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Cover Image
80 Charlotte Street, London
Main client: Derwent London
Architect: Make Architects
Main contractor: Multiplex
Structural engineer: Arup
Steelwork contractor: Bourne Steel
Steel tonnage: 3,200t

BCSA

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Steel benefits from exposure

Nick Barrett - Editor

The attractions of exposing constructional steelwork seem to be growing, as we have been noticing in the increasing number of projects making a virtue of its aesthetic qualities, both internally and externally.

Exposed steelwork has long been familiar in shopping malls and airport terminals for example where their slenderness and lightness are appreciated by building users. Exposed bracing is a familiar feature on well-known major buildings like Cannon Place, Heron Tower and Broadgate Tower in London.

Supporting the architects in their drive to express their vision is a supply chain including structural engineers, steelwork contractors and steel manufacturers. Weathering steel and strong tubular sections are in demand particularly for external use.

Often the exposed steel decision has been taken to acknowledge the heritage of the locality; so we see exposed steelwork in former industrial areas. Weathering steel is increasingly selected for external use in these and other areas, again for aesthetic reasons. The gradually acquired patina has become a feature in its own right on many iconic local landmarks. Architect designed houses are being built for discerning clients attracted to the weathering qualities of exposed steelwork.

Engineering support has been provided by the BCSA and its members in overcoming concerns about issues like thermal movement of exposed steelwork, the impact of penetrations being made unavoidably through the building envelope, the quality of paint finishes, important for conventional steelwork whether it is exposed internally or externally, fire protection of structural sections which might otherwise have been protected by boarding, and fabrication stamping and marking on the steel.

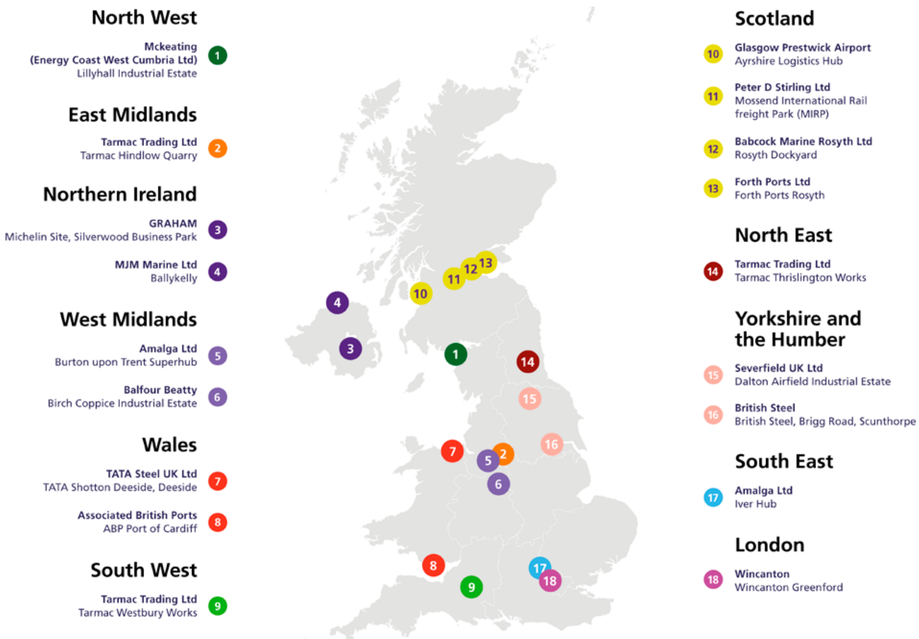
These issues have obviously all been overcome, hence the growing presence of exposed steelwork, and expressed structures, nationally. Several examples in this issue of NSC show some projects that are taking advantage of exposed steelwork while other examples can be seen on structures of all types up and down the UK.

In this issue we see exposed steelwork at a building in the heart of London's creative and technology industries in Hoxton, a key element of a refurbishment project that gives new life to an existing building previously used as offices and to house a printworks. The internal fabric of the building will be exposed, providing the internal 'feel' and ambience that tenants in that part of London appreciate, as well as acknowledging its industrial heritage.

Exposed steelwork, whether weathering steel or painted steel, also blends pleasingly with other buildings in heritage areas. A stone's throw from Hoxton, in another City fringes area, Shoreditch, we reported in our March issue on One Crown Place where exposed steelwork features alongside a retained facade on a mixed use and residential project where parts of the 15 trusses supporting twin residential towers will be exposed as architectural highlights.

It is encouraging that such a wide range of building owners and users appreciate the virtues of exposed steelwork; steel construction's other virtues will have become apparent during the construction process of course, both to clients and construction teams.

Steel sites make Heathrow expansion hub shortlist



Heathrow has announced the names and locations of the 18 shortlisted sites that remain in the running to help deliver the expanded airport, signalling the project has reached a new and significant milestone on its path to delivery.

The shortlist includes three steel construction-related sites: British Steel in Scunthorpe, Severfield UK in Dalton, Yorkshire and Tata Steel's Shotton premises in North Wales.

The sites have been selected from a longlist of 65, all of which were visited during a nationwide tour which concluded in the summer of 2018. The longlisted locations were then all invited to take part in a pre-qualification questionnaire which helped to determine which sites were best placed to be involved in the delivery of Britain's largest infrastructure project.

In the autumn, the 18 sites shortlisted will have the opportunity to pitch to the airport's bosses for their chance to become one of the final four construction centres, to be announced early next year, ahead of work starting in 2021.

The final four sites will become offsite construction centres that will help to deliver Britain's new runway, bringing jobs and economic opportunities to every corner of the country as Heathrow looks to construct as much of the expanded airport offsite as possible.

This innovative approach will also help to make the project more affordable and sustainable – by transporting assembled components in consolidated loads.

Steel supplier invests in cutting-edge plate processing

Murray Metals Group said it has made a significant investment in its Plate Processing Centre of Excellence in Middlesbrough, by installing a new profiling and machining centre.

Part of a £1.3M investment, the company has also increased its material storage and handling equipment, as well as enhancing its stock range.

Murray Metals Group CEO Graeme Hill said: "This investment programme is driven by strong customer demand and our clear ambition to create one of the UK's foremost processing facilities.

"We already enjoy an enviable reputation for flexibility, quality and delivery, and this latest investment will further strengthen our position in the UK marketplace."

The capabilities of our new profiling and machining centre include the ability to profile steel plate in length and width combinations of 15m × 3050mm and up to a maximum thickness of 200mm."

The new equipment is said to improve the Middlesbrough plant's modern, multi-head oxy-gas and high definition plasma facilities with large area machine beds, together with just-in-time CNC bevelling and drilling facilities.

Mr Hill added: "Following this investment, our group strategy is to deliver increased efficiency and productivity for our customers by consolidating Murray Plate Processing at our Middlesbrough site. This will enable us to better service customers in all construction, engineering and manufacturing sectors, including the specialist Scottish energy market."

New roof for Manchester shopping centre

Steelwork is playing a significant role in the £75M overhaul of the Trafford Centre's Barton Square in Manchester.

Designed by Leach Rhodes Walker, an extension will add more than 10,000m² of retail space to the centre, and feature a steel-framed glazed roof and dome over the two previously open malls and central courtyard.

Working on behalf of main contractor Vinci Construction, S H Structures is supplying approximately 1,400t of steel for scheme, which started in August 2018.

In order to minimise the impact on shoppers, most of the steel erection work is being carried out at night.

The project is due to open to the public in early 2020 with Primark having been secured as the anchor tenant.

Steelwork complete for City's tallest tower

Multiplex and Severfield have announced that they have successfully placed the last steel beam at Twentytwo at 22 Bishopsgate – the City of London's tallest building.

It is the culmination of over two years work on the 62-storey, 278m-tall project's superstructure, which began when the first piece of steel was placed in January 2017.

The completed building contains 17,023t of steelwork, made up of 14,593 individual pieces of steel, more than 300,000 bolts and approximately 170,000m² of metal decking.

Multiplex Project Director Andrew Feighery praised the teamwork of everyone involved and commented that the installation has gone "remarkably well, considering the unique challenges of a such a tall building" also pointing out that the amount of steel in Twentytwo at 22 Bishopsgate is twice what went into the Eiffel Tower.

Severfield Project Manager Kyle Fletcher said: "It's not all that often you are presented with the opportunity to work on a project of this scale, and it was a great, landmark moment to erect the last piece of steelwork. A project of this scale in the centre of London possesses a variety of inherent and unique challenges, which, due to the skillset and experience of all involved, did not affect our ability to deliver to programme with an outstanding safety record."

When complete, Twentytwo at 22 Bishopsgate will provide over 92,000m² of flexible, modern workspace including a gym,

indoor market, cycle storage hub, art gallery and social spaces, while the fifty-seventh floor will be home to the highest public viewing platform in Western Europe.

Major expansion delivers Yorkshire's largest galvanizing facility

Humber Galvanizing (part of the Wedge Group) has completed a multi-million-pound project to create what it claims is the biggest galvanizing bath in Yorkshire.

The business has increased capacity by approximately 50% due to a major expansion that includes the installation of new tanks

and a substantial enlargement of its yard.

The new-look site, at Citadel Way, will be officially opened by Karl Turner, MP for East Hull, on May 17.

Humber Galvanizing General Manager Richard Speake said: "This is a major investment that will have a significant impact on the business.

"It will increase both the number and size of the jobs we're able to do and that extra capacity will also boost our turnover.

"It's a project that will give us the infrastructure we need to ensure we're 'Fit for the Future' and the kind of platform from which we can grow even stronger."

Expansion of the site, including the yard extension completed six months before, included major groundwork to extend an existing pit for the new main bath, which measures 7.5m-long, 1.2m-wide and 2.7m-deep.

Mr Speake added: "Our old bath wasn't always big enough for some of the work that customers wanted and we'd have to send projects to one of our sister plants within the group.

"Now we have the size of bath that can cope with much longer lengths of steel and that will have fantastic implications for us moving forward.

"We've been at this site for 22 years and never up-scaled before so we've moved with the times and it's an historic moment for us. It is also a commitment to the future of the business."

The plant has also invested in two new 'triple acid' baths and made a string of changes in support of its commitment to health and safety.

Ficep announces new welding partnership

Steel machinery equipment manufacturer Ficep has announced an exclusive partnership in the UK with Austrian company Zeman Bauelemente Produktionsgesellschaft to supply automated welding equipment to steelwork contractors.

The new partnership includes a deal to supply Zeman's advanced automated plate component sorting storage system - the SPS. The system automatically picks fittings produced from thermal plate processing machinery and allows each part to be accurately scanned by laser for size.

The system automatically recognises the part identity, picks it up with a robot and transfers it to a storage system, with up to 40 bins depending on contract, job, or processing requirements.

With the additional ability to allocate bins to the required location or fabrication bench within a factory and completely track the process, Ficep says it is a system which could transform plate processing operations in steel service centres and steel fabrication companies.

Ficep UK Managing Director Mark Jones said: "Both our existing and new customers now have access to an unrivalled range of steel fabrication machines that will improve their productivity, reduce costs and improve quality, production capability and processes in steel fabrication.

"The overall plan is to provide fully automated factories for the future with our technological expertise and innovation for the steel industry."

Ficep will be hosting a Zeman open house from the 20th to 28th of May. For more information contact: *marketing@ficep.co.uk*

NEWS IN BRIEF

The £60M **Sandwell Aquatics Centre**, which will host events at the 2022 Commonwealth Games in Birmingham has been given the final go-ahead by local councillors. The new centre, to be built on Londonderry Playing Fields in Smethwick, will be built by Wates Construction and run by Sandwell Leisure Trust (SLT). It is expected to be completed by 2021.

Billington Holdings has announced a record performance for 2018. Revenue was up 5.2% to a record £77.3M, compared to £73.5M in 2017. Profit before tax increased by 11.4% to £4.9M up from £4.4M the previous year. Billington Chief Executive Officer Mark Smith said: "We are delighted at the progress which has been made across all our Group companies during 2018 and this has helped Billington deliver a record performance."

Manchester City Council has approved plans for two warehouses of 9,500m² and 12,800m² at **Icon Manchester Airport**, a growing global logistics area. Icon Industrial - a joint venture between Stoford and TPG Real Estate - said that the latest developments will meet rising occupational demand at the 45-acre build-to-suit logistics park, which has outline planning consent for circa 92,000m².

Developer Mitsubishi Estate London, construction manager Lendlease and development manager Stanhope have started preliminary work on the 50-storey tower development at **8 Bishopsgate** in the City of London. The 204m-structure will feature 52,000m² of prime office space, retail units on the ground floor and a public viewing gallery at its summit. Construction work on the steel-framed £300M project is expected to complete in late 2022. The tendering process for the major steelwork package is still ongoing.

Kloeckner Metals UK/Westok has been awarded with two new certificates; BS EN 3834-2:2005 as well as EN 1090-2, which maintains their CE certification in the European Union in the event of a 'No Deal Brexit'.

PRESIDENT'S COLUMN

This magazine provides engineers, architects, main contractors and clients with an enormous amount of information, technical guidance, news and case studies every month. It also showcases structural steelwork and shows the industry the range of benefits that designing and building in steel can bring.

