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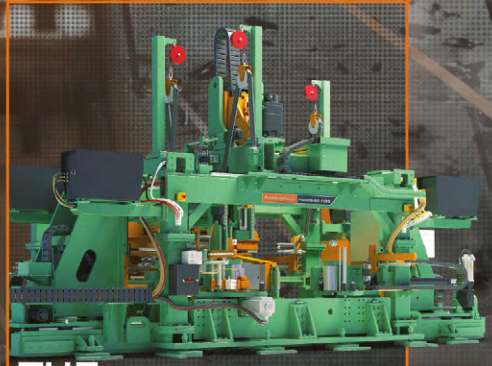

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NSC

MAY 2022
Vol 30 No 5

Cover Image
4 Angel Square, Manchester
Developer: MEPC
Architect: SimpsonHaugh and Partners
Main contractor: Bowmer + Kirkland
Structural engineer: Buro Happold
Steelwork contractor: Billington Structures
Steel tonnage: 2,400t

EDITOR
Nick Barrett Tel: 01323 422483
nick@newsteelconstruction.com

DEPUTY EDITOR
Martin Cooper Tel: 01892 538191
martin@newsteelconstruction.com

PRODUCTION EDITOR
Andrew Pilcher Tel: 01892 553147
admin@newsteelconstruction.com

PRODUCTION ASSISTANT
Alastair Lloyd Tel: 01892 553145
alastair@barrett-byrd.com

COMMERCIAL MANAGER
Fawad Minhas Tel: 01892 553149
fawad@newsteelconstruction.com

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The British Constructional Steelwork Association Ltd
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone 020 7839 8566
Website www.steelconstruction.org
Email postroom@steelconstruction.org

Steel for Life Ltd
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone 020 7839 8566
Website www.steelforlife.org
Email steelforlife@steelconstruction.org

The Steel Construction Institute
Silwood Park, Ascot, Berkshire SL5 7QN
Telephone 01344 636525 Fax 01344 636570
Website www.steel-sci.com
Email reception@steel-sci.com

CONTRACT PUBLISHER & ADVERTISING SALES
Barrett, Byrd Associates
7 Linden Close,
Tunbridge Wells, Kent TN4 8HH
Telephone 01892 524455
Website www.barrett-byrd.com

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Image courtesy of Billington Structures Ltd

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Steel undergoing technical transformation

Nick Barrett - Editor

Questions have inevitably been raised about how strongly commitments to achieving net-zero carbon targets will survive new and growing, and perhaps more obviously immediate, economic and other pressures.

Attention has recently shifted from pandemic-related problems towards the humanitarian tragedy of the war in Ukraine, rising energy costs and other inflationary pressures, so fears can be expected to grow that the climate change battle could be left behind. The path towards achieving radical policy objectives like combatting climate change is never entirely smooth, but that doesn't mean they won't be achieved.

Wars eventually end, as do pandemics and periods of inflation, but climate change is one problem that cannot comfortably be shelved while we deal with other matters. Many individuals have taken the climate struggle on board and are making many adjustments to their behaviours to minimise their own carbon footprints. So have many companies, as have industries.

The steel sector is certainly making a leading-edge contribution, such as the efforts of ArcelorMittal that feature in this issue (p10). The company says that decarbonisation is the most important aspect of its long-term strategy, and it has committed to reduce European steelmaking CO_2 emissions by 35% by 2030 and be carbon neutral by 2050. Along with other steel manufacturers, ArcelorMittal is at the forefront of technical transformations needed to decarbonise the steel used in construction.

Across the steel industry many decarbonisation projects are underway, underpinned by an industry's shared determination to ensure that designers and constructional steelwork contractors always have low embodied carbon solutions to offer an increasingly sustainability-conscious world. Good examples of the high sustainability projects already being provided can be seen in this, and every, issue of NSC.

The industry's intention is to maintain a steadily improving trend towards ever more carbon neutrality, from an already impressively high level. For example, we have a report on a project at 4 Angel Square in Manchester, that faces the steel-framed 1 Angel Square, which was the first office building to achieve BREEAM 'Outstanding'. The aim at 4 Angle Square is operational carbon neutrality - earning it a BREEAM 'Excellent' rating - which will increasingly be a demand of tenants with an eye on their own carbon credentials.

In Reading we visit another project aiming at BREEAM 'Excellent', in a new Leisure Centre. We quote a local councillor confirming that taking action on the climate emergency is a 'top priority', which will be a priority shared with users of the Centre. We can only expect to see these sustainability ambitions growing across both private and public sectors.

The latest sustainability boosting initiative from the BCSA is release of a new Model Specification for the purchase of reclaimed steel sections (see News). Steel has an almost unique capacity for being reused when a structure that it was originally used to create has reached the end of its useful life, and the new specification will help increase awareness of the benefits of using it.

Most, possibly all, of the original benefits including the sustainability-related ones, will still reside in the reclaimed steel. Whatever pace of progress towards achieving net-zero carbon is achieved, steel will be playing a sustainable role in driving these ambitions forward.

BCSA issues Model specification for the purchase of reclaimed steel sections

To help the growing demand and increase the awareness of the benefits of reusing structural steel, the British Constructional Steelwork Association (BCSA) has developed a new Model specification for the purchase of reclaimed steel sections.

This specification should be used in conjunction with Annex J – Sustainability Specification of the National Structural Steelwork Specification for Buildings (NSSS), BCSA Pub. No. 65/22.

The model specification applies to suppliers of steel products placed on the market as reclaimed structural steel sections for the fabrication of structural steelwork.

It applies to the contract between the stockholder (the supplier) and the steelwork contractor (the purchaser). The supplier should comply with the requirements of this specification, unless otherwise agreed with the purchaser.

Further information on technical issues is available from the SCI reuse protocol (SCI P427), which answers many questions for steel produced since 1970. Work is underway to extend this guidance to older steelwork.

"Although business models for the reclamation and reuse of structural steelwork are still evolving, the environmental and potential cost

benefits of steel reuse are compelling, and the market will define the most efficient models going forward. The supply chain will need to adapt to these new procurement models," said BCSA Sustainability Manager Michael Sansom.

Steel reuse is an important demand-side reduction measure under the circular economy strategy within the BCSA 2050 decarbonisation roadmap published last year.

A copy of the Model specification can be downloaded from *www.steelconstruction.info*

Steel beams installed for Coventry flyover

A total of 32 steel beams with a combined weight of 710t have been lifted into place to form the four main spans for the £61M A46 Binley Flyover in Coventry.

The steelwork consists of 16 braced pairs of girders that are up to 42m-long.

Working on behalf of main contractor Geoffrey Osborne, specialist teams, including steelwork contractor Severfield, carried out the work using a 750t-capacity crane.

The scheme is part of a congestion-busting upgrade to alleviate queues for motorists and improve local traffic flows. Once complete, drivers staying on the A46 will not need to slow down for a roundabout, instead they will use the new flyover.

The A46 is an important road link between the East and West Midlands, connecting Coventry and Warwickshire to the surrounding motorway network.

The overall scheme involves building a flyover to separate local and commuter traffic at the Binley Junction. It will help promote economic growth by unlocking one of the region's biggest bottlenecks. Work also includes improvements to the existing footways and cycle paths.

The project is due to complete later this year.

Steel extension uncorks more wine storage space

Farrans Construction is building a £10M warehouse for The Wine Society that will enable the company to increase its storage capacity from 7.6 million bottles to over 11 million.

Steelwork contractor Walter Watson is fabricating, supplying and erecting 525t of steel for the project. The tonnage includes Westok cellular beams that form the building's two 31.2m-wide clear internal spans.

Either side of a central row of columns, the cellular roof rafters have three splices; one 15.6m-long central section with two 7.8m-long pieces at both ends.

On completion, the 70m-long warehouse will use the latest temperature moderating technology to create a strictly controlled environment for the wine.

Farrans Construction Regional Director Cathal Montague said: "The development of a warehouse for a product as delicate as wine requires strict temperatures, structured flooring and a technologically controlled environment.

"Constructing this building to seamlessly link into the existing live warehouses requires careful planning and effective materials distribution. We are utilising our in-house expertise of laser scan point cloud technology to verify elements of the warehouse using BIM models."

Chancellor Rishi Sunak welcomed by BCSA steelwork contractor

Steelwork contractor Caunton Engineering welcomed the Chancellor of the Exchequer, Rishi Sunak MP, to its Moorgreen, Nottingham manufacturing facility.

Mr Sunak was given a tour of the company's fabrication works as well as Caunton's Apprentice Training Academy.

Showing an interest in how recruits are trained, he held an informal meeting with a team of eight apprentices, together with some that had previously graduated from Caunton's apprenticeship scheme.

Apprentices explained to Mr Sunak their career development to date and why they chose to join the steel construction industry. One of the apprentices even gave the Chancellor some practical training in fabricating steelwork.

During the day, Caunton also hosted a meeting between the Chancellor and local business leaders from the Ashfield (East Midlands) area. As the visit also coincided with the Spring Statement, Mr Sunak was also interviewed in the fabrication facility by the main media and TV outlets.

Irish food wholesaler shops for steel

Requiring 1,000t of structural steelwork, a new distribution centre is being erected for the Musgrave Group at Kilcock in County Kildare.

Measuring 120m-long × 100m-wide and 19.5m-high, the steel-framed structure consists of three equal spans formed with 686 × 254 × 125UB roof rafters.

Working on behalf of CField Construction, the steelwork is being fabricated, supplied and erected by Kiernan Structural Steel.

The completed warehouse will include dock levellers along two elevations, a two-storey office block, a two-storey goods-in office and a further single storey transport office.

Founded in 1876, Musgrave Group is said to be Ireland's largest grocery distributor with estimated annual sales of approximately £4bn.

Contractor named for landmark Bradford commercial scheme

Muse, in partnership with Bradford Council, has appointed Caddick Construction to deliver the landmark One City Park office scheme, which will continue the transformation of the heart of Bradford city centre.

The 5,240m² sustainable development on the former police HQ site is the first high-quality, modern office scheme to be delivered in Bradford city centre for more than 20 years. Muse said it will directly address the need for offices by offering exceptional workspace with adaptable floor plans to accommodate agile working practices.

The five-storey development – rated BREEAM 'Excellent' – will also feature new public realm areas around the scheme. The building will connect seamlessly to the multi award-winning City Park with new stepped access and attractive seating areas. It is also within walking distance to cultural assets including City Hall, St George's Hall and new music venue Bradford Live, which is due to open later this year.

More than 300 jobs will be created throughout the construction with a further 450 jobs based in the building once completed. Enabling works are already underway with construction due to start on site later this month, and the building due to complete by summer 2023.

NEWS IN BRIEF

Cooper & Turner (part of Watermill Holdings) has won a Queen's Award for Enterprise in the International Trade category. Originally founded in 1876, the company is one of the world's leading manufacturers and distributors of high-strength safety critical fasteners for the construction, wind, tunnelling, rail, oil & gas, OEM, power generation and nuclear power markets.

Developer **Capital & Centric** has been given the go-ahead by Bolton Council's planning committee to overhaul Farnworth market precinct to create a new neighbourhood with homes, shops, bars and green spaces. The project, led by the Manchester-based social impact developers, is backed by the Government's Future High Street Fund.

Gilbert-Ash has been appointed main contractor for the £22M project to develop a performing arts building at Brighton College. The scope of works includes the demolition of existing buildings and the construction of a 400-seat multifunctional theatre, dance and drama studio. The programme also includes classrooms and social space for informal gatherings.

Property developer and asset manager, **Sovereign Centros**, has submitted a planning application outlining its masterplan proposals for the reimagination of the St. Enoch Centre in Glasgow. The major proposals focus on the creation of a mixed-use development, focusing on retail, leisure, entertainment, hotel, offices and city centre living.

Plans have been submitted by **West Suffolk NHS Foundation Trust** for a new replacement hospital in Bury St Edmunds. Forming part of the Government's Hospital building programme, the new 100,000m² hospital is designed by Ryder Architecture. The project's buildings will consist of structures up to seven storeys high and it will be built on town's Hardwick Manor parkland.

PRESIDENT'S COLUMN

Large energy and construction material price increases, due to the recovery from COVID-19 and more recently with the problems in Ukraine, are still the main issues affecting our industry. To provide some perspective, the Flat Cost forward baseload price of electricity has moved from circa £65 / Mgwh in April 2021 to £216 / Mgwh in April 2022, with prices breaking the £340/ Mgwh barrier at the beginning of the war in Ukraine. And, we have now seen steel price rise announcements totalling circa £800/tonne since the beginning of 2021. I can remember the days when a MD of a steelwork contractor would have had to have a lie down if the price of steel had risen by £8/tonne without ample warning.

When the price of all construction materials, including steelwork, increases rapidly without notice, cost plans are blown to smithereens. There is either a mad panic to procure materials before the price rises take effect, leading to high demand and supply problems, or the reverse with clients and Principal Contractors leaving the market. Whichever way it goes, life becomes harder for Tier 2 steelwork contractors.

