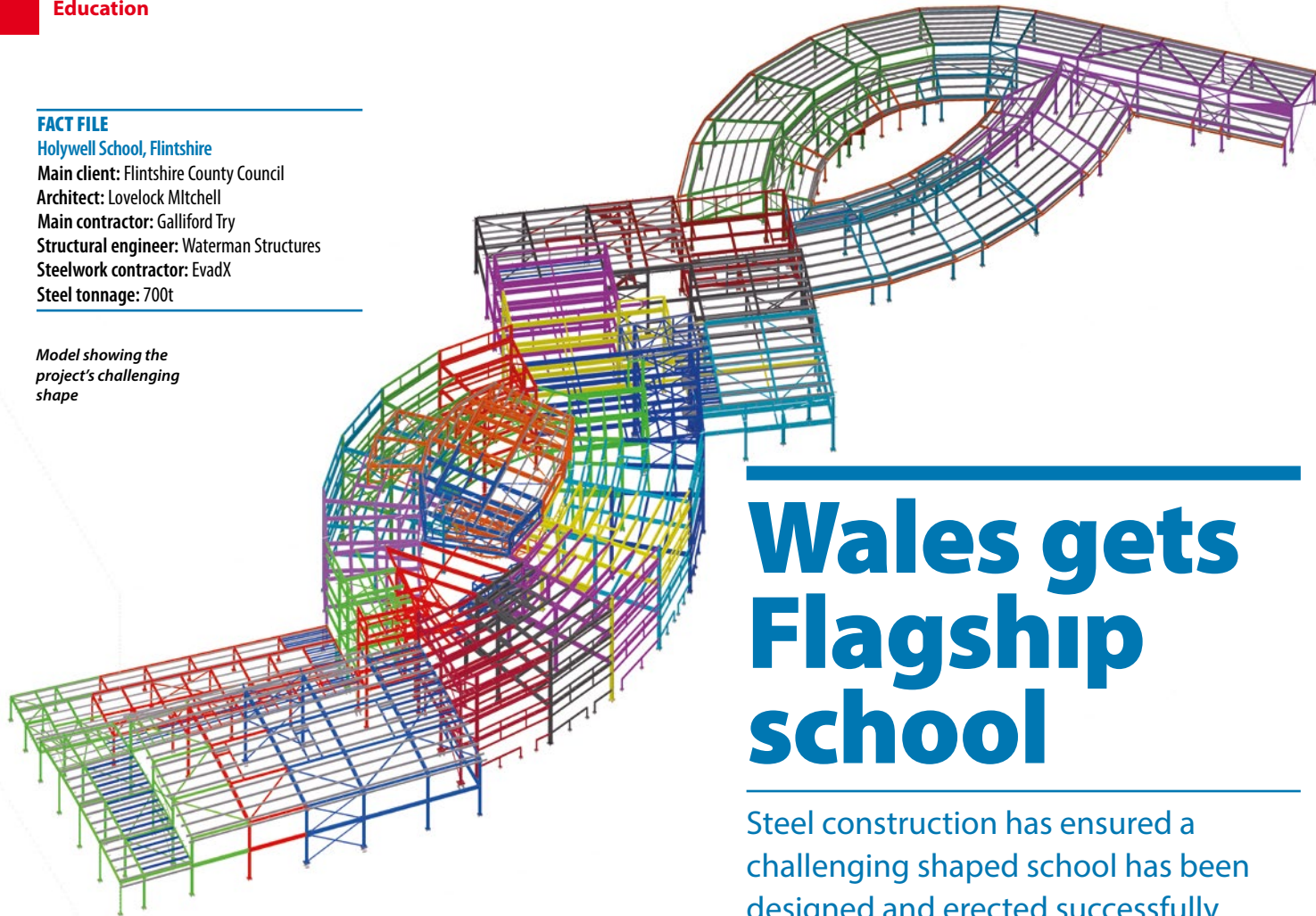
Main contractor: Galliford Try

Structural engineer: Waterman Structures

Steelwork contractor: EvadX

Steel tonnage: 700t

Model showing the project's challenging shape



Wales gets Flagship school

Steel construction has ensured a challenging shaped school has been designed and erected successfully

One of the first projects in Wales' 21st Century Schools Programme is currently under construction in Holywell, Flintshire. The flagship £30M steel-framed super school will provide a combined facility for 600 high school students and 315 infant and junior school pupils.

The new build will replace the existing High School, which is situated next to the construction site, and two local primary schools.

Building work began in January 2015 and completion is set for this coming summer, in time for the schools to settle in for the autumn term. At this point main contractor

Galliford Try will begin phase two of the scheme that consists of demolishing the old school buildings to create new sports pitches.

In contrast to many of the schools currently under construction in the UK, Holywell has an elaborate design combining a three-storey secondary school with a single storey primary school, both housed within two elliptical-shaped zones.

Apart from the sports hall, drama hall and dining areas, the entire school is architecturally challenging as it is curved both on plan and elevation.

The steel frame forms a stretched figure of eight shape, with the primary school formed around an open elliptical-shaped courtyard

in the top loop and a three-storey atrium infilling the lower loop, which is surrounded by the secondary school classrooms.

Between the two elliptically-shaped areas there is a two-storey sector which is not curved as it contains the school's main entrance, a drama studio, kitchens and a dining hall. The other non-curved part of the steel structure is the secondary school's sports hall, which is connected to the end of the three-storey element.

"The curves respond to the sloping site as there is a 2m-drop from one end of the building to the other," says Galliford Try Senior Project Manager Graham Ford. "To compensate for this, there are a couple of

The school's curvature responds to the site's slopes



steps incorporated into the ground floor slab.”

Beyond the new build’s footprint the slope becomes even more pronounced as the school’s land descends downwards towards the estuary of the River Dee. A lot of earthmoving will be required during Phase two of the works to level the ground for the new sports fields. The sloping topography however does mean many of the new school’s classrooms will have stunning views across to the Wirral.

A large earthmoving programme was also needed to create a level platform for the new school. Once this was completed bored pile foundations were installed in readiness for the erection of the steel frame.

Locally-based steelwork contractor EvadX began its **erection** programme in the middle of the school, building the reception area first. This area is stabilised by a **staircase core**, and once up it allowed the erectors to work from here in both directions, with two gangs each having their own **mobile crane**.

“Prior to erecting the steelwork we had to make use of the architects/engineers’ model and then manually load it into our own Tekla model to make sure all of the project’s challenging radii were checked,” says EvadX Project Manager Steve Morris.

Setting out all of the steelwork during the design phase and avoiding any clashes between steel members and services required a high level of accuracy.

“We used Level 2 Building Information Modelling (BIM) for this project, whereby all trades used the same design model,” adds Waterman Structures Project Engineer James Mackey. “It would have been difficult to design this school without using BIM.”

Even though the majority of the classrooms are set out around either a courtyard or an atrium, they do follow a standard design.

Set out around the radius of their respective ellipses, the primary classes are generally 7m wide, laid out in pairs with a shared cloakroom positioned between each

pair of rooms.

Because the primary school part of the building is single storey, these classes benefit from an airy 5m-high roof beneath a double-pitched roof.

The **steel design** for all classrooms has steel columns positioned along the exterior elevations and in the corridors, leaving the study areas column-free. The majority of the steel frame’s **bracing** is located in the partition walls, as well as in stairwells.

The main difference between the primary school classes and the secondary rooms, in terms of size, is the fact that the latter do not have interconnected cloakrooms, although some can be enlarged and combined with their neighbouring classrooms via sliding partitions, thereby adding **flexibility** to the design.

