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Cover Image
Thruxton Motorsports Centre, Hampshire
Main client: British Automobile Racing Club
Architect: Chapman Partnership
Main contractor: Mata Construction
Steelwork contractor: REIDsteel
Steel tonnage: 60t

NSC

May 2018
Vol 26 No 5

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NSC IS PRODUCED BY BARRETT BYRD ASSOCIATES ON BEHALF OF THE BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION AND STEEL FOR LIFE IN ASSOCIATION WITH THE STEEL CONSTRUCTION INSTITUTE

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Steel's winning ways

Nick Barrett - Editor

The industry's clients have never been more cost conscious than today, always alert for ways of keeping a lid on final project prices. Against a rapidly changing background of rising materials and other prices, not helped by sometimes adverse currency movements, who can blame them?

The steel sector's latest contribution to the cost control battle is being distributed with this issue of NSC and several other key construction industry magazines. Our Cost supplement, based on a new series of quarterly updated studies from Aecom, BCSA and Steel for Life, is part of a commitment to provide the essential guidance needed to provide accurate costs for building frames.

Surveys have confirmed that cost is often the key driver in selecting framing materials, and the steel sector's analysis of decisions made in the real world has revealed that it is easy to fail to undertake a proper cost analysis, thereby producing an inaccurate result. The frame can account for 10% of a building's cost so it should always come under scrutiny.

Steel is expected to usually provide the cost-effective option when all the relevant factors are properly considered, which is why over 90% of single storey industrial buildings and around 70% of multi-storey buildings are framed in steel. Some decision making processes however are not as robust as they should be. The outcome can be cost estimates that are too high, creating disappointment when decisions on whether to proceed with a project are being taken; or too low, guaranteeing a shocked client when tenders are returned.

It is obviously in everybody's interests that cost analyses are properly undertaken, providing the basis for good decision making. Comprehensive cost guidance is provided by this regularly updated series – that can be found on *www.steelconstruction.info* - across five key sectors – offices, education, mixed-use, retail and industrial.

Key cost advantages of steel framing discussed in the new Cost supplement include column-free floorplates, adaptability, offsite manufacture, services integration, low self-weight and construction programme benefits.

Involving the steelwork contractor at an early stage of course can sometimes mean initial cost estimates turn out to have been unduly pessimistic, as we see in this issue of NSC where REIDsteel was able to refine the original design of a hospitality suite at Thruxton Circuit in Hampshire by replacing some large roof beams with cantilevering purlins instead.

Examples of that sort of cost advantage are everyday occurrences on steel construction projects, as we regularly see reported in our project profiles.

Also in this issue we see an innovative design for a major distribution project, in a sector where cost can make or break developments, said to be setting a new benchmark for the industry. The speed of steel construction is one of those cost factors that can sometimes be overlooked, but it was a major plus on this project, where it took Severfield just ten weeks to erect a frame for a building that could accommodate ten football pitches. If a building can be offered quicker and for less, everyone's a winner.

London has more than 500 towers in the pipeline

London now has more than 500 tall buildings planned and a record 115 under construction, according to new research published by New London Architecture (NLA).

The fifth NLA London Tall Buildings Survey, with research partners GL Hearn and data provider EG, reveals that, despite signs of a slowdown, London has 510 tall (over 20 storeys) buildings proposed, in planning or under construction, compared to 455 in 2016, and with 115 schemes under construction.

Half of the tall buildings pipeline is in east London with 252, followed by central London with 99, and a third from outer London.

GL Hearn Planning Director Stuart Baillie said he was anticipating a boom of completions in the next two years, but with Brexit and skills issues to the fore that may be optimistic.

"We will have to see if the projected boom in the next two years will happen," he added.

Chairman of NLA Peter Murray said: "We continue to see a steady increase in the number of tall buildings coming forward and with London's population continuing to increase and the demand for new homes only getting higher, our view remains that that well designed tall buildings, in the right place, are part of the solution.

"Uncertainties and challenges to deliver these tall buildings remain, which is perhaps why we are seeing a slight slowdown in the in the number of applications, construction starts and completions.

"However, our reports over the past five years show us that in the right places, towers allow us to use the finite resource of land very efficiently."

Metsec launches new range of steel framing systems

voestalpine Metsec has launched a new range of steel framing systems (SFS) that it claims reduces both environmental impact and cost to customers.

The company said the range has undergone stringent testing and assessments using multiple board and insulation options coupled with the new range of sections.

This data offers contractors the potential to reduce project costs for framing by ensuring there is no over specification on the project.

Ryan Simmonds, Sales Director of Framing at Metsec, said: "We are taking a new approach to our range of SFS framing systems. Today's buildings need to perform as efficiently as possible, structurally, acoustically and thermally and be as safe as possible in terms of fire performance.

"Our new products can offer improved design efficiency. Over specification is something to be avoided in any case, but in today's cost-driven market the need to ensure that designs optimise the amount of material used is increasingly important.

"We have also placed a greater emphasis on sustainability – this isn't just about saving the planet but looking at how sustainability translates into real-world savings on-site such as transport and wastage.

The new range is BIM Level 2 compliant with Kitemarks for both BIM projects and BIM objects.

Latest Snowhill scheme nears topping out

The third of three steel-framed office blocks in Snowhill, Birmingham, and one of the UK's largest speculative office developments to be constructed outside of London, is rapidly taking shape.

Sat next to its sister buildings, One and Two Snowhill, Three Snowhill is a 19-storey office tower that forms a stunning gateway to the city's business district, completing the final phase of Ballymore's Snowhill Estate development.

Offering nearly 38,000m^2 of BREEAM 'Excellent' rated Grade A office floor space, together with retail and leisure units at podium and ground floor levels, Three Snowhill, like its sister buildings, has a composite design comprising a steel frame with cellular beams supporting metal decking.

Working on behalf of main contractor BAM Construction, Severfield is fabricating, supplying and erecting some 4,500t of steel for this project.

The building wraps around a large central atrium, which allows plenty of natural light to penetrate the building's inner areas as it is topped with a glazed roof.

This glazing also spans over the double-height upper floor, creating a large light-filled breakout space.

Three Snowhill is due to complete by Spring 2019.

Light gauge accommodation solution

Offering 180 students accommodation, a new campus building for the University of Leeds has been completed on time with the aid of Kingspan Steel Building Solutions' KingBuild System (KBS).

The system was used to provide a complete building structure and shell solution, resulting in the project being shortlisted for the Best Use of Steel Award at the 2018 OFFSITE Awards.

The contemporary seven-storey building has been developed by S Harrison Developments and designed by architects Carey Jones Chapman Tolcher. It features a stepped design containing 29 cluster flats with large shared kitchen and living spaces, in addition to a range of communal facilities including a reception area, study rooms, games area and a common room.

Kingspan Steel Building Solutions was selected by GMI Construction to design, engineer, manufacture, supply and finally install their KingBuild System (KBS), enabling the external structure to go up in just 18 weeks.

GMI Construction Contracts Manager Bob Priestley said: "We chose to work with Kingspan on this project due to their excellent reputation, the suitability of their products for this project, and their in-house design and installation abilities."

The proposed structure was first 3D modelled in-house by Kingspan's design team, using Tekla modelling software. The data was then sent to the production facility to ensure the panels were manufactured to the exact project requirements, minimising on-site waste on the restricted site.

The panelised system is said to have allowed a rapid, predictable assembly of the seven storeys, providing a weathertight envelope that could be worked on internally even as the external finishes were being applied.

The use of steel also reduced the environmental impact of the project: the light gauge steel is said to offer a high strength-to-weight ratio and therefore reduces material usage over traditional materials, minimising the carbon footprint and providing structural efficiency.

Ten-screen cinema for Kilkenny

Structural steelwork is going up for a new ten-screen cinema complex in Kilkenny, Republic of Ireland.

Designed by locally-based Brian Dunlop Architects, the 1,400-seat cinema is located on a prominent city centre site. The landmark building will form the centrepiece of a much larger development on this nine-acre plot.

Steel & Roofing Systems is fabricating, supplying and erecting 250t of steel for the project, as well as installing the cladding and roof decking.

Steelwork contractor plans new facilities

Caunton Engineering has announced plans to extend its production and office facilities at Moorgreen, Nottinghamshire.

The company has started work on the first phase, known as the Production Office.

This phase of the development will convert part of an existing manufacturing building into a two-storey unit with improved and enlarged welfare facilities for employees working in production.

The project's second phase will see the construction of a new flagship head office called Caunton House. This building will house all existing administration, IT, sales, commercial, contracts, site management and technical staff.

The third phase of the development will see the existing offices converted into new production space. This will allow the Caunton Secondary Steelwork Division to move into the main production area from its existing separate site.

Caunton said the aim of this development is to increase production capacity, improve overall efficiency, and upgrade the resources for all the people who work for the company.

NEWS IN BRIEF

Elland Steel Structures has become the first SCCS client to achieve certification to BS EN ISO 3834-2:2005, quality management in the field of welding. The SCCS is a wholly-owned subsidiary of the British Constructional Steelwork Association. It was established in the early 1980s to provide quality management certification for steelwork contracting organisations.

Billington Holdings has announced a pre-tax profit increase of 15.8% to £4.4M in the year to the end of December, up from £3.8M in 2017, supported by strong performance from the structural steel division.

British Steel said it has released a film, giving a never-before-seen insight into its manufacturing operations. The film was shot at its Scunthorpe steelworks and at its Teesside operations including Teesside Beam Mill and Special Profiles mill in Skinningrove. It can be viewed at: *https://youtu.be/2-Zv2cpLvEw*

Prime Minister Theresa May has announced that £70M of investment will be earmarked to transform **Alexander Stadium** into a world-class athletics venue for the Birmingham 2022 Commonwealth Games. It will host athletes from across the Commonwealth competing in track and field, as well as the opening and closing ceremonies.

Scottish Premier League football club **Aberdeen** has been granted official planning permission for a new stadium and training complex. Aberdeen City Council's planning department has formally approved the £50M development at Kingsford, near Westhill. The club hopes to begin construction of the 20,000-capacity stadium in June.

PRESIDENT'S COLUMN

I've learnt over the years that my view of the world isn't shared by everyone else. And when we think about design, that is certainly the case.

From an architect's perspective, design can be seen as a bridge – one between a client's vision and the actual form of the structure. When I have met with architects or heard them speak, they have often referred to design as both an art and a science. Then when the design is passed onto the engineer, mathematics, science and modelling dominate, and practical design issues such as buildability, cost and safety come to the fore.

Like engineers, steelwork contractors use modelling to ensure the safety, buildability and cost-effectiveness of the steel structure. But for us, design provides much more than this.

First and foremost, a good design process means a technically correct and complete model is handed over to the steelwork contractor. But all too often, information is missing, unclear and sometimes just plain wrong. So with the clock already ticking on the programme, the steelwork contractor spends time chasing up information or querying design issues, and is often put under pressure to start processing the steelwork before the design is finalised. Naturally, this can lead to costly rework and delays later on.

Why does this happen?

One reason is the 2008 recession, which hollowed out many mid-career engineers; those who would have provided support today for their younger, less experienced colleagues. This gap is now being filled with IStructE and others developing a range of training programmes for their members over the last few years.

The second reason is procurement. A good design process is reliant on an effective procurement process, and this remains a major issue in the construction sector. The design cannot be completed when key follow-on trades such as M&E and cladding contractors have not yet been contracted, so the consultant and steelwork contractor are forced to make assumptions that often need to be changed later on.

Willingness to pay for a proper design sometimes comes into it as well – who can blame consultants for only doing what they're contracted to do?

BIM was touted as the answer to the problem of good and complete design. As we all know, steelwork contractors have enthusiastically adopted Level 2 BIM. However, to be fully effective, BIM as a process requires engagement of the various parts of the supply chain at the right time in the procurement process.

If the government is to improve efficiency and productivity, as it says it wants, it could start by looking at early engagement with the supply chain and finalisation of the design to drive a more effective design process.

Tim Outteridge
BCSA President & Sales Director Cleveland Bridge

Manufacturing trainees join British Steel

More than 150 manufacturing trainees have joined British Steel in the last year and the company is now looking for a further 60.

Trained to perform roles including crane driving, fork lift truck driving and machine operations, the trainees are all based at Scunthorpe.

British Steel Deputy CEO Paul Martin said: "We've a great history of recruiting trainees to our business and we're maintaining this tradition with our manufacturing trainees.

"I'm pleased to say they've made excellent starts to their careers with British Steel and are already making significant contributions to the business. As their skill, knowledge and experience grows, I'm confident they'll make an even bigger impact as we look to build a sustainable future."

British Steel Senior Resourcing Advisor Lucy Lings said: "In the coming months we're looking to recruit dozens more manufacturing trainees in Scunthorpe, all of whom will be given first-class training from our highly-skilled employees and North Lindsey College.

"Throughout the process the standard of applications has been incredibly high and we look forward to hearing from people who want to build a career with us."

Applicants must have achieved GCSE (or equivalent) Maths and English to C grade or above or functional skills level 2 in English and Maths. They will need to be an intermediate IT user, capable of using Microsoft packages such as Word, Excel, PowerPoint and Outlook.

