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NSC

Triple Kirks houses students

Vol 27 No 1 January 2019

New steel joins old in Broadgate expansion

Roofs meet at Waterloo

Avonmouth sheds support growth

Inland port for East Midlands

Cover Image
100 Liverpool Street, London
Main client: British Land
Architect: Hopkins Architects
Main contractor: Sir Robert McAlpine
Structural engineer: AKT II
Steelwork contractor: Wiliam Hare
Steel tonnage: 6,000t

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Outlook bright beyond Brexit

Nick Barrett - Editor

The start of a new year is a traditional time for crystal ball gazing by journalists; it gives us a chance to change our focus from reporting on what has already happened to talking about what we see happening next. However, it is never an easy task, and journalists' track records in forecasting are no better than anyone else's.

This year the outlook is even more unclear than usual, with the uncertainty surrounding Brexit playing havoc with economic fundamentals. At the time of writing it was completely unclear what the outcome would be – deal, no-deal, Norway plus or something else.

The media has been full of stories about what might happen if the UK does or doesn't strike a deal. In the construction press, stories abound about possible threats to imports of key construction materials, and of companies stockpiling materials in case of supply disruptions. Other fears centre on the ability of the construction sector to function without the ease of access to a European workforce that it has come to rely on, with some 10% of workers in the industry now said to be from the EU, with a far higher percentage in London.

The structural steelwork supply chain has been looking at what the potential is for disruption to its own supply chain; the good news is that the sector is confident that steelwork will continue to be supplied as usual, whether a deal is struck or not.

The BCSA stresses that there is no threat to the supply of structural steelwork to UK construction projects arising from Brexit. The domestic steelmaking sector has a long established supply chain of its own, which does not depend on raw material or other supplies from European sources. While the UK does rely on raw steel imports from Europe, the steel supply chain is highly developed with stockholders and distributors maintaining sufficient stock of steel as part of their service.

BCSA President Tim Outteridge in a recent President's column in NSC explained that even a no-deal Brexit is in fact unlikely to cause any upset to the production or availability of structural steelwork in the UK.

Another vexed question for the construction industry is the impact of leaving the EU on the availability of a skilled workforce, but the steel sector expects minimal impact from this. Steelwork contractors operate their fabrication workshops throughout the UK but, because their workforce is largely specialist, full-time and offsite, the sector does not face the same labour force issues as many other trades.

However Brexit works out over the coming year, the steel construction sector is confident of being able to continue to supply world-leading constructional steelwork needed to meet the needs of its customers in a post-Brexit world.

RIBA Award for Royal Birmingham Conservatoire

The RIBA West Midlands' Building of the Year Award 2018 has been presented to the Royal Birmingham Conservatoire, the first purpose-built music college built in the UK since 1987.

According to the judging panel, the steel-framed Conservatoire represented not only a rare opportunity to create a state-of-the-art facility fit for the digital era, but also to anchor Birmingham City University's expanding City Centre Campus with a building of civic stature.

The building's signature performance spaces: a 500-seat orchestral concert hall, a smaller recital hall, organ studio, 'black box' experimental room and the Eastside Jazz Club, posed the biggest challenges to the construction team.

Each of them required a different acoustic treatment to suit their size and intended programme of music which, in turn, influenced all aspects of the design, necessitating an exceptional level of architectural, environmental and acoustic integration.

A box within a box design, whereby all the spaces are individually isolated from each other, was employed for the music spaces. Each steel-framed space is separated from its neighbour by insulation and a void of at least 20mm.

Working on behalf of main contractor Galliford Try, Mifflin Construction fabricated, supplied and erected the project's steelwork.

Tin Pan Alley redevelopment taking shape

A mixed-use development that combines retail, leisure and entertainment spaces, commercial offices and residential accommodation across four new buildings and a number of existing buildings is taking shape at London's St Giles Circus.

The largest of the new buildings are both steel-framed structures of seven and five storeys, with the tallest incorporating an innovative, retractable façade on its middle floors, revealing an urban public gallery that will open at street level.

The building's foundations straddle the Crossrail tunnel, above which the team, which includes main contractor Skanska and steelwork contractor Severfield, is constructing an underground steel-framed box within a box to contain an auditorium.

In a second phase of works, the team will refurbish the adjacent buildings along the north side of Denmark Street, which is also known as Tin Pan Alley, an area with a rich musical history.

The street was once home to the NME and Melody Maker magazines, as well as recording studios that saw The Kinks, the Rolling Stones and Elton John pass through their doors.

The refurbishment covers a number of Grade II listed buildings on Denmark Street, Denmark Place and St Giles High Street, some dating back to before the Great Fire of London in 1666.

Construction work started in July 2017 and is expected to be completed in 2020.

Tay Bridge refurbishment wins national award

Following a 20-year refurbishment of the Tay Bridge, the UK's longest railway structure, the work has been recognised as an outstanding achievement and awarded the top prize at the National Railway Heritage Awards.

The prize went to Network Rail and main contractor Taziker Industrial, which carried out the extensive programme of strengthening, repair and repainting works on the Category A-listed bridge.

Local repairs and repainting of its approach spans started in 1996 while strengthening repairs took place between 2000 and 2004. Grit blasting and repainting began in 2006 - with a total of 245,000m^2 of wrought iron and steel repainted.

Spanning a distance of 4.4km, the Tay Bridge carries the railway across the Firth of Tay. It was built between 1883 and 1887 and consists of 80 spans constructed of wrought iron and 44 masonry arches on the approaches to the north and south.

Large quantities of materials were used in the construction of the bridge, with approximately 16,000t of wrought iron used for the piers and girders. A further 3,500t of steelwork was also used along with 2,500t of cast iron. The structure also contains more than three million rivets.

Matthew Spence, Route Delivery Director for Scotland at Network Rail, said: "It is great to see the project recognised in this way and this award caps two decades of hard work in what can be extremely testing conditions.

"Delivering a job of this scale in such an exposed location has been an ongoing challenge for our engineers and our contractors, but with the refurbishment now complete, the bridge will require minimal maintenance for the next 25 years."

SCI Steel Day highlights construction efficiency

Entitled 'Transforming construction using steel to deliver greater productivity' the Steel Construction Institute's (SCI) annual event, held at the Royal College of Physicians in London, showcased how steel is ideally placed to meet the UK Government's objective to transform construction to improve efficiency.

Speakers from both the SCI and its member companies highlighted the cost, time and energy savings that have been achieved through innovations in manufacturing and digital technologies.

Expedition Engineering Senior Director Chris Wise spoke on marginal gains in construction, an industry strategy to deliver more value with less cost.

Mark Farmer of Cast Consulting explained his report, entitled 'Modernise or Die', that recommends the construction sector take up integration of procurement models, modularisation in design and construction, and greater offsite manufacturing.

Ramboll Principal Engineer Paul Astle delivered a speech on the new Civil Engineering Building for the University of Cambridge. Its steel-framed design was refined to make it efficient and allow further buildings to be added in the future.

Further speakers highlighted advances in light gauge modular buildings and how the Steel Bridge Group is working to help the sector to become more cost-efficient.

Steelwork continues apace on St James retail scheme

A major transformation is taking place in Edinburgh city centre as the St James Centre continues to take shape.

The project will reinvigorate the city's East End and will provide 79,000m² of retail and leisure space including Edinburgh's first Everyman Cinema, a W Hotel with over 200 rooms, and 150 residential apartments.

Martin Perry, Project Director, Edinburgh St James, said: "Edinburgh St James is going to be a major new landmark for the city, opening up the East End of Edinburgh and creating a truly inspiring place for people to live, shop and play. We look forward to making further announcements about progress on site ahead of the opening in 2020."

Working on behalf of main contractor Laing O'Rourke, BHC will fabricate, supply and erect approximately 15,000t of steel for the project.

Grandstand finish in sight at Curragh racecourse

Steelwork for the new main grandstand at the Curragh racecourse in Ireland, which forms the centrepiece to the large redevelopment scheme, is nearing completion.

Working on behalf of main contractor John Sisk & Son, Kiernan Structural Steel is fabricating, supplying and erecting 1,100t of steel for the project.

The new steel-framed grandstand features a cantilevering roof which juts out by up to 45m at the western end.

The completed structure will incorporate five star corporate facilities, restaurants, bars and viewing facilities for the public.

A new arrivals and reception area will incorporate a visitor attraction, including a museum to celebrate the history of racing in Ireland and the contribution Ireland has made to the sport worldwide.

A new parade ring will ensure that more patrons can share in the excitement and build-up to the racing. A new weigh room will provide even better facilities for the jockeys.

Demolition of the old Curragh grandstand and Weigh Room commenced last January and was completed in June. This was carried out while work was also ongoing on the reconstruction of the historic Viewing Stand, which was first built in the 1850s to commemorate the visit of Queen Victoria.

Work on the refurbishment is due to complete in time for the 2019 racing season.

NEWS IN BRIEF

ArcelorMittal has updated its slim floor design software CoSFB v1.6 to include the UB and UC range of sections from EN 10365:17. CoSFB allows designers to develop shallow steel solutions using composite action through use of a web dowel, spans of up to 14m can be achieved. Current users of CoSFB v1.6 can activate the "check for update" feature and new users can download the software from: *http://sections.arcelormittal.com/download-center/design-software/composite-solutions.html*

Steelwork contractor **Cairnhill Structures** has agreed a deal to sponsor the Melrose Sevens in 2019, a competition which is said to be the world's oldest sevens tournament. The main stand at Melrose's ground, the Greenyards, will be renamed the Cairnhill Steel Solutions Stand as part of the deal, with the Cairnhill logo appearing on the Melrose players' kit during the Sevens event and a number of other tournaments.

Peel Land and Property has submitted a planning application for a logistics and advanced manufacturing development on land adjacent to Doncaster Sheffield Airport. The development will comprise up to 325,160m² of state-of-the-art logistics space and supporting infrastructure. It is claimed the scheme will provide 5,300 jobs once fully operational, with a long-term cumulative economic impact of up to £1.94bn.

The new Istanbul Airport, which is expected to become the world's busiest airport, handling close to 200 million passengers a year, and contains steelwork from **British Steel** has been officially opened. Richard Farnsworth, British Steel's Managing Director for Construction said: "This is a phenomenal project, the scale of which is awe-inspiring. We were delighted to be invited to supply our sections into the airport so it's exciting to see it open." The development covers 76.5M m² and contains 640,000t of steel – enough to build 80 Eiffel Towers.

The steel-framed Coal Drops Yard retail scheme, the latest development in Argent's King's Cross master plan has been completed and is now open to the public. Designed by Heatherwick Studio, the retail scheme has been built on the site's Victorian coal drops and uses over 80,000 roof tiles from North Wales and 1,300t of structural steelwork erected by **Severfield**.

PRESIDENT'S COLUMN

I've written before about the benefits that accrue to clients, main contractors and specifiers from using a BCSA member for their structural steelwork. This is due to BCSA's membership assessments which cover competence, capability and recommended contract size, but also because BCSA members are always up-to-date with the latest regulatory requirements and best practice, and have member-only access to a wide range of education and training.

Structural engineers and architects have their own professional bodies to support their education and professional development, but many of them also benefit from the wide-ranging role that BCSA and its sister organisation Steel for Life play in keeping them knowledgeable about structural steelwork.

BCSA owns and keeps up-to-date the National Structural Steelwork Specification (NSSS), which is used across the UK and Ireland for the specification of structural steelwork. Without it, the specification of steelwork would be considerably more difficult, as well as much more variable. The NSSS also reduces tender risk because it is so well understood across the sector. The NSSS is updated regularly, when required, and provided at a subsidised cost to specifiers.

Engineers will be very familiar with the SCI / BCSA Eurocodes steel design guides. These key documents provide detailed guidance to engineers on designing to the Eurocodes and were funded by BCSA and Tata Steel. As issues are brought to the attention of BCSA's main technical committee, it commissions research and design guidance, all aimed at structural engineers and architects. One recent example is the guidance on steel connections to concrete cores. Again, all design guides are provided at subsidised prices to specifiers.

And what about this magazine which is circulated to 12,000 readers 10 times a year and consistently publishes useful information and interesting case studies for its readers? Or the *www.steelconstruction.info* website that provides detailed, up-to-date information on steel construction for engineers and architects? Both are managed and funded by Steel for Life, BCSA's market development arm.

Steel for Life is funded by BCSA and a number of its Industry Members. These companies are showing a huge commitment to best practice in the structural steelwork sector – have a look on the page 5 of this magazine to see who they are.

Steel for Life has bold ambitions for this year and beyond. It will be running more seminars for engineers and architects to provide them with face-to-face information and education on steel design. It will of course, continue to publish NSC magazine, support the *www.steelconstruction.info* website, maintain the vital Blue Book and provide quarterly updates on the all-important cost of structural steelwork.

