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NSC

Cover Image
One Leadenhall, London
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Architect: Make
Construction Manager: Multiplex
Structural engineer: Robert Bird Group
Steelwork contractor: William Hare
Steel tonnage: 5,900t

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

The smart choice for innovation is steel

Nick Barrett - Editor

As outgoing BCSA President Mark Denham notes in his President's column this month, we have lived in interesting times for the past few years with challenges from COVID-19, Brexit, war in Ukraine, and rampant inflation to name but a few.

The challenges are all being risen to, but it is certain that new and unsuspected ones to be grappled with are already approaching the horizon. We are also living in fast-changing times. Not that long ago current board level priorities like sustainability, net zero carbon, building fire safety, skills shortages, and diversity would have been far away from the thinking of the upper levels of senior management. Today, these are major boardroom concerns and ignoring them risks that other new sounding concern - reputational damage.

One tried and tested strategy to protect reputations, especially as regards anything sustainability related, is to select structural steelwork as the framing solution for buildings and other structures. The message is catching on, as we see in the high proportion of steel frames being chosen for the latest growth surge in London.

After an unsteady start to the year confidence seems to be returning to the London commercial market. The latest Tall Buildings Survey of projects planned or being built in London from New London Architecture shows confidence has returned, to the Capital at least. Planners are reported to be about as busy as ever with planning applications and construction of buildings of over 75m.

NLA says there have been six approvals in the last two years for schemes up to 309m, with two in planning, another four possible by the end of the year and another two in early talks. At NSC's editorial advisory board meeting this month our round-the-table discussion revealed an encouraging list of forthcoming and current projects across the UK. As far as steel is concerned, as we can see in this month's NSC, confidence never went away.

From Bolton we report on a vitally needed new facility to train up to 3,000 students a year to enter clinical healthcare sector, and provide a high boost to the local economy. Steel was chosen particularly for its cost-effective, speedy construction, on a site within a working hospital where impact on patients and healthcare professionals had to be minimised.

We report on steelwork being completed on the UK's biggest ever speculative warehouse development, at Avonmouth. Sustainability is at the heart of this project on a brownfield site which is looking for a BREEAM 'Excellent' rating.

From One Leadenhall we report on the City of London's latest high-rise commercial development. As our report from the 35-storey site says, there is a continuing flow of high-rise office blocks underway or planned, amid reports of a shortage of Grade A space. BREEAM 'Outstanding' is the objective on this project.

Design efficiency, flexibility to accommodate changing requirements in the future and low carbon benefits have been cited by the construction team as key advantages of a light steel structure selected for an office block at the University of Oxford's Life and Mind Building. Crucially, the pleasing structure will create an inviting space that will support innovative thinking. The smart thinking has already been done - the University selected steel.

SCCS becomes the 5th Recognised Assessment Body for Build UK's Common Assessment Standard

The Steel Construction Certification Scheme (SCCS) has become the fifth recognized assessment body for Build UK's Common Assessment Standard (CAS).

There are two CAS offerings for companies; SCCS Build Assured Lite (desktop assessment) and SCCS Build Assured Elite (a more comprehensive site-based assessment).

"SCCS is delighted to become a Recognized Assessment Body for Build UK's Common Assessment Standard, which helps streamline the PQ process for companies, as well as supporting enhanced requirements for supply chains, while raising the bar in a cost-effective and efficient way," said Stephen Blackman, BCSA Director of Certification.

The Common Assessment Standard (CAS) is a standardised set of questions, which incorporates PAS 91 and corresponding assessment standards, covering 10 key areas to assess a company's competency.

It has been developed to minimise duplication in the PQ process and is being adopted by many main contractors across the UK. Data can be shared with other accredited suppliers to minimise the need to complete numerous assessments.

To find out more and enquire about gaining the Common Assessment Standard with SCCS, visit:

https://steelcertification.co.uk/common-assessment-standard/

Work on schedule for Rotherham Forge Island bridge

Fabrication is currently being undertaken for a new pedestrian bridge that will be installed at Forge Island, Rotherham, providing a vital connection from the town centre to the new family-friendly leisure destination.

The 46m-long bridge is currently being fabricated by SH Structures in North Yorkshire before being installed on site in June. It will become a key element of the new landmark scheme Muse is delivering in partnership with Rotherham Council.

The bridge's design is said to take inspiration from the world-famous Bailey Bridge; a portable, steel truss bridge designed and developed by Rotherham-born civil engineer, Donald Bailey, which was used by the military throughout Europe during the Second World War.

Designed by FaulknerBrowns Architects, the new steel bridge will be clad with red/brown perforated steel panelling that matches the colour of the planned Forge Island buildings and celebrates the history of the area, which originated as a steel forge in the 19th century.

Andrew Fairest, Muse Project Director, said: "It's fantastic to see the bridge taking shape and see how a contemporary take on the pioneering Bailey Bridge design will create something quite special at Forge Island."

Forge Island is set to open to the public in 2024.

Ground broken on net zero speculative development in Doncaster

Panattoni has put the first spade in the ground to start speculatively developing its 38,793m² logistics facility at Doncaster.

Winvic Construction has been appointed main contractor for the construction of Panattoni Doncaster 420, following the approval of planning consent from Doncaster Council in February.

Severfield will be fabricating, supplying and erecting the steelwork for what is said to be the largest speculative logistics facility currently under construction in Yorkshire.

It is strategically located close to junction 3 of the M18, the M1, A1(M) and M62 motorways. The facility also benefits from its easy accessibility to the ports of Hull, Immingham and Liverpool.

The facility will be net zero carbon and is being built to a BREEAM sustainability rating of 'Excellent' and an EPC rating of 'A'. Other sustainability features include 20% electric vehicle charging spaces, 15% rooflights and the roof being designed to hold up to 100% PV panels.

The project comprises 37 loading doors, an 85m deep yard with parking for 74 HGVs, 358 parking spaces, 15m clear internal height and up to 1.5 MVa of power.

Dan Burn, Development Director at Panattoni, said: "Panattoni are delighted to be underway with another sustainable speculative commitment in the South Yorkshire region and we were very pleased to welcome Cllr Glyn Jones and representatives of Business Doncaster to the site to witness the early progress we have made.

"Panattoni Doncaster 420 occupies a prime location in South Yorkshire with fantastic transport links, providing easy access to both national and international consumer and industrial markets."

Completion of the development is expected in January 2024.

Steelwork contractor opens new Blackburn facility

Taziker said it has invested in excess of £1M to establish a brand-new production facility in Blackburn, Lancashire, which has been designed to support a two-fold increase in fabrication capacity.

Located at Frontier Park, the new facility will be used for heavy steel fabrication in support of structural steel infrastructure projects across the UK.

The new facility has over 9,000m² of fabrication space, with the ability for overhead cranes to lift up to 80 tonnes. A 40m-long bay will also be dedicated to the manufacture of footbridge projects.

Additionally, the site accommodates a 120m x 40m fully concreted yard space, which provides the capability to complete trial erections on site, reducing transportation and labour costs.

Jarrod Hulme, Managing Director Structural Solutions, Taziker said: "After the success Taziker has had over the past three years with regards to our engineering capabilities, it is time to further expand our services so that we can offer more to our clients.

"Having the ability to fabricate larger, heavier steelwork is imperative to our growth and success within the industry, and the new unit fits our needs perfectly."

Steel-framed Maidenhead offices completed

Main contractor VolkerFitzpatrick has celebrated the completion of its second office block at Foundation Park, Maidenhead.

Providing 5,200m² of Grade A office space over three floors, Snashall Steel Fabrications fabricated, supplied and erected 400t of steelwork for the project.

The building features open-plan workspaces, a full-height atrium with internal staircase, and a roof terrace. The structure also features energy-saving LED lighting and photovoltaic roof panels.

According to VolkerFitzpatrick, throughout the project, the team worked strategically to overcome a series of logistical challenges, not least working within a live business park, neighbouring an aerodrome.

Close collaboration with the airport during the planning phase allowed both parties to coordinate their schedules, ensuring that work to erect the building's steel frame could proceed on time, with minimal disruption.

Scott Reynolds, Project Manager at VolkerFitzpatrick, commented: "This high-quality project was delivered on time and within budget and I would like to thank the core team involved who showed real teamwork to complete the build in under twelve months."

Developer commits to £2bn West Midlands warehousing and industrial programme

SEGRO has been announced as a strategic partner of the West Midlands Combined Authority (WMCA), with a commitment to invest £2bn over the coming decade to deliver next generation, net zero warehouse facilities in the West Midlands.

As a strategic partner, SEGRO aims to deliver 1,250,000m² of sustainable warehouse space across the West Midlands by the end of 2033, focused on tech-enabled logistics facilities as well as purpose-built space for research & development and light manufacturing.

The development programme is expected to create up to 14,000 jobs across a wide range of employment types and industry sectors and will contribute significantly to economic growth and 'levelling up' for the region – two core aims of the WMCA.

The investment will be focused on a mix of warehousing types across the region. This includes the development of SEGRO Park Coventry - a 450-acre site that has planning permission for the construction of 340,000m² of industrial buildings and warehouses.

David Sleath, Chief Executive Officer, SEGRO said: "There is a long-term shortage of modern, sustainable industrial employment space in the West Midlands, which is vital to enable the efficient movement of goods across the country, and to support high-tech research & development and manufacturing.

"By working closely with the West Midlands Combined Authority we can identify and unlock brownfield sites for development and deliver critical infrastructure that serves the whole of the UK, creating a diverse mix of local employment and supporting the creation of a more resilient economy across the country."

NEWS IN BRIEF

Stockport Mayoral Development (MDC) has announced **The English Cities Fund** (ECF) – a JV with Legal and General and Homes England – as its preferred long-term joint venture partner to develop an eight-acre site, known as Stockport 8. The project will transform the town centre site in Greater Manchester into a new digitally enabled, green and fully walkable neighbourhood, which is set to deliver over 1,200 new homes, alongside retail, leisure, and office space.

The University of Derby has appointed **Kier** to deliver its new business school in the heart of the city centre. The scheme will have a footprint of 9,317m² and is planned to include a 233-seat auditorium, a stock market financial trading room, a creativity lab, an extended reality (XR) suite and a range of social collaborative study spaces and quiet contemplation areas.

A planning application for a striking new pedestrian and cycle bridge at **Royal Victoria Dock** has been submitted by The Silvertown Partnership. The design consists of an elegant, step-free bridge which skims the water in a 'double S-curve' shape, with ample space for both cyclists and pedestrians.

Glencar Construction has been awarded a project to build the new LHR21 facility for Vantage Data Centers at their second London Campus, near Heathrow Airport. The 18,000m² data centre will be six-storeys high and house data processing equipment (telecommunications and computers) that will serve various businesses and enterprises that deliver online data services.

Rocket manufacturer **Orbex**, has announced that construction has begun at Sutherland Spaceport (formerly known as Space Hub Sutherland) in Scotland, which will be the first vertical launch spaceport to be built on the UK mainland. The site will launch up to 12 orbital rockets per year for the deployment of satellites into Earth's orbit.

PRESIDENT'S COLUMN

As my time as BCSA President is ending, it's natural for me to reflect on the past three years in office and the challenging times we have all faced.

I was elected BCSA President in June 2020 at the start of the pandemic. Back then we were in lock-down and even our AGM was online. I reported that GDP had fallen by 20.4% in April 2020 and the construction sector had fallen by a massive 44%. We didn't know when the pandemic was going to end, or what its effect would be on mortality and if a vaccination was possible. The Job Retention scheme was in place, and we all learnt a new word, 'furlough', with many businesses taking advantage of this scheme and laying off staff on 80% pay. We were also talking about CIBLS (Coronavirus Business Interruption Loan Scheme) and reverse VAT.

Fortunately, a vaccination was developed, rolled out very quickly and the restrictions began to be lifted. Things started to improve, but at the 2021 AGM I reported that in 2020 GDP fell by 9.9% and this was the worse fall for over 300 years. The positive news was that the sector was expected to grow by 16.2% in 2021 and 10.6% in 2022. I'm sure we all remember the 'boom' and the material shortages in 2021/22.

I was hoping that I'd have something more normal to report at the 2022 AGM but sadly no. Russia invaded Ukraine in February 2022 and that resulted in massive increases in energy prices and large fluctuations in steel prices, seemingly increasing by £100/tonne on a monthly basis.

We are all now very familiar with the cost-of-living crises, high inflation, and high interest rates. But fortunately, there appears to be some green shoots with energy prices coming down and inflation forecast to be 5% or lower by the end of the year.

BCSA has continued to support the industry throughout the last three years and some of the major developments include the 7th edition of the NSSS, along with an updated Commentary and a new Annex J Sustainability Specification.

Sustainability is now front and centre, as we tackle the climate emergency, and BCSA is playing its part with the 2050 Decarbonisation Roadmap, an updated Sustainability Charter, a series of carbon footprinting tools to help members measure and reduce their emissions and a model specification for the purchase of re-used steel.