New tower rises up at Canary Wharf

Requiring 9,500t of structural steelwork, the 27-storey One Bank Street is the latest steel-framed tower in London's Canary Wharf.

The tower will offer 60,000m^2 of high-quality office space including three levels of state-of-the-art trading floors, a retail unit at ground level, a free-standing retail kiosk on South Dock Promenade, public realm, planting and landscaping, and basement car and cycle parking.

Designed by world renowned architects Kohn Pedersen Fox, One Bank Street will contribute to strengthening the role of Canary Wharf as a prime London office and employment location, providing capacity for an additional 5,837 full-time jobs.

Designed to achieve a BREEAM 'Outstanding' rating, the steel-framed structure sits atop a triple 16m-deep basement and gains its stability from a large centrally-positioned reinforced concrete core.

From the top of level three to level 12, a series of raking columns, facetted on each floor, creates a feature slope, which then continues upwards, less steeply to level 23, via cantilevering floors, where the elevation becomes vertical.

Working on behalf of Canary Wharf Contractors, William Hare is the project's steelwork contractor.

Installation complete for Taplow Thames crossing

Site work has now been completed for a new River Thames footbridge designed by Knight Architects and structural engineers Cowi at Taplow in Buckinghamshire.

Berkeley Homes is the client for the project, which will provide a pedestrian link over the River Thames to serve the new Taplow Riverside mixed-use development.

The shallow arch form of the design is inspired by Brunel's nearby Maidenhead Bridge and is echoed in the slender steel box structure.

Fabricated triangular-section box girders form the twin structural arches that support the deck.

Slender steel plate hangers are said to emphasise the composition and ensure the structure is lightweight and transparent in long river views.

Working on behalf of main contractor Land & Water, fabrication of the bridge sections was undertaken by S H Structures (SHS).

SHS site-assembled the 39m-long, 38t footbridge, having brought it to site in sections. Land & Water then lifted it onto a barge so it could be taken along the river and then rotated into position.

Latest metal floor deck launched into UK market

Structural Metal Decks (SMD) says that it has followed up on its 2016 launch of roof deck profiles with a new floor deck product for the UK market.

The company claims its long-span profile TR220 metal decking product augments the existing range and follows on from SMD signing an exclusivity agreement with an overseas manufacturer for the product which can span up to 6m.

The TR220 product is said to offer designers an alternative to pre-cast planks, and has been specifically designed for car parks or buildings where space uninterrupted by supporting beams or columns is required.

SMD Technical Director Jamie Turner said: "We are spanning the gap in our product range. This will open up a whole new sector of the market and allow us to provide an even more comprehensive service.

"The TR220 will complement and not compete with our existing products as it provides a different solution – one we have been seeking to introduce for some time."

He added: "The TR220, because of its span, is often used on the lower two floors of high-rise buildings and is an engineering solution we haven't previously been able to offer.

"It will enable us to tender for whole building contracts whereas previously our opportunities may have been restricted to upper levels of this type of project."

New contractor sought for major Durham scheme

Durham County Council has agreed an application allowing for the creation of a brand-new living, working and leisure destination in the heart of the city.

The permission enables the joint venture of Arlington Real Estate and the Richardson family to deliver the first phase of development at Milburngate which, on completion, will provide a range of leisure facilities, bars and restaurants, high quality offices and luxury apartments.

The joint venture is currently engaged in a pre-qualification process with potential construction partners and, following the completion of this in the coming weeks, an invitation to submit tenders from shortlisted contractors will be issued.

Milburngate has attracted a range of premium occupiers including the Everyman boutique cinema, Pitcher & Piano and the new concept steak restaurant Bar + Block.

These high-profile brands will be joined by a 92-bed Premier Inn hotel; a detailed planning application for which will be submitted separately to Durham County Council.

This landmark development in Durham will create a regionally-significant destination and lead to the creation of more than 1,000 new jobs, as well as enhancing the leisure, business and residential opportunities in the area.

Supermarket to anchor redevelopment of former prison

Fast-growing UK supermarket group Lidl has been announced as the retail anchor for the redevelopment of Northallerton's former prison.

The popular brand will take a 1,950m^2 unit in the Treadmills scheme – and bring up to 40 new jobs for the local community.

The multi-million pound investment will be the key element of the first phase of the Treadmills scheme, which will also feature another 550m^2 retail unit and parking for around 130 vehicles.

A detailed planning application for the first phase is expected to be submitted this summer and, subject to planning approval, construction is likely to begin early next year with the Lidl store due to open by late 2019.

Hambleton District Council and Hull-based regeneration company Wykeland Group have formed the Central Northallerton Development Company to drive forward the North Yorkshire town's most significant regeneration scheme for decades.

As well as the major stores, the £16M scheme will include independent retail units, managed workspaces, restaurants, a cinema, an area for public events and a heritage centre within the 3.5-acre former prison site.

The scheme will preserve and enhance a major part of Northallerton's history and heritage; regenerate a large brownfield site; deliver a major boost to the local economy; and bring significant new community assets and facilities to the town.

Five listed former prison buildings will be refurbished and incorporated into the Treadmills scheme – whose name reflects that the jail was once home to the world's largest treadmill and several other treadwheels which were used by inmates sentenced to hard labour.

Diary

For SCI events contact Jane Burrell, tel: 01344 636500 email: *education@steel-sci.com*
For Institution of Structural Engineers events email: *training@istructe.org* or telephone 0207 201 9118

Tuesday 22 & Wednesday 23 May 2018
Design for Torsion
This 1 hour webinar covers the design steps, best practice and practical recommendations for members and connections when torsion must be accommodated in design.

Tuesday 12 & Wednesday 13 June 2018
Fire Design of Beams and Columns
This 1 hour webinar covers how a little extra design can be used to calculate more realistic behaviour under fire conditions.

Tuesday 26 & Wednesday 27 June 2018
Essential Steelwork Design 2 day course
This course introduces the concepts and principles of steel building design, before explaining in detail the methods employed by Eurocode 3 for designing members in bending, compression and tension. Bristol

Luke Broughton, Shutterstock

SSDA celebrates 50 years

Having started in 1969, the Structural Steel Design Awards are this year celebrating their 50th anniversary. In the second of a series of articles, NSC looks back at the 1980s.

Since the Structural Steel Design Awards (SSDA) were initiated in 1969 by the British Constructional Steelwork Association (BCSA) and the British Steel Corporation there have been many changes in the construction and the steel sectors, but one constant asset is the way that steel not only confers efficiency and economy but also has an aesthetic which designers are able to exploit to the benefit of the built environment.

The qualities of engineering excellence, innovation, attention to detail, economy and speed of construction have been brought together in each of the structures that have been given awards during the past 49 years.

Following on from last month's look back at the 1970s, in this issue we highlight the 1980s. Two examples of this decade's Award winners are the Humber Bridge (a 1982 winner) and the Greater Manchester Exhibition & Event Centre (a 1987 winner).

Opened in June 1981, the Humber Bridge was the longest suspension bridge in the world, with a main span of 1,410m long, a record it held until the late 1990s.

Still regarded as an iconic landmark, the bridge crosses the Humber Estuary between Hessle and Barton-upon-Humber, and was constructed in order to cut travel times and assist in economic development, two objectives that have been fulfilled.

The 1982 SSDA judges commented that engineering excellence and structural innovation have been combined with high aesthetic quality in this magnificent structure which has the longest single span in the world.

Designed by a team consisting of architect R E M Slater and structural engineer Freeman Fox & Partners, the project's steelwork contractor was British Bridge Builders.

For fabrication, assembly and erection

The Humber Bridge has become a symbol of British engineering excellence

Mike Peel, Wikimedia Commons

The events centre is still in use today

The Manchester Central project used existing ironwork and new steel

the suspended structure was divided into separate boxes, generally 18.1m-long and weighing around 140t. There were 124 boxes, and the total weight of the suspended structure steelwork is about 17,000t.

A standard box is made up of 23 stiffened panels which were fabricated at various workshops throughout the country. These panels were then assembled into boxes in a yard 3km downstream of the bridge site.

A fleet of pontoons transported the boxes to the site, where they were raised into position by lifting gantries straddling the main cables.

Another Award winner from 1980s which is still very much in use today is the Greater Manchester Exhibition & Event Centre.

Opened in 1986 it was subsequently renamed as Manchester Central, in honour of its previous use as a mainline railway station.

A team comprising architect EGS Design, structural engineer Brian Colquhoun & Partners and steelwork contractor Redpath Dorman Long completed the project.

The 1987 SSDA judges commented: 'Central Station was one of the best examples of our built heritage, and it has been rescued by painstaking work in which steel is a vital element. The new steelwork structures around the original building are well conceived and complementary.'

The existing Victorian railway shed comprises 18 wrought iron arches spanning 65m with a height of 25.85m. These sit on an undercroft of brick vaulting which extends over an area of some seven hectares.

The primary design philosophy was to enhance the grandeur of the existing structure, and to carefully integrate the complex services required for a sophisticated building within both new and existing structures.

As well as new steel framed parts of the project, many new elements within the scheme were created by reusing cast iron, re-cast from original columns and brackets taken from platform extensions to the side of the building's main hall.

A full list and description of all Award winners can be found at: *https://www.steelconstruction.info/SSDA_2018_-_50th_Anniversary_Year*

The 2018 Awards, which are jointly sponsored by the BCSA and Trimble Solutions (UK) Ltd, will be announced in early October.

Pete Richman, Flickr

Opened in 1981, the Humber Bridge was the longest suspension bridge in the world

Jamestown's expansion allows for a number of large bridges to be fabricated simultaneously

Continued success at Jamestown

Architects and engineers are having greater input through the constructional steelwork fabrication process on 'higher-end' projects says structural components specialist Jamestown. The visual quality of steelwork is also increasingly important.

Jamestown has increased output and broadened its range of services to the structural steel and heavy engineering sectors following its move some three years ago to a state-of-the-art, 17-acre facility in Portarlington, 40 miles south of Dublin. Company director Fiacre Creegan said: "The scale of the task in moving an entire fabrication plant, relocating staff, moving IT systems etcetera, is one that not all companies could cope with. With the input from managers, great staff input, and the support of our key customers this has been a very long journey, but a great success."

Jamestown's new general manager Niall Fortune says that the company's workload is gradually shifting away from basic steel fabrication towards higher-end projects where the project architects and engineers have much more input throughout the manufacturing stages. "This is especially true regarding aesthetic features and visual quality of steelwork," he says. "It's much more common now to hear terms like semi-automotive paint finish in relation to a heavy structural column, where even the slightest surface imperfection is not allowed."

He adds that it is not unusual for an architect to demand a particular level of finish on a welded structure or member, which is above any of the common NSSS requirements. "Jamestown has embraced a number of projects of this type and met and exceeded client expectations," said Mr Fortune.

Jamestown's compliance manager Mark Morris added:"Focus on the clients' requirements and a thorough understanding of the relevant quality standards is vital in our sector now, and without a strong drive in this department a service company will not thrive."

Jamestown stresses the importance of continued support of Steel for Life, the BCSA and *New Steel Construction*. "This comes from the underlying belief that development of the steel market is good for the industry and good for the economies of both Ireland and the UK," says Mr Creegan. "With continued support from shareholders, with focus on innovation and process improvement and with ongoing investment Jamestown will continue to develop and grow.

"As well as our structural steel output for the construction sector, we produce steel for the maritime industry, power generation, crane handling, shipping, and engineering applications. With continued effort and with a renewed focus Jamestown is set to expand further and continue on the success path."

Jamestown is a headline sponsor of *Steel for Life*

Continued investment in plant and people

An 80Te, 40m long weathering steel bridge beam being fully fabricated

Since moving to its new premises Jamestown has continued to invest heavily in plant and equipment. Last year saw the arrival of another new long-bed Voortman plasma cutter, for the manufacture of webs and flanges. This allows Jamestown to respond to even tighter quality controls and shorter lead times in the manufacture of plate girder and box girder sections. CNC drilling & milling equipment has been purchased and this too will help to keep Jamestown at the leading edge of the industry, says Jamestown's production manager Mr Aidan Clear.

"We are currently trialling a number of pieces of equipment which will aid in the fast inspection of finished beams, either in the final inspection stage or actually in the pre-welding stage to ensure correct fabrication set-out," he said.

Mr Morris said: "There are advances now which Jamestown is investigating which, if employed, will speed-up and possibly automate the assessment of finished welds vs. NSSS weld acceptance criteria. Some of this technology has been around for years and used in other sectors of industry, but it's not so common or so well developed in the structural steel sector. At Jamestown we are continually pushing for new techniques and new methods to improve on old accepted methods of operation."

Repeat business from valued clients

Jamestown is continually reviewing its corporate structure to ensure the best service to clients, architects, engineers and fabricators. The company sees its success as based on completing projects to client and engineers specification, underpinned by the continual review of capability and process. Jamestown says the amount of repeat business secured from clients is testament to this fact.