Tim Outteridge
BCSA President & Sales Director Cleveland Bridge

Manchester city centre landmark formed in steel

Containing 1,800t of structural steelwork, a Manchester city centre commercial development, known as the Landmark, is rapidly taking shape.

Due to complete later this year the Landmark in St. Peter's Square is a 14-storey steel-framed building that will offer 16,700m² of BREEAM 'Excellent' office space and 50 car parking spaces in two levels of basement.

The steel frame offers clear spans and maximum flexibility for the floorplates, with an offset core situated along one elevation.

Squire & Partners Project Architect Stephen Barrett said: "From a spatial point of view a steel frame was chosen at the initial stages as this would allow for larger spans, which provide an open-plan office space without any interruption.

"The benefits of steel also allow for a quicker programme in terms of installation and coordination of services where steel beams can be penetrated offsite to allow for sufficient openings for the distribution of services within the ceiling void."

Working on behalf of main contractor Bowmer & Kirkland, Billington Structures is fabricating, supplying and erecting the steelwork.

Huddersfield reveals plans for new training complex

Premier League football club Huddersfield Town has revealed plans for the redevelopment of its training complex to bring the facility up to elite standards.

The new complex is scheduled to be completed in time for the 2020/21 pre-season and is set to create new elite sports facilities for the club's first team and academy.

A new showpiece pitch will be developed in the first stage of the work, which is being managed by Frank Whittle Partnership Group, with TRP Consulting providing civil, structural and environmental engineering services.

In the second stage, a new steel-framed first team building will be created featuring a hydrotherapy suite, new changing rooms and gymnasiums, medical treatment areas, analysis theatre, a new media suite and office and dining spaces for staff.

An estimated £15M to £20M has been committed to the project by club Chairman Dean Hoyle and the board of directors.

Huddersfield Town Chief Executive Julian Winter said: "It's been fantastic to see the response to the initial announcement and to hear directly from fans in the early stages of our consultation process. It's clear that they all understand how important these plans are to the long-term, sustainable success of their football club."

Milestone reached at Jedburgh Campus

The new steel-framed Jedburgh Intergenerational Community Campus project has reached an important milestone as financial close has been achieved.

The £32M educational facility is being delivered by Hub South East in partnership with Scottish Borders Council, with BAM Construction appointed as main contractor and Hescott Engineering as steelwork contractor.

Jedburgh Intergenerational Community Campus will replace all three schools in the town, with provision for nursery, primary and secondary school children alongside further education.

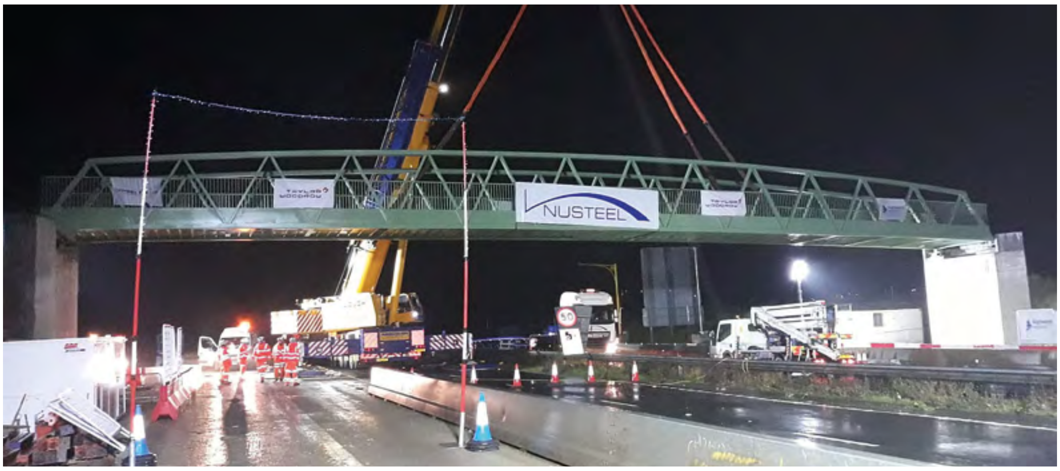
Community facilities will include a multi-use games area, 2G hockey pitch, 3G sports pitch, 100m running track, external changing pavilion and rural skills area.

Scott Brown, Hub South East's Projects Director, said: "Reaching financial close is the latest significant milestone in making the new Jedburgh Campus a reality, so we're delighted this has been achieved.

"A great deal of work has gone into the development and design of the new campus and construction works are progressing at pace, with the steel structure already taking shape.

The fact that discussions began from a standing start only 18 months ago is demonstrable evidence of what can be achieved when the true partnership working ethos of the Hub initiative is embraced."

Footbridge installed over M20 motorway



A fully assembled single span footbridge weighing 45t has been installed over the M20 in Kent during a night-time closure of the motorway.

Fabricated and supplied by locally-based Nusteel Structures, the steel bridge has been designed for pedestrians, cyclists and equestrians, and forms part of the ongoing junction 10a improvement scheme.

The existing Highfield Lane bridge is scheduled to be demolished next year, following the installation of East and West Gyratory Bridges which form the new junction near Ashford. The new footbridge will then open to the pubic later next summer.

Hempel launches organic zinc primer

Hempel has launched its new Hempadur Avantguard 860 that uses innovative organic, zinc-rich primer coating technology.

Avantguard zinc-rich primers are said to be ideal for harsh environments, such as on bridges, offshore oil platforms and coastal power plants, or any asset that faces humid and aggressive atmospheres.

Hempadur Avantguard 860 is said to offer the same anticorrosive performance as zinc silicates with the same level of zinc content, but without the usual drawbacks – such as mud-cracking at a relatively high dry film thickness.

Hempel said as a result of this technology only a short, one-hour, over-coating interval is required, there is no need to apply a mist coat, and consequently there is a boost to productivity.

Avantguard's activated zinc-rich epoxy primer coating technology incorporates tiny hollow glass spheres and a special proprietary additive called an 'activator'. Hempel said it is because of these innovations that the coating provides galvanic, barrier and inhibitor protection.

The galvanic protection increases the zinc's ability to carry the corrosion current, even if the zinc particles are not in direct contact, which is said to improve the steel's corrosion protection.

The coating's hollow glass spheres are also said to play a vital role in its performance. Firstly, they block the spread of micro-cracks, and contribute to the coating's low permeability, and secondly, they actively inhibit corrosion.

Somerset steelwork contractor wins product award

Taunton Fabrications has won Willmott Dixon's Product Award at the contractor's recently held Wales & The West Supply Chain Awards.

The award is given to a supply chain partner that demonstrates an obsession about quality of product, embraces innovation in systems and design, has an open and honest approach to realistic workloads and capabilities, and produces a defect free product.

Commenting on the Aurora office development in Bristol, where Taunton Fabrications supplied a seven-flight steel feature staircase, Andrew Daniel of Willmott Dixon said: "Taunton provided an outstanding service in pre-construction and a defect-free product that is a showpiece in the building which the client is immensely proud of."

Taunton Fabrications Managing Director Jason Rigby said: "Project Aurora was particularly challenging and involved almost 100 pages of calculations, 300 hours of design, 350 drawings and 25t of steel.

"To have designed, manufactured and installed all of that work with no defects is a credit to our staff."

L-R, Phil Harris, Taunton Fabrications Design Manager; Chris Sampson, Taunton Fabrications Senior Estimator; and Mike Chaney, Willmott Dixon Supply Chain Manager.

Diary

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

Tuesday 15 January 2019
The National Structural Steelwork Specification (NSSS)
This webinar will cover the key content, with helpful background to the specification clauses. Webinar

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

Tuesday 26 February 2019
Straight to the Point in Eurocode Design - Half Day Course
This four hour course contains minimum theory and maximum hands-on member design – focusing on practical design using the Blue Book. London

Tuesday 26 February 2019
Wind Actions and Snow Loads to BS EN 1991 - Half Day Course
This short course will cover the calculation of wind actions and snow loads in accordance with the Eurocodes and the UK National Annexes. London

Tuesday 5 March 2019
Steel Frames and Disproportionate Collapse Rules
This course provides a solid introduction into the design of steel-framed buildings to avoid disproportionate collapse. London

Tuesday 12 March 2019
High Strength Steel Structures
This webinar will cover various aspects of high strength steel including; production and fabrication, its applications and when to use HSS and design to EC3. Webinar

Shaping the steel sector

The use of curved steel bent into shape by UK specialist steel bending companies continues to help designers create elaborate landmark structures.

Curved steelwork allows architects and designers to express a variety of forms and makes exposed steelwork an attractive solution. Curved steel is often a key feature of award-winning projects at the Structural Steel Design Awards. Recently recognised structures include Bloomberg London, London Bridge Station and The Ordsall Chord Viaduct.

As well as being aesthetically pleasing, curved steel can be a very economical process and enhance structural efficiency. Curved steelwork is used across a variety of sectors and many sporting stadia have curved steel as large span structures that avoid the use of columns and enhance the viewing experience.

Curved beams and roofs

Curved roof structures provide many architectural opportunities for expression, particularly where the walls and roof are combined in one overall structural solution, so that the demarcation between these elements is removed. The physical nature of these roofs or enclosures is that they are curved to a radius to achieve maximum

One of the project's steel ribs during fabrication

Manchester Victoria Station

The £44 million project undertaken by Network Rail to redevelop and transform Manchester Victoria station includes a state-of-the-art roof which has been constructed around 15 curved steel ribs, all of which are unique in both size and curvature.

In fact, all of the square hollow steel sections required three or four different radii within each length, but this was all within the capability of the specialist bender and the engineering team. The second part of the project required steel plate measuring up to 550mm wide by 50mm thick to be curved to various radii in order to make the larger sections of each rib.

Each plate section has been curved to a specific set of dimensions to allow it to be assembled into a curved box-section by the steelwork contractor. These were then transported to the station site where they were welded together to create the complete rib which was then carefully positioned and installed. Each of these unique ribs required considerable precision and tight tolerances to ensure the installation process went smoothly.

Most of the curved beams were installed using the UK's largest telescopic crane, a 1,200t behemoth, while rib 9, the largest of the ribs measuring 96m in length and weighing nearly 86t, was installed using a 750t crawler crane, which is one of Europe's largest of its type.

usable space internally.

Castellated and cellular curved beams have been used successfully in long-span roofs with intermediate supports. Here the lightness of the highly perforated sections is combined with the ability to curve the sections in the re-welding process.

Curved roofs may be formed in one direction by using single-curved tubular members or, in two directions, by using double-curved assemblies. Space frames may also be designed to form curved enclosures. The use of 'column trees' to support roofs has been used to great architectural effect in airport terminals and other public spaces.

Inclined curved members may be connected at their ends and crest and used to create not only usable roof space but also visual appeal in multi-storey office buildings. The horizontal forces at the pinned ends of the curved roof members are resisted by tension in the beams at roof level.

Curved steel's impact on the cost and construction programme

Bending steel sections to help create stunning architectural designs not only allows steelwork to show its flexibility in construction, the process is also very economical.

Section bending is a cost-effective way of changing the shape of a structure, as it is relatively inexpensive when compared to manufacturing a multi-faceted member.

The additional cost of curving steelwork is usually small in relation to the overall cost of the structure.

Early involvement of a specialist steel bender and a steelwork contractor by architects and engineers encourages best design practice and ensures that the most appropriate components and details are specified for the job.

Generally, if a member can be curved, it will be cheaper than a faceted, multi-jointed member. It also saves on fabrication time by reducing welds in a structure. Using a CE approved bending company ensures that the curved member will be fit for purpose.

The Curve

Section bending allows unusual projects, such as Slough's Curve, to be delivered

The centrepiece of Slough's town centre regeneration scheme is a highly architectural and uniquely shaped steel-framed library and cultural centre.

As the name suggests the structure is a steel-framed curved rectangle in shape and plan. Each of the building's elevations feature either cantilevers or sloping and curving façades, with the main north side presenting the most striking aspect with a long sweeping, predominantly glazed, elevation looking on to the adjacent listed church.

A specialised bender bent all of the ribs and the curved tube. The ribs were delivered to site in complete sections, requiring no splices to form the façade. These ribs vary in height up to 9m, depending on where they are located along the curving tubular section.

As the tubular section's curvature changes radius along its length it was also brought to site in various lengths. In order to give the tubular section a seamless appearance the various lengths are connected via internal bolts that are hidden behind plates which were retro welded into place.

Thanks to Barnshaw Section Benders Limited for contributing to this article

Inspired design

A number of challenges have been overcome to erect a steel-framed student accommodation scheme that shares a constrained site with a Grade-A listed church spire.