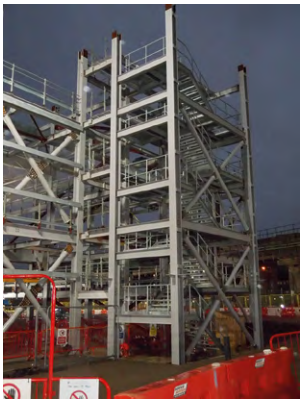
So, where is all this heading? Large steelwork contractors are now seeing a number of projects being put on hold, with the QS convinced that the project will be more feasible a year or two down the road. Historically, they are probably right to think this, as soon as the market tightens, steel and other construction material prices will drop rapidly and the QS may be proven correct.

However, I've looked at the price of steel from the BCIS and compared the increase over time with house prices from the ONS. Steel prices have gone up on average 6.08% per year over 51 years, whereas house prices have increased by 8.25% over the same period. Index benchmarking of historic housing prices suggests they are more than double the index price of steel in the year 2021. OK, you could argue that it isn't a fair comparison, house prices versus steel prices, after all "they've stopped making land" and that represents a large chunk of a house price. But, they have also stopped making iron ore and although structural steel at end of life is in the order of 99% recycled, there also isn't enough scrap to go around either.

There is no doubt that the price of construction materials needed to rise, the index price of steel in 2020 was lower than it was in 2008. The problem is the exponential rise over the last two years. Most people felt steel prices had to rise, more stable rises would have been preferred, but they still wouldn't have been welcomed in such a fiercely competitive market. Steel prices are now more sustainable for the long-term survival of the steelmaking industry here in the UK, but If clients turn off the tap of new orders, the steel construction industry will seriously retract. It's very much a case of it's a lot easier to turn the tap off and reduce production, than turning the tap back on and returning to full production. What we need is long-term thinking and a period of stability.

Mark Denham
BCSA President

Steelwork underway for major Sellafield works



Harry Peers Steelwork (part of the Severfield Group) is undertaking two major projects at the Sellafield reprocessing plant in Cumbria.

The company is fabricating, supplying and erecting over 1,200t of structural steelwork for the Sixep Continuity Plant (SCP) and 1,300t for the Sellafield Product and Residue Store Retreatment Plant (SRP).

The scope of works for Harry Peers also includes the installation of metal decking, shear studs, concrete floors, cladding, lightning protection and the application of intumescent coatings, both off and on-site.

The SCP is being built next to the existing Site Ion Exchange Effluent Plant (SIXEP), termed the kidneys of the site. The SCP facility will assist SIXEP in cleaning the site's liquid effluents.

The new SRP plant is located next to the existing Sellafield Product and Residue Store (SPRS) and will provide storage space for Sellafield's special nuclear material.

Harry Peers was acquired in October 2019 and forms part of the Severfield Nuclear and Infrastructure division.

Severfield's recently appointed Divisional Managing Director Jim Martindale said: "The Harry Peers business has a very strong presence and excellent reputation for supplying structural steelwork into some of the most demanding sectors across the construction industry, including nuclear and defence. The culture and structure of the business have evolved around nuclear safety requirements, which are essentially the extreme end of quality compliance.

"My plan is to take the business to the next level, I want to grow the business based on how I do business – straightforward, deal with any issues and strive to excel at everything we do."

Plans revealed for major British Library extension

Developers Stanhope and Mitsui Fudosan UK have unveiled plans for a major extension to the British Library site in London's St Pancras area.

Designed by architect Rogers Stirk Harbour + Partners (RSHP), the scheme will comprise more than 74,000m² of floor space. It will include new areas for the British Library, station works for the proposed Crossrail 2 and floors to be let as commercial space.

Work could start on site next year with a completion date set for 2029.

According to RSHP, the extension will include two 12-storey blocks, surrounding a large atrium that will be spanned by a number of linking footbridges.

The project will also open up public access to the British Library as it will include pedestrian thoroughfares.

British Library said the project will represent a major element of the larger St Pancras Knowledge Quarter. Spaces in the extension will be available to small local businesses, particularly those specialising in science and the creative industries.

SEGRO appoints contractor for Croydon logistics park

Glencar Construction has been awarded a contract to construct 14,399m² of Grade A industrial and distribution space in a range of units from 464m² to 7,900m² at SEGRO Park Croydon.

The site serves as a well-established strategic location for trade counter, light industrial and warehousing. Units are expected to complete and be ready for occupation in early 2023.

In keeping with the developer's sustainability commitments, the site is being developed to EPC Grade A specification, incorporating a variety of sustainability features including photovoltaic panels, intelligent low energy lighting and EV charging points.

Roy Jones Glencar Managing Director London and South said: "Glencar are absolutely delighted to have been appointed on this high-quality logistics scheme in one of the most connected urban centres in the South East.

This instruction serves to reinforce Glencar's continued expansion across London and the South and within the fast-expanding logistics sector."

Landmark car park planned for Sunderland Riverside scheme

A planning application for the development of an eye-catching 650-space multi-storey car park in Sunderland city centre has been submitted.

The multi-storey facility – which will be illuminated with colourful lights and a living wall - will be located on Farringdon Row and will be the latest addition to Riverside Sunderland, a new urban quarter overlooking the River Wear.

It follows the approval of plans for two new offices – providing some 18,500m² of commercial space – by institutional investor Legal & General. The application is likely to go before Sunderland's planning committee in April and, if approved, work is expected to start in the summer months.

The multi-storey car park (MSCP), which will stand in a prominent position on the edge of the Riverside Sunderland development, will cater for the increased number of people who will live, work and play in the city, as regeneration advances at pace.

Councillor Graeme Miller, Leader of Sunderland City Council, said: "Sunderland's skyline has been transformed over the past 12 months with the opening of The Beam and work continuing apace on City Hall and – as work on two new office buildings and the Holiday Inn moves forward – it's becoming clear for all to see just how much of a transformational impact this development is having on the city.

Wind farm factory planned for Teesside

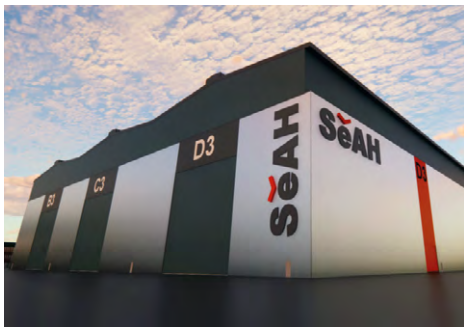
South Korean pipe manufacturer SeAH Wind has revealed plans for a 40m-tall wind farm factory, which will be located on a 90-acre site in the Teesside Freeport.

On completion, it will have a 105,000m² footprint, making it one of the largest facilities of its type in the world.

The factory will service the offshore wind sector, producing monopiles that form the foundations of offshore wind turbine construction. It will create 750 direct jobs and 1,500 more in the supply chain and during construction. Work begins in July and the plant is expected to be fully operational by 2026.

Tees Valley Mayor Ben Houchen said: "2022 is our year of construction and we are rebuilding a new skyline for Teesside – one that looks to the future and is creating hundreds of well-paid jobs in the cleaner, healthier and safer industries of tomorrow.

"It's fantastic to see that both SeAH Wind and its construction consultants, K2 Consultancy, are committed to employing local workers and using the region's talent and suppliers to deliver the facility."



Contractor appointed for sustainable school

Willmott Dixon has been appointed by Newport City Council to deliver significant improvements to Bassaleg Comprehensive School that will create over 300 extra school places.

Procured using the SEWSCAP3 framework by the council's property partner Newport Norse, the project will see the creation of a three-storey teaching block, which contains dining and assembly areas, as well as 3G sports facilities, playing fields and associated external works.

The contractor said sustainability will play a key role in the development, with the teaching building incorporating a wide range of energy efficient methodologies, including an enhanced building envelope to maximise airtightness, alongside triple glazed windows. The roof will also feature an array of photovoltaic (PV) solar panels, harnessing renewable energy.

Bassaleg Comprehensive School is the latest scheme to be delivered with matched funding from the Welsh Government through its Sustainable Communities for Learning Programme.

According to Willmott Dixon this project marks the latest milestone in the company's sustainable schools building programme, underpinned by its sector-leading sustainability strategy, Now or Never, where the company has committed to ensuring all new building projects and major refurbishments will achieve net-zero operational carbon by 2030.

Diary

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

Mon 16, Wed 18, Tue 24, Wed 25, Thu 26 May
Steel Building Design to EC3
Online
An overview of the Eurocode provisions for steel building design. The course focuses on orthodox construction, covering the primary design issues for practicing engineers. The course follows the process of determining actions, considering combinations of actions, frame analysis and the assessment of second order effects. The course will then demonstrate how the resistance of members are calculated, but also how they can be extracted immediately from resources such as the 'Blue Book'.

Tuesday 17 May 2022
Fire Resistance of Light Steel Framing
Webinar, SCI/BCSA members only
The webinar will cover the fatigue phenomenon and the assessment of fatigue life. Fatigue loading and Miner's summation of fatigue damage and how it is dealt with by EN 1993-1-9 will be addressed.

Wed 8 , Thu 9 June 2022
Steel Frame Stability
Online
Online course covering frame stability and second order effects.

This course will demonstrate that second order effects are always present, and how they are managed in design. Starting with members and then moving on to entire frames, the course will review the behaviour being assessed, and how this is covered in the design standards. The design of braced frames and portal frames will form the core of the course.

Steel is the sustainable choice

ArcelorMittal says that for many years steel has been the world's most prolific construction material and its excellent sustainability credentials and recyclability has made it the material of choice in many sectors.

There is little doubt that the current climate emergency is impacting on all sectors and that success in achieving the Paris Agreement targets will be hard won.

The decarbonisation of steel's manufacturing processes will contribute greatly to a zero-carbon world and, with 50% of steel production being used in buildings and infrastructure, steel construction has a major part to play.

Decarbonisation is the most important aspect of ArcelorMittal's long-term strategy. We are committing to reduce European CO_2 emissions by 35% by 2030 and be carbon neutral by 2050.

ArcelorMittal has been working hard to be at the forefront of the technical transformations needed to decarbonise the steel used in construction and has initiated many decarbonisation projects that will ensure achieving Paris Agreement targets in 2050 and also offer designers and steelwork subcontractors low embodied carbon solutions.

Smarter steels for people and planet

ArcelorMittal published its latest Climate Action Report (CAR2) in July 2021. This report crystallises much of ArcelorMittal's efforts towards the technical transformations needed to decarbonise an asset base that includes 47 blast furnaces (BF), 32 electric arc furnaces (EAF) and 12 direct reduced iron (DRI) facilities. In-depth knowledge and understanding of multi-method steel manufacturing, together with years of successful operation, places ArcelorMittal in a unique position to assess and implement the technological transformation needed to decarbonise steelmaking.

Scan to know more

The report discloses a net-zero roadmap that shows our journey to carbon-neutrality which features five levers that act as stepping stones to achieving carbon-neutrality by 2050. These are:

(1) Steelmaking transformation,
(2) Energy transformation,
(3) Increased use of scrap,
(4) Sourcing of clean electricity and
(5) Offsetting residual emissions.

Pioneering breakthrough carbon-neutral technology routes

If 2030 and 2050 targets are to be achieved, decarbonisation needs to have started already.

At ArcelorMittal's Ghent site in Belgium, work has started with the deployment of Carbalyst and Torero technologies which are due to

ArcelorMittal's Sestao plant in Spain aims to be the world's first full-scale zero carbon emissions steel plant.

Achieving low carbon targets in construction

The low carbon intensity achievable with XCarb® recycled and renewably produced is shown in the table below against LETI targets. It is shown that the low carbon intensities achieved using XCarb® allow 2030 targets to be met today.

	Steelwork intensity *	Target carbon intensity for steel frame **	Carbon intensity using XCarb® ***
Steel-framed low rise building	55	100	18
Steel-framed high rise building	90	100	30
Complex steel frame	110	100	37
Large span single storey, low eaves **	35	-	12
Large span single storey, high eaves **	45	-	15

* based on BCIS Steelwork Indices 3/S2 for Building Works, kg/m².
** LETI target, based on 2030 targets, 48% of 350kgCO_2e/m² = 168kgCO_2e/m² for superstructure less an allowance for the floor, say 68kgCO_2e/m². LETI gives no target values for single span buildings.
*** kgCO_2e/m² based on XCarb® recycled and renewably produced EPD (A1-A3) 333kgCO_2e/t.


Bridge solutions with Histar and Arcorox®

be commissioned later this year. Carbalyst encompasses a family of technologies involving gas-fermentation to convert waste gases into advanced bioethanol for use in transport and to make plastics. The Torero process enables waste wood and end-of-life plastics to be converted into biofuels that can replace fossil fuels in the steelmaking process. Together these processes are expected to reduce annual emissions by 900kt CO_2e per year as part of the larger 3.9Mt reduction planned for Belgium by 2030.

In Hamburg, ArcelorMittal is developing a new innovation project aimed at the first industrial-scale production and use of Direct Reduced Iron (DRI) made with 100% hydrogen as the reductant. With an annual production of 100,000 tonnes of steel, this project is due to start production by 2025.