In 2022 the Building Safety Act became law which introduced some of the most important changes to the construction of buildings in a generation. One key change was a requirement for all those involved in the design and construction of buildings to demonstrate their competence and capability. In response, BCSA updated, improved and simplified its Register of Qualified Steelwork Contractors (Buildings), and opened the new scheme up to non-members in April 2023. BCSA also revised the 7th edition of the NSSS to introduce this new assessment scheme for steelwork contractors to demonstrate their competence and capability in the fabrication of structural steelwork, and make it mandatory from 2nd October 2023.

It's fair to say that my three years as BCSA President have been some of the most difficult years the country and our industry have seen. What has impressed me though is the resilience of our constructional steelwork industry and the BCSA. We have met all of these challenges and emerged stronger.

Mark Denham
BCSA President

Yorkshire MP recognises industry concerns during factory visit

Left to right: Jonathan Sochart, Commercial Director NTS; Kevin Hollinrake MP;Jeanne Bianco, Managing Director NTS; Mike Mannion, Group Manufacturing Director Severfield; David Moore, BSCA CEO.

MP for Thirsk and Malton, Kevin Holinrake, acknowledged steel sector concerns about retentions, training and public contracts when he visited the North Yorkshire facility of National Tube Stockholders (NTS).

During the visit, Mr Holinrake, who is also a minister in the department of business and trade, met with executives from NTS, Severfield and staff from the British Constructional Steelwork Association (BCSA). They discussed the industry's contribution to the UK economy and what steelwork companies are doing to generate more growth across the sector.

With retention clauses affecting the cash flow for firms across the steelwork sector, Mr Hollinrake was happy to engage on the issue. The allocation of publicly funded projects to UK-based firms was also discussed, along with concerns over the skill set of the future workforce.

Mr Hollinrake MP said: "The steel industry is a vital part of the UK economy and it was great to discuss with leaders from NTS and Severfield about how we can plan for more growth in the future.

"I've been continuing my work connecting local engineering businesses with apprentices and it's clearly so important we source skilled workers from the local area for future projects for these firms."

Lindapter launches steel connection solutions for fabricators brochure

Lindapter, the manufacturer and designer of steel connection solutions, has launched a Fabricator's Brochure that offers advice on every stage of construction process.

The company said, fabricating steel structures requires efficient and reliable connection solutions that can save time, reduce costs, and improve overall project efficiency. Our new brochure addresses these challenges by offering a comprehensive range of solutions to help fabricators, engineers and construction professionals overcome common problems and deliver exceptional results.

Traditional methods, such as welding, drilling and bolting can be time-consuming and costly. Lindapter said its unique and innovative steel connection solutions offer significant benefits for fabricators.

Its solutions are said to be up to 50% faster than site welding and up to 28% faster than drilling and bolting.

In addition, they offer up to 35% cost savings compared to site drilling.

The installation process is adjustable, reducing the need for expensive and time-consuming surveys. Lindapter said its solutions can be installed using standard hand tools without causing any damage to the steelwork and finishes.

The brochure can be downloaded for free at: *https://www.lindapter.com/fabricators-support-for-every-construction-project*

Horsham bridge to spur future development

Spanning the A264 in north Horsham, West Sussex, a steel footbridge provides a vital link between the £1bn Mowbray estate and the town centre.

Working on behalf of main contractor Natta Building, Nusteel Structures designed, fabricated, painted and erected more than 200t of steelwork for the bridge and its access ramps.

The bridge's bow Vierendeel main span is 53m-long x 4.8m-wide and 5.4m-high at mid-span. The main span was fabricated and transported to site in sections, which were spliced together onsite, prior to being installed as a complete piece.

Once the main span was in place, approximately 150m of curved and straight twin-stringer 3.5m-wide approach ramps were installed.

Currently under construction, the new Mowbray estate consists of 2,750 homes, shops, businesses and a school, which will provide places for 1,620 pupils aged four to 16.

Altrincham poised for much-needed logistics space

Caddick Construction has begun work on two high specification industrial units in Altrincham, Manchester on behalf of Quorum Developments.

Meeting the increased demand for logistics space in the area, the £7M Ocean Street development involves the demolition of an existing two-storey office and removal of external hardstanding. Caddick will then commence construction of two steel-framed industrial units offering 3,437m² and 2,322m² respectively.

Designed and constructed to a BREEAM 'Very Good' rating and aiming to achieve an EPC rating of 'A', Caddick said it is dedicated to hitting its sustainability targets and delivering developments that continue to work towards the Government's net zero aspirations.

Both buildings will have a two-storey office and mezzanine deck. External facilities are set to include 80 car parking spaces, with seven EV charging ports, five level access doors, landscaping, drainage and a new site entrance onto George Richards Way.

Green light for Southport Events Centre

Southport's new Marine Lake Events Centre has reached a milestone after it was approved by Sefton Council's Planning Committee.

Construction work, led by main contractor Kier, on the state-of-the-art, £73M venue is set to start on site, this summer.

Based on the site of the former Southport Theatre, the Marine Lake Events Centre will be a flexible events space. It is expected to bring more than half a million new visitors to Southport each year and generate an annual £18M boost for the local economy.

Sefton Council's Planning Department said it worked closely with the project's architects and specialists during the pre-planning phase to make sure the eventual application was of the best quality possible.

The Marine Lake Events Centre is one of the schemes being developed as a result of the successful bid for £37.5M of Town Deal funding for Southport. A significant proportion of this funding is for the Events Centre, as well as for the Light Fantastic, a water, light and sound show in the neighbouring Marine Lake.

Planning consent sought for Ardrossan community campus

North Ayrshire Council has received a planning application to develop a new community campus on the former Shell refinery site in Ardrossan.

Designed by JM Architects, the facility will comprise learning provision across early years, primary, secondary and additional support needs.

Dubbed a super school, the project will have shared community facilities including a library and learning hub; a swimming pool; sports hall; gymnasium; dance studio & fitness studio, and outdoor sports facilities including two sports pitches and a Multi-Use Games Area (MUGA).

If the application is approved by North Ayrshire Council's planning committee later this year, it is anticipated that the new campus will be open in August 2026.

Construction is due to begin next year, but before the structure can be built an extensive remediation programme and other enabling works will be carried out.

Diary

For SCI events contact SCI Education, tel: 01344 636500 email: *education@steel-sci.com* web: *https://portal.steel-sci.com/trainingcalendar.html*

Tue 13 & Thu 15 June 2023
Designing in Stainless Steel
Online
This course will equip engineers with the skills necessary to design structural stainless steel in accordance with current European design practice. Topics to be covered include: material and mechanical properties; recent case studies; designing members and connections; and fire resistance. The differences in properties and behaviour compared to carbon steel will be highlighted. Each delegate will be given a PDF copy of the SCI Publication *Design Manual for Structural Stainless Steel* (P413)

Tue 4 July 2023
Connection to Cores
Webinar, SCI/BSCA Members only
The webinar will follow the contents of SCI publication P416, *The Design of Cast-In Plates*. All members will receive a PDF copy of the book along with the handouts. Topics addressed will include: the behaviour of simple connections to cast-in plates; connections with coincident axial shear forces; the design model for the cast-in plate; contractual arrangements and design responsibilities; the effect of construction tolerances. Features of the design example included in the publication will be discussed.

Tue 5 September 2023
Acoustics
Webinar, SCI/BSCA Members only
This webinar will provide an introduction to the sound and acoustic performance of steel-framed buildings. It will include background information on sound and implications for acoustic detailing, regulations and requirements. Presented by Andrew Way from the Steel Construction Institute.

Helping to make nationwide deliveries, the company has a fleet of 28 trucks.

Your national tube partner

National Tube Stockholders (NTS) are structural steel tube specialists, its reputation has been built by delivering quality products and consistently high levels of service. Commercial Director, Jonathan Sochart, answers our questions and explains how the company tailors its service to meet the needs of the structural fabrication market.

Q: What range of stock does NTS hold?

"We have over 30,000 tonnes of onsite stock in the UK, including hot and cold structural hollow section up to 30mm-thick and lengths from 7.5m through to 17m, delivered on our fleet of 28 trucks. We also carry stock of hot finished seamless tubes up to 120mm-thick."

Q: How is NTS different from other providers?

"We've been supplying the construction industry for over 35 years. During this time, we have amassed considerable knowledge and experience, which has ultimately led to our recent investment in state-of-the-art laser processing to support the demands of the sector.

"Our overall approach to service is driven by the ever-changing needs of our customers. Teamwork and a dedication to 'going the extra mile' are the hallmarks of 'The NTS Way' of developing longstanding customer relationships.

"I feel, when evaluating your supply chain, the main thing to consider, alongside stock availability and service level, should be capability. This is where NTS excels. For us, the total customer experience is driven by continually adding value. It begins with effective communication, ensuring customers are informed about progress and developments, keeping delivery promises and meeting expectations. It all culminates in quick, reliable deliveries being made across the UK and Ireland."

Q: What changes has NTS seen over the last 35 years?

"Having stocked and supplied steel tubes across five decades, we've seen a noticeable increase in processing demand, driven either by customers looking to increase their productivity or due to a general labour and skills shortage. As the UK structural steelwork market evolves and becomes more efficient, NTS continues to invest in new technology to support the sector development. In 2020, we invested in a purpose-built laser-profiling unit, containing four BLM laser profiling machines – two jumbo laser machines (LT14 and LT24 - the largest in the UK) which can profile up to 610 ØD, for larger projects, and then two LT8 machines, which can process up to 219 ØD - perfect for smaller jobs."

NTS has a dedicated team of skilled workers that use the most up-to-date steel processing equipment.

Q: What are the typical laser applications & benefits?

"You've got items like roof trusses, one-off complex tubular structures and then smaller parts like bracings and even edge protection components. We produce saddle cuts, complex cuts, weld preps, mitres, holes and slots.

"The primary benefits over conventional methods of production are accuracy, repeatability, quality of cut and in many cases costs. The cost calculation is specific to the job content and the in-house capabilities of the fabricator."

Q: Do you have the capability to manage 3D drawings?

"Yes, absolutely. For starters, we have a dedicated CAD team, which can accept multiple file types including widely used Tekla files. The CAD team draws all the parts itself to ensure accuracy before we begin profiling."

Q: What is the direction of travel for NTS?

"We invest in long-term relationships with quality suppliers, which ensures operating stability to give our customers a stable supply chain so we can consistently deliver."

"The internal focus of the business is centred around building a professional team who are comprehensively trained in the relevant products and services."

Q: How does NTS approach customer service?

"We are thoroughly committed to delivering service excellence. This approach has driven the business from its outset and has delivered a sustained growth in our regular customer base We call it 'The NTS Way', – our culture is built on openness and dependability."

Q: How can interested businesses contact you?

"If you'd like to speak with us about your requirements, then please get in touch by phone or email us." ■

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sales@nationaltube.co.uk

National Tube Stockholders is a Gold sponsor of Steel for Life

STEEL for life

BCSA

Make sure your Steelwork Contractor is RQSC approved

Image courtesy of William Hare Limited

Specify an approved company from the Register of Qualified Steelwork Contractors for Buildings, to ensure your project meets the Building Safety Act requirements. As of October 3rd 2023 it will become mandatory in the NSSS that all Steelwork Contractors are RQSC approved.

Tel: 020 7839 8566
Email: postroom@bcsa.org.uk
Web: www.bcsa.org.uk/buildings-directory

RQSC

The Register of Qualified Steelwork Contractor **Buildings**

Steel-framed addition for City skyline

Maximising office spaces and increasing the site's available footprint with a raking transfer structure, a steel-framed design has provided a number of solutions for One Leadenhall, the City of London's latest high-rise commercial development.

The One Leadenhall development incorporates widened pedestrian thoroughfares along two elevations.

FACT FILE
One Leadenhall, London
Main client: **Brookfield Properties**
Architect: **Make**
Construction Manager: **Multiplex**
Structural engineer: **Robert Bird Group**
Steelwork contractor: **William Hare**
Steel tonnage: **5,900t**

The City of London's appetite for new commercial buildings shows little sign of abating; as one tall building completes another is already rising up out of the ground.

With a number of new structures in the concept stage or awaiting planning permission, it's all good news for the steel construction sector, as the UK's high-rise office blocks are invariably designed with a steel frame.

Currently under construction in the square mile, and a good example of how steel construction can help provide the efficient and modern column-free commercial spaces required by today's tenants, is One Leadenhall.

Topping out at 35-storeys, including two basement levels, the tower will offer 40,000m² of office accommodation, a free public terrace at fourth floor level as well as retail space alongside its ground floor double-height entrance lobby.

Located on a plot adjacent to the Grade II*-listed Leadenhall Market, which was once the site of the ancient Roman Forum, the new structure will join the cluster of well-known commercial City structures.

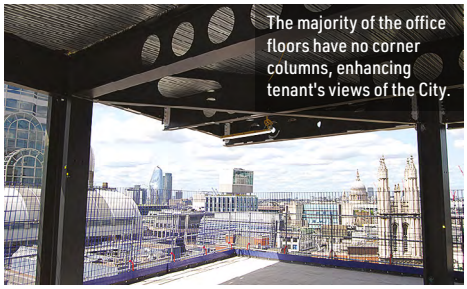
Work on the site commenced in 2020, with the demolition of the existing eight-storey 1980s-built office block. Enabling works included the installation of a piled raft foundation solution, while much of the former concrete framed structure was crushed onsite into a granular material and reused as a piling mat.