FACT FILE
Triple Kirks, Aberdeen
Main client: Dandara
Architect: Halliday Fraser Munro
Main contractor: Dandara
Structural engineer: Dandara
Steelwork contractor: EvadX
Steel tonnage: 600t

Aberdeen's student population, which is estimated to stand at more than 21,000, is set to receive an accommodation boost once a prestigious and highly-challenging scheme in the city centre completes in late 2019.

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

The spire once served three separate churches (kirks), hence the Triple Kirks name. These structures fell into disrepair a long time ago and, when developer Dandara purchased the site, only the protected spire remained.

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

Initially planned as a Grade-A office building, changing market conditions led the landmark scheme to be changed into high-end student accommodation, helping to deliver a key element of the city's new master plan – by providing the chance to live as well as work and study in the city centre.

Dandara says the commercial property market remains strong in Aberdeen and it continues to invest heavily in commercial development throughout the region. Within the city core however the dynamic has changed.

The company adds that its flexibility and market-leading capability as a premium housebuilder allowed it to review the plans and re-approach this iconic site to deliver a development that will benefit the city.

The Triple Kirks' apartments will regenerate the former religious site and fit seamlessly with Aberdeen City Council's vision for the rejuvenation of the Denburn valley area. At the same time, it will deliver a vital boost in the availability of academic accommodation – as Aberdeen has been suffering from a critical shortfall for decades.

Explaining the design, Dandara Engineering Director Greg Kerwick says: "The project was always going to be steel-framed, whether an office or student accommodation. On a tight and constrained site like this steel has the advantage of being fabricated offsite. This results in far less material on the footprint as it is brought to site and erected immediately. It is also quick to erect which is something we like."

Altering the design from a commercial office block to a residential building did however mean a rethink of the steel frame. The office was conceived as a braced frame, but the accommodation blocks' design contains many more windows along each elevation, meaning there is no room for traditional cross bracing.

The solution was to install three jump-formed concrete cores, one for each of the conjoined blocks, and use these for the overall structural stability instead of bracing. Radiating out from the cores, the floors are then formed with a composite design using metal decking and a concrete topping supported on steel beams.

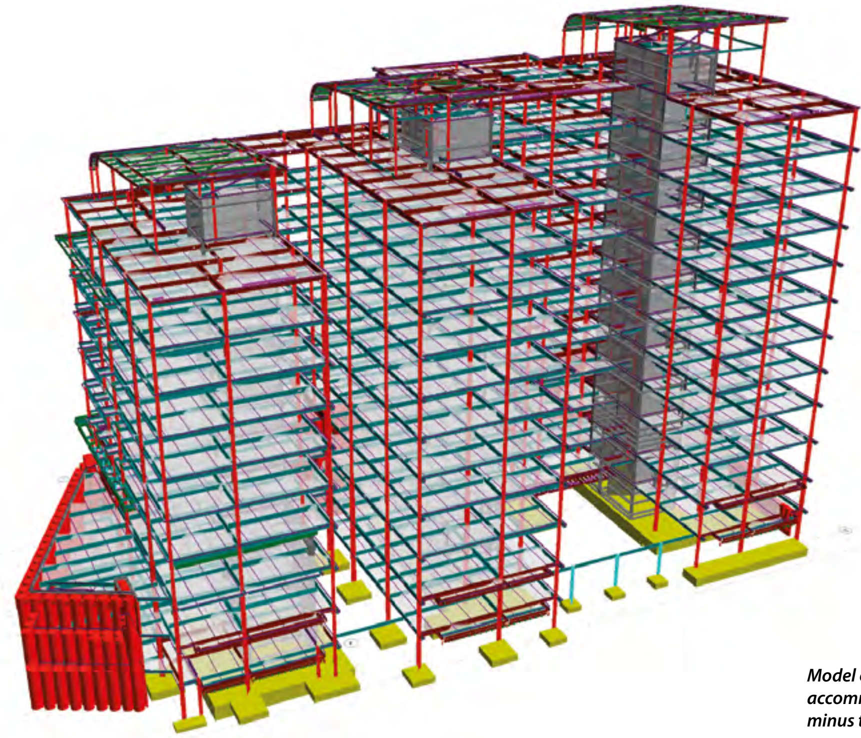
Prior to steelwork contractor EvadX starting on-site, Dandara had prepared the site by installing the concrete cores and pad foundations, demolishing some remaining church walls, and importantly constructing a 10m-high CFA piled retaining wall along three sides of the site's footprint.

The site sits at the bottom of a slope with ground level access from the B986 dual carriageway, one lane of which has been closed to create a delivery yard. To the north and east of the site, Schoolhill and a smaller thoroughfare, Belmont Street, are actually 10m higher, with the former road becoming a viaduct as it crosses the dual carriageway below.

This means that what is essentially ground floor level is referred to as Level -3, with ground being the main entrance along Schoolhill.

How to support the retaining wall during the construction process was another challenging aspect of the scheme due to the confined nature of the plot. Once the steel frame, which ties into the wall for its three lowest levels, is complete, the wall has

How the completed scheme will look



Model of the three accommodation blocks minus the spire

full support. Up until that point a series of 356UC steel props have been installed to support the wall. These large steel members are each absorbing approximately 2,000kN of load from the wall.

"There wasn't room for hydraulic props, so using steel beams was the best option as the steel frame and floors can be built and cast around them," says Mr Kerwick.

"Once the steel frame is erected the beams will be cut up and removed in pieces, with the holes in the floors then filled in."

The steel frame totals 600t, but the piece count is very high, as there are no particularly long spans, with no beam longer than 6.5m. The grid pattern is also very irregular, as it has to encompass three different room sizes, all of which are present on each floor, as well as amenities such as a gym and reception area.

Typically, the design has a central corridor with accommodation units situated either side. Blocks one and two sit to the north of the spire and block three is positioned to the south. Two and three are linked via a narrow corridor structure that wraps behind the spire.

The new building never touches the spire, and open courtyards on either side of it allow natural light to penetrate the student units that face the retained feature.

"We used pretty much the entire footprint of the site for the new building, excluding the area around the spire, and consequently there was no room to position a mobile crane," says Mr Kerwick. "All of the steel was erected via two luffing jib tower cranes which have been installed within the steel frame's footprint."

"Once the project nears completion the cranes will be dismantled and the gaps within the frame will be simply in-filled with metal decking, similar to the procedure necessary for the large props."

Dandara envisage that Triple Kirks will become Aberdeen's premier student accommodation, helping to address a well-documented shortfall of rooms.

Different room sizes are located on each floor

The project wraps around the historic spire

Distribution centre offers more access

The steel frame nearing completion

Avonmouth Access 18, one of the South West's largest distribution parks, continues to expand as developer St. Modwen constructs the largest speculative building currently under way in the region.

Work is swiftly progressing on Unit 15, a 14,000m² distribution warehouse with an attached three-storey office space, which is being developed at the Avonmouth Access 18 distribution park.

According to the site's developer St. Modwen, this latest phase is in response to continued market demand for logistics and production space close to the M5 motorway.

Scheduled to be ready for occupation in March 2019, the new unit is part of St. Modwen's overall strategy to accelerate commercial development activity with a national pipeline of almost 1.4M m² of new industrial and logistics space in the next five to eight years, based on occupier demand, planning and strength of location, from its existing commercial land holdings.

Peter Davies, Development Director for St. Modwen West and Wales said: "Unit 15 should appeal to regional and national logistics companies, With Access 18 offering the prime location to access Junction 18 of the M5 and with the proximity to relevant local labour force, public transport and amenities, this is a key strategic site for St. Modwen."

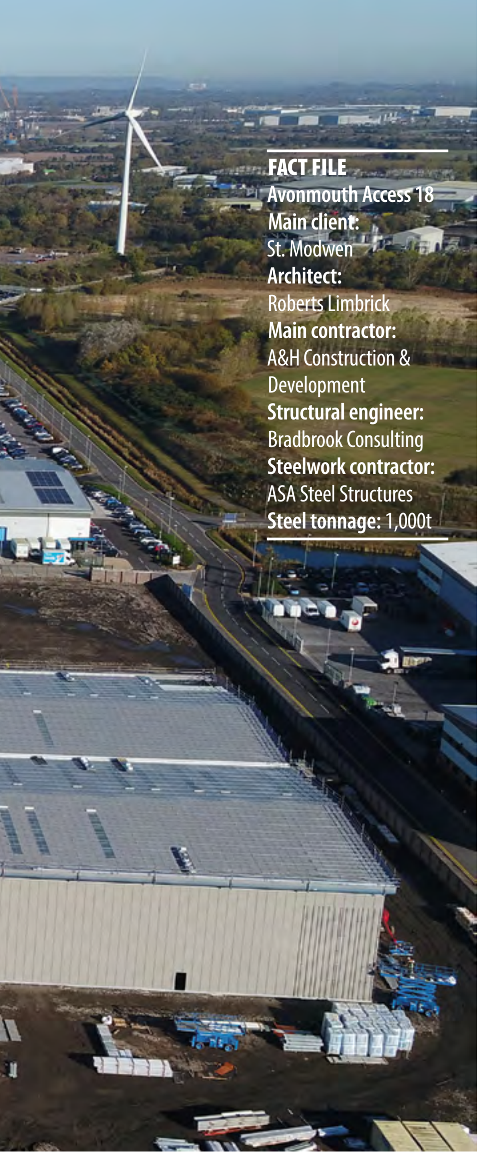
The Access 18 distribution park is being delivered in phases and is already home to 14 companies, including Kent Foods, Hermes Parcelnet and Budget Greetings Cards.

A further four new occupiers – Commercial Electrical Factors, GB Liners, Plant-Ex and Movianto – have recently taken up residence in four units totalling 7,060m².

Unit 15 is being built by Midlands-based A&H Construction & Development, who have sub-contracted ASA Steel Structures on a design and build basis to design, fabricate, supply and erect the project's steelwork.

The warehouse is a twin-span portal frame, with a total width of 70m and an overall length of 190m. The portal frames are designed as hit and miss with a central

Visualisation of the project's three-storey office block



FACT FILE
Avonmouth Access 18
Main client:
St. Modwen
Architect:
Roberts Limbrick
Main contractor:
A&H Construction & Development
Structural engineer:
Bradbrook Consulting
Steelwork contractor:
ASA Steel Structures
Steel tonnage: 1,000t

line of valley columns in alternate bays omitted and the rafters supported on valley beams.

The valley line is stabilised by bracing in the plane of the roof leading to vertical braced panels. The valley beams are substantial elements and are present in a continuous line down the full length of the building.

Built to an expected BREEAM 'Good' rating, Unit 15 is 12.5m high to the underside of the haunches and will feature 16 dock level loading doors, in addition to two surface level loading bays.

The three-storey offices are built into the overall structure and occupy the north-western end of the building. The two upper floors have a composite design, with steelwork supporting metal decking and a concrete topping. These column-free office floors will offer 286m² of space.

Externally, the distribution centre will have 20 HGV parking spaces, a separate staff car park, while additional land is also available if the tenant wishes to negotiate a yard extension.

Using a combination of two mobile cranes and a variety of MEWPs, ASA Steel Structures completed the steel erection programme in November, with the distribution centre on course for its planned March 2019 completion.

Access 18 – the vision

St. Modwen acquired the 212- acre Avonmouth site in 2003 and immediately undertook an 18 month programme of demolition and remediation work. This involved an extensive environmental clean-up as over 750,000t of earth was removed and then over 99% of other on-site materials were recycled on site.

Since then, St. Modwen has built a new access road to link the site to Avonmouth Way and improve access to the nearby port facilities, the M5 and onwards to the South West and the M4.

To date, 14 new warehouse and industrial accommodation units have been delivered, including St. Modwen's regional HQ offices. As well as Unit 15, a further 10 distribution centres are planned for the site, ranging in size from 460m² to 14,000m².

Summing up Peter Davies, Development Director for St. Modwen West and Wales, says: "National and local demand for premium quality industrial and logistics space close to the M5 means that our speculative steel-framed building programme is continuing to deliver to meet occupier requirements."

The warehouse is a twin-span portal

Steel erection was completed by the end of 2018

Work gets under way on the new roof structure

All change at Waterloo

FACT FILE
Waterloo station redevelopment, London
Main client, Architect, Structural engineer & Main contractor: Wessex Capacity Alliance (Mott MacDonald, Skanska, AECOM, Colas, Network Rail Joint Venture)
Steelwork contractor: Bourne Steel
Steel tonnage: 300t

Part of the project to revamp the former Eurostar terminal at Waterloo station, a roof structure, requiring a high degree of complex design work, will bridge the gap between two existing structures to form a new covered concourse.