One of the main steelwork design challenges involves the three-storey atrium within the secondary school zone. Internal corridors ring the atrium, while link **bridges** on the first and second floor span the void.

“The architectural desire for the atrium was for a large column-free space so we had to set back all of the corridor columns, so all of the **steelwork balconies** on the first and second floors are cantilevering,” says Mr Mackey.

Only two columns are visible within the atrium and these are two **CHS** columns that support the 18m-long link bridges.

Adjoining the three-storey secondary school is a four-court sports hall, formed by a series of 18m-long rafters. This is one of only two areas within the project that has straight elevations. The hall’s roof features two steps with corresponding column lines dividing the hall into the main sports area, changing rooms within the first step and a corridor beneath the lowest roof.

Summing up, Mr Ford says: “This is a very complex steel frame, especially in the areas where low level parts of the building meet high level zones. The project would not have been possible without coordination between all of the project team and subcontractors.”



The three-storey secondary school under construction



Overlooking the sports hall during the steel erection programme



Classrooms have views across the River Dee



The primary school after the cladding had been installed



A brief history of LTB

David Brown of the SCI reviews the (relatively) recent history of lateral torsional buckling of beams. Part 1 includes a reminder of the underlying structural mechanics and the transition from theory into BS 449 and BS 5950. Part 2 looks at the comparison with BS EN 1993-1-1 and gazes into the near future.

In the beginning - Euler

Almost all **buckling** begins with Euler. Leonhard Euler (1707 – 1783) was a Swiss mathematician and physicist. In structural engineering he is most famous for identifying the elastic critical buckling load for a column. In the Eurocode, this load

is called N_{cr} and is expressed as $N_{cr} = \frac{\pi^2 EI}{L^2}$. This is a purely

theoretical load, as it assumes infinite material strength and assumes the strut is perfectly straight – neither of which is true. The obvious connection with a beam is that the compression flange is rather like a strut – if the web and tension flange are ignored.

In a beam, the resistance to lateral buckling of the compression flange is generated by:

- The lateral bending resistance of the compression flange,
- The tension flange, which restrains the compression flange, being connected by the web,
- The torsional stiffness of the section.

The elastic critical buckling moment for a beam is analogous to

the Euler load for struts, but rather more complicated because of the additional contributions. In the Eurocode, this moment is called M_{cr} . The elastic critical stress for a beam is simply the moment divided by modulus. In the same way as a strut, the elastic critical moment is a theoretical moment, assuming infinitely strong material, and a perfectly straight beam.

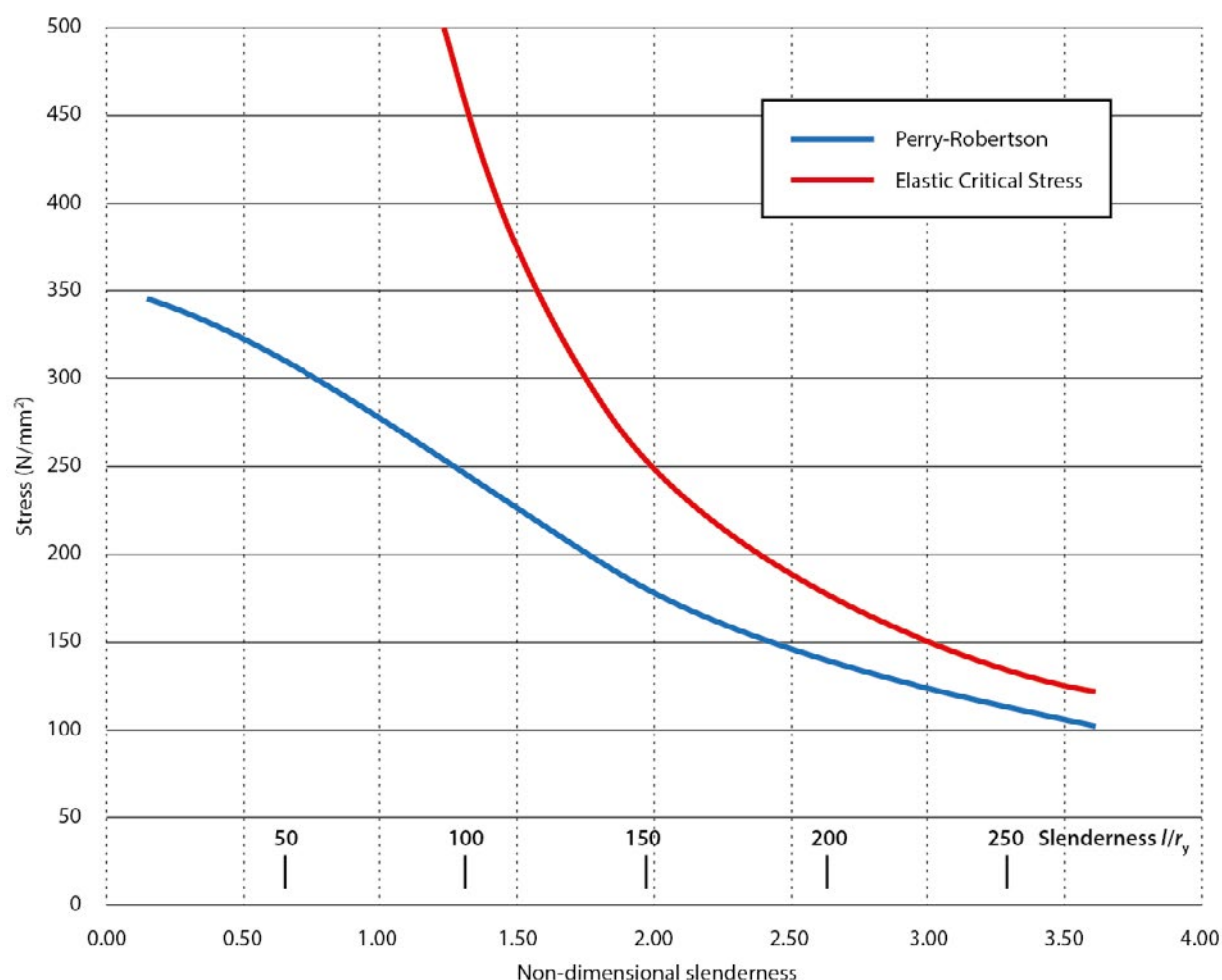
From Euler to allowable stress –

Messers Ayrton, Perry and Robertson

In 1886, Ayrton and Perry related the elastic critical stress to a failure stress, allowing for an initial imperfection (lack of straightness) and limited to the **yield strength** of the material. They did not resolve what the initial imperfections should be.

In 1925, Robertson developed the Ayrton-Perry formula, establishing imperfection values on the basis of experimental tests. This work was adopted as a basis of the strut curves (and LTB curves) in BS 449 and BS 153 (the bridge design Standard). Sadly, the reference to Ayrton seems to have been dropped and the expression became commonly known as the Perry-Robertson formula.