The proximity of the listed market, along the site's southern boundary, required a staged ground movement analysis, aligned with the construction programme, to be undertaken, in order to estimate the movement prior to, during and after the demolition.

The old building was separated from the market with a series of bearings, keeping the two structures independent and ensuring no adverse movement. On the new build, these bearings have been replaced with new ones, installed in the exact same positions along the ground floor mezzanine and first floor levels.

The new building's steel frame begins at basement level one, sitting atop a lower concrete plant level. Having the steel columns founded below the ground floor level is part of the security design strategy. It enhances the robustness of the steel frame by removing the column base plate connections from within the potential blast zone in the event of an explosion.

Wrapped around a centrally-positioned stability-giving concrete core, the steelwork supports a concrete ground floor slab, and a composite metal decked flooring solution for all of the upper levels. Floor beams are typically 650mm-deep Fabsec


The majority of the office floors have no corner columns, enhancing tenant's views of the City.

cellular sections that enable the integration of the building's services within their depth.

As with most city centre projects, and in particular jobs in the Square Mile, the One Leadenhall site is very tight, with roads along three boundaries.

"The building's footprint uses all of the 55m × 55m plot and so the delivery of materials can be challenging.

"We've had to liaise closely with Transport for London and the City of London highways teams, in order to obtain external pit lanes along Leadenhall and Gracechurch Street, while a third one has required us to partially close Whittington Avenue for the duration of the works," explains Multiplex Engineering Lead Dylan Wright.

Maximising the site's footprint is one of the key elements of the steel design. The office floorplates are clear column-free spaces with spans of up to 15m on the uppermost levels. There are only two internal columns in the structure, and these are located from level 22 upwards, where the core contains fewer lifts and reduces in size. However, the two columns do not intrude into the office spaces as they are positioned within bathroom partition walls.

Creating more valuable space and increasing the structure's floorplates, the design incorporates a series of perimeter raking columns that splay outwards from first to sixth floor.

Over-sailing the busy Leadenhall and Gracechurch Street thoroughfares, the raking design creates a colonnade around two sides of the building that will benefit from an enhanced pedestrian environment, with widened and resurfaced pavements.

According to project architect Make, its's design embraces the heritage of the unique setting, and complements the surrounding architecture in scale, proportion and materials. The section of the building incorporating the raking columns is known as the 'street block' and its pre-cast concrete cladding will reflect characteristics of similarly sized neighbouring buildings. Above this zone, the structure reverts to a typical fully-glazed office tower.

The raking columns are 600mm × 600mm fabricated box sections, that reduce in size to 356mm × 406mm UC rolled sections once the structure straightens at sixth floor.

"There are some large loads being transferred through these raking columns and to stop the frame from splaying outwards, there are large complex connections and embedment plates cast in to the concrete core to resist the tension generated in the sixth-floor steelwork and compression in the first-floor steelwork," explains Robert Bird Group Project Director Matt Quilty.


Raking columns, from first to sixth floor, help to increase the structure's available floor space.


Sat adjacent to the historic Leadenhall market and the well-known Lloyd's Building, the One Leadenhall project has used a number of design features to maximise its floorplates.

Incorporated within the raking part of the structure, the fourth-floor public terrace will allow significant new views of the City's historic architecture, from the 19th-century ironwork of the market's rooftop to the spires of the area's medieval churches.

The public terrace, accessed via its own dedicated lift, will sit alongside a restaurant accommodated within a large double-height space, which is created by the fact that the fifth floor, which houses plant, only extends over half of the structure's footprint.

Steelwork contractor William Hare began the erection package in September 2022 and is due to complete the frame, which consists of approximately 6,000 pieces, this October.

One of its final steel elements will be a rooftop grillage that will support the building's Building Maintenance Unit (BMU). Adding to the project's sustainability credentials that include a BREEAM 'Outstanding' rating, much of the grillage will be sourced entirely from re-used steel.

All of the steelwork has been erected using the project's three tower cranes, but another consequence of the constrained nature of the site, has been the challenge of where to position the lifting equipment.

To this end, one of the cranes has been installed on a cantilever gantry tied back to the steel frame and overhanging the Whittington Avenue elevation and thereby outside of the footprint.

When the project completes the crane will be dismantled and the gantry will also be removed. However, the steelwork bracing that ties the tower crane gantry back to the main core for support will remain.

Consisting of a series of shallow box sections, the bracing has been installed to the underside of the eighth, 17th and 27th floors, alongside the cellular beams and is slim enough, so as not to interfere with the permanent services runs.

"This is the benefit of having Robert Bird Group as the structural engineer also undertaking the temporary works design in an integrated manner. It made sense to have the temporary bracing designed as permanent steelwork, as the contractor won't have the extra workload of having to remove steel members at the end of the project, when other follow-on trades will be busy finishing the floors with the fit-out," adds Mr Wright.

One Leadenhall is due to complete by the end of quarter one 2025. ■

Located within the grounds of the Royal Bolton Hospital, the medical training college will train up to 3,000 students a year.

Medical training framed in steel

A new steel-framed medical training college in Bolton will provide a timely boost to the NHS and the local economy.

Helping to alleviate NHS staffing pressures in Greater Manchester and the North West, the Bolton College of Medical Sciences (BCMS) will train up to 3,000 students a year and contribute as much as £150M to the borough's economy when completed in 2024.

This flagship steel-framed facility is a collaborative project between the University of Bolton, Bolton College, Bolton NHS Foundation Trust and Bolton Council.

The BCMS will give people a direct route into clinical healthcare employment. with a focus on practical, skills-based learning in a hospital environment.

In addition to a range of new courses and apprenticeships that will provide entry-level and higher-level skills development for those aged 16+, the BCMS will also deliver continual professional development opportunities for existing NHS staff.

Annette Walker, Director of Finance at Bolton NHS Foundation Trust, says: "The project will help us develop our existing staff and provide new routes for those who want a future in healthcare to expand their skills. It really is an exciting project both for us as an organisation and the whole town."

Bolton Council's Executive Cabinet Member for Regeneration, Councillor Adele Warren, adds: "The BCMS will be a great asset to our borough, creating jobs and giving residents the opportunity to learn skills and train for a new career. The council is proud to work closely with our partners on this development, one of many key regeneration projects being delivered across the borough."

The project is located within the grounds of the Royal Bolton Hospital and main contractor Willmott Dixon began work in July 2022. It initially remediated the plot and then installed new drainage and foundations.

The foundations consist of pads sat on more than 400 individual concrete modular columns, which are up to 8m-deep. This method was considered to be the most efficient solution for providing not only ground improvement, but also support for the steel-framed five-storey BCMS building.

According to Kier Design & Business Services, the project's structural engineer, a steel frame was chosen as it offered a quick construction programme and the most cost-effective solution.

The steel frame was completed in March, but during the erection programme, steelwork contractor Leach Structural Steelwork had to coordinate its work around a number of other onsite trades. Consequently, the company had little room for materials storage throughout its programme.

"It's quite a confined site, so the steelwork was mostly delivered one load per day, which was then erected using a single 150t-capacity mobile crane," says Willmott Dixon Building Manager Gary Dearden.

With the crane predominantly positioned within the frame's footprint, the steelwork was installed sequentially from west to east, with each bay of the structure erected to its full height.

Overall, the steelwork forms a large braced frame, and in common with many other educational buildings with numerous windows, suitable locations for bracing were scarce around the elevations.

FACT FILE
Bolton College of Medical Sciences
Main client: **University of Bolton**
Architect: **Associated Architects**
Main contractor: **Willmott Dixon**
Structural engineer:
Kier Design & Business Services
Steelwork contractor:
Leach Structural Steelwork
Steel tonnage: **390t**

Adopting a design in-keeping with steel-framed structures, the majority of the stability-giving cross bracing is located around the building's precast lift and stair cores.

Perimeter columns are spaced at 6m intervals, while, internally, each floor has a central corridor dividing two rows of rooms that are 7m- and 9m-wide respectively.

Flexibility has been designed into the steel frame, as the partition walls contain no columns or bracings and could be removed in the future if larger teaching rooms or offices were required.

On all of the upper levels, steel beams support metal decking and a concrete topping to form a composite flooring solution. All of these floors have a uniform 3.8m-high floor-to-ceiling height.

As the ground floor has the main entrance it is slightly different and has a 6m floor-to-ceiling height. Its larger volume allows it to accommodate a lecture theatre at the western end of the building. In order to omit some internal columns and create the required open-plan space, a 18m-long × 1.5m-deep truss is positioned at first floor level.

"Weighing close to 12t, the truss was fabricated and delivered in one piece. It was slightly tricky manoeuvring it into site, as it represented the largest steel item on the job, as well as the heaviest piece of steelwork we had to install," says Leach Structural Steelwork Contracts Manager Ian Wallwork.

Alongside the lecture theatre, the remainder of the ground floor will have a library, kitchen and canteen alongside the main entrance, which is framed with two architectural and exposed feature galvanized CHS columns.

The entrance lobby will have a feature staircase leading to a first-floor atrium. This triple-height space, will have glazed façades on two sides and will allow natural light to flood into the building.

Levels one, two and three are all similar and accommodate an array of offices and training rooms, some of which overlook the atrium.

Teaching activities will focus heavily on practical learning, and utilising the latest medical technology, such as simulation suites and surgical and acute care environments.

Finally, the uppermost level of the building is set back and contains offices along the southern elevation and an outdoor plant deck, surrounded by a 2.5m-high screen, on the north side.

As well as constructing the BCMS building, Willmott Dixon is also undertaking an extensive exterior works package. This includes landscaping around the building, a new car park and an outdoor teaching area.

The first intake of BCMS learners is due in 2024. ■


Visualisation of the completed project.


An 18m-long truss creates the column-free space for a ground floor lecture theatre.


The top floor of the building accommodates offices along one elevation and a plant deck on the other.

Steel adds to hybrid design

The completed project will provide a new and engaging educational facility for the University.

Creating a multi-disciplinary hub for innovation, discovery and research, the University of Oxford's Life and Mind Building will merge psychology and biology departments under one roof and provide flexible classroom and adaptable laboratory spaces.

Representing the University of Oxford's largest building project to date, the Life and Mind Building will create a world-class centre for life and mind sciences.

The scheme will, on completion, provide a new home for the Departments of Experimental Psychology, Plant Sciences and Zoology, while creating space for increased collaboration and knowledge exchange between the different disciplines.

According to project architect NBBJ, the design will enhance teaching and research facilities for students, staff and researchers – further elevating the reputation of the University's Science Area and setting a new standard for research buildings within the University of Oxford estate.

Darius Umrigar, Science & Higher Education Director at NBBJ, says: "The new Centre will house best-in-class research and teaching facilities, which underline the University of Oxford's reputation as one of the leading academic institutions in the world. Modern science is becoming increasingly collaborative and our designs will provide an inviting space that will support innovative thinking and multi-disciplinary communication between students and researchers with different specialisms, while encouraging engagement with the wider community."

Overall, the project comprises two new four-storey buildings; one concrete-framed structure for laboratories and a steel-framed office block focussed around workplace flexibility.

The two blocks are separated by a central terraced steel-framed atrium, which links the new public realm in the north with a south facing roof terrace, while continuing into the lower ground which in turn is connected to the new public plaza via a sunken stepped courtyard.

Four steel-framed bridges, one on each of the upper floors, will span the atrium and provide links between the two buildings. Each of the upper floors within the atrium are sequentially recessed, with the fifth floor being the narrowest, forming a stepped design.

Positioned along one end of the atrium, the existing, structurally-independent, concrete-framed Chemistry Teaching Laboratory (CTL) block adjoins both of the new buildings. Two new steel-framed floors have been added to this structure, creating more flexible space.

In order to not overload the existing foundations, a lightweight solution was required for these new floors. To satisfy that requirement, steel beams, supporting cross-laminated timber flooring was the chosen method. Following the existing grid pattern, the new steelwork provides open-plan column-free spaces, with spans of up to 13m-long.

"As the existing CTL building has been in use throughout the construction work, we had to install the new floors over 10 weekends to avoid any disruption to students and staff," explains Bourne Steel Project Manager Theodoros Pitrakkos.

The CTL block is the only remaining part of the

The steel-framed office block takes shape.

The concrete-framed laboratory building is topped with a steel-framed saw-tooth roof that covers a plant area.

site's previous buildings, which were demolished as part of the project's early works.

The new office block part of the project has a steel frame that comprises cellular beams throughout. They support a composite flooring solution of metal decking and a 130mm-deep concrete topping. Two precast concrete cores provide the steelwork with its overall stability.

"A lightweight steel-framed solution was chosen for the office block as it offers an efficient and low carbon method for this type of structure," explains Ramboll Project Engineer Murray Forsyth.

"Flexibility has been designed into the entire scheme, as lightweight partitions could be removed to create larger internal spaces if they were required in the future."

A column grid pattern of 7.5m x 6m has been used for the four upper floors of the office block, while the ground floor has a larger grid with fewer internal columns. To achieve the more open-plan floorspace, a series of transfer structures are located at first floor level, picking up the extra columns of the upper levels.