Steel's high strength-to weight ratio delivers the most efficient designs and allows for the design of longer, flexible internal column-free spaces. It also delivers spectacular buildings and structures with ease. Steel buildings are highly adaptable and flexible, offering future-proofed design solutions.

Steel is the most cost-effective framing material for buildings and structures of all types. Cost savings in steel buildings start at the foundations, where the loads imposed by a steel frame are up to 50% less than those of a concrete alternative. AECOM's most recent cost study shows that on a typical city centre office building, the frame and upper floors cost of the cellular steel composite beam and slab option was 7% lower than the concrete alternative.

Steel construction is also fast. It gives the earliest start on-site and earliest possible pay back on investment, with time related savings amounting to between 3% and 5% of the overall project value. Accurate offsite fabrication eliminates time-wasting, quality issues and reworking on-site, making way for other critical path operations. And just-in-time deliveries are sequenced with the overall construction programme.

Quality assurance runs throughout the steel construction supply chain, delivering high-quality finished buildings. Steel sections are tested, certified, and CE Marked before delivery, and fabrication processes are quality assured and fully CE Marked. 3D BIM models combined with automatic fabrication systems then deliver precision-engineered components to tight tolerances.

More is understood about the behaviour of steel in fire than any other construction material, and it is well known that steel performs well in fire. Advanced design and analysis techniques avoid over-specification of fire protection requirements.

Steel is the world's most recycled material and 99% of structural steel used in the UK is either re-used or recycled. In fact, steel is multicycled, meaning that it can be used again and again without any loss of quality. In addition, studies show that almost all steel-framed buildings can provide optimal thermal mass.

And then there are the individual project-by-project benefits that using a BCSA steelwork contractor brings to clients and main contractors. BCSA members are pre-assessed across many different aspects which means that clients and contractors can be assured they have the specialist experience and qualifications for the job.

Tim Outteridge
BCSA President & Sales Director Cleveland Bridge

The future unveiled at French property expo

Dubbed the most significant cultural and energy-efficient attraction planned for the 21st Century, Yorkshire's Future Park has won the Best Futura Mega Project award at MIPIM (Le marché international des professionnels de l'immobilier), the world's leading property market, held annually in Cannes, France.

Leeds-based Adept will be providing civil and structural engineering services to Bond Bryan Architects and developer Fallons – the companies behind Future Park.

A planning application will be submitted later this year for the facility, which will include a range of farms, restaurants, factories, shops and a marketplace, education, research facilities and events spaces. It also aims to showcase new technologies, with a particular focus on the environmental and agricultural sectors.

The development will be located off the A1 near Harrogate and will be built around a lake with structures built into the existing landscape. It has been estimated that the scheme could support the creation of 1,000 jobs and attract an about 3.5 million visitors a year.

Adept Managing Director Erol Erturan said: "Future Park is such an exciting concept, which will showcase a whole range of innovative technologies, whilst also benefiting the local economy.

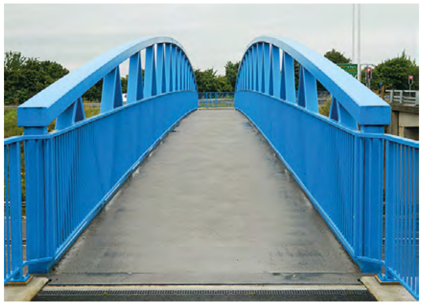
"It's very early days in the architectural design and concept structural design, but it is likely that columns and main structural beams for many of the structures will be steel."

Footbridge installed over A55

Working on behalf of main contractor Balfour Beatty Mott MacDonald, Nusteel Structures has installed a 50m-long × 3m-wide cycle/footbridge across the A55/A483 Wrexham interchange, just south of Chester.

The bridge was delivered to site from Nusteel's Kent fabrication facility in two sections, with both parts already featuring an integrally welded balustrade.

The bridge sections were bolted together on site, before the entire 51t structure was lifted into place by a 500t-capacity crane.



Health and safety award for steel contractor

The Darlington-based Cleveland Bridge has achieved a Gold award in the internationally-renowned RoSPA Health and Safety Awards, said to be the longest-running industry awards scheme in the UK.

The RoSPA Awards scheme, which receives entries from organisations around the world, recognises achievement in health and safety management systems, including practices such as leadership and workforce involvement.

Cleveland Bridge said it has made considerable investment in developing its behavioural safety ethos, which underpins its programme of training, coaching, information and supervision.

Head of Safety and Health at Cleveland Bridge Susan Debnam said: "This award is in recognition of all the hard work we have put in on a daily basis to embed safety in all we do.

"It is the most critical element of any job and this Gold Award is testament to the level of dedication and teamwork we have."

RoSPA's Head of Qualifications, Awards and Events Julia Small said: "The RoSPA Awards have become the key fixture in the health and safety calendar with new sponsors and new awards.

"Highly-respected, with almost 2,000 entrants every year, RoSPA award winners benefit from the wide-ranging rewards of improved sector reputation."

Cleveland Bridge's award will be presented at a ceremony at the ExCeL Centre in London on 18 June.

London commercial block reinvented with steel

Originally opened in 1997, the concrete-framed 1 Triton Square in central London is being refurbished and enlarged with three new upper levels and additional internal floor space partially infilling an atrium.

The new nine-storey building is now centred around this reconfigured atrium, which will provide links between floors via internal feature staircases.

According to project structural engineer Arup, the decision to use a steel-framed solution for the project's new additions was because the design needed to employ a lightweight solution.

A range of innovative strengthening techniques for the existing structure have also been employed, which has resulted in almost doubling the internal area of the building.

Unusually for a concrete-framed structure, 1 Triton Square's original design contained four braced steel cores, one in each corner. Each of the cores is being heightened up to the top floor level with new steelwork.

Bracing has been replaced in the cores and where possible the strengthening of existing steel columns has typically been undertaken by welding steel plates to the existing UC sections.

These plates have typically been positioned between the flanges of the UC section, allowing the size of the columns to remain largely unchanged while achieving a significant increase in capacity.

Working on behalf of main contractor Lendlease, William Hare is fabricating, supplying and erecting 1,920t of steelwork for the project, which will complete in late 2020.

Tower cranes herald latest addition to Coventry's skyline

Reaching a height of 72m, Winvic Construction has erected two tower cranes that will reside in Coventry's city-centre skyline for the rest of the year as it continues to construct UNINN Parkside Development Ltd's luxury student accommodation scheme.

The steel-framed project will offer 502 ensuite rooms that will be a mix of studio and cluster bedrooms constructed within three towers of six-storeys, 13-storeys and 19-storeys.

Mark Jones, Winvic's Director of Multi-room, commented: "We have been working with UNINN Parkside Development, a new client for Winvic, for the last 6 months, refining the design and solving engineering challenges. The arrival of the tower cranes on site marks an important milestone on our programme when the people of Coventry can begin to watch this six, 13 and 19-storey development really take shape."

Andrew Jamieson, Managing Director of UNINN Parkside Development, added: "Winvic has been making excellent progress on Parkside and their knowledge of city-centre, high-rise developments is evident. Already there is a buzz about Coventry's next luxury student accommodation provision and we look forward to welcoming students into their new rooms in summer 2020. Together with Winvic, we're confident to exceed expectations."

Caunton Engineering has been appointed to fabricate, supply and erect the project's steelwork.

Contractor named for Leicester City's new training centre

Leicester City Football Club has appointed McLaren Construction as the principal contractor to build its new state-of-the-art training centre at the former Park Hill Golf and Fishing Centre at Charnwood.

Blending into the landscape, the main building will be partially underground and surrounded by 11 full-size outdoor pitches, eight smaller pitches, five training grids and two goalkeeping areas.

The indoor facilities include 35 bedrooms, a hydrotherapy pool, rehabilitation facilities and dining areas for the club's academy and first team, as well as administration offices and a media centre.

The centre will include a sports turf academy, to train the next generation of grounds-people, and a 499-seat mini-venue show pitch, so that the under-23 and under-18 teams can experience a match environment.

The centre's main buildings will be steel-framed structures and BHC will be fabricating, supplying and erecting the project's steelwork.

The project supports biodiversity in the area, with the creation of 17 new ponds over 9,400m^2, to attract wildlife and help to manage surface water drainage. In addition, 38,000 new trees will be planted across more than 11 hectares of retained woodland, alongside 4.4 hectares of new planting and landscaping and 14.6 hectares of wildflower grassland.

The centre is set to complete in mid-2020.

Diary

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

Tuesday 21 May 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. Load combinations, frame stability, brittle fracture and connection design are also covered.
Cambridge

Thursday 6 June 2019
Light Gauge Steel Design Course
This course introduces the uses and applications of light gauge steel in construction, before explaining in detail the methods employed by Eurocode 3 for designing light gauge steel members in bending and compression and calculation of section properties. Specific design issues related to the different uses of light gauge steel are addressed. London

Tuesday 11 June 2019
Why and How is BIM Changing the Way We Work
This presentation will explain why we are facing a digital disruption with Building Information Modelling methodologies in the construction sector. It will cover the main concepts, uses and technologies changing the Engineering practice and the benefits of integrating them.
Webinar.

Wednesday 19 June 2019
The Use of Structural Justification to Underpin HSE/ONR Explosives Licences
The seminar will cover the legal and regulatory framework that underpins explosives licensing and will be illustrated by practical case studies with presentations from the regulator, licence holders and consultants.
London

Protective coatings for structural steel

Safeguarding structural steelwork with the correct corrosion protection system will give a steel frame a long life and reduce ongoing maintenance costs. NSC provides some key facts regarding the use and application of paint coatings and hot-dip galvanizing.

Spraying is the most commonly used method of applying paint to structural steelwork

Paint systems for steel structures have developed over the years to comply with industrial environmental legislation and in response to demands from bridge and building owners for improved durability performance. Previous five and six coat systems have been replaced by typically three coat alternatives, and the latest formulations have focussed on application in even fewer numbers of coats, but with increasing individual film thickness.

Composition of paints and film formation

Paints are made by mixing and blending three main components:

- **Pigments** are finely ground inorganic or organic powders which provide colour, opacity, film cohesion and sometimes corrosion inhibition.
- **Binders** are usually resins or oils but can be inorganic compounds such as soluble silicates. The binder is the film forming component in the paint.
- **Solvents** are used to dissolve the binder and to facilitate application of the paint. Solvents are usually organic liquids or water.

Paints are applied to steel surfaces by many methods but in most cases this produces a 'wet film'. The thickness of the 'wet film' can be measured, before the solvent evaporates, using a comb-gauge. As the solvent evaporates, film formation occurs, leaving the binder and pigments on the surface as a 'dry film'. The thickness of the 'dry film' can be measured, usually with an electro-magnetic induction gauge. In general the corrosion protection afforded by a paint film is directly proportional to its dry film thickness.

A Paint System

Protective paint systems usually consist of primer, intermediate/build coats and finish coats. Each coating 'layer' in any protective system has a specific function, and the different types are applied in a particular sequence of primer followed by intermediate/build coats in the shop, and finally the finish coat (or top coat) either in the shop or on site.

- **Primers** are applied directly onto the cleaned steel surface, or in the case of duplex systems, the sealed metal coating, to wet the surface, to provide good adhesion for subsequently applied coats and to provide corrosion inhibition.
- **Intermediate coats** are applied to 'build' the total film thickness of the system. Generally, the thicker the coating the longer the life. Intermediate coats are specially designed to enhance the overall protection and, when highly pigmented, decrease permeability to oxygen and water. The incorporation of laminar pigments, such as micaceous iron oxide (MIO), reduces or delays moisture penetration in humid atmospheres and improves tensile strength. Modern specifications now include inert pigments such as glass flakes to act as laminar pigments. Undercoats must remain compatible with finishing coats when there are unavoidable delays in applying them.
- **The finish coat** provides the required appearance, the surface resistance of the system and the first line of defence against weather and sunlight, open exposure, and condensation.
- **Stripe coats** are additional coats of paint that are applied locally to welds, fasteners and external corners to build a satisfactory coating thickness at edges and corners where paint has a tendency to contract and thin upon drying.

The various superimposed coats within a painting system have to be compatible with one another so generally all paints within a system should be obtained from the same manufacturer and used in accordance with the manufacturer's recommendations.

Application of paints

The method of application of paint systems and the conditions of application have a significant effect on the quality and durability of the coating. Standard methods used to apply paints to structural steelwork include application by brush, roller, conventional air spray and airless spray/electrostatic airless spray.

Airless spray has become the most commonly used method of applying paint coatings to structural steelwork under controlled shop conditions. Brush and roller application are more commonly used for site application, though spraying methods are also used. 'Stripe' coatings applied to edges and sharp corners are usually applied by brush.

The principal conditions that affect the application of paint coatings are temperature and humidity. These can be more easily controlled under shop conditions than on site.