However, the most ambitious project for ArcelorMittal is perhaps at its Sestao plant in Spain, which aims to become the world's first full-scale zero carbon-emissions steel plant. By 2025, the Sestao plant, which manufactures a range of flat steel products for the automotive, construction and general industry sectors, will produce 1.6 million tonnes of zero carbon-emission steel. This will be achieved by increasing the use of scrap and using green hydrogen-produced DRI, powering all steelmaking assets with renewable electricity and introducing several key emerging technologies to replace the remaining use of fossil fuel with carbon-neutral energy inputs, such as sustainable biomass or green hydrogen.

Towards carbon neutral steel with XCarb®

ArcelorMittal's decarbonisation strategy has led to the development of XCarb®, which brings together all our current reduced, low and zero-carbon products and steelmaking activities.

Firstly, an XCarb® innovation fund to which ArcelorMittal commits $100m per year to the development of technologies that lead to the acceleration of decarbonising steelmaking.

Secondly, XCarb® green steel certificates are aimed at products currently made via the blast furnace route. The decarbonisation investments we have underway are resulting in significant CO_2 savings. We can now pass these savings onto our customers in the form of a certificate, which has been verified by an independent auditor. In 2021, 100kt of XCarb® green steel certificated products were available, and this figure is expected to be extended to 600kt in 2022.

Scan to know more

Finally, there is XCarb® recycled and renewably produced, which uses scrap and 100% renewable energy in an electric arc furnace, giving our finished steel products an extremely low CO_2 footprint.

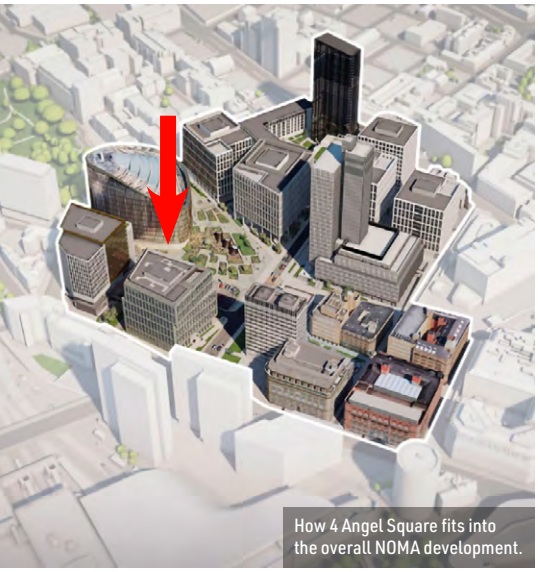
For this strand of XCarb® environmental product declarations (EPDs) are published which credit rolled sections with an "up-front" A1-A3 embodied carbon value of 333kgCO_2e/t. Also, synergies in smart design can combine XCarb® recycled and renewably produced sections with Histar460 for very low embodied carbon columns and trusses, and Arcorox® weathering steel for lower embodied carbon solutions in infrastructure projects. ■

Carbon neutral means Excellence

Sustainability is at the heart of the NOMA mixed-use scheme in Manchester as the latest steel-framed office development is aiming for a BREEAM 'Excellent' rating.

Located in the north of Manchester city centre, NOMA is a multi-million-pound mixed-use development and one of the largest in North West England.

Situated close to Manchester Victoria station, the eight-hectare scheme is revitalising the area with the creation of more than 400,000m² of office, residential, retail, leisure and hotel space.



How 4 Angel Square fits into the overall NOMA development.

Steel construction has played a major role in the overall scheme as a number of NOMA's buildings are steel-framed structures, such as the latest development, 4 Angel Square. This is an 11-storey office block, offering more than 22,000m² of Grade A office space and aiming to achieve a BREEAM 'Excellent' rating.

Interestingly, the project sits directly opposite the steel-framed One Angel Square, which completed in 2012 and was the first office building to achieve a BREEAM 'Outstanding' accreditation (see *NSC* March 2013).

Accommodating the Co-op headquarters, the building was heralded as a sustainable landmark as it also achieved an A+Energy Performance Certificate and a Display Energy Certificate A for operational standards.

Continuing NOMA's high sustainability credentials, developer MEPC says 4 Angel Square will be a carbon-neutral office block with an EPC A rating and space to house around 2,000 workers.

MEPC Head of Development Paul Pavia says: "With widespread public and business support for a true 'green recovery' after the pandemic is over, we expect occupier and investor demand for quality, sustainable workspace to grow further, which is why we have committed to making 4 Angel Square operationally net zero-carbon and raising the standard for sustainable office development.

"The building will help drive Manchester's recovery and support the city's long-term growth by creating high quality employment space designed to appeal to major occupiers and support thousands of jobs."

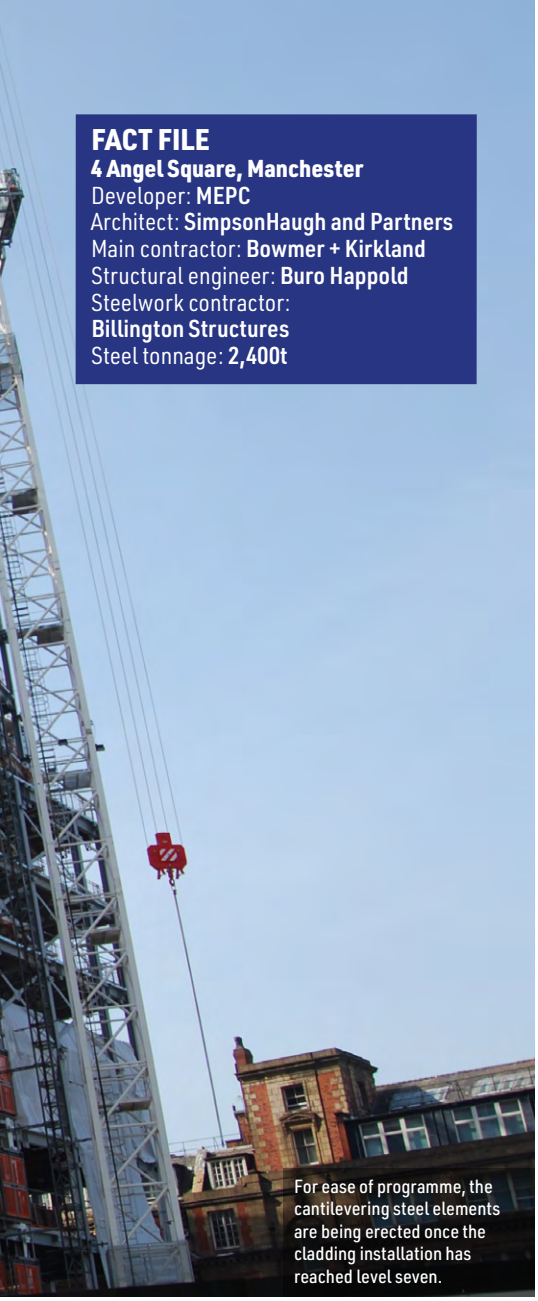
Designed by SimpsonHaugh architects, the steel-framed structure is set around a centrally-positioned concrete core that helps maximise the extent of clear span floor space, while also allowing greater penetration of sunlight.

The steelwork is based around a regular 8m perimeter column spacing, with internal spans of up 18m-long. Most of the beams are fabricated plate girders with bespoke web openings for the building's services. The beams support metal decking and a concrete topping to form a composite flooring solution.

Adding some architectural drama and creating a stand-out landmark building, 4 Angel Square is not a regular straightforward structure. Instead, it is split into two blocks, with the upper four floorplates shifting around a central pivot point.

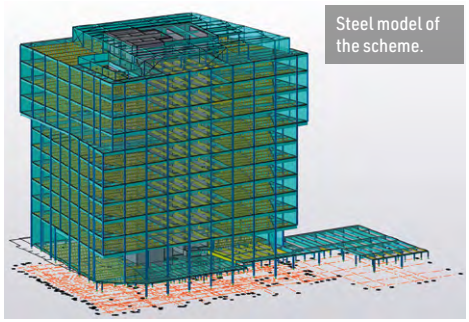
Looking up at the building, the structure gives the impression of a square box where the upper

FACT FILE
4 Angel Square, Manchester
Developer: **MEPC**
Architect: **SimpsonHaugh and Partners**
Main contractor: **Bowmer + Kirkland**
Structural engineer: **Buro Happold**
Steelwork contractor: **Billington Structures**
Steel tonnage: **2,400t**

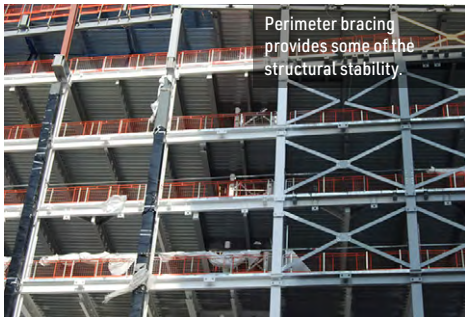


For ease of programme, the cantilevering steel elements are being erected once the cladding installation has reached level seven.

Visualisation showing one of the building's cantilevering corners.



Steel model of the scheme.



Perimeter bracing provides some of the structural stability.

Most of the project's structural steelwork has been erected by the site's tower crane.

portion has been slightly unscrewed.

The upper block is said to respond to city views towards Victoria Station and the structure's 'twist' forms a couple of 3.5m-wide corner cantilevers at seventh floor. Correspondingly, the opposite corners of the building have two corner recesses on the same floor, creating terraces.

The first bays of steel on the elevations adjacent to the corner cantilevers form full-height Vierendeel girders that control deflection of the cantilevered zone and allow installation of the cladding system. However, due to the desired construction sequence, the cantilevering overhang steelwork was not erected at the same time as the rest of the seventh-floor steel.

The design requires all of the concrete cladding panels to be fixed to the columns up to level seven, before this steelwork is installed. This will require steelwork contractor Billington Structures to commence these high-level areas at the end of its programme.

Meanwhile, to form the recesses a series of transfer beams at level seven have been installed to support the columns above, which do not match the grid of the lower floors.

Further down the building, the steel frame begins at basement level, which extends beyond the footprint of the structure to form a subterranean car park.

The ground floor is a double-height space, accommodating the main entrance foyer, two retail units and a separate ground floor office suite aimed at start-ups or other small businesses.

A double-height pedestrianised colonnade, aligned with a forthcoming public route will connect 4 Angel Square with the existing NOMA estate.

The building will be environmentally conditioned with heat pumps. The LED lighting, too, is extremely efficient while the roof has been used to house banks of photovoltaic panels. All systems are electric – no fossil fuels are involved.

The roof steelwork steps back from the main structure in order to accommodate a BMU, and to form this area a further series of transfer beams are installed at level 11.

Bowmer + Kirkland North West Regional Commercial Director, Paul Sykes, says: "4 Angel Square will be a landmark office development, setting new benchmarks for sustainability and creating new high-quality workspace that will support Manchester's recovery."

Summing up, Sir Richard Leese, Leader of Manchester City Council, says: "NOMA is playing a crucial role in revitalising a key part of Manchester city centre and will create jobs and drive investment into the city. Cities will need to move quickly to mitigate the economic impact of COVID-19 and major projects such as this help drive vital growth and signal a city that remains attractive for development."

4 Angel Square is scheduled for completion by early 2023. ■

Construction work has been undertaken around a 'live' railway environment, as the station is on the busy Reading to Basingstoke line.

Steelwork arrives at new station

Safety concerns and technical challenges have been overcome with the use of prefabricated steel elements for the main building and footbridge at the new Green Park station in Reading.

Sustainable transport in Reading is getting an important boost as a new railway station will open at the end of the year, providing a new link to the south of the Berkshire town.

Green Park will be a new station at the northern end of the existing Reading to Basingstoke line. Travellers will be able to reach Reading's main station in just six minutes and Basingstoke in 20 minutes, with both destinations offering connections to London and beyond.

Reading Borough Council says the station will help to alleviate queues on the already busy A33 by offering an alternative sustainable mode of travel. This will be a boon to both residents and workers alike, as the station sits within the fast-growing Green Park Village residential scheme, which has plans for more than 1,000 new homes, and adjacent to Green Park Business Park.

Reading FC are currently not having the best season, but their supporters and those of visiting teams will be cheered by the fact that this new transport development will also serve the nearby Madejski Stadium.

Tony Page, Reading Borough Council Lead for Strategic Environment, Planning and Transport says: "When operational, Green Park will form an integral part of Reading's ever-growing sustainable transport infrastructure, serving the homes, businesses and leisure developments planned in the south of the borough.

Steel construction has taken the driving seat in the design of the station. Connecting the two 150m-long platforms is a 15m-long steel footbridge, while other steel structures include the east platform's main building/ticket office and an attached canopy, and a further shelter canopy structure on the west platform.

Complementing these facilities, the station will also be part of a multi-modal interchange with surface level car parking, bus stops, a taxi rank and cycle parking.

Using steelwork has provided the project with a number of benefits, such as speed of construction, as well as the fact that steel elements can be brought to site as prefabricated units that can be lifted into place with less onsite work required. This has been important, as Green Park is on a 'live' railway line and any lifting work undertaken had to be liaised with Network Rail to avoid any possible disruption to rail services.