Other than very localised one-off projects, Jamestown has carried out repeat business for all its clients. "We are at present fabricating almost 3000 tonnes of plate girders for an extremely high-end project in central London, whilst concurrently working on 1500 tonnes of heavy complex asymmetric plate girders for a significant UK fabricator working in Canary Wharf in London," says Mr Creegan.

"At the same time we are building a 400 tonne bridge for installation in a tidal flood plain in the west of Scotland for a customer who we've worked with for the past ten years. We have been very selective about the clients for whom we work, and indeed selective about the projects in which we get involved."

Jamestown's financial controller Mr Kevin Maher said: "We have been lucky to escape any of the major collapses which have happened in the UK recently. Strong focus on business systems and insuring trade debt are key elements of our approach to business, and we have found that a prudent approach has served us well."

Jamestown are specialists in the fabrication of cellular beams and plate girders

Internal changes and process improvement

The facility allows the company to trial assemble large bridge structures in the workshop

Jamestown regards machine processes and equipment as important and necessary, but only one part of the recipe for success. "The overriding factor determining long-term success in any company is the selection, positioning, and managing of the people therein," said Mr Creegan. "All the best equipment in the world and the best order book etcetera will not make a success unless the right people are in the right places and are given the support, instruction, and freedom to fulfil their roles."

A significant recent move has been the appointment of Niall Fortune as General Manager who is intended to usher in a new wave of development and positive change at Jamestown. "We seek to improve continuously and get leaner in terms of all our processes and workflow," says Mr Fortune. "We are currently on a drive to restructure internally so that we can offer our clients the best possible service, and meet the demands of the future."

Design and manufacturing with computer software

In this article NSC examines how computer software supports the full steelwork design and manufacturing process, the benefits it delivers to the steel construction sector and how it might evolve in the future.

The transition from 2D to 3D models has improved design team communication and workflow

The steel construction sector has been utilising 3D design software for over 25 years and is well versed in the benefits and efficiencies it provides to manufacturing and construction programmes. Today computer software is integral to the design, fabrication, erection and everyday operational processes at most steelwork contractors' facilities.

Software is seamlessly interwoven into each stage of the steel fabrication process supporting activities such as knowledge and bid management, project planning, frame analysis, connection design, 3D modelling, BIM co-ordination and the fabrication process itself.

At the earliest stage, modelling and estimating software plays an essential role in the bidding process for the steelwork contractor, and its use is increasing. This software provides the ability to create a model of the steel frame so steelwork contractors can visually present the content of their bid alongside the associated costs, provide insight into the sequence of construction works and identify solutions to reduce health and safety risks.

The practiced use of 3D modelling software allows steelwork contractors to create a virtual prototype of the steel frame, and is one of the most important pieces of software a steelwork contractor uses today. Data from the model can then feed into many business processes. Importantly, data from other parties can be imported into the modelling software and the steel model can be exported in Industry Foundation Classes (.IFC) format for use by others. It's this function which plays an important role in the adoption of BIM.

During the design phase, the structural steel will be modelled to facilitate fabrication. Materials Resource Planning (MRP) software then processes the bill of materials data from the model which is used for procurement of materials, manages data to drive automated cutting and fabrication machinery, plans logistics, as well as piece weights for crane planning. MRP software can also be used to monitor progress of fabrication by capturing data about each part as it passes through the different fabrication processes.

Moving beyond desk-based software and from 3D to mixed reality

Already data is being transferred from model to site and back again. Advances in software interoperability means that specific data from a design model can be imported directly to the surveying equipment used on site. The process can also be carried out in reverse, enabling data captured on site to be imported back into the construction model for compliance and comparison purposes.

Actual progress of the works can also be captured and reported back using an increasing number of mobile devices and Apps available for use on-site.

Over the last few years the transition from 2D documents to 3D models was a natural evolution, which improved team communication and coordination. However, further technological advancements will drive the adoption and advancement of mixed reality and holographic technology, which will bring 3D models out of the screen and provide users with the ability to engage and interact with design data more intuitively.

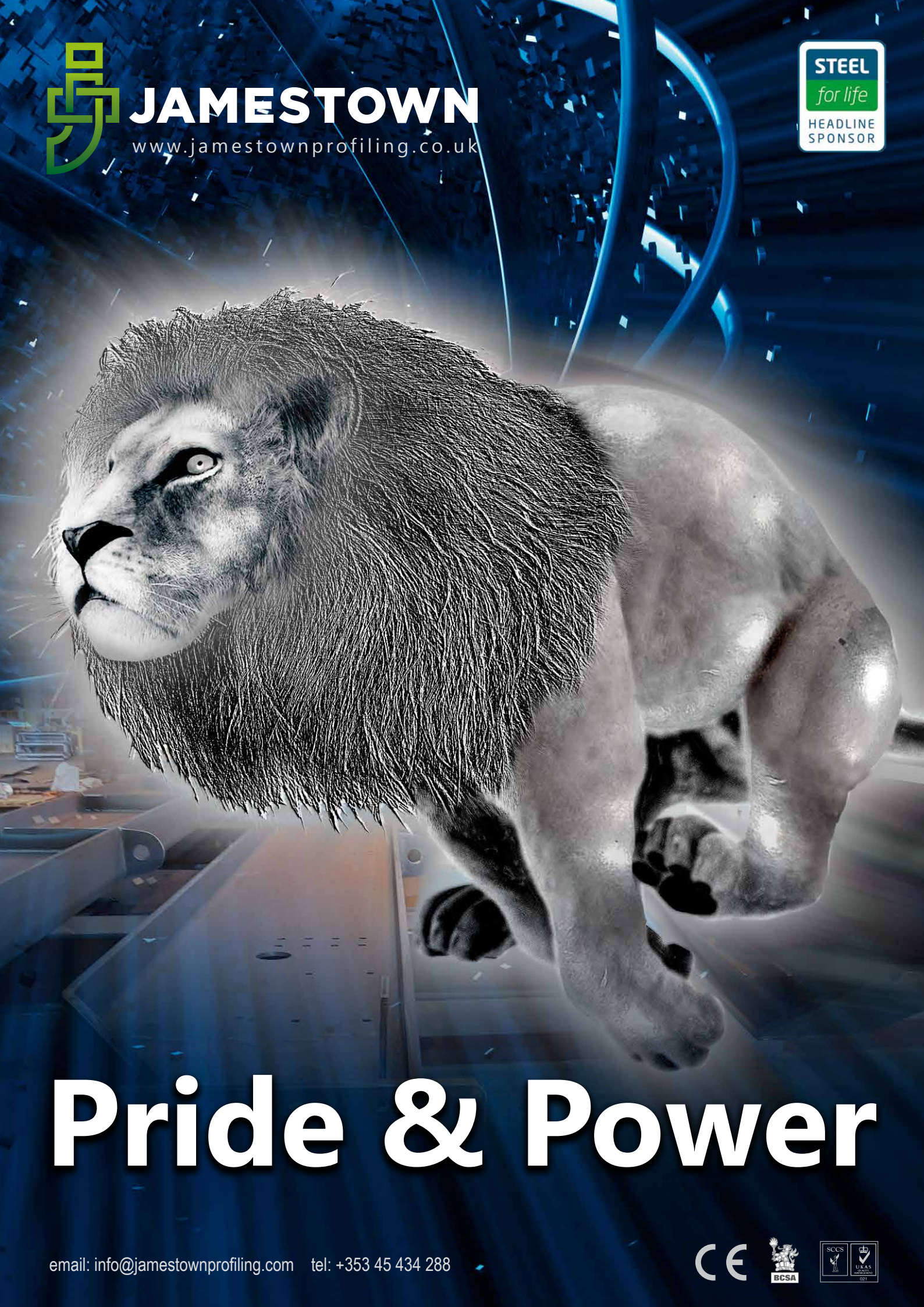
By being able to view holograms of 3D structural frames in the real world, engineers will be able to visualise a variety of constructions on site to see what they will look like, and confirm if they can physically be created.

For steelwork contractors, while viewing the 3D holographic image they will be able to isolate connections and extract them from the model to see if they are correct and if they can be fabricated in the workshop.

This device and technology will not only work on a building site or in cities, but in workshops, where steelwork contractors could wear the headset to see if there are any missing components, such as bolts, or anomalies within the structure, and physically use the hologram as a guide to creating the steel components.

The technology could also be used to perform a 'construction rehearsal' where the steelwork contractor and site staff virtually walk through the construction sequence and connection processes. This would ensure the steelwork contractor's detailing aligns with the erection team's preferred method of assembly, before manufacturing instructions are sent through to production.

Thanks to Trimble Solutions (UK) Ltd for contributing to this article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Circuit revs up hospitality

The racing day experience at Hampshire's Thruxton Circuit has been enhanced by a new £1.5M steel-framed hospitality suite.

Forming the cornerstone of a wider redevelopment programme, Thruxton's new steel-framed two-storey hospitality complex includes a restaurant, bar, exhibition gallery, function rooms, hospitality suites, catering facilities, viewing terraces and a balcony.

Featuring an innovative design, which fully utilises steelwork's aesthetic qualities by leaving the majority of the framing material exposed, it also includes a grand atrium and entrance lobby said to reflect the dynamism of motorsport as well as the circuit's rich heritage.

Initially designed by architects Chapman Partnership, they and the client always envisaged the scheme being built as a steel-framed structure.

The building's shape has two distinct conjoined parts, one curved and shaped like an open fan on plan, and the other a more traditional rectangle. Both parts are topped by a series of curved barrel-vaulted roofs, which cantilever over a balcony that wraps around the front of both parts and overlooks the racing circuit.

"We chose a steel frame for a combination of reasons. Our architectural intent was to emphasis the high-tech nature of motorsport in the building's design. The steel frame facilitated the complex roof geometry and cantilevers that echo the famous curves of Thruxton's iconic circuit," says Zac Chapman of Chapman Partnership.

"The ability for large internal spans and resulting lack of columns made the project viable for a variety of programmatic criteria. Since the construction phase was restricted to the motor racing off-season [September to April], the pace of steel frame construction was another factor instrumental in its selection and ultimately vital in the project's successful completion.

"REIDsteel's early involvement and our regular design team meetings have resulted in an excellent final design, full of architectural and engineering merits."

Working on a design and build contract for the project's steelwork, cladding and glazing, REIDsteel helped to rationalise the design by working collaboratively with the rest of the design team to ensure they had a steel frame that could be built easily on-site.

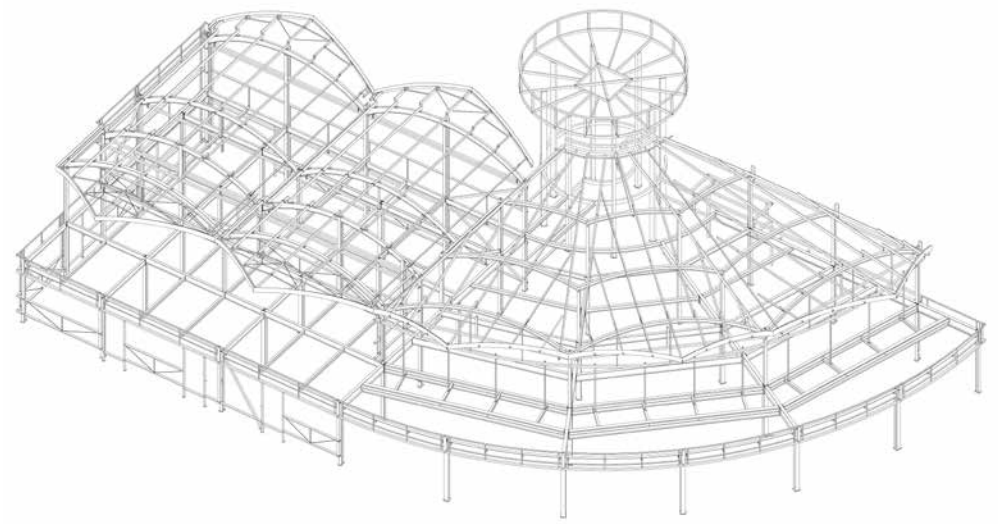
"We made a number of refinements to the steelwork," explains REIDsteel Structural Engineer John Harrison. "Most notably, omitting some large roof beams and introducing cantilevering purlins instead."

"As the purlins are hidden in the sheeting, it gives the illusion of no roof support for the cantilever, as well as being a more cost-effective design."

The barrel-vaulted roof cantilevers over the balcony

The hospitality suite is part of a larger redevelopment at Thruxton

Steelwork's speed of construction was one of the main reasons for its use



After being value-engineered, the design still retained many of the architect's original concepts, such as keeping as much of the steel frame as visible as possible.

According to REIDsteel it was also important to keep the design as modern-looking as possible and so all of the main columns and beams are box sections, as they are said to have a more aesthetic appearance.

Steelwork for the 1,415m² hospitality centre is based around a regular grid, albeit one that radiates inwards around a constant radius on one side of the structure to form the fan-like area.

To form the roof of the fan, four rafters splay out from a central point, supporting the curved members that form the barrel-vault.

The structure has minimal internal columns, creating open-plan areas and maximum flexibility, with spans generally up to 10.5m-long.

Stability for the structure is provided by semi-continuous frames for the ground floor, while the first floor is a mix of portalised and tied barrel roofs.