- Air temperature and steel temperature affect solvent evaporation, brushing and spraying properties, drying and curing times and the pot life of two-pack materials, etc. Where heating is required, this should only be by indirect methods.
- Paints should not be applied when there is condensation present on the steel surface or the relative humidity of the atmosphere is such that it will affect the application or drying of the coating. Normal practice is to measure the steel temperature with a contact thermometer and to ensure that it is maintained at least 3°C above the dew point. However, moisture cured paints are available. These paints are specifically formulated for application in damp and humid conditions.

Metallic Coatings

There are four commonly used methods of applying metal coating to steel surfaces. These are hot-dip galvanizing, thermal spraying, electroplating and sherardizing. The latter two processes are not used for structural steelwork but are used for fittings, fasteners and other small items. In this article NSC looks in more detail at the hot-dip galvanizing process.

Hot-dip galvanizing is a process that involves immersing the steel component to be coated in a bath of molten zinc (at about 450°C) after pickling and fluxing, and then withdrawing it. The immersed surfaces are uniformly coated with zinc alloy and zinc layers that form a metallurgical bond with the substrate. The resulting coating is durable, tough, abrasion resistant, and provides cathodic (sacrificial) protection to any small damaged areas where the steel substrate is exposed.

As the zinc solidifies, it usually assumes a crystalline metallic lustre, often referred to as spangling. The thickness of the galvanized coating is influenced by various factors including the size and thickness of the workpiece, the steel surface preparation, and the chemical composition of the steel. The typical minimum average coating thickness for structural steelwork is 85 μm. Thick steel parts and steels which have been abrasive blast cleaned tend to produce relatively thick coatings up to 140 μm.

Since hot-dip galvanizing is a dipping process, there is obviously some limitation on the size of components that can be galvanized. However, 'double-dipping' can often be used when the length or width of the workpiece exceeds the size of the bath. The longest tank in the UK is currently 21 metres in length, the maximum double-dip dimension is 28 metres, and the maximum lift weight is 16 tonnes.

Some aspects of the design of structural steel components need to take the galvanizing process into account, particularly with regards the ease of filling, venting and draining and the likelihood of distortion. To enable a satisfactory coating, suitable holes must be provided in hollow sections to allow access for the molten zinc, the venting of hot gases, and the subsequent draining of zinc. Further guidance on the design of articles to be hot-dip galvanized can be found in BS EN ISO 14713-1.

The suitability of steels for hot-dip galvanizing should also be considered. Structural steel that is to be hot-dip galvanized should be clearly specified, by invoking the appropriate options in the material standards, e.g. Option 5 in BS EN 10025-1.

Andrew Harrison, Sales & Marketing Director at Wedge Group Galvanizing says: "Hot dip galvanizing is highly sustainable, producing minimal waste, while the non-ferrous properties of the metal make it indefinitely recyclable without loss of physical or chemical properties.

"Galvanized products, once constructed or installed can also be removed, re-galvanized and re-used."

Duplex coatings

For many applications, hot-dip galvanizing is used without further protection. However, to provide extra durability, or where there is a decorative requirement, paint coatings are applied. The combination of metal and paint coatings is usually referred to as a 'duplex' coating. When applying paints to galvanized coatings, special surface preparation treatments must be used to ensure good adhesion. These include light blast cleaning to roughen the surface and provide a mechanical key, and the application of special etch primers or 'T' wash, which is an acidified solution designed to react with the surface and provide a visual indication of effectiveness.

Galvanized steelwork was chosen for much of the M&S car park frame at Longbridge

Steelwork raises flagship development

A multi-million-pound research facility is set to help collaboration between industry and academia as well as providing a significant boost to the Welsh economy.

FACT FILE
Advanced Manufacturing Research Facility, Broughton, North Wales
Main client:
Welsh Government
Architect:
Austin Smith Lord
Main contractor:
Galliford Try
Structural engineer:
Arup
Steelwork contractor:
EvadX

The Welsh Government is investing £20M in a flagship development at Broughton in North Wales in order to increase productivity, commercialisation, innovation and skills development across a range of sectors including aerospace and automotive.

Located alongside the huge Airbus UK manufacturing centre, the facility will be managed by the University of Sheffield Advanced Manufacturing Research Centre (AMRC), who will occupy half of the new building, with Airbus taking the other half.

Executive Dean of the AMRC Professor Keith Ridgway says: "We share the Welsh Government's bold ambition to enhance North Wales' reputation for manufacturing excellence, creating secure, high-value jobs and wealth for the whole of Wales by acting as a magnet for inward investment.

EvadX erecting the initial bay of steelwork

"The new facility will bring the research and innovation talents and experience of the University of Sheffield AMRC to a new venture in a region rich in manufacturing history and opportunity."

The aim of the project is to make the facility an open access research hub that will drive significant improvements in productivity, performance and quality not just in the aerospace sector but across the broader advanced manufacturing sector in North Wales.

Airbus is a long-standing partner of the AMRC and its involvement will ensure the it remains at the forefront of aerospace development, supporting skills in the area and upskilling its manufacturing supply chain partners.

The facility is housed in a large twin-span propped portal frame that measures 80m-long × 60m-wide with a maximum height of 24m. One row of offset internal valley columns separate the main workshop part of the building into two parts, one with a span of 33m and the other 27m.

One end of the structure houses a full-width office block, divided in half by an entrance and atrium. This part of the scheme has a composite design with steelwork supporting steel decking and a concrete topping to form the floors.

One half of this block is two-storeys high and will accommodate the facility's offices, while the other side is four-storeys and will house further office space on the ground floor, a first-floor canteen and then two upper levels for plant equipment.

Explaining the project's use of steel, Galliford Try Project Manager Graham Ford says: "This project was always going to be a steel-framed job, as the long spans could only be economically constructed with steel."

The initial steel design was done by Arup, but later in the programme EvadX was sub-contracted as project steelwork contractor on a design and build basis.

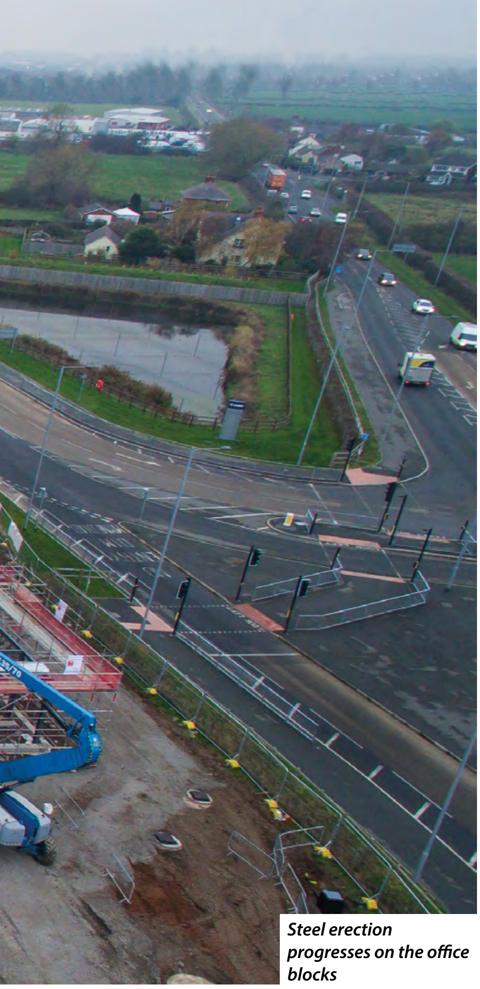
Using Building Information Modelling (BIM), EvadX redesigned the entire frame and made some significant weight savings with a more economic design.

One of the more onerous parts of the steel design were the crane beams that are installed along the entire length of both spans that allow four 12t-capacity gantry cranes (two in each spans) to operate inside the facility.

"We had to design the supporting steelwork to some very tight tolerances, 8mm plus or minus, as any movement on the beams would stop the cranes working," says EvadX Project Manager Steve Morris.

The crane beams are supported by the structure's perimeter columns as well as on brackets positioned on either side of the valley members. Because of the extra loadings and vibration associated with crane movements, the column sections are larger than would ordinarily be required.

A series of long rafters form the roof and



Steel erection progresses on the office blocks

A steel frame was said to have been the only viable solution

the two workshop spans. To allow these sections to be easily transported to site from EvadX's fabrication shop in Rhyl, they were delivered in sections and then assembled into complete rafters before installation.

For the longer 33m-span, the rafters arrived in three sections, while the 28m span required two pieces. As well as steelwork, EvadX has also installed staircases, hand railing and maintenance walkways.

EvadX has also erected three separate single-storey ancillary buildings on site, these include an energy centre, compressor house and a bin storage structure.

As with most steel construction projects, the frame was one of the first elements of the scheme to get under way after the groundworks, on this greenfield site, had been completed.

However, on some projects the ground floor slab is sometimes installed first, giving the steel erection team a clean and flat surface to run their MEWPs on. The slab needed for this facility had to be cast in a dry and sheltered environment and so the steel frame and roof cladding had to be installed first to provide the necessary protection.

"Because of the excessive loadings that will be exerted by the work and equipment within the workshops, the concrete slab is 900mm-deep and had to be cast in two separate pours," explains Mr Ford.

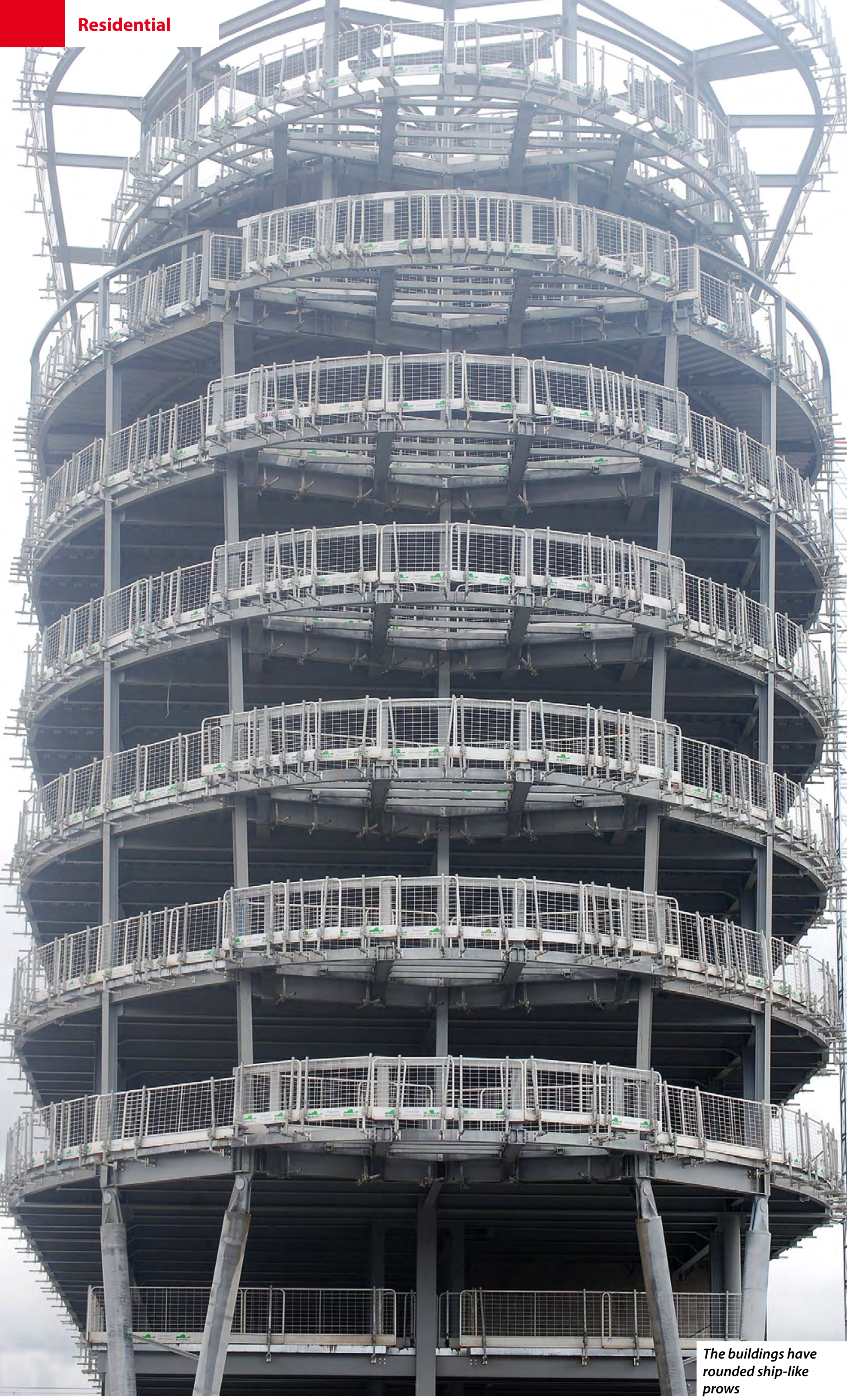
Summing up, the Welsh Government Economy Secretary Ken Sates says: "The fact that the AMRC will be managing Wales' first Advanced Manufacturing Research Facility on Deeside really is cause for celebration.

"The AMRC has a 15-year record of delivery and has long demonstrated that it has leading industry capability in the delivery of research, manufacturing support and partnership services.

