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NSC

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Vol 27 No 8 September 2019

Connecting Cornish castle

New City benchmark

Steel frames logistics hub

Speedy steel tops class in Leeds


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Cover Image
Tintagel Castle Footbridge, Cornwall
Main client: English Heritage
Architect: William Matthews Associates
Main contractor: American Bridge
Structural engineer: Ney & Partners
Steelwork contractor: Underhill Engineering
Steel tonnage: 47.5t

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Steel at the centre of communities

Nick Barrett - Editor

Hardly a major development these days doesn't feature a centrepiece, sometimes iconic, structure that anchors the project in the public imagination and shows the world what great design can achieve. Nearly all of them will feature the use of structural steelwork to make the realisation of the architect's vision possible, and the task of the construction team easier.

Some excellent examples can be seen in NSC this month, such as a new benchmark for City offices being developed at Fenchurch Street. The City skyline remains busy with tower cranes despite the Brexit-related uncertainties of the past few years, but the cranes used here are lower than passers-by may have been used to as the development is a relatively modest 15 storeys high, considerably less than the norm for City commercial schemes. The developers see the EightyFen development as a interesting alternative to the usual towering multi-storeys and are hoping to achieve a BREEAM 'Excellent' rating.

Exposing external structural elements has become a popular theme in the past few years, but EightyFen also makes a virtue of steelwork internally, leaving all seven internal columns exposed as a design feature that showcases the beauty of steel.

New communities are being created across the UK to accommodate a growing population, sometimes regenerating redundant land previously used by industry or the UK's defence establishment. One of the latter is underway in Surrey where the former army barracks at Deepcut is being redeveloped to create a new community of some 1,200 houses with essential village amenities like shops and a pub. One of the first amenities being created for the new community at Mindenhurst is a steel-framed primary school for up to 420 children. Its striking design is intended to act as a landmark for the entire new community, and its shape and long spans could only have been created with steel.

Growing school populations have also created a need for a new Leeds school that we feature this month, accommodating 1,000 children of all ages from four to 16. Flexibility in classroom configuration will be needed to allow for potential changes in the needs of any large school, but even more so when such a large range of age groups are involved.

New schools will also feature as centrepieces at the former British Steel steelworks site at Ravenscraig in Lanarkshire, where a thriving community has already been created thanks to regeneration developments over the past ten years or so, carried out in partnership between Scottish Enterprise, Tata Steel and Wilson Bowden. In News this month we report on planning approval for a new masterplan for the next stage of the site's regeneration that will significantly build on what has already been achieved with new schools, housing, offices and retail space. A steel-framed college campus features as a key element of what has already been achieved at Ravenscraig, and we look forward to bringing you news of future developments.

Government agrees to one-year reverse VAT delay

The UK government has agreed to a one-year delay to reverse VAT following an extensive lobbying campaign from industry bodies including the British Constructional Steelwork Association (BCSA).

If the government's plans to impose reverse VAT on 1 October had been implemented, countless construction sub-contractors would have gone out of business as their cash flow would have been sent into negative territory.

HMRC has said that it will delay implementation until 1 October 2020 as businesses need time to prepare for the proposed VAT changes.

BCSA is now calling for the government to use this delay period to review the decision to impose reverse charge VAT altogether, as it has calculated that for an average subcontractor turning over £15M, reverse VAT will mean increasing negative cash flows, peaking at £262,500 in month three of the change.

"This would have been the end for many subcontractors who are already experiencing late payment, difficulties in agreeing final payment amounts and other additional costs such as the apprenticeship levy and increased pension contributions," said Sarah McCann-Bartlett, Director General of the BCSA.

BCSA believes that the government did not fully understand the implications of yet another financial blow to subcontractors and had not communicated the changes sufficiently to industry. This is borne out by data collected by the Federation of Master Builders that shows that over two-thirds of construction SMEs (69%) have not even heard of reverse charge VAT.

"The potential damage to subcontractors' cash flow is significant, which is why BCSA was calling for this delay," said Sarah McCann-Bartlett.

Barrett Steel completes Shoreham facility acquisition

Steel stockholder Barrett Steel has completed the acquisition of the Shoreham site of John Parker & Son, which will now be integrated into its nationwide depot network.

The company said this is a strategic geographical acquisition, adding an exclusive and dedicated bulk receipts port facility, which will offer greater flexibility as well as speed of supply to service UK customers.

In addition to the port, the acquisition also sees Barrett Steel acquire extensive processing equipment on the site, including shot blast prime and paint facilities, alongside six additional Ficep Endeavour saw-drill lines.

The move has also seen Barrett Steel welcome over 50 new employees to its team, who transfer employment under the acquisition, thereby securing jobs in the area.

The site will now operate as Barrett Steel Shoreham and Group Managing Director James Barrett commented: "This acquisition allows the Group to develop its presence in the South of England which complements our existing processing hubs in the North. We are excited to welcome the Shoreham team to our business and are positive about the future of the steel industry."

Go-ahead given for Ravenscraig masterplan

The former steelworks site at Ravenscraig near Motherwell is set for further transformation after a new masterplan was given the green light by planning officials.

North Lanarkshire Council has granted outline planning permission to redevelop 376 hectares of derelict land for new homes, offices, retail spaces and schools.

Nick Davies, Director of Ravenscraig Ltd, said: "This is a momentous decision that will unlock Ravenscraig's potential and help to attract more investment into this famous site. There has already been significant regeneration work over the last decade and we're proud to say Ravenscraig is now a thriving community.

"This represents the beginning of the next phase of regeneration at Ravenscraig. With planning approval now granted, we will move forward with our ambitious plans to further transform the site, ensuring sustainability and inclusive growth are at the heart of our approach."

The planning decision comes just weeks after initial works began on a new £3.7m public park at Ravenscraig. It also follows North Lanarkshire Council's announcement of a £190M roads programme that will boost Ravenscraig's regeneration.

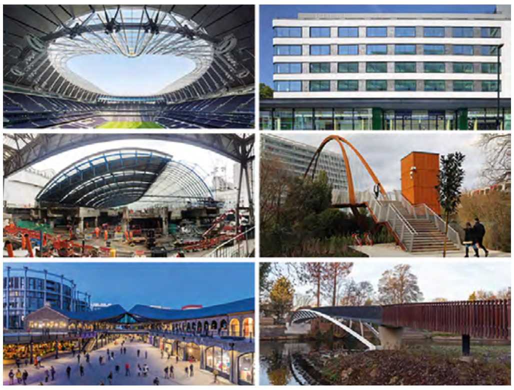
Since 2006, a number of successful projects have been delivered on the Ravenscraig site. Hundreds of homes have been built, while there is also a state-of-the-art steel-framed college campus and major regional sports facility, as well as a hotel and pub/restaurant.

Ravenscraig Ltd is a joint venture between Scottish Enterprise, Wilson Bowden and Tata Steel.

Steel projects feature on Structural Awards 2019 shortlist

Six UK steel-framed projects, involving British Constructional Steelwork Association [BCSA] members, have made it onto the Institution of Structural Engineers [IStructE] Structural Awards shortlist for 2019.

Featuring projects from around the world, the Awards are divided into 12 categories and the winners will be announced at a London evening event on 15 November.



The new Tottenham Hotspur Stadium (top left) is one of four projects on the Long Span Structures category, awarded for structural engineering excellence in buildings or stadia [not bridges] incorporating long spans.

Working on behalf of main contractor Mace, Severfield erected the steelwork for Spurs' new home, which opened earlier this year.

Two UK jobs have been shortlisted in the Pedestrian Bridge award category: Chiswick Park Footbridge (middle right) and Taplow Footbridge (bottom right).

Linking a west London business park to a local underground station, Severfield was the steelwork contractor for the three-span Chiswick bridge, while S H Structures provided the steel for the latest Thames crossing at Taplow.

Three projects, involving BCSA steelwork contractors are shortlisted for the Structural Transformation award: 160 Old Street (top right), Coal Drops Yard (bottom left), and Waterloo Station & Waterloo International Terminal Redevelopment (middle left).

Bourne Steel was the steelwork contractor for both the redevelopment of 160 Old Street in London, which saw a 1970s structure converted into a modern commercial premises, and the Waterloo Station job, where the company's work included a new roof spanning between the Victorian Station and former Eurostar building.

Severfield were the steelwork contractor for Coal Drops Yard, the company's third shortlisted project. This scheme includes a bespoke curving steel roof that spans between two restored buildings to provide a new retail centre with its crowning glory.

56m-long girders depart for East Midlands bridge

Steelwork contractor Cleveland Bridge has broken their own company record and fabricated a pair of 56m-long girders for a new bridge spanning the A45 in Coventry.

Previously, the company's record for its longest girders was 50m, set in 2017 for the Aberdeen Western Peripheral Route project.

Cleveland Bridge has been contracted to supply, fabricate and erect the bridge, which features a double-span ladder deck and a striking mast.

The bridge components, including the girders, have been fabricated at the company's production facility in Darlington, County Durham.

Following fabrication of the girders, Cleveland Bridge engineers undertook a complex delivery programme. Once loaded on to the trailers, the girders were carried as part of a convoy of two vehicles, each measuring more than 60m-long, on their 180-mile journey to the bridge construction site. The bridge will subsequently be installed in March 2020.

Chris Droogan, Managing Director of Cleveland Bridge, said: "The fabrication of these bridge girders is testament to the skills of our workforce and our extensive production capabilities. It is always a proud moment when a project is loaded out for installation, but when it breaks a previous company record it's particularly satisfying.

"It is also a major achievement to transport a load of this size and navigating the route across the country demonstrating the ability of our team and contractors to deliver a successful operation."

Contractor named for Wimbledon tennis complex

Willmott Dixon has been chosen by The All England Lawn Tennis Club (AELTC) to construct an integrated world-class facility on Somerset Road, adjacent to the venue for its world-famous prestigious event, The Championships, Wimbledon.

The Somerset Road project will see Willmott Dixon demolish the existing indoor facilities and replace them with 12 new tennis courts (six indoor and six outdoor).

The works will also include associated club house facilities; a single-storey underground car park for up to 338 vehicles that will be the hub of The Championships' courtesy car operation; an enhanced arrivals experience for competitors at The Championships; and upgraded Centre Court chiller plant.

The building's double-curved roof structure and surrounding landscaping will ensure it blends in sensitively with the local area, retaining the AELTC's guiding principle of 'tennis in an English garden' throughout its Grounds.

Work is due to commence this month and the project is programmed to be completed by the end of October 2021.

The steelwork is due to begin erection next year, with the programme beginning in late July after The Championships finish.

NEWS IN BRIEF

Manchester Galvanizing [part of the Wedge Group] has more than doubled its works footprint at Heywood, near Rochdale, following a £1M expansion project.

A contract to build the new research and storage facility for the British Museum at Wokingham, Berkshire has been awarded to **Graham Construction**. The 16,000m^2 new-build facility will adjoin the University of Reading's Thames Valley Science Park and house ancient artefacts from the Museum's Archaeological Research Collection.

St. Modwen is delivering a 29,500m^2 distribution centre in the heart of the Midlands, which it claims is the largest speculative build in the company's history. Forming part of a wider 35-acre distribution site known as St. Modwen Park Tamworth, Severfield is fabricating, supplying and erecting the project's steelwork.

Costain has been appointed by Network Rail Southern Region to deliver the £150M redevelopment of Gatwick Airport station. The company, which previously led the scheme through its planning and design stages, will now undertake the improvement works needed to create a safer, more convenient interchange between the station platforms and Gatwick International Airport. Work is expected to begin in early 2020 and be completed during 2022.

Plans for the redevelopment of **Alexander Stadium** – the centrepiece of Birmingham's Commonwealth Games - have been released. The redeveloped stadium will see its seating capacity increase from 12,700 to 18,000, with temporary seating adding a further 12,000 during the Games.

PRESIDENT'S COLUMN

From small acorns grow mighty oaks. This well-known proverb applies perfectly to the UK's structural steelwork sector.

BCSA has many substantial member companies who only a generation or two ago were just starting out and are now contributing significant amounts to the UK's economic growth, productivity improvements and employment. And BCSA's small and medium sized member companies are individually and collectively contributing to UK PLC. While some of these companies will continue to remain SMEs, others will grow and become large individual contributors to the economy in their own right.

Or will they? Not if the government persists in bringing in new regulations and taxes that affect SMEs and construction sub-contractors disproportionately.

Construction sector sub-contractors have already had to deal with raw material price increases coupled with sluggish tender prices. They are managing skills shortages and the consequential labour cost inflation, and they have put in their own training and apprenticeship programmes to manage this. But as they grow in size and employ more staff, they are hit with the apprenticeship levy.

As we roll into the second half of the year, the government's reverse charge VAT for construction sub-contractors due to come into force on 1 October will lead to a loss of productivity, reduced cashflow and in the worst cases, tip some companies over the edge.

SMEs will be least able to cope, as they already spend on average 44 hours per year, which is the equivalent to six working days, on VAT compliance.

BCSA has joined 15 UK construction bodies in calling for a six month delay to the implementation of reverse VAT. BCSA has also written to the Chancellor asking the government to use this time to review its decision to impose reverse VAT altogether.

BCSA has calculated that for an average subcontractor turning over £15 million, reverse VAT will mean increasing negative cash flows, peaking at £262,500 in month three of the change.

BCSA believes that the government does not fully understand the implications of yet another financial blow to subcontractors and has not communicated the changes sufficiently to industry. This is borne out by data collected by the Federation of Master Builders that shows that over two-thirds of construction SMEs (69%) have not even heard of reverse charge VAT.

Let's hope that the government sees sense and reconsiders yet another burden on construction sub-contractors and SMEs, allowing more of those acorns to shoot.

Tim Outteridge
BCSA President and Jamestown Manufacturing

• At the time of going to print, HMRC announced a one-year delay to the implementation of reverse charge VAT until 1 October 2020.

RIBA Stirling prize shortlist highlights steel's flexibility

The redevelopment of London Bridge Station and the Macallan Distillery and Visitor Experience, both which made extensive use of structural steelwork, have made the shortlist for this year's RIBA Stirling prize.

RIBA, the Royal Institute of British Architects, will announce the winner of highest accolade in October.