"The requirement to keep the steelwork exposed within the completed building dictated the stability system we chose for each floor," explains Mr Harrison.

The upper level has a lot of glazing and so an unobtrusive portal frame was deemed to be the most effective method.

The hospitality suite will be able to host up to 400 guests over two floors, with extra capacity available outside on the balcony.

The balcony is 3.5m-wide along the curved part of the building, but increases in depth to 6.7m along the straight part of the structure. Temporary grandstands could be erected along this wider floorspace, helping the complex to add to its capacity.

The wider part of the balcony can also be used to exhibit cars during launch events. To enable vehicles to be lifted on to the balcony the steel balustrade is removable.

At the rear of the building, positioned at the point where the curved fan-like part connects to the rectangular part of the building, there is an 8m-diameter round turret that contains the main staircase.

The staircase is attached to the roof of the turret via a series of Macalloy rods. Because the stairs also provide a fire escape route, the rods are deemed to not offer enough support so the staircase also cantilevers off the side of the turret.

The turret is a facetted circle formed with 16 straight sides. This negated the need for more expensive curved members and made the installation of the glazing easier, as curved glazing panels are also expensive.

Mr Harrison says: "Thruxton wanted an innovative and modern hospitality centre to reflect its status as one of the most iconic racing venues in the UK.

"Having designed, manufactured and supplied stadia for a wide range of clients, we are delighted to have delivered this landmark project which will support the venue's growth for years to come."

Summing up, Marketing Manager at Thruxton Ben Norton says: "Our flagship hospitality centre is the latest addition as part of ambitious modernisation and growth plans in our 50th anniversary year.

"It is an exciting development which will allow us to deliver stunning and memorable events for groups of all sizes with hospitality of the highest standard."

FACT FILE

Thruxton Motorsports Centre, Hampshire

Main client: British Automobile Racing Club

Architect: Chapman Partnership

Main contractor: Mata Construction

Steelwork contractor: REIDsteel

Steel tonnage: 60t

FACT FILE
Magna Park Plot 520, Milton Keynes
Main client: Gazeley
Architect: Chetwood
Main contractor: VolkerFitzpatrick
Structural engineer: Hydrock
Steelwork contractor: Severfield
Steel tonnage: 3,000t

Distribution park expands with steel

Magna Park is forging ahead with its expansion plans as the latest steel-framed distribution centre, offering 72,000m² of floor space, nears completion.

Plot 520's 200m-wide frame during construction

Situated between junctions 13 and 14 on the M1, Magna Park, Milton Keynes is said to be a strategically located distribution park that is within a 4.5-hour HGV drive of 54.8M people in the UK, which is 85% of the British population.

According to the site's developer Gazeley, it also benefits from a strong labour force, with 932,000 working age people living within a 30-minute drive.

The development is an established location for logistics, home to the distribution operations of some of the UK's largest and most successful brands including John Lewis, River Island, Waitrose, Barr soft drinks and UK Mail.

Unsurprisingly, steel construction – which accounts for over 90% of the UK shed market - has played an important role in the development of the site as all of the Park's distribution centres are steel-framed structures.

According to Severfield Operations

Illustration showing the entire Magna Park site with Plot 520 in the foreground and Plot 510 top left

Manager Stephen Jay-Hanmer, his company has had a long relationship with Magna Park as it has erected seven previous buildings on the site prior to starting on Plot 510 (see box) and then the larger Plot 520.

Main contractor VolkerFitzpatrick began work on Plot 520 in December 2017 and started by installing pad foundations in readiness for the steel package.

Speed is of the essence for all construction projects, but possibly more so with distribution centres. From the moment, the main contractor starts on-site, its main objective is to get the frame up as quickly as possible.

"The weather hasn't been great this winter but the steelwork has been unaffected by the wet and snowy conditions," says VolkerFitzpatrick Project Manager Jon Evans. "The entire steel frame was up in just 10 weeks."

Plot 520 measures 349m-long × 200m-wide and is 20m-high. Inside its mammoth interior of 72,000m² it could ▶20

Taller the better

Working on behalf of Readie Construction, Severfield has also recently completed Magna Park Plot 510, a building that Gazeley claims is the tallest and largest speculative logistics warehouse in the UK.

Known as Altitude, the warehouse is 21m-high and 410m-long × 126m-wide. The building offers 51,660m² of floorspace - equal in size to seven football pitches - and is formed by four 31.5m-wide spans.

Construction of the warehouse began in August 2017 and took 26 weeks to complete. Within that overall programme, the steelwork package, which comprised of 2,300t, was erected in six weeks.

Severfield Operations Manager Stephen Jay-Hanmer says: "We had two main erection teams working on the project, one starting at one end of the building and the other starting in the middle.

"Both worked in the same direction using four mobile cranes each and, due to our design and on-site expertise, the first team connected their final steel elements seamlessly to the parts that had already been erected."

Severfield had 40 men on site to complete Plot 510, which included a third gang using a single crane to erect the warehouse's office block and ancillary buildings.

The building is said to feature an innovative design which provides occupiers with the highest degree of operational flexibility and efficiency. Some of its features include: an enhanced mezzanine capacity and an increased number of pallet positions; double deck loading doors in every position, at a ratio of one door per 418m² - reducing time as well as financial and environmental operating costs for occupiers; an increased incoming power load provision of up to 4 MVA to cater for the evolving needs of customers, and designed to the WELL Ready Standard certification, which is said to make the building a healthier and more productive space for its occupants.

Commenting on the development, Gazeley Development Director Joe Garwood said: "Magna Park, Milton Keynes is already one of the UK's most established hubs for logistics, and the development of Altitude will only serve to strengthen that position and appeal to occupiers as a leading location for ecommerce, logistics and distribution companies.

"Altitude brings together a combination of innovation, technology, efficiency, sustainability and intelligent logistical thinking from some of the most experienced figures in the business to create a building that sets a new benchmark for the industry."

520's frame was erected in ten weeks

▶18 accommodate ten full-size football pitches.

The portal-framed structure has six spans, two at 37m and four at 31.5m.

To erect the frame Severfield used four mobile cranes and a workforce of 25. The erection method consisted of completing one row of bays across the whole width of the building before moving onto the next set of bays.

Soon after each row was complete they were handed over to the cladding team, who worked immediately behind the steel erectors. By working in this sequential manner, the frame was weathertight soon after the steel was completed.

The initial 200m-wide steelwork required a significant amount of temporary bracing to keep it stable during the erection process.

"Bearing in mind the structure is 20m-high and subject to quite considerable wind loads, we had to design a temporary bracing system for each of the span's valley lines," explains Severfield Design Manager Dan Dockerty.

Severfield used its own re-usable temporary bracing system, which was installed along with the main frame, and was then removed once the permanent stability system was installed."

Once 520 is complete further distribution centres are planned

The building's columns are 762 UBs along the perimeters, while internally the company has used plated columns. These members support the roof rafters which were all fabricated and delivered to site in two pieces (two 18.5m rafters for the 37m span and two 15.75m sections for the other spans).

Once the main warehouse structure was up, the final part of the steelwork package involved the erection of an attached three-storey office block. This building required approximately 260t of steel and is a traditional column and beam structure with composite metal deck floors.

At ground floor, the 54m-long office building bridges over a 16m-wide HGV route into the warehouse. To create this bridge, a series of plated girders is positioned at first floor over the thoroughfare.

Above the second floor level the building also features a plant deck and an outdoor terrace.

Plot 502 is scheduled for completion by September.

Designing without expansion joints

Plot 520 is 349 m long with no expansion joints. Richard Henderson of the SCI discusses the implications

Plot 520 comprises 3 bays of 9.66m and 40 bays of 8.0m between the centres of the gable frames at the ends. A consideration of the possibility of leaking expansion joints in a portal frame with a clear height of 20 m and the associated commercial risks, resulted in a decision to design the building without joints. Three vertical panels of tubular bracing provide stability in the longitudinal direction and, because the structure is continuous, the braced panels inhibit free expansion due to temperature changes. The design of the building includes thermal load cases to take the thermal effects into account where they arise in the continuous members.

The internal temperature range recommended in the Steelwork Design Guide to BS5950 Volume 4 Essential data for designers (SCI publication P070) is -5 °C to +35 °C, a temperature range of $\Delta T \pm 20$ K. The coefficient of linear thermal expansion $\alpha = 12 \times 10^{-6}$ K^{-1} so the maximum thermal strain $\alpha\Delta T$ is about 2.4×10^{-4}. Depending on the position of the braced bays, expansion joints could be required to allow for movement of ± 40 mm; instead, the braced bays resist expansion of the continuous members between them, resulting in a maximum theoretical stress $\sigma = E\alpha\Delta T$ of about 50 MPa which would arise if the braced panels were perfectly rigid.

The building has six spans of portal frames across the width of the building totalling 200 m. The structural form of the portal frames means that thermal expansion in the plane of the frames results in an increase in the axial force in the rafters, accompanied by a rise in the apex of the frames. A reduction in temperature has the opposite effect.

The portal frames are designed as hit and miss with valley columns in alternate bays omitted and the rafters supported on valley beams. The five valley lines are stabilized by bracing in the plane of the roof leading to the vertical braced panels. The valley beams are substantial elements spanning 16 m or more which are present in continuous lines down the length of the building.

In practice, the braced panels have some flexibility and the longitudinal members (eg the valley beams) may have some movement capability in their end-connections as a result of the standard 2 mm oversize holes. The result is that thermal stresses are not as high in practice as the maximum theoretical values would suggest.

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Seaside leisure

Sporting pursuits are set for a substantial boost in the West Sussex seaside town of Littlehampton as a new £17M leisure centre is under way.

Steel has provided the most cost-effective solution for the client

FACT FILE
Littlehampton Leisure Centre
Main client: Arun District Council
Architect: Space & Place
Main contractor: Willmott Dixon
Structural engineer: Furness Partnership
Steelwork contractor: William Haley Engineering
Steel tonnage: 300t

A buoyant sector within the construction industry at present is the leisure category, as a number of local authorities around the UK are currently updating and replacing old swimming pools, aquatics parks and sports halls.

Steelwork, more often than not, is the framing solution for these projects as the material can easily create the long span column-free spaces required in leisure centres.

An example of this work is the £17M steel-framed leisure centre under construction for Arun District Council at Littlehampton.

Replacing an existing centre, the new multi-million pound facility will include an eight-lane 25m-long swimming pool, 17m-long training pool with a moveable floor, 100 station gym, dance studio, spinning studio, four-court sports hall as well as a café and meeting rooms.

Project architect Space & Place (S&P) says it has been designing sports and leisure centres for over 35 years and has gained a great understanding of the benefits steel can bring, in particular in providing visually lightweight structures over the long span, column-free volumes required for sports halls and swimming pools.

"Improvements in paint technology and protective systems, combined with reduced cold bridging, ensure steel offers our clients an attractive long term structure without high maintenance costs," explains S&P Associate Director Nic Bryant.

"At Littlehampton the seaside location has poor and wet ground conditions so cantilevered steel frames and transfer trusses were used to help reduce the number of columns and associated piles and ground beams.

"By ensuring an economic steel structure the client's budget can be focused on providing sports facilities to the local community."

The design is slightly elevated above the existing ground level to minimise the impact of the high water table during construction, but more importantly above potential flood levels should the sea wall ever be breached. This approach has the added bonus of improving views out to sea and increasing visibility along the seafront.

Contained within one large steel-framed structure, the project has been designed along trusted and well-used parameters. As Furness Partnership Project Engineer Joe Haines says: "We have worked on a number of leisure centres in collaboration with Space & Place (see Rhyl waterpark in NSC April 2018), and together we have developed an optimised design solution which always uses structural steelwork."

Steelwork has offered the design team the most efficient method of forming the long uninterrupted spans needed within the centre, as well as being a material that is quick to erect, thereby helping to keep the construction programme on schedule.

Main contractor Willmott Dixon started on-site late last year, inheriting a plot that had already been cleared of its previous buildings.

"Our early works included flattening the site and installing a piling mat, with piles up to 28m-deep. This then allowed the steel frame to be erected which was completed by the end of March," explains Willmott Dixon Senior Building Manager Tom Hooper-Smith.

Steelwork contractor William Haley Engineering erected the majority of the project's steelwork using a 60t-capacity mobile crane, with the only exception being a 22m-long × 3.5m-deep truss which required the use of a 130t-capacity crane.

Weighing 10t, the truss runs down the spine of the facility and is an important element of the project as it sits between the two pools and creates an open-plan space for the entire aquatics area.

The truss performs two essential tasks; its top chord supports a series of 22m-long beams that span over the main pool, while its bottom chord picks up the steelwork that forms a plant deck that in turn spans over the training pool.

Like most of the steelwork throughout the project, this truss will be left exposed within the completed scheme.

Much of the steelwork will remain exposed in the completed building

Consequently, the client did not want any visible splices ruining its vision of a clean aesthetic steelwork centrepiece.

"We had to fabricate the truss from box sections for cost and efficiency and then deliver it to site in one piece," says William Haley Engineering Project Manager Steve Worner.