"It has built up incredibly strong relationships with a range of partnerships, from global corporates through to local SMEs and supply chains, and it will play a vital role in developing sustainable, long term leading innovation and skills.

"This can only be good news for the future of advanced manufacturing here in Wales and for the regional and wider Welsh economy."

The 60m-wide structure is divided into two parts by a row of valley columns



The buildings have rounded ship-like prows

Ship-shape residences

The first phase of an ambitious residential scheme, overlooking the Manchester Ship Canal, has chosen a steel-framed solution for its first two apartment blocks.

Things are about to change for the better on Pomona Island in Greater Manchester as a new residential scheme, that will breathe new life into the area, is beginning to take shape

The scheme, known as X1 Manchester Waters, will help regenerate the island which has been identified as a new destination for business, residential and leisure by the local authority, complementing nearby Manchester city centre and Salford Quays.

Almost a kilometre long, Pomona Island is a strip of land sandwiched between the Manchester Ship Canal and the Bridgewater Canal that has been unused in recent times having previously served as docks for the once thriving inland port of Salford.

Further back in history, during the early Industrial Revolution, the island was home to botanical gardens and the Royal Pomona Palace, a venue that was bigger than London's Albert Hall.

Manchester Waters is being developed by X1 with Liverpool-based Vermont Construction as main contractor. In total, the scheme is set to deliver five blocks in two phases, with the first two blocks (phase one) due to be complete by early next year.

The initial two steel-framed blocks (A and B) are 10-storeys and 12-storeys high and will contain a total of 216 apartments. These will be a mix of studio, one, two and three-bed units.

The planned second phase will consist of three blocks of 15-storeys, 17-storeys and 19-storeys that will bring a further 526 new homes to the market. The overall vision for the scheme will see the blocks progressively step up in height from the Salford Quays end of the island in the direction of Manchester city centre.

The design of all of the buildings is influenced by their prominent canal-side setting. Consequently, the structures will all have a nautical appearance with a rounded and raking front, which incorporates a cantilever supported by two pairs of V-shaped tubular columns.

Vermont started work on this brownfield site late last year and its initial groundworks for the first phase included the installation of piled foundations to a depth of 13m.

Block A and B's concrete cores were then cast, which then allowed Elland Steel Structures to begin its steel erection programme.

Elland Steel has recently completed the erection of the 10-storey block A and it is due to commence work on the second (12-storey) block B later this month (May).

Commenting on the chosen framing solution, WSP Project Engineer Antony Jones says the decision to go for a steel


Balconies are to be retrofitted later in the programme


How the completed Phase One will look

construction method for the first phase was led by the contractor and was essentially a commercial decision based on cost.

Falconer Chester Hall Architects Associate Gareth Jones agrees and says the choice was based on economies of scale, as steel construction was the most cost-effective and quickest option for the initial two blocks.

He says: "A simple pallet of materials is expressed throughout the buildings, comprising smooth large format metallic panels, contrasting textured dark grey panels with a mixture of dark Terracotta tiles, all emphasising the layering of the building's façade.

"This architectural language extends into the steel frame, with the exposed geometrical raking steel columns to the entrance areas located on the riverside elevations. This clear architectural dialogue, form and shape resonates with the maritime character of the former Pomona Docks."

Both of the two blocks in phase one have a similar design, with the only main differences being the second building is taller, slightly longer and contains two concrete cores instead of one.

Block A is based around a regular column grid pattern incorporating 9.6m-wide bays. The floors are compositely formed with steel beams supporting metal decking and a concrete topping.

"As a residential building, acoustics have greater implications than a for a similar commercial building. Part of the solution in this case was to utilise heavier 190mm thick floor slabs. This had implications on the steel sections utilised," says Mr Jones.

"Further challenges with respect to the steel section sizes selected was hiding the steel within the walls and limited ceiling zones and maintaining tight deflection criteria."

Throughout the building, a central spine corridor separates two rows of apartments on each of the floors.

The building has terraces on the eighth and ninth levels as the main structure steps back slightly.

The most prominent part of block A, and in time, all of the buildings, is the canal-facing rounded ship-like front. This is formed by curved members that create balconies from level three upwards.

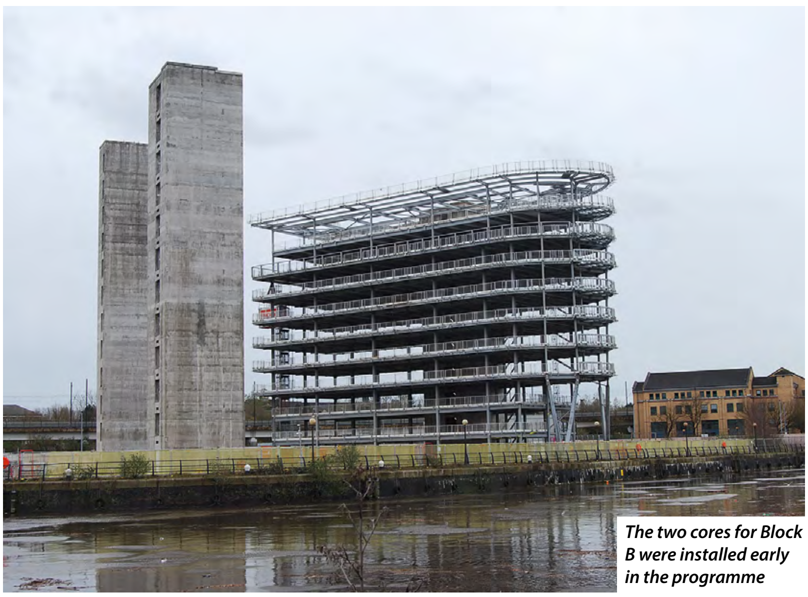
Ground floor, first floor and second floor are all set-back at the front of the building, below a cantilever which is supported by the previously mentioned CHS columns. These feature tubular members are 457mm-diameter and each weigh 8t.

Elsewhere on the building, retrofit balconies are to be installed later in the construction programme. The pre-fabricated units will be brought to site and bolted to plates that Elland Steel previously fixed to the perimeter beams.

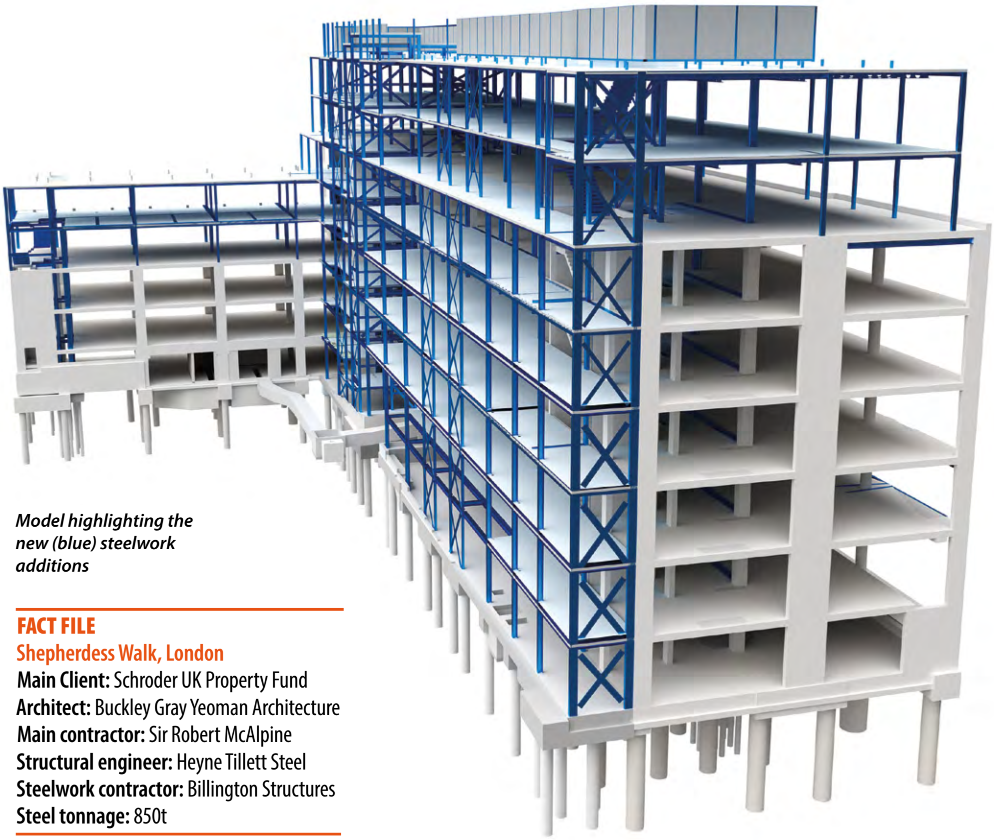
Manchester Waters Phase One is due to be complete by late 2020.

As well as phase two, future plans also include a podium that will wrap around all of the blocks. This will contain a ground level car park with a landscaped rooftop.

FACT FILE
X1 Manchester Waters Phase One
Main client: X1 Developments
Architect: Falconer Chester Hall
Main contractor: Vermont
Structural engineer: WSP
Steelwork contractor: Elland Steel Structures
Steel tonnage: 1,100t


The two cores for Block B were installed early in the programme


Twin pairs of V-shaped tubular columns support a cantilever



Model highlighting the new (blue) steelwork additions

FACT FILE
Shepherdess Walk, London
Main Client: Schroder UK Property Fund
Architect: Buckley Gray Yeoman Architecture
Main contractor: Sir Robert McAlpine
Structural engineer: Heyne Tillett Steel
Steelwork contractor: Billington Structures
Steel tonnage: 850t

Steel additions

A 1980s multi-use structure is being refurbished and enlarged into a modern commercial development with the aid of new steelwork elements. Martin Cooper reports.

Straddling the northern boundary of the City of London, the previously working class district of Hoxton has undergone a radical makeover in recent times.

During the 1990s, its proximity to the centre of London and a plentiful array of former industrial warehouses drew artists, creative industries as well as small dot-com companies to the area, changing the landscape into a trendy and vibrant community.

The new steel-braced cores have been moved to the rear façade

An example of this changing environment is located on Shepherdess Walk, a thoroughfare previously noteworthy for the Eagle public house, made famous for being name-checked in the 'pop goes the weasel' nursery rhyme.

A former 1980s building that was once divided into two parts to accommodate offices and a printing press is being refurbished along with the addition of new steel-framed upper storeys to create approximately 14,000m² of high quality commercial space.

The original six-storey building, was constructed with a concrete frame, and also includes an attached three-storey annex along Micawber Street, that together form an overall L-shape on plan.

"In short, we've got rid of a dividing wall to create one large building, rationalised the existing cores to suit the new layout, added two new floors and constructed a brand-new rear façade that extends all of the floorplates," explains Sir Robert McAlpine Project Engineer Andrew Timbers.

The refurbishment has made use of steel construction to form the new floors, façade and new cores, as this framing solution provided a quicker construction programme and meant minimal new foundations were required.

"Steelwork offered a lighiweight solution that needed less strengthening works to the original structure, and we justified 93% of the existing foundations to carry the loads from the additional storeys." explains Heyne Tillett Steel Associate James Mumford.

Based around the existing 7.2m × 7.2m column grid pattern, the new steel-framed floors continue the same pattern to form a seventh and eighth storey to the main Shepherdess Walk part of the scheme and a new fourth and fifth storey to the lower annex.

The only exceptions to the regular column pattern are a couple of terraces formed in the new upper floors, one of which was required as a rights-to-light planning issue.

In these areas, carbon-fibre strengthening has been added to the underside of the offset columns and the adjacent members.

Interestingly, the new rear façade, that adds an extra bay to the existing main block and then ties into the new upper floors, was initially going to be built with reinforced concrete, but after a value engineering exercise the design team changed it to a steel frame.

As well as adding new elements, plenty of work has been undertaken to reconfigure the existing building into a modern office block. This has included infilling and moving the four cores that previously served the building's two distinct parts.

"The cores were islands in the middle of the footprint, so we've pushed them to the rear of the building to create more floor space," explains Mr Mumford.

One of these cores served both parts of the building with two staircases that were separated by a dividing shear wall. The wall has been removed, most of the core infilled with steelwork, and new lift shafts installed around a stability-giving braced steel frame.

Two more cores have been partially infilled and extended upwards to create additional floor space, while the remaining core has been completely infilled.

Much of this work has involved a tricky process of lifting and installing steelwork into the existing structure via the open roof and then down through the floorplates using openings created by the cores.

"We had to thread the steel beams and columns into the building by using one of the site's two tower cranes and then move the sections to their final positions with a block and tackle," explains Mr Timbers.

The two tower cranes are sat on the uppermost level of the retained building and because of a lack of space, their bases will form part of the new steel-framed structure. Parts of the crane bases had to be positioned over column locations and so once the cranes have been dismantled, parts of the base will remain as permanent columns.

Logistics governed the entire erection programme as the site is very confined with no room for materials storage and very little space in which to manoeuvre steelwork into place.