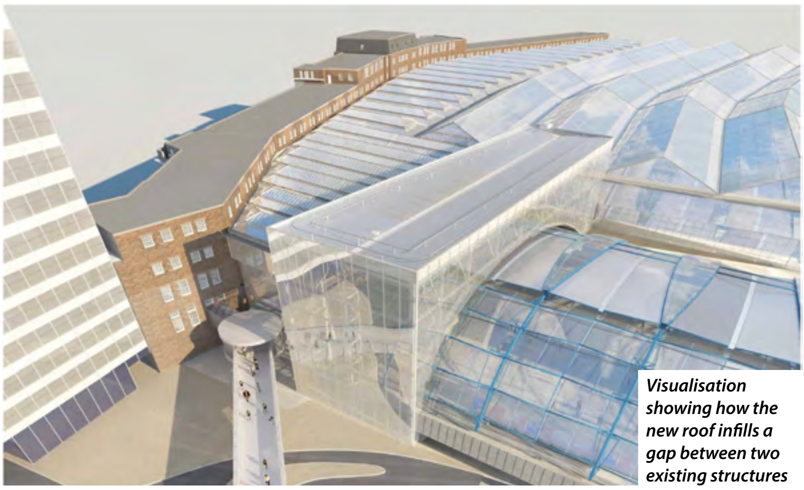
Once the terminus for Eurostar services to Paris and Brussels, the 1990s-built Waterloo International Terminal (WIT), located at the western end of Waterloo mainline station, is being revamped to accept domestic train services and accommodate shops, bars and restaurants.

Disused since London's Eurostar terminus was moved to St Pancras International in 2007, the structure is in the midst of a major refurbishment, which includes preparing the five platforms to increase the number of train services into Waterloo.

A two-storey shopping and leisure complex will be situated in the former Eurostar arrivals and departure lounges, beneath the platforms.

Improving access around the Waterloo station concourse is also ongoing and this work includes the construction of a steel roof that will infill a gap between the original Victorian-built Waterloo station canopy and the adjacent curved and glazed roof of the WIT structure.

"Previously there was no need for this infill roof as passengers would have entered the Eurostar terminal at a lower level



Visualisation showing how the new roof infills a gap between two existing structures

and a now dismantled canopy sheltered them," explains Wessex Capacity Alliance Engineering Manager, Chris Kitching.

"We have now installed a new composite steel bridge, which will allow passengers to access the revamped terminal at platform level and so a new high-level infill roof is needed."

Bourne Steel Divisional Manager Andy Davies adds: "In simple terms, the infill roof is a rectangular steel-framed box, tapered along one side to accommodate the shape of the WIT structure and over-sailing the two station roofs."

The new roof structure is 52m-long × 18m-wide × 26m-high at the western end and 21m-high at the eastern end and is supported at either end by steel-framed and glazed gable walls.

The eastern gable is supported on Waterloo's 1840s-built masonry walls, but apart from this, the new structure is completely self-supporting. It sits within millimetres of both the WIT roof and the adjacent 19th Century-built Waterloo roof, but never touches either.

A steel-framed solution was the only viable design for the project as a lightweight structure was needed because no foundations could be installed to support it. Piling the site was impossible as a number of tunnels as well as Waterloo station's underground ticket hall sit beneath the site.

"The entire roof structure including glazing is only 400t," says Mr Kitching. "But however light this may be, we still needed to work out where the loads could be transferred to and if we could free-up any capacity from the existing structures."

The solution involved some nifty juggling of loads and required the buffer stops in the WIT structure to be moved 50m down line. This was feasible as domestic trains are not as long as Eurostar trains. So, by moving any potential train impact away from the new roof, nearly enough load capacity was found for the new structure.

Nearly being the operative word, as the roof still needs two 508mm-diameter circular hollow section (CHS) columns to support it in the middle.

"Using circular columns means the steelwork is less harsh on the eye and importantly they have been located so they do not hinder the important views in the station concourse," adds Mr Kitching.

The vistas which Network Rail is keen to preserve are the views of the Grimshaw-designed WIT arches seen when entering the former Eurostar terminal, and the listed Waterloo station Victory Arch and Stairs viewed when leaving the same platforms.

As well as providing additional support to the roof, the CHS columns allow the structure to have a central area with a 26m clear span. However, as no foundations can be installed, the CHS members are founded directly on top of the WIT platform slab.

Because of the WIT's propped cantilever design the slab is subject to movement of up to 100mm +/-, and so the columns are placed on bearings to allow for any potential shift, which would otherwise crack the new roof's glazing.

Forming the main span of the roof is a 52m-long spine truss, which is 4.2m-deep and weighs 27t. It was brought to site in three sections, with the longest element, which spans between the CHS columns, weighing 13.5t.

The central spine truss supports a series of eight pairs of gullwing trusses that sit perpendicular to the main structure and form overhangs on either side. Each wing measures approximately 8.3m-long x 4.0m-deep.

Steelwork for the project has all been erected by a 300t-capacity mobile crane positioned towards the northern end of the site. The working area for the project is extremely tight, squeezed in between a 'live' functioning railway station and office buildings. Finding a suitable location for the crane was not only determined by space constraints, but also by what is underneath the site.

It had to be positioned to one side of the new structure, away from any subterranean facilities. This position meant a larger capacity unit with a longer reach was required; one much bigger than would ordinarily be needed.

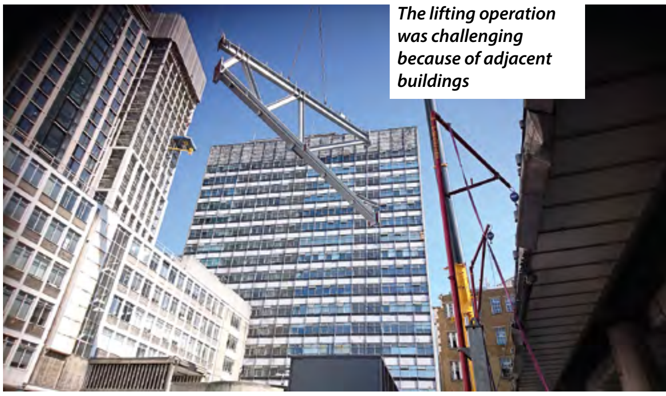
Keeping the frame stable during erection was one of the main challenges for steelwork contractor Bourne Steel. Due to the confined nature of the site, the structure was erected on substantial temporary works comprising two towers over 20m in height, a 'planar' trestle and a temporary lattice girder spanning approximately 25m between the towers.

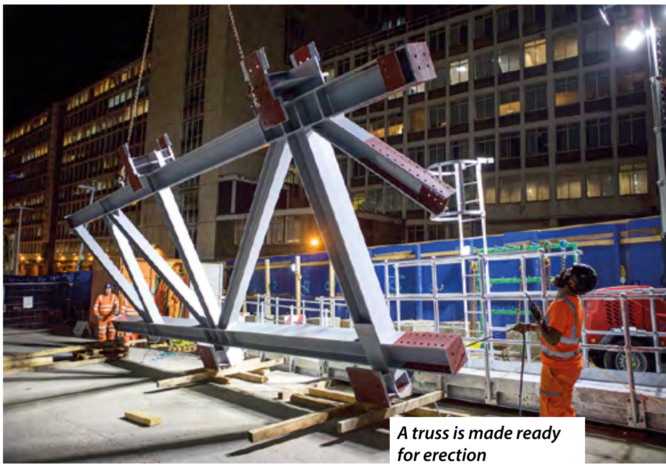
The temporary works enabled sequential erection from east to west and the installation of the gullwing trusses and roof steelwork without the spine truss being fully complete. The temporary towers and truss also allowed the wing trusses to be set at the correct level before de-propping, when the building load is then transferred to the feature columns.

This was exacting work as Mr Davies explains: "Each gullwing truss had to be in an exact pre-set position before the frame was de-propped and the glazing was installed, so they needed to be individually surveyed, checked and then released by our designers before the erection sequence could continue."

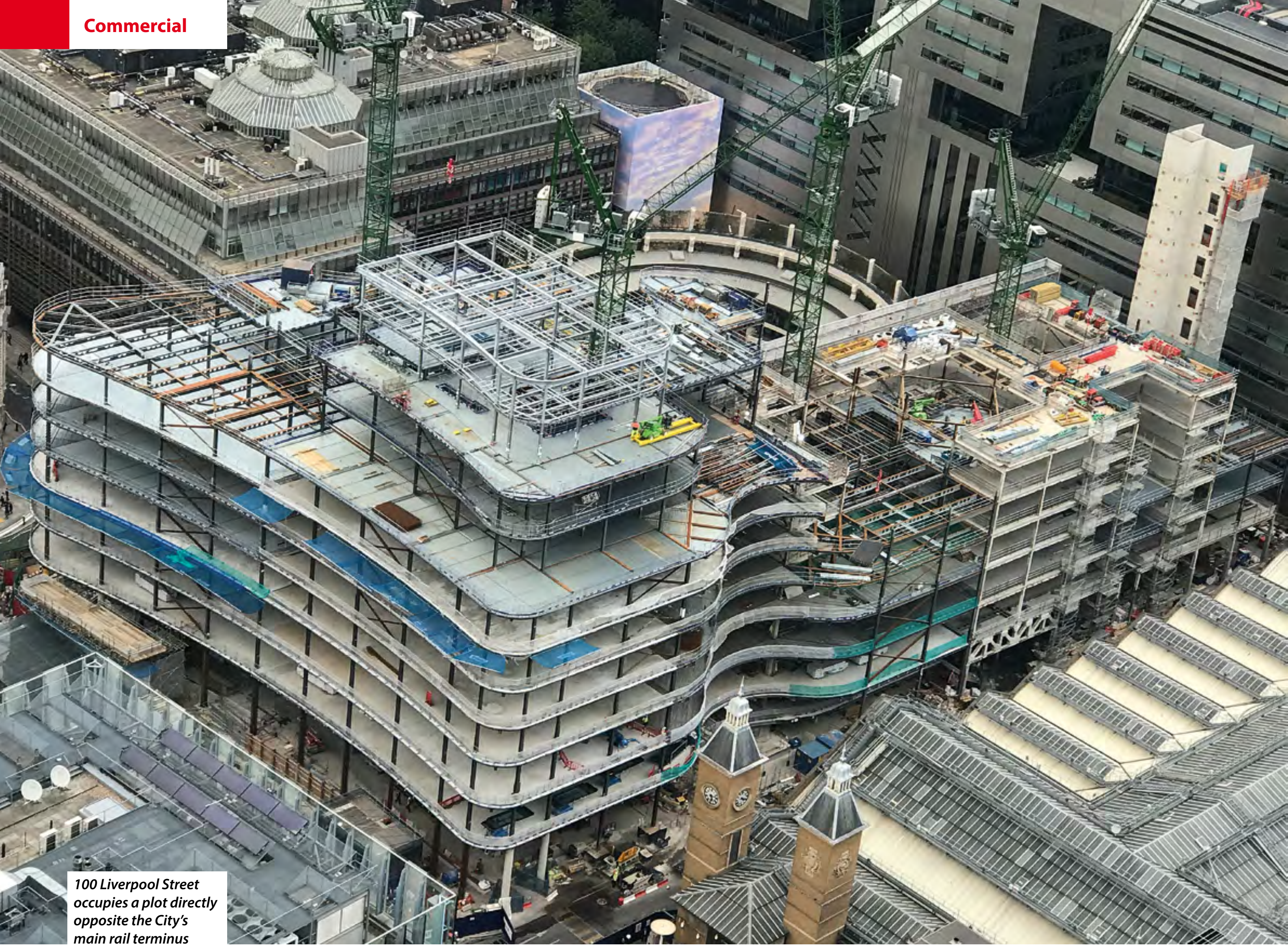
The new roof is due to complete by early 2019, while the ongoing works on the former Eurostar terminal will continue into 2019.


A truss element arriving from Bourne's Poole facility


The lifting operation was challenging because of adjacent buildings


A truss is made ready for erection


A temporary support tower is installed



100 Liverpool Street occupies a plot directly opposite the City's main rail terminus

Rebuild, remodel

One of the first phases of the wider Broadgate redevelopment, the 100 Liverpool Street project will link together two existing buildings and add four extra floors to the overall new structure. Martin Cooper reports.

How the completed scheme will look

FACT FILE
100 Liverpool Street, London
Main client: British Land
Architect: Hopkins Architects
Main contractor: Sir Robert McAlpine
Structural engineer: AKT II
Steelwork contractor: William Hare
Steel tonnage: 6,000t

Construction projects in the City of London invariably have to contend with a host of challenges, notably the congested nature of the square mile above ground and the myriad of infrastructure that can be encountered below ground.

100 Liverpool Street, which forms an initial phase of the City's Broadgate redevelopment, is a case in point as this site is situated adjacent to one of the nation's busiest railway stations - Liverpool Street Station - with the terminus's west entrance even passing through the site along with a shopping mall.