London Bridge (above left) is one of the UK's busiest railway stations and reopened last year following a £1 billion redevelopment programme.

The Stirling Prize jury said its voluminous spaces and impressive new concourse had significantly improved the experience of those who use it daily.

Two major steelwork packages were undertaken on the project, one for the new bridge decks, which was awarded to Cleveland Bridge and another for platform canopies and associated areas, which was completed by Severfield.

The £140M redevelopment of the Macallan Distillery in Speyside, Scotland (above right) has created a new facility with an undulating grass-covered roof.

The Stirling Prize jury said the distillery is futuristic, but also blends into the rolling hillside environment.

Working on behalf of main contractor Robertson Construction, S H Structures fabricated, supplied and erected the steelwork for the Macallan Distillery scheme.

Latest Canary Wharf towers taking shape

Steelwork is nearing completion on the two latest high-rise towers in London Docklands.

Provisionally known as D1/D2, the largest of the structures is a 14-storey commercial block which has required 2,300t of structural steelwork.

B3 is a hybrid building as its design incorporates 10-storeys of concrete-framed structure, accommodating hotel and leisure space, with four-levels of steel-framed offices on top. A total of 880t of steel is being erected for this scheme.

Working on behalf of Canary Wharf Contractors, Elland Steel Structures is fabricating, supplying and erecting the steelwork for both buildings.

The buildings form part of the Wood Wharf development which aims to create a new neighbourhood for the capital. It is set to bring 20,000 jobs to the region and boast one of the largest clusters of tech and creative businesses in the UK.

American aircraft manufacturer invests in new hangar

US-based Gulfstream Aerospace has awarded VolkerFitzpatrick a £34M contract to construct a new maintenance, repair and overhaul (MRO) aircraft hangar at Farnborough Airport.

The design and build project will see VolkerFitzpatrick build a purpose-built 20,400m² hangar to house up to 16 of Gulfstream's private jets as well as maintenance facilities. The building will also include three floors of office space, customer experience areas and a café.

The structure will be composed of a steel frame, on top of concrete pad foundations, with a series of 67m-long trusses over the hangar doors. The building's envelope will consist of composite clad walls and a standing seam roof.

Specialist services will be installed, as well as hangar doors, cranes and a deluge foam sprinkler system. External works will include a new car park, which will connect to the airport's perimeter road.

In addition, the project includes demolition and reconstruction of an external apron, which ties into the taxiway, along with associated lighting and service installation.

Stuart Deverill, Managing Director of VolkerFitzpatrick's Building division, said: "We are delighted to have been awarded this exciting project to deliver Gulfstream's first purpose-built MRO hangar facility in the UK. This is a fantastic opportunity and I look forward to our collaboration over the coming months."

The new hangar is due to be completed in summer 2020, ready for the Farnborough Airshow.

Work underway for Luton Airport fast transit system

Steelwork erection has commenced for a new viaduct that forms an integral part of the £225M Luton fast transit system, which will link London Luton Airport with Luton Parkway railway station.

The fully automated and driverless transit system will be approximately 2.1km in length and will provide a journey time between the station and airport terminal of less than 5 minutes.

From a new dedicated station adjacent to Luton Parkway, the system will be elevated on the viaduct until it reaches the A1081 where it will cross via a new bridge.

Beyond the bridge, the route will be at ground level or in a shallow cutting, before finally entering a tunnel under the airport taxiway.

Working on behalf of main contractor VolkerFitzpatrick-Kier joint venture, Severfield is fabricating, supplying and erecting 830t of steelwork for the eight-span viaduct.

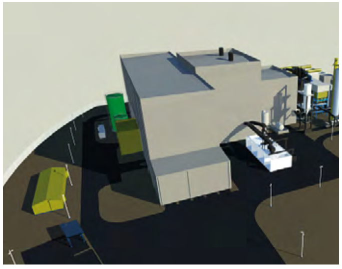
In cross section the structure is three plate girders wide at the station end, but it then tapers down, between piers two and three, to only two girders wide. Overall it consists of 25 main longitudinal plate girders, which have a maximum length of 42m and weigh up to 36t each.

As well as the viaduct, which is expected to be fully erected by November, Severfield is also supplying the steelwork for the system's two stations.

Steelwork contractor chosen for Cheshire energy plant

Caunton Engineering has been awarded the contract to fabricate, supply and erect structural steelwork for a new Bio Power facility being constructed by Burmeister & Wain Scandinavian Contractor (BWSC).

The gasification facility in Hooton Cheshire will be fuelled by locally-sourced waste, using up to 240,000t of refuse-derived fuel each year. The facility is



expected to generate more than 200 GWh of electricity annually.

The steelwork needed for the project comprises over 800t and consists of framing for a boiler house, turbine hall, fuel storage depot, and a fuel unloading building, along with all associated secondary steel.

BWSC has been awarded a full turnkey build contract as well as a contract to operate and maintain the facility for 15 years.

The plant is scheduled for completion in the second half of 2021.

BWSC has previously built nine biomass-fuelled power facilities in the UK and Caunton Engineering supplied steelwork for six of these projects.

Steel starts for flagship M&S store in Kent

Steelwork erection is now underway for a new Marks & Spencer store at Eclipse Park in Maidstone.

Working on behalf of main contractor Gallagher Group, H Young Structures is fabricating, supplying and erecting 600t of structural steelwork for the project.

The 7,808m² store is due to open in the summer of 2020 and will sell clothing and home products as well as having a foodhall and M&S café. The store will create up to 300 jobs in the local area.

M&S said it identified Maidstone as the ideal location for this major new store, which will be the largest new store opening in 2020, and designed to be 'inspirational', drawing people from a wide catchment area.

The design of the store is said to be attractive, with smart, clean glazing and cladding and Kentish Ragstone walling.

Pat Gallagher, Chairman of Gallagher Group, said: "We are delighted to welcome Marks & Spencer to Eclipse Park. Marks & Spencer choosing Maidstone for the location of this new store is a major vote of confidence in Kent's county town.

Sacha Berendji, Retail, Operations and Property Director at Marks & Spencer, said, "As part of our transformation plan, we're reshaping our store estate to respond to the needs of the modern consumer. In Maidstone, we're creating a shopping experience fit for the future by investing in our new store at Eclipse Park."

Located close to Junction 7 of the M20 motorway, Eclipse Park is one of Maidstone's most modern office, retail and hotel business parks.

When complete, it will total over 16 acres of Grade A commercial development and deliver more than 27,800m² of commercial office accommodation, including 150-bed hotel with conference facilities.

Diary

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

Wednesday 18 September 2019
Steel Frame Stability Course
Frame stability concerns the significance of second-order effects and is highlighted as an essential check for all frames in BS 5950 and EC3.
Bristol

Tuesday 8 October 2019
Light Gauge Steel Design Course
This one day course introduces uses and applications of light gauge steel before explaining in detail methods employed by EC3.
Leeds

Tuesday 8 October 2019
Reuse of steel structures and the circular economy
This FREE seminar presents findings from Two EU-funded research projects (REDUCE and PROGRESS) investigating design for deconstruction and reuse of steel structures.
London

Tuesday 15 October 2019
Open Section Truss Joints
This webinar will consider the design of the joints using simple calculations of the component resistances.
Webinar

Tuesday 15 October 2019
Steel Frame Disproporationate Collaspse Rules Course
This course provides a solid introduction into the design of steel-framed buildings to avoid disproportionate collapse.
Milton Keynes

Thursday 7 November 2019
UK Steel Construction Day 2019: Innovative Steel Solutions
At this event we will look at a range of different solutions that address the multiple needs to build with improved speed, quality, safety, predictability, and using less materials. Some of these solutions are already being applied, others are for the future. London

High-performance solution

In 2018, ArcelorMittal launched the Steligence® concept to facilitate the next generation of high-performance buildings and construction techniques for its customers.

According to ArcelorMittal a holistic approach has been encompassed in the Steligence® concept which can help to deliver a broad range of thinner, lighter, high-performance steel solutions. Demonstrating the potential to reduce the embodied carbon footprint of a building by 38%, the Steligence® approach can also enhance a building's flexibility and provide economic benefits. Considering the amount of global emissions which are caused by the built environment, the impact of Steligence® could be particularly significant.

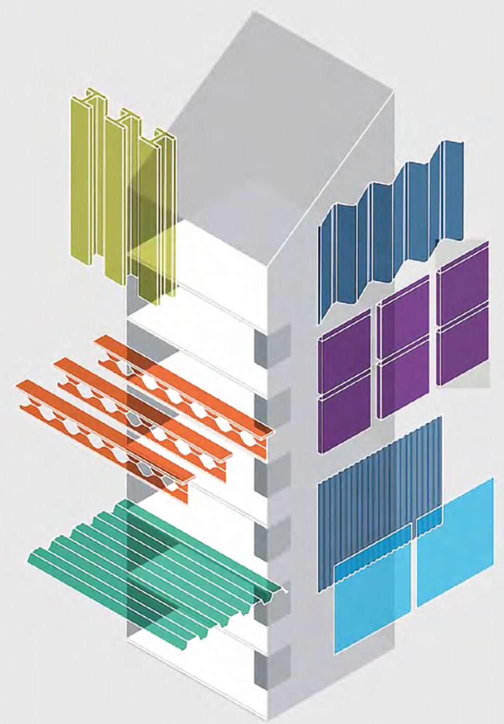
Steligence ® is supported by a White Paper which can be downloaded from *https://steligence.arcelormittal.com/en/benefits#white_paper_section*. This independent White Paper outlines the science-based approach taken by Steligence® to compare building construction options with respect to their impacts on the environmental, economic and social domains of sustainability.

Sustainability is a broad concept, the Steligence® assessment methodology chose to focus on BREEAM, LEED, ISO21292, CEN TC350 and the FP7 Superbuildings Project to produce 17 KPI's against the three main impact domains of environmental, economic and social.

These KPI's include operational energy, consumption of natural resources, emissions, end of life, speed of construction, thermal and acoustic comfort and design for flexibility. Full Life Cycle Assessments (LCA) from manufacture to use to disposal and recycling, and Life Cycle Cost Analysis (LCCA - the cost of an asset through its life-cycle) support many of the KPI's.

Key comparisons from the Steligence® White Paper when comparing a typical eight-storey office building in Europe:

- **Floor-to-floor heights** are reduced by 30% and column-free flexibility is achieved with steel solutions when compared with concrete alternatives.
- **Overall building height** is reduced by 2.7m and cladding costs are reduced by 11% for steel-framed solutions.
- **Building weight** is reduced by 50% resulting in a 34% cost saving for foundations whilst providing sustainability benefits by using steel solutions.
- **The environmental footprint** of the building is reduced by 16% in the steel solution, global warming potential is reduced by 22% and acidification potential by 27%.
- **Speed of steel construction** accounts for a 24% saving with site traffic reduced by up to 30%.
- **BREEAM and LEED**, three extra points can be achieved for both BREEAM and LEED achieving the highest rating in each scheme.
- **Total costs of building ownership**, taking into account all economic benefits, are at least 15% less than when



Some of the ArcelorMittal products used and referenced in the Steligence® White Paper include:

Angelina®: A new generation of castellated beams for sustainable structures which are lightweight, long-spanning, structural elements enabling the design of large column-free spaces.

HISTAR® and heavy "Jumbo" rolled sections, have high strength and low alloy content, offering considerable weight, cost and sustainability savings with a CE Mark.

Magnelis®, an innovative metallic coating offering protection in the harshest environments and up to a 25-year guarantee; suitable for a wide range of structural applications, including façades, composite decking, purlins and side rails.

Estetic® BioAir an innovative pre-painted steel made with 100% bio-sourced resin, designed specifically for indoor use. Estetic® BioAir has low levels of volatile organic compounds (VOCs), improves indoor air quality and is free of chromates and heavy metals.

using traditional materials, when all components of the concept are applied.

UK construction is acknowledged as being a steel intensive sector with many years of successful market development. Steligence® builds upon these advances and confirms many known benefits of steel construction whilst advancing the understanding of others. However, its eye is very much on the future, giving direction to ArcelorMittal's construction activities and steel construction's solutions for future global climate needs.

ArcelorMittal publishes first Climate Action Report

ArcelorMittal has published its first Climate Action Report in which it announces its ambition to significantly reduce CO_2 emissions globally and be carbon neutral in Europe by 2050.

To achieve this goal ArcelorMittal is building a strategic roadmap linked to the evolution of public policy and developments in low-emissions steelmaking technologies. A target to 2030 will be launched in 2020, replacing ArcelorMittal's current target of an 8% carbon footprint reduction by 2020, against a 2007 baseline.

The report explains in greater detail the future challenges and opportunities for the steel industry, the plausible technology pathways ArcelorMittal is exploring as well as its views on the policy environment required for the steel industry to succeed in meeting the targets of the Paris Agreement.

As one of the world's most prolific materials, with 1.7 billion tonnes of steel produced in 2018, the steel industry today accounts for approximately 7% of global emissions. With demand for steel and materials set to further increase - forecasts show demand rising to 2.6 billion tonnes in 2050. It is vital the industry finds ways to significantly reduce its carbon emissions to successfully meet the ambitions of the Paris Agreement and help limit the global average temperature rise to less than two degrees.

At present carbon is used as a reductant in the blast furnace to separate oxygen from iron ore as a critical part of the steelmaking process. Significantly reducing the emissions footprint of steel will, in all likelihood, require a fundamental change in the science of steelmaking.

ArcelorMittal recognises it has a leading role to play in developing breakthrough technologies that will support and enable a global transition to a low-carbon economy and has identified three distinct pathways that have the potential to deliver a significant reduction in carbon emissions.

These are:

- **Clean power steelmaking**, using clean power as the energy source for hydrogen-based steelmaking, and longer-term for direct electrolysis steelmaking;
- **Circular carbon steelmaking**, which uses circular carbon energy sources, such as waste biomass, to displace fossil fuels in steelmaking, thereby enabling low-emissions steelmaking;
- **Fossil fuel carbon capture and storage**, where the current method of steel production is maintained but the carbon is then captured and stored or re-used rather than emitted into the atmosphere.