Figure 1
Elastic critical stress
and Perry-Robertson –
S355 steel



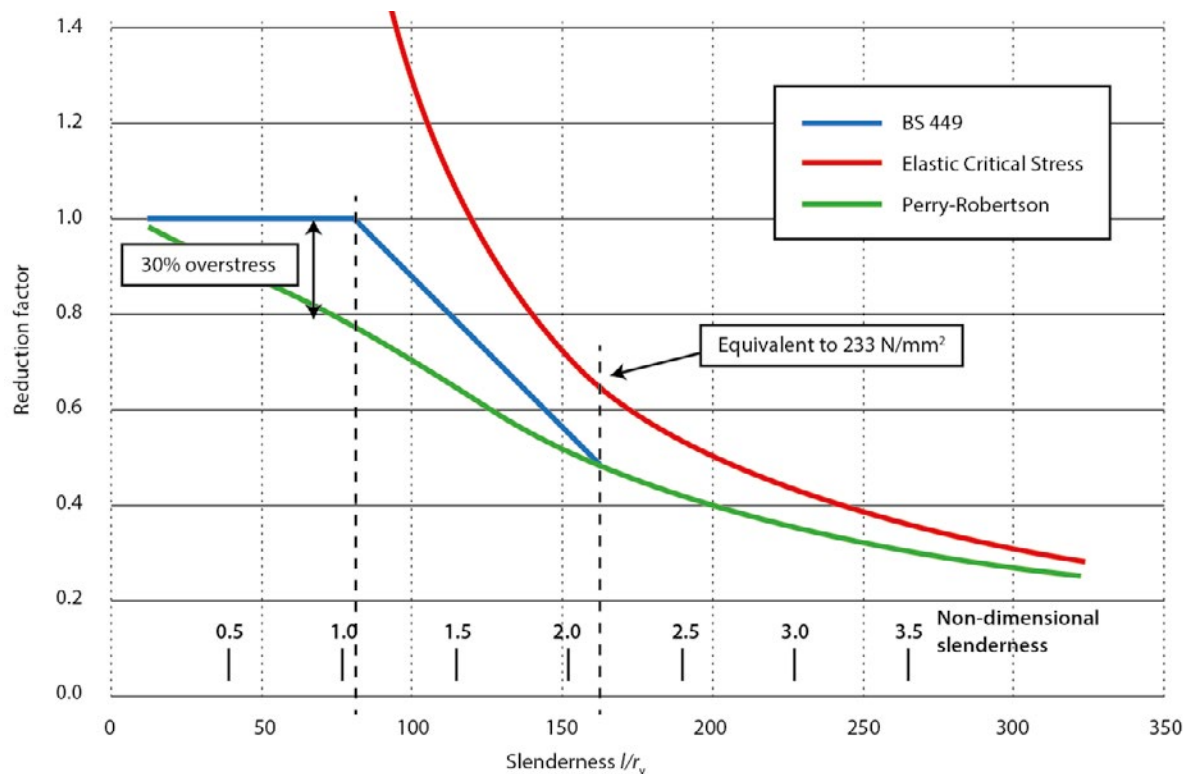


Figure 2
Normalised stresses vs
slenderness

Although the precise form of the Perry-Robertson curve depends on the Perry factor assumed, Figure 1 shows the relationship between the elastic critical stress and the Perry-Robertson curve.

It should be noted that there is no plateau in Figure 1. The Perry-Robertson formula is an elastic approach and is based on failure when the stress at the extreme fibre of the section reaches yield. At low slenderness, one might expect plastic behaviour, where the whole cross section reaches yield. At low slenderness therefore, the Perry-Robertson curve is quite conservative.

Application to LTB of fabricated beams

The salient paper is by Kerensky, Flint and Brown (sadly, no relation) of 1956, where they described the basis of design for beams and plate girders in the revised bridge Standard, BS 153. This important paper was used to prepare the design guidance in the 1969 (metric) version of BS 449.

The first step is to establish the elastic critical stress in bending. Kerensky, Flint and Brown (KFB) present the critical stress for a symmetrical I section as

$$f_{b,crit} = \frac{\pi^2 E I_y}{2 Z_x L^2} \sqrt{1 + \frac{4 G K L^2}{\pi^2 E I_y h^2}}$$

Even without describing the variables, the comparison with the commonly-used expression for M_{cr} in the Eurocode is clear – the physics has not changed.

KFB proposed using the Perry-Robertson formula to establish an allowable stress as it had “evolved in conjunction with extensive tests and has a background of satisfactory application in design”. The problem at low slenderness remained to be solved – by curve fitting. KFB proposed a plateau extending to a slenderness of l/r_y of 60, and then joining (with a straight line) to the Perry-Robertson curve at $l/r_y = 100$. KFB noted that this led to a maximum ‘overstress’ (compared to the Perry-Robertson stress) of 13%.

KFB recognised that for certain cross sections, the ‘elastic’ background to the approach could “seriously penalise” the use of such members. The problem is more noticeable when the member has a higher ‘shape factor’, which is $\frac{\text{plastic modulus}}{\text{elastic modulus}}$.

However, as they were covering plate girders, where the shape factor could be as low as 1.0, the basic formula was not modified.

Transition of KFB proposals into BS 449 for rolled sections

In BSI papers of 1969, notes are provided on the amendments to BS 449 – which included the conversion to metric units, but of more interest to this discussion, also describe the development of the LTB rules that appear in BS 449.

The basis for the BS 449 curve is the KFB paper, simplified for building designers and modified to account for the shape factor of the rolled I sections commonly used.

Firstly, the KFB formula for the critical stress is simplified. With approximations for various variables, the expression for the elastic critical stress becomes:

$$\text{Elastic critical stress} = \left(\frac{1675}{l/r_y} \right)^2 \sqrt{1 + \frac{1}{20} \left(\frac{I_T}{r_y D} \right)^2}$$

In BS 449, this is given the symbol “A”, and (if anyone can find an old copy of BS 449) appears over Table 7. In clause 20 of BS 449, this value of A is described as the elastic critical stress for girders with equal moment of inertia about the major axis – i.e. a symmetrical section. For unsymmetrical sections, the calculation of the elastic critical stress is modified.

The BS 449 drafters then dealt with the problems with the Perry-Robertson curve at low slenderness. A slightly different plateau length was proposed by extending the plateau until the Perry-Robertson stress was exceeded by the 13% described in the KFB paper, but also allowing for a shape factor of 1.15 for rolled sections. The product of these two factors is $1.13 \times 1.15 = 1.3$.

Thus the plateau was extended until the Perry-Robertson stress was exceeded by 30%. Although KFB proposed the intersection with the Perry-Robertson curve at $l/r_y = 100$, the drafters of BS 449 modified this to a point when the critical stress was $17/1.2$ tonsf/in², or 233 N/mm². The actual slenderness at this intersection point varies with D/T .

This results in the curve (for one specific beam, with $D/T = 24$) shown in Figure 2. Note that the bending stresses have been normalised by dividing by the yield strength, to give a reduction

factor. The slenderness is plotted against slenderness (l/r_y) and non-dimensional slenderness (to assist future comparisons)

The form of the BS 449 curve may be confirmed by simply plotting values in any one column from Table 3a.

Observations on the BS 449 approach to LTB

BS 449 has a simple approach to LTB. The look-up table is simple to use, but rather more complicated to embed in a spreadsheet or other program. It might also be noted that the plateau seems relatively long (The Eurocode plateau is limited to a non-dimensional slenderness of 0.4, or $l/r_y = 32$). Finally we note that BS 449 had no way of dealing with non-uniform moment, which was a major change introduced in BS 5950.

Bring on BS 5950

As long ago as 1969, a committee was appointed to prepare a successor to BS 449 as a limit state code. Note that the metric version of BS 449 had only just been issued!