Below ground a mass of infrastructure, including a Central Line tunnel, a disused Victorian tunnel, various access routes and substations are all present.

The project consists of two existing buildings, 100 Liverpool Street and 8-12 Broadgate, which are being reconfigured into a single structure. All of the substructure is being retained as well as approximately 50% of the original steel frames that extend up to eight-storeys high.

New steelwork is being erected to knit the structures together, replace the demolished areas and add four new floors to the top, creating a new 12-storey landmark building.

"All of the project's constraints required careful consideration, and drove the project's design," explains Sir Robert McAlpine Project Manager Peter Watts.

"The biggest constraint however, was the fact that we couldn't gain access to the existing foundations because ground floor retail units and the mall have to remain open throughout our programme."

Sustainability is also at the core of this design, as only steel construction would have allowed the project to reuse the foundations, and then strengthen retained steelwork to allow them to support new lightweight steel floors.

The mall and the west entrance to the railway station also played a significant role in determining when the project kicked-off. Initially a start date at the end beginning of 2017 was penciled in by the team, however with a Christmas closure of the entrance and its shops organised during the festive season, the programme started two weeks early.

Taking advantage of the lull in passenger numbers coming into the City, Sir Robert McAlpine was able to partition the mall and begin the minor demolition works which would allow the steelwork erection programme to begin. Although the mall has remained open, access routes have been moved to allow work to continue, with most work involving the installation of large beams being carried out overnight.

The existing steel-framed buildings were built in the 1980s by main contractor Bovis, with the steelwork contract being undertaken by Redpath Dorman Long. The records of this construction programme and its structural design were readily available and proved to be invaluable when AKT II needed to carefully analyse the structure.

"Analysis of the structure allowed us to identify and utilise redundancies in the original design, and work out which areas of the retained steel frames would need strengthening," explains AKT II Technical Director David Watson.

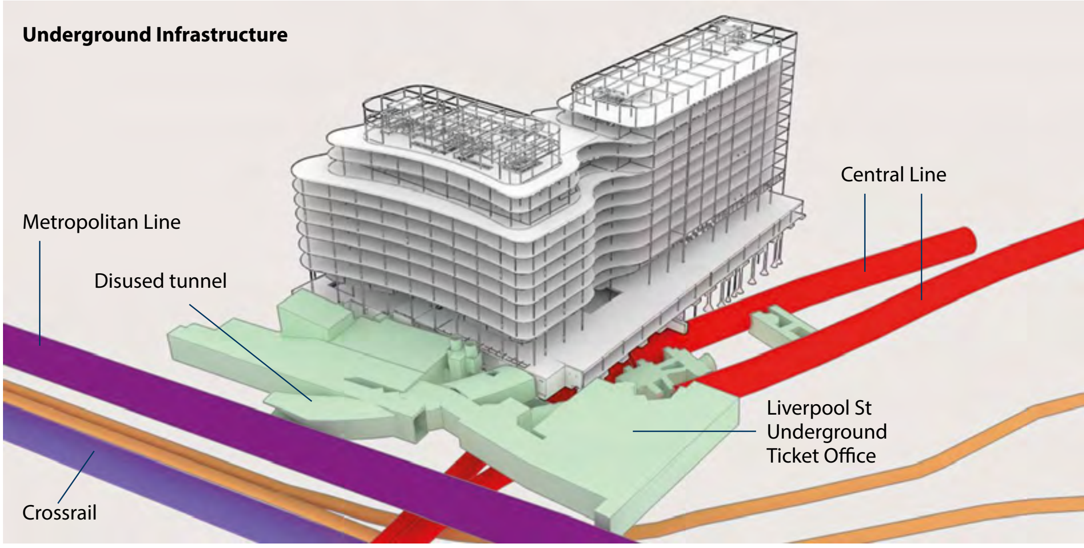
"The lightweight nature of a new steel composite design, using Fabsec cellular beams means we have been able to reuse the foundations and only had to strengthen 33% of the existing columns to support the new build elements."

New steel columns are bolted to the existing steel frame where possible, and the building follows the original structural grid, based around a 7.5m × 7.5m column spacing.

Adding some architectural interest to the new steelwork, fabricated steel transfer beams have been installed to enable set-backs on the new upper levels. These set-backs occur at level eight and 12 on the southern elevation and on level 12 along the northern façade.

Tying in a new steel frame to an existing 1980s frame has been done as seamlessly as possible. Floor slab thicknesses vary

▶20



New composite flooring abutting existing flooring

Some existing columns have new steel beams connected to them

One of the retained trusses that form the bus depot

▶19

throughout the scheme, but in areas where new build meets retained structure, the new slab corresponds to the old.

In the old building, services were accommodated below the steel beams, but as the new areas have cellular beams, allowing the services to be placed within the steelwork's depth, there are areas where the services transfer from one configuration to another.

The one exception to the standard 7.5m grid pattern is the eastern elevation of the building that spans over the Liverpool Street Bus Station, which has been closed temporarily during the construction works.

Here a series of 15m-long × 2.9m-deep trusses, positioned at level two, have been retained as part of the new design as they create the column-free space for the buses.

Above the bus station, the original structure has been retained up to level seven, with new steelwork added to the top to form the 12-storey new building. Above the trusses the grid reverts back to the 7.5m × 7.5m pattern, with a series of columns supported on the trusses at mid-span. However, from level eight upwards the new floor levels incorporate a 15m span, avoiding additional load on the trusses, while also providing more open office space on the higher levels.

A new steelwork grillage has been installed on top of these bus station trusses and a new floor will be hung from them. This new office level will be within the depth of the trusses in order to maintain the necessary headroom in the bus station.

Explaining the unconventional process, William Hare Project Manager Ivo Garcia says: "Our new steel above the slab connects to the retained steelwork underneath the slab via a series of threaded rods that go through the slab, connecting to the top portion of the retained beam.

"We have to cut the bottom half of the retained UB, transforming the retained section into a tee hung from the above new structure, and effectively transferring the load from the below retained structure to the top structure. This arrangement allows us to maintain the top flanges of the retained beams that include shear studs. After this load transfer operation is undertaken, we then have a series of 200 × 100 RHSs hung from the web of the newly formed tee to support the new hanging floor."

100 Liverpool Street is due to complete in January 2020.

Strengthening existing steelwork

David Brown of the SCI offers some pointers

Only a third of the existing columns had to be strengthened during the redevelopment of 100 Liverpool Street – demonstrating the lightweight nature of steel construction, but also showing that strengthening is relatively straightforward with steel members. Column strengthening is usually achieved by attaching plates or other sections to the existing column – generally by welding. The additional steelwork may be attached to the outside of the flanges, maintaining a 'H' cross section, or across the tips of the flanges, creating a box section. The latter option may be preferred if minor axis buckling is the critical design check.

Generally, it is difficult to de-stress the columns, so the strengthening works are completed whilst the existing column is at least partially loaded – though usually much less than the original design load. Assuming that flexural buckling is critical, it is conservative to calculate the buckling stresses in the existing section under the temporary load and add them to the stresses within the compound section caused by increasing the temporary load to the final design value.

The stress in the original section can be determined by assuming an elastic stress distribution based on:

$$\frac{\text{temporary force}}{\text{area}} + \frac{\text{moment}}{\text{modulus}}.$$

The moment depends on the initial eccentricity, amplified due to the axial load. The initial eccentricity should be back-calculated from the original design resistance of the section, and then amplified due to the temporary force to determine the moment to be considered in the temporary case. More details of the process are given in reference 1.

The stress distribution in the compound section should be based on the increase in load from the temporary state to the final design value, although the initial imperfection should be amplified based on the final design value, not the increase in load. The cross sectional area and inertia will have increased, and the slenderness will decrease compared to the original section. Generally it is good practice to ensure that reinforcing elements do not suffer reductions in resistance due to local buckling, so are Class 1 or Class 2. The two stress diagrams can be superimposed and the cross section checked to see if any point exceeds the yield strength. Although flexural buckling is likely to be critical, the cross section may need verification, particularly at connection locations where it may be difficult to reinforce the cross section.

The reinforced section must behave as a compound section, so welding the reinforcing plates or sections is usual. Appropriate welding procedures will be required for the materials, thickness, welding process and welding position.

1. Member imperfections, September 2011, New Steel Construction

Eastern Gateway

The southern boundary of the park abuts East Midlands Airport

Huge quantities of steelwork and vast amounts of earthmoving are involved in the creation of one of the UK's first inland ports, which will offer half a million square metres of development plots for storage and distribution warehouses.

FACT FILE
SEGRO Logistics Park East Midlands Gateway
Main client: Roxhill Developments & SEGRO
Architect: PHP Architects
Main contractor: Winvic Construction
Steelwork contractor: Severfield
Steel tonnage: 12,300t

A game-changing distribution hub (inland port) known as the East Midlands Gateway is under construction in Leicestershire. Covering 700 acres, the site combines links to the M1 and East Midlands Airport with a major new rail freight terminal.

To facilitate this grand scheme, project developers Roxhill and SEGRO have also funded £100M of infrastructure, including a 50-acre rail terminal and extensive road improvements, designed to give the best possible connectivity to the 10 plots that will be available to occupiers.

SEGRO Chief Operating Officer Andy Gulliford says: "SEGRO Logistics Park East Midlands Gateway will be truly multi-modal: with its proximity to the M1 providing easy road access to the whole of the UK; the fact that it neighbours East Midlands Airport – the UK's second largest freight airport – and that we are building a Strategic Freight Interchange as part of the scheme."

East Midlands Gateway is located close to the very centre of England, with Nottingham 13 miles to the north-east, Leicester 20 miles to the south and Derby 14 miles to the north west.

This is said to give it a strong, three city labour supply with one million people within a 30-minute drive, and 332,000 typical logistics employees within a 30-minute drive.

The rail freight hub links directly to the Castle Donington freight line, which provides access to major UK ports such as Southampton, Felixstowe and London Gateway.

Main contractor Winvic is undertaking a huge earthmoving operation to prepare the ground for the planned structures. This involves over half a million cubic metres of plateau, screening and topsoiling, with a plant fleet of 65 vehicles moving approximately 105,000m^3 of earth every week.

Four of the site's planned steel-framed distribution centres are currently being constructed by Winvic. Severfield is fabricating, supplying and erecting steelwork for three plots, while a fourth is being done by Caunton Engineering (see box p24).

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

The structure is the largest of the four under construction and measures just over 250m-long × 151m-wide and internally it consists of eight 31.6m spans. The structure also has an externally attached single storey ▶24

Plot One nearing completion

Steel bridge creates Gateway access

The bridge was launched during a weekend closure of the M1

One of the major infrastructure works that has been undertaken around the East Midlands Gateway project is a new bridge across the M1, which will join the A6 Kegworth Bypass to the A453 to serve the distribution park.

Working on behalf of main contractor Buckingham Group, and to a design by structural engineer Cass Hayward, Cleveland Bridge fabricated, delivered, assembled and installed the bridge over one of the UK's busiest motorways.

The bridge was delivered to site in four sets of braced girders, fabricated from weathering steel.

The bridge span is approximately 50m, and the completed steel structure weighed approximately 330t. However, with the concrete deck added, the total bridge weighed close to 1,250t.

The girders were assembled adjacent to the M1 motorway. The concrete deck was then cast by Buckingham Group onto the steel girders and, once sufficiently cured, the central supports were de-propped to allow the bridge to settle, prior to launching.

The proximity of the airport meant that large cranes were effectively prohibited for the installation process. Consequently, Cleveland Bridge used Self Propelled Mobile Transporters (SPMTs) to offload the 50m-long braced girder pairs from the delivery vehicles. These girder pairs were lifted and transported onto temporary supports, designed by Cleveland Bridge, in a secure area adjacent to the M1.

The girder pairs were then bolted together and handed over to Buckingham Group to cast the full-width concrete deck. Casting the concrete prior to launching the bridge minimised the need for extensive works once the bridge was in place.

When the concrete had cured, Cleveland Bridge returned to site to install the entire bridge during a weekend closure of the M1 – limiting disruption to road users.

A fleet of SPMTs was the preferred option to launch the structure into the final position. They lifted and manoeuvred the structure into place and then lowered it on to the abutments.

"We were extremely happy with the quality of the product supplied by Cleveland Bridge. They worked to a challenging programme and collaborated well throughout the project," says Buckingham Group Project Manager David Lane.

The launch attracted a large crowd of onlookers

Plot Three is divided into high-bay and low-bay areas

▶22

office block running along one of its shorter elevations.

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

Completed in a six-week programme, the building's frame covers an area of 55,741m^2 and required almost 2,500t of structural steelwork.