Main contractor Balfour Beatty were also required to liaise closely with Network rail during their preliminary works, in order to find safe positions for their piling rig. Some of the piles, supporting the precast platforms, which were completed prior to the steelwork erection, are up to 30m-deep and were safely installed within metres of the 'live' railway line.

Bourne Rail & Special Projects Divisional Director Craig Galway says: "The new station at Green Park is a very exciting project and we had to overcome the challenges of working next to a 'live' track in terms of safety systems and short notice changes to shift patterns. By undertaking assembly, cladding and glazing offsite, we de-risked the installation of the main footbridge span."

Overall, the footbridge was brought to site in a number of fully assembled and prefabricated elements, which were lifted into place during four separate overnight rail possessions.

As well as the main span, this consisted of two sets of stairs, two support towers, two lift shafts and two lobby areas (that connect the lifts to the main overbridge), which were all lifted into place using a 200t-capacity mobile crane.

Each of the prefabricated elements are substantial, as the main span, which is an enclosed, glazed steel-framed box, measures 15.2m-long × 2.9m-wide × 3.4m-high and weighed 18t. Each of the prefabricated 10m-high lift shafts weighed 9.6t, the lobbies weighed 5.3t and the stairs 10.5t.

"Locations where we could position the crane were limited, while overhead high-tension wires on the western side of the tracks created another challenge as they had to be avoided during our

FACT FILE
Green Park station, Reading
Main client: **Reading Borough Council**
Main contractor: **Balfour Beatty**
Structural engineer: **Arup**
Steelwork contractor: **Bourne Rail & Special Projects (part of Bourne Group)**
Steel tonnage: **215t**

Close coordination between all stakeholders ensured the safe erection and installation of the station structures.

lifts," explains Bourne Rail & Special Projects' Adam Barlow.

"Steelwork could only be delivered to the eastern side of the station and because there were underground cables in this area, we had to install crane mats to safely straddle these services for all of our lifting operations."

Other parts of the steelwork package also had to be erected during rail possessions. This consisted of the cantilevering beams and channels forming the canopy edges, on both platforms, as they were deemed to be too close to the 'live' railway to be erected during normal working hours.

The main station building/ticket office is a steel braced box measuring 8.4m-long × 2.9m-wide and 6.1m-high. The design specified universal beams and columns, while the canopy structures are typically constructed with tubular RHS sections.

The building has a canopy over the platform along its entire length, while another canopy, attached to and wrapping around the base of the overbridge stairs, is positioned next to it.

The western platform also has a canopy structure, supported on steel columns, measuring 39m-long × 6m-wide, it extends southwards from the overbridge stairs.

Summing up, GWR Business Development Director Tom Pierpoint says: "It's exciting to see Reading Green Park station starting to take real shape. We are working closely with the Council and Network Rail to deliver a project which will provide even better connectivity for customers.

"Reading is a key destination on our network and this new station will help to secure the economic prosperity of the region as we seek to build back better from the pandemic."

The complete footbridge was erected during four overnight rail possessions.

Westok cellular beams have created the required column-free space for the sports hall.

Leisure boost

Structural steelwork is providing all of the answers for the construction of a state-of-the-art BREEAM 'Excellent' replacement leisure centre in Reading.

Leisure facilities in Reading will soon get a major boost when the borough's new Rivermead Leisure Centre opens next year.

The new steel-framed centre is being delivered by Pellikaan Construction, a company that specialises in sport and leisure facilities. Its design and build ethos for such projects usually involves steel-framed structures, in order to achieve the long column-free spans leisure and sports clubs require.

Pellikaan Construction started work onsite in August 2021, but this is not the first time the company has worked on this plot, as it also built the existing and adjacent Rivermead Leisure Centre more than 30 years ago.

The current leisure centre is said to have reached its end-of-life and the new replacement facility will include a range of amenities including a 25m-long eight-lane competition pool with a moveable floor; a 5m-deep diving pool with a moveable floor; a six-court sports hall; a 120-station gym with three studios, and an entrance foyer with a café, information hub and soft play area.

The existing leisure centre will remain open until the new centre is complete to ensure no gap in people's leisure service. Consequently, the construction programme involves two phases, with the construction of the new leisure centre and the external public spaces completed before the demolition of the existing facility in Phase 2, which will make way for the remaining external areas, new sections of car park and a new play area.

Commenting on scheme, Cllr Graeme Hoskin, Reading Borough Council's Lead Councillor for Sport, says: "Despite the unprecedented challenges of the past two years, the Council and our leisure partners, GLL, remain fully committed to delivering the modern new leisure facilities a town of our size and status deserves.

"As a Council, taking action on the climate emergency is a top priority for us. The new centre will be constructed to achieve a BREEAM 'Excellent' environmental standard and adopt renewables wherever we can. Measures to reduce carbon emissions and improve environmental efficiency will hopefully make Reading's leisure facilities as environmentally-friendly as possible."

Overall, the new leisure centre is an L-shaped steel-framed structure, stabilised by cross bracings strategically positioned in walls and around the stair and lift cores.

The two ends of the L-shape are occupied by large double-height spaces, accommodating the sports hall, and the swimming pool and diving pool.

A series of 27m-long Westok cellular rafters form the column-free sports hall and the main pool hall roofs. The adjacent diving pool zone is slightly smaller because of the building's configuration and it is consequently spanned with a series of 22m-long cellular beams.

"To make them transportable, all of the cellular beams were brought to site in two pieces. The bolted connection was then made during the erection process," explains Adstone Construction Structural Engineer Elliott Laidlaw.

"As well as being shorter, the diving pool rafters needed to form a higher ceiling so these beams are slightly shallower at 542mm-deep, compared to 831mm-deep in the main pool area."

As well as erecting the steelwork, Adstone has also been responsible for the installation of the precast lift shafts and precast stairs.

In the middle of the structure there is another, albeit smaller, double-height zone occupied by the main entrance and foyer. This part of the leisure centre is sign-posted from the outside by a canopy, supported by a series of 9.5m-high × 193mm-diameter Circular Hollow Section (CHS) columns.

The circular columns are not just a feature element of the project, they have also been used to accommodate and hide drainage pipes that carry run-off from the roof.

FACT FILE
Rivermead Leisure Centre, Reading
Main client: **Reading Borough Council, GLL**
Architect: **Saunders Boston**
Main contractor: **Pellikaan Construction**
Structural engineer: **Furness Partnership**
Steelwork contractor: **Adstone Construction**
Steel tonnage: **300t**

"The new centre will be constructed to BREEAM 'Excellent' environmental standard and with renewables wherever possible. Measures to reduce carbon emissions and improve environmental efficiency will hopefully make Reading's leisure facilities as environmentally-friendly as possible."

Surrounding the entrance area is a two-storey zone that accommodates the fitness suite, studios, changing rooms and access to spectator seating that overlooks the main pool. The first floor is formed with a composite solution with steel beams supporting metal decking and a concrete topping.

Prior to the steelwork erection commencing, Pellikaan had completed the ground floor slab, installed CFA piles to support the steel frame and excavated the pools.

"Installing the slab early has helped the steel erection as it provided Adstone with a flat and clean surface for its MEWPs," explains Pellikaan Construction Project Manager Sam Hulme.

To allow for the safe excavation of the pools, a contiguous piled wall was installed. However, due to the site having a high-water table, as the River Thames is less than 100m away, a dewatering operation had to be undertaken during the pool construction works.

The steel erection has been undertaken with the use of mobile cranes and a sequenced programme, whereby the sports hall was initially built, with the rest of the frame following on sequentially. The pool areas will be the final steel elements to be installed.

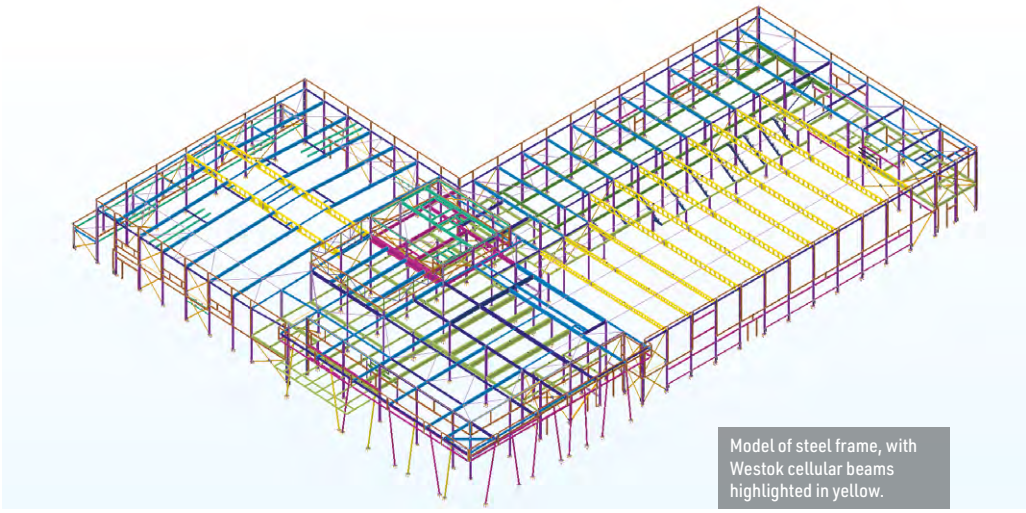
Raking beams, supporting precast terrace units, descend from the upper floor to the north of the main pool to form spectator seating. These needed to be lowered into place, which in turn required the installation of the first-floor metal decking to provide lateral stability. Once this two-storey part of the structure was installed, the long-span roof rafters were erected over the pools.

Alongside the development of new Rivermead Leisure Centre facilities, there will be a drive to improve health and wellbeing across Reading, aiming for a 40% increase in participation levels, with targeted activities to help reduce health inequalities, including discounts for young, older, and disabled people; weight management courses, cardiac and cancer rehabilitation, fall prevention interventions and dementia-friendly training for staff.

Summing up, GLL's Partnership Manager for Reading Craig Woodward, says: "The benefits that the new Rivermead Leisure Centre and pool will offer the local community are huge. The pandemic has highlighted the importance of keeping physically active and maintaining a healthy weight; offering a modern, welcoming, state-of-the-art environment will undoubtedly encourage greater participation. It will also enable us to provide a wide range of dedicated courses and activities, giving residents of all ages and fitness levels far greater choice."

Rivermead Leisure Centre is due to open in mid-2023. ■

Visualisation of the completed leisure centre.



Model of steel frame, with Westok cellular beams highlighted in yellow.

Feature CHS columns support a canopy above the centre's main entrance.

Steel on call for ambulance centre

The new ambulance centre will improve emergency services for the region.

A steel-framed solution is being utilised for the South East Coast Ambulance Service NHS Foundation Trust's new multi-purpose ambulance, 999 and NHS 111 centre in Gillingham.

A steel-framed solution was chosen for its speed of construction.

Bringing together and integrating many of its services under one roof, a new ambulance centre in Gillingham will allow the South East Coast Ambulance Service (SECAmb) to offer a more efficient service.

The four-storey steel-framed building will accommodate SECAmb's Make Ready vehicle preparation and maintenance system on the two lower floors, while staff currently based at the Trust's East 999 Emergency Operations Centre (EOC) in Coxheath and Trust NHS 111 staff, currently based in Ashford, Kent, will benefit from modern open-plan offices on the two floors above.

SECAmb Executive Director of Operations Emma Williams says: "It's really great that building work is now under way on this important development. Our current building at Coxheath is outdated and not adequate for our requirements. Having operations centres for 999 and 111 under one roof will ensure we further optimise functions between the services.

"The new centre provides us with greater capacity, means we can improve the ratio of 999 call taking across our two EOCs and will bring local

FACT FILE
Ambulance centre, Gillingham
Main client: **South East Coast Ambulance Service NHS Foundation Trust**
Architect: **Ubique Architects**
Main contractor: **Westridge Construction**
Structural engineer: **Stephen Wilson Partnership**
Steelwork contractor: **Mifflin Construction**
Steel tonnage: **300t**

"Within the steel design, we were also able to conceal bracing within the wall that separates the garage from the offices as well as around the first-floor mezzanine."

Much of the ground floor is a double-height space for the facility's vehicle maintenance garage.

Visualisation of the completed centre.

recruitment opportunities for people across both 999 and 111 services."

The site for the new centre is a brownfield plot previously occupied by a builder's merchant. Main contractor Westridge Construction started onsite last year and began by demolishing the existing buildings. This was followed by an extensive groundworks programme, which included building a 2m-high retaining wall, levelling the previously sloping site and creating a raised plateau that accommodates the centre and sufficient drainage beneath. Beyond the main building, the rest of the site then steps down to the main car parking area, which has electric charging points.

The installation of pad foundations then allowed steelwork contractor Mifflin Construction to begin its steel erection programme, which was completed earlier this year.

"A steel-framed solution was primarily chosen for the centre because of the speed of construction it provides," says Westridge Construction Kent Area Manager Roger Russell.