"Transporting it to site was a bit tricky, especially through the narrow streets of Littlehampton town centre, but it all went smoothly."

The remainder of the project's steelwork was brought to site in smaller sections, including the beams that span the pools. These members all have a splice splitting the beam at third points.

The roof beams were assembled on the ground and then lifted into place as one section. A similar scenario was also played out for the 20m-long rafters that span the sports hall.

The sports hall is a large braced box with flat vertical bracing positioned around its four windowless walls. Other areas of the leisure centre, because of glazed elevations, were a little trickier when it came to finding locations for the bracing. In these areas, such as the pool hall, hollow section bracing has been installed within the roof steelwork.

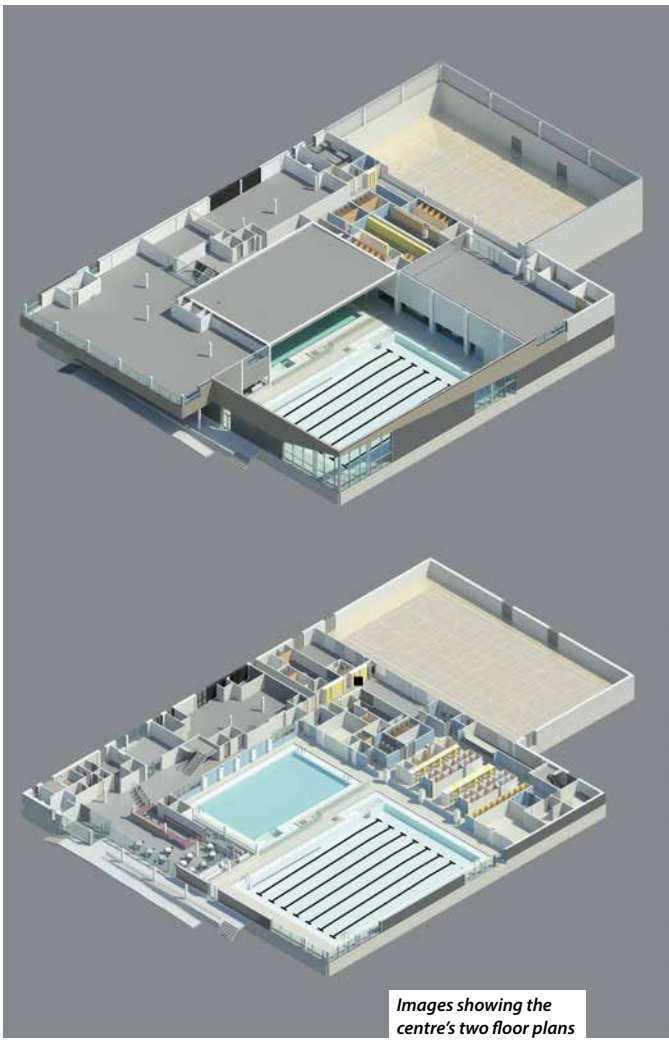
Accommodation is spread over two-storeys with views into and out of the pool from the park, while the south facing gym and café look out across the beach, with particularly spectacular views from the gym which is on the first floor. The high quality contemporary design is said to reflect the Council's commitment to regeneration through design, in addition to a reflection of the importance of the seafront location.

On the upper level, some of the bracing has been turned into an architectural feature, with rod bracing placed within the large glazed façade of the gym which, as well as being positioned along the seaside facing elevation of the building, is also above the main entrance.

The upper level is formed with a composite slab using metal decking supported by the steelwork. The floor wraps around the pool and sports hall – which are both double-height spaces – in a large L-shape. As well as the gym, the upper floor also accommodates the two studios.

Working for William Haley Engineering, Composite Profiles are detailing, supplying and installing more than 1,700m² of Tata Steel ComFlor 51+ decking, 500m of edge shutter and 9,000 thru-deck welded shear studs to this project.

Summing up, Arun District Council's Chairman, Councillor Mrs Jacky Pendleton says: "This is a fantastic facility which will be a superb centre. This is the location that the community favoured and it will sit well next to our award-winning Edwardian Mewsbrook Park."



Images showing the centre's two floor plans

Spanning a congregation

Including a large flexible auditorium and a sports hall, the Green Pastures Church in Ballymena is benefitting from using a steel framing solution. Martin Cooper reports.

FACT FILE
Green Pastures Church, Ballymena, County Antrim
Main Client: Green Pastures
Architect: HPA Architecture
Main contractor: martin & hamilton
Structural engineer: RPS
Steelwork contractor: Walter Watson
Steel tonnage: 840t

Said to be one of the largest construction projects the Northern Ireland town of Ballymena has seen for many years, the Green Pastures Church is rapidly taking shape on the outskirts of the Ulster town.

Looming large on the southern approaches to Ballymena, the imposing steel-framed structure, set within a 96-acre site, will comprise a main 1,600-capacity auditorium, sports hall, classrooms, meeting spaces, crèche, a gym, café, offices, a fitness studio, wedding and reception venue, as well as a large exterior car park.

Green Pastures spokesperson Jason Kennedy says: "We believe that the church of Jesus Christ should have a relevant and influential position at the heart of the community. We are focused on meeting the needs of our local communities and committed to bringing the hope of the Gospel of Jesus to the local area.

"The new facility is the first stage of a larger, long term not-for-profit legacy project, desiring to play a part in bringing spiritual, social and economic revival to our town."

Green Pastures was founded in Ballymena in 2007 by Jeff Wright, whose father started Wrightbus, the town's largest employer and the manufacturer of London's latest red buses.

The church has grown significantly in just 11 years and says it has over 1,000 people of all ages in attendance across its Sunday services. Known as Project Nehemiah, the new Church and its many facilities will be a big boost to the local community.

Construction of the Church got under way last year with an enabling works package that included installing drainage and preparing the plot by levelling the sloping ground.

Locally-based contractor martin & hamilton (m&h), who are responsible for the Church structure, then started on-site during July and began by installing pad foundations and lift shafts in readiness for the steel frame to be erected.

"As with many buildings it was important to get the structural frame up as quickly as possible on this job to allow the numerous follow-on trades to get started," explains m&h Project Manager Martin McCready.

To this end, steelwork contractor Walter Watson had fabricated, supplied and erected all of the project's 840t structural steel by the end of March.

"Steel was not only chosen for its speed of construction," adds Mr McCready. "It is also provided the most efficient way of creating

The auditorium can be enlarged in the future

The large open-plan first floor sports hall

the very long spans needed for the sports hall and auditorium."

The auditorium's roof is formed by a series of long rafters, spliced together at mid-point to create an overall 46m clear span. They were transported to site in 23m-long pieces using Walter Watson's own fleet of extendable rear steer trailers.

Two 60t-capacity mobile cranes were used to lifted the 7.5t rafters into position, with each crane lifting a single beam. The rafters were then connected to the stanchions at eaves level before being connected at the apex haunch. One crane would remain connected to the portal rafter, while the other crane lifted the purlins and tie beams into position. This stabilised the portal before the second crane released its load.

At two locations within the main auditorium roof, the 43m-long rafters are supported off a carrier beam spanning two bays to leave a large clear opening for a skylight.

"Additional lateral bracing had to be designed and fitted at these two locations to stabilise the carrier beams in the absence of any first-floor slab to prevent spreading of the portal and dipping of the apex," explains Walter Watson General Manager Structural Division Trevor Irvine.

The auditorium has been designed as a portal frame and it is propped at the surrounding first floor of the building to negate any deflection.

Some added flexibility has been designed into the auditorium so that it can be doubled in size to create a larger 3,200-capacity venue. At present the auditorium's seating rakers are arranged in a quarter circle configuration around a stage, but by removing one perimeter wall further steelwork can be bolted to the frame to form a larger half circle auditorium around an enlarged stage.

"A steel-framed structure was always the preferred design for this building for a number of reasons, with its flexibility and ease of adding an extension a prime mover," says RPS Project Engineer John Ellis.

Covering the auditorium's roof is a seven-layer insulated cladding, which has been specified to prevent any noise from escaping from within the venue to keep the neighbours happy.

Surrounding the auditorium on three sides is the building's first floor. This upper level contains the structure's other large column-free space; a double-height sports hall.

Forming the sports hall is a series of trusses that required a tandem lift erection procedure to install them. The trusses measure 18m-long × 2m-deep and they were brought to site as complete sections on extendable trailers and then erected using two mobile cranes.

The two-level element of the building has been designed as a braced frame with bracings located within the exterior walls. In order to avoid windows and doors, wind portals (goal posts) with no diagonal members have been used.

A spokesman for the Church said: "Green Pastures Church believes in Ballymena and is committed to supporting local companies, local jobs and the local economy."

Green Pastures hopes to have its first service in the building in late 2019.

How the completed facility will look

Academic design exposed

A famous London seat of learning has chosen to use an aesthetically-pleasing exposed steel frame for its latest redevelopment project. Martin Cooper reports.

The world-renowned London School of Economics' (LSE) continuing redevelopment of its central London properties currently includes the Central Building Redevelopment (CBR) that will create a state-of-the-art flexible and highly sustainable academic and teaching building.

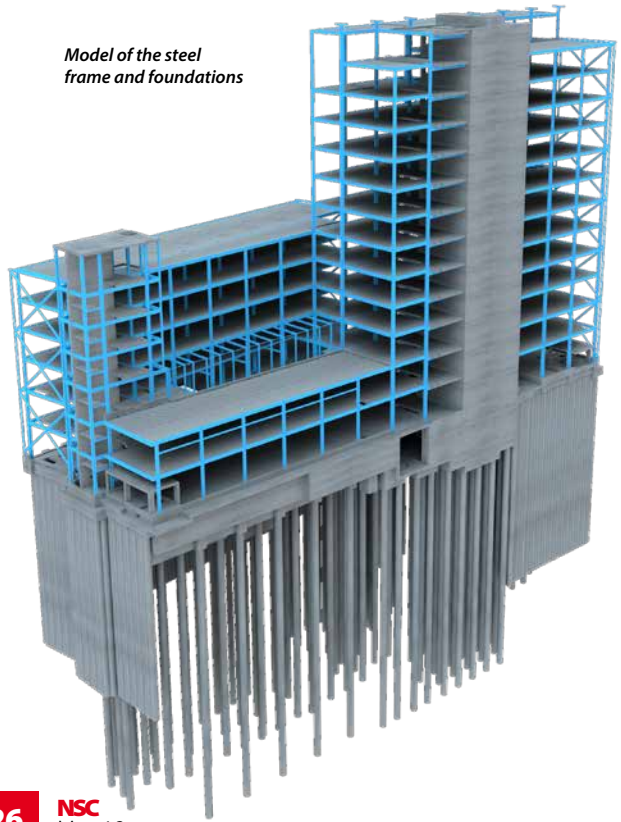
Situated just south of Lincoln Inn Fields, and just a short walk from the LSE's Academic Building (see NSC May 2007), the CBR project replaces four previous buildings that were demolished as they were deemed to be no longer fit-for-purpose.

Once complete the project will offer a slightly smaller gross internal floor area of 15,507m² as the scheme also includes a new landscaped public square.

A modern and stylish environment will be created by leaving much of the new building's steel frame largely exposed, a design that has required a number of bespoke steelwork elements in order to fulfil the project's architectural vision.

Another part of the architectural intent is to provide a slimmed down floor construction, in order to maximise available space. This design has been achieved by using RHS or plated floor beams, featuring bottom plates to support the building's long span precast floor units which sit within the depth of the beams.

The steel frame will remain exposed



Model of the steel frame and foundations

As exposed steelwork plays such an important role within the design, the fabrication process had to rise to the challenge accordingly as Mace Project Director Frank Connolly explains.

"Billington, our steelwork contractor, was tasked with making sure that the majority of the steel connections were hidden from view in accordance with the client's requirements.

"Flush connections are the order of the day, or alternatively they have positioned end-plates to help create shadow gaps which, in turn, are then used as repeating architectural features."

Shear forces and torsional moments applied to the RHS beams, in conjunction with the desire to avoid site welding, led to the bespoke hidden connection design. Many of the steel members have an internal bolted connection, hidden from view and accessed via a hatch.

Having the steel frame and the ductwork exposed not only creates an aesthetic environment within the completed building, it also brings ventilation advantages.

"Exposed steelwork supporting exposed precast flooring planks creates a flat soffit and contributes to the building's MEP strategy via the material's high thermal mass qualities," explains AKT II Director Ricardo Baptiste.

Overall, the building consists of two conjoined parts; the 13-storey Tower Block and the six-storey Houghton Block. At either end of the blocks, that sit side-by-side for just under half of their lengths, exposed SHS bracings bookend the project and form another highly visible exposed steelwork element.

This exo-skeleton bracing, which sits approximately 300mm outside of the building envelope, is not just an aesthetic element as it is also a structural requirement, sharing the stability with two concrete cores.