Plot Two has seven spans, three in the high-bay section (measuring 29.8m, 35.8m and 42.7m) and four in the lower part (measuring 27m, 2 × 35m and 45m).

Lifting steelwork to a height of 35m is not a problem ordinarily, however as Severfield Site Manager Eric Wardle explains this is no ordinary site. "The structures are all being erected adjacent to the airport runway and so there is a crane height limit for safety reasons. When lifting in the roof steelwork for this plot our crane had to work within metres of the maximum allowed height."

Situated along one corner, Plot Two has a 36.9m wide three-storey attached office. Unlike the offices in the other units, this one is not a solid structure as at ground floor level there is a 15m opening to let HGVs pass underneath.

Beyond this opening, part of the office is cantilevered and in its final condition is supported by three pairs of forked feature columns.

The 9m cantilevered floor beams had to be temporarily supported using 7m-high trestles during the erection. They were removed using a jacking system, once the steelwork was complete, to transfer the loads to the feature columns.

The third plot is the smallest of three Severfield distribution centres (46,451m^2) and will be occupied by another online retailer. Up to 20m-high, the portal-framed structure requires 2,300t of steel. It consists of five spans, measuring 37.2m each and also has a two-storey office block attached to one gable end.

EMG Plot Four

Working on a design and build contract, Caunton Engineering has fabricated, supplied and erected 900t of hot and cold rolled steelwork for Plot Four at the East Midlands Gateway.

Measuring 244m × 69m and reaching a height of 12m, the unit will offer just over 16,000m^2 of floorspace. This portal-framed structure will be occupied by Swiss-based transport and logistics company Kuehne + Nagel.

It will include a 3,700m^2. temperature-controlled area to accommodate the company's growth plans within the pharmaceutical sector.

The structure has twin spans of 34.5m, supported by valley columns designed in a hit and double-miss configuration.

"Many portal frames are designed with valley columns missing every other bay (hit and miss)," explains Caunton Engineering Project Engineer Julian Harrold. "On this frame design, we have gaps with two columns missing, as this was a client requirement to create more space for its racking systems."

As the centrally-positioned spine beam has longer spans to bridge over, the member size changes in order to take into account the bigger loadings that are encountered on the top of each column.

Thicker plate sections, measuring 400mm-wide and 8.5m-long, are positioned over the columns and these are then spliced to narrower 17m-long members that span between the columns.

Supporting the spine beam is a series of plate girder columns each weighing 5t.

As well as designing and erecting the main frame, Caunton has also installed precast stairs within an attached three-storey office block, which is positioned along one of the gable ends, a pre-cast lift shaft and a walkway that connects the main office to a smaller hub office.

The office block has a composite beam and column design, with internal clear spans of up to 10m. Caunton has subcontracted Structural Metal Decks (SMD) to install the steel decking.

At the opposite gable end to the office, the structure features a large 15m-deep loading canopy that stretches the entire 69m-width of the warehouse and is supported on a series of CHS columns.

"Similar to the hub, we've erected the canopy late in the programme as these two external features would otherwise hinder the cladding installation," says Caunton Engineering Deputy Erection Department Manager Richard Patterson.

"Once the cladding was in place in these areas, we installed the canopy steelwork connecting to stubs that were left protruding and this then gave us a clean precise finish."

Illustration of fatigue design of a crane runway beam

As indicated in the technical article[1] in the September 2018 issue of New Steel Construction Richard Henderson of the SCI discusses the fatigue design of crane runway beams with an illustrative design example.

Crane Loading

The loads on crane runway beams are determined in accordance with BS EN 1991-3[2]. This code sets out the groups of loads and dynamic factors to be considered as a single characteristic crane action. The relevant partial factors are set out in Table A.1 in Annex A of the code. At ultimate limit state for the design of the crane and its supporting structures, the characteristic crane action being considered is combined with simultaneously occurring actions (eg wind load) in accordance with BS EN 1990. The final ultimate design loads from the crane end carriage which are supported by the runway beam can thus be determined.

The groups of loads are identified in Table 2.2 of BS EN 1991-3 and include the actions listed in the table below. Several of the loads have a dynamic factor associated with them which depend on the class and function of the crane.

Item	Description of load	Dynamic factor
1	Self-weight of crane	φ_1 or φ_4
2	Hoist load	φ_2, φ_3 or φ_4
3	Acceleration of crane bridge	φ_5
4	Skewing of crane bridge	-
5	Acceleration or braking of crab or hoist block	-
6	In-service wind	-
7	Test load	φ_6
8	Buffer force	φ_7
9	Tilting force	-

Unfavourable crane actions have a γ_Q value of 1.35, not the usual value of 1.5. Fatigue assessment is regarded as a serviceability limit state with a partial factor of 1.0.

Fatigue Assessment

BS EN 1991-3 provides a simplified approach to designing crane runway beams (gantry girders) for fatigue loads to comply with incomplete information during the design stage, when full details of the crane may not be available. The crane fatigue loads are given in terms of fatigue damage equivalent loads Q_e that are taken as constant for all crane positions. The fatigue load may be specified as follows:

$$Q_e = \varphi_{fat} \lambda_i Q_{max,i}$$

where, as stated by the code, $Q_{max,i}$ is the maximum value of the characteristic vertical wheel load, i and $\lambda_i = \lambda_{1,i} \lambda_{2,i}$ is the damage equivalent factor to make allowance for the relevant standardized fatigue load spectrum and absolute number of load cycles in relation to N = 2.0 × 10^6 cycles. This concept was discussed in reference [1].

The damage equivalent dynamic impact factor φ_{fat} for normal conditions may be taken as:

$$\varphi_{fat,1} = \frac{1+\varphi_1}{2} \quad \text{and} \quad \varphi_{fat,2} = \frac{1+\varphi_2}{2}$$

The factors $\varphi_{fat,1}$ and $\varphi_{fat,2}$ apply to the self-weight of the crane and the hoist load respectively.

In BS EN 1991-3, Annex B Table B.1 gives recommendations for loading classes S in accordance with the type of crane and Table 2.12 gives a single value of λ for each of normal and shear stresses according to the crane classification. Overhead travelling cranes are in either S-class S6 or S7 so that, having selected an S class, the corresponding λ value is determined. (The classes S_i correspond to a stress history parameter s defined in BS EN 13001-1[3] but the details are not required for this example).

The method for carrying out the fatigue assessment is set out in section 9 of BS EN 1993-6[4]. Once the fatigue loads are determined, the stress ranges (denoted $\Delta\sigma_{E,2}$) for the critical details of the crane runway beam can be calculated. These are the damage equivalent stress ranges related to 2 million cycles. The fatigue stress range is multiplied by the partial factor for fatigue loads γ_{Ff} stated in BS EN 1993-6 section 9.2 which is equal to 1.0. The critical details must be categorized according to Tables 8.1 to 8.10 in BS EN 1993-1-9 and the detail category number noted. The category number (denoted $\Delta\sigma_C$) is the reference value of the fatigue strength at 2 million cycles. The partial factor for fatigue strength is γ_{Mf} and is given as 1.1 in the National Annex to BS EN 1993-1-9 for a safe-life fatigue assessment. The fatigue check involves showing that, for direct stresses:

$$\frac{\gamma_{Ff}\Delta\sigma_{E,2}}{\Delta\sigma_C/\gamma_{Mf}} \leq 1.0$$

A similar check is required for fluctuating shear stresses:

$$\frac{\gamma_{Ff}\Delta\sigma_{E,2}}{\Delta\tau_C/\gamma_{Mf}} \leq 1.0$$

If both direct and shear stresses are present, a further check is required.

Example

Consider an EO travelling crane of S-class 6 and hoisting class HC3 supported on 8.0m span runway beams in steel grade S355 which have laterally restrained compression flanges at 2.0 m centres. The crane is wholly inside a building and so there are no other simultaneously occurring actions. The relevant weights of the crane, the proportion of the weight applied to the end carriage in the worst case and the resulting maximum loads are:

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Wind Analysis Toolkit

Software components from SCI

KEY FEATURES:

- Support for BS 6399 and BS EN 1991-1-4 & UK NA
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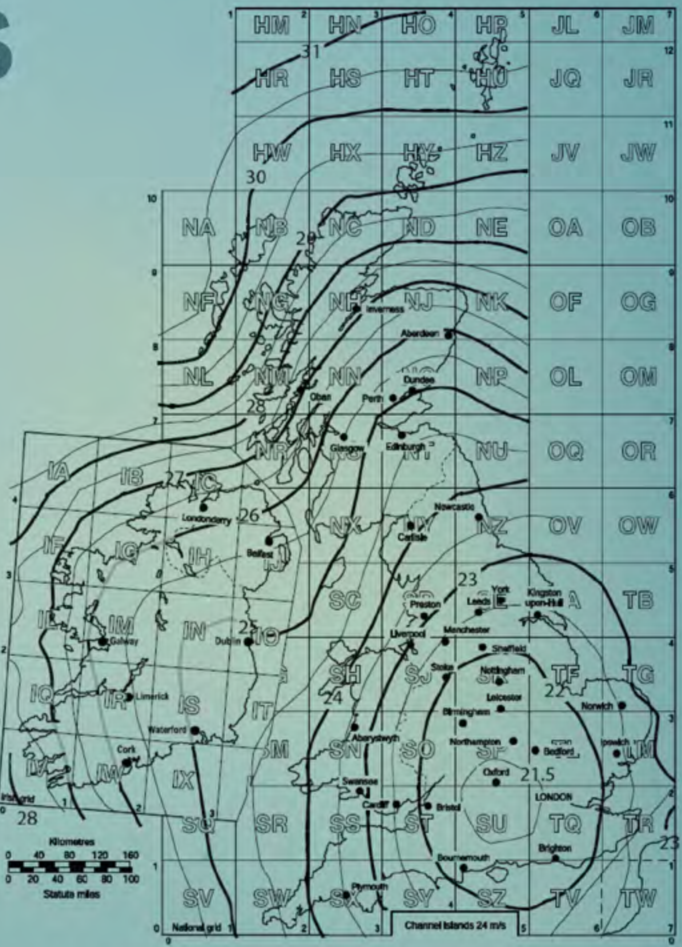


Figure NA.1 from the UK National Annex to BS EN 19910104:2005+A1:2010
Image supplied courtesy of BSI

Wind360

Location by postcode or grid reference

Site analysis in 12 directions

Satellite image to assess local shielding with annual update of terrain

Web service for seamless integration

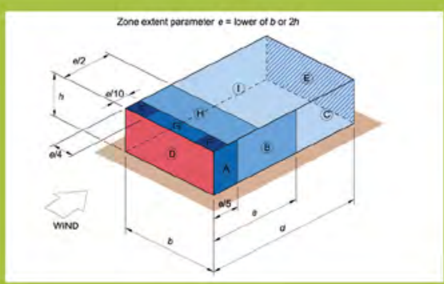
WindPlus

Seamless integration with Wind360

Design loads on walls and roofs in four building directions

Support of multiple roof types, including curved and hipped roofs

Web service for seamless integration

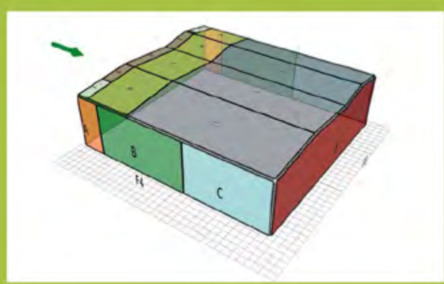


Zone Viewer

3D, scaled interactive graphic component showing building, zones and loads for use in applications

Seamless integration with WindPlus

.Net component for Windows applications



For technical details, license arrangements and a demonstration of Wind360 and WindPlus, visit www.steel.sci.com/windanalysis

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Item	Load (kN)	Proportion of load	Load on end carriage (kN)
End carriage and bridge (Q_c)	164	50%	82
Crab (Q_c)	36	90%	33
Payload (Q_h)	300	90%	270

For the purpose of this example, consider load group 1 from Table 2.2 of BS EN 1991-3:

$$\varphi_1 Q_c + \varphi_2 Q_h + \varphi_5 (H_L + H_T)$$

where H_L and H_T are caused by acceleration or deceleration of the crane bridge and for simplicity will not be considered further. From Table 2.4 of BS EN 1991-3, the upper-bound value of $\varphi_1 = 1.1$ and the value of φ_2 is given by:

$$\varphi_2 = \varphi_{(2,min)} + \beta_2 v_h$$

where v_h is the steady hoisting speed and β_2 is a coefficient. According to Table 2.5 of BS EN 1991-3, for hoisting class HC3, $\varphi_{2,min} = 1.15$ and $\beta_2 = 0.51$. Taking the steady hoisting speed as $v_h = 1.0$ ms^{-1}, the value of φ_2 is 1.66. Applying the dynamic factors gives the following loads:

Item	Dynamic factor	Factored Load on end carriage (kN)
End carriage and bridge (Q_c)	1.1	90
Crab (Q_c)	1.1	36
Payload (Q_h)	1.66	448

The crane end carriage will be assumed to have wheels 2.0 m apart and the loads are distributed between them as indicated in the table below (the weight of the crane bridge is assumed not to be distributed evenly). The ultimate loads on each wheel are as indicated:

Item	Load Wheel 1 (kN)	Load Wheel 2 (kN)	Total (kN)
End carriage and bridge (Q_c)	50	40	90
Crab (Q_c)	18	18	36
Payload (Q_h)	224	224	448
Ultimate load (factor = 1.35)	393	381	774

The maximum moment in the beam occurs when the centre of the span bisects the distance between the resultant of the loads and a wheel load as shown in figure 1.