Because of the nature of the project, the steelwork package has overlapped with the demolition programme, albeit in different parts of the site. This has required a lot of coordination between trades and a strict delivery programme, as the project only has one entrance for materials.

The initial steel construction elements of the scheme to be undertaken were in the building's basement and ground floor.

Originally, the building had two main entrances that were accessed via nine steps. They have now been amalgamated into one entrance and lowered to street level. New steelwork supports the new ground floor and creates a large double-height entrance foyer.

Steelwork contractor Billington Structures is supplying and erecting approximately 850t of steel, along with more than 2,000m of edge protection barriers from easi-edge.

Sir Robert McAlpine will complete the project in November.

Parts of the crane bases will remain as permanent columns

Exposure to heritage

Adding some modern-day aesthetics to the scheme, the internal fabric of the completed building will be exposed, in order to highlight the industrial heritage of the building. This exposed design will include the existing reinforced concrete slabs and columns on the lower floors, along with the steelwork in the new areas.

"The new upper storeys utilise cellular beams allowing integrated service runs that will be partially hidden behind a transparent mesh ceiling to create an industrial yet contemporary aesthetic," says Heyne Tillett Steel Associate James Mumford.

As the frame is exposed, thermal breaks have been incorporated at roof level where plant screen and mansafe posts are fixed down to the new roof steelwork. There are also thermal breaks between the precast concrete canopy on the front elevation and the supporting steelwork behind.

Steelwork forms a new rear façade

Steel highlights bespoke design

Fully exposed steelwork and floor slabs are the order of the day for a high-profile architecturally-driven mixed-use scheme in London's Fitzrovia. Martin Cooper reports.

The client liked the idea of a design incorporating slender steel columns

Occupying a prime central London plot between the BT Tower and Tottenham Court Road, in the heart of the Fitzrovia district, the 80 Charlotte Street development will on completion offer high-quality offices, residential apartments and ground floor retail units along with a new south-facing public space.

Overall, the 35,300m² scheme comprises three separate buildings: the main 80 Charlotte Street part - a nine-storey new build that infills a rectangular block that is also bounded by Whitfield Street, Chitty Street and Howland Street - as well as the adjacent 65 and 67 Whitfield Street. The latter are two existing structures that have been renovated, with each one receiving three new steel-framed floors enabling them to offer 1,020m² of offices and 4,180m² of residential space.

Befitting a project in such a prestigious location, the design of 80 Charlotte Street has used a bespoke steel-framed solution, whereby all columns and beams will be left exposed within the completed scheme, along with the underside of the precast flooring planks.

Discussing the design team's choice of a steel-framed solution, Make Architects Jason McColl says: "The client liked the idea of an expressed steel frame and the slender columns the material allows.

"While the kind of tenants the scheme and the area has attracted don't really want a traditional 'white box' office environment where everything is boarded up and hidden from view."

The majority of 80 Charlotte Street has been pre-let to Arup Group and The Boston Consulting Group (BCG).

Sometimes referred to as an industrial-look, the exposed steelwork combined with the 9m × 6m column grid pattern, create a contemporary and spacious office environment.

Many offices may have a larger column pattern, but the 9m × 6m grid was chosen as the optimum size to accommodate the thin precast planks that allow the project to maintain a 3.3m floor-to-ceiling height and get nine-storeys into a designated height restriction.

Having the steelwork fully exposed within the completed building means the connections and their bolts will also be on show. Plenty of thought went into the choice of bolts and hexagonal units were chosen as the design team and client thought they offered a look more in keeping with the rest of the scheme.

"The exposed internal steelwork and the connecting bolts will be a feature element within the building, and so all of the end plates are flush and the beams and columns are all being repainted once they have been lifted into position in order to get the best possible high-quality decorative finish," says Bourne Steel Divisional Manager Kevin Springett.

The precast flooring planks are supported within the steel beam's depth, thereby creating a clean, flush and uniform surface. Because the underside will be left exposed, the precast planks have been manufactured with a high-quality finish.

"The challenge for the team has been to understand the protection the steel and precast units need during the transportation to site and installation in order to manage the expected quality finish," says Multiplex Senior Project Manager Stephen Sebborn.

Adding to the scheme's industrial look, all of the services, which will be accommodated within bespoke cells cut into the plate girder beams, will also be on show within the completed building.

As well as fabricating, supplying and erecting the steelwork, Bourne Steel also designed and installed the 6m-long precast planks. A grand total of 4,800 of these prestressed planks were needed for the project, with the majority being bespoke units that could only fit in one particular location.

"Although the column grid spacing is regular throughout the scheme, there are some slight adjustments because of the shape of the plot and building, and so there are almost 100 different plank types," explains Mr Springett.

"We are also working to some exceptionally tight tolerances as there is only 2mm in level between each plank in the centre of the span."

Previously, the 80 Charlotte Street site was occupied by a concrete-framed office block built around a central courtyard. The concrete frame is being replaced with a steel-framed structure, while the original Whitfield Street elevation is now tied into and fully supported by the new frame.

"This is a Conservation Area and the retained façade, as well as being historically significant, helps the new building deviate away from being one large form," says Mr McColl.

"Brickwork and concrete panel cladding along the other elevations continue this design."

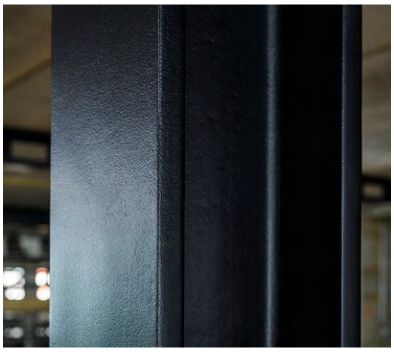
Steelwork for the new 80 Charlotte Street structure starts at basement level and then incorporates a double-height ground floor before extending upwards to the ninth floor with a uniform grid pattern.

Using all four of the site's tower cranes, alongside one mobile crane during the early stages of the project, Bourne Steel erected the steelwork by dividing the main plot into five areas. ▶20

Bourne Steel installed precast planks along with temporary propping

FACT FILE
80 Charlotte Street, London
Main client: Derwent London
Architect: Make Architects
Main contractor: Multiplex
Structural engineer: Arup
Steelwork contractor: Bourne Steel
Steel tonnage: 3,200t

Bourne Steel had the use of four tower cranes for the steel erection



Once the steel was erected it was all repainted to get a high-quality decorative finish to suit the exposed design

▶19

Working around the building's one centrally-positioned core in a clockwise manner, the steelwork was erected two floors at a time. The flooring planks were installed behind the steel programme and temporarily propped until the concrete topping had been cast and cured.

Once the topping was cured the props were dismantled, to be reused elsewhere on the job, while MEWPs were then able to use the recently formed floor to erect the next two levels of steelwork.

It was a complex erection programme because of the bespoke nature of the steel and flooring.

"It was completed ahead of schedule and the fact that the team did a trial erection before starting on site, using four columns, four beams and six precast planks, to show the client how it would look was a great help and prevented any problems," adds Mr Sebborn.

One of the site's tower cranes is positioned outside of the project footprint along Howland Street, but the other three are all within the new steel frame. Once the scheme is nearing completion and the cranes are removed, the gaps they leave behind in the frame will become atria that allow natural light to penetrate into the building's inner areas.

The 80 Charlotte Street development is due to complete in early 2020.

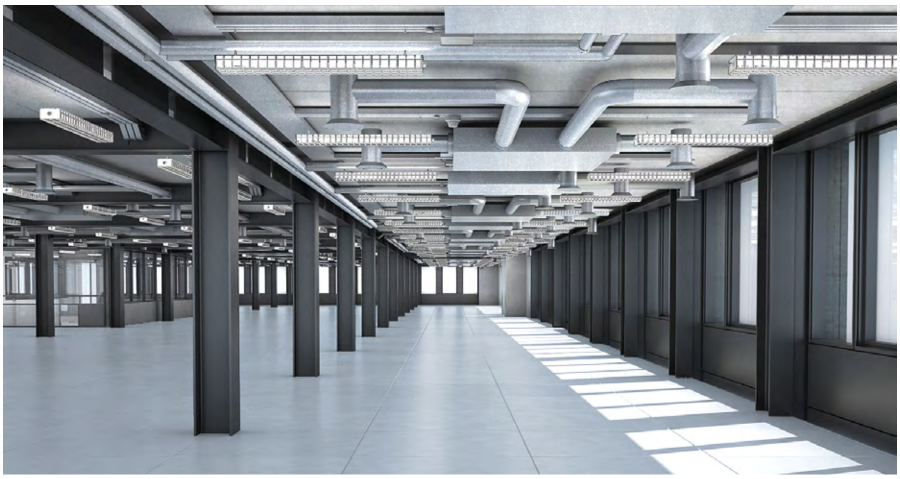
Exposed structure and services integration

Richard Henderson of the SCI discusses the solution adopted.

80 Charlotte Street has a simple beam and stick steel frame with lateral stability provided by concrete cores. The simplicity of the steelwork belies the effort that has been put into maintaining a 450mm high structural zone at floor levels to make the most of the available storey height of 3.335m and to comply with British Council for Offices guidance. Prestressed precast planks 100mm thick with fair faced soffits are supported on shelf plates welded to the webs of 450mm deep primary beams. A 50mm concrete topping completes the concrete floor. The primary beams stand down by 300mm so that the upper third is embedded in the floor slab. These beams are provided with holes in the webs for reinforcement to pass through for tying and anchorage. Columns are tied together for robustness in the direction perpendicular to the primary beams by 150mm deep tie beams within the depth of the slab such that only the bottom flange is visible from below. The zone immediately below the slab between the primary beams is therefore uninterrupted by structure and the horizontal runs of heavy building services from the core are uninhibited.

In certain areas, the orientation of the precast planks changes so that some beams support planks on one side only. These beams have been designed to carry the planks on their top flange and are 300mm deep to maintain the same level to the underside of the structure throughout the floorplate. The webs of these beams and of primary beams which cross the runs of services have been perforated where necessary to maintain the same zone for services everywhere.

The steelwork is to be left exposed when complete and the detailing of the connections is simple and unfussy. Flush end plates have been adopted with toe plates in certain places. Some tie beams have also been provided with horizontal triangular fillets in the connection of their bottom flanges as an architectural feature. Fire protection requirements for beams which pass through compartment walls and for beams with top flanges at floor level were optimised using computational heat transfer modelling. The structure has a 90 minute fire resistance period and is provided with intumescent paint pigmented with a dark grey colour to add to the industrial feel of the space.



Improved parking

Two steel-framed car parks in Sussex are forming integral elements of large developments that will reshape a town centre and a university campus.

Metal decking was chosen as the most cost-effective solution for Piries Place Car Park

FACT FILE
Piries Place Car Park, Horsham
Main client: Horsham District Council
Architect: HNW Architects
Main contractor: Kier Regional Building Southern
Structural engineer: Gyoury Self
Steelwork contractor: Caunton Engineering
Steel tonnage: 600t

The West Sussex market town of Horsham is undertaking the multi-million-pound redevelopment of Piries Place, an important town centre location for both its daytime and evening economies.

Including a three-screen Everyman cinema, a Premier Inn hotel and a range of new restaurants and retail outlets, the scheme also includes a distinctive five-level multi-storey car park.

Meanwhile, forming one of the initial parts of the University of Brighton's expansion programme for its Moulescoomb campus, a new multi-storey car park is under construction that will provide 550 spaces for staff and visitors on six-levels (see Box).

According to main contractor Kier, the delivery of the car parks has involved some successful partnering with the company's subcontractors.

"No partnering works effectively without trust and honesty from all parties and it is vital to honour these agreements made in the early stages of a project," says Kier Construction Design Manager Charley Latimer.

"When Horsham District Council and University of Brighton invited Kier to tender for their respective new car parks, it was evident that the best way forward was a steel-framed and metal deck solution and to bring in Caunton Engineering as part of our bid proposals."

As part of the bids, Kier and Caunton put together some options for the clients to review. According to Kier, Caunton's design team rose to the challenge and turned around a full 3D model with circulation and bays identified in less than 48 hours.

This collaborative early engagement demonstrated to the respective clients that both Kier and Caunton understood their needs and were fully committed to providing a high level of service and collaboration.

Caunton's input into the bid stage provided invaluable knowledge and support. "By having Caunton at the table with the wider design team enabled swift value engineering options, design development, coordination, production of the planning application information and RIBA stage 4 contractor's proposals," adds Charley Latimer.

HNW Architects Director Steve Duffy adds: "Agreeing a set of design principles for all disciplines, including the main contractor, to develop at the very earliest stage is a great example of design and build, which relies on involving key design partners from the start."

Piries Place Car Park is a new build to replace the outdated and challenging town centre car park, providing 519 spaces, public toilets and baby change, green walls and improved public security all within the existing building footprint.

Initially, a reinforced concrete design was the option for the car park, but this did not provide Horsham with the right solution

Visualisation of the completed Horsham car park

The Horsham car park was erected in a very confined site

for the varying bay sizes needed and did not fall within their budget.