The transfer structures consist of five pairs of double beams, which are each 1m-deep and 16m-long.

Weighing 10t each, the beams were individually lifted into place by one of the site's tower cranes, before being connected to another section to form the five pairs.

As the open-plan ground floor will accommodate the main entrance, as well as forming the main frontage of the project along South Parks Road, these two elevations feature perimeter CHS columns. Chosen for their aesthetic value, the circular columns are 3.8m-high and only extend to the underside of the first floor.

Bourne Steel has also erected some further steelwork elements to the roof of the concrete-framed laboratory building. This steelwork includes an L-shaped saw-tooth structure that covers approximately one-quarter of the entire roof and will enclose a plant room.

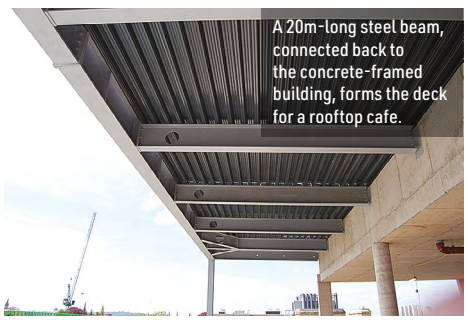
The majority of the steelwork package was erected using one of the site's tower cranes. However, in order to free-up the cranes for other trades, the high-level steelwork on top of the laboratory building was installed using a spider crane, mounted on the roof.

Steelwork also forms the high-level deck for a rooftop café as well as bracketry, which will connect and support the building's cladding systems.

Construction of The Life and Mind Building is due to complete during the final quarter of 2024. ■

FACT FILE
Life & Mind Building, Oxford
Main Client:
University of Oxford and Legal & General JV
Architect: **NBBJ**
Main contractor: **Wates Construction**
Structural engineer: **Ramboll**
Steelwork contractor: **Bourne Steel**
Steel tonnage: **1,000t**

"A lightweight steel-framed solution was chosen for the office block as it offers an efficient and low carbon method for this type of structure"



A 20m-long steel beam, connected back to the concrete-framed building, forms the deck for a rooftop cafe.

Going big in Avonmouth

Comprising two distribution centres, structural steelwork has been completed on the UK's largest-ever speculative development

The project comprises two warehouses, which together represent the UK's largest-ever speculative development.

Both warehouses feature internal two-storey offices.

FACT FILE
Panattoni Park, Avonmouth
Main client: **Panattoni**
Architect: **AJA Architects**
Main contractor: **ISG**
Structural engineer: **Hydrock CDP**
Steelwork contractor: **Severfield**
Steel tonnage: **4,900t**

The construction of vast distribution centres shows little sign of slowing down, as a raft of projects are currently underway across the UK, with many more about to kick-off later this year.

With nearby major international docks and rail freight facilities, as well as being close to both the M4 and M5 motorways, Avonmouth near Bristol has become one of the prime locations for distribution centres.

A short distance from the River Severn, developer Panattoni is currently constructing the UK's largest-ever speculative development in order to supply what is said to be an under-supplied market. The scheme, known as Panattoni Park, Avonmouth, consists of two 17m-high units; one offering 37,718m² of floorspace and a much larger unit providing 82,727m².

Sustainability is at the heart of the project as both units are aiming to achieve a BREEAM 'Excellent' rating and an EPC rating of 'A'. They will also benefit from sustainability features such as roof-mounted solar PVs, rooflights and EV charging points.

The biggest warehouse, Unit 2, has five spans and offers 82,727m² of floorspace.

As part of Panattoni's net zero programme, Avonmouth is the latest development to be targeting net zero for embodied carbon during construction, by enhancing a number of sustainable credentials.

One of these measures is the use of an analytics system, which helps the company monitor the fuel consumption required for its site cabins. By rationalising and turning off power in unused rooms, it enabled the downsizing of the required generator, thereby making some considerable cost and fuel savings.

Work on the brownfield site, which was previously occupied by an ICI facility, began in 2018. Drainage and flood defences were formed in anticipation of a groundworks and profiling package that included a large-scale remediation programme.

Prior to the two building's steel frames being erected, over 14,000 × 250mm-diameter driven piles were installed to a maximum depth of 14m.

The piled foundations support the unit's ground floor slabs, as well as the structure's steel frame, as each column, which are spaced at 3.3m intervals, is founded on four individual piles.

Working on a design and build contract, steelwork contractor, Severfield, says a sustainable approach has been undertaken, so that all of the steel sections used for the project are as efficient as possible.

Once the site was ready, Severfield began its erection programme with the larger Unit 2. This portal–framed building is 425m-long (53 bays) × 188m-wide and comprises five 37.6m-wide spans.

Predominantly using three mobile cranes for the erection of each building, both unit's spans were erected with each rafter being lifted into place in two pieces.

Severfield Operations Director Stephen Jay-Hanmer, says: "Once the rafter's two pieces have been connected to their supporting columns using two cranes, the central splice is bolted up. A third crane is then used to install infill secondary steelwork, while the other cranes continue to support the main rafter."

Within its footprint, Unit 2 includes a two-storey office as well as a couple of two-storey hubs. All three of these facilities are formed with steel beams supporting metal decking and a concrete topping for a composite flooring solution. The roof of the office is formed with the same method as it accommodates a plant deck.

"Speed of construction, especially for the steel frames, is vital on projects such as this."

The main office is on the project's critical path as it requires more fit-out than the majority of the building. For this reason, it was one of the first parts of the steel frame to be erected.

Before Severfield had completed the steel frame for Unit 2, the erection programme for Unit 1 had already begun. At this point, there were two separate gangs working simultaneously with a total of six cranes onsite.

"Speed of construction, especially for the steel frames, is vital on projects such as this," says ISG Project Director Phil Sidell. "A number of other ▸20

Panattoni Park, Avonmouth benefits from its proximity to the nearby docks and motorway links to London, the South West, and Wales via the Severn Crossings.

▸19

trades follow-on directly behind the steel erectors, so once a few bays are up, the cladding and roofing installation is begun, making the building watertight as quickly as possible."

The smaller Unit 1, measures 255m-long × 144m-wide and consists of four 36m-wide spans. Similar to its larger neighbour, this building also contains a two-storey office with a rooftop plant deck and a two-storey hub office.

A further steelwork package includes a three-level car park for Unit 2. Positioned at the front of the building, it will provide 693 parking spaces, 10% of which will have EV charging points. Unit 1 will have a similar steel-framed car park, offering 380 spaces over two levels.

Summing up, James Watson, Head of Development, Panattoni said: "It's great to see such great progress at the site, developing the largest-ever speculative logistics facility in the UK."

Panattoni Park, Avonmouth is due to complete in September. ■

Each of the warehouses has two-storey hubs, to be used as staff welfare areas.

Designing for steel erection

The distribution centre at Panattoni Park serves as a reminder that even apparently orthodox forms of construction demand a thoughtful approach when the steelwork is erected. David Brown of the SCI reminds designers of their obligations to consider erection in the design process.

The Panattoni Park, Avonmouth Distribution centre is similar to many others around the UK – multiple spans, hit and miss frames to maximise the column-free space. One notable comment in the main article is that the rafters were lifted separately and the apex splice completed at height – not bolted on the ground. The rafter pair had then to remain on the cranes whilst a third crane was used to erect some of the purlins. Two issues are highlighted here. Firstly, a rafter pair spanning nearly 38 m is a very slender member to attempt to pick up as one unit. In this case, the better solution was to use a crane for each of the individual rafters, but this introduces different risks of completing the apex joint at height.

The second issue is that a rafter pair is unstable until at least some of the purlins are attached – so the rafter pair must remain supported by the cranes until these vital restraints are added. The situation when erecting trusses is another common case – the compression chord will buckle out of plane unless intermediate restraints are added, so the truss must be supported until additional members are erected.

Common practice in the UK is generally to assume these issues of temporary stability are entirely the steelwork contractor's responsibility, but this is not the case. Designers have an obligation to consider hazards which give rise to risks, and – so far as is reasonably practicable – eliminate or reduce the risks and provide information on the risks that remain to be managed by others.

Although BS EN 1090-2 might be assumed to only cover the responsibilities of steelwork contractors, the standard does place obligations on the designers of structures. Clause 9.3.1 covers the Design basis for the erection method, which is required if the structural stability of the part-erected condition is not evident. Items a) to s) of that clause illustrate the issues to be considered, including requirements for temporary bracing, or propping, and the conditions for removal of such temporary works. The National Structural Steelwork Specification (NSSS) 7th edition presents the same guidance in Table 1.5 and clause 8.4.1 – a further reminder that the designer of the structure should be considering the temporary conditions during erection and providing information on necessary restraints.

Anecdotal evidence suggests that the temporary condition is often not considered at the design stage – so there is "room for improvement". ■

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Building for the future

A steel-framed solution has proven to be ideal for the construction of the UK's first foam glass plant, which will produce a new lightweight building block.

Leading construction company and building products manufacturer, Thomas Armstrong, is constructing the world's largest foam glass production facility at its Great Heck site in North Yorkshire.

Using recycled glass as a raw material, the facility will also be the first of its kind in the UK. With an annual production capacity of more than 240,000m³, the majority of the foam glass will be used in the production of lightweight aggregate blocks for the construction industry.

This new method of production is said to be more sustainable, as previously lightweight blocks were produced from the waste material generated at coal-powered energy plants. As these plants have been phased out, the material is no longer available in this country and recycled glass is filling the gap.

As well as being recycled and sustainable, using glass will produce five times the number of blocks from the same weight of material used in the old method.

Working on behalf of client and main contractor Thomas Armstrong, Evadx is fabricating, supplying and erecting 390t of steelwork for the project's four main elements.

The steel-framed elements are all structurally-independent but linked to form one large production plant. They consist of a glass storage bunker that excepts the raw material and feeds the processing equipment; a grinding mill structure that spans over the processing equipment; an independent six-storey mezzanine that supports the processing equipment within the grinding mill; and a block production building. There are also four associated silos connected to the plant, but sitting outside of the steel frames.

Early works for the project included the installation of pad foundations for all of the buildings and the excavation of a number of pits throughout the site to accommodate machinery and elevator bases.

Once this work was complete, the steel erection programme commenced with the installation of the mezzanine structure, which is 20m-high × 21m-long × 12m-wide.

"Coordination between EvadX and our machinery supplier was key to this part of the project," explains Thomas Armstrong Plant Manager Andy Clark. "Once each level of the mezzanine structure was erected, along with its mesh flooring, the plant installation team came on site and fitted the associated equipment.

"When the machinery had been installed, the next level of steelwork was erected. Working in tandem, the entire mezzanine was erected, along with the plant equipment installation, in the same one-level-at-a-time sequence."

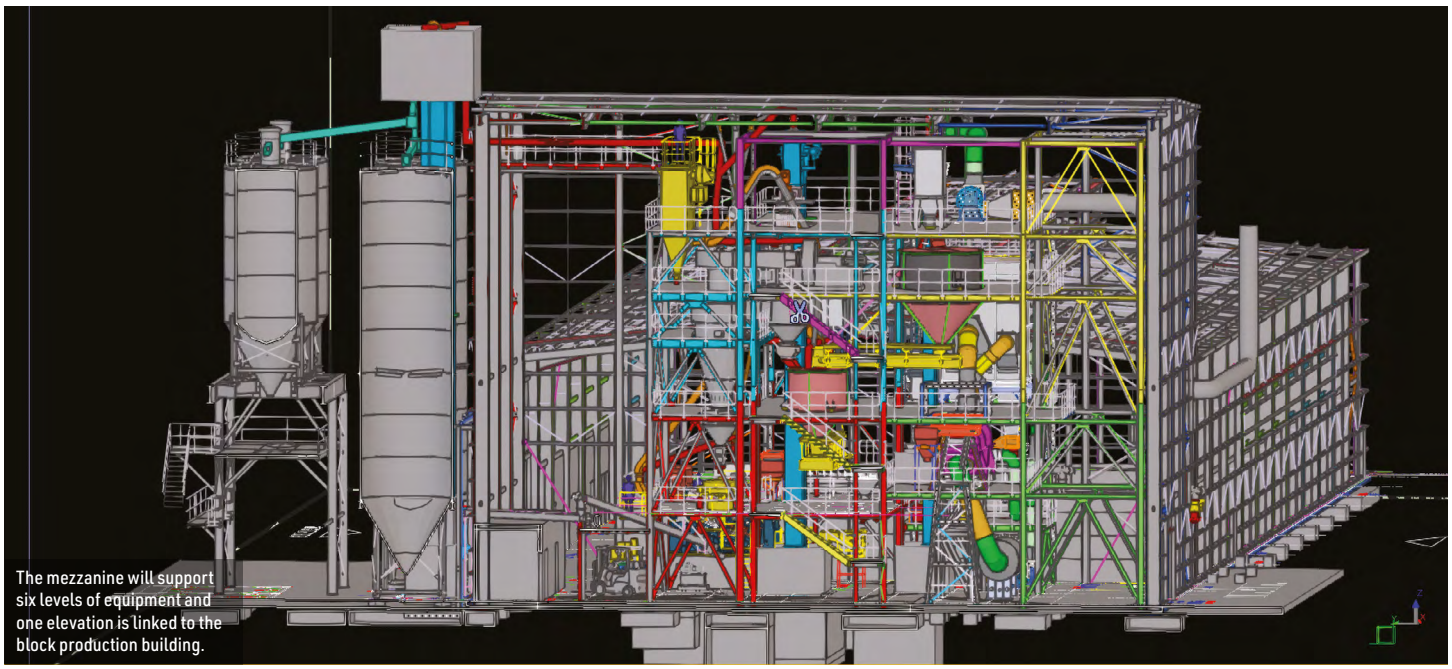
Each of the mezzanine's levels feature cross bracing, providing the structure with permanent stability, as well as sufficient rigidity while it was under construction and the plant installation was ongoing.