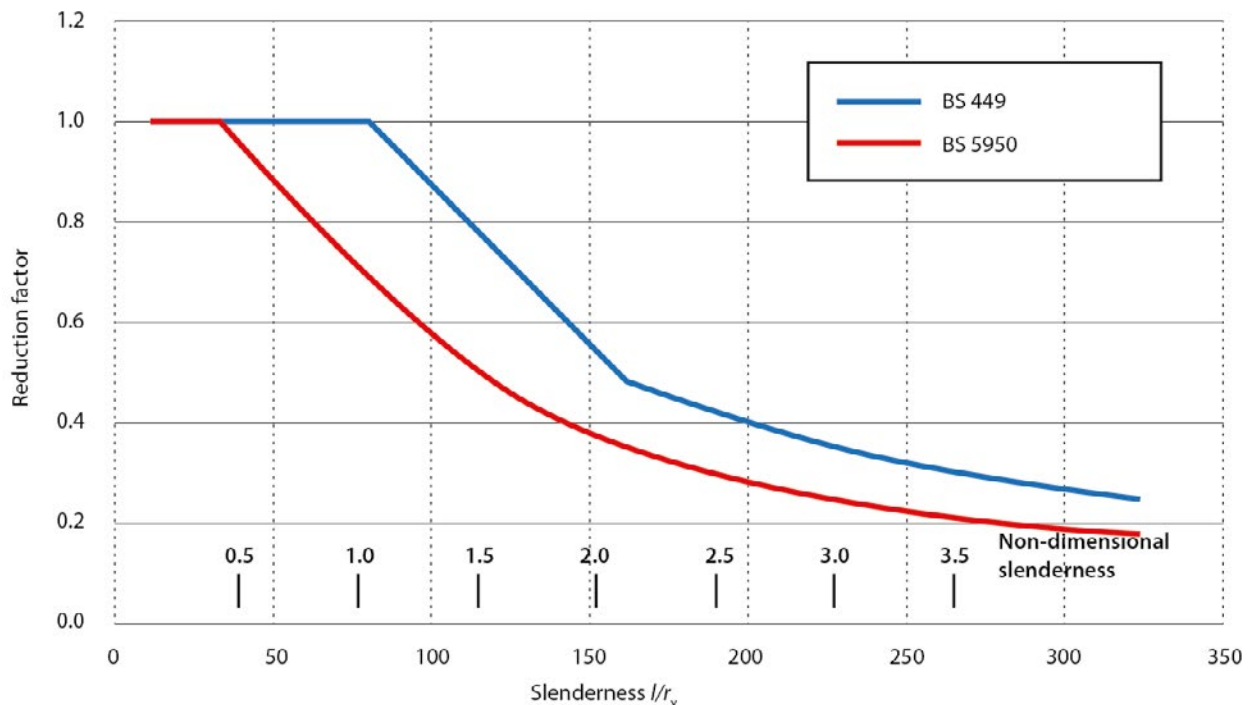
In a background document to BS 5950, the comment is made that the new code is based on the same underlying theory as BS 449. The new rules took account of moment gradient (an improvement), but it was noted that the results of the new procedures were more conservative, especially at low slenderness. Perhaps one might expect this looking at the optimistic plateau length in Figure 2. In the background document, the elastic critical moment M_E is expressed as

$$M_E = \frac{\pi}{L} \sqrt{\frac{EI_y GJ}{\gamma}} \sqrt{1 + \frac{\pi^2 EH}{L^2 GJ}}, \text{ which should again look}$$

familiar.

Having calculated an elastic critical stress, BS 5950 determines an allowable bending strength using the Perry-Robertson formula, found in B.2.1 of BS 5950. The Perry factor and Robertson Constant are given. The formulation of the expressions in B.2.3 has a plateau length of λ_{LT0} .

Figure 3
Comparison between
BS 449 and BS 5950
LTB curves



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For S355 steel, $\lambda_{LT0} = 0.4 \left(\frac{\pi^2 E}{p_y} \right)^{0.5} = 30.6$

In Eurocode terms, this is equivalent to a non-dimensional slenderness of 0.38. The comparison between the LTB curves in BS 449 and BS 5950 (for a beam with $D/T = 24$) is shown in Figure 3.

The BS 5950 buckling curve is generally significantly lower than that in BS 449. Designers of a certain age may recall the general view that resistances had reduced. To some degree, this would have been offset by the change to a limit state code, when the load factor was approximately 1.55 compared to the 1.7 in BS 449. In comparisons made in 1979, it was noted that BS 449 "gives wide variations in the factor of safety" in some circumstances "which are below what is generally considered appropriate", so perhaps the reductions in resistance are not surprising.

In 1989, Amendment 8 to BS 449 was published with a revised Table 3a. For the specific beam used in this comparison, Figure 4

now shows the reduction factor as given in the revised Table. Perhaps as might be expected, the form of the curve given by Amendment 8 very closely follows that given in BS 5950. SCI has not been able to locate background documents giving the expressions behind the Amendment 8 curves – Figure 4 is simply plotted from the values in the Standard. It is not inconceivable that the Amendment follows the BS 5950 expressions, but with some allowance for the different factors of safety. If the Amendment 8 curve is plotted at 90% of its value, there is close correspondence with the BS 5950 curve – and $1.55/1.7 = 0.91$. Of particular note is the much reduced plateau length compared to BS 449.

The second major change in BS 5950 was the introduction of methods to deal with a non-uniform moment, via the m_{LT} factor in Table 18. Technical exposition on the treatment of non-uniform moments appeared in AD 251 and is not repeated here.

In Part 2, the comparisons are extended to the Eurocode, with a forward-looking view of the future LTB formulae.

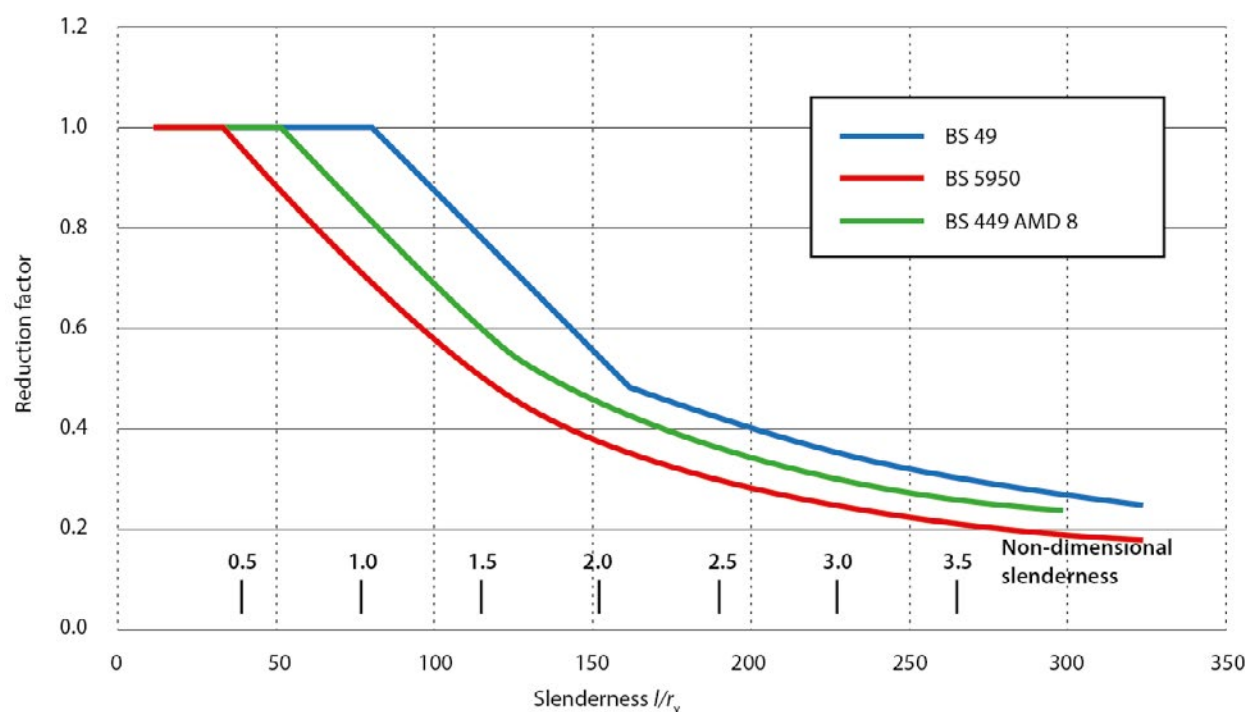


Figure 4
Comparison between
BS 449, BS 5950 and
BS 449 Amendment 8

GRADES S355JR/J0/J2 STEEL

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AD 394:

New Rules on the Selection of Execution Class for Structural Steel

Until recently, the process for determining [Execution Class](#) for structural steel was based on the approach given in BS EN 1090-2:2008+A1:2011 (issued August 2011). This approach has now been superseded by an alternative method given in BS EN 1993-1-1:2005+A1:2014 (issued June 2015) and the amendment to its accompanying National Annex.

BS EN 1090-2 introduced the concept of Execution Class as an aid to designers when specifying the Execution requirements for steel structures. Four Execution Classes were identified – Class 4 being the most onerous. Orthodox buildings are typically Class 2. Some years after its publication, the European committees responsible for the design (BS EN 1993-1-1) and Execution (BS EN 1090-2) standards for structural steel recognised that the recommendations for the selection of Execution Class would be better placed in the design standard, BS EN 1993-1-1. The work to move this guidance is now complete and the British Standards Institute (BSI) recently published a revised version of BS EN 1993-1-1 together with a new National Annex NA+A1:2014 to BS EN 1993-1-1:2005+A1:2014 (issued June 2015).

BS EN 1993-1-1:2005+A1:2014 now contains a new normative 'Annex C – Selection of Execution Class'. There are a couple of major differences between the recommendations in Annex C of BS EN 1993-1-1 and those given in Annex B of BS EN 1090-2. The first difference is that the Annex C is normative and engineers must use the approach given in the standard. The guidance given in Annex B of BS EN 1090-2 was informative and engineers could either adopt the guidance or use an alternative approach. The second change concerns the approach for selecting Execution Class. The relationship in Annex C is based on Consequences Class (CC)/Reliability Class (RC), type of loading and the grade of steel. Production Class has been removed.

The new Annex C of BS EN 1993-1-1:2005+A1:2014 also contains provisions for national determination. These allow member states to recommend an alternative approach to the selection of Execution Class and to place limitations on the use of Execution Class 1. The UK's approach for the selection of Execution Class is given in Clause NA.2.27.3 and Table NA.4. of the revised National Annex to BS EN 1993-1-1. Table NA.4. is reproduced at the bottom of the page.

Note that the broad division in the table is between structures subject to fatigue, and those where [fatigue](#) is not a design consideration. EXC2 is the anticipated Class for most building structures. Bridges, being subject to fatigue, will generally be Execution Class 3.

The use of EXC1 is not encouraged by the standard or the UK [National Annex](#). The standard states that EXC1 "is not endorsed for general use." and the National Annex notes that the use of EXC1 "might result in a higher probability of structural failure than is normally accepted for most structures in the UK"

Although BS EN 1090-2:2008+A1:2011 has not yet been amended to remove Annex B, it is recommended that the selection of Execution Class should be based on the recommendations given in 'normative' Annex C of BS EN 1993-1-1:2005+A1:2014 and its supporting National Annex.

BCSA is in the process of developing a practical guide to the selection of Execution Class based on the National Annex, which will be available early 2016.

Contact: **Dr David Moore**
Tel: **0207 7478122**
Email: **advisory@steel-sci.com**

| Parts of BS EN 1993 which are applicable to the design of the structure ⁽¹⁾ | | All relevant Parts except Part 1 9 or Part 1 12 | All relevant Parts including Part 1-9 and/or Part 1 12 | |
|---|--------------------|---|--|----------------|
| Other Eurocodes applicable to the design of the structure ⁽¹⁾ (in addition to BS EN 1990 and BS EN 1991) | Required | – | – | BS EN 1998 |
| | Optional | BS EN 1994 | BS EN 1994 | BS EN 1994 |
| Execution Class | RC1, CC1, RC2, CC2 | Minimum EXC2 | Generally EXC3 | Generally EXC3 |
| | RC3, CC3 | EXC3 | Minimum EXC3 | Minimum EXC3 |

Note: (1) or a distinct, clearly identifiable zone of a structure.



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From BSI Updates January 2016

BS EN PUBLICATIONS

BS EN ISO 9018:2015

Destructive tests on welds in metallic materials. Tensile test on cruciform and lapped joints
Supersedes BS EN ISO 9018:2003

NEW WORK STARTED

EN ISO 3506-1

Mechanical properties of corrosion-resistant stainless steel fasteners. Bolts, screws and studs
Will supersede BS EN ISO 3506-1:2009

EN ISO 3506-2

Mechanical properties of corrosion-resistant stainless steel fasteners. Nuts
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EN ISO 12354-1

Building acoustics. Estimation of acoustic performance of buildings from the performance of elements. Airborne sound insulation between rooms
Will supersede BS EN 12354-1:2000

EN ISO 12354-2

Building acoustics. Estimation of acoustic performance of buildings from the performance of elements. Impact sound insulation between rooms
Will supersede BS EN 12354-2:2000

EN ISO 12354-3

Building acoustics. Estimation of acoustic performance of buildings from the performance of elements. Airborne sound insulation against outdoor sound
Will supersede BS EN 12354-3:2000

EN ISO 12354-4

Building acoustics. Estimation of acoustic performance of buildings from the performance of elements. Transmission of indoor sound to the outside
Will supersede BS EN 12354-4:2000