ArcelorMittal believes that all three pathways offer significant emissions reduction potential which are aligned with science-based targets and is currently testing various technologies across all three pathways in its European operations.

To support this, ArcelorMittal recommends:

- **A global level playing field** is needed to maintain the competitiveness of low-emissions steelmaking and to avoid the risk of carbon leakage, for example, through green border adjustments;
- **Access to abundant clean energy at affordable prices** will be key to be able to scale up low-emissions technologies;
- **Facilitating necessary clean energy infrastructure** will be needed to advance large-scale implementation of low-emissions technologies;
- **Access to sustainable finance** in order to accelerate and roll out technology development;
- **Accelerate transition to a circular economy** by incentivising the use of waste streams as inputs in manufacturing processes.

ArcelorMittal's Climate Action Report is available for download at *http://corporate.arcelormittal.com/sustainability/arcelormittal-climate-action-report.*

ArcelorMittal is a headline sponsor of *Steel for Life*

STEEL for life

Back to school with lightweight frame

The school expects to have a full complement of students by 2023

Steelwork having the highest strength-to-weight ratio of any construction material was one of the main reasons it was chosen for the frame of a new school in Leeds.

Responding to the need for more educational places in Leeds, a new 1,000-pupil school is now under construction in the suburb of Chapeltown.

Dixons Trinity Chapeltown plans to be a full all-through primary and secondary school, accommodating pupils aged between four and 16.

Currently housed in temporary buildings, adjacent to the work site, the school took in its first pupils in late 2017. It will be able to occupy its new premises once Willmott Dixon has completed a full fit-out in May 2020. The school expects to have a full complement of pupils by 2023.

The new steel-framed school building is a three-storey structure measuring approximately 80m-long × 30m-wide and offering 6,780m² of floor space.

"From an early stage, it was agreed that the school would be a steel-framed structure," explains Roscoe Project Engineer Adam Tyszkiewicz.

"Steel is much faster to erect compared to concrete, and another advantage is that it can be fabricated offsite by professional fabricators and delivered to site as ready to fix elements.

"They can be easily assembled, disassembled and replaced.

"And we need to remember that steel has the highest strength-to-weight ratio of any construction material."

Construction work on this former industrial site started in February this year. The school building's plot was initially compacted and a series of 7m-deep steel piles installed to support the building's frame.

Commenting on the use of steelwork for the school, Willmott Dixon Construction Manager Lianne Lawson says another of the reasons steelwork was chosen, was for its lightness as the material required shallower foundations.

"The steelwork, along with the metal decked flooring option, also provided a quick programme, which allowed the follow-on trades to get started on-site promptly."

As well as erecting the steelwork, Billington Structures has also installed the project's precast lift shaft and precast stairs.

The building's precast lift shaft offers no stability to the steel frame and is a freestanding structure. All of the structural stability comes from vertical bracing, mostly located at the gable ends and around the lift shaft and stairwells, together with some horizontal roof bracing.

Using a 50t-capacity mobile crane, the steel programme was completed in 6 weeks. The largest and heaviest steel elements were a series of 9.9m-long beams that span the sports hall and weigh close to 2t each.

Interestingly, the sports hall is located on the second floor, alongside the school's assembly hall. The two areas are divided by an internal non load-bearing wall.

The halls occupy the northern end of

Along with the steel, Billington also installed a precast lift shaft and stairs the rectangular structure in what Willmott Dixon's project team describe as the 'noisy zone', as this is where the extracurricular activities will take place.

The ground floor of this zone houses the main entrance, dining hall and kitchen, while the first floor accommodates a lecture theatre and IT suites.

These areas differ from the rest of the school's regular grid pattern, as each floor has longer column-free spaces. The 'noisy zone' is also higher than the rest of the school building in order to accommodate the necessary 7m floor-to-ceiling height required by the second floor.

Having a sports hall on the uppermost floor was a design feature born out of necessity due to the lack of space and the requirement for a single-building design.

Supported on the long span beams, the sports and main hall, both have sprung acoustically-treated floors, to negate any vibration being felt in the rooms below.

"Having a sports hall at upper floor level may cause problems with floor vibration for longer span beams. However, to minimise that effect, all of our beams were designed to have a natural frequency not less than 9Hz," says Mr Tyszkiewicz.

The remainder of the school building (accounting for approximately three quarters of its length) is taken up by three levels of classrooms.

The primary school will occupy the ground floor and one-third of the first floor. This part of the building is mostly based around a regular 7.2m × 7.8m column grid pattern, although the classroom configuration and partition walls do change between floors.

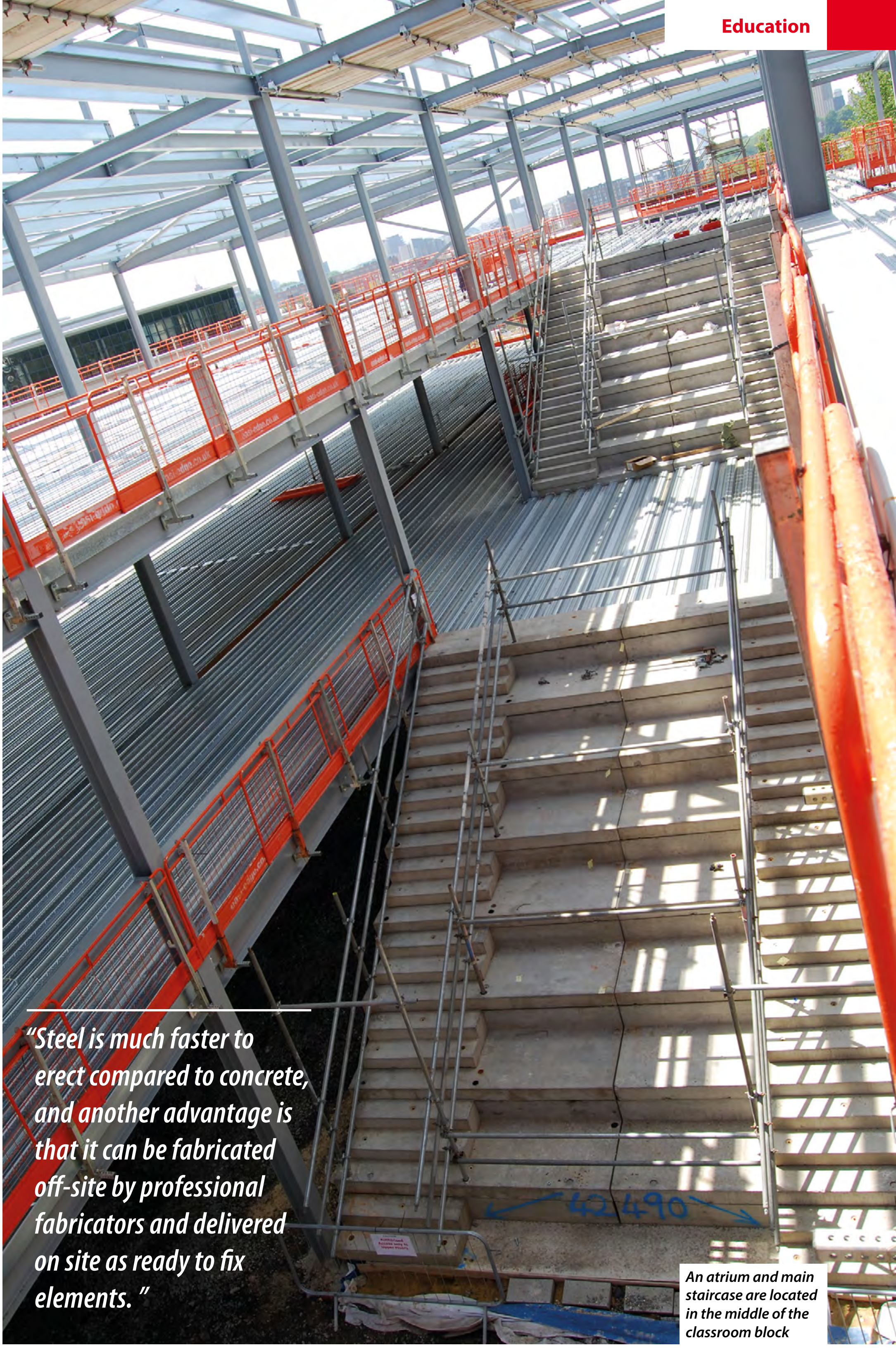
The primary school areas have more toilets, while the upper levels' secondary school classrooms are slightly smaller and have toilets located at the ends of the block.

"Using steel for the framing solution has given the school added flexibility, as partition walls could be removed in the future if teaching requirements change and larger classroom spaces were needed," says Ms Lawson.

Occupying the middle of the classroom block is a full-height atrium, with roof lights allowing plenty of natural light to penetrate the school's inner zones.

Corridors on the first and second floors overlook the atrium void, while a main central staircase provides access to the upper levels.

Adding further to the lightweight nature of the project, the cladding chosen for the school building is predominantly brickwork with some curtain walling, as both of these materials are reasonably lightweight and will minimise the loadings on the steel frame.



"Steel is much faster to erect compared to concrete, and another advantage is that it can be fabricated off-site by professional fabricators and delivered on site as ready to fix elements. "

An atrium and main staircase are located in the middle of the classroom block

The main building is approximately 80m long

FACT FILE
Dixons Trinity Chapeltown, Leeds
Main client: Department of Education
Architect: Faulkner-Browns Architects
Main contractor: Willmott Dixon
Structural engineer: Roscoe
Steelwork contractor: Billington Structures
Steel tonnage: 250t

School parades redevelopment

A primary school is one of the first assets to be constructed at Mindenhurst, a new community taking shape on former military land in Surrey.

FACT FILE
Mindenhurst Primary School, Surrey
Main client: Defence Infrastructure Organisation
Architect: AWW
Main contractor: Skanska
Structural engineer: Skanska
Steelwork contractor: William Haley Engineering
Steel tonnage: 220t

Home to an Army training centre since the late nineteenth century, Deepcut (known as the Princess Royal Barracks since the 1960s) is being redeveloped into a new community with 1,200 new homes, 69 hectares of public green space and village amenities.

This new era for the historic site is being delivered by Skanska on behalf of the Defence Infrastructure Organisation (DIO) and forms part of the wider Project Wellesley. This involves the construction of a new training facility at Worthy Down near Winchester (see box) that, in part, will replace Deepcut.

All military functions and personnel are being relocated in a phased programme, which is due to complete by February 2021. Once vacated, the remaining Army buildings will be demolished, with the exception of three listed structures, making way for further phases of the redevelopment scheme.

Currently, work is all being undertaken 'outside the wire' on land adjacent to the functioning military facility. So far, two parcels of land have been awarded to housebuilders with more to follow in the near future, on a scheme that Skanska expects to run until 2025.

Known as Mindenhurst, the new community will boast village-style retail outlets, business premises, a pub, a community hall adjoining the site's historic garrison church of St Barbara at Deepcut and a new primary school. The latter is already under construction and is due to take-in its first pupils in September 2020.

"The first homes are nearing completion and there will shortly be a need for the 420-capacity primary school," explains Skanska Development Manager Peter Cater.

The T-shaped steel-framed primary school building has a distinctive design, as its main two-storey classroom block forming the T's upright section is topped with a four-peaked saw-tooth roof.

"As a key piece of infrastructure, we wanted the school to be a signature building for the site, acting as a signpost to the development as it has a prominent position near to a new main road that we have built," adds Mr Cater.

The saw-tooth feature not only creates a stand-out building, it also means the upper level of classrooms will have a higher floor-to-ceiling height and will be flooded with natural light as the vertical sections of the roof will have large glazed windows.

The roof is formed with a series of cranked south-facing rafters, with a bolted

The school has been designed as a landmark for the new community

"The overall design for this eye-catching structure could not have been done in any material other than steel."

The school will be one of Mindenhurst's first assets to be completed

The distinctive saw-tooth roof is formed by a series of cranked rafters

knuckle joint, that forms an inclined section from two separate steel members. Completing each saw-tooth ridge, the north side is formed with a single rafter that slopes outward and downwards to its supporting column.

Overall, the school will include two nursery classrooms with associated spaces that can be operated independently on the ground floor. Elsewhere, two reception and 12 more classrooms will be available to accommodate year one and two pupils on both the ground and first floors.

The ground floor is 2m wider than the upper level along the western elevation, allowing these classes to have more room.

Because of this longer span on the ground floor, the column line for this elevation's first floor does not align with the lower level.

The first-floor columns are consequently supported on a series of box section members, acting as a transfer structure.

The 500mm × 300mm box sections each measured 8m-long and weighed 2.5t. These were the heaviest steel elements that steelwork contractor William Haley Engineering had to erect on the project.

The top portion of the T-shaped structure accommodates a large double-height space for two halls. These column-free spaces are both 12m-wide and will be separated by a moveable partition, allowing them to be used as one or two separate areas.

Adjacent to the hall is another two-storey zone, accommodating the school's kitchen on the lower floor and a plant deck above.

Stability for the steel frame, which supports precast planks to form the upper level, is provided by bracing, located in corridors and partition walls.

"The decision to use precast flooring was all about speed of installation," sums up Skanska Construction Director George Taylor. "William Haley erected the steel and all of the project's precast units, which included a lift shaft, in just five weeks.

"Also, the overall design for this eye-catching structure could not have been done in any material other than steel, because of the shape and length of spans."