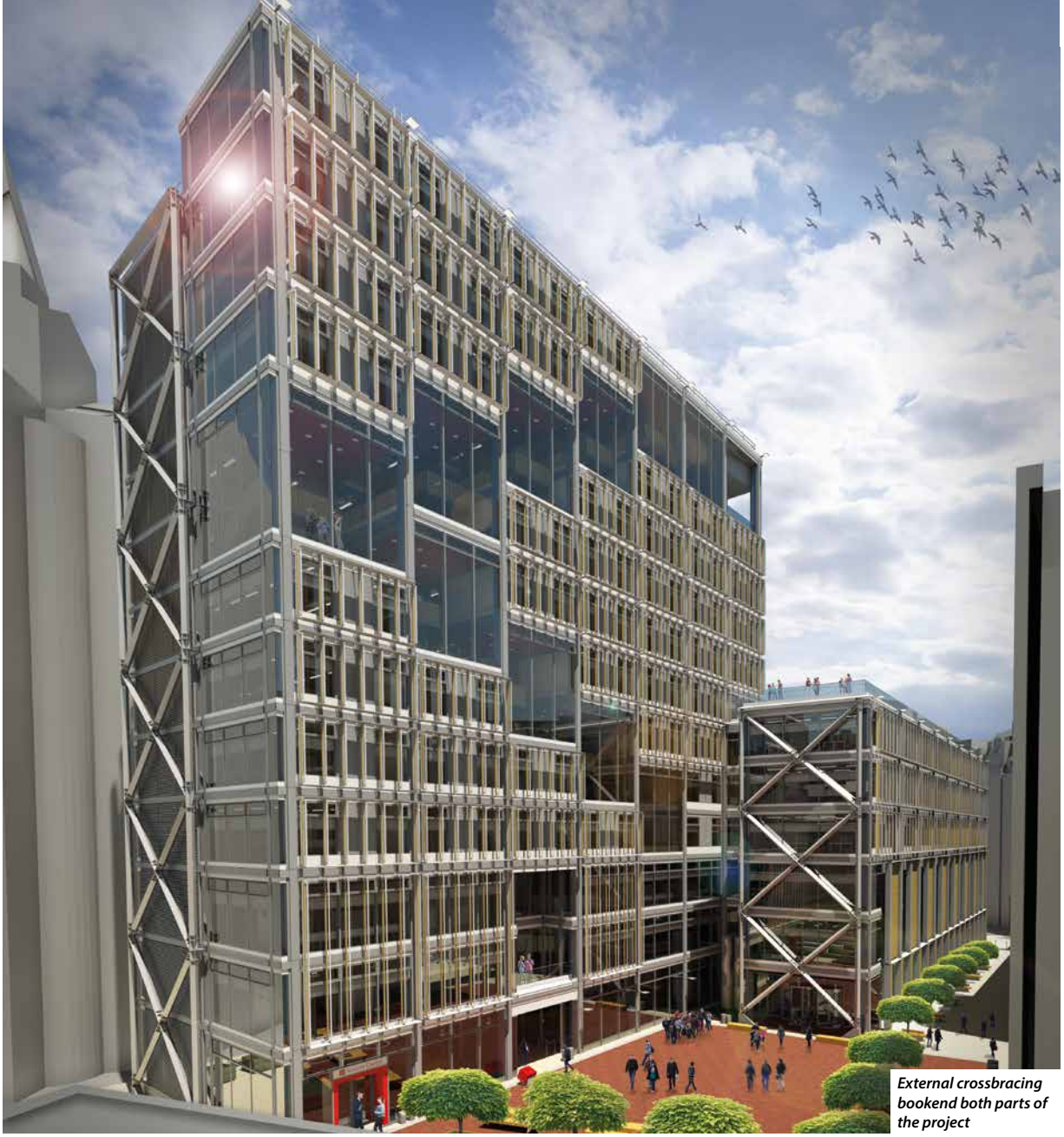
Significant forces are transferred both within and into the SHS bracing system, and so bespoke cruciform node joints were engineered with machined flush plates to ensure the correct standard of finish was achieved.

Full stability to the structure was only achieved once the entire frame was erected and all of the precast flooring was installed. Until that point was reached Billington had to install temporary bracing to each floor, which was only removed once each level was fully complete.

According to Billington Structures Managing Director Mark Smith, to allow flexibility in the overall build sequence the temporary stability system was developed to largely ignore any benefit that the concrete cores may have offered.

"Due to the architecturally sensitive nature of the exposed frame, we had to be mindful of the subsequent impact of any of the connection points for the temporary bracing, and so bolted cleats were used to negate the need for any removal of welded plates," he says.

The majority of the project's steelwork begins at ground floor level, however in order to form a large subterranean auditorium two large plate girders had to



External crossbracing bookend both parts of the project

FACT FILE
London School of Economics Central Building Redevelopment
Main Client: London School of Economics
Architect: Rogers Stirk Harbour + Partners
Main contractor: Mace
Structural engineer: AKT II
Steelwork contractor: Billington Structures
Steel tonnage: 1,100t

be installed during the basement works programme.

"The basement level is predominantly formed with concrete, although we did use steel plunge columns for the foundations," explains Mr Connolly.

"This subterranean level will be used for plant rooms, but it also houses the building's 200-seater auditorium and associated spaces such as a bar, and this large column-free area is formed by the two long plate girders."

Encased in concrete and positioned at ground floor level, the two girders measure 17m long × 1,600mm deep and each one was brought to site in two pieces for ease of transportation. The main steel frame has been erected entirely by tower crane, but these girders needed a 400t-capacity mobile crane to be used for their installation.

The part of the basement that contains the auditorium does not lie beneath the new building, but instead it is positioned in front of the structure and below the new public square.

"Creating the square was integral to the overall scheme and having the auditorium below it was the most efficient position," says Mr Baptista. "Because of the girder's position they are working extremely hard as they are designed to carry heavy loads from fire engines in an emergency, and a mobile crane required to replace rooftop plant."

Access to the auditorium is via the Tower Building's atrium, which accommodates a staircase to the lower level and is a void formed with exposed steel columns that start at basement level.

The atrium also offers access to the Tower's main staircase, known as the meandering stair as it as it shifts along the structure one bay per floor.

Formed with a lightweight prefabricated steel frame, this staircase was lifted into position piece by piece along with the main steel frame. Its design is said to mimic the movement within the square, as well as allowing better connectivity and collaboration between different departments on different floors.

Summing up, Mr Connolly says this is a complex and challenging project on a confined inner city site, surrounded by businesses and our client's other facilities. Collaboration, such as having a visual mock-up of the steel frame on-site to iron out any snags prior to the steelwork being delivered, has been the key to our success.

The LSE CBR opens in mid-2019.

An external bracing node at the fabrication yard

The use of S355 fin plates

Increasing interest in the use of S355 for fin plates prompted questions about the stiffness of such connections – are they still nominally pinned? David Brown of the SCI presents the results of the project comparing the behaviour of fin plate connections with both S275 and S355 fin plates.

Existing guidance

Rules for the design and detailing of fin plates were originally presented in the BS 5950 version of the Green Book[1]. At the time, fin plates were all from S275 material. Standardised connection details were presented, with design rules for each of the components. In support of the introduction of this type of connection to the UK, a series of physical tests were completed by Moore and Owens[2].

With any nominally pinned connection, ductility is required. One critical detailing rule to achieve ductile behaviour was therefore that either the supported beam web, or the fin plate, could be no thicker than $d/2$ in S275 material or $0.42d$ in S355 material. This rule was arranged that for Class 8.8 bolts, the bolt shear resistance (perceived as a relatively brittle failure mode) was no less than the bearing resistance – which was perceived as a ductile behaviour.

Thus for an M20 Class 8.8 bolt, according to BS 5950, the shear resistance is 92 kN

The bearing capacity for a bolt (assuming the end distance was not critical) is given by:

$P_{bs} = k_{bs} d t_p p_{bs}$

where:

$k_{bs} = 1.0$ for bolts in standard clearance holes

d is the bolt diameter

t_p is the thickness of the plate

$p_{bs} = 460$ N/mm^2 in S275 and 550 N/mm^2 in S355 (from Table 32 of BS 5950)

Thus for a 20 mm bolt in 10 mm thick S275 material, the bearing capacity is given by:

$P_{bs} = 1.0 \times 20 \times 10 \times 460 \times 10^{-3} = 92$ kN

If the material was S355, to ensure the shear resistance of the bolt is not critical, then

$$t_p < \frac{92 \times 10^3}{1.0 \times 20 \times 550} = 8.36 \text{ mm or } 0.42d$$

The advent of the Eurocodes

When the Eurocodes were introduced in 2005, two important changes had an impact on the rules for the design of fin plate connections. Firstly, the Eurocode demanded that the connections be formally classified – in the case of a fin plate to demonstrate that the connection was nominally pinned and secondly, the bearing resistance according to the Eurocode increased substantially.

Bearing resistance to BS EN 1993-1-8

According to BS EN 1993-1-8, the bearing resistance is given by:

$$F_{b,Rd} = \frac{k_1 \alpha_b f_u d t}{\gamma_{M2}}$$

If end and edge distance do not limit, then $k_1 = 2.5$ and $\alpha_b = 1.0$. In 10 mm thick S275 material, with $f_u = 410$ N/mm^2 the bearing resistance for an M20 bolt becomes 164 kN, much higher than the BS 5950 value of 92 kN, and much higher than the bolt shear resistance, which according to the Eurocode is 94 kN for a Class 8.8 M20 bolt. Thus the previous rule to ensure ductility, that the bearing resistance should be less than the shear resistance, was impossible to meet in practice.

Connection classification to BS EN 1993-1-8

The Eurocode provided rules for the numerical calculation of connection stiffness, and a stiffness limit for nominally pinned connections. The rules are unfortunately only appropriate for end plate connections. Clause 5.2.2.1(2) also allows a joint to be classified on the basis of experimental evidence or evidence of previous satisfactory performance.

The Green Book to the Eurocode

In 2014, SCI and BCSA published the Eurocode Green Book[3]. The view taken was that there was both test evidence and significant previous experience to demonstrate that the standardised connections performed satisfactorily in practice, but that was conditional on the previous proven rules being followed. The Eurocode Green Book was at pains to point out that only the standardised connections were known to be satisfactory, and that varying the details might invalidate the proven behaviour. An important part of the limited scope was that the previous rules regarding fin plate or beam web thickness must be observed.

Changes to modern practice and the need for research

In recent years, the use of S355 has become more widespread, such that S355 is now the normal grade for rolled sections in the UK. In parallel, the use of S355 plate is becoming more common, and some steelwork contractors wished to use S355 fin plates. The limiting thickness of 8 mm was considered by many to be simply too thin – and so the need to assess the performance of fin plate connections with S355 plate was identified. The objective of the research was simply to compare moment-rotation and stiffness performance of fin plate connections. If connections with S355 fin plates were markedly stiffer than those with S275 plates, the classification as nominally pinned would be threatened.

Research programme

Firstly, an extensive desk study was undertaken to identify tests of fin plate connections. Physical test results are essential if the Finite Element (FE) model is to be calibrated – in other words to demonstrate that the FE model is a good model of the real behaviour. The test results must be comprehensive, as the measured properties of the components are needed, not just the nominal values. In addition, the results must be sufficiently detailed to allow a comparison of the moment-rotation behaviour. After reviewing the available test results, the original research by Moore and Owens[2] was the most comprehensive containing the necessary data.

For the connection chosen to calibrate the FE model, the comparison between the FE and the test results is shown in Figure 1.

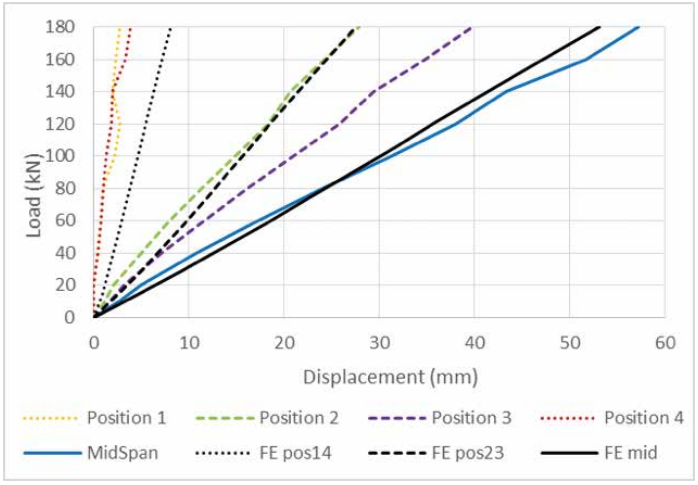


Figure 1: Comparison of FE and test results

In each case, the straight (black) lines in Figure 1 are the FE results, and illustrate deflection at points along the supported beam. The irregular lines show the measured deflections.

From Figure 1, it can be seen that the FE model was a good predictor of the test results. The stress patterns at the fin plate connection are shown in Figure 2. As anticipated, the higher stresses are at the extreme bolt locations in the fin plate. It should be noted that the stresses indicated are three-dimensional Von Mises stresses, so are not immediately comparable to (for example) a calculated bearing stress at a bolt location. The deformed shape of the fin plate (with an exaggerated horizontal scale) is also shown in Figure 2, and demonstrates behaviour as expected.