"We had two erection gangs, each with their own mobile crane, working on this part of the project," says EvadX Contracts Manager Andrew Roberts. "The team working on the mezzanine also helped with the machinery installation, in between the periods of steel erection."

While the mezzanine was underway, EvadX had a separate erection gang working on the adjacent portal-framed production building. This structure

"Ensuring internal open space was critical for plant and site operations on this job. Steel proved to be the ideal solution."

The four main steel-framed elements will form one large, inter-linked, production facility.



The mezzanine will support six levels of equipment and one elevation is linked to the block production building.

FACT FILE
Great Heck foam glass production facility, North Yorkshire
Main client: **Thomas Armstrong Group**
Architect: **Ellis Healey Architecture**
Main contractor: **Thomas Armstrong Group**
Structural engineer: **Curtins**
Steelwork contractor: **EvadX**
Steel tonnage: **390t**

is 85m-long × 38m-wide and reaches a height of 11m.

Using a 60t-capacity mobile crane, this team started their programme two bays in from the mezzanine structure and after inserting some temporary bracing, worked their way down the building to the furthest point.

Leaving two bays of steelwork out until later in the programme, allowed room for a crane, working on the mezzanine steelwork erection, to have sufficient room.

The production building is predominantly column-free, with the exception of one line of internal members that support a partition wall.

The perimeter columns are spaced at 8m centres and support a series of 19m-long rafters, spliced at the apex of the roof, to form the full 38m-wide span.

Meanwhile, once the mezzanine erection and equipment installation was complete, a steel-framed envelope was erected around and over this part of project to form the complete grinding mill building.

The envelope reaches a maximum height of 21m and is 29m-long × 18m-wide, and formed with a series of full-height columns and a series of spliced (two × 9m) roof rafters. Stability for this portion of the scheme is derived from a combination of moment frames and cross bracing.

The final piece of the steelwork programme was the erection of the glass store, which links into the opposite side of the grinding mill structure from the production building.

The glass store, will contain hoppers and is the area that accepts the raw material for the manufacturing process. It is another large column-free zone, measuring 38m × 17m, and reaching a height of 9m.

Similar to the grinding mill structure, it is stabilised via a combination of moment frames and bracing, while the mono-pitch roof is formed with a series of 38m-long cellular beams.

The beams are 1,300mm-deep sections and were delivered to the project in three sections. Assembled on the ground, each of the three splices contains a total of 80 M20 bolts.

Once assembled, the cellular roof beams were lifted into place using two 60t-capacity mobile cranes, working in tandem.

Summing up and explaining the choice of a steel-framed solution, Curtins Project Engineer James Smith, says: "Ensuring internal open space was critical for plant and site operations on this job.

"With the exception of the mezzanine, internal columns were limited so as not to impact on the working space for loading shovels and forklifts. Steel proved to be the ideal solution." ■

The block production building has a 38m-long internal clear span.

Mezzanine steelwork has been erected alongside and simultaneously with the installation of the processing equipment.

Steel design since 1932

Successive editions of BS 449 illustrate significant changes in steel design and practice over the last 90 years. For a recent project, the design rules since 1932 were reviewed. David Brown of the SCI identifies some of the more interesting features.

Figure 1: Recovered steel members (courtesy Cleveland Steel & Tubes Ltd)

Introduction

No-one can have escaped the fact that minimising embodied carbon in construction is a really important part of the sustainability agenda. In structural steelwork, one opportunity to save both carbon and money is to reuse steelwork. Not to recycle, but to carefully recover beams and columns (Figure 1) during demolition, refabricate and erect into new structures. It is said that around 70% of current enquiries for structural steelwork reflect this desire to reuse in some form. In 2019, SCI published P427[1] which has become the "go-to" guide on steel reuse – if there is any doubt, see *The Structural Engineer*[2] of March 2023.

P427 has a limited scope, covering steel used in construction after 1970. Material characteristics (such as yield and ultimate strengths) are available from around that time, which were then used in the determination of material factors recommended in P427. As interest in reuse grew, extending the advice to cover the reuse of 'older' steel became important. This advice has now been published in P440[3]. As part of the work leading to this supplementary guidance, the design standards and material standards of the time were reviewed, revealing some historically interesting details. The start date was selected as 1932, since this was when BS 449 was first published.

Buckling – in the beginning

Early in the development of P440, the overall objective was to ensure that an 'old' piece of steel designed to the Eurocodes would not be credited with any more resistance than it would have at first use. It might be said that the steel never knew which code it was designed to, and that its structural mechanics has not changed over time – so if we know 'more' now, why not use that knowledge? However, it is clear that steel production may have changed over the last 100 years, perhaps especially during the war years when steel was in short supply. The decision taken was that the buckling codes of the time were appropriate for the steel of the time, and that the advice in P440 should be conservative. That decision resulted in a detailed review of the buckling rules in BS 449 since 1932. Surprisingly, the earliest edition at the SCI was from 1935 – The IStructE library was able to assist.

Compression

The first issue of BS 449 in 1932 had both a formula and a chart to determine the "Working stresses on Pillars and on Compression Members". Designers will recognise the Perry-Robertson expression also seen in BS 5950 and its algebraic equivalent in the Eurocode. In that sense, not much change over the last 100 years. The 1932 edition also included a table of effective lengths, noting that the values were "in respect of typical cases only and embody the general principles which should be employed in assessing the appropriate value for any particular pillar". Thus the designer was left to reach their own decision, in some cases assessing the "efficiency of the imperfect restraint". The length of a member "adequately restrained at both ends in position and direction" was to be taken as 0.75 of the actual pillar length. By the 1935 edition, the familiar values of 0.7 and 0.85 appeared accompanied by guidance on how the end restraint could be assessed. In the Eurocode, the designer must decide what the buckling length is without guidance, which some might say does not show progress.

The 1932 and 1935 editions introduce the design model for columns in braced construction, with beams applying moments based on the eccentricity of the reaction. Those moments may be divided proportionally to the stiffness of the lengths above and below. By 1948 the assumed eccentricity of the reaction was tabulated and the simplification introduced that if the stiffnesses of the lengths above and below did not exceed a ratio of 1.5, the moment could be divided equally. It was not until the 1959 edition when the eccentricity was defined as 4 inches from the face of the section, which is the 100 mm still used today.

Lateral-torsional buckling

In the 1932 edition of BS 449, lateral torsional buckling was simplicity itself. There was no reference to lateral torsional buckling, but rules are given for uncased beams without lateral support. The allowable stress on the extreme fibre of an uncased beam was given in Tons/in² by:

$$11 = 0.15\,\frac{L}{b}$$

If the length L was less than $20b$ then the allowable stress was 8 Tons/in². This is what we would recognise as the plateau. Finally, the L/b ratio could not exceed 50.

Figure 2 shows the comparison for a 305 × 165 × 40 UB. The allowable stress has been converted into a non-dimensional reduction factor.

The plateau extends to 20 × 165 = 3300 mm

No values are given past a length of 50 × 165 = 8250 mm

Figure 2 also shows the elastic critical stress, which has been calculated from M_{cr} and the reduction factor according to BS EN 1993-1-1 (the special method for rolled sections). The BS 449 resistance looks optimistic, extending out to a plateau of 0.8 in Eurocode terms, and past the elastic critical buckling curve.

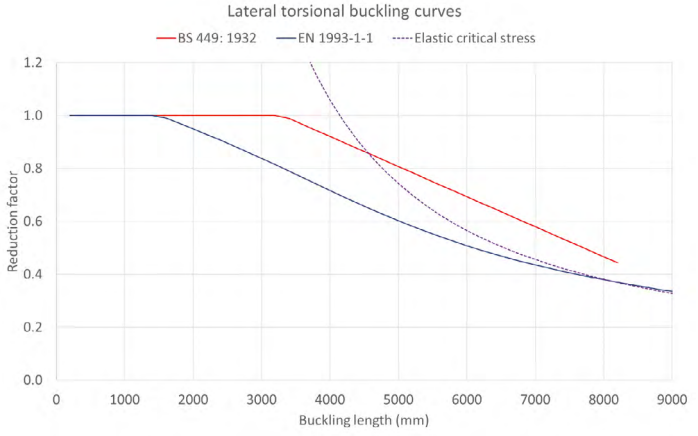


Figure 2: Lateral torsional buckling curves – BS 449:1932 and EN 1993-1-1

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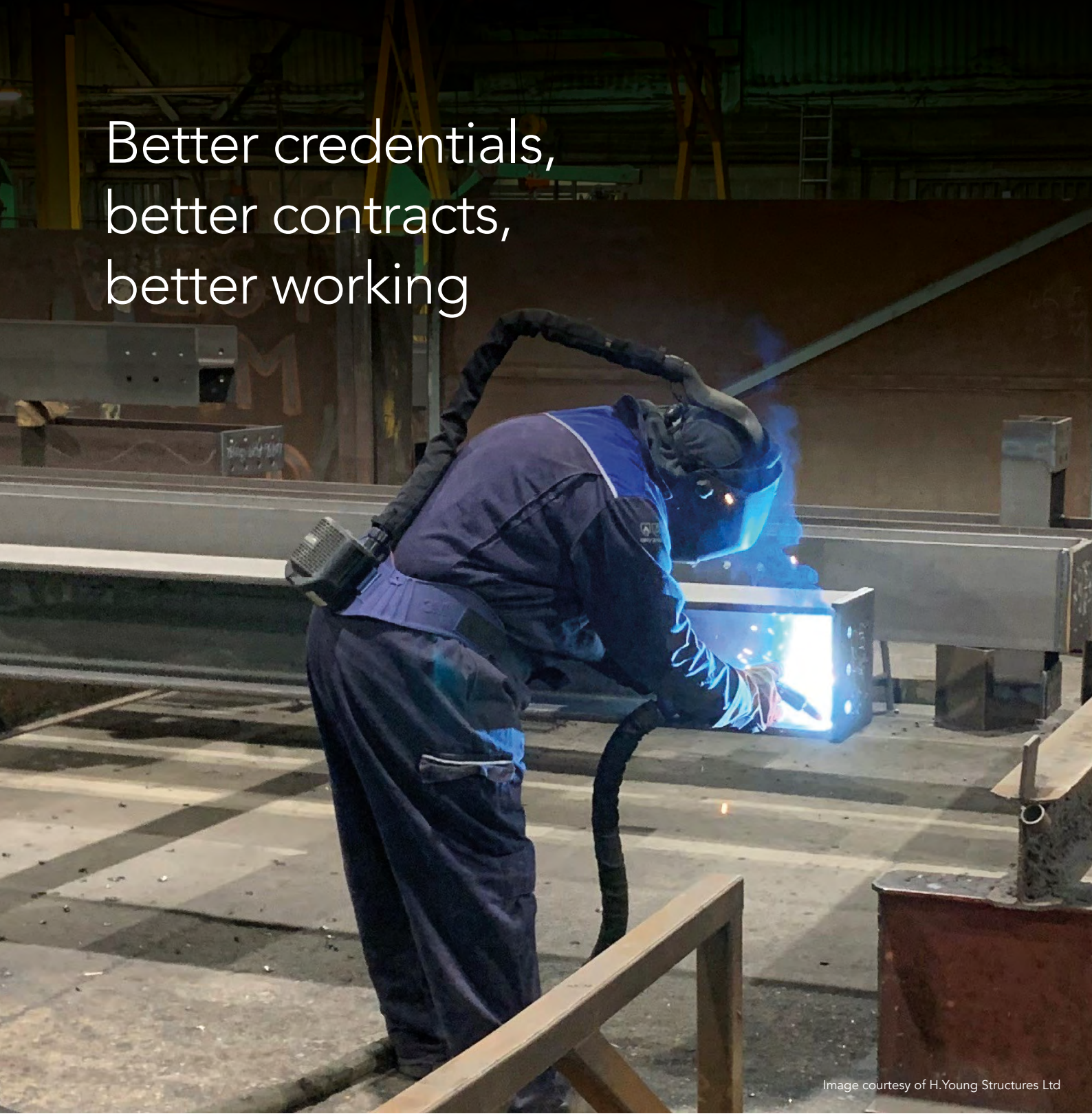

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The formula for lateral torsional buckling resistance had changed by 1948. The bending stress was given (in Tons/in²) by:

$\frac{1000}{l/r} \times K_1$ but not exceeding 10.

where K_1 is a bending stress factor, depending on the ratio $\frac{r_{xx}}{r_{yy}}$. Tall, narrow sections have a lower value of K_1.