Worthy Down redevelopment

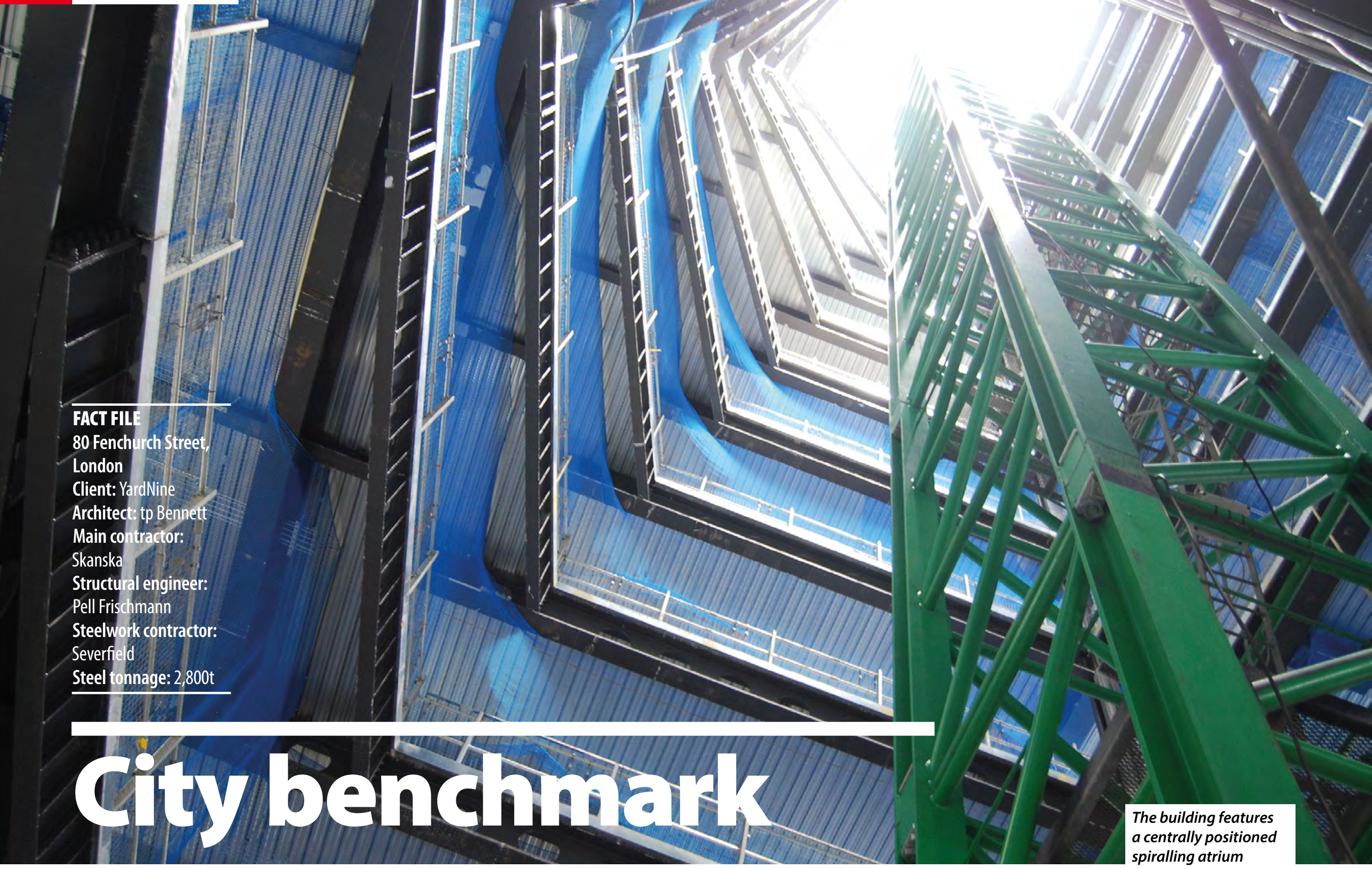
A total of 26 new buildings are being constructed by Skanska at Worthy Down, 14 of which are steel-framed structures.

Steelwork contractor William Haley Engineering has fabricated, supplied and erected approximately 2,000t of steel for these buildings during a phased programme that started in 2015.

The steel-framed buildings have included accommodation blocks, a combined sergeants' and officer's mess, retail and leisure facilities, a physical recreation and training facility and most recently an entrance building and museum (pictured), requiring 125t of steel.

The museum is a rectangular braced frame structure with a 2,130m^2 ground floor and an L-shaped upper level with 479m^2 of space. The lower level will accommodate a site reception, café and the main exhibition space, while upstairs there are offices, a plant area and a visitor walkway that will allow visitors to look down on the museum exhibits.

Commenting on the choice of a steel solution for the museum and many of Worthy Down's other structures, Skanska Design Director Dan Bennett says: "Steel is ideal for the long spans required in these buildings and it was a more cost-effective solution compared to alternative structural solutions. Steel is also more versatile, creating complex shapes, while it is also relatively lightweight, resulting in smaller, more efficient foundation solutions."



The building features a centrally positioned spiralling atrium

FACT FILE
80 Fenchurch Street, London
Client: YardNine
Architect: tp Bennett
Main contractor: Skanska
Structural engineer: Pell Frischmann
Steelwork contractor: Severfield
Steel tonnage: 2,800t

City benchmark

Open-plan floorplates, a spiralling atrium and landscaped terraces are just some of the features of 80 Fenchurch Street, one of the City's latest commercial schemes.

The upper floors will have access to roof terraces

The construction of new commercial buildings in the City of London shows little sign of waning, as a host of new structures are currently underway with their tower cranes dominating the skyline.

Construction activity is now pushing the square mile's traditional high-rise cluster further east towards its Aldgate boundary. One example of this trend is 80 Fenchurch Street, a 15-storey commercial block that will offer 23,200m² of floor space and is aiming to achieve a BREEAM 'Excellent' rating.

The scheme had been given consent a few years ago. However, work failed to materialise and a cleared site remained unused until developer YardNine's involvement commenced in 2018.

Once on-board, YardNine comprehensively redesigned the steel-framed structure's lower floors and, in particular, its amenities.

Also, known as EightyFen, the building is said to have been conceived as a refreshing alternative to the more traditional towers of the City. A double-height, and largely column-free, timber-clad entrance foyer will have integrated cafes, restaurant and health facilities, while a centrally-positioned atrium will flood the area with natural light.

"The building will be a benchmark for this part of the City, with floorplates ranging from 460m² up to 1,850m², with the uppermost five floors benefitting from landscaped roof terraces," explains Skanska

Senior Project Manager Rohit Gorasia.

From level 10 to 14, the building's floorplates decrease in size as each of these levels has a roof terrace. Each outdoor space is in a slightly different position to the others, as they are arranged in a stepped formation that ascends around two sides of structure.

"If you look at the top of the building in plan and divide it into nine squares, five of the outer squares become terraces from level 10 to 14 and the floorplate progressively decreases creating a 'Giant's Causeway-like effect'," says Pell Frischmann Associate Director Kee Leung.

The building's steel frame generally has a 15m × 9m grid pattern, with one area designed around a larger 15m × 15m column spacing. Fabsec cellular beams – chosen to integrate the services within their depth – support metal decked composite floors.

The long span arrangement means there are only seven internal columns, all of which will remain exposed in the final scheme.

"As the columns will be feature elements within the building, we will apply a decorative final coat of paint once the internal fit-out is nearing completion," says Severfield Senior Project Manager Michael Bryars. "Doing this late in the construction programme, means there is less chance of them getting damaged."

Aesthetics has played a further role in the design of these seven exposed columns, as 460 grade fabricated plate girder sections have been used, as opposed to conventional 355 grade members, which have been used around the building's perimeter.

"These columns were chosen as they offer the required stiffness, but are slimmer, meaning they take up less of the valuable office footprint," says Mr Leung. "They may cost more, but we ended up using less steel, which evens out economically."

The column splices are also concealed in the structural floor zone, again adding to the overall clean and neat aesthetic look the architect and client desired.

Stability for the frame is predominantly derived from an offset concrete core, which is positioned along the eastern elevation. Similar to the choice of column sizes, the core's position was chosen so it would not intrude into the floor space, while also giving the impression of a more open-plan environment.

The opposite western elevation has been designed as a sway frame, to restrict torsion and provide some extra stability to the area furthest away from the offset core. This is particularly important as the only area to feature a 15m × 15m grid is in the south west corner of the building.

Commenting on the sway frames, Mr Leung adds that although stability was an important consideration, the main reason for the design was the strict cladding deflection limits along this elevation.

Possibly the most impressive feature of 80 Fenchurch Street is the full-height central atrium.

The sway frame is created by two parallel ladder frames that extend up the whole western façade. They are formed by a series of 8m-long × 4m-high H-shaped fully-welded assemblies each weighing 6.5t. They are fabricated from 725mm × 300mm plated beams and 600mm × 400mm plated columns.

Possibly the most impressive feature of 80 Fenchurch Street is the full-height central atrium, which will have a glazed roof.

Standing at ground floor and looking up through the 9m by 9m void, one can observe a spiralling effect as the floor beams along two sides of the atrium are slightly cranked at a different angle on each level to give the impression of a twist.

Forming the roof of the atrium has been one of the more significant design challenges of the project. Taking into account the extra loading that the landscaping of the terraces will impose on the structure - as it will include some large planters with small trees - the atrium roof structure has been designed as an independent Vierendeel frame.

It sits between floors 12 and 14, and this standalone structure supports the glazing and is completely detached vertically from the slab edges at levels 13 and 14, which isolates it from the post-construction movements.

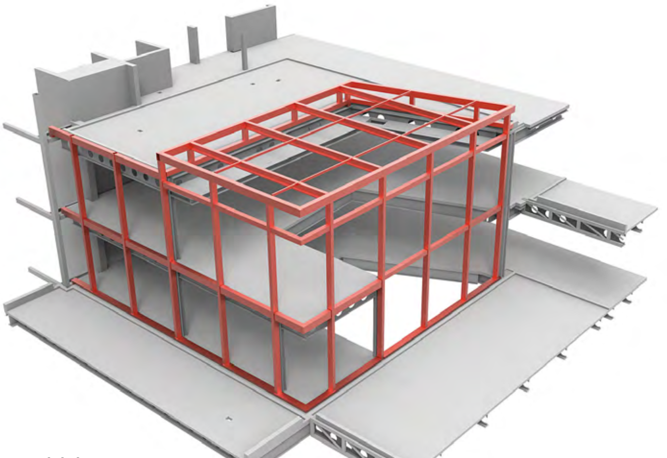
The box is approximately 8.6m tall and works as a Vierendeel frame in two directions, spanning 13m in one direction and 7.5m in the other. It is supported vertically at key discrete points of the main frame.

According to Pell Frischmann Senior Engineer Alexandru Gaftea, the frame was designed so that the deflections are limited during each of the construction stages, starting from the erection of the frame and finishing with the building being fully-occupied and operational.

"By closely coordinating with the architects and the façade subcontractor, we managed to achieve the best balance between the sizes of the steel frame elements and the predicted movements that would have an impact on the glazing panels."

Due to the large size of this frame and the transportation limitations, hidden splices were introduced at specific locations in order to minimise the visual impact of the exposed steelwork.

80 Fenchurch Street is due to complete in June 2020.



Model showing the structurally-independent roof frame

One of the seven internal columns

The western elevation's ladder frames have a kink at second floor level to accommodate the changing profile of the cladding

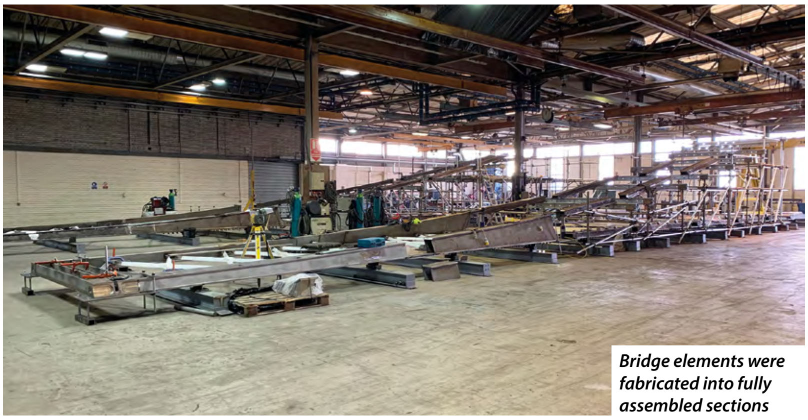
The footbridge replaces a winding staircase that previously offered access to the main castle

You can view drone footage of the Tintagel footbridge at https://www.newsteelconstruction.com/wp/tintagel-video/

Historic link restored

For the first time in more than 500 years, the two halves of Tintagel Castle have been reconnected after the installation of a new steel footbridge.

FACT FILE
Tintagel Castle Footbridge, Cornwall
Main client: English Heritage
Architect: William Matthews Associates
Main contractor: American Bridge
Structural engineer: Ney & Partners
Steelwork contractor: Underhill Engineering
Steel tonnage: 47.5t



Bridge elements were fabricated into fully assembled sections

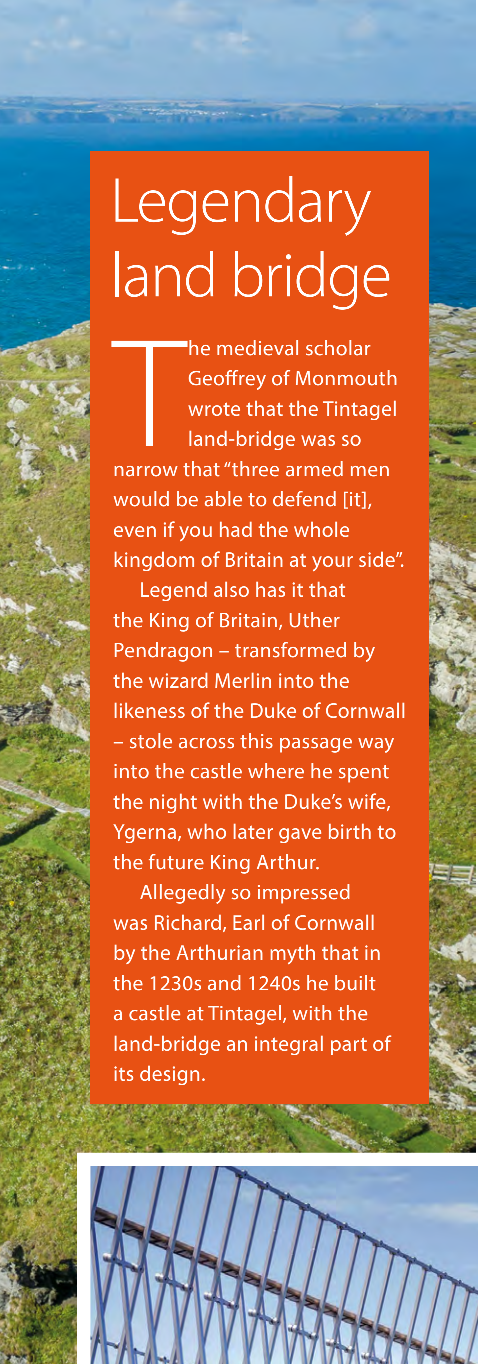
Perched on two rocky outcrops along the north coast of Cornwall, Tintagel Castle is a spectacular site, inextricably linked with the legend of King Arthur [see box] and visited by almost 250,000 tourists every year.