"A steel frame provided a lightweight and relatively quicker option in comparison with a concrete frame structure. The reduced weight of the superstructure was also beneficial for the foundation design, especially along two elevations where due to the close proximity of existing foundations, cantilever RC pile caps were designed to support steel columns above," explains Gyoury Self Project Engineer Monika Koclega.

A steel-framed solution also offered a much greater ability to accommodate the desired long clear spans and minimise column sizes, which resulted in a more aesthetically pleasing and user-friendly car park.

The structure is generally based around a column grid pattern of 8.5m × 15.6m, with a centrally-positioned vehicular ramp.

The floors are formed with steel beams supporting steel decking and a concrete topping.

Steel decking provided a more flexible option to suit the existing site constraints, as the new Piries Place car park was designed to fit around some existing residential buildings.

"A steel decking option with 150mm deep concrete slabs was considered to be a cost and time-effective solution in comparison to precast flooring, as well as providing a cleaner soffit," says Ms Koclega.

The main floor beams for the longer spans are 610mm × 229mm cambered UB sections, while the shorter 8.5m-long beams are 457 UBs. All of the project's columns are either 305 or 254 UC sections, which were all brought to site in complete 20m-long sections that required no splice to reach the full height of the car park.

Stability for the structure is provided by vertical bracing in the building's two lift and stair cores.

Caunton Engineering Contracts Manager, Adrian Downing says: "This is a very tight town centre site and a lot of coordination was needed between trades."

Summing up, Ms Koclega says: "Offsite fabrication allowed steel elements to be installed quickly, accurately and assembled with proven techniques.

"Steelwork also provides a solution that reduces waste material and improves site safety."

University challenge

The Brighton car park has a core at either end

The University of Brighton car park will provide 550 spaces for staff and visitors on six levels.

It will also be able to accommodate 330 bicycles, while the structure's ground floor will include showers for cyclists, a parking office and a recycle bin storage area.

Based around a 4.8m x 15.9m column grid pattern, the structure has been designed with cambered 610 x 229 UB sections for the longer spans, and 305 UBs for the shorter spans. Either 305 or 254 columns have been used throughout and these are spliced at the underside of level four.

According Stripe Consulting, the project architect and engineer, speed of construction was one of the main reasons for choosing a steel frame design with metal decked flooring.

"This solution also provided us with a lightweight structure that required less foundation work," says Stripe Consulting Engineer Enrico Tomasi.

There are two lift and stair cores positioned at either end of the structure, but these provide no stability as the car park gains all of its rigidity from braced bays.

The steel-framed car park has been designed as a Vertical Circulation Module (VCM), which is said to offer a more efficient solution for confined city plots, like the Brighton site. The design contains no external ramps as all of the circulation is via slopes within the floors, which creates more parking spaces.

Caunton has also erected some additional steelwork features to the uppermost level of the car park. This includes a canopy over the central vehicle access route that will prevent rainwater from running down the slope to the covered floors below.

A series of secondary beams has been added to two elevations along the top floor. These members will support planters, which will contain hanging vines that will form architectural living 'green' walls.

As well as the car park, the overall University of Brighton scheme, which has been dubbed the 'Big Build', will also include five new halls of residence, a new academic building, a new students' union building and fitness facilities, and a new footbridge over the A270 linking both parts of the campus.

FACT FILE
University of Brighton Multi-Storey Car Park
Client:
University of Brighton
Architect and structural engineer:
Stripe Consulting
Main contractor:
Kier Regional Building
Steelwork contractor:
Caunton Engineering
Steel tonnage: 750t

Visualisation of the completed Brighton car park

The design of crane girders

Recent correspondence in *Verulam*[1] suggested that there were no decent examples of crane girder design to the Eurocodes. David Brown of the SCI rises to the challenge…

The problem

According to the contribution in *Verulam*, a number of problems exist with the design of a mono-symmetric member (a plate welded to the top flange of a UB) and destabilising loads:

- BS 5950 examples have 'mysteriously disappeared' from the equivalent Eurocode publications.
- The only way to design the member is to use 'a piece of software from a French website'.
- There is no way of checking the result (from the French software).
- Gantry girders would have to be doubly symmetric, or have the top flange fully restrained.

What are the options?

Looking back at the BS 5950 examples in the SCI library, most are mono-symmetric with a channel welded to the top flange. An example with a plain plate welded to the top flange is presented in early editions of the 'Red Book'[2].

Some of the examples calculate the section properties of the compound section – not a precise task, (especially before channels had parallel flanges) and verify the fabricated member on that basis. Alternative examples adopt the traditional and simpler approach of assuming that the additional plate (or channel) carries the horizontal loads, and the rolled section carries the vertical loads.

If one held the pessimistic expectation that the Eurocodes always adopt the most complex approach, one might be pleasantly surprised to find that the simple approach is allowed in clause 5.6.2(4) of EN 1993-6, which is the Standard covering the design of crane supporting structures. According to this clause, lateral loads are resisted by the top flange, and vertical loads are resisted by the main beam under the rail. This simple approach will be familiar, and facilitates the use of mono-symmetric sections.

Following this simple approach, torsional moments are resisted by a couple acting horizontally on the top and bottom flange. As an alternative, torsion may be treated rigorously.

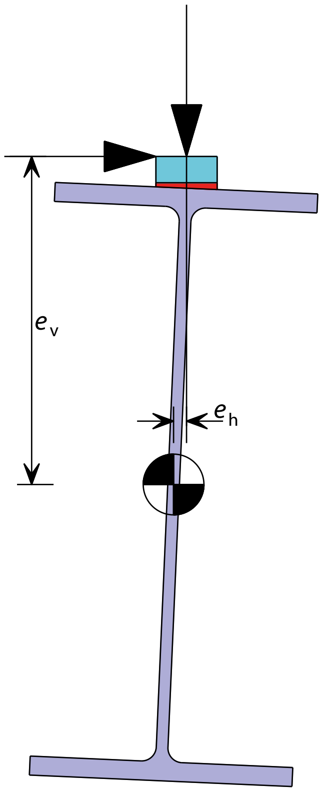


Figure 1 Torsions on a gantry girder

Lateral-torsional buckling

Gantry girders are unrestrained, and have lateral loads applied at the top flange level (or above). As the beam buckles, the vertical loads may be eccentric to the shear centre, so there are additional torsions on the section, as indicated in Figure 1. Clause 6.3.2.1 of EN 1993-6 insists (quite properly) that these torsions must be accounted for. The designer again has options, according to clause 6.3.2.3.

The first option is to simply consider the top flange and part of the web acting entirely alone, and check it as a simple strut. Safe, certainly, but conservative. The second option is to assess the member for the combined effects of lateral-torsional buckling, minor axis moment and torsion, using the interaction expression presented in Annex A of the Standard. The UK National Annex endorses the use of this alternative.

Of course, the interaction expression looks complicated:

$$\frac{M_{y,Ed}}{\chi_{LT} M_{y,Rk}/\gamma_{M1}} + \frac{C_{Mz} M_{z,Ed}}{M_{z,Rk}/\gamma_{M1}} + \frac{k_w k_{zw} k_\alpha B_{Ed}}{B_{Rk}/\gamma_{M1}} \le 1$$

A numerical worked example would help, as the correspondence in *Verulam* notes. Fortunately there is a full worked example in P385[3], which is SCI's publication on the design of steel beams in torsion. Example 2 is precisely the case under consideration – a gantry girder, except the selected member is a UB with no plate. Because this comprehensive numerical example exists, no further attention is paid to the interaction expression in this article.

Destabilising loads

Loads that move with the buckling compression flange are classed as destabilising. As the correspondence in *Verulam* indicates, one would normally assume that gantry girders are subject to destabilising loads.

EN 1993-6 offers an interesting twist (no pun intended) to the classification of destabilising loads. Clause 6.3.2.2 suggests that if the crane rail is fixed directly to the runway beam, the applied vertical load can be considered as stabilising. This unexpected conclusion is because, as shown in Figure 2, as the runway beam starts to twist, the application of load moves to the 'high' side of the rail, which is actually on the 'restoring' side of the shear centre. Thus the load is stabilising and in these circumstances the Standard notes that it may be assumed that the loads are applied at the shear centre. ▶26

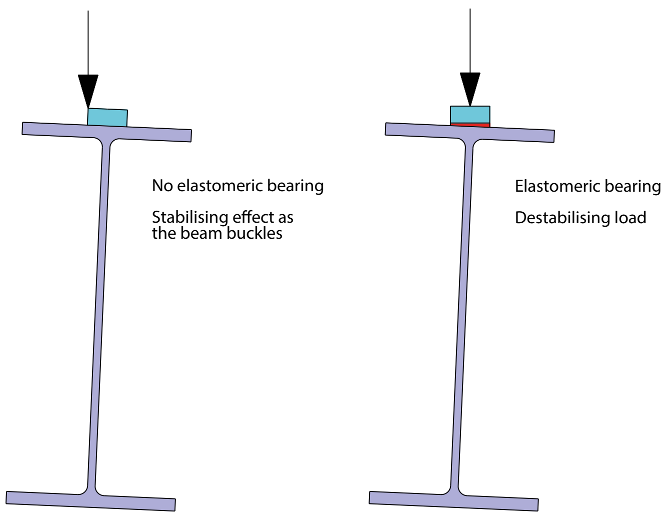


Figure 2 Influence of crane rail on load classification

▶24 If the rail is supported on a flexible elastomeric pad, the loads are destabilising and the Standard notes that the loads should be assumed to be applied at the top of the flange.

In BS 5950, destabilising loads were treated by multiplying the system length by 1.2 (typically), with further adjustment depending on the support conditions. The equivalent uniform moment factor m_{LT} had to be taken as 1.0 (so no benefit from the shape of the bending moment diagram). The Eurocode deals with destabilising loads by adjusting the calculated value of M_{cr}, which will lead us to the comment about using software from a French website.

Calculation of M_{cr}

The background to the problem of M_{cr} is that BS 5950 presents bending strengths p_b for different values of slenderness, λ_{LT}, which is very convenient for the designer, as long as one is not interested how the values have been derived. If interest is sparked, Annex B of BS 5950 provides the background. With patience and algebraic dexterity, one can demonstrate that the BS 5950 terms depend on a familiar friend – the elastic critical buckling moment, M_{cr}. This has been discussed previously[4].

M_{cr} can be calculated using a formula. The version of the formula which allows for destabilising loads is perfectly amenable to computation by paper, pencil and calculator as the *Verulam* correspondence wished. Software solutions merely make the process easier and, many would say, less open to error. After extensive experience asking course delegates to complete a manual calculation of M_{cr} even without destabilising loads, the conclusion is that generally over 80% fail to compute the correct answer. Sadly, the main problem is that delegates attempt to use inconsistent units within the calculation. Maybe software is safer after all.

The French software mentioned is *LTBeam*, which has been discussed several times. Despite the assertion in *Verulam*, independently written software from the UK (does that make it better?) exists and is freely available at *steelconstruction.info*

If necessary, these two programs could be used for mutual checking, and then proved by hand calculation – though a spreadsheet is strongly recommended to remove the tedium of the latter option.

How to check?

The calculation of M_{cr} is merely a step on the way to the result, so checking of the final resistance is probably wise. Options are available, starting with a 'sense check' against the results from BS 5950. Since the introduction of the Eurocodes the consistent message has been that the structural mechanics has not changed, so one would not expect to find significant differences in the results obtained by either code. Generally, the LTB resistance according to the Eurocode is a little higher than according to BS 5950, so that needs to be recognised, as well as taking m_{LT} = 1.0 for destabilising loads.

The wise authors of BS 5950 recognised that increasing the effective length of the member was a good way to allow for destabilising loads. That simple check can be completed by looking at the calculated member resistances for the two lengths.

Simple design assessment

Some straightforward checks of the example presented in P385 have been completed. The example demonstrates the verification of a member subject to combined major and minor axis bending combined with torsion, but if the example is reconfigured to assume lateral loads (and torsional effects due to eccentricity) are taken by a plate welded to the top flange, the exercise becomes a review of the main member.

The vertical loads are destabilising, so according to EN 1993-6 are assumed to be applied at the level of the top flange. Accounting for the position of the loads, M_{cr} = 320 kNm*, according to P385, and M_b = 277 kNm*.

The span of the gantry girder is 7.5 m, so applying a factor of 1.2 results in a span of 9 m. Then one must make a reasonable estimate of the shape of the bending moment diagram, or conservatively assume that C_1 = 1.0

Looking at the bending moment diagram (Figure 3), it looks vaguely similar to that for a UDL, admittedly with some angularity, but for a quick check, assume that C_1 = 1.13, mainly for easy use of the look-up tables in the Blue Book.

For the trial section of a 533 × 210 × 101 UB in S275 (note that all beams are S355 nowadays!), a buckling length of 9 m and C_1 = 1.13, the buckling resistance M_b = 288 kNm. As a coarse check, this is quite reassuring when compared to the computed value of 277 kNm*.