"The quick programme was also aided by the decision to use precast planks for the flooring, as these were installed by Mifflin as the steel frame went up."

As the centre will be a multi-use facility, the lower two floors slightly differ from the upper levels. One half of the ground floor will accommodate SECAmb's Make Ready vehicle maintenance garage and storage facilities within a double-height garage space. To allow for vehicle movements this area has longer spans, up to 12m long, and fewer internal columns, created by transfer beams installed at second floor level. Creating some important extra floor space, the vehicle maintenance area also incorporates a first-floor plant mezzanine. The ease with which a steel frame can create a double-height space is said to be another reason a steel solution has worked for this project.

The Make Ready concept focusses on the turnaround and maintenance of ambulances, so that crews are able to hand over a vehicle that is fully serviced and ready for each shift. With 36 dedicated ambulance parking bays around the building this will allow the Make Ready Team to service and keep the vital ambulance fleet running to enable the teams to respond to important calls.

Ambulances are regularly deep-cleaned and swabbed for the presence of micro-organisms including MRSA and CDiff. Each vehicle is fully stocked to a standardised specification with equipment checked and serviced regularly.

Opposite the garage space, the other side of the lower two floors of the building is arranged around a regular 8m × 8m column grid and will accommodate a ground floor IT server room, the main entrance, offices, and an ambulance staff rest room. The first floor houses modern training rooms including a state-of-the-art simulation room to allow situational training with locker and shower facilities for all staff.

This regular column layout is repeated above, as the second floor houses the 738m² open-plan EOC call centre and ancillary offices and the 738m² open-plan '111' telephone service on the uppermost third floor, along with additional training and meeting rooms. These two departments, housed in open-plan office floors, can be considered similar to call centres, although the importance of their work is significant.

▸20

The garage incorporates a first-floor plant deck mezzanine level.

▸19

Stability for the centre's steel frame is provided by cross bracing, which is predominantly positioned around the stair and lift cores, as well as within the building's two gable ends.

"Within the steel design, we were also able to conceal bracing within the wall that separates the garage from the offices as well as around the first-floor mezzanine," explains Stephen Wilson Partnership Structural Engineer Samwel Waweru.

Topping the building, the steelwork forms a pitched roof, while along one side of the structure, further steelwork is to be erected to form a mono-pitch structure that will house a vehicle wash, as well as acting as a secure shelter for the onsite back-up generators.

SECAmb Associate Director of Contact Centres and Integrated Care, John J O'Sullivan says: "Our current Emergency Operations Centre for the East of our region is outdated, lacks space and is no longer fit for purpose. In addition, bringing our 999 and 111 operations under one roof provides us with greater resilience and enables the two services to work more closely together to benefit patients across our whole region.

"This latest stage in the roll-out of our Make Ready system is an important step in the development of the service we are able to provide our patients locally. The system is more efficient and also means ambulance crews have access to improved modern facilities for training." ■

Precast floors

While conventional in-situ composite slabs and beams are often the default solution, the Gillingham ambulance centre is a reminder that precast floors can be a suitable alternative. David Brown of the SCI offers some reminders of the key design considerations.

Precast floor planks have a number of advantages that should not be dismissed lightly. When erection of the planks is integrated with erection of the structural steelwork, the floor construction is quick and provides an immediate working platform. As demonstrated by the 8 m × 8 m grid at the Gillingham ambulance centre, spans can be considerable, meaning fewer steel beams to erect. If exposed, the flat soffits of precast planks may be advantageous.

The supporting steel beams are restrained in the final condition, but with careful detailing, studs and in-situ infill may be designed as composite beams with the advantages of reduced section depth and increased stiffness. More details and comprehensive advice is given in SCI publication P401.

The most discussed issue with precast plank floors concerns the temporary condition during erection – in particular the twisting of the supporting beam if it is subject to out of balance loading. This can occur when planks are placed on one side only of a beam, or from unequal spans, or when planks on one side of a beam span parallel to the beam. For practical reasons on site it may not be possible to follow a preferred method of loading each side of the beam in an alternating sequence. The designer should consider a realistic erection sequence (and declare this in the design basis method of erection – see BS EN 1090-2 clause 9.3.1). Beams with out of balance loading will need to be verified for combined bending and torsion – advice is given in P401. End connections should be detailed to resist the resulting torsion.

The second common question relates to restraint from the precast plank in the temporary condition. It is assumed that precast planks provide restraint by a combination of friction and (for equal spans on each side) a restoring moment, such that spans up to 8 m (coincidentally the span at the ambulance centre) may be assumed to be restrained in the temporary condition.

Overall construction depth may be reduced by locating the planks on shelf angles, bolted or welded to the beam webs, or by using "slim floor" beams comprising a UC section and plate welded to the bottom flange. If using shelf angles, careful detailing is required to ensure that the planks can be placed without obstruction from the top flange.

In an end bay, the beam is loaded from one span only and thus may be a smaller section. From bitter experience, eccentricity on a small beam should be avoided. ■

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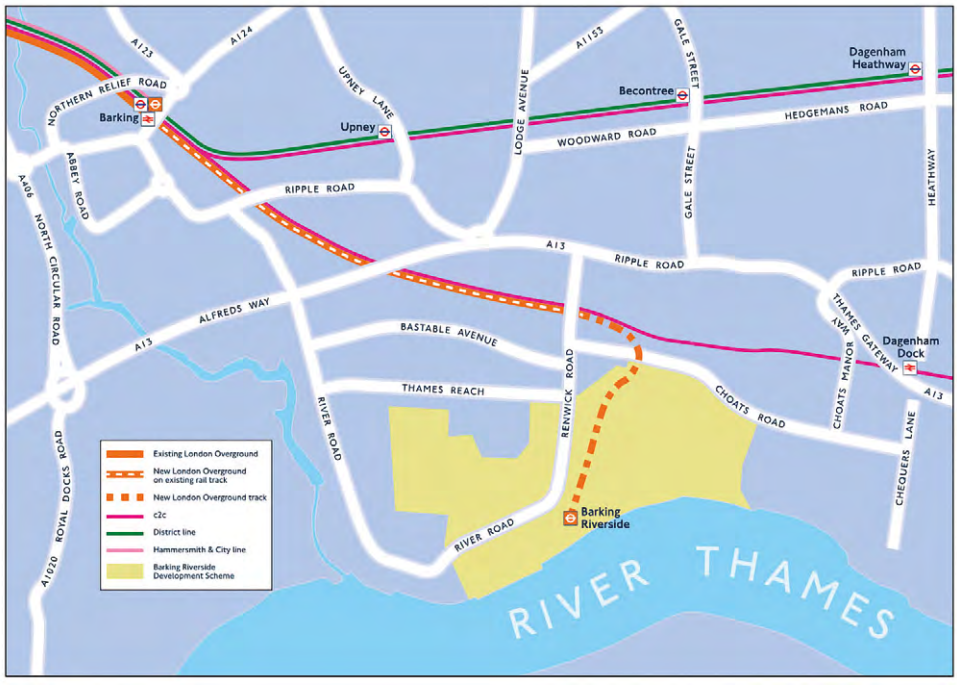
BCSA

STEEL for life

Railway extension on time with steel

The longest spans of the 1.5km-long Barking Riverside Viaduct, which is a vital component of a new railway extension, have been formed with structural steelwork. Martin Cooper reports.

Some piers within the cargo depot have openings to allow for easier vehicle movements.



Located on the site of a former coal-fired power station, Barking Riverside is said to be east London's largest housing-led mixed-use development, with planning permission for up to 10,800 new homes, along with numerous healthcare, shopping, community and leisure facilities.

The former brownfield area is not best served by public transport and in order for the new development to realise its full potential a dedicated railway extension and station are being built.

The extension will add 4.5km to the London Overground network, extending the Gospel Oak line from Barking to a new elevated Barking Riverside terminus, which will be situated in the main square of the development.

Better public transport links go hand-in-hand with the development's sustainability goals. The new railway, along with planned river transport, will mean there will be less reliance on resident's having to drive. Other green credentials at Barking Riverside include over 41% of the site being dedicated to open space, including a new ecology

"Steelwork was chosen for the northern end of the viaduct as it was the only material that could efficiently create the longer spans, up to 42m-long, needed to pass over rail, road and river obstacles."

With an overall length of 400m, steelwork forms a total of nine spans.

park with all green areas linked by parkland, cycle routes and footpaths.

A key element of the extension is a 1.5km-long viaduct that carries the final part of the new twin-railway line over a number of infrastructure assets, such as the existing London to Tilbury rail lines, a DB Cargo freight yard, High Speed One tunnels, roads and a waterway.

Being able to span these obstacles is the main reason why this part of the new branch line has been built on a viaduct, although a high-water table is also a major factor. Meanwhile, the elevated railway and its terminus will create a focal point in the heart of the new town square as well as providing commercial and retail opportunities in the bays under the raised station.

Overall, the viaduct can be divided into two parts; a concrete structure with precast beams and piers supporting a cast in-situ deck; and a steel viaduct also supported on concrete piers.

The former creates the longest part of the viaduct and ends at the Barking Riverside terminus, while the latter is approximately 400m-long and consists of nine spans at the northern end.

Explaining the reason for choosing two different construction designs, Transport for London's (TfL) Head of Programme James Barrow says: "Steelwork was chosen for the northern end of the viaduct as it was the only material that could efficiently create the longer spans, up to 42m-long, needed to pass over rail, road and river obstacles."

As well as creating the required long spans, the use of steel has allowed the project team to minimise disruption to these infrastructure assets. Less time and equipment was needed to erect the steel part of the viaduct, as prefabricated girders were brought to site, ready to be erected during a series of weekend possessions.

All of the sections used are fabricated from weathering steel, which was specified because the material is durable and requires no future maintenance or painting. This is an important consideration, as any work carried out on the viaduct in the future could cause major disruption to the operational railway assets below.

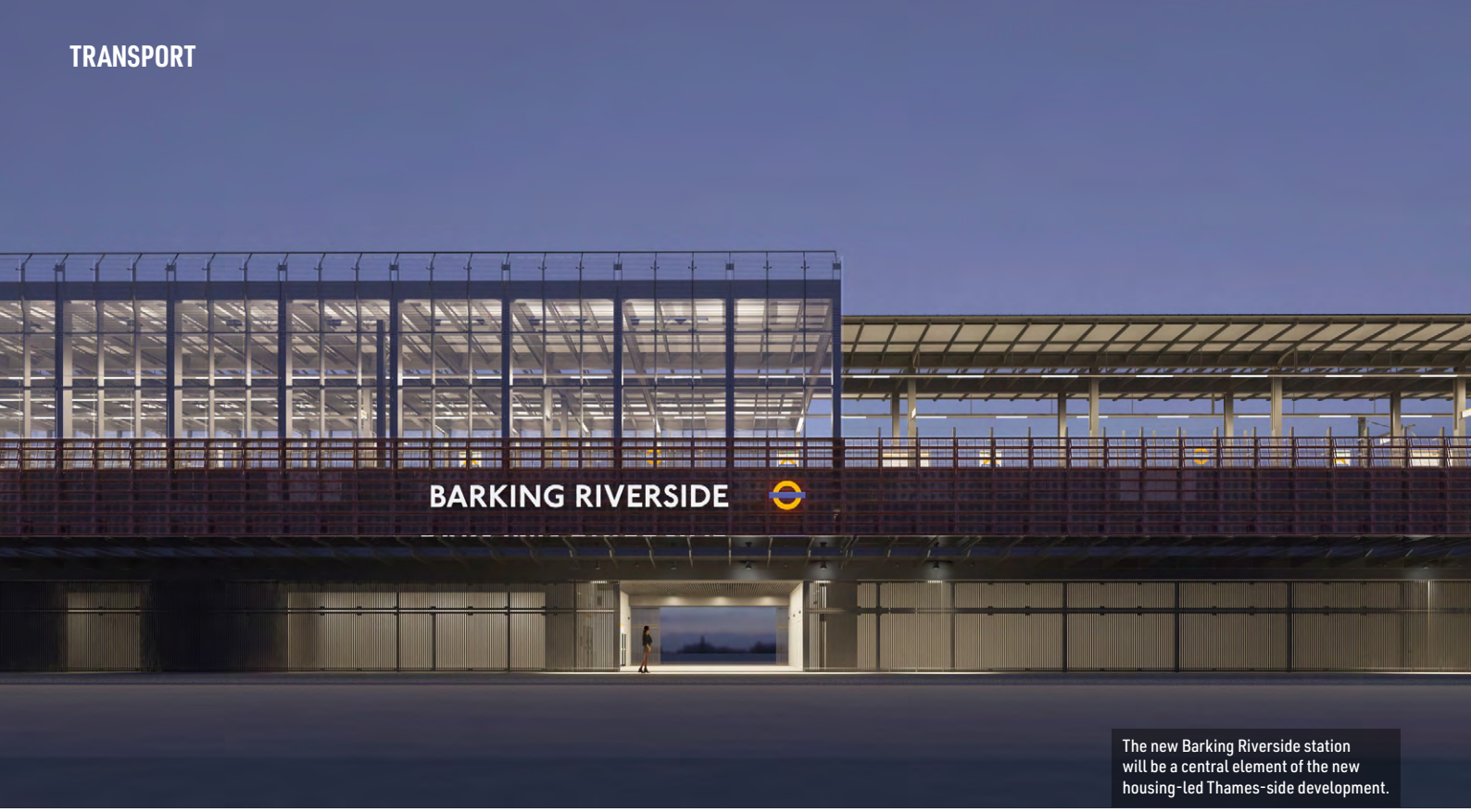
Working on behalf of TfL, construction of the viaduct was begun by Morgan Sindall/VolkerFitzpatrick joint venture (MSVF) in 2019.