Now separated by a steep gorge, the castle, which is predominantly positioned on a headland, was once linked to the mainland and its gatehouse by a narrow strip of land that was lost to erosion sometime during the 15th or 16th century.

The recent opening of a new footbridge has restored this link, allowing visitors to once again walk in the footsteps of the site's medieval inhabitants.

Replacing the original rock, earth and grass, English Heritage's new footbridge has been constructed using steelwork, locally-sourced Cornish slate for the deck, and oak.

Fabricated in Plymouth by Underhill Engineering and designed by structural engineers Ney & Partners alongside William Matthews Associates architectural practice, the bridge consists of two independent



Legendary land bridge

The medieval scholar Geoffrey of Monmouth wrote that the Tintagel land-bridge was so narrow that "three armed men would be able to defend [it], even if you had the whole kingdom of Britain at your side".

Legend also has it that the King of Britain, Uther Pendragon – transformed by the wizard Merlin into the likeness of the Duke of Cornwall – stole across this passage way into the castle where he spent the night with the Duke's wife, Ygerna, who later gave birth to the future King Arthur.

Allegedly so impressed was Richard, Earl of Cornwall by the Arthurian myth that in the 1230s and 1240s he built a castle at Tintagel, with the land-bridge an integral part of its design.

33m-long cantilevers that reach out from either side of the gorge and almost touch in the middle.

At the centre of the bridge, a narrow gap (40mm) has been designed to represent the transition between the mainland and the island [headland], the present and the past, history and legend.

English Heritage's Chief Executive Kate Mavor says: "Tintagel Castle has been made whole again. Once more, people will cross from one side of the castle to the other and their footsteps will echo those from hundreds of years ago.

"As a charity, English Heritage's core purpose is to care for historic sites like Tintagel Castle and to inspire people to visit them. Our new bridge does both – protecting the castle's archaeology and bringing its story to life in a brilliant, imaginative way."

In order to achieve the client's vision, the design had a number of considerations and challenges to overcome, not least the site, which is inaccessible for many vehicles and large deliveries of materials.

"Steel was the only choice for the bridge as we needed a lightweight solution, and one that could be fabricated offsite into deliverable pieces," explains project Architect William Matthews.

Getting the steel elements to site was just one of the challenges that needed to be overcome as the gatehouse can only be accessed by one narrow lane. A multi-axle vehicle was used to deliver the steelwork and navigate the winding road.

Lifting the steel into place was another significant challenge. With no room or access for a crane in the gorge, which is more than 60m-deep, or on either side, the construction team utilised a lifting procedure not often seen the UK.

A cable crane, which are used in the Alps to install power lines and ski lifts, was installed across the gorge. It had a 5t lifting capacity, could pick-up steel elements from a small delivery yard on the headland and subsequently fed the construction of the bridge's two cantilevers.

None of the bridge's steel elements exceeded the cable crane's capacity, while the largest two pieces, each 10m-long × 4.5m-deep and installed at either end of the cantilevers where the structure meets the abutments, where within a size that was transportable on the access route.

All of the steel elements were fabricated by Underhill into fully assembled and erectable pieces, that included a top and bottom cord, bracings and cross members.

A total of six pieces were needed for each of the cantilevers and they are formed from a combination of mild steel and stainless steel parts.

"As the bridge is in a very aggressive ▶20

The cantilevers nearly touch in the middle of the bridge

The spectacular bridge is now open to tourists

▶19 environment with plenty of wind-borne sea salt around, we chose mild steel for the parts which can be easily repainted and stainless steel, which is more resistant to corrosion, for the areas where painting would be more difficult," explains Mr Matthews.

This means the bridge's main top and bottom cords are fabricated from mild steel, while the bracings and cross members are stainless steel.

The connection points between each individual steel assemblage [two on each piece] are also fabricated from stainless steel and were welded to the main cord members during the fabrication stage. The connections consist of finger joints that interlock with opposite members on the adjoining section, similar to a woodwork dovetail joint. Once the individual sections were lifted and manoeuvred into place during the erection programme, the connections were then bolted up.

Underhill's fabrication process required some precise engineering and each section was trial erected with its neighbouring piece to ensure the two cantilevers could be seamlessly erected on-site.

The steel assemblies have finger joints that connect with adjoining sections

During the erection programme the permanent handrails, along with temporary floor boards, were installed to create a safe working environment. The erection team took delivery and erected at least one bridge section every day, and once the two cantilevers were fully erected, the slate flooring was installed.

The bridge is part of a larger £5M programme of works at Tintagel Castle which also includes improving footpaths around the site, helping to limit the impact of visitors on the unique archaeology and ecology.

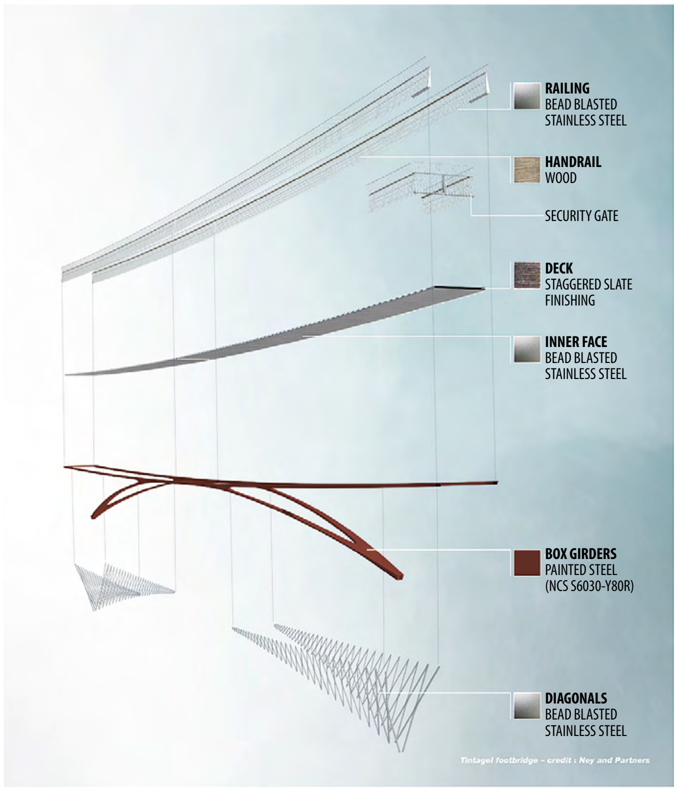
Tintagel Bridge: steel material selection

The bridge at Tintagel, designed by Ney and Partners and William Mathews Architects, is exposed to a coastal environment so material selection is a key design step. Richard Henderson of the SCI, with a review from Matthieu Mallié of Ney and Partners, discusses some of the issues.

The Ney and Partners/William Matthews Architects successful competition entry for the Tintagel bridge involved approximately 33 m long cantilevers reaching out from each cliff face. The design included delicate balustrades and structural bracing for carrying shear forces and more substantial tension and compression top and bottom chords to transfer the bending moments back to the abutments. The fact that the original land bridge was lost a few hundred years ago underlines the exposure of the site to the power of the Atlantic Ocean. The choice of material was affected by durability, maintenance requirements and visual appearance. In the competition entry, weathering steel was to be used for the main top and bottom chords and duplex stainless steel for all other steel elements. SCI was engaged by English Heritage to assess the suitability of different steels through a programme of corrosion tests at the site, in collaboration with the design team and Arup Materials.

The table of corrosivity categories in ISO 9223 lists category "C5 very high" with the example description for a typical external environment including "… coastal areas with high salinity". The predicted thickness loss for carbon steel in the first year of exposure is given as >80 to 200 µm.

Corrosion tests on steel samples were carried out over a one-year period to determine the rate of corrosion and suitability of steel for the project before the choice of material was finalised. The C5 corrosivity category of the site was confirmed by the tests and data on the rate of steel loss collected. Following the completion of the assessment, weathering steel was showing a potential 70 to 120 year life span depending on the prediction models. Nevertheless, the Client could not accept the risk of an



unexpected corrosion rate and a painted carbon steel solution was chosen for the tension and compression chords.

The more slender members of the bridge which form the "Telford" diagonals of the cantilevers, the bridge deck (the trays in which the slates are placed), its shear bracing in plan view and the balustrades are made from stainless steel. The stainless steel chosen was duplex grade 1.4462, which has very good resistance to corrosion combined with high strength.

Logistics in the frame

An East Midlands logistics park is currently completing its third phase, proving that steelwork has the right attributes to make it the ideal framing solution for distribution centres.

Northamptonshire has in recent times become the hub of the UK's distribution centre infrastructure, as its geographic location in the heart of England is a key attraction, as is being close to the UK's main motorways and the area's good links to the port of Felixstowe via the A14.

This has helped the county to attract leading retailers and logistics firms, as well as branded food and consumer goods manufacturers, to set up distribution centres on its many purpose-built parks.

One of these is Warth Park, a 160-acre logistics and business park, adjacent to the A45 near Raunds, where a third phase is now under construction.

The latest work includes two new steel-framed distribution centres for Howdens Joinery (known as Units 2 and 3), which will add to the company's existing on-site warehouse (Unit 1), which was completed as part of Warth Park's phase two (see box).

Steel is the most commonly used framing solution for the construction of distribution centres and the material has a sector market share of approximately 90%.

The material enables large clear spans – crucial for today's modern distribution centres - to be created easily and economically. Designers also like the fact that a steel frame can be easily modified, strengthened and extended if a user's future requirements change.

"There are always options when it comes to designing and building a warehouse,

Partitions subdivide Unit 2 into three zones

"The steelwork for Unit 2 was erected in just nine weeks."

Unit 2 incorporates a three-storey office block along one gable end

but the main reasons we've gone for a steel-framed solution are cost and speed of construction," says Winvic Construction Project Manager Nick Lakin.

"The steelwork for Unit 2 was erected in just nine weeks, which allowed us to get all of the trades, such as cladders and roofers, quickly on site to follow on behind the progressing steel programme."

Unit 2 is the larger of the two distribution centres, with a total area of 61,900m², and its steel erection programme was completed slightly ahead of its neighbour, although both have an overall completion date of November 2019.

Measuring 314m-long × 190m-wide, with a maximum height to eaves of 16.3m, Unit 2 has five 38m-wide internal spans and required a total of 2,200t of steelwork.

It will feature a total of 56 cross docks and 19 level access doors, while internally, it is sub-divided into three separate zones by two partition fire walls.

Within the footprint of the five-span steel frame, the unit accommodates a three-level office block positioned along one of its gable ends. Additional office space is also provided by an attached 370m² single-storey pod located alongside the northern elevation.

Providing 3,700m² of space, the three-level offices are based around a 7.5m × 7.5m column grid pattern. It measures 60m-long and 22m-deep and its beams support metal decking to form the two upper floors.

Externally, the majority of this gable façade (four spans) has glazed cladding, as opposed to horizontal composite panels, which clad the other elevations. The glazing extends beyond the current length of the office block and adds some flexibility to the overall scheme.

"The extra glazing has been installed in case the client wishes to extend the office block in the future," says Mr Lakin.

Project steelwork contractor Caunton Engineering has been subcontracted on a design and build basis for both buildings. The company's Senior Structural Engineer Jay Hutton adds: "The portal-framed structure, particularly the overall stability, has been designed with the extended 160m-long office already taken into account."

The steel design for Units 2 and 3 incorporates a hit and miss configuration for the internal columns, whereby one row of columns is omitted every other bay. This design creates more space for the end-user, but in Unit 2, even more column-free floor area was required by the client at one end of the structure.

This request required the frame to have a double-miss configuration for the last two bays along the opposite gable end to the offices.

"This means there are no internal columns for the final 20m of the structure and so the adjacent columns had to be designed so they could absorb additional vertical and horizontal forces," says Mr Hutton.

The smaller Unit 3 has a total area of 28,100m² and measures 208m-long × 131m-wide with a maximum height to eaves of 16.3m. This four-span structure required 1,050t of steel and also includes a 1,600m² two-level office block.

As well as the two distribution centres, Winvic's £45M phase 3 works also includes the construction of new associated infrastructure, such as a development road and a 15m-span bridge for an existing road.

Unit 2 has five 38m-wide internal spans

FACT FILE
Warth Park, Raunds, Northamptonshire
Main client:
Roxhill Developments
Architect: UMC
Main contractor: Winvic Construction
Structural engineer: RPS
Steelwork contractor: Caunton Engineering
Steel tonnage: 3,250t

Groundworks underway for the construction of Unit 3

Phase 1 and 2

Winvic was first contracted by Roxhill Developments in 2013 to construct new highways infrastructure and undertake a major cut and fill earthworks scheme to re-profile the site, which sloped up to 10m, to create plateaus for the distribution centres.

Phase 1 was completed the same year and included the delivery of a 3,900m² steel-framed warehouse for DPD, with steelwork being fabricated and erected by Caunton Engineering.

Three further steel-framed distribution centres were completed during phase 2, which finished in 2016. These consisted of a 12,000m² warehouse for Airwair International (steel by Caunton), a 38,200m² warehouse for DSV (steel by Severfield), and Howdens Joinery initial Warth Park facility (Severfield), which offers 60,880m² of floor space and a three-level office block.

Cross-braced lateral load-resisting systems

Cross bracing is a traditional means of providing lateral stability to structures. Richard Henderson of the SCI discusses some of the features of this structural system.

As structural engineers of a certain age will recall from their student days a cross-braced panel is a statically indeterminate (or hyperstatic) structural system: the forces in the members cannot be determined simply by invoking equilibrium at the joints. Determining the forces used to be an exercise in the application of virtual work to structural problems.