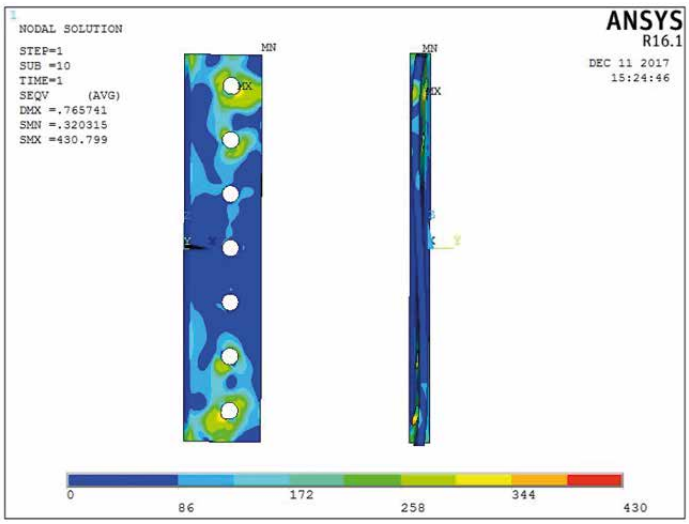


Figure 2: Stress diagram and deformed fin plate

Once the FE model was considered to provide a good model of the connection behaviour, a parametric study was undertaken, considering 28 different fin plate connections. Beams and connections were selected:

- with thin beam webs, so that the influence of the fin plate should not be significant,
- with thicker beam webs, so that the behaviour of the fin plate would be important,
- with one and two vertical columns of bolts,
- with a range of bolt rows.

In every case, the geometry of the standardised details shown in the Green Book was respected. Each case was analysed with a S275 fin plate and with a S355 fin plate.

Typical analysis results

Figure 3 shows the moment-rotation behaviour for the smallest connection considered – a 254 × 102 × 22 UB with just two bolts. Figure 3 also shows the limit for a nominally pinned classification, according to BS EN 1993-1-8. The connection is nominally pinned, and the moment-rotation plots are identical for S275 and S355 fin plates. This behaviour is expected, as the beam web is only 5.7 mm, so would be expected to be the critical component rather than the fin plate.

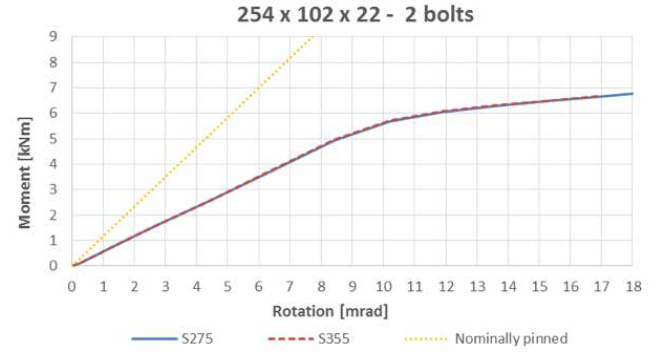


Figure 3: Moment-rotation curves for 254 × 102 UB, 2 bolts

Figure 4 shows the moment-rotation relationship for a 406 × 178 × 54 UB, with two vertical columns each of four bolts. Some small difference between the S275 and S355 fin plates is shown, at higher rotations. The initial stiffness is identical, and the connection would be classed as nominally pinned.

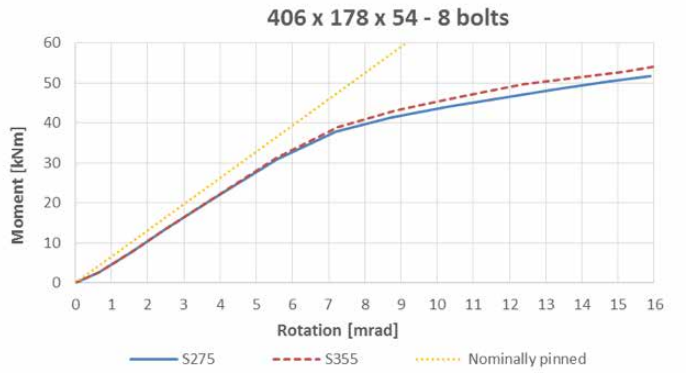


Figure 4: Moment-rotation curves for 406 × 178 UB, 8 bolts

The largest connection modelled was an 838 × 292 × 176 UB, with two vertical columns of 8 bolts. The web of this beam is 14 mm, so it would be expected that the behaviour would be dominated by the fin plate. The moment-rotation curves are shown in Figure 5. The connection is nominally pinned, with some increased stiffness at higher rotations with the S355 fin plate. It is suggested that the initial stiffness of the connection is dominated by deformation in bearing and that initially, this deformation is similar for both material grades.

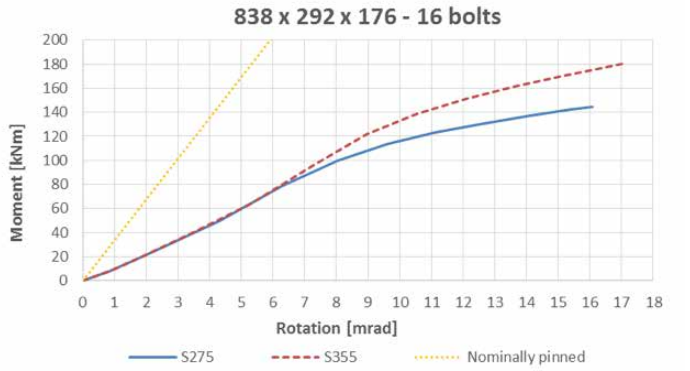


Figure 5: Moment-rotation curves for 838 × 292 UB, 16 bolts

Conclusions

The study has shown that as long as the standardised connection geometry presented in the Green Book[3] is respected, 10 mm fin plates in S355 are classed as nominally pinned connections and may be used as an alternative to S275 plates.

If the connection stiffness largely depends on the fin plate (i.e. the web of the beam is relatively thick), the connection stiffness for a given fin plate detail is similar and independent of the beam size. In contrast, the stiffness limit for a nominally pinned classification depends on the beam stiffness, which increases with the larger beams, making the nominally pinned classification more readily achieved for the larger sections.

One final observation is that the challenges of FE work should not be underestimated. This apparently straightforward study of a simple connection type involved contact surfaces, three-dimensional stresses, constraint by the bolts and plastic strains – reinforcing the need for calibration against physical tests.

Acknowledgements

This study was commissioned and funded by the BCSA and Steel for Life. The study was completed by Antonia Pilpilidou, formerly SCI.

References

1 Joints in steel construction. Simple connections (in accordance with BS 5950-1), (P212) "Green Book to BS 5950", SCI, 2009
2 Moore, D. B. and Owens, G. W., "Verification of design methods for fin plate connections", The Structural Engineer, Vol. 70, No.3/4 1992
3 Joints in steel construction. Simple joints to Eurocode 3, (P358) "Green Book", SCI, 2014

AD 418: Web-post buckling in composite beams with rectangular and elongated web openings

The design of composite beams with large web openings is presented in SCI P355, which has been adopted in the development of software for the design of both hot rolled and fabricated steel sections with openings of various shapes and sizes. In P355, the method for addressing web buckling next to or between rectangular or elongated openings identifies two cases; closely spaced and widely spaced openings. For rectangular openings, the transition between the two cases is taken at an edge-to-edge spacing s_o, equal to the length of the opening ℓ_o. For elongated openings, this transition occurs at an equivalent opening length, which may be taken as ℓ_o - 0.55h_o.

For widely spaced openings, web buckling next to an opening is checked by considering the local transfer of the vertical shear force in the Tees acting on a strut of width equal to half the opening depth.

For closely spaced openings, the relevant compression force acting on the equivalent strut is taken as equal to the horizontal shear force in the web-post and the check for web-post buckling is based on an inclined strut whose slenderness depends on the spacing of the openings.

The issue in the design of beams with large web openings is the potentially high 'step' in the shear resistance at the transition between closely and widely spaced openings, which occurs due to the high slenderness of the inclined strut. To partly reduce this issue, some changes in the application of P355 are now appropriate, which relax the current rules for long openings. These relaxations align with the current work to provide normative clauses on the design of beams with large web openings in Eurocodes 3 and 4.

Web-post buckling in P355

In P355, the buckling length of the web-post for closely spaced openings is given by:

$$\ell_w = 0.7(h_o^2 + s_o^2)^{0.5} \quad \text{for rectangular openings} \quad (1)$$

$$\ell_w = 0.5(h_o^2 + s_o^2)^{0.5} \quad \text{for circular or elongated openings} \quad (2)$$

where:

h_o is the opening height

s_o is the edge-to-edge distance between the openings.

For rectangular and elongated openings, the maximum opening length is $\ell_o \le 2.5\, h_o$ for unstiffened openings and the minimum edge-to-edge spacing, s_o should exceed 0.5 ℓ_o. In comparison, for circular openings, $s_o \ge 0.1h_o$ for steel beams and $\ge 0.3h_o$ for composite beams.

Relaxation for adjacent rectangular openings

For adjacent rectangular openings, it is now accepted that to align with the work on large web openings in the new part of Eurocode 3, EN 1993-1-13, the maximum buckling length for web-post buckling between rectangular openings of the same height may be taken as:

$$\ell_w \le h_o \quad (3)$$

This leads to an upper bound nondimensional slenderness of the web-post given by:

$$\bar{\lambda}_{wp} \le \frac{3.5h_o}{t_w \lambda_1} \quad (4)$$

where:

$\lambda_1 = \pi(E/f_y)^{0.5}$

λ_{wp} is used to obtain χ_{wp}, which is the reduction factor due to buckling of the web-post acting as a strut. For rolled sections, buckling curve 'a' in EN 1993-1-1 may be used and for fabricated sections, buckling curve 'c' should be used. The buckling resistance of the web-post is given by:

$$N_{wp,Rd} = \chi_{wp}\, t_{w,min}\, s_o\, f_y/\gamma_{M1} \quad (5)$$

where:

$t_{w,min}$ is the smaller web thickness above/below the opening

f_y is the yield strength of the steel

This buckling resistance is compared to the horizontal shear force, $V_{wp,Ed}$, acting in the web-post. The upper bound shear resistance is given by $\chi_{wp} = 1/\sqrt{3} = 0.577$, which corresponds to pure shear resistance of the web-post rather than buckling.

For rectangular openings, a further check should be made on the in-plane moment acting at the top or bottom of the web-post due to the effects of horizontal shear, which may control for narrow web-posts. For a symmetric section, this moment is given by $0.5V_{wp,Ed}\, h_o$, which should not exceed the in-plane bending resistance of the web-post, which is taken as $t_{w,min}\, s_o^2\, f_y/(6\gamma_{M1})$.

Relaxation for adjacent elongated openings or circular and elongated openings

The maximum buckling length for web-post buckling between circular or circular and elongated openings of the same height may be taken as:

$$\ell_w \le 0.7h_o$$

This leads to an upper bound nondimensional slenderness of the web-post given by:

$$\bar{\lambda}_{wp} \le \frac{2.4h_o}{t_w \lambda_1} \quad (6)$$

Relaxation for adjacent circular and rectangular openings

For adjacent circular and rectangular openings, or openings of different lengths, it is proposed that the transition between closely spaced and widely spaced openings is taken as the average of the two opening lengths. For adjacent circular and rectangular openings, this corresponds to a transition at an edge-to-edge spacing of $s_o = 0.5(\ell_o + h_o)$. It is proposed that the minimum edge-to-edge spacing is $0.25(\ell_o + h_o)$ for the case of adjacent rectangular and circular openings. The upper bound nondimensional slenderness of the web-post is taken as the average of the two openings.

A further AD will address unequal opening height and positions in the beam depth.