Figure 3 includes the 1948 buckling curve for the same 305 × 165 × 40 UB, indicating an even more optimistic buckling curve.

The ratio $\frac{r_{xx}}{r_{yy}} = \frac{129}{38.6} = 3.34$ and the K_1 factor becomes 1.415.

The length of the plateau is given by (1000 × 1.415 × 38.6)/10 = 5462 mm, or in Eurocode terms, a plateau length of about 1.23 (contrast with the Eurocode maximum value of 0.4).

The 1969 edition of BS 449 pulled the curve back to the 1932 line, and also limited the resistance to the elastic critical value. The final drama appeared when Amendment 8 to BS 449 was issued in 1989 (four years after BS 5950 was first issued), and the lateral torsional buckling curves were pulled back further and broadly align with the Eurocode curves. Note that BS 449 made no allowance for a non-uniform bending moment diagram. The approach taken in P440, as with compression, was to formulate a curve that is (just) conservative compared to all editions of BS 449.

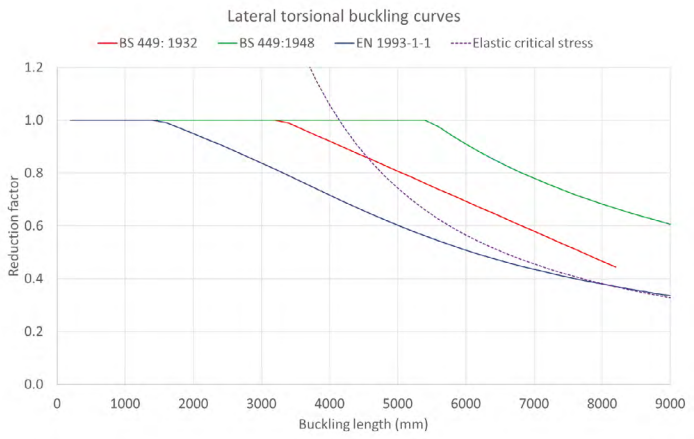

Figure 3: Lateral torsional buckling curves – BS 449:1932, 1948 and EN 1993-1-1

Connection methods

The 1932 edition of BS 449 is silent on welding, describing rivets, "turned bolts of driving fit" and "black bolts" for work in both the fabrication works and on site. Three years later, the 1935 edition notes welding as an option in both the workshop and on site "when so specified by the Engineer or Purchaser". No design guidance for welds was included.

By the time the 1948 edition was published, welding was extensively addressed with rules for butt welds, fillet welds and (in Addendum No 1) welding round the ends of hollow sections.

Welding of 'early' steel is possible, although better practice would be to form joints as anticipated at the time – using bolts. Double angle cleats would be an appropriate connection for the ends of simply supported beams, for

example. If welding is considered, the advice of the Responsible Welding Coordinator will be needed and welding trials should be considered.

Brittle fracture

The various editions of both the design standard and the material standards chart the advancing knowledge about the risk of brittle fracture. Before the Second World War, there was little interest in impact toughness in building structures. This changed dramatically with the losses of "Liberty ships" during the war, when the problems of low temperatures, high stress and stress concentrations led to around 1500 instances of significant brittle fractures. The material standard for structural steel, BS 15, had no impact toughness requirements specified in the 1948 or 1961 editions, so it seems that after the war the construction industry did not treat the issue with urgency.

It was not until the 1959 edition of BS 449 that the standard included a note that whilst welded structures of steel to BS 15 are normally satisfactory, brittle fracture was a possible failure mode in certain circumstances. Amendment 6 of 1966 included impact test requirements for the first time. Steel designers will recognise the comprehensive requirements in BS 5950 of 1985, and the even more involved considerations within EN 1993-1-10, which represent a huge change from perhaps less informed days.

One of the key recommendations in P440 is that 'early' steel may have low toughness properties, and that even subgrade JR cannot be assumed.

Reducing scope – but increasing page count

The early editions of BS 449 covered the design of the entire building, including design guidance for other materials such as masonry, concrete and mortar. The standards also included imposed loading (50lb/ft² for office floors, which is 2.4 kN/m², so quite consistent – or unchanged over 90 years despite changing use of office space?) and wind loading.

In 1932, wind loading is covered in two paragraphs. A minimum of 15lb/ft² (0.7 kN/m²) was stipulated with a further provision to be made on the sea coast and similarly exposed situations (but no advice on what that provision should be). If the building height was less than twice its width, wind pressure could be neglected altogether, provided the building was "adequately stiffened by floors and walls". By 1948, the clauses covering wind loads ran to about six pages, including internal pressures, local pressures, multi-span roofs and different categories of terrain. By 1959, BS 449 – which was always in A5 format - focussed solely on steelwork design but the page count had still grown from 33 pages in 1932 to 87 pages in 1948 and to 115 pages in 1959. One wonders what the designers of the 1930s would make of our current design standards. ■

References

1. Brown, D.G. Pimentel, R. J. Sansom, M. R.
   Structural Steel Reuse (P427)
   SCI, 2019
2. *The Structural Engineer*
   March 2023, Volume 01, Issue 3
   The Institution of Structural Engineers, 2023
3. Brown, D. G. Dougherty, L. A.
   Reuse of pre-1970 steelwork: Supplement to P427
   SCI, 2023

New and revised codes and standards

From BSI Updates May2023

BS EN PUBLICATIONS

BS EN 10248-1:2023
Hot-rolled steel sheet piles. Technical delivery conditions
supersedes BS EN 10248-1:1996

BS EN 15725:2023
Extended application on the fire performance of construction products and building elements. Principle of EXAP standards and EXAP reports
supersedes BS EN 15725:2010

BS IMPLEMENTATIONS

BS ISO 4215:2022
Corrosion of metals and alloys. Test method for high-temperature corrosion testing of metallic materials by thermogravimetry under isothermal or cyclic conditions
no current standard is superseded

BS ISO 52000-3:2023
Energy performance of buildings. Overarching EPB assessment. General principles for determination and reporting of primary energy factors (PEF) and CO_2 emission coefficients
no current standard is superseded

PAS STANDARDS

PAS 2080:2023
Carbon management in buildings and infrastructure
supersedes PAS 2080:2016

CORRIGENDA TO BRITISH STANDARDS

BS EN ISO 5173:2023
Destructive tests on welds in metallic materials. Bend tests
Corrigendum, April 2023

UPDATED BRITISH STANDARDS

BS EN 10025-4:2019+A1:2022
Hot rolled products of structural steels. Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels
Amendment, April 2023

BS EN 10025-6:2019+A1:2022
Hot rolled products of structural steels. Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
Amendment, April 2023

NEW WORK STARTED

EN ISO 11970
Specification and qualification of welding procedures for production welding of steel castings
will supersede BS EN ISO 11970:2016

EN ISO 18276
Welding consumables. Tubular cored electrodes for gas-shielded and non-gas-shielded metal arc welding of high strength steels. Classification
will supersede BS EN ISO 18276:2017

EN ISO 26304
Welding consumables. Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels. Classification
will supersede BS EN ISO 26304:2018

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

23/30437924 DC
BS EN ISO 14732 Welding personnel Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials
Comments for the above document were required by 20 May, 2023

23/30458743 DC
BS EN ISO 15614-13 Specification and qualification of welding procedures for metallic materials. Welding procedure test. Upset (resistance butt) and flash welding
Comments for the above document were required by 5 May, 2023

23/30457395 DC
BS ISO 18893 Mobile elevating work platforms. Safety principles, inspection, maintenance and Operation
Comments for the above document were required by 21 May, 2023

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AD 509: Non-slip connections in wind bracing

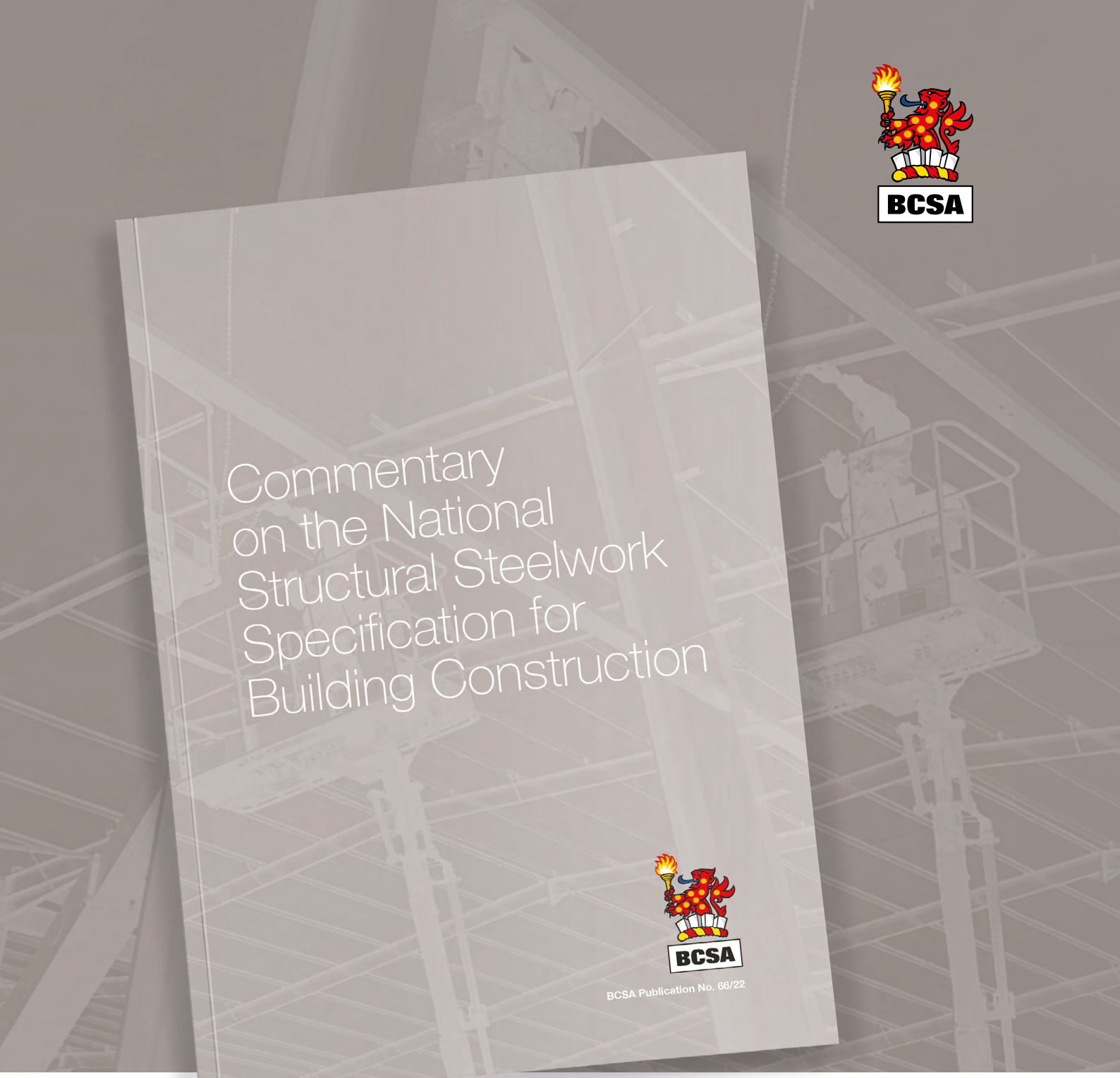
SCI have received reports that frame designers are specifying non-slip connections for wind bracing – typically on the elevations or in the roof – noting that such connections are subject to load reversal.

Clause 6.1.7.2 of BS 5950 identifies that when load reversal is solely due to wind, preloaded assemblies to produce non-slip joints are not necessary. The guidance is equally appropriate to structures designed to the Eurocodes.

Non-slip joints are more expensive to prepare than connections with ordinary bolts, the fasteners themselves are more expensive and the installation will cost more than connections with ordinary bolts.

In some cases, such as site connections of large trusses or moment resisting connections in plate girder splices, non-slip joints are necessary, but as has been demonstrated by decades of successful practice, this is not the case for wind bracing.

Contact: **David Brown**
Telephone: **01344 636555**
Email: **advisory@steel-sci.com**



The 3rd edition of the Commentary on the National Structural Steelwork Specification for Building Construction 7th edition (NSSS) is now available.

The Commentary has been prepared to give guidance and additional information on the background and philosophy behind the recommendations given in the NSSS.