ISO PUBLICATIONS

ISO 636:2015

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ISO 1071:2015

(Edition 3)
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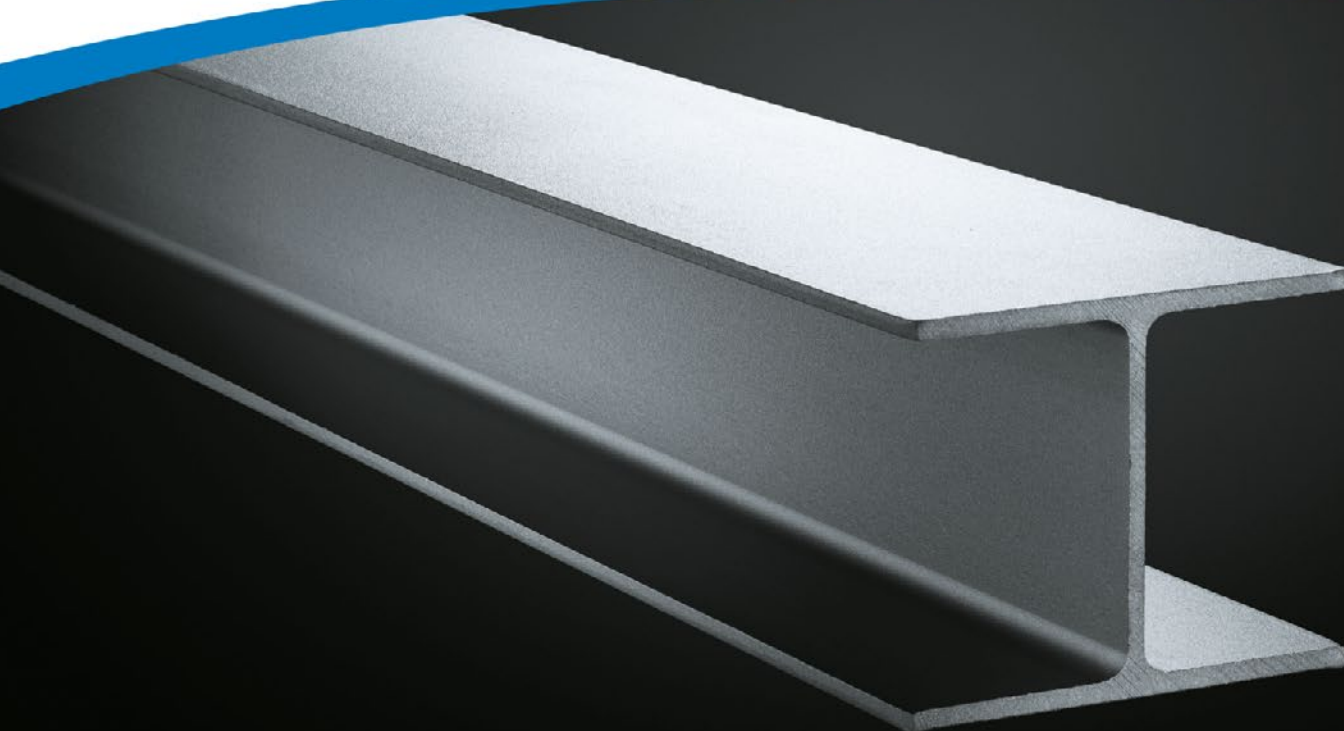
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| Cairnhill Structures Ltd | 01236 449393 | ● | | | ● | ● | ● | ● | ● | ● | | | | ● | ● | ✓ | 4 | ● | Up to £3,000,000 |
| Caunton Engineering Ltd | 01773 531111 | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | ● | ● | ✓ | 4 | ● | Up to £6,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✓ | 4 | ● | Above £6,000,000* |
| CMF Ltd | 020 8844 0940 | | | | ● | | ● | ● | | ● | ● | | | ● | ● | ✓ | 4 | | Up to £6,000,000 |
| Cook Fabrications Ltd | 01303 893011 | | | | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Coventry Construction Ltd | 024 7646 4484 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | ✓ | 2 | | Up to £800,000 |
| D H Structures Ltd | 01785 246269 | | | ● | ● | | ● | | | ● | | | | | | | 2 | | Up to £100,000 |
| Duggan Steel Ltd | 00 353 29 70072 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | ✓ | 4 | | Up to £4,000,000 |
| ECS Engineering Services Ltd | 01773 860001 | ● | | | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ✓ | 3 | | Up to £3,000,000 |
| Elland Steel Structures Ltd | 01422 380262 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✓ | 4 | ● | Up to £6,000,000 |
| EvadX Ltd | 01745 336413 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ✓ | 3 | ● | Up to £3,000,000 |
| Four Bay Structures Ltd | 01603 758141 | | | ● | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Fox Bros Engineering Ltd | 00 353 53 942 1677 | | | ● | ● | ● | ● | ● | | ● | | | | ● | | | 2 | | Up to £2,000,000 |
| Gorge Fabrications (Engineers) Ltd | 0121 522 5770 | | | | ● | ● | ● | ● | | ● | | | | ● | ● | ✓ | 2 | | Up to £1,400,000 |
| Gregg & Patterson (Engineers) Ltd | 028 9061 8131 | | | ● | ● | ● | ● | ● | | | | ● | | ● | | ✓ | 3 | | Up to £2,000,000 |
| H Young Structures Ltd | 01953 601881 | | | ● | ● | ● | ● | ● | | | ● | | | ● | ● | ✓ | 2 | ● | Up to £2,000,000 |
| Had Fab Ltd | 01875 611711 | | | | ● | | | | ● | ● | ● | | | | ● | ✓ | 4 | | Up to £3,000,000 |
| Hambleton Steel Ltd | 01748 810598 | | ● | ● | ● | ● | ● | ● | | | | ● | | ● | | ✓ | 4 | ● | Up to £2,000,000 |

| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |
|---|--------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|-----|-----|--------------------------|
| Harry Marsh (Engineers) Ltd | 0191 510 9797 | | | ● | ● | ● | ● | | | | ● | ● | | | ● | ✓ | 2 | | Up to £1,400,000 |
| Hescott Engineering Company Ltd | 01324 556610 | | | ● | ● | ● | ● | | | ● | | | | ● | ● | ✓ | 2 | | Up to £3,000,000 |
| Intersteels Ltd | 01322 337766 | | | | ● | ● | ● | ● | | | | | ● | | | ✓ | 3 | | Up to £2,000,000 |
| J & A Plant Ltd | 01942 713511 | | | | ● | ● | | | | | | | | | ● | | 2 | | Up to £200,000 |
| James Killelea & Co Ltd | 01706 229411 | | ● | ● | ● | ● | ● | | | | | ● | | ● | | | 4 | | Up to £6,000,000* |
| John Reid & Sons (Strucsteel) Ltd | 01202 483333 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✓ | 4 | | Up to £6,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✓ | 4 | ● | Up to £3,000,000 |
| kloECKner metals UK Westok | 0113 205 5270 | | | | | | | | | | | | ● | | | ✓ | 4 | | Up to £6,000,000 |
| Leach Structural Steelwork Ltd | 01995 640133 | | | ● | ● | ● | ● | ● | | | ● | | | | | ✓ | 2 | ● | Up to £6,000,000 |
| Legge Steel (Fabrications) Ltd | 01592 205320 | | | ● | ● | | ● | | ● | ● | ● | | | ● | ● | | 3 | | Up to £800,000 |
| Luxtrade Ltd | 01902 353182 | | | | | | | | | ● | ● | | | | ● | ✓ | 2 | | Up to £800,000 |
| M Hasson & Sons Ltd | 028 2957 1281 | | | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | ✓ | 4 | | Up to £2,000,000 |
| M J Patch Structures Ltd | 01275 333431 | | | | ● | ● | | | | ● | ● | | | | ● | ✓ | 2 | | Up to £800,000 |
| M&S Engineering Ltd | 01461 40111 | | | | ● | | | | ● | ● | ● | | | ● | ● | | 3 | | Up to £1,400,000 |
| Mackay Steelwork & Cladding Ltd | 01862 843910 | | | ● | ● | | ● | | | ● | ● | | | ● | ● | ✓ | 4 | | Up to £800,000 |
| Maldon Marine Ltd | 01621 859000 | | | | ● | ● | | ● | ● | ● | | | | | ● | ✓ | 3 | | Up to £1,400,000 |
| Mifflin Construction Ltd | 01568 613311 | | | ● | ● | ● | ● | | | | ● | | | | | | 2 | | Up to £3,000,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | | | ● | | ● | | | | ● | | | | ● | ✓ | 4 | | Up to £1,400,000 |
| Newbridge Engineering Ltd | 01429 866722 | ● | | ● | ● | ● | ● | | | | ● | | | | ● | ✓ | 3 | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | | | | | | ● | ● | ● | ● | | | | | | ✓ | 4 | | Up to £4,000,000 |
| Overdale Construction Services Ltd | 01656 729229 | | | ● | ● | | ● | ● | | | ● | | | | ● | | 2 | | Up to £400,000 |
| Painter Brothers Ltd | 01432 374400 | | | | | | | | ● | | ● | | | ● | ● | ✓ | 2 | ● | Up to £6,000,000 |
| Pencro Structural Engineering Ltd | 028 9335 2886 | | | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ✓ | 2 | | Up to £2,000,000 |
| Peter Marshall (Steel Stairs) Ltd | 0113 307 6730 | | | | | | | | | ● | | | | | ● | ✓ | 2 | | Up to £800,000* |
| PMS Fabrications Ltd | 01228 599090 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| R S Engineering SW Ltd | 01752 844511 | | | | ● | | | | | ● | ● | | | ● | ● | ✓ | 2 | | Up to £100,000 |
| Rippin Ltd | 01383 518610 | | | ● | ● | ● | ● | ● | | | | | | ● | ● | | 2 | | Up to £1,400,000 |
| S H Structures Ltd | 01977 681931 | ● | | | | | ● | ● | ● | ● | ● | ● | | | | ✓ | 4 | ● | Up to £2,000,000 |
| SDM Fabrication Ltd | 01354 660895 | ● | ● | ● | ● | ● | ● | | | | ● | | | ● | ● | ✓ | 4 | | Up to £1,400,000 |
| Sean Brady Construction Engineering Ltd | 00 353 49 436 4144 | | | ● | ● | ● | ● | | | ● | ● | | | ● | ● | | 2 | | Up to £800,000 |
| Severfield plc | 01845 577896 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ● | Above £6,000,000 |
| Shaun Hodgson Engineering Ltd | 01553 766499 | ● | | ● | ● | | | | | ● | ● | | | ● | ● | ✓ | 3 | | Up to £800,000 |
| Shipley Structures Ltd | 01400 251480 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Snashall Steel Fabrications Ltd | 01300 345588 | | | ● | ● | ● | ● | ● | | | ● | | | | ● | | 2 | | Up to £1,400,000 |
| South Durham Structures Ltd | 01388 777350 | | | ● | ● | ● | | | | ● | ● | ● | | | ● | | 2 | | Up to £800,000 |
| Southern Fabrications (Sussex) Ltd | 01243 649000 | | | | ● | | | | | ● | ● | | | ● | ● | ✓ | 2 | | Up to £800,000 |
| Taziker Industrial Ltd | 01204 468080 | | | | | | | | | ● | | | | ● | ● | ✓ | 3 | | Above £6,000,000 |
| Temple Mill Fabrications Ltd | 01623 741720 | | | ● | ● | ● | ● | | | | ● | | | ● | ● | ✓ | 2 | | Up to £400,000 |
| Traditional Structures Ltd | 01922 414172 | | | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ✓ | 2 | ● | Up to £2,000,000 |
| TSI Structures Ltd | 01603 720031 | | | ● | ● | ● | ● | ● | | | ● | | | ● | | | 2 | | Up to £1,400,000 |
| Tubecon | 01226 345261 | | | | | | ● | ● | ● | ● | | | | ● | ● | ✓ | 4 | ● | Above £6,000,000* |
| Underhill Engineering & Building Services Ltd | 01752 752483 | | | | ● | | ● | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | Up to £3,000,000 |
| W & H Steel & Roofing Systems Ltd | 00 353 56 444 1855 | | | ● | ● | ● | ● | ● | | | | | | ● | ● | | 4 | | Up to £2,000,000 |
| W I G Engineering Ltd | 01869 320515 | | | | ● | | | | | ● | | | | | ● | ✓ | 2 | | Up to £200,000 |
| Walter Watson Ltd | 028 4377 8711 | | | ● | ● | ● | ● | ● | | | | ● | | | | ✓ | 4 | | Up to £6,000,000 |
| Westbury Park Engineering Ltd | 01373 825500 | ● | | ● | ● | | ● | ● | ● | ● | ● | | | | ● | ✓ | 4 | | Up to £800,000 |
| William Haley Engineering Ltd | 01278 760591 | | | ● | ● | ● | | | ● | ● | ● | | | ● | | ✓ | 4 | ● | Up to £4,000,000 |
| William Hare Ltd | 0161 609 0000 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ● | Above £6,000,000 |
| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |



Corporate Members

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

| Company name | Tel | Company name | Tel |
|--------------------------------------|---------------|---|--------------------|
| A Lamb Associates Ltd | 01772 316278 | PTS (TQM) Ltd | 01785 250706 |
| Balfour Beatty Utility Solutions Ltd | 01332 661491 | Sandberg LLP | 020 7565 7000 |
| Bluefin Group | 020 3040 6723 | Structural & Weld Testing Services Ltd | 01795 420264 |
| Griffiths & Armour | 0151 236 5656 | SUM Ltd | 0113 242 7390 |
| Highways England Company Ltd | 08457 504030 | Welding Quality Management Services Ltd | 00 353 87 295 5335 |
| Kier Construction Ltd | 01767 640111 | | |



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 |
|--|---------------|---|---|---|---|---|---|---|---|---|-----|-----|
| 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 | |
| BW Industries Ltd | 01262 400088 | ● | | | | | | | | | M | |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|-------------------------------------|---------------|---|---|---|---|---|---|---|---|---|-----|-----|
| Cellbeam Ltd | 01937 840600 | ● | | | | | | | | | M | |
| Cellshield Ltd | 01937 840600 | | | | | | | | ● | | N/A | |
| Cleveland Steel & Tubes Ltd | 01845 577789 | | | | | | | | ● | | M | |
| CMC (UK) Ltd | 029 2089 5260 | | | | | | | | ● | | D/I | |
| Composite Profiles UK Ltd | 01202 659237 | ● | | | | | | | | | D/I | |
| Cooper & Turner Ltd | 0114 256 0057 | | | | | | | | ● | | M | |
| Cutmaster Machines (UK) Ltd | 01226 707865 | | | | ● | | | | | | N/A | |
| Daver Steels Ltd | 0114 261 1999 | ● | | | | | | | | | M | |
| Dent Steel Services (Yorkshire) Ltd | 01274 607070 | | | | | | | | ● | | M | |



Steelwork contractors for bridgeworks



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

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

- FG** Footbridge and sign gantries
PG Bridges made principally from plate girders
TW Bridges made principally from trusswork
BA Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
CM Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
MB Moving bridges
RF Bridge refurbishment

- AS** Ancillary 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
SCM Steel Construction Sustainability Charter
 (● = Gold, ○ = Silver, ● = Member)