When cross bracing is used to resist lateral loads, the bracing members are usually designed as tension only and the designer assumes that the element which forms the compression member buckles elastically as the frame deforms so as to shorten the relevant diagonal. This approach is favoured when analysing and designing structures by hand as determining the buckling resistance of the member is avoided. Crossed flats were traditionally used for this purpose although angle bracing could be used so the bracing members had some out of plane stiffness to make handling easier. Cautionary tales regarding finishes being pushed off by bowing bracing are told, leading to the adoption of different bracing arrangements.

Flat bar bracing

A flat bar tension only bracing member in a 4 m × 6 m pin-jointed braced panel (say a 130 mm × 10 mm flat), bolted to the opposing diagonal member at the centre, has a system length of √13 m, assuming the tension diagonal provides a point of restraint at the centre connection. (For a detailed assessment see BS EN 1993-2 Annex D). The out of plane second moment of area is 1.083×10^4 mm^4 giving an Euler buckling load:

$$N_{cr} = \frac{\pi^2 \times 210 \times 1.0833 \times 10^4}{13 \times 10^6} = 1.73\text{kN}$$

The buckling resistance of the member $N_{b,Rd}$ is very close to the Euler load because of the high out of plane slenderness and has a value of 1.69 kN, assuming S355 material. A compression force of this magnitude is unlikely to have any effect on a bracing connection designed for a tension force of 450 kN and is usually safely ignored.

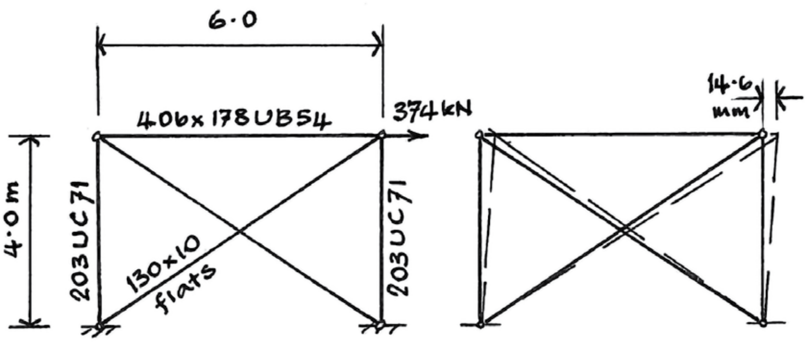


Figure 1: Braced panel

An estimate of the bow in the compression member which is making no contribution to the lateral resistance of the braced panel can be made if the panel members are known, assuming the member buckles into a circular arc. As an example, assume 203 UC 71 columns and a 406 × 178 UB 54 beam framing the 130 ×10 flat cross bracing (Figure 1), with a horizontal design load of 374 kN applied to the braced panel.

The horizontal displacement of the top of the panel relative to the bottom is 16.2 mm or 14.6 mm depending on at which end of the beam the force is applied and the displacement calculated. The extension of the bracing is about 12.1 mm (taking the smaller displacement). If the shortening of the opposing diagonal is taken as the same value, the bow is about 94 mm (neglecting the elastic shortening of the bracing member under the axial load). If the flat is unrestrained in the middle, the bow is about 180 mm. Clearly, such a bow could be sufficient to push dry lining off a wall concealing the braced panel. The low Euler load indicates clearly that the member buckles elastically and will behave satisfactorily when the loads are reversed.

An elastic stick finite element analysis that includes all the members without somehow allowing for the buckling behaviour of the bracing will produce a diagonal load in the compression member which corresponds to its axial stiffness. In such an analysis, the tension and compression diagonals share the load and carry a force which is close to half the force in the member assuming tension-only.

Tubes used as tension only bracing

An alternative form of bracing member consisting of RHS tubes, also assumed to behave as tension-only, is sometimes adopted. Consider 90 × 50 × 5 RHS tubes with centrelines in the same plane with a welded joint in the middle. Assume for the purpose of this example that the middle joint is pinned and behaves in a similar way to the crossed flats in providing a point of restraint in the middle of the compression member. The minor axis buckling resistance of the RHS for a length of √13 m is 71.6 kN by calculation. The compression member therefore carries a force of at least 71.6 kN which the connections must be able to sustain. The maximum theoretical load on the connection is equal to the Euler load and is equal to 78.4 kN, about 9.5% higher. If the connection (perhaps a gusset) is designed for tension only, it is possible that a load equal to the compression resistance is sufficient to deform the gusset permanently, compromising its ability to resist tension when the bracing load is reversed.

The amplified bow in the bracing member that corresponds to the buckling resistance can be found from back calculation. The assumed initial bow e_0 is given by:

$$e_0 = \frac{W_e}{A}\alpha(\bar{\lambda} - 0.2)$$

▶26

▶24

where $\bar{\lambda} = \sqrt{\frac{Af_y}{N_{cr}}} = \sqrt{\frac{1270 \times 355}{78420}} = 2.4$, and the imperfection factor for an RHS = 0.21.
Substituting values in the formula for the initial bow gives:

$$e_0 = \frac{19.7 \times 10^3}{1270} \times 0.21 \times (2.4 - 0.2) = 7.16\text{mm}$$

The amplified bow at failure is

$$\frac{N_{cr}}{N_{cr} - N_{b,Rd}} e_0 = 11.48 \times 7.16 \approx 82\text{mm}$$

This is the bow at which the extreme fibre at the point of maximum bow (and bending moment) reaches yield stress due to combined axial load and bending. The bow is about 15% less than that in the flat bar. As the frame deflects and load on the member is increased, the bow increases, the member shortens more and more quickly and the stiffness of the compression member decreases as shown in Figure 2. The member reaches its buckling load as the frame reaches its maximum sway deflection of 14.6 mm.

Column shortening

If a cross-braced panel with bracing that is intended to behave as tension-only has significant axial loads in the columns, the bracing will develop axial loads which may confuse the unwary. An elastic stick finite element analysis which includes all the elements in the model with pinned connections and which

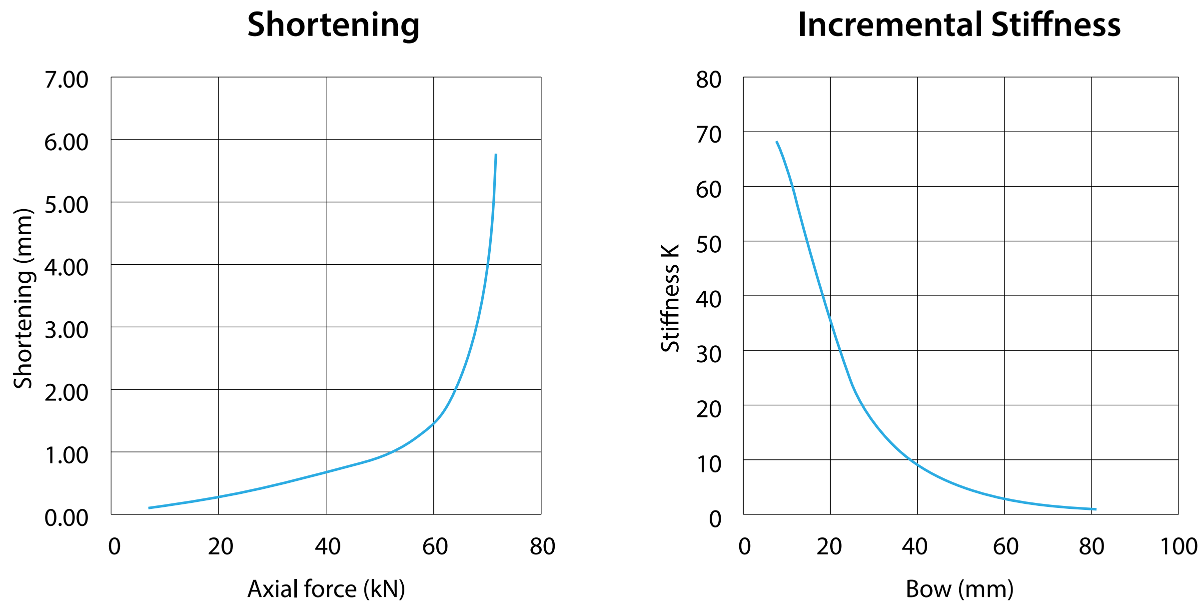


Figure 2: Member shortening and incremental stiffness

makes no provision for members intended to buckle when in compression, will exhibit compression forces in the bracing and a tension force in the beams: see Figure 3. The forces may or may not be sufficient to cause the bracing members to buckle, depending on the magnitude of the applied forces and the bracing section chosen.

If the braced panel is modelled with pinned joints and only the tension element present and if only vertical loads are applied, no axial forces will be developed in the bracing member or beams. The braced panel will deflect sideways however, to accommodate the bracing member which remains at its original length.

Lateral stiffness

It is advantageous to mobilise both tension-only bracing members in a cross-braced panel if this can be achieved, because the increased stiffness is beneficial to the overall stability of the building. The contribution of the bracing members to the lateral stiffness is of course doubled and the magnitude of the α_{cr} value for the building increased, thereby reducing any amplifier on the lateral loads. A cross bracing system formed of rods, perhaps adopted for architectural reasons, can be pre-tensioned to prevent the rod forming the compression diagonal from going slack. In this case, the bracing members in both diagonals will be effective as the tension force in the member in the shortening diagonal will be reduced as the bracing resists a lateral load. There are proprietary systems of rods, rod-ends, turnbuckles and connecting rings which are designed to achieve this effect [1].

Tensioned bracing is more difficult to achieve when the bracing members are a different geometry from rods. In the past it has been standard practice in some drawing offices to detail the holes in cross bracing members such that the length of the diagonal is 5 mm "short". This required the erection team to lean the columns when making the connections for the first bracing member to be erected. Installing the second member was much more difficult as it involved tensioning the first diagonal so as to shorten the opposing diagonal by enough to make the final connection.

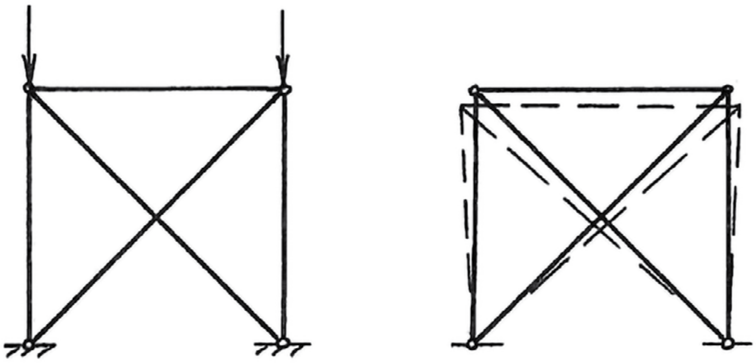


Figure 3: Deflection under vertical loads

Conclusion

Tension-only bracing members provide a simple means of resisting lateral loads on a structure but certain features of the behaviour of the bracing need to be considered:

1) The slack member of flat bar cross bracing can bow significantly which could possibly damage finishes.
2) If using tubes as cross bracing, the connections must be capable of resisting a compression force at least equal to the buckling resistance of the member.
3) A simple stick finite element analysis model of a frame with cross-bracing will develop compression forces in both bracing members unless steps are taken in the analysis to avoid this.
4) Mobilising both bracing members (eg by pre-tensioning) increases the α_{cr} value of the frame and is therefore beneficial.

1. Round bar cross bracing, p21 NSC, September 2015

New and revised codes & standards

From BSI Updates July and August 2019

NEW WORK STARTED

EN 1993-1-2
Eurocode 3. Design of steel structures. General rules. Structural fire design
Will supersede BS EN 1993-1-2:2005

EN 1993-1-3
Eurocode 3. Design of steel structures. General rules. Supplementary rules for cold-formed members and sheeting
Will supersede BS EN 1993-1-3:2006

EN 1993-1-4
Eurocode. Design of steel structures. General rules. Supplementary rules for stainless steels
Will supersede BS EN 1993-1-4:2006+A1:2015

EN 1993-1-5
Eurocode 3. Design of steel structures. Plated structural elements
Will supersede BS EN 1993-1-5:2006+A1:2017

EN 1993-1-9
Eurocode 3. Design of steel structures. Fatigue
Will supersede BS EN 1993-1-9:2005

EN 1993-1-10
Eurocode 3. Design of steel structures. Material toughness and through-thickness properties
Will supersede BS EN 1993-1-10:2005

EN 1993-1-11:2006
Eurocode 3. Design of steel structures. Design of structures with tension components
Will supersede BS EN 1993-1-11:2006

EN 1993-2
Eurocode 3. Design of steel structures. Steel Bridges
Will supersede BS EN 1993-2:2006

BRITISH STANDARDS

BS 5975:2019
Code of practice for temporary works procedures and the permissible stress design of falsework
Supersedes BS 5975:2008+A1:2011

BS EN PUBLICATIONS

BS EN 10210-2:2019 – TC
Tracked Changes. Hot finished steel structural hollow sections. Tolerances, dimensions and sectional properties
No current standard is superseded

BS EN 10219-2:2019 – TC
Tracked Changes. Cold formed welded steel structural hollow sections. Tolerances, dimensions and sectional properties
No current standard is superseded

BS EN ISO 14174:2019
Welding consumables. Fluxes for submerged arc welding and electroslag welding. Classification
Supersedes BS EN ISO 14174:2012

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS EN ISO 2560:2009
Welding consumables. Covered electrodes for manual metal arc welding of non-alloy and fine grain steels. Classification

BS EN 10111:2008
Continuously hot rolled low carbon steel sheet and strip for cold forming. Technical delivery conditions

BRITISH STANDARDS WITHDRAWN

BS 5975:2008+A1:2011
Code of practice for temporary works procedures and the permissible stress design of falsework
Superseded by BS 5975:2019

BS EN ISO 14174:2012
Welding consumables. Fluxes for submerged arc welding and electroslag welding. Classification
Superseded by BS EN ISO 14174:2019

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT - ADOPTIONS

19/30396713 DC
BS EN 10340-2 Steel castings for structural uses. Technical delivery conditions
Comments for the above document were required by 9 July, 2019

19/30382759 DC
BS EN 17412 Building Information Modelling. Level of Information Need. Concepts and principles
Comments on the above document were required by 19 August, 2019

AD 433: Dynamic modulus of concrete for floor vibration analysis

The purpose of this AD note is to provide advice on the choice of elastic modulus of concrete when undertaking the vibration analysis of a composite floor.