Main updates include:

- References to British Standards
- Section 5 – Workmanship
- Section 10 – Protective treatment (corrosion and fire)
- Section 11 – Quality management

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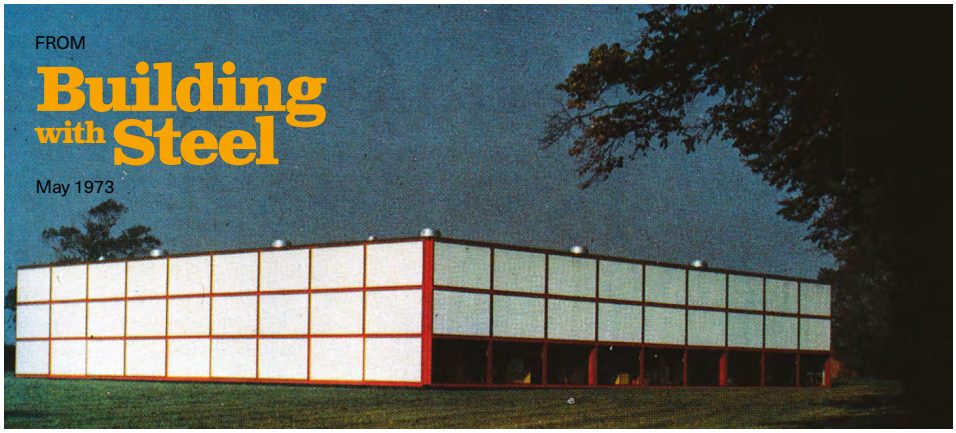
system building for industry..000... system ..000 system building at Milton Keynes.



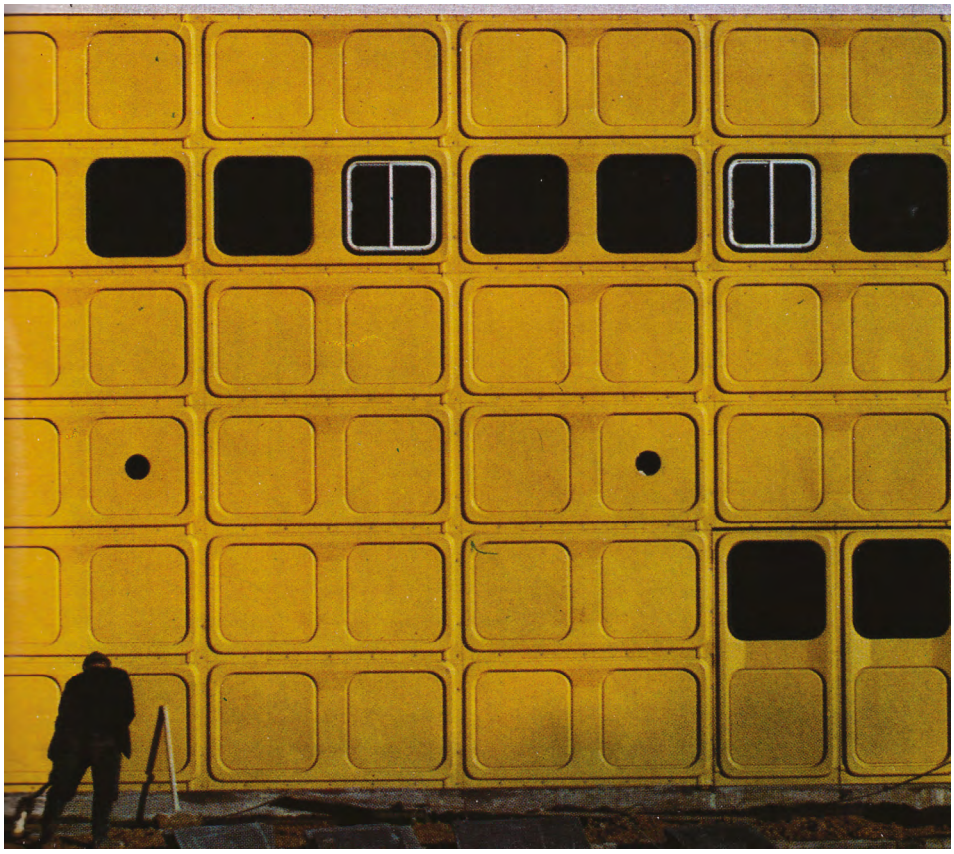
Industrial buildings are essential to Milton Keynes and have been intensively studied in the Development Corporation. The results are unusual and interesting and in these notes from the BSC Strip Mills Division. Two methods of cladding are described.

One of the awards in the 1972 Structural Steel Design Competition was for the prototype of a systemized factory building produced by architects of the Milton Keynes Development Corporation. In the words of the judges 'A single-storey building, with austere and pleasing proportions, making use of standardized bays to achieve speed of erection and economy. Good use has been made of coloured plastic-coated steel panels which add interest to the appearance.'

This building is part of the concept of System Building for Industry (SBI) at Milton Keynes which includes provision of service roads, landscaping and two forms of cladding.

One of the claddings is basically suitable for offices and the other is more suited for use on factories and warehouses. Both are substantially factory made in order to minimize on-site labour and to erect the buildings in as short a time as possible. Other requirements by the Development Group include attractive appearance and the possibilities of incorporating modifications to the buildings at a later date without great expense or conflicting with the overall appearance.

SBI provides well-appointed factory accommodation currently renting at 60-70p/sq ft, and air-conditioned office facilities at £1.50 to £1.75/sq ft. Both use a steel framework and Stelvetite cladding (the coloured plastic-coated steel mentioned in the citation) in components which can be likened to huge tiles and in which individual tiles are replaced or modified to incorporate windows, doors, exhaust ducting or other necessary industrial items.



Stelvetite is manufactured by the Strip Mills Division of British Steel Corporation at Shotton Works and is a laminate of PVC and galvanized mild steel. PVCs of various thicknesses, colour texture and finish for both interior and exterior use can be used and it is not necessary to decorate or finish in any way. Life expectancy is easily the projected life of the factory or office accommodation at Milton Keynes but, if necessary, replacement sheets of cladding can be obtained. Minor scratches or damage can be touched up.

Although conditioned by the particular circumstances at Milton Keynes, the general approach is applicable to many situations and a major point to emerge in basic research is that an industrial building should very rarely be tailored to the industrialist's apparent needs at the initial stages. The reason is that changes in process and material are frequent with new machines very often altering production methods or layout. Also, the purpose of the building can change drastically by having a new occupant. To adapt to changes of this sort the building shell must be able to be fitted with services which can be easily updated and changed.

A system approach is particularly relevant to Milton Keynes, as more than 365,000m² of industrial floor space is due to be built by the end of 1978. Rationalization of components and procedures saves time and money in design and construction. Obsolescence is reduced to negligible proportions by standardizing on a generous sized shell which can be rapidly changed, at a reasonable cost. SBI does not attempt to meet all circumstances but fits in with the declared aim of the Development Corporation to give as much freedom as possible to the individual without affecting the overall concept of the development.

With very few exceptions the modern factory is single storey in order to avoid problems of expensive fire protection, heavy floor loading, complicated materials handling and general inflexibility. Another point borne in mind during a survey of the possible requirements at Milton Keynes is that, nationally, the overwhelming majority of factory buildings are small in size.

One survey has shown that 80 per cent of factories are under 560m² and that only 0.1 per cent employ more than 2,000 people. Another study, although excluding factories below 460m², indicated that 90 per cent of new buildings given locational approval in 1945-57, were less than 4,600m². Generally, though, the average size of a factory falls between 1,850 and 2,340m².

In recent years there has been a trend towards wider spans in industrial buildings but the architects at Milton Keynes feel that, taking into account the flexibility of a square bay, a standard of 12m by 12m is more than adequate for the majority of industry which will set up there, and a 16m square option is available for special cases such as warehousing.

Whatever the size of bay chosen, a possibly more critical dimension is the clear height. After an intensive study of various surveys and recommendations a standard height of 5.5m was chosen although 3.5 and 7.5m are also offered. This standard height will accommodate most of the machines in general use plus overhead conveyors. Two-storey offices or mezzanine floors for production purposes are built within the factory shell, providing the most flexible and economical solution.

The roof space is designed to accept all the services necessary and measures 1.2m deep over the whole area. The roof is a flat profiled metal deck covered by built-up felt (continuous membrane roofing). This flat roof concept is so important to people at Wavendon Towers, headquarters of the Development Corporation that they devoted a great deal of time to designing the specification. It is also one of the factors in maintaining a reasonable renting charge by saving on guttering details, materials for pitched roofs and maintenance. For instance, although initially cheaper, asbestos is difficult to repair, requires close purlin spacing and, as it becomes brittle with age, is easily damaged even when carrying out maintenance. In fact, the Industrial Estates Management Corporation, which probably has more experience of factory development than any other agency in the country, has found that it is cheaper to use steel when maintenance and performance over a longer period are considered.

Roof-mounted equipment such as cooling towers are often required in factories and the large openings and supports necessary are most easily accommodated by a flat metal roof.

Of the three basic roof types appropriate to the concept: castellated beams and perforated cold formed sections; lattice trusses; space trusses - the one chosen was a lattice truss configuration. This most easily meets requirements of free roof space providing the least obstructed passage for services. The Development Corporation claim that by closely controlling the material specification yet leaving the choice of design solution open enough to accommodate individual manufacturers' preferences, cost is about 15 per cent lower than by following traditional design and tendering procedures.

Type1

Using a common roofing system and standard bays for three different classifications of building means that variations can more easily be accommodated in the cladding systems without cost becoming prohibitive. Type 1 is suitable for factory units and consists of a series of very powerfully modelled tile elements. The panels are fixed to cladding rails and each other by plastic-capped self-tapping screws round a flat perimeter. All joints overlap with capillary breaks formed in the panels.

The system fully exploits the advantages of prefinished steel by eliminating finishing trades thus speeding erection and allowing subsequent operations on site. The panel measures 1m by 2m and creates, in effect, a module into which cladding, personnel doors and vehicle doors can be easily accommodated. Window openings can either be punched out on production or cut using a simple jigsaw on-site. Up-and-over vehicle doors which give a clear height of 5·0m and 4·0m width are faced with the same panel.

The design is a result of collaboration between Milton Keynes Development Corporation, Rubery Owen who produce the panel, Shotton Works and the Product Development Centre at Shotwick. The Stelvetite supplied by Shotton Works uses a special deep drawing grade of 20swg and the colour is standard Gold 2617. PDC recommended the best profile shape for good pressing characteristics and supervised press shop trials at Rubery Owen.

The panel requires two forming operations and is then trimmed and punched for fixing. When required, window openings are also punched out. Glass, 3mm thick, is fixed using Neoprene H gaskets, and where opening windows are required horizontal sliding aluminium frames are similarly fixed. Personnel doors are in pairs using panels vertically rather than horizontally.

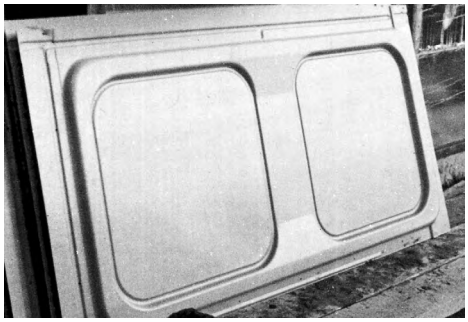
Mild steel cladding rails, 127mm by 76mm are fixed to the edge beam and roof structure at 2.0m centres. T-pieces are fixed horizontally at 1.0m centres to support foil backed industrial grade plasterboard with a plastic inner face. All joints are sealed with mastic to form a continuous vapour barrier. Impregnated battens are shot-fired through the plasterboard to the cladding rails at 2.0m centres to act as cavity spacers. Patent and registered design applications are pending in respect of the panel. First application of this system is at Brickiln Farm employment area and consists of two facing multi-occupation buildings as shown in the photographs.

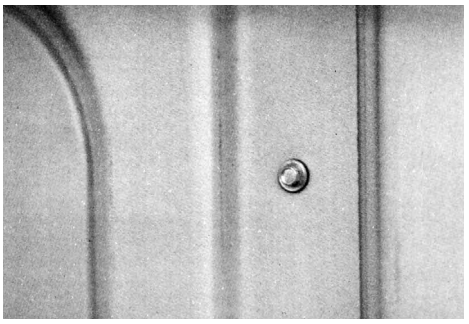
Type 2

Type 2 cladding is suitable for office buildings and warehouses and consists of prefabricated welded frames of hot-rolled sections bolted to the foundation and to the roof structure. Each frame measures 4.0m by 6.7m high, has two cross members and is made up of 127 by 76mm hot-rolled channels and tees. As erection proceeds, each frame is attached to its neighbour with bolts and the joint sealed with a two-part polysulphide mastic. Partly because they are accurately jig-welded in the factory and partly because of the design, each unit can accommodate misalignment of fixing-down bolts up to 20mm longitudinally and in height. Also the gap between them can vary from 2mm to 20mm.

Normally factory painted, these units create a powerful rectangular feel to the building. The cladding is also rectangular - echoing the shape of the frame - but the outline is softened by the use of a Neoprene gasket which seals the cladding within the crossmembers and uprights. Each cladding element measures 952mm by 2,035mm and there are four to each infill section. Jointing between the cladding is by means of PVC extrusions to match the panel facing. Panels can be removed and openings of any kind formed so that glazing or door openings can be of any area or size required within the frame limits. Full-height sliding vehicle doors can be made up from a standard cladding frame to give an opening 4.0m by 5.5m on the standard clear height. The cladding is produced by Bradley Laminates, London, and consists of a sandwich of polyurethane foam 25mm thick between two sheets of Stelvetite.

One of the buildings under construction includes a two-tier high version and will provide 40,000 sq ft of offices for a large computer firm, while another project uses the three-tier high version to provide large mezzanine areas.