As well as the interfaces with existing transport infrastructure, the site is also home to a myriad of underground services, all of which had to be located and then worked around when MSVF started the piling programme.

Once the viaduct's piers had been constructed, the installation of the viaduct's deck was begun. For the steelwork element of the viaduct, this work started with the most northerly steel girders for span five. Beyond this, spans one to four form the ramp of the viaduct, that bring the structure up to its regular 12m height.

Span five goes over a DB Cargo siding, that forms part of its Ripple Lane depot. Requiring weekend possessions and close coordination with the rail freight provider, steelwork contractor Severfield and its lifting partner, Sarens, installed the span's two main plate girders, each weighing more than 100t and measuring 35m-long × 3m-deep.

Each of the viaduct's steel spans has up to 22



The new Barking Riverside station will be a central element of the new housing-led Thames-side development.

cross beam members, which are all 12m-long (corresponding with the width of the viaduct). Four cross beams were also installed during the span five weekend possession, with the remainder lifted into place during the following week. This initial steelwork, and most of the subsequent lifts, were done using a Sarens 1,000t-capacity mobile crane.

The next four spans also go over the Ripple Lane depot and include one span supported by smaller, slender columns designed to allow easier vehicle movements around Ripple Lane.

"The viaduct piers are mostly large solid structures, and would be intrusive within the depot and impede vehicle movements," explains Mr Barrows. "For one span, we have installed two slender columns instead of a pier as they allow vehicles to easily pass, while the adjacent pier has been designed with a large opening in the middle for vehicular access."

One of the final steel spans to be installed was also the longest and, because of site constraints, required the use of one of the UK's biggest mobile cranes, with a lifting capacity of 1,200t.

Two steel girders, measuring 42m-long × 3m-deep and each weighing 120t, represented some of the largest sections ever fabricated by Severfield at its Lostock facility near Bolton.

Moving these large steel sections around the yard and onto delivery trucks was a significant challenge as Severfield Assistant Project Manager Gethin Williams explains: "Our overhead cranes at Lostock have a lifting capacity of 100t, which is not enough to lift these items.

"The solution was to fabricate each girder on temporary trestles. Once the sections were ready to leave the factory, self-propelled modular transporters (SPMTs), each with a maximum lifting capacity of 140t, were reversed under the temporary trestles and jacked up towards the steel beams to allow for safe loading on to delivery trucks."

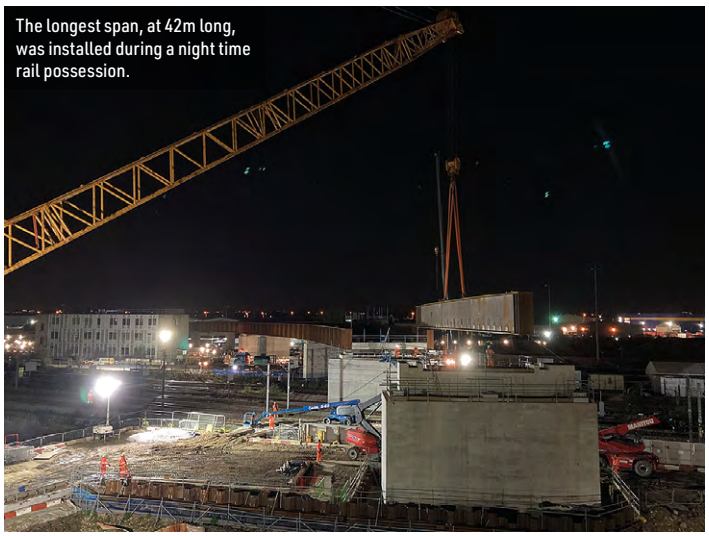
Transporting the girders to east London was also challenging. Severfield had to liaise with local councils and police to temporarily remove traffic lights and other street furniture that would otherwise obstruct their movement – both near the factory and in Barking.

Once delivered to site, the girders were installed using a Sarens Gottwald 1,200t-capacity mobile crane lifting the 120t girders at a 65m radius, with a 71m main boom, and requiring 350t of lift ballast.

The installation of this vital span, which crosses the Ship and Shovel waterway, allowed the team to lift the next and final steel girders into place last April, allowing the follow-on trades installing the deck and tracks to begin their work.

Barking Riverside train services are scheduled to start during Autumn 2022. ■

FACT FILE
Barking Riverside Viaduct
Client: **Transport for London (TfL)**
Architect: **Weston Williamson**
Main contractor: **MSVF (Morgan Sindall/VolkerFitzpatrick jv)**
Structural engineer: **Arcadis**
Steelwork contractor: **Severfield**
Steel tonnage: **3,500t**



The longest span, at 42m long, was installed during a night time rail possession.

The main viaduct girders are up to 3m deep.

Proposed changes to assessment of frame stability

In this second article looking at the forthcoming revisions to EN 1993-1-1, David Brown of the SCI considers the proposed guidance on frame stability with some disappointment that the requirements can be easily misunderstood. Experienced designers will no doubt use the correct approach, but those looking at the standard for the first time could be misled.

Once, there was BS 449

Designers of a certain age might comment that the first time that assessment of frame stability was highlighted occurred with the introduction of BS 5950. That is not true – BS 449 required sway stability to be considered, but gave no advice on how this was to be carried out. Clause 10c of BS 449 required that all structures "shall be adequately strong and stiff to resist sway". There was no advice on what was considered to be adequately stiff.

In the same clause, BS 449 introduced notional horizontal forces to allow for "practical imperfections such as a lack of verticality", which were only applied in combination with vertical loads, and not when wind or other horizontal loads were applied.

Frame stability in BS 5950

With the introduction of BS 5950, the need for structures to have adequate stiffness against sway was highlighted, but in the early versions there was still little guidance on what assessment should be completed. In the 1990 version, clause 2.4.2.3 required that to ensure adequate stiffness against sway "a separate check should be carried out for notional horizontal loads". In the author's opinion, confusion was introduced by this rather loose requirement in the standard, which has remained ever since.

In BS 5950, the notional horizontal forces (NHF) are used to allow for imperfections such as a lack of verticality. They appear in the load combinations with only vertical loads but, according to BS 5950, not when real lateral loads are applied. The confusion arises because in later versions of the standard, the very same notional horizontal forces are used entirely independently as part of the assessment of frame stability. With the benefit of hindsight, perhaps having some entirely different forces used in the assessment of frame stability – also with a different name – might have demonstrated the difference.

With the issue of the 2000 version of BS 5950 further clarity was added. In clause 2.4.2.4 the NHF are described as allowing for imperfections such as a lack of verticality (one wonders why "out of plumb" was not used). Separately, in clause 2.4.2.5, the need for sway stiffness is described and that secondary forces and moments must be allowed for in design if they are significant. These secondary forces and moments are described as "second order" and "PΔ". This emphasis on "significance" is entirely correct – second order effects are always present, but may not be significant.

BS 5950 also included a measure of significance, λ_{cr}, which will be familiar to pre-Eurocode designers. The value of λ_{cr} is to be calculated for each storey in a structure, and is given by:

$$\lambda_{cr} = \left(\frac{h}{200\delta}\right)$$

where h is the storey height and δ is the horizontal displacement over the storey, due to the NHF (only) applied to the frame. BS 5950 clarifies that the deflection δ is due to "horizontal forces equal to 0.5% of the factored vertical dead, imposed and crane loads applied to the frame at each storey level". Thus differently loaded storeys would have different horizontal loads, in proportion to the factored vertical load on the storey.

The value of 200 appearing in the denominator is inextricably linked to the definition of the NHF being 0.5% (or 1/200) of the factored vertical loads applied at that level. As will be seen later, the measure of frame stability (or, the significance of second order effects) can be determined using any consistent set of forces and complementary expression for frame stability. Using a set of forces distinctly different from the NHF would perhaps have reduced the confusion referred to earlier.

One point to note is that the BS 5950 approach demanded a separate loadcase to be analysed, with only the NHF applied. This loadcase was only used to determine λ_{cr}

2005 and BS EN 1993-1-1 arrives

The Eurocodes were available for use from 2005 – it is not surprising that revisions are being developed over 15 years later. Within the Eurocode, "PΔ" effects become the "Effects of deformed geometry of the structure" in clause 5.2.1 and the measure of frame stability becomes α_{cr}.

The value of α_{cr} is again calculated for each storey and is given by:

$$\alpha_{cr} = \left(\frac{H_{Ed}}{V_{Ed}}\right)\left(\frac{h}{\delta_{H,Ed}}\right)$$

The value of H_{Ed} is the horizontal shear at the base of the storey and is equal to the summation of the horizontal loads applied to the structure above that level. In general, the horizontal loads are typically wind loads, plus the equivalent horizontal forces (EHF). Unlike BS 5950, the Eurocode requires that the EHF are always applied (unless the externally applied loads are very large).

The Eurocode defines $\delta_{H,Ed}$ as the relative displacement when the frame is "loaded with horizontal loads (e.g. wind) and *fictitious* horizontal loads which are applied at each level". Practice has assumed that these fictitious horizontal loads are the EHF elsewhere described in the standard. Use of the EHF is ideal, since they are based on a proportion of the factored vertical load applied at that level.

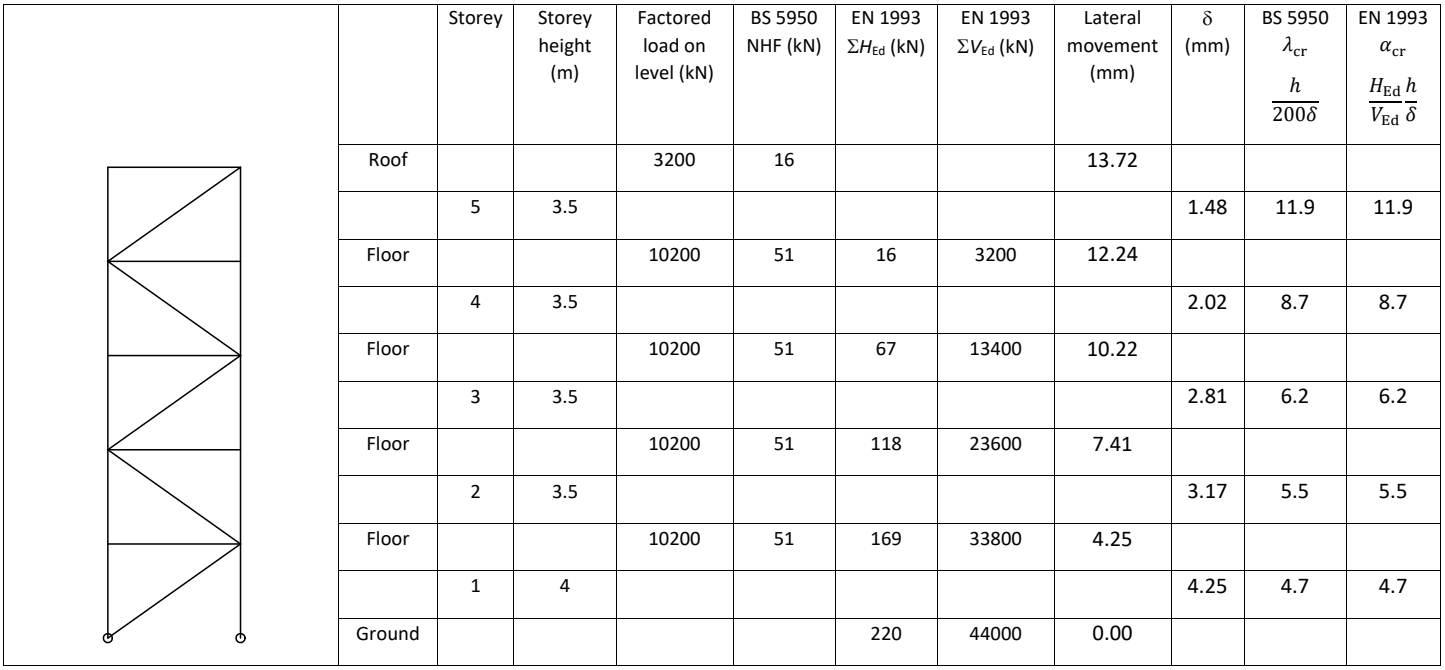
The EHF are based on the sway imperfection given in 5.3.2, which is 1/200 of the factored vertical loads, with optional fudge factors. Thus the value of H_{Ed} can be considered to be $\left(\frac{V_{Ed}}{200} + \text{wind}\right)$, which is quite the same as BS 5950 if one chooses to ignore the wind. Towards the base of an orthodox multi-storey building, the value of $\frac{V_{Ed}}{200}$ is large, and the contribution of the wind loads comparatively small.