The elastic modulus of concrete depends on the constituent materials of the concrete mix and on the age of the concrete. It also depends on the duration of loading and whether the concrete is assumed to be cracked or un-cracked. Table 3.1 in BS EN 1992-1-1 gives strength and deformation characteristics for concrete by strength class. The values are tabulated for normal weight concrete with quartzite aggregates and are based on the cylinder strength f_{ck} at 28 days. The formula for the secant modulus E_{cm} is: $E_{cm} = 22[(f_{ck}+8)/10]^{0.3}$.

The value is in GPa when the cylinder strength is in MPa. Adjustments to the values for quartzite aggregates are given for limestone, sandstone and basalt aggregates. Practice in continental Europe is to use a dynamic modulus based on E_{cm} enhanced by 10%[1].

In UK practice, values for elastic modulus determined from the code are not considered suitable for the calculation of beam deflections from which the natural frequency of the beam is to be determined. The dynamic behaviour generally involves small amplitude vibrations to which the secant modulus at 28 days E_{cm} is not relevant. Instead, given the uncertainty regarding the parameters which affect the actual properties of concrete (type of aggregate, age of concrete, compressive strength etc.), an approximate dynamic modulus should be used which (from practice) gives reasonable results.

SCI publication P354 *Design of floors for vibration: a new approach*[2] and Concrete Centre publication: *A design guide for footfall induced vibration of structures*[3], both recommend the same values for the dynamic modulus of concrete which is appropriate for the estimation of the dynamic response of composite or concrete structures. Values are given for normal weight and light weight concrete as follows:

Uncracked concrete	Dynamic modulus (GPa)
Light weight	22.0
Normal weight	38.0

When using references 2 and 3, the stated values for dynamic modulus should not be enhanced by 10%.

Contact: **Callum Heavens**
Tel: **01344 636555**
Email: **advisory@steel-sci.com**

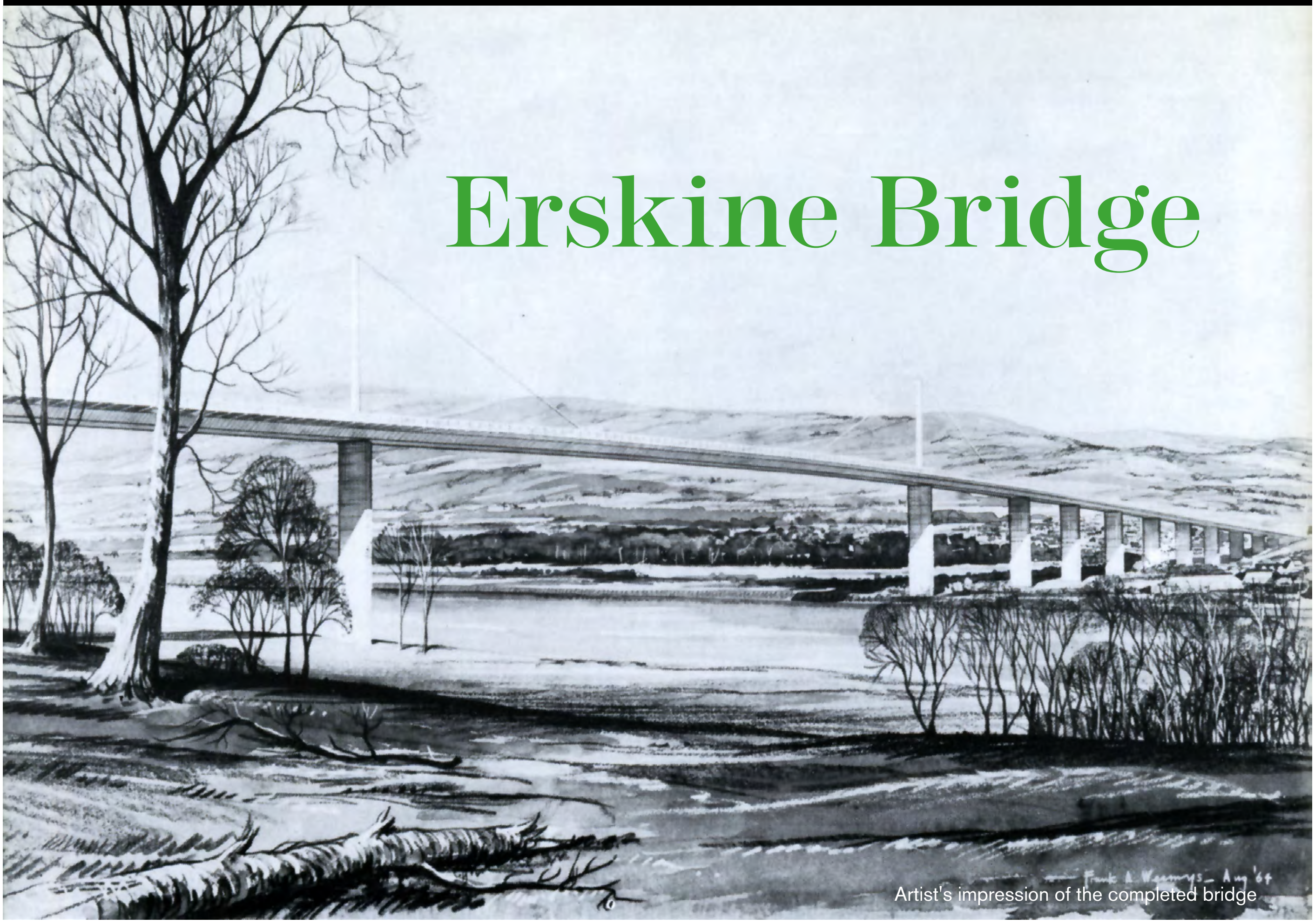
References

1. European Commission – Technical Steel Research: *Generalisation of criteria for floor vibrations for industrial, office, residential and public building and gymnastic halls*, RFCS; Report EUR 21972 EN, ISBN 92-79-01705-5, 2006.
2. Smith, A L, Hicks, S J, Devine P J, *Design of floors for vibration: a new approach,* Revised edition, February 2009, SCI publication P354
3. Willford, M R, Young, P, *A design guide for footfall induced vibration of structures*, Concrete Centre, November 2006

BUILDING WITH STEEL

Reprinted from Volume 5 No. 4
June 1969

Erskine Bridge



Artist's impression of the completed bridge

There has been a ferry across the River Clyde between Erskine and Old Kilpatrick for centuries but the density of traffic has increased so much that one is now faced either with a long queue at the ferry or with a journey into Glasgow to use an alternative crossing. A new scheme has been drawn up linking the A8 (Glasgow-Gourock) and A82 (Glasgow-Inverness) trunk roads, costing over £8M. Erskine Bridge is part of this scheme.

The bridge is a multi-span all-welded steel box girder on single shaft concrete piers in which the main span of 1,000ft will be the longest cable-stayed span in the world. To allow large ships such as the QE2 to continue using the Clyde there will be a minimum clearance of 180ft above HWOST.

Piers

The fourteen piers are all single diamond shaped shafts of heights varying from 22 to 175ft. The shape was developed to give a slender, graceful appearance and to offer minimum wind resistance. The piers are constructed of concrete and are designed to flex longitudinally to accommodate movements of the bridge due to temperature changes.

Deck Structure

The total length of the bridge is 4,334ft, comprising the main cable-stayed span of 1,000ft, two anchor spans of 360ft, and twelve approach spans, four on the south side and eight on the north, generally of 224ft. The total weight of steelwork involved is about 11,000 tons. All movement due to temperature changes is accommodated by the rolling leaf expansion joint in the deck between piers 7 and 8, and by a toothed deck joint and roller bearings at both abutments.

The steel deck girder is of elegant aerodynamic shape similar to those of the Severn and Wye bridges. It is generally 10ft 7½in deep at the centre with cantilevers on both sides to carry cycle tracks and footways. The total width varies from 102ft 6in at the main span, where the central reservation is wider, to 97ft 6in over the approach spans.

The supporting cables are 2½in diameter wire strands arranged in groups anchored to the steelwork in the central reservation and passing over 125ft high tapering steel masts of box section rising from the main piers.

The roadway surface is of mastic asphalt affixed directly to the steel deck plate. Design of the cycle tracks is such that they may be used to extend the carriageway whenever the expected increase in volume of traffic should warrant a third lane. Four 24in diameter water mains and two 12in diameter gas mains will be carried below the footways so that any maintenance on them will not interrupt traffic flow.

Fabrication

The all-welded trapezoidal box girder of high yield stress steel to B.S.968 consists of a deck plate, ½in thick throughout, sloping web plates generally $^3/_8$in thick but increased to $^7/_{16}$in thick and ½in in parts of the main and anchorage spans, and a bottom plate ½in thick at the piers, ¾in thick at the towers or otherwise $^3/_8$in thick.

All the plates have continuous longitudinal stiffeners which pass through transverse stiffening plates at 14ft centres. The longitudinal stiffeners for the deck plate are V-shaped at 2ft centres; those for the bottom flange and lower web sections are 8in bulb flats at 1ft 4in centres; for the upper and central web sections, they are 5in bulb flats at 2ft centres.

Diaphragms of stiffened plate, ¼in thick except over the piers where the thickness is increased to 1in, also occur at 14ft centres and they are welded to the transverse stiffening plates referred to above.

The steelwork is prepared and welded up in the fabricator's shops into components suitable for transport to the site by road. These units are generally 56ft long, 8ft wide and 12 to 15ft deep. On arrival at the site they are offloaded either on the north or the south bank where site assembly yards have been established adjacent to the abutments. At the site the components are welded and bolted together to form 56ft long boxes complete with cantilevers ready for lifting into the bridge. The greatest care is taken in this assembly, by fabricating each box against its preceding and succeeding neighbours, to ensure that the boxes, which weigh from 120 to 160 tons each, will fit without difficulty when offered up at the bridge head.

Fabrication of the V-Shaped stiffeners is worthy of special mention. So far in Britain it had been possible to produce such members only by pressing and in lengths limited by the size of the press. Because of the advantages of continuous longitudinal stiffeners, however, the steelwork fabricator has developed a rolling process by which they can now be produced in any desirable length. This process involved the adaptation of machinery previously used for producing similar profiles but in lighter gauge material and of smaller girth. The V-stiffeners for Erskine Bridge are of ¼in thick high yield stress steel with a depth of 9in and a girth of 24in.

Erection

Erection of the steelwork is so planned that the centre will be reached from both ends simultaneously. This meant starting on the north abutment where the first two spans were erected by specially designed gantry cranes on falsework and welded up so that the remainder of the boxes could be erected by the cantilevering process.

Each succeeding box is lifted onto trolleys on the second span and winched out to the bridge head where specially designed launching girders are used to lower it and then to support it in position while it is welded to the preceding section.

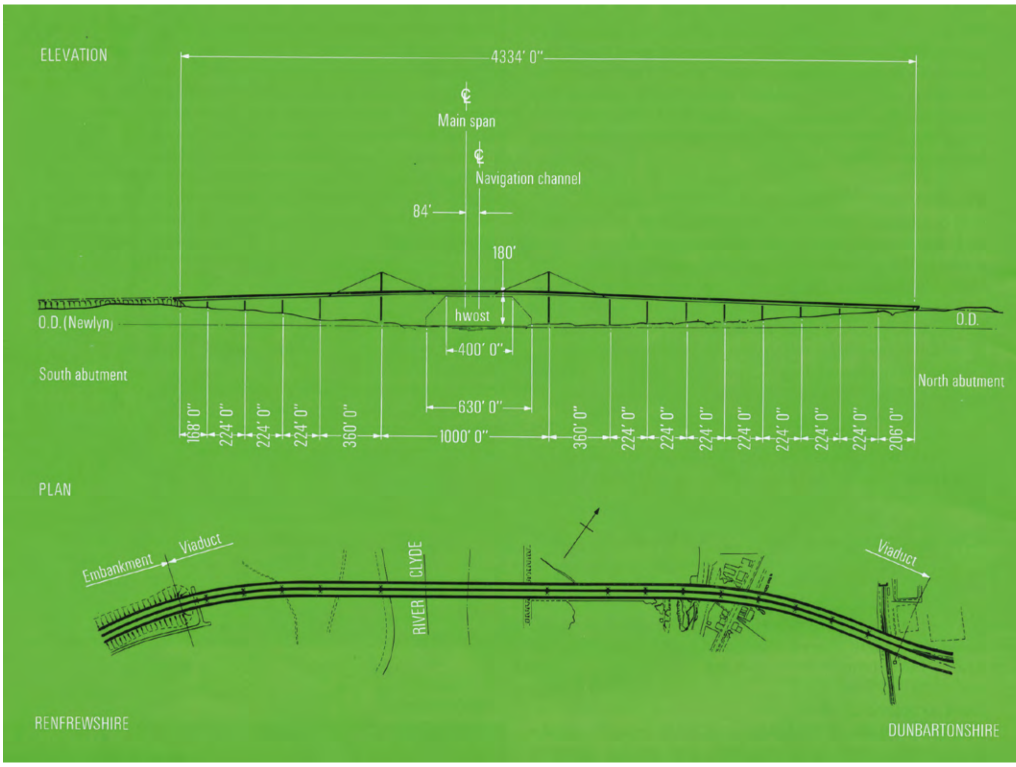
The launching girders, developed from those used for the Wye Bridge, are then moved forward ready to receive the next box.

Before the last section of any approach span can be positioned, the cantilevered part has to be jacked up with the aid of a temporary prop to counteract the sag of about 4ft so that the next section will pass over the top of the supporting pier.