A further approach is to use the look-up tables in the back of P362[5], where χ_{LT} depends only on h/t_f and L/i_z, which more mature designers will recognise as D/t and L/r_{yy} in previous nomenclature. The tables in P362 assume C_1 = 1.0, so are likely to deliver a smaller resistance than computed with precision.

h/t_f = 536.7/17.4 = 31

L/i_z = 9000/45.7 = 196

Using Table E2 from P362, χ_{LT} = 0.38 with some approximate interpolation.

Therefore $M_b = 0.38 \times 2610 \times 10^3 \times 265 \times 10^{-6} = 262$ kNm

This seems to offer reassurance that we are in the correct parish, at least, when compared to the computed value of 277 kNm*.

What has not been addressed!

In the opinion of the author, the challenge with gantry girders is not in fact the member verification, but the determination of the applied actions in accordance with EN 1991-3, a problem which was not mentioned in *Verulam*. A treatise on the subject is available for download[6], but the topic is complex.

Other issues not addressed here are the deflection limits for crane supporting structures, which may be more important than the member resistance. Designing the supporting structure to control the spread of the gantry beams will be important. Finally, fatigue design may govern the size of the member – an introduction to the subject[7] and example calculations[8] have been published in NSC.

*Footnote

Readers trying to replicate the calculation of M_{cr} as quoted in P385 may have some difficulty. The correct value of M_{cr} appears to be between 336 and 340 kNm and consequently M_b = 288 kNm. Although it would be tempting to blame the software, it appears the user calculated the level of load application as 533/2 + 65 = 331 mm, when 286 mm should have been used (the load is applied at the top flange, not on top of the 65 mm rail).

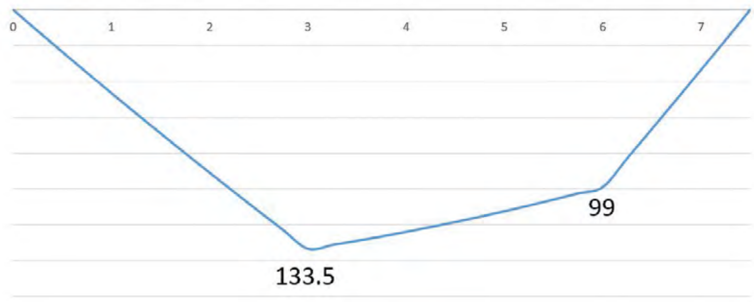


Figure 3 Bending moment diagram

References

1 Verulam, The Structural Engineer, March 2019
2 Handbook of Structural Steelwork, BCSA and SCI (second edition of 1991)
3 Design of steel beams in torsion, (P385) SCI, 2011. Available on steelconstruction.info
4 A brief history of LTB, New Steel Construction, February & March 2016
5 Steel Building Design: Concise Eurocodes (P362) SCI, 2017
6 Sedlacek et al Actions induced by cranes and machinery *https://estudijas.llu.lv/pluginfile.php/127337/mod_resource/content/1/20100609%20Exemple-Aachen%20Piraprez%20Eug%C3%A8ne.pdf*
7 Henderson, R. Introduction to fatigue design to BS EN 1993-1-9. New Steel Construction, September 2018
8 Henderson, R. Illustration of fatigue design of a crane runway beam. New Steel Construction, January 2019

AD 430: Wind load on unclad frames

The purpose of this note is to correct errors in BRE Special Digest SD5 which lead to the prediction of significantly higher wind loads on unclad frames than were calculated using the report which SD5 superseded.

BRE published Special Digest SD5 in July 2004. The document was produced principally because at the time, the current guidance for determining wind loads on frames, lattice structures and individual members was based on the BS code of practice CP3 Chapter V: Part 2 which had been withdrawn in October 2001. SD5 is based on BS 6399-2 and includes guidance on determining loads on individual members and lattice structures. It also includes a section on unclad building frames which is based on and intended to supersede BRE report BR173, Design guide for wind loads on unclad framed building structures during construction.

BR173 considers a series of identical parallel frames of overall width W at spacing S. The parameter S is used to select the appropriate normal force coefficient C_D according to the ratio W/S and the total solidity ratio denoted φ. In a given direction, φ is presented in BR173 as the sum of the horizontal and vertical solidity ratios: $\varphi = \varphi_v + \varphi_h$. In the direction perpendicular to the secondary beams, the horizontal solidity ratio used is the equivalent solidity ratio which allows for all the secondary beams in a bay denoted $\varphi = \varphi_v + \varphi_h^*$ (see item iii in the design example in BR173 para. 4.2.2). In SD5, the total solidity ratio is erroneously given as $\varphi = \varphi_v + \varphi_h + \varphi_{h,s}$ ie the equivalent horizontal solidity ratio $\varphi_{h,s}$ is added to, instead of substituted for the horizontal solidity ratio φ_h. The total solidity ratio in this direction should be given in SD5 as $\varphi = \varphi_v + \varphi_{h,s}$.

The spacing of the secondary beams is used in the determination of the equivalent solidity ratio for secondary beams. In BR173, this parameter is also denoted S and is likely to be different from the frame spacing but unfortunately, SD5 does not differentiate between the two parameters. In SD5, the relevant equation is no. 11: $\varphi_{h,s} = (\varphi_1 + \varphi_2)\varphi_h$ where $\varphi_2 = (n - 1)(S/d - 7.5)/25$. According to BR173, in the expression for φ_2 the parameter S is the secondary beam spacing not the frame spacing. The equivalent expression in BR173 is equation (4): $f_2 = (N_{bb} - 1)(S/b - 7.5)/25$. The secondary beam spacing should be used in the determination of φ_2.

The approach to determining the wind load on unclad structures (lattice structures, frames and individual members) in SD5 (corrected as indicated) can also be used with BS EN 1991-1-4 and its UK National annex as the design pressures have identical target reliability to BS 6399-2.

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

New and revised codes & standards

From BSI Updates April 2019

NEW WORK STARTED

EN 1990
Eurocode. Basis of structural and geotechnical design
Will supersede BS EN 1990:2002+A1:2005

ISO PUBLICATIONS

ISO 17607-1
Steel structures. Execution of structural steelwork. General requirements and vocabulary
Will supersede None

ISO 17607-2
Steel structures. Execution of structural steelwork. Steels
Will supersede None

ISO 17607-3
Steel structures. Execution of structural steelwork. Fabrication
Will supersede None

ISO 17607-4
Steel structures. Execution of structural steelwork. Erection
Will supersede None

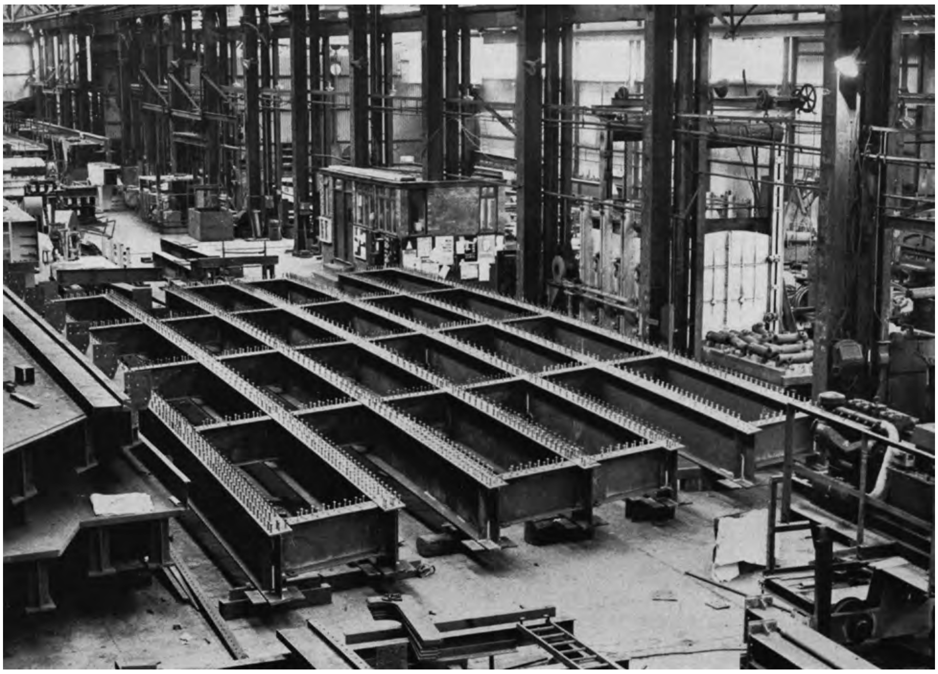
ISO 17607-5
Steel structures. Execution of structural steelwork. Welding
Will supersede None

ISO 17607-6
Steel structures. Execution of structural steelwork. Bolting
Will supersede None

BUILDING WITH STEEL

Reprinted from Volume 5 No. 4
June 1969

First British Rail bridge in weathering steel



Trial assembly in shop.

The first stage of the British Rail Freightliner network was virtually completed in mid-summer 1967 and plans were then prepared for the next stage of the development. Market research had shown that a second terminal would be required in Manchester and that it would need to be a major terminal using Goliath cranes spanning six railway tracks.

The only railway site available with suitable connections in the area was at Trafford Park adjacent to a motive power depot which was to be closed. Existing road access to the site, however, was very poor and it could not be improved because of the position of the Manchester United F.C. ground and adjoining industrial premises. The solution was to construct a completely new access to the site from Westinghouse Road on the other side of the Bridgewater Canal. The scheme entailed the building of a bridge over the canal and the demolition of some premises of the Springfield Warehouse Company through which the northern approach to the bridge would pass.

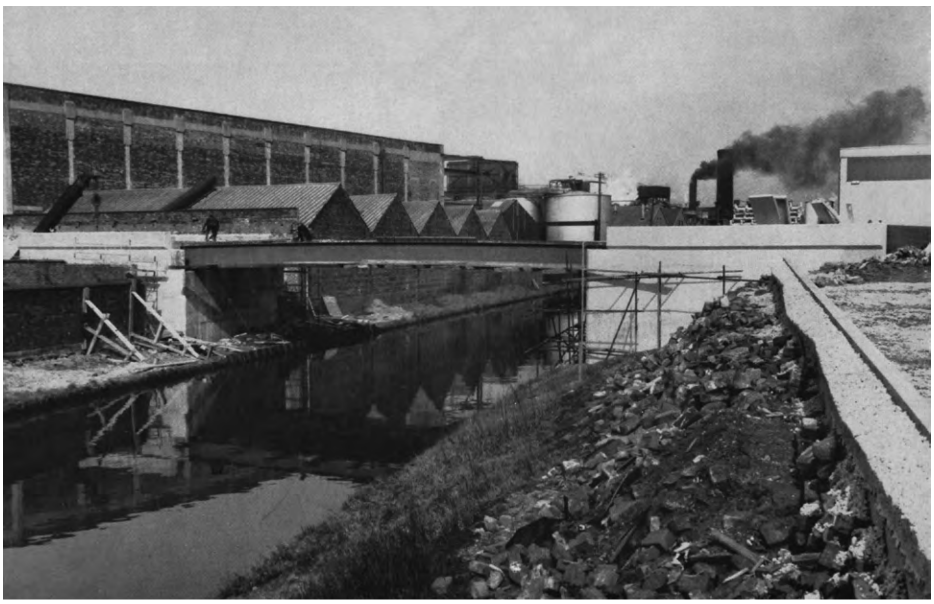
The design of the bridge presented no great difficulties; the span, 61ft between bearings, is moderate and the skew, 17° 30´, not large. A simply supported welded steel plate girder bridge on piled concrete abutments was therefore decided upon. The question of maintenance naturally had to be considered and, in view of the limited headroom of little more than 12ft above water level, it was felt by the Chief Civil Engineer, London Midland Region, British Railways Board, that here was an excellent opportunity to gain experience of using a corrosion resistant, or weathering, steel. Such steels had successfully been welded for a number of bridgeworks in North America but there was no knowledge of their behaviour in this country and, although it was intended to use Cor-ten B steel produced under licence in Great Britain to the specification of the United States Steel Corporation it was considered desirable to call for welding tests before making a firm decision to order it. Consequently, the BCSA arranged for comprehensive tests to be carried out by the Welding Institute (formerly the BWRA). The results of these tests having proved satisfactory, British Rail decided to have the bridge at Trafford fabricated in Cor-ten B steel and the necessary materials were ordered.

The bridge consists of seven welded plate girders, 63ft long at 5ft centres, with 24in × 9in welded I-section diaphragms of ½in plate flush with the top flanges. Each girder. 2ft 8in deep, is fabricated from a web plate 29¾in deep and ½in thick, a top flange plate 12in × ¾in and a bottom flange comprising a plate 11in × ¾in welded under another 12in × ¾in plate. The total weight of Cor-ten B steel is 33 tons.