Neglecting the relatively small influence of the wind, and neglecting the optional fudge factors in the determination of the EHF, the expression for α_{cr} becomes:

$$\alpha_{cr} = \left(\frac{V_{Ed}/200}{V_{Ed}}\right)\left(\frac{h}{\delta_{H,Ed}}\right) = \frac{h}{200\delta}$$, or the same as BS 5950.

The advantage of completing the analysis of the frame using the "actual" loads of H_{Ed} and V_{Ed} was said to be that designers would have that load combination modelled as a matter of course, and that an additional, separate loadcase with just the EHF was inconvenient. Of course, it does not matter what forces are being used in the current Eurocode (and hence the use of the word fictional) since under an elastic analysis, the lateral deflection is proportional to the applied lateral loads – the ratio $\frac{H_{Ed}}{\delta_{H,Ed}}$ is a constant.

An analysis of a simple bracing system demonstrating the equivalence of BS 5950 and EN 1993-1-1 is shown in Table 1 (over). In the example the braced bay has been extracted from the structure for simplicity (the rest of the structure is of "simple construction" and does not contribute to the lateral stability). ▸26



	Storey	Storey height (m)	Factored load on level (kN)	BS 5950 NHF (kN)	EN 1993 ΣH_{Ed} (kN)	EN 1993 ΣV_{Ed} (kN)	Lateral movement (mm)	δ (mm)	BS 5950 λ_{cr} $\frac{h}{200\delta}$	EN 1993 α_{cr} $\frac{H_{Ed}}{V_{Ed}}\frac{h}{\delta}$
Roof			3200	16			13.72			
	5	3.5						1.48	11.9	11.9
Floor			10200	51	16	3200	12.24			
	4	3.5						2.02	8.7	8.7
Floor			10200	51	67	13400	10.22			
	3	3.5						2.81	6.2	6.2
Floor			10200	51	118	23600	7.41			
	2	3.5						3.17	5.5	5.5
Floor			10200	51	169	33800	4.25			
	1	4						4.25	4.7	4.7
Ground					220	44000	0.00			

Table 1: Frame stability according to BS 5950 and BS EN 1993-1-1

▸25

Looking to the future

As has been noted in earlier articles, the draft of EN 1993-1-1 is mature – significant changes are not anticipated.

The proposed measure of frame stability is called $\alpha_{cr,sw}$ (the subscript "sw" indicates "sway") and is given by:

$$\alpha_{cr,sw} = \frac{K_{st}H_{st}}{\Sigma N_{Ed,i}}$$ (the subscripts "st" indicate "storey")

K_{st} is the lateral rigidity of the storey and is given by:

$$K_{st} = \frac{H_f}{\Delta_f}$$

where

H_f is a fictitious horizontal force applied at the top of the columns of the storey;

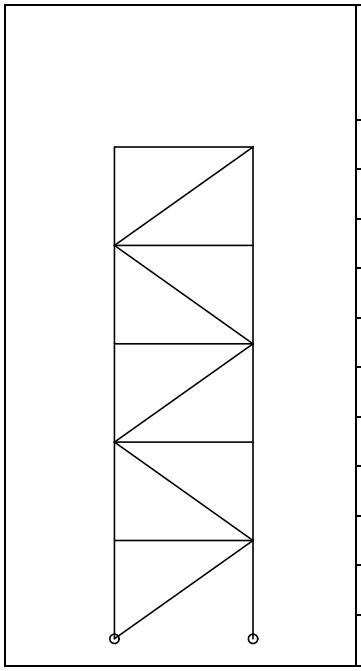
Δ_f is the horizontal displacement at the top of the storey due to H_f relative to the bottom of the storey;

$\Sigma N_{Ed,i}$ is the sum of axial forces within the columns under consideration;

H_{st} is the height of the storey.

For Eurocode designers, the formula for $\alpha_{cr,sw}$ looks like a simple rearrangement of the current expression for α_{cr}, but care must be taken when evaluating K_{st}. The draft seems to imply that the lateral rigidity of a multi-storey frame can assessed by considering each storey in isolation. Designers may be tempted to do just that and model single storeys, in isolation, with some arbitrary load applied at the top of the storey.

The correct deflections over a storey can only be determined from including the full height of the building in one analysis and calculating the differential deflections over the storey under consideration. Figure 5.1 of the current standard helpfully shows the assessment of one storey as part of a larger model – indicating that the entire stability system should be modelled, not storeys in isolation. In addition, the draft does not clarify that the fictitious load applied at the top of the columns at each storey must be consistent throughout the model. The fictitious load must be some fixed proportion of the factored vertical load applied at that level.



	Storey	Storey height (m)	Factored load on level (kN)	Fictitious force (2%)	Lateral movement (mm)	δ (mm)	$\alpha_{cr,sw}$ $\frac{H_{st}}{50\delta}$
Roof			3200	64	54.56		
	5	3.5				5.81	12.0
Floor			10200	204	48.74		
	4	3.5				8.02	8.7
Floor			10200	204	40.72		
	3	3.5				11.17	6.3
Floor			10200	204	29.55		
	2	3.5				12.61	5.6
Floor			10200	204	16.94		
	1	4				16.94	4.7
Ground					0.00		

Table 2: 2% fictitious lateral loads, and resulting values of $\alpha_{cr,sw}$

Although one might feel disappointment with the proposed rules, they are not significantly different to the current standard – which similarly does not clarify the need for the lateral loads to be a fixed proportion of the vertical loads. Previous practice with BS 5950 (and the general use of the EHF to determine frame stability) has probably meant designers "knew" what was required, rather than being left uncertain by the standard.

Recommended approach

Every storey should be modelled in one analysis, exactly as was done in BS 5950 and the current version of the Eurocode. The fictional lateral loads applied at each level should be the same proportion of the factored vertical load at that level. To avoid confusion with the NHF of BS 5950 and the EHF of the Eurocode, perhaps these fictitious loads, used only to establish the measure of frame stability, could be 2% of the factored vertical load at that level. The final calculation becomes a convenient expression:

$$\alpha_{cr,sw} = \frac{H_{st}}{50\delta}$$

This equation may look different to the Eurocode, but yields the same result, as demonstrated in Table 2. The deflections are of course larger, but the end result is the same – allowing for some loss of precision.

Conclusions

The proposed clause will hopefully go a long way to clarify the confusion between the use of notional/equivalent/fictitious horizontal forces to assess frame stability, and separately the use of notional/equivalent horizontal forces to allow for a lack of verticality. The wording of the clause could be improved, in particular to advise that the fictitious forces should be a fixed proportion of the loads applied at each level. Using a fixed absolute force at each level will yield the wrong result (unless the vertical loads at each level are identical), as will attempting to model single storeys in isolation. ■

AD 484:
Snow design situations

This advisory note aims to offer clarity when considering snow loading – in particular the drifted snow design situations. Snow loads are covered by BS EN 1991-1-3 and the associated National Annex. The most important advice is that NA.2.2 clarifies that the design situations to be considered in the UK are given in Case B2 of Table A.1 of BS EN 1991-1-3. Clause NA.2.3 specifies that Annex B of the core Eurocode should be used to determine the exceptional snow drift loads. If this advice is followed, it should stop designers even considering several design situations in the core Eurocode, as these are not relevant for structures constructed in the UK.

Case B2 of Table A.1 identifies two persistent design situations and one accidental design situation. The accidental design situation covers drifted snow, which is considered in valleys, behind parapets, behind obstructions and on lower roofs abutting taller structures. As noted above, Annex B is used to determine the loading in these accidental design situations. As an accidental case, the design combination of actions should be calculated in accordance with expression 6.11b of BS EN 1990.

Perhaps somewhat confusingly, the second persistent case is also described as a drifted snow design situation - although it is treated as a persistent case and attracts the normal partial factors used in expressions 6.10, 6.10a and 6.10b of BS EN 1990. This second drifted case is the removal of all the snow from one roof slope, so it might be better described as an asymmetric case. In the core Eurocode, clause 5.3.3 and Figure 5.2 indicate that half the snow is removed from one roof slope, but this is amended by clauses NA.2.13, NA.2.18 and Figure NA.3 of the UK National Annex to specify that all the snow is removed from one roof slope.

Some designers appear to ignore this second persistent case. Designers may recall snow loads determined from BS 6399-3 which had exactly the same asymmetric load with no snow on one slope, but this situation only needed to considered for roof slopes greater than 15°. There is no limiting roof slope in the Eurocode, so designers are reminded of this design situation.

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

New and revised codes and standards

From BSI Updates April 2022

BS EN PUBLICATIONS

BS EN ISO 3834-2:2021
Quality requirements for fusion welding of metallic materials. Comprehensive quality requirements
supersedes BS EN ISO 3834-2:2005

BS EN ISO 3834-3:2021
Quality requirements for fusion welding of metallic materials. Standard quality requirements
supersedes BS EN ISO 3834-3:2005

BS EN ISO 3834-4:2021
Quality requirements for fusion welding of metallic materials. Elementary quality requirements
supersedes BS EN ISO 3834-4:2005

BS EN ISO 12671:2021
Thermal spraying. Thermally sprayed coatings. Symbolic representation on drawings
supersedes BS EN ISO 12671:2014

BS EN ISO 10140-2:2021
Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of airborne sound insulation
supersedes BS EN ISO 10140-2:2010

BS EN ISO 10140-3:2021
Acoustics. Laboratory measurement of sound insulation of building elements. Measurement of impact sound insulation
supersedes BS EN ISO 10140-3:2010+A1:2015

BS EN ISO 10140-4:2021
Acoustics. Laboratory measurement of sound insulation of building elements. Measurement procedures and requirements
supersedes BS EN ISO 10140-4:2010

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS EN ISO 17635:2016
Non-destructive testing of welds. General rules for metallic materials

PD ISO/TR 13392:2014
Health and safety in welding and allied processes. Arc welding fume components

PD ISO/TR 24679-3:2015
Fire safety engineering. Performance of structure in fire. Example of an open car park

PD ISO/TR 16732-2:2012
Fire Safety Engineering. Fire risk assessment. Example of an office building

PD ISO/TR 16732-3:2013
Fire safety engineering. Fire risk assessment. Example of an industrial property

PD ISO/TR 18786:2014
Health and safety in welding. Guidelines for risk assessment of welding fabrication activities

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

22/30397897 DC
BS EN 1993-1-5 Eurocode 3. Design of steel structures. Plated structural elements
Comments for the above document are required by 24 May, 2022

22/30397903 DC
BS EN 1993-1-2 Eurocode 3. Design of steel structures. General rules. Structural fire design
Comments for the above document are required by 24 May, 2022

22/30397906 DC
BS EN 1993-1-3 Eurocode 3. Design of steel structures. General rules. Supplementary rules for cold-formed members and sheeting
Comments for the above document are required by 24 May, 2022

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This view of the car-park in use clearly shows the Unibat space frames

Space frame structures are usually associated with roof frameworks but in this new car-park at Heathrow they have been used for the floor decks. Also unusual is the use of chipped wire reinforcement for the floor slabs. Chosen against strong competition this building shows once more that for economy in construction steel must be first choice

Steel car-parks are economical and demountable: two reasons which led to the use of the material for this new structure at Heathrow Airport for BOAC. Both in its use of space frame decks and chopped wire reinforcement for the slabs this car-park breaks new ground and is of great interest.

BOAC's design brief stipulated that the car-park should be 50ft wide, 440ft long, providing accommodation for a total of 325 vehicles. The ground floor was to be utilized in addition to two elevated decks to which access was to be gained by a one-way ramping system. Illumination was required to the undersides of the decks and electrical heating incorporated within the ramps.

Early in the tender stage Robert Frazer Ltd established that the client was keenly interested in the principal of a demountable building (or, in accountancy terms, a movable fixed asset) provided that the attribute of demountability could be provided at a cost of little more than that of a permanent structure.

Since the introduction in 1968 of the new waiver procedure applicable to exposed steel frameworks for multi-storey car-parks considered as group 8 buildings in Building Regulation E.2, Storage and General Buildings, there has been a number of steel-framed car-parks constructed in the UK. Such structures however have utilized a beam and stanchion system of framing and whilst certain parks have been termed 'relocatable' this statement holds true only if the new site is of suitable dimensions to accept the original building, as little structural change to the original building is possible because of the basic framing method adopted.

By adapting the Unibat system Frazers consider they have developed a minimal cost relocatable car-park. This form of structure allows the building owner to reconstruct the car-park on other sites using the modular steel and concrete deck units to form entirely different plan forms.

Unibat is marketed under exclusive licence in the United Kingdom by Robert Frazer and was developed primarily for wide-span roof construction. A recent structure of this type has been built by them at Leeds, providing a warehouse 180ft square without any internal stanchions.