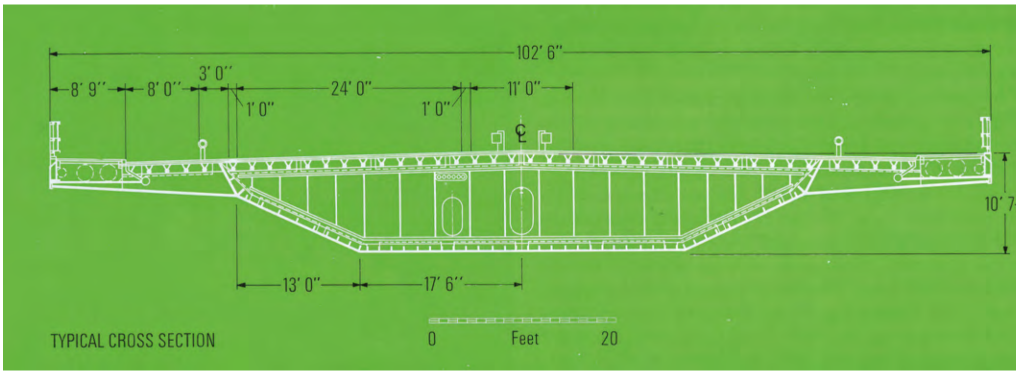
When the anchor and main spans are erected, special steps will be taken because the box is not strong enough to span the distances concerned. In the 360ft long anchor span, a temporary intermediate pier will be erected to limit the effective span to about 240ft. In the case of the main span, however, where the deck girder has to cantilever out 500ft to the centre, use will be made of permanent cables. When the girder cantilevers about 190ft, the steel mast will be erected over the main pier and some of the cable strands will be attached in temporary positions to support the steelwork while erection proceeds.

As soon as the bridge head has advanced sufficiently (about 375ft from the main pier), the remainder of the strands will be attached in their final positions and the rest of the box sections can be cantilevered out.

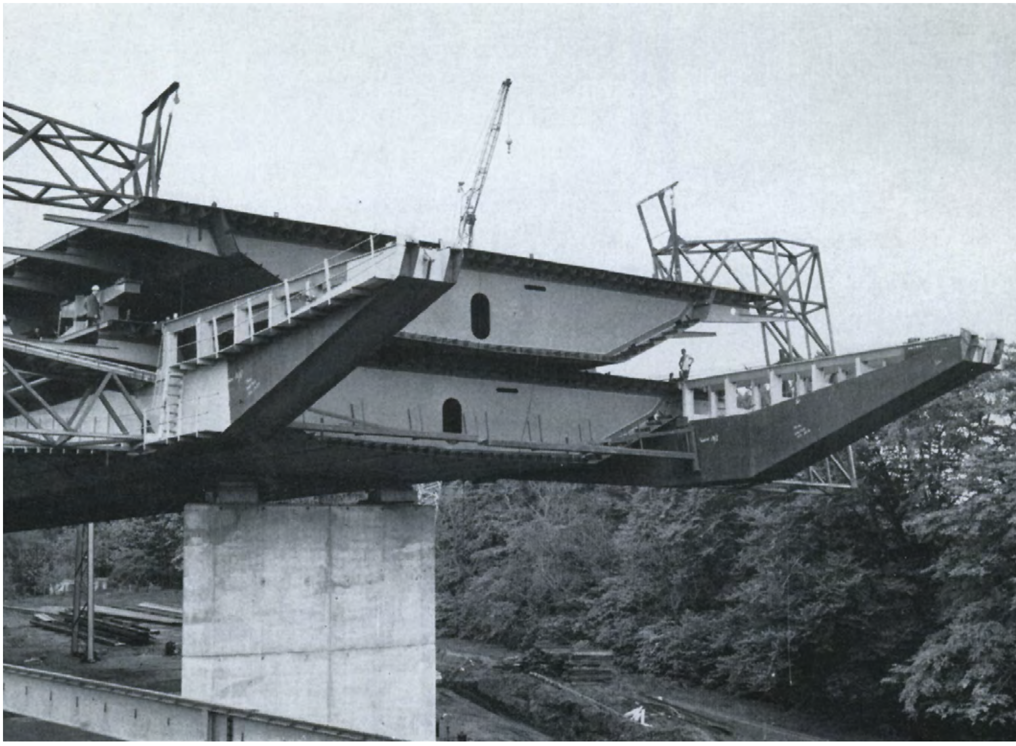
On closing the bridge, the temporary cable strands will be fixed in their permanent positions.



Elevation and plan



Typical cross section



A view of the launching girder

Steelwork contractors for buildings

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

Lorraine MacKinder, Marketing and Membership Administrator,
The British Constructional Steelwork Association Limited, Unit 4 Hayfield Business Park, Field Lane, Auckley, Doncaster DN9 3FL
Tel: 020 7747 8121 Email: *lorraine.mackinder@steelconstruction.org*

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

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

- **FPC** Factory Production Control certification to BS EN 1090-1
  - 1 – Execution Class 1
  - 2 – Execution Class 2
  - 3 – Execution Class 3
  - 4 – Execution Class 4
- **BIM** BIM Level 2 assessed
- **QM** Quality management certification to ISO 9001
- **SCM** Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		3			Up to £400,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	4			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3	✔	Silver	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	Gold	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		Silver	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Apex Steel Structures Ltd	01268 660828					●	●			●	●			●	●		2			Up to £3,000,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●	●	●		●	●			●	●	✔	4		Gold	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950				●	●	●	●		●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	Silver	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4	✔	Silver	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4			Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		Silver	Up to £4,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	Gold	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●		●	●			●		●	●	●	✔	3		Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●		●	●	●			✔	4		Gold	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011			●	●		●			●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £1,400,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £40,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●	●	●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072	●	●	●	●	●	●	●	●		●				●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	✔	Gold	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●			●	✔	3		Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●	●	●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		Member	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
G.R. Carr (Essex) Ltd	01286 535501	●		●	●			●			●			●	●	✔	4			Up to £800,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
H Young Structures Ltd	01953 601881			●	●	●	●	●						●	●	✔	2		● (green)	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●			●	●		●		✔	4		● (grey)	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●			●	●				●	✔	2			Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Intersteels Ltd	01322 337766	●			●	●	●	●		●				●	●	✔	3			Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	● (amber)	Up to £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		● (grey)	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3			Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4		● (green)	Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●				●	✔	3			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £2,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●			●	●				●		✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						3			Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711									●				●	●	✔	4			Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●	●		●	●		●	●	✔	4		● (grey)	Up to £2,000,000
North Lincs Structures	01724 855512			●	●					●	●				●		2			Up to £400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		● (amber)	Up to £3,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●							●		2			Up to £400,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			Up to £6,000,000*
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●			●	●	✔	3			Up to £6,000,000
S H Structures Ltd	01977 681931	●			●	●	●	●	●	●	●	●			●	✔	4	✔	● (amber)	Up to £2,000,000
SAH Engineering Ltd	01582 584220			●	●	●				●	●			●	●		2			Up to £800,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	● (amber)	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £200,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●	●			●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		2			Up to £1,400,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £1,400,000
Steel & Roofing Systems	00 353 56 444 1855			●	●	●	●				●	●		●	●	✔	4			Up to £3,000,000
Structural Fabrications Ltd	01332 747400	●			●	●		●	●	●	●			●	●	✔	3		● (grey)	Up to £1,400,000
Taunton Fabrications Ltd	01823 324266				●	●				●	●			●	●	✔	2		● (grey)	Up to £2,000,000
Taziker Industrial Ltd	01204 468080	●		●	●		●			●	●		●	●	●	✔	3			Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●			●	●			●	●	✔	2			Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	3	✔	● (grey)	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2	✔		Up to £2,000,000
Underhill Engineering Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4	✔		Up to £3,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2			Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●	●	●	●	●	●	●				●	✔	4		● (green)	Up to £800,000
William Haley Engineering Ltd	01278 760591				●	●	●									✔	4		● (amber)	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	● (amber)	Above £6,000,000
WT Fabrications (NE) Ltd	01642 691191			●	●	●	●				●			●	●	✔	4			Up to £40,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	**Guide Contract Value (1)**

Steelwork contractors for bridgeworks

RQSC The Register of Qualified Steelwork Contractors Scheme

BCSA

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

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

- **FB** Footbridges
- **CF** Complex footbridges
- **SG** Sign gantries
- **PG** Bridges made principally from plate girders
- **TW** Bridges made principally from trusswork
- **BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
- **CM** Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
- **MB** Moving bridges
- **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, ● = Member)

Notes

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

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

BCSA steelwork contractor member	Tel	FB	CF	SG	PG	TW	BA	CM	MB	SRF	FRF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●	●	●	●	✓	4				Silver	Up to £3,000,000
Bourne Group Ltd	01202 746666	●			●	●				●		●	✓	4	✓		✓	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	●	✓	4			✓	Silver	Up to £4,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●					●	✓	3			✓	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	●	✓	3			✓	Silver	Up to £1,400,000
ECS Engineering Services Ltd	01773 860001	●			●	●	●		●			●	✓	3					Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●			●	●	●		●	●	●		✓	3			✓	Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●				●				●		●	✓	4	✓		✓	Gold	Up to £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●	●	●		●	✓	4			✓	Member	Up to £2,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		●	●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●	●	●	●	●	●					●	✓	4			✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £4,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	Gold	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499									●		●	✓	3			✓		Up to £800,000
Structural Fabrications Ltd	01332 747400	●		●	●	●	●			●	●	●	✓	3				Silver	Up to £1,400,000
Taziker Industrial Ltd	01204 468080	●		●	●	●	●	●	●	●	●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●	●	●	●	●				●	●	●	✓	4	✓		✓		Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●		●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Non-BCSA member																			
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓	Silver	Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	●	✓	4					Up to £2,000,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓		Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●	●		●	✓	4			✓	Member	Up to £1,400,000
Ekspan Ltd	0114 261 1126	●				●			●	●	●	●	✓	2					Up to £400,000
Francis & Lewis International Ltd	01452 722200											●	✓	4			✓	Gold	Up to £2,000,000
Harrisons Engineering (Lancashire) Ltd	01254 823993	●		●	●	●	●	●	●	●		●	✓	3		✓			Up to £1,400,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●			●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879								●	●	●	●	✓	3			✓		Up to £200,000
IHC Engineering (UK) Ltd	01773 861734	●										●	✓	3			✓		Up to £400,000
In-Spec Manufacturing Ltd	01642 210716								●	●		●	✓	4			✓		Up to £400,000
Lanarkshire Welding Company Ltd	01698 264271	●		●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £2,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●		●		●			●	●	●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	●		●	✓	4		✓	✓	Silver	Above £6,000,000

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

Company name	Tel
Inspire Insurance Services	02476 998924
Kier Construction Ltd	01767 640111
McGee Group (Holdings) Ltd	020 8998 1101
Sandberg LLP	020 7565 7000

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

Industry Members

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

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

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	10	CE	SCM	BIM
Air Products PLC	01270 614167										●	N/A		
AJN Steelstock Ltd	01638 555500								●			M		
Albion Sections Ltd	0121 553 1877	●										M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●			D/I		
Ayrshire Metals Ltd	01327 300990	●										M		✓
BAPP Group Ltd	01226 383824									●		M		
Barrett Steel Services Limited	01274 682281								●			M		
Behringer Ltd	01296 668259					●						N/A		
British Steel Ltd	01724 404040				●							M		
British Steel Distribution	01642 405040								●			D/I		
BW Industries Ltd	01262 400088	●										M		
Cellbeam Ltd	01937 840600	●										M		
Cleveland Steel & Tubes Ltd	01845 577789								●			M		
Composite Metal Flooring Ltd	01495 761080	●										M		
Composite Profiles UK Ltd	01202 659237	●										D/I		
Cooper & Turner Ltd	0114 256 0057									●		M		
Cutmaster Machines (UK) Ltd	01226 707865					●						N/A		
Daver Steels Ltd	0114 261 1999	●										M		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●										M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●			M		
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●			M		
easi-edge Ltd	01777 870901							●				N/A	● Gold	
Fabsec Ltd	01937 840641	●										N/A		
Farrat Isolevel	0161 924 1600	●										N/A		
Ficep (UK) Ltd	01924 223530					●						N/A		
FLI Structures	01452 722200	●										M	● Gold	
Forward Protective Coatings Ltd	01623 748323						●					N/A		
Hadley Industries Plc	0121 555 1342	●										M	● Silver	
Hempel UK Ltd	01633 874024						●					N/A		
Highland Metals Ltd	01343 548855						●					N/A		
Hi-Span Ltd	01953 603081	●										M	● Member	

Company name	Tel	1	2	3	4	5	6	7	8	9	10	CE	SCM	BIM
International Paint Ltd	0191 469 6111						●					N/A	● Gold	
Jack Tighe Ltd	01302 880360						●					N/A		
Jamestown Manufacturing Ltd	00 353 45 434288	●										M		
Joseph Ash Galvanizing	01246 854650						●					N/A		
Jotun Paints (Europe) Ltd	01724 400000						●					N/A		
Kaltenbach Ltd	01234 213201					●						N/A		
Kingspan Structural Products	01944 712000	●										M	● Gold	
Kloeckner Metals UK	0113 254 0711								●			D/I		
Lincoln Electric (UK) Ltd	0114 287 2401					●						N/A		
Lindapter International	01274 521444									●		M		
MSW UK Ltd	0115 946 2316	●										D/I		
Murray Plate Group Ltd	0161 866 0266								●			D/I		
National Tube Stockholders Ltd	01845 577440								●			D/I		
ParkerSteel Limited	01227 783200								●	●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●						N/A		
PPG Architectural Coatings UK & Ireland	01924 354233						●					N/A		
Prodeck-Fixing Ltd	01278 780586	●										D/I		
Rainham Steel Co Ltd	01708 522311								●			D/I		
SDS/2 Ltd	07734 293573		●									N/A		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●					N/A	● Silver	
Structural Metal Decks Ltd	01202 718898	●										M		
StruMIS Ltd	01332 545800		●									N/A		
Stud-Deck Services Ltd	01335 390069	●										D/I		
Tata Steel – Tubes	01536 402121				●							M		
Tata Steel – ComFlor	01244 892199	●										M		
Tension Control Bolts Ltd	01978 661122						●			●		M		
Trimble Solutions (UK) Ltd	0113 887 9790		●									N/A		
voestalpine Metsec plc	0121 601 6000	●										M	● Gold	
Wedge Group Galvanizing Ltd	01909 486384						●					N/A		
Wightman Stewart (WJ) Ltd	01422 823801					●						N/A		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