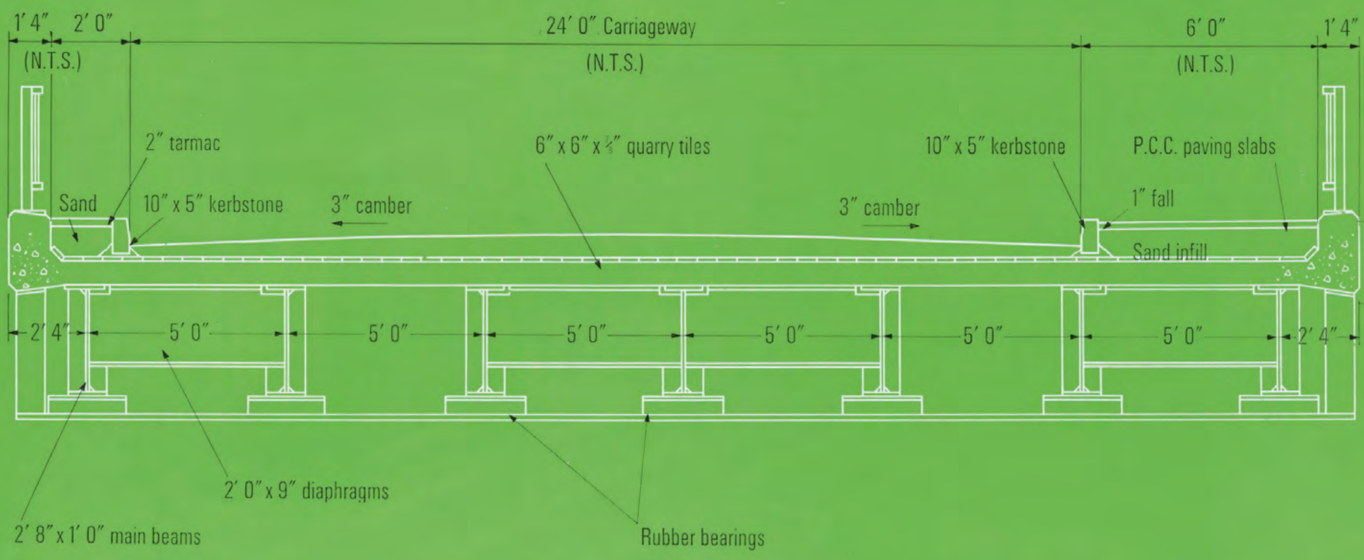
Stud shear connectors welded to the top flanges of both girders and diaphragms ensure composite action with the 8in thick concrete deck slab which is surmounted by a bituminous waterproofing membrane protected by a layer of quarry tiles and an asphalt wearing surface laid with a camber of 3in to both sides of the 24ft wide carriageway. An initial camber built into the plate girders provides for longitudinal falls from the centre of the bridge. The girders were welded up complete with diaphragm brackets, stiffeners and shear connectors in the shop, where a complete trial assembly of the steelwork was made before delivering all the components to the site. All welds are ¼in fillets and all site connections are made with ⅞in diameter high tensile bolts in 15/16in diameter holes. The bolts and washers are zinc plated and the nuts are cadmium plated. Site erection was carried out with the aid of a mobile crane.

The bridge and the associated roadworks are due for completion in May 1969 and the Freightliner terminal is expected to commence operating in August 1969.

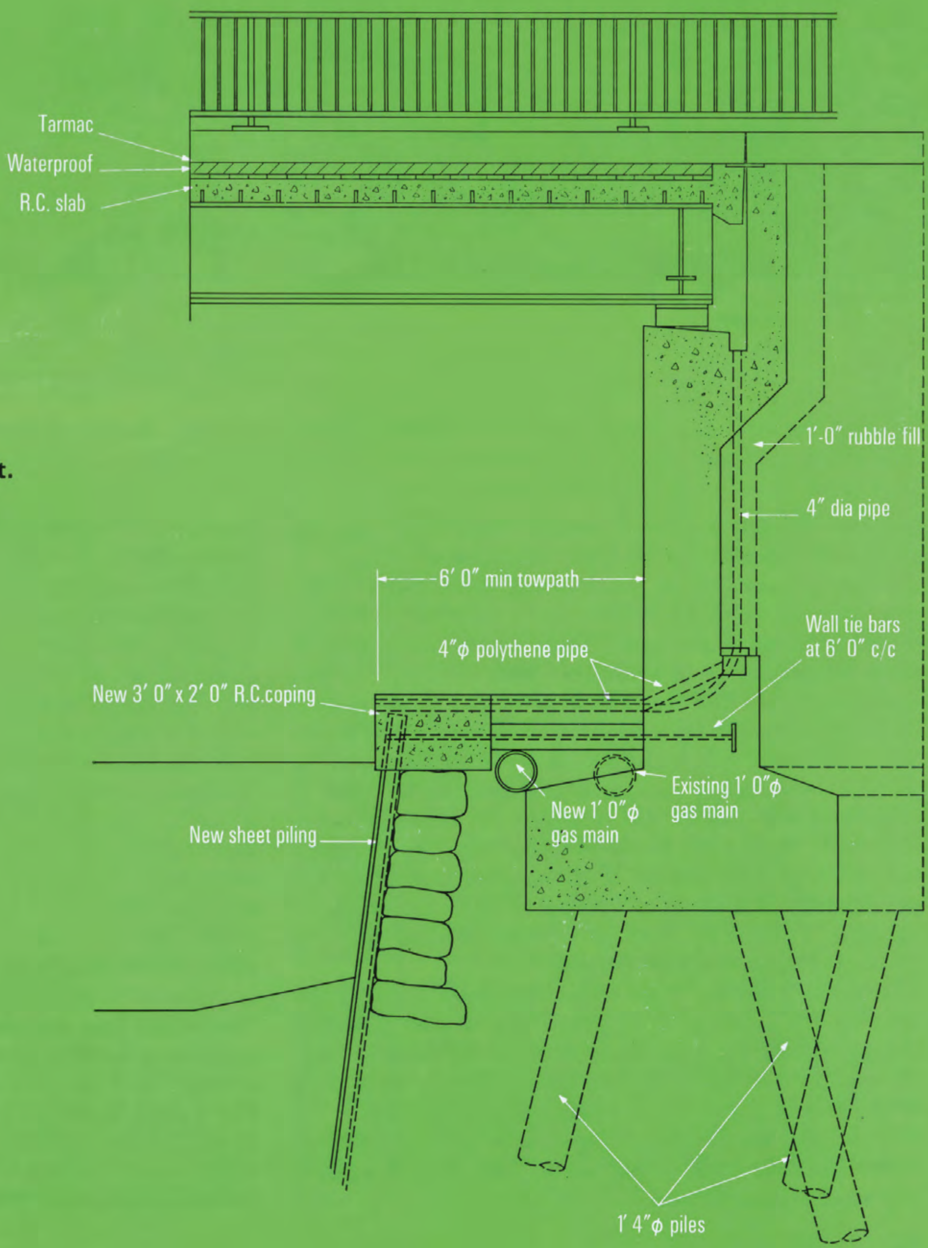
The design of the bridge was carried out by the chief Civil Engineer, London Midland Region, British Railways Board, whose permission to publish this article is gratefully acknowledged.



Construction of bridge after steelwork erection



Bridge details at north abutment.



Steelwork contractors for buildings

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

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

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

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

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		3			Up to £400,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	4			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3	✔	Silver	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	Gold	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		Silver	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Apex Steel Structures Ltd	01268 660828					●	●			●	●			●	●		2			Up to £3,000,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●	●	●		●	●			●	●	✔	4		Gold	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950				●	●	●	●		●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	Silver	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4	✔	Silver	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4			Up to £6,000,000
Builders Beams Ltd	01227 863770			●	●	●	●			●	●			●	●	✔	2	✔		Up to £2,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		Silver	Up to £4,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	Gold	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●		●	●			●		●		●	✔	3		Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●		●	●	●			✔	4		Gold	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011			●	●		●			●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £1,400,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £40,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●		●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072		●	●	●	●	●	●	●		●	●			●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	✔	Gold	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●			●	✔	3		Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		Member	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000

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
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4		● (green)	Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●				●	✔	3			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £2,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●			●	●				●		✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						3			Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711									●				●	●	✔	4			Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●	●		●	●		●	●	✔	4		● (grey)	Up to £2,000,000
North Lincs Structures	01724 855512			●	●					●	●				●					Up to £400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		● (orange)	Up to £3,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●							●		2			Up to £400,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			Up to £6,000,000*
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●			●	●	✔	3			Up to £6,000,000
S H Structures Ltd	01977 681931	●			●	●	●	●	●	●	●	●			●	✔	4	✔	● (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)

Steelwork contractors for bridgeworks

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

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

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

Notes

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

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

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

Corporate Members

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

Company name	Tel
Control Energy Costs Ltd	01737 556631
Gene Mathers	0115 974 7831
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Inspire Insurance Services	02476 998924
Kier Construction Ltd	01767 640111
McGee Group (Holdings) Ltd	020 8998 1101
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

Industry Members

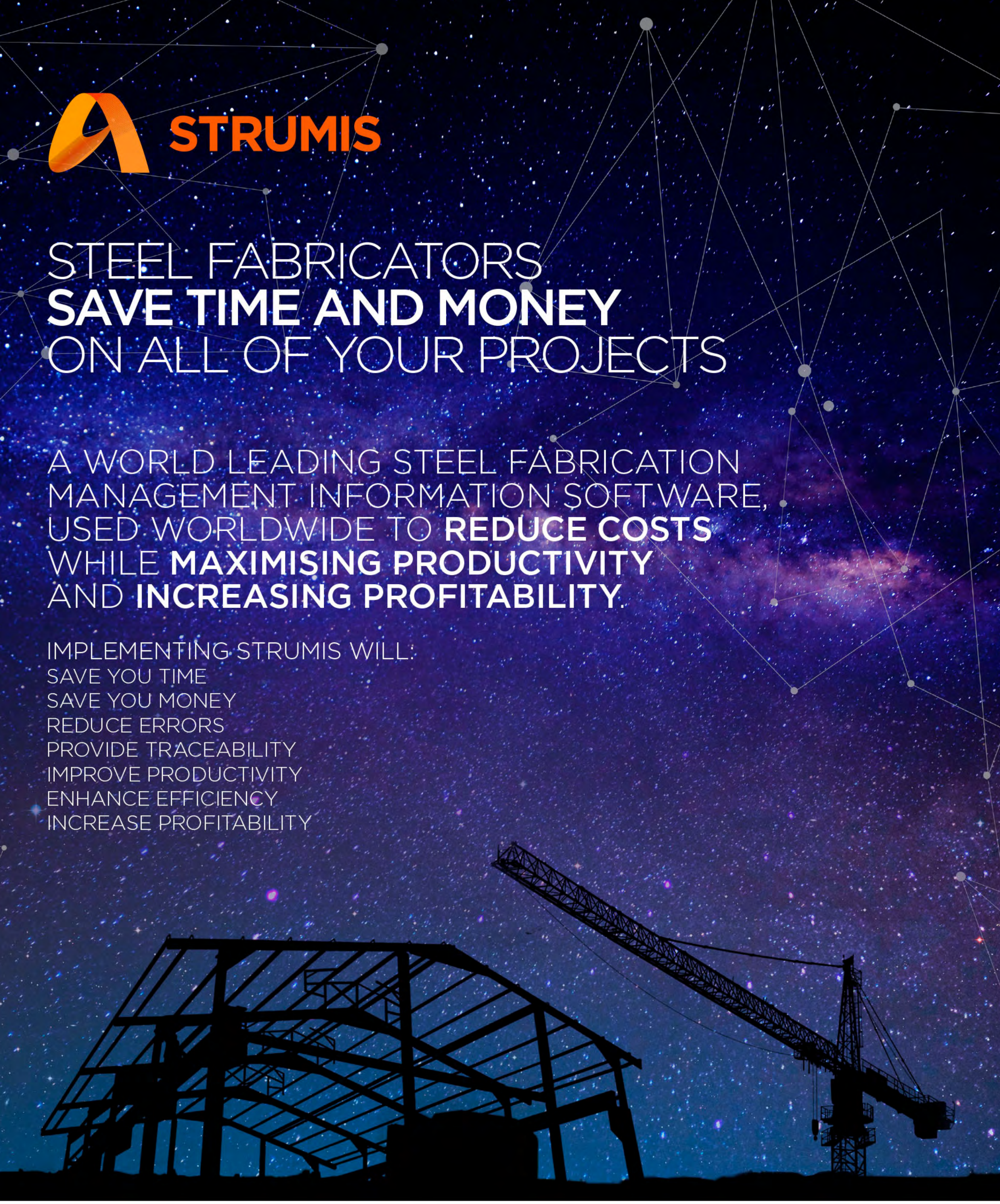
Industry Members are those principal companies involved in the direct supply to all or some Steelwork Contractor Members of components, materials or products. Industry member companies must have a registered office within the United Kingdom or Republic of Ireland.

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	00 353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	Gold	
Fabsec Ltd	01937 840641	●									N/A		
Farrat Isolevel	0161 924 1600	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	Gold	
Forward Protective Coatings Ltd	01623 748323						●				N/A		
Hadley Industries Plc	0121 555 1342	●									M	Silver	
Hempel UK Ltd	01633 874024						●				N/A		
Highland Metals Ltd	01343 548855						●				N/A		
Hi-Span Ltd	01953 603081	●									M	Member	
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		
Wightman Stewart (WJ) Ltd	01422 823801					●					N/A		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