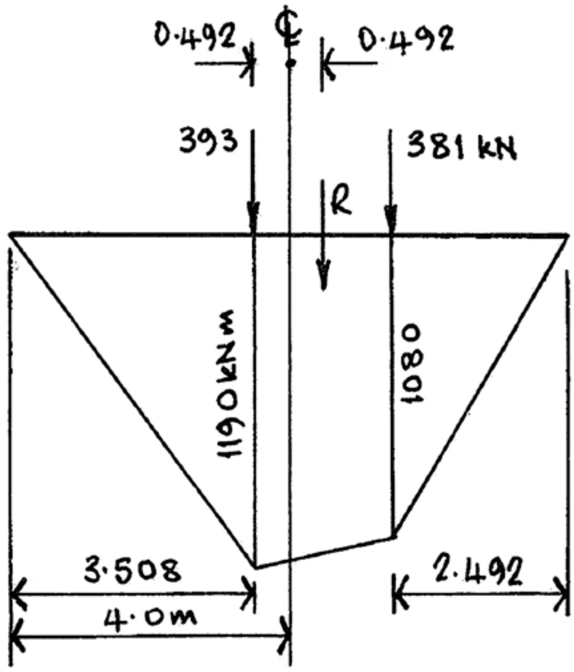

Figure 1: Ultimate bending moments

The maximum bending moment is 1190 kNm. Assuming a uniform bending moment between compression flange restraints, using the Blue Book, a 610 × 229 UB 125 with restraints at 2.0 m centres has a buckling resistance moment (with $C_1 = 1.0$) of 1230 kNm which is satisfactory for ultimate loads. The elastic modulus of the beam W_e is 3220 cm^3.

As indicated above, BS EN 1991-3 gives a simplified approach to calculating the fatigue damage equivalent load Q_e which may be expressed as follows:

$$Q_e = \varphi_{fat} \lambda Q_{max,i} = \lambda \left[\varphi_{fat,1} (Q_{max,i})_1 + \varphi_{fat,2} (Q_{max,i})_2 \right]$$

where $\varphi_{fat,j} = (1 + \varphi_j)/2$ and the index j refers to the dynamic factor. Substituting values for φ_1 and φ_2 gives $\varphi_{fat,1} = 1.05$ and $\varphi_{fat,2} = 1.33$. and calculating the characteristic and fatigue damage equivalent loads gives the following results:

Item	Load Wheel 1 (kN)	Load Wheel 2 (kN)	Total (kN)
Characteristic load $(Q_{max,i})_1$	62	53	115
Characteristic payload $(Q_{max,i})_2$	135	135	270
$\Sigma\, \varphi_{fat,j}\,(Q_{max,i})$	245	231	

The maximum bending moment in the beam is shown in Figure 2 and is equal to 734 kNm.

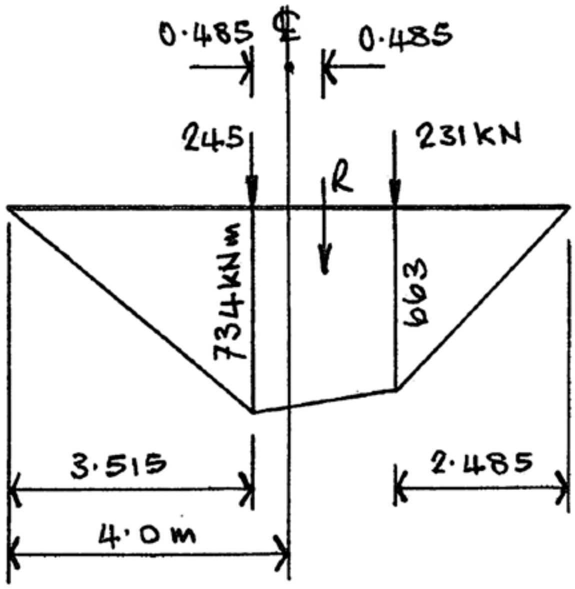

Figure 2: Bending moments from fatigue loads

The maximum direct stress due to fatigue loads is therefore 228 MPa. The self-weight bending moment at the same position is about 9.7 kNm which gives a stress of about 3.0 MPa. Table 2.12 of BS EN 1991-3 gives a single value of $\lambda = 0.794$ for direct stress for class S_6.

The fatigue stress range is therefore:

$$\Delta\sigma_{E,2} = (228 \times 0.794) - 3.0 = 178 \text{ MPa}$$

Consider the bottom flange first: the detail category is 160 which corresponds to a rolled section with as-rolled edges, fettled in accordance with the requirements stated in BS EN 1993-1-9 Table 8.1 for the relevant detail category, so $\Delta\sigma_C = 160$ MPa. For the fatigue verification, considering direct stress:

$$\frac{\gamma_{Ff}\Delta\sigma_{E,2}}{\Delta\sigma_C/\gamma_{Mf}} \leq 1.0$$

so, substituting values:

$$\frac{1.0 \times 178}{160\ /\ 1.1} = 1.23 \text{ — fails!}$$

The fatigue load case is obviously more critical than the ultimate load case. Note that the highest fatigue class was chosen for the assessment. If the top flange is considered and the crane rail is fastened to the top flange with bolted cleats (a more onerous case), the relevant detail category is 90 (description: structural element with holes subject to bending and axial forces) and the factored fatigue stress is about 82 MPa. The stress $\Delta\sigma_{E,2}$ must be less than this value to satisfy the verification equation so a much larger beam is required. The elastic modulus must at least equal:

$$3220 \times \frac{178}{82} = 6990 \text{ cm}^3$$

A 914 x 305 UB 201 has an elastic modulus of 7200 cm³. This beam has a buckling resistance moment of 1310 kNm for a length of 8 m between lateral restraints so no intermediate restraints are required.

For a complete assessment, the axial and transverse forces which have been neglected increase the stresses in the beam and must be considered.

References

[1] Henderson R, Introduction to fatigue design to BS EN 1993-1-9, NSC, September 2018
[2] BS EN 1991-3: 2006 Eurocode 1 – Actions on structures Part 3: Actions induced by cranes and machinery
[3] BS EN 13001-1:2015 Cranes – General Design Part 1: General principles and requirements
[4] BS EN 1993-6: 2007 Eurocode 3 Design of steel structures – Part 6: Crane supporting structures
[5] BS EN 1993-1-9:2005 Eurocode 3 Design of steel structures – Part 1-9 Fatigue

New and revised codes & standards

From BSI Updates November 2018

BS EN PUBLICATIONS

BS EN 560:2018
Gas welding equipment. Hose connections for equipment for welding, cutting and allied processes
Supersedes BS EN 560:2005

BS EN IEC 60974-1:2018
Arc welding equipment. Welding power sources
Supersedes BS EN 60974-1:2012

BS EN IEC 62822-1:2018
Electric welding equipment. Assessment of restrictions related to human exposure to electromagnetic fields (0 Hz to 300 GHz). Product family standard
Supersedes BS EN 50445:2008

BS EN ISO 2401:2018
Welding consumables. Covered electrodes. Determination of the efficiency, metal recovery and deposition coefficient
Supersedes BS EN 22401:1994

BS EN ISO 3690:2018
Welding and allied processes. Determination of hydrogen content in arc weld metal
Supersedes BS EN ISO 3690:2012

BS EN ISO 4042:2018
Fasteners. Electroplated coating systems
Supersedes BS EN ISO 4042:2000

BS EN ISO 7539-6:2018
Corrosion of metals and alloys. Stress corrosion testing. Preparation and use of precracked specimens for tests under constant load or constant displacement
Supersedes BS EN ISO 7539-6:2011

BS EN ISO 8249:2018
Welding. Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals
Supersedes BS EN ISO 8249:2000

BS EN ISO 10683:2018
Fasteners. Non-electrolytically applied zinc flake coating systems
Supersedes BS EN ISO 10683:2014

BS EN ISO 11124:2018
Preparation of steel substrates before application of paints and related products. Specifications for metallic blast-cleaning abrasives
Part 1: General introduction and classification
Part 2: Chilled-iron grit
Part 4: Low-carbon cast-steel shot
Supersedes BS EN ISO 11124-1, 2 & 4:1997

BS EN ISO 11125:2018
Preparation of steel substrates before application of paints and related products. Test methods for metallic blast-cleaning abrasives.
Part 2: Determination of particle size distribution
Part 3: Determination of hardness
Part 4: Determination of apparent density
Part 5: Determination of percentage defective particles and of microstructure
Part 6: Determination of foreign matter
Supersedes BS EN ISO 11125-2, 3, 4, 5 & 6:1997

BS EN ISO 11126:2018
Preparation of steel substrates before application of paints and related products. Specifications for non-metallic blast-cleaning abrasives.
Part 1: General introduction and classification
Part 3: Copper refinery slag
Part 4: Coal furnace slag
Part 8: Olivine
Supersedes BS EN ISO 11126-1, 3, 4 & 8:1997/8

BS EN ISO 11699-2:2018
Non-destructive testing. Industrial radiographic films. Control of film processing by means of reference values
Supersedes BS EN ISO 11699-2:2011

BS EN ISO 18275:2018
Welding consumables. Covered electrodes for manual metal arc welding of high-strength steels. Classification
Supersedes BS EN ISO 18275:2012

PUBLISHED DOCUMENTS

PD CEN/TR 10261:2018
Iron and steel. European standards for the determination of chemical composition
Supersedes PD CEN/TR 10261:2013

PD CEN/TR 17079:2018
Design of fastenings for use in concrete. Redundant non-structural systems
No current standard is superseded

PD CEN/TR 17080:2018
Design of fastenings for use in concrete. Anchor channels. Supplementary rules
No current standard is superseded

PD CEN/TR 17081:2018
Design of fastenings for use in concrete. Plastic design of fastenings with headed and post-installed fasteners
No current standard is superseded

NEW WORK STARTED

BS EN 1993-1-5:2006/A
Eurocode 3. Design of steel structures. Plated structural elements

BS ISO 630-4
Structural steels. Technical delivery conditions for high-yield-strength quenched and tempered structural steel plates

BS ISO 7788
Steel. Surface finish of hot-rolled plates and wide flats. Delivery requirements

BS ISO 11971
Steel and iron castings. Visual testing of surface quality
Will supersede BS ISO 11971:2008

AD 425: Full depth stiffeners and lateral torsional buckling

The SCI Advisory Desk sometimes receives questions about the potential to use full depth stiffeners to restrain lateral torsional buckling, suggesting that the stiffeners prevent relative movement of the compression and tension flanges. Whilst this is true, lateral torsional buckling is a displacement and twist of the complete section, which stiffeners alone do nothing to prevent. The American Institute of Steel Construction notes that "transverse stiffeners are simply along for the ride" as the sketch indicates.

Contact: **Richard Henderson**
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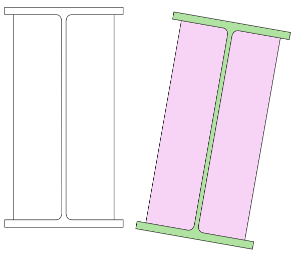
Email: **advisory@steel-sci.com**



AD 426: Bolt head protrusion through nuts and threads in grip lengths

To ensure that bolt threads are fully engaged in the nut, BS EN 1090-2 clause 8.2.2 specifies that the protrusion must be at least one thread pitch. This is because the very end of the bolt may be slightly convex, leading to a reduced resistance if threads are not fully effective.

The same clause specifies the necessary numbers of threads within the grip length (between bolt head and the nut). For non-preloaded bolts, one full thread is required – to ensure the nut can be properly tightened. For preloaded bolts according to BS EN 14399-3 (HR system, generally used in the UK in preference to the HV system) or according to BS EN 14399-10 (HRC system, commonly known as a 'tension control bolt'), a minimum of four threads within the tensioned length is specified. The reason for the threads in the tensioned length is to encourage ductile behaviour – AD 268 (which related to the BS 5950 requirements) reproduces a figure from Owens and Cheal (Butterworths), showing significantly more elongation when there are more threads in the tensioned length. Incidentally, BS 5950-2 required three and five threads in the tensioned length, for class 8.8 and 10.9 bolts respectively.