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BCSA

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- **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)
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- **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, ● = Bronze, ● = Certificate

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	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●		✔	2			Up to £5,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3		●	Up to £3,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●							●		✔	2	✔	●	Up to £3,400,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		●	Up to £3,400,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,200,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2		●	Up to £2,400,000
Arromax Structures Ltd	01623 747466			●	●	●	●	●	●	●	●				●		2			Up to £800,000
ASME Engineering Ltd	020 8966 7150			●	●	●		●	●	●	●		●	●	●	✔	4		●	Up to £5,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,200,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	●	Up to £2,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●			●	✔	4	✔	●	Up to £2,400,000
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 Group 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 £6,500,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Above £6,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●	●	●	●	●		●	●	●	✔	3		●	Up to £10,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,500,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £1,200,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £400,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●	●	●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072	●	●	●	●	●	●	●	●		●				●	✔	4			Up to £10,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	4		●	Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	✔	●	Up to £10,000,000
EvadX Ltd	01745 336413		●	●	●	●	●	●		●	●	●			●	✔	3		●	Up to £3,400,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		●	Up to £2,000,000
Fox Bros Engineering Ltd	+353 (0) 53 942 1677			●	●	●	●	●		●	●				●		3			Up to £2,400,000
BCSA steelwork contractor member	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	Guide Contract Value (1)

BCSA steelwork contractor member	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	3			Up to £1,200,000
G.R. Carr (Essex) Ltd	01286 535501	●		●	●			●			●			●	●	✔	4			Up to £800,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●			●	●	✔	4	✔	🟢	Up to £5,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £4,000,000
HBE Services Ltd	01525 854110				●	●				●				●	●	✔	2			Up to £800,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Hillcrest Structural Steel Ltd	023 8064 1373			●	●	●	●	●		●	●			●	●	✔	3		🟣	Up to £3,400,000*
Intersteels Ltd	01322 337766	●			●	●	●	●	●	●			●	●	●	✔	3	✔		Up to £5,000,000
J & A Plant Ltd	01942 713511				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●					4			Up to £6,500,000
Jamestown Manufacturing Ltd	00 353 45 434 288		●	●	●	●	●	●	●	●		●	●			✔	4			Up to £10,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	🟡	Above £10,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4		🟣	Up to £6,000,000
Leach Structural Steelwork Ltd	01995 642000			●	●	●	●	●			●					✔	2		🟣	Up to £6,500,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●					●	●			●	●		2			Up to £600,000
Littleton Steel Ltd	01934 311670				●					●	●			●	●	✔	3			Up to £1,400,000
Loaninghill Fabrications Ltd	01506 858466				●				●	●	●			●	●		3			Up to £400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●			●	●	✔	4		🟢	Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●	✔	3			Up to £2,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●			●	●	●				●	✔	3			Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £5,000,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●			●	●				✔	4		🟣	Up to £2,000,000
North Lincs Structures	01724 855512			●	●					●	●				●		2			Up to £600,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		🟡	Up to £6,000,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			Up to £6,000,000*
Peter Marshall (Steel Stairs) Ltd	0113 307 6730				●	●				●	●				●	✔	3			Up to £2,000,000
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £2,400,000
REIDsteel	01202 483333			●	●	●	●	●	●	●	●	●	●		●	✔	4		🟢	Up to £6,000,000
SAH Luton Ltd	01582 805741			●	●	●				●	●			●	●		2			Up to £600,000
S H Structures Ltd	01977 681931	●		●	●	●	●	●	●	●	●	●	●		●	✔	4	✔	🟡	Up to £3,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●			●	●			●	●	✔	4			Up to £2,000,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	🟡	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499	●			●		●			●	●			●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●	✔	2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £2,000,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £1,400,000
Steel & Roofing Systems	00 353 56 444 1855	●		●	●	●	●				●	●		●	●	✔	4			Up to £5,000,000
Taziker Industrial Ltd	01204 468080	●		●	●		●	●		●	●		●	●	●	✔	3		🟡	Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●					●	●				●	✔	2			Up to £400,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2	✔		Up to £2,000,000
W I G Engineering Ltd	01869 320515				●					●	●			●	●	✔	2		🟤	Up to £600,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Above £10,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●	●	●	●	●	●	●				●	✔	4		🟢	Up to £2,400,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	🟡	Above £10,000,000
BCSA steelwork contractor member	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)

RQSC | The Register of Qualified Steelwork Contractors Scheme **Bridgeworks**

Steelwork contractors for bridgeworks

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

BCSA

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
- **SRF** Site-based bridge refurbishment
- **FRF** Factory-based 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 ● = Bronze ● = Certificate

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	SRF	FRF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
Adey Steel Ltd	01509 556677	●		●	●	●	●				●	●	✓	3			✓	●	Up to £3,000,000
AJ Engineering & Construction Services Ltd	01309 671919	●		●	●	●	●	●	●	●	●	●	✓	4				●	Up to £3,400,000
Billington Structures Ltd	01226 340666	●		●	●	●	●					●	✓	4	✓	✓	✓	●	Above £6,000,000
Bourne Group 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 £6,500,000
Cementation Fabrications	0300 105 0135	●	●	●	●	●	●	●	●	●	●	●	✓	3			✓	●	Up to £10,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	●	✓	4			✓		Up to £800,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●		●			●	✓	4				●	Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●	●	●		●	●	●	●	✓	3			✓	●	Up to £2,000,000
Jamestown Manufacturing Ltd	00 353 45 434 288	●	●	●	●	●	●					●	✓	4			✓		Up to £10,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●			●	●				●	●	●	✓	4	✓		✓	●	Above £10,000,000
M&S Engineering Ltd	01461 40111	●	●	●	●	●	●	●		●	●	●	✓	3					Up to £2,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓	●	Up to £1,400,000
Millar Callaghan Engineering Services Ltd	01294 217711	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●	●	●	●	●	●					●	✓	4			✓		Up to £5,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £6,000,000
REIDsteel	01202 483333	●		●		●	●	●				●	✓	4				●	Up to £6,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	●	Up to £3,000,000
Severfield plc	01204 699999	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	●	Above £6,000,000
Taziker Industrial Ltd	01204 468080	●	●	●	●	●	●	●	●	●	●	●	✓	3		✓	✓	●	Above £6,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	●	Above £10,000,000
Non-BCSA member																			
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	●	Up to £3,400,000
Beaver Bridges Ltd	01204 668773	●		●	●	●	●	●	●	●	●	●	✓	4					Up to £3,000,000
Carver Engineering Services Ltd	01302 751900	●		●	●	●	●		●	●	●	●	✓	4			✓		Up to £5,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	●	✓	4					Up to £3,400,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●		●	●	✓	4			✓	●	Up to £6,000,000
Eiffage Metal	00 33 388 946 856	●	●	●	●	●	●	●	●			●	✓	4					Above £6,000,000
Harrisons Engineering (Lancashire) Ltd	01254 823993			●	●	●	●	●	●	●	●	●	✓	3		✓			Up to £3,000,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879									●	●	●	✓	3			✓		Up to £800,000
J&D Pierce Contracts Ltd	01505 683724	●	●	●	●	●	●	●	●		●	●	✓	4			✓		Above £10,000,000
Kelly's Welders & Blacksmiths Ltd	01383 512 517											●	✓	2			✓		Up to £350,000
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £3,000,000
Malin Group	0141 370 5467	●			●	●	●			●	●	●	✓	4			✓		Up to £4,000,000
North View Engineering Solutions Ltd	01325 464558											●	✓	3					Up to £1,200,000
Shaw Manufacturing Ltd	01642 210716			●						●	●	●	✓	4			✓		Up to £1,200,000
Smulders Projects UK Ltd	0191 295 8700	●	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
Tecade S.A.U.	00 34 955 833 811		●	●	●	●	●	●	●			●	✓	4		✓	✓		Up to £6,000,000
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

BCSA

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
Gene Mathers	0115 974 7831
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	0300 123 5000
Keiths Welding Limited	07791 432 078

Company name	Tel
MMCEngineer Ltd	01423 855939
Paul Hulme Engineering Ltd	07801 216858
QHSE-Interspect Ltd	07438 413849
Sandberg LLP	020 7565 7000

Company name	Tel
Structural & Weld Testing Services Ltd	01795 420264
SUM ADR Ltd	07960 775772

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.

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
NHSS National Highway Sector Scheme

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

SCM
Steel Construction Sustainability Charter
● = Gold ● = Silver
● = Bronze ● = Certificate

SfL
Steel for Life Sponsor

Structural components

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Albion Sections Ltd	0121 553 1877	✓	M	4			
BW Industries Ltd	01262 400088	✓	M	3			
Cellbeam Ltd	01937 840600	✓	M	4	20		
Composite Profiles UK Ltd	01202 659237		D/I				
Construction Metal Forming Ltd	01495 761080	✓	M	3			
Daver Steels Ltd	0114 261 1999	✓	M	3			
ES Steel	0161 511 8386	✓	N/A				
Farrat Isolevel	0161 924 1600	✓	N/A				
Hadley Industries Plc	0121 555 1342	✓	M	4		●	
Hi-Span Ltd	01953 603081	✓	M	4		●	
Kingspan Structural Products	01944 712000	✓	M	4		●	
MSW UK Ltd	0115 946 2316		D/I				
Prodeck-Fixing Ltd	01278 780586	✓	D/I				
Structural Metal Decks Ltd	01202 718898	✓	M	4			
Stud-Deck Services Ltd	01335 390069		D/I				
Tata Steel – ComFlor	01244 892199	✓	M	4			
voestalpine Metsec plc	**0121 601 6000**	✓	**M**	4		●	**Gold**

Computer software

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Autodesk Ltd	01252456600		N/A				
Fabsec Ltd	01937 840641		N/A				
IDEA StatiCa UK Ltd	**02035 799397**		**N/A**				**Silver**
StruMIS Ltd	01332 545800		N/A				
Trimble Solutions (UK) Ltd	0113 887 9790		N/A				

Steel producers

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
British Steel Ltd	01724 404040	✓	M		3B		
Tata Steel – Tubes	01536 402121	✓	M		3B		

Manufacturing equipment

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Behringer Ltd	01296 668259		N/A				
Cutmaster Machines (UK) Ltd	**07799 740191**		**N/A**				**Silver**
Ficep (UK) Ltd	**01924 223530**		**N/A**				**Silver**
Kaltenbach Ltd	01234 213201		N/A				
Lincoln Electric (UK) Ltd	0114 287 2401	✓	N/A				
Peddinghaus Corporation UK Ltd	01952 200377		N/A				

Membership services

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Deconstruct UK Ltd	02035 799397	✓	N/A				

Protective systems

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Forward Protective Coatings Ltd	01623 748323	✓	N/A				
Hempel UK Ltd	**01633 874024**	✓	**N/A**				**Silver**
Highland Metals Ltd	01343 548855	✓	N/A				
International Paint Ltd	0191 469 6111	✓	N/A				
Jack Tighe Ltd	01302 880360	✓	N/A		19A		
Joseph Ash Galvanizing	01246 854650	✓	N/A				
PPG Architectural Coatings UK & Ireland	01924 354233	✓	N/A				
Sherwin-Williams UK Ltd	01204 521771	✓	N/A			●	
Vale Protective Coatings Ltd	01949 869784		N/A				
Wedge Group Galvanizing Ltd	**01902 601944**	✓	**N/A**				**Gold**

Safety systems

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
easi-edge Ltd	01777 870901	✓	N/A				
TRAD Hire & Sales Ltd	01614 304666	✓	N/A				

Steel stockholders

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
AJN Steelstock Ltd	01638 555500	✓	M	4			
Arcelor Mittal Distribution - Scunthorpe	**01724 810810**	✓	**D/I**	**4**	**3B**		**Headline**
Barrett Steel Services Limited	**01274 682281**	✓	**M**	**4**	**3B**		**Headline**
British Steel Distribution	01642 405040	✓	D/I	4	3B		
Cleveland Steel & Tubes Ltd	**01845 577789**	✓	**M**	**3**	**3B**		**Gold**
Dent Steel Services (Yorkshire) Ltd	01274 607070	✓	M	4	3B		
Dillinger Hutte U.K. Limited	01724 231176	✓	D/I	4		●	
Duggan Profiles & Steel Service Centre Ltd	00 353 567722485	✓	M	4			
Kloeckner Metals UK	0113 254 0711	✓	D/I	4	3B	●	
Murray Plate Group Ltd	0161 866 0266	✓	D/I	4	3B		
NationalTube Stockholders Ltd	**01845 577440**	✓	**D/I**	**4**	**3B**		**Gold**
Rainham Steel Co Ltd	01708 522311	✓	D/I	4	3B		
The Alternative Steel Co Ltd	01942 826677	✓	D/I				

Structural fasteners

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
BAPP Group Ltd	01226 383824	✓	M		3		
Cooper & Turner Ltd	0114 256 0057	✓	M		3		
Lindapter International	01274 521444	✓	M				

Welding equipment and consumables

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Air Products PLC	01270 614167		N/A				

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[1] *https://worldsteel.org/steel-topics/life-cycle-thinking/lca-eco-profiles/*