In essence, Unibat consists of shopfabricated pyramidal units. The units are delivered to site stacked like ice-cream cones. They are then site bolted to each other and also to a grid of bottom tie members using friction grip bolts. The structure when fully assembled at ground level forms a rigid double-layer grid. This is then hoisted in large sections up to its final position using cranes or winches. The depth of the grid depends upon the span and loading of the structure: for example, the 180ft square warehouse roof referred to above uses pyramids 7ft deep, whereas the BOAC car-park, with a clear span of 50ft, requires pyramids only 2ft 6in deep.

Having decided upon the basic deck construction the most economic method of protection was then investigated bearing in mind that as the building was open-sided an outdoor quality of surface protection was required.

The following considerations affected the decision.

1. The client's programme requirements necessitated a rapid method of applying the surface protection.
2. A maintenance-free life of at least 6-8 years was essential to satisfy the client.
3. Because of the structural design requirements, all site connections in the space frame had to be capable of developing a slip factor sufficient to allow friction grip bolt connections to be used.
4. The protective system would require to be robust enough to withstand the abrasion caused during stacking and transportation (250 miles to site), together with handling on site prior to erection.
5. The chief architect of BOAC required to be satisfied with the final protective system in terms of aesthetics.
6. The Local Authority Architects Department required to be satisfied with the protective system in terms of aesthetics if planning approval were to be granted to the project.

Galvanizing was seen to immediately satisfy conditions 2 and 4. The galvanizers confirmed that batches of 50 pyramids per day could be galvanized, thus enabling a programme to be put forward with the tender in which final surface protection was undertaken virtually concurrently with fabrication.

The problem of faying surfaces was overcome by roughening the precise areas concerned with a pneumatic needle hammer tool.

Samples of the latter treatment were tested to

FROM

Building with Steel

February 1972

establish that the resulting slip factor was adequate for high-strength friction grip bolt connections.

In order to ensure that galvanized steelwork would satisfy conditions 5 and 6 preliminary meetings took place in advance of the submission of the tender and approval was received.

Having decided upon the main deck construction and its protection, it was now necessary to establish the most suitable form of deck slab construction. Because the Unibat grid presented, on its top side, a modular pattern 3ft 6in square of interconnecting steel members, it was possible to consider the design of small highly stressed panel deck units thus taking advantage of the small spans between grid members. On this basis the efficiency and cost of a wide range of structural media were investigated; the design requirement being that a point load of one ton had to be supported in the centre of each 3ft 6in square area. Among the deck systems investigated were rolled steel plates, grit blasted and zinc sprayed, covered with non-skid plastic panels or epoxy coating. Further examinations were made into traditionally reinforced pre-cast concrete plank and panel units and finally into Wirand reinforced concrete panels, the latter being 3ft 6in square. An advantage of using small deck slabs is that when the car-park is being reconstructed, the deck panels, being of the same modular dimensions as the supporting space frame units, can be refixed to suit the new building plan.

Of all the systems investigated, Wirand reinforced concrete panels proved to be the cheapest. Initially, little design information was available on the use of Wirand slabs, however, the Wirand manufacturers, Richard Johnson and Nephew Limited, confirmed that the material would be available to suit the building programme, consequently a series of tests was initiated at Teesside Polytechnic to confirm that the percentage of Wirand anticipated to be required for design was entirely adequate.

The method of jointing and fixing the panels was then discussed in detail with the slab suppliers, Richard Miller Ltd, and ultimately a sandwich form of construction was adopted for the joint in which cement grout occupies upper and lower sections and a flexible bituminous compound occupies the centre of the joint. In view of the interlocking nature of the panels and the fact that they are prevented from moving across or along the structure because of restraints welded on perimeter steelwork, it was considered that no bolting or other direct fixing between panels and grid was necessary.

The double layer grid steelwork is laid to a 6in fall across the width of the building, and a curb has been built into the Wirand edge panels on the lower side of the structure thus forming a gutter which drains at intervals into several outlets along the length of the building. Ramps are formed in structural steelwork decked with two-way-spanning traditionally reinforced concrete panels, all of which are removable and contain a circuit of heating elements.

The BOAC structure is in two complete halves and has been open for total occupation since late 1971.

This view of the car-park during construction shows the structural system and diagonal grid form. Decks were assembled on the ground and lifted in one piece.

Life-size picture of the Wirand strands

Stacked Unibat pyramids emerging from the galvanizing bath

Unibat space frames for a stores building. Clear spans 50m x 50m

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, Membership Manager
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, ● = Bronze, ● = Certificate

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

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

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 C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●		✔	2			Up to £3,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3		●	Up to £3,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●							●		✔	2	✔	●	Up to £3,000,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		●	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2		●	Up to £1,400,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●				●		2			Up to £800,000
ASME Engineering Ltd	020 8966 7150			●	●	●		●		●	●			●	●	✔	4		●	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	●	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●			●	✔	4	✔	●	Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4		●	Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●						●	✔	4		●	Up to £6,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●		●	●	●	●	●		●	●	●	✔	3		●	Up to £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
DAM Structures Ltd	01377 271843	●		●	●	●		●	●	●	●			●		✔	4			Up to £6,000,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £200,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●	●	●	●		●	●	●	✔	4			Up to £400,000
Duggan Steel	00 353 29 70072	●	●	●	●	●	●	●	●		●				●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	4		●	Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	✔	●	Up to £6,000,000
EvadX Ltd	01745 336413		●	●	●	●	●	●		●	●	●			●	✔	3		●	Up to £4,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		●	Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
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)
G.R. Carr (Essex) Ltd	01286 535501	●		●	●			●			●			●	●	✔	4			Up to £800,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●			●	●	✔	4	✔	●	Up to £3,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Harry Peers Steelwork Ltd	01204 528393	●		●	●	●	●	●	●		●					✔	4			Above £6,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Hillcrest Structural Steel Ltd	023 8064 1373			●	●	●	●	●		●	●			●	●	✔	3		●	Up to £3,000,000
Intersteels Ltd	01322 337766	●			●	●	●	●	●	●			●	●	●	✔	3			Up to £3,000,000
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	✔	●	Above £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4		●	Up to £6,000,000
LA Metalworks Ltd	01707 256290				●	●				●	●			●	●	✔	2			Up to £2,000,000
Leach Structural Steelwork Ltd	01995 642000			●	●	●	●	●			●					✔	2		●	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●				●	●	●			●	●		3			Up to £800,000
Littleton Steel Ltd	01275 333431				●				●	●				●	●	✔	3			Up to £1,400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●			●	●	✔	4		●	Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £2,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
Maldon Marine Ltd	01621 859000				●	●			●	●	●				●	✔	3			Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						3			Up to £3,000,000
Murphy International Ltd	00 353 45 431384	●			●		●	●	●		●				●	✔	4			Up to £2,000,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●			●	●				✔	4		●	Up to £2,000,000
North Lincs Structures	01724 855512			●	●					●	●				●		2			Up to £400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●		✔	4		●	Up to £6,000,000
Painter Brothers Ltd	01432 374400	●			●				●	●	●				●	✔	3			Up to £6,000,000*
Peter Marshall (Steel Stairs) Ltd	0113 307 6730				●	●				●	●				●	✔	3			Up to £1,400,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
REIDsteel	01202 483333			●	●	●	●	●	●	●	●	●	●		●	✔	4		●	Up to £6,000,000
SAH Luton Ltd	01582 805741			●	●	●				●	●			●	●		2			Up to £400,000
S H Structures Ltd	01977 681931	●		●	●	●	●	●	●	●	●	●	●		●	✔	4	✔	●	Up to £3,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●			●	●			●	●	✔	4			Up to £2,000,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●				●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●	✔	2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £2,000,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £1,400,000
Steel & Roofing Systems	00 353 56 444 1855	●		●	●	●	●				●	●		●	●	✔	4			Up to £4,000,000
Taziker Industrial Ltd	01204 468080	●		●	●		●			●	●		●	●	●	✔	3		●	Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●			●	●			●	●	✔	2			Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	3	✔	●	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2	✔		Up to £2,000,000
Underhill Engineering Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4	✔		Up to £3,000,000
W I G Engineering Ltd	01869 320515				●					●	●			●	●	✔	2			Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●	●	●	●	●	●	●				●	✔	4		●	Up to £800,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	Guide Contract Value (1)

Steelwork contractors for bridgeworks

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

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

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

Notes

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

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

BCSA steelwork contractor member	Tel	FB	CF	SG	PG	TW	BA	CM	MB	SRF	FRF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
Adey Steel Ltd	01509 556677	●		●	●	●	●				●	●	✓	3			✓	●	Up to £3,000,000
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●			●	✓	4				●	Up to £3,000,000
Billington Structures Ltd	01226 340666	●		●	●	●	●					●	✓	4	✓	✓	✓	●	Above £6,000,000
Bourne Group Ltd	01202 746666	●			●	●				●		●	✓	4	✓		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓	●	Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	●	✓	4			✓	●	Up to £6,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●					●	✓	3			✓	●	Up to £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	●	✓	4			✓		Up to £400,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	●	✓	3		✓	✓	●	Up to £1,400,000
ECS Engineering Services Ltd	01773 860001	●			●	●	●		●			●	✓	4				●	Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●	●	●		●	●	●	●	✓	3			✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●			●	●				●	●	●	✓	4	✓		✓	●	Above £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓	●	Up to £1,400,000
Millar Callaghan Engineering Services Ltd	01294 217711	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●	●	●	●	●	●					●	✓	4			✓		Up to £2,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £6,000,000
REIDsteel	01202 483333	●				●	●	●				●	✓	4				●	Up to £6,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	●	Up to £3,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499											●	✓	3					Up to £800,000
Taziker Industrial Ltd	01204 468080	●		●	●	●	●	●	●	●	●	●	✓	3		✓	✓	●	Above £6,000,000
Underhill Engineering Ltd	01752 752483	●	●	●	●	●				●	●	●	✓	4	✓		✓	●	Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●		●	✓	4	✓	✓	✓	●	Above £6,000,000
Non-BCSA member																			
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●			●	●	✓	4	✓		✓	●	Up to £3,000,000
Carver Engineering Services Ltd	01302 751900	●		●	●	●	●		●	●	●	●	✓	4			✓		Up to £3,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	●	✓	4					Up to £3,000,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●		●	●	✓	4			✓	●	Up to £1,400,000
Eiffage Metal	00 33 388 946 856	●	●	●	●	●	●	●	●			●	✓	4					Above £6,000,000
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 £800,000
In-Spec Manufacturing Ltd	01642 210716									●	●	●	✓	4			✓		Up to £800,000
J&D Pierce Contracts Ltd	01505 683724	●		●	●	●	●	●	●		●	●	✓	4			✓		Above £6,000,000
Kelly's Welders & Blacksmiths Ltd	01383 512 517											●	✓	2			✓		Up to £200,000
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £3,000,000
Malin Group	0141 370 5467	●			●	●	●			●	●	●	✓	4			✓		Up to £4,000,000
North View Engineering Solutions Ltd	01325 464558											●	✓	3					Up to £800,000
Smulders Projects UK Ltd	0191 295 8700	●	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
Tecade S.A.U.	00 34 955 833 811		●	●	●	●	●	●	●			●	✓	4		✓	✓		Up to £6,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●		●		●				●	●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000

Corporate Members

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

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

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

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

Industry Members

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

QM Quality management certification to ISO 9001
FPC Factory Production Control certification to BS EN 1090-1
1 Execution class 1 2 Execution class 2
3 Execution class 3 4 Execution class 4
NHSS National Highway Sector Scheme

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

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

SfL
Steel for Life Sponsor

Structural components

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
Albion Sections Ltd	0121 553 1877	✓	M	4			
BW Industries Ltd	01262 400088	✓	M	3			
Cellbeam Ltd	01937 840600	✓	M	4	20		
Composite Profiles UK Ltd	01202 659237		D/I				
Construction Metal Forming Ltd	01495 761080	✓	M	3			
Daver Steels Ltd	0114 261 1999	✓	M	3			
Farrat Isolevel	0161 924 1600	✓	N/A				
FLI Structures	01452 722200	✓	M	4	20	●	
Hadley Industries Plc	0121 555 1342	✓	M	4		●	
Hi-Span Ltd	01953 603081	✓	M	4		●	
Jamestown Manufacturing Ltd	**00 353 45 434288**	✓	**M**	4	20		**Gold**
Kingspan Structural Products	01944 712000	✓	M	4		●	
MSW UK Ltd	0115 946 2316		D/I				
Prodeck-Fixing Ltd	01278 780586	✓	D/I				
Structural Metal Decks Ltd	01202 718898	✓	M	4			
Stud-Deck Services Ltd	01335 390069		D/I				
Tata Steel – ComFlor	01244 892199	✓	M	4			
voestalpine Metsec plc	**0121 601 6000**	✓	**M**	4		●	**Gold**

Computer software

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

Steel producers

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

Manufacturing equipment

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

Membership services

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

Protective systems

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

Safety systems

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

Steel stockholders

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

Structural fasteners

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
BAPP Group Ltd	01226 383824	✓	M		3		
Cooper & Turner Ltd	0114 256 0057	✓	M		3		
Lindapter International	01274 521444	✓	M				
Tension Control Bolts Ltd	**01978 661122**	✓	**M**		**3**		**Silver**

Welding equipment and consumables

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

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