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BUILDING WITH STEEL

Reprinted from Volume 5 No. 3
July 1968

Designed for Colour Transmission

Yorkshire Television Studios

Steelwork under construction: quick erection time was an outstanding feature of this project

Yorkshire Television Ltd began as a race against time in the middle of 1967 for on 12 June the company was allotted the new ITV broadcasting contract for the completely new Yorkshire TV region: and transmissions were due to begin in July 1968. The company was thus faced with the task of designing and constructing a major new studio complex within this extremely short time period.

The architects were commissioned to prepare a feasibility study as part of the company's overall proposals submitted to the ITA. Their proposals were for a major TV Centre costing £1.5m on a site made available by the City Corporation at Leeds and which was to be completed in two stages. The first stage included all the essential production facilities which the company would need in order to begin broadcasting in July this year, further studios and administrative offices to be completed as soon as possible thereafter.

The architects built up and co-ordinated a full project team which was prepared to go ahead at high speed with design and construction as soon as the ITA announced its award. Prior to the design team commencing its final design of the building and its structure, the general contractor carried out some initial studies for the construction period required for the superstructure in both steel and concrete and, as a result of these investigations, it was concluded that a steel frame would give the shortest construction time.

An additional factor in the decision to adopt a steel frame was that in view of the time factor involved, structural design had to proceed concurrently with and at times ahead of general planning and the relative ease of adaptability of a steel frame was felt to be desirable. The main requirements of Phase I construction consisted of two studios measuring 80ft by 64ft and 40ft by 40ft respectively with three storey ancillary accommodation housing technical areas, control rooms, ventilation plant etc and a single-storey cafeteria, kitchen and workshop space. For acoustic reasons the structures of the two studios are entirely independent of the surrounding three-storey structure. The frame of the larger of the two studios included in the first phase is constructed with 60ft span lattice trusses supported on steel stanchions.

Final lateral stability of this studio structure, which, of course, derives no support from the surrounding structure is provided by 9 in thick infill panels of brickwork necessary for acoustic reasons but temporary vertical bracing was used to provide initial stability until sufficient brickwork had been constructed. The studio roof structure carries a complete grid of suspended steelwork over the entire area of the studios to facilitate the support of the extensive production lighting required. In the interest of speed the steel structure was kept as simple as possible. Composite floor construction was adopted for the three storey block. A proprietary precast prestressed plank floor with in situ topping was chosen for the floor slab and this was kept to a standard thickness throughout, varying intensities of superimposed loading being catered for by adjusting the centres of the steel floor beams within the general stanchion grid of 25ft by 20ft. Black bolting was used for site connections as far as possible with high strength friction grip bolts where moment connections were required. Concrete encasure of the steelwork was confined to the stanchions and perimeter wall beams, the necessary two hour fire protection being provided elsewhere by the use of vermiculite panel cladding.

Final design of the structure was begun towards the end of June 1967 and the steelwork sub-contractor commenced erection during the last week in August 1967 and completed in November 1967 within days of the programme's target. During this comparatively short period the steelwork sub-contractor had erected some 450 tons of steelwork and carried out numerous detailed revisions to the structure which had become necessary as final planning proceeded. Sections of the building were completed and handed over to the clients to begin technical installation progressively from 5th March 1968.

Second phase construction is programmed for completion in early 1969. This phase includes a further main studio measuring 80ft by 100ft, additional three-storey accommodation and a large single storey scenery workshop. A further 250 tons of steelwork are involved, the construction adopted being similar in all respects to the first phase.

The studios are sited at the north-west end of the Kirkstall industrial estate about one mile from the centre of Leeds. The site is a slum clearance area, the greater part of which is to be a new landscaped public recreation space which will adjoin the new studios.

These are the first new studios in Britain to be designed for colour transmission from the outset.

Architects: George/Trew/Dunn

Consulting Engineers: W. V. Zinn & Associates.

Interior of studio: view from the gallery showing the windows to the control rooms, production lighting grid and the acoustic treatment to the walls.

Steelwork contractors for buildings

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

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

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

- **C** Heavy industrial platework for plant structures, bunkers, hoppers, silos etc
- **D** High rise buildings (offices etc over 15 storeys)
- **E** Large span portals (over 30m)
- **F** Medium/small span portals (up to 30m) and low rise buildings (up to 4 storeys)
- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
- **K** Towers and masts
- **L** Architectural steelwork for staircases, balconies, canopies etc
- **M** Frames for machinery, supports for plant and conveyors
- **N** Large grandstands and stadia (over 5000 persons)
- **Q** Specialist fabrication services (eg bending, cellular/castellated beams, plate girders)
- **R** Refurbishment
- **S** Lighter fabrications including fire escapes, ladders and catwalks
- **FPC** Factory Production Control certification to BS EN 1090-1
  1 – Execution Class 1 2 – Execution Class 2
  3 – Execution Class 3 4 – Execution Class 4
- **BIM** BIM Level 2 assessed
- **QM** Quality management certification to ISO 9001
- **SCM** Steel Construction Sustainability Charter
  (● = Gold, ● = Silver, ● = Member)

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		3			Up to £400,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●					●		●	●	●		●	●		✔	3			Up to £400,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	4			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3	✔	Silver	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	Gold	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		Silver	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Apex Steel Structures Ltd	01268 660828					●	●			●	●			●	●		2			Up to £2,000,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2			Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	4			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●	●	●		●	●			●	●	✔	4		Gold	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950				●	●	●	●		●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	Silver	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4	✔	Silver	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4			Up to £6,000,000
Builders Beams Ltd	01227 863770			●	●	●	●			●	●			●	●	✔	2	✔		Up to £3,000,000*
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
ESL (GB) Ltd	01482 787986	●					●	●	●	●	●	●	●	●	●	✔	4			Up to £400,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●			●	✔	3		Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		Member	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		● (green)	Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		● (grey)	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●			●	●				●	✔	2			Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Intersteels Ltd	01322 337766	●			●	●	●	●		●			●	●	●	✔	3			Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●	●	●	●	●	●	●	●	●	●	●	●	✔	4		● (orange)	Up to £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		● (grey)	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3			Up to £800,000
Luxtrade Ltd	01902 353182									●	●			●	●	✔	2			Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4		● (green)	Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●				●	✔	2			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £2,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●		●	●	●	●			●	●	✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						3			Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711									●				●	●	✔	4			Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●	●		●	●		●	●	✔	4		● (grey)	Up to £2,000,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		● (orange)	Up to £4,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		2			Up to £400,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			Up to £6,000,000*
Pencro Structural Engineering Ltd	028 9335 2886			●	●	●	●	●	●		●			●	●		2			Up to £2,000,000
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●			●	●	✔	3			Up to £6,000,000
S H Structures Ltd	01977 681931	●			●		●	●	●	●	●	●			●	✔	4	✔	● (orange)	Up to £2,000,000
SAH Engineering Ltd	01582 584220			●	●	●				●	●			●	●		2			Up to £800,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		● (orange)	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		● (orange)	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	● (orange)	Above £6,000,000
WT Fabrications (NE) Ltd	01642 691191			●	●	●	●				●			●	●	✔	4			Up to £40,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)

RQSC
The Register of Qualified Steelwork Contractors Scheme

Steelwork contractors for bridgeworks

BCSA

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

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

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

RF Bridge refurbishment
AS Ancillary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
QM Quality management certification to ISO 9001
FPC Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1 2 – Execution Class 2
3 – Execution Class 3 4 – Execution Class 4
BIM BIM Level 2 compliant
SCM Steel Construction Sustainability Charter
(Gold = Gold, Silver = Silver, Member = Member)

Notes
(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year, the value is the proportion of the steelwork contract to be undertaken within a 12 month period.
Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification level are those of the parent company.

BCSA steelwork contractor member	Tel	FB	CF	SG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value [1]
A&J Fabtech Ltd	01924 439614										●	✓	3					Up to £400,000
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●	●	●	✓	4				Silver	Up to £3,000,000
Bourne Group Ltd	01202 746666	●			●	●				●	●	✓	4	✓		✓	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	✓	4			✓	Silver	Up to £4,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●				●	✓	3			✓	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	✓	3			✓	Silver	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●			●	●	●		●		●	✓	3					Up to £3,000,000
ESL (GB) Ltd	01428 787986									●	●	✓	4			✓		Up to £400,000
Four-Tees Engineers Ltd	01489 885899	●			●	●	●		●	●		✓	3			✓	Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●				●				●	●	✓	4			✓	Gold	Up to £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●			●	✓	4			✓	Member	Up to £2,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●	●	●				●	✓	4			✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £4,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	Gold	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499									●	●	✓	3			✓		Up to £800,000
Structural Fabrications Ltd	01332 747400	●		●	●	●	●			●	●	✓	3				Silver	Up to £1,400,000
Taziker Industrial Ltd	01204 468080	●		●	●	●	●	●	●	●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●			●	●	●			●	●	✓	4	✓		✓		Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Non-BCSA member																		
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●		●	●	✓	4			✓	Silver	Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	✓	4					Up to £2,000,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓		Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●	●	●	✓	4			✓	Member	Up to £1,400,000
Ekspan Ltd	0114 261 1126	●				●			●	●	●	✓	2					Up to £400,000
Francis & Lewis International Ltd	01452 722200									●	●	✓	4			✓	Gold	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
Harrisons Engineering (Lancashire) Ltd	01254 823993	●		●	●	●	●	●	●	●	●	✓	3		✓			Up to £1,400,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879									●	●	✓	3			✓		Up to £200,000
IHC Engineering (UK) Ltd	01773 861734	●									●	✓	3			✓		Up to £400,000
In-Spec Manufacturing Ltd	01642 210716									●	●	✓	4			✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500									●		✓	N/A					Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●		●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £2,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●		●		●				●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Silver	Above £6,000,000

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

Company name	Tel
Highways England Company Ltd	08457 504030
Kier Construction Ltd	01767 640111
McGee Group (Holdings) Ltd	020 8998 1101

Company name	Tel
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

Industry Members

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

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

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
AJN Steelstock Ltd	01638 555500								●		M		
Albion Sections Ltd	0121 553 1877	●									M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I		
Ayrshire Metals Ltd	01327 300990	●									M		✓
BAPP Group Ltd	01226 383824									●	M		
Barrett Steel Services Limited	01274 682281								●		M		
Behringer Ltd	01296 668259					●					N/A		
British Steel Ltd	01724 404040				●						M		
British Steel Distribution	01642 405040								●		D/I		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
Composite Metal Flooring Ltd	01495 761080	●									M		
Composite Profiles UK Ltd	01202 659237	●									D/I		
Cooper & Turner Ltd	0114 256 0057									●	M		
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A		
Daver Steels Ltd	0114 261 1999	●									M		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00353 567722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	Gold	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	Gold	
Forward Protective Coatings Ltd	01623 748323						●				N/A		
Hadley Industries Plc	0121 555 1342	●									M	Silver	
Hempel UK Ltd	01633 874024						●				N/A		
Highland Metals Ltd	01343 548855						●				N/A		
Hi-Span Ltd	01953 603081	●									M	Member	
International Paint Ltd	0191 469 6111						●				N/A	Gold	
Jack Tighe Ltd	01302 880360						●				N/A		
Jamestown Manufacturing Ltd	00 353 45 434288	●									M		
John Parker & Son Ltd	01227 783200								●	●	D/I		
Joseph Ash Galvanizing	01246 854650						●				N/A		
Jotun Paints (Europe) Ltd	01724 400000						●				N/A		
Kaltenbach Ltd	01234 213201					●					N/A		
Kingspan Structural Products	01944 712000	●									M	Gold	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lincoln Electric (UK) Ltd	0114 287 2401					●					N/A		
Lindapter International	01274 521444									●	M		
MSW UK Ltd	0115 946 2316	●									D/I		
Murray Plate Group Ltd	0161 866 0266								●		D/I		
National Tube Stockholders Ltd	01845 577440								●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A		
PPG Architectural Coatings UK & Ireland	01924 354233						●				N/A		
Prodeck-Fixing Ltd	01278 780586	●									D/I		
Rainham Steel Co Ltd	01708 522311								●		D/I		
SDS/2 Ltd	07734 293573		●								N/A		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				N/A	Silver	
Structural Metal Decks Ltd	01202 718898	●									M		
StruMIS Ltd	01332 545800		●								N/A		
Stud-Deck Services Ltd	01335 390069	●									D/I		
Tata Steel – Tubes	01536 402121				●						M		
Tata Steel – ComFlor	01244 892199	●									M		
Tension Control Bolts Ltd	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		