Notes

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

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

| BCSA steelwork contractor member | Tel | FG | PG | TW | BA | CM | MB | RF | AS | QM | FPC | NHSS 19A 20 | SCM | Guide Contract Value ⁽¹⁾ |
|---|--------------------|----|----|----|----|----|----|----|----|----|-----|----------------|-----|-------------------------------------|
| A&J Fabtech Ltd | 01924 439614 | ● | ● | | ● | | | | ● | ✓ | 3 | | | Up to £400,000 |
| Bourne Construction Engineering Ltd | 01202 746666 | ● | ● | ● | | | | ● | ● | ✓ | 4 | | ● | Above £6,000,000 |
| Briton Fabricators Ltd | 0115 963 2901 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | Up to £4,000,000 |
| Cairnhill Structures Ltd | 01236 449393 | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | ✓ | Up to £3,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ● | Above £6,000,000* |
| Donyal Engineering Ltd | 01207 270909 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | Up to £1,400,000 |
| Four-Tees Engineers Ltd | 01489 885899 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 3 | | ✓ | Up to £2,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | ● | | ● | | | | ● | ● | ✓ | 4 | | ✓ | Up to £3,000,000 |
| Millar Callaghan Engineering Services Ltd | 01294 217711 | ● | | | | | | ● | ● | ✓ | 4 | | | Up to £800,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | ● | ● | | | | | ● | ✓ | 4 | | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | ● | ● | ● | ● | ● | | ● | ● | ✓ | 4 | ✓ | ✓ | Up to £4,000,000 |
| S H Structures Ltd | 01977 681931 | ● | | ● | ● | ● | ● | | ● | ✓ | 4 | | ✓ | Up to £2,000,000 |
| Severfield (UK) Ltd | 01204 699999 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | Above £6,000,000 |
| Taziker Industrial Ltd | 01204 468080 | ● | | | | | | ● | ● | ✓ | 3 | ✓ | ✓ | Above £6,000,000 |
| Underhill Building & Engineering Services Ltd | 01752 752483 | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | | Up to £3,000,000 |
| Non-BCSA member | | | | | | | | | | | | | | |
| Allerton Steel Ltd | 01609 774471 | ● | ● | ● | ● | | | | ● | ✓ | 4 | | ✓ | Up to £4,000,000 |
| Centregreat Engineering Ltd | 029 2046 5683 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 4 | | | Up to £800,000 |
| Cimolai SpA | 01223 836299 | ● | ● | ● | ● | ● | ● | | ● | ✓ | 4 | | | Above £6,000,000 |
| Concrete & Timber Services Ltd | 01484 606416 | ● | ● | ● | ● | ● | ● | | ● | ✓ | 4 | | ● | Up to £800,000 |
| Francis & Lewis International Ltd | 01452 722200 | | | | | | | ● | ● | ✓ | 2 | | ✓ | Up to £2,000,000 |
| Harland & Wolff Heavy Industries Ltd | 028 9045 8456 | ● | ● | ● | ● | ● | | ● | ● | ✓ | 3 | | | Up to £2,000,000 |
| HS Carlsteel Engineering Ltd | 020 8312 1879 | ● | ● | | | | | ● | ● | ✓ | 3 | | ✓ | Up to £400,000 |
| IHC Engineering (UK) Ltd | 01773 861734 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | Up to £400,000 |
| Interserve Construction Ltd | 020 8311 5500 | | | | | | | ● | ● | ✓ | N/A | | | Above £6,000,000* |
| Lanarkshire Welding Company Ltd | 01698 264271 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ● | Up to £2,000,000 |
| P C Richardson & Co (Middlesbrough) Ltd | 01642 714791 | ● | | | | | | ● | ● | ✓ | N/A | | | Up to £3,000,000 |
| Total Steelwork & Fabrication Ltd | 01925 234320 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | Up to £3,000,000 |
| Victor Buyck Steel Construction | 00 32 9 376 2211 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ● | Above £6,000,000 |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|--|-------------------|---|---|---|---|---|---|---|---|---|-----|-----|
| Duggan Profiles & Steel Service Centre Ltd | 00 353 56 7722485 | ● | | | | | | | ● | | M | |
| easi-edge Ltd | 01777 870901 | | | | | | | ● | | | N/A | ● |
| Fabsec Ltd | 0845 094 2530 | ● | | | | | | | | | N/A | |
| Ficep (UK) Ltd | 01942 223530 | | | | | ● | | | | | N/A | |
| FLI Structures | 01452 722200 | ● | | | | | | | | | M | ● |
| Forward Protective Coatings Ltd | 01623 748323 | | | | | | ● | | | | N/A | |
| Goodwin Steel Castings Ltd | 01782 220000 | ● | | | | | | | | | N/A | |
| Graitec UK Ltd | 0844 543 8888 | | ● | | | | | | | | N/A | |
| Hadley Group Ltd | 0121 555 1342 | ● | | | | | | | | | M | ○ |
| Hempel UK Ltd | 01633 874024 | | | | | | ● | | | | N/A | |
| Highland Metals Ltd | 01343 548855 | | | | | | ● | | | | N/A | |
| Hilti (GB) Ltd | 0800 886100 | | | | | | | | ● | | M | |
| Hi-Span Ltd | 01953 603081 | ● | | | | | | | | | M | ○ |
| International Paint Ltd | 0191 469 6111 | | | | | | ● | | | | N/A | ● |
| Jack Tighe Ltd | 01302 880360 | | | | | | ● | | | | N/A | |
| Jamestown Cladding & Profiling Ltd | 00 353 45 434288 | ● | | | | | | | | | M | |
| John Parker & Sons Ltd | 01227 783200 | | | | | | | ● | ● | | D/I | |
| Joseph Ash Galvanizing | 01246 854650 | | | | | | ● | | | | N/A | |
| Jotun Paints (Europe) Ltd | 01724 400000 | | | | | | ● | | | | N/A | |
| Kaltenbach Ltd | 01234 213201 | | | | | ● | | | | | N/A | |
| Kingspan Structural Products | 01944 712000 | ● | | | | | | | | | M | ● |
| kloekner metals UK | 0113 254 0711 | | | | | | | ● | | | D/I | |
| Lindapter International | 01274 521444 | | | | | | | | ● | | M | |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|---|-------------------|---|---|---|---|---|---|---|---|---|-----|-----|
| Longs Steel UK Ltd | 01724 404040 | | | | ● | | | | | | M | |
| MSW UK Ltd | 0115 946 2316 | ● | | | | | | | | | D/I | |
| Murray Plate Group Ltd | 0161 866 0266 | | | | | | | | | ● | D/I | |
| National Tube Stockholders Ltd | 01845 577440 | | | | | | | | | ● | D/I | |
| Peddinghaus Corporation UK Ltd | 01952 200377 | | | | | ● | | | | | N/A | |
| PPG Performance Coatings UK Ltd | 01773 814520 | | | | | | ● | | | | N/A | |
| Prodeck-Fixing Ltd | 01278 780586 | ● | | | | | | | | | D/I | |
| Rainham Steel Co Ltd | 01708 522311 | | | | | | | | | ● | D/I | |
| Sherwin-Williams Protective & Marine Coatings | 01204 521771 | | | | | | ● | | | | M | ○ |
| Sika Ltd | 01707 384444 | | | | | | ● | | | | M | |
| Simpson Strong-Tie | 01827 255600 | | | | | | | | | ● | M | |
| Structural Metal Decks Ltd | 01202 718898 | ● | | | | | | | | | M | ● |
| StruMIS Ltd | 01332 545800 | | ● | | | | | | | | N/A | |
| Tata Steel Distribution UK & Ireland | 01902 484000 | | | | | | | | | ● | D/I | |
| Tata Steel Ireland Service Centre | 028 9266 0747 | | | | | | | | | ● | D/I | |
| Tata Steel Service Centre Dublin | 00 353 1 405 0300 | | | | | | | | | ● | D/I | |
| Tata Steel Tubes | 01536 402121 | | | | ● | | | | | | M | |
| Tata Steel UK Panels & Profiles | 0845 3088330 | ● | | | | | | | | | M | |
| Tension Control Bolts Ltd | 01948 667700 | | | | | | ● | | | ● | M | |
| Trimble Solutions (UK) Ltd | 0113 887 9790 | ● | | | | | | | | | N/A | |
| voestalpine Metsec plc | 0121 601 6000 | ● | | | | | | | | | M | ● |
| Wedge Group Galvanizing Ltd | 01909 486384 | | | | | | ● | | | | N/A | |
| Yamazaki Mazak UK Ltd | 01905 755755 | | | | ● | | | | | | N/A | |

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