Contact: **Prof Mark Lawson**
Tel: **01344 636555**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates April 2018

BS EN PUBLICATIONS

BS EN ISO 9017:2018
Destructive tests on welds in metallic materials. Fracture test
Supersedes BS EN ISO 9017:2013

BS EN ISO 13918:2018
Welding. Studs and ceramic ferrules for arc stud welding
Supersedes BS EN ISO 13918:2008

BS EN ISO 17633:2018
Welding consumables. Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels. Classification
Supersedes BS EN ISO 17633:2010

BS EN ISO 26304:2018
Welding consumables – Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels – Classification (ISO 26304:2017)
Supersedes BS EN ISO 26304:2011

UPDATED BRITISH STANDARDS

BS EN 1993-4-2:+A1:2017
Eurocode 3. Design of steel structures. Tanks
Amendment, February 2018

BRITISH STANDARDS WITHDRAWN

BS EN ISO 9017:2013
Destructive tests on welds in metallic materials. Fracture test
Superseded by BS EN ISO 9017:2018

BS EN ISO 13918:2008
Welding. Studs and ceramic ferrules for arc stud welding
Superseded by BS EN ISO 13918:2018

BS EN ISO 17633:2010
Welding consumables. Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels. Classification
Superseded by BS EN ISO 17633:2018

NEW WORK STARTED

ISO 8504-1
Preparation of steel substrates before application of paints and related products. Surface preparation methods. General principles
Will supersede BS EN ISO 8504-1:2001

ISO 8504-2
Preparation of steel substrates before application of paints and related products. Surface preparation methods. Abrasive blast-cleaning
Will supersede BS EN ISO 8504:2:2001

ISO 11124-5
Preparation of steel substrates before application of paints and related products. Specifications for metallic blast-cleaning abrasives. Steel cut wire shot

ISO 13918:2017/A1
Welding. Studs and ceramic ferrules for arc stud welding

ISO 15609-1
Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Arc welding
Will supersede BS EN ISO 15609-1:2004

ISO 15614-1:2017/A1
Specification and qualification of welding procedures for metallic materials. Welding procedure test. Arc and gas welding of steels and arc welding of nickel and nickel alloys

ISO PUBLICATIONS

ISO 12944-5:2018
Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Protective paint systems
Will be implemented as an identical British Standard

Steelwork contractors for buildings

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

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

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

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

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

BIM BIM Level 2 assessed

QM Quality management certification to ISO 9001

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

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		3			Up to £400,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●					●		●	●	●		●	●		✔	3			Up to £400,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	2			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3	✔	●	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	●	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4			Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Apex Steel Structures Ltd	01268 660828					●	●			●	●			●	●		2			Up to £2,000,000
Arc Fabrication Services Ltd	01709 557654			●	●	●	●	●	●	●	●			●	●		3			Up to £40,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2			Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	4			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●	●	●		●	●			●	●	✔	4		●	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2		●	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		●	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4			Up to £6,000,000
Builders Beams Ltd	01227 863770			●	●	●	●			●	●			●	●	✔	3	✔		Up to £3,000,000*
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		●	Up to £4,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●			●			●		●		●	✔	3		●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4		●	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011			●	●		●			●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £1,400,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £40,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●		●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072		●	●	●	●	●	●	●	●	●	●			●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	✔	●	Up to £6,000,000
ESL (GB) Ltd	01482 787986	●					●	●	●	●	●	●	●	●	●	✔	4			Up to £400,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●			●	✔	3		●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●											●	●	●	✔	3		●	Up to £2,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	**Guide Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		●	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		●	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●			●	●				●	✔	2			Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Intersteels Ltd	01322 337766	●			●	●	●	●		●			●	●	●	✔	3			Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Up to £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Up to £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		●	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 £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £1,400,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●		●	●	●	●			●	●	✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						3			Up to £3,000,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●	●		●	●		●	●	✔	4		●	Up to £2,000,000
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								●		●			●	●	✔	3			Up to £6,000,000*
Pencro Structural Engineering Ltd	028 9335 2886			●	●	●	●	●	●		●			●	●	✔	2			Up to £2,000,000
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●		2			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●			●	●	✔	3			Up to £3,000,000
S H Structures Ltd	01977 681931	●			●		●	●	●	●	●	●			●	✔	4	✔	●	Up to £2,000,000
SAH Engineering Ltd	01582 584220			●	●	●				●	●			●	●		2			Up to £800,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2			Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		●	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £800,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●	●			●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		2			Up to £1,400,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £800,000
Steel & Roofing Systems	00 353 56 444 1855			●	●	●	●					●		●	●	✔	4			Up to £3,000,000
Structural Fabrications Ltd	01332 747400	●							●	●						✔	3		●	Up to £1,400,000
Taunton Fabrications Ltd	01823 324266				●					●				●	●	✔	2		●	Up to £2,000,000
Taziker Industrial Ltd	01204 468080									●				●	●	✔	3			Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●			●	●	✔	2			Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	3	✔	●	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2	✔		Up to £2,000,000
Underhill Engineering Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4	✔		Up to £3,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2			Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●	●	●	●	●	●	●				●	✔	4		●	Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●	●				●					✔	4		●	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	**Guide Contract Value (1)**

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:

- **FB** Footbridges
- **CF** Complex footbridges
- **SG** Sign gantries
- **PG** Bridges made principally from plate girders
- **TW** Bridges made principally from trusswork
- **BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
- **CM** Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
- **MB** Moving bridges
- **RF** Bridge refurbishment
- **AS** Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
- **QM** Quality management certification to ISO 9001
- **FPC** Factory Production Control certification to BS EN 1090-1
  1 – Execution Class 1 2 – Execution Class 2
  3 – Execution Class 3 4 – Execution Class 4
- **BIM** BIM Level 2 compliant
- **SCM** Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes

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

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

BCSA steelwork contractor member	Tel	FB	CF	SG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●			●	●	●				●	✓	3					Up to £400,000
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●	●	●	✓	4					Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666	●			●	●				●	●	✓	4	✓		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	✓	4			✓	●	Up to £4,000,000
Cementation Fabrications	0300 105 0135	●			●						●	✓	3			✓	●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	✓	3			✓	●	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●			●	●	●		●		●	✓	3					Up to £3,000,000
ESL (GB) Ltd	01428 787986									●	●	✓	4			✓		Up to £400,000
Four-Tees Engineers Ltd	01489 885899	●			●	●	●		●	●	●	✓	3			✓	●	Up to £2,000,000
Had Fab Ltd	01875 611711									●	●	✓	4					Up to £3,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●				●				●	●	✓	4			✓	●	Up to £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●			●	✓	4			✓	●	Up to £2,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●	●	●				●	✓	4			✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £4,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499									●	●	✓	3			✓		Up to £800,000
Structural Fabrications Ltd	01332 747400	●		●	●	●	●			●	●	✓	3				●	Up to £1,400,000
Taziker Industrial Ltd	01204 468080	●			●	●	●			●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●			●	●	●			●	●	✓	4	✓		✓		Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	●	Above £6,000,000
Non-BCSA member																		
Allerton Steel Ltd	01609 774471	●		●	●	●	●			●	●	✓	4			✓	●	Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	✓	4					Up to £1,400,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●		●	●	●	●	●		●	✓	4			✓	●	Up to £800,000
Ekspan Ltd	0114 261 1126	●				●			●	●	●	✓	2					Up to £400,000
Francis & Lewis International Ltd	01452 722200									●	●	✓	4			✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879									●	●	✓	3			✓		Up to £40,000
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
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

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
Control Energy Costs Ltd	01737 556631
Gene Mathers	0115 974 7831
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030

Company name	Tel
Kier Construction Ltd	01767 640111
McGee Group (Holdings) Ltd	020 8998 1101
PTS (TQM) Ltd	01785 250706
Sandberg LLP	020 7565 7000

Company name	Tel
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

Industry Members

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

1 Structural components
2 Computer software
3 Design services
4 Steel producers
5 Manufacturing equipment
6 Protective systems
7 Safety systems
8 Steel stockholders
9 Structural fasteners

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
AJN Steelstock Ltd	01638 555500								●		M		
Albion Sections Ltd	0121 553 1877	●									M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I		
AVEVA Solutions Ltd	01223 556655		●								N/A		
Ayrshire Metals Ltd	01327 300990	●									M		✓
BAPP Group Ltd	01226 383824									●	M		
Barrett Steel Services Limited	01274 682281								●		M		
Behringer Ltd	01296 668259					●					N/A		
British Steel Ltd	01724 404040				●						M		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
Composite Metal Flooring Ltd	01495 761080	●									M		
Composite Profiles UK Ltd	01202 659237	●									D/I		
Cooper & Turner Ltd	0114 256 0057									●	M		
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A		
Daver Steels Ltd	0114 261 1999	●									M		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	●	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	●	
Forward Protective Coatings Ltd	01623 748323						●				N/A		
Hadley Industries Plc	0121 555 1342	●									M	●	
Hempel UK Ltd	01633 874024						●				N/A		
Highland Metals Ltd	01343 548855						●				N/A		
Hi-Span Ltd	01953 603081	●									M	●	
International Paint Ltd	0191 469 6111						●				N/A	●	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
Jack Tighe Ltd	01302 880360						●				N/A		
Jamestown Manufacturing Ltd	00 353 45 434288	●									M		
John Parker & Son Ltd	01227 783200								●	●	D/I		
Joseph Ash Galvanizing	01246 854650						●				N/A		
Jotun Paints (Europe) Ltd	01724 400000						●				N/A		
Kaltenbach Ltd	01234 213201					●					N/A		
Kingspan Structural Products	01944 712000	●									M	●	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lincoln Electric (UK) Ltd	0114 287 2401					●					N/A		
Lindapter International	01274 521444									●	M		
MSW UK Ltd	0115 946 2316	●									D/I		
Murray Plate Group Ltd	0161 866 0266								●		D/I		
National Tube Stockholders Ltd	01845 577440								●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A		
Pipe and Piling Supplies Ltd	01592 770312	●									M		
PPG Architectural Coatings UK & Ireland	01924 354233						●				N/A		
Prodeck-Fixing Ltd	01278 780586	●									D/I		
Rainham Steel Co Ltd	01708 522311								●		D/I		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				N/A	●	
Structural Metal Decks Ltd	01202 718898	●									M		
StruMIS Ltd	01332 545800		●								N/A		
Stud-Deck Services Ltd	01335 390069	●									D/I		
Tata Steel – Tubes	01536 402121				●						M		
Tata Steel – ComFlor	01244 892199	●									M		
Tension Control Bolts Ltd	01948 667700						●			●	M		
Trimble Solutions (UK) Ltd	0113 887 9790		●								N/A		
voestalpine Metsec plc	0121 601 6000	●									M	●	
Wedge Group Galvanizing Ltd	01909 486384						●				N/A		
Yamazaki Mazak UK Ltd	01905 755755					●					N/A		

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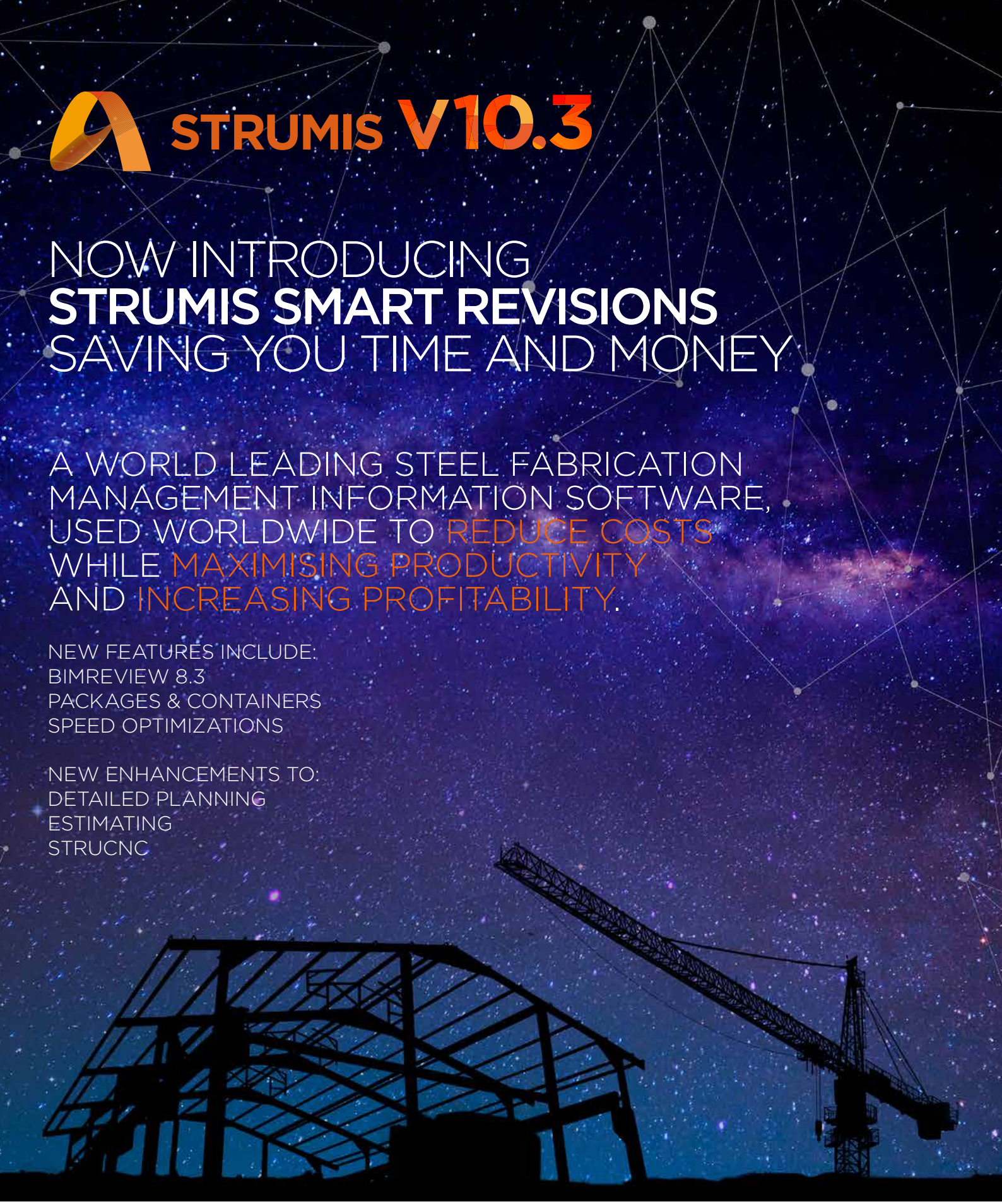

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