JANUARY 2021

NSC

Steel takes centre stage at King's Cross

Rising high in Belfast

HS2 factories forge ahead

Trusses support aquatics centre roof

JANUARY 2021
Vol 29 No 1

NSC

Cover Image
P2 Building, King's Cross, London
Main client: King's Cross Central Limited Partnership
Architect: Allford Hall Monaghan Morris (AHMM)
Main contractor: Kier
Structural engineer: AKT II
Steelwork contractor: Severfield
Steel tonnage: 3,600t

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High Strength Steels – What you need to know
SCI Webinar Event – FREE to attend

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Structural Design of High Strength Steels

STROBE (Stronger Steels in the Built Environment) is a European research project developing cost-efficient design rules for high strength steel structures.

This series of four webinars will inform engineers how to design high strength steels (HSS) in accordance with current European practice, as well as cover brand new developments in design guidance arising from the STROBE project. Each delegate will receive a copy of the new SCI publication **P432 'High Strength Steel Design and Execution Guide'.**

The webinars are from 12:00 to 13:15. Each webinar will include case studies and design examples.

19 January 2021:
Introduction to the use of HSS in structures

26 January 2021:
Design of HSS – plastic design

2 February 2021:
Design of HSS - member stability and dynamic response

9 February 2021:
Weight, cost and carbon savings with HSS

Partners in the STROBE project include three universities: RWTH Aachen (Germany), Imperial College London (UK), University of Coimbra (Portugal), one steel producer: Dillinger (Germany) and one design consultancy: Hochtief Engineering (Germany). SCI co-ordinates the project.

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Offices of the future demand steel's flexibility

Nick Barrett - Editor

Twelve months ago, the first Editor's Comment of 2020 lamented that events had thrown all sectors of the economy into even more uncertainty than usual - and that was before the unprecedented uncertainties created by the COVID-19 pandemic. Fortunately, that comment stopped short of making predictions for the year, as they would have been rendered redundant by the pandemic's hit to the economy.

A couple of sectors of the economy fared relatively well, like online retail and protective equipment for the health sector, but emergency measures made normal economic life impossible for most. Construction suffered large initial falls but quickly started to rebound, although it will surely take a couple of years or so to fully get back to pre-pandemic levels of output.

Against this background it was unsurprising that many investors decided to hold fire and delay investment decisions. At the start of 2021 investment plans are being scrutinised in boardrooms worldwide, but now that COVID-19 vaccines are being rolled out the question is increasingly how quickly and to what extent the world will get back to where it was before the pandemic erupted.

Brexit will create its own reasons to pause on UK investment decisions, and as we went to press the future of the UK's relations with the European Union remained uncertain. Trade deal or no trade deal, some readjustments to usual trading arrangements will be needed and it may take some months before things settle down again.

But with Brexit and the pandemic uncertainties soon to be behind us, there appear to be reasons to be cheerful heading into 2021. There is a level of pent-up investment likely to be unleashed once businesses have a clearer picture of the risks ahead. The world still needs offices and is short of them in many locations.

A recent report published by property specialists CBRE for example says that Grade A office space in Glasgow has reached a critically low level; just one more modest letting would leave no Grade A space available to offer tenants or investors. There is 1.4 million sq ft of office space under construction, and some 81% of that has already been taken, so companies coming to the end of their existing leases and new potential occupiers will find nothing available. It seems unlikely that developers will fail to respond to that opportunity.

Signs of recovery are already being reported in the commercial property market, and fears for the future of offices are lifting because as well as accelerating the home working trend the pandemic has exposed its limitations. Face-to-face interaction, collaboration and staff training and development seem unlikely to be capable of being sustained by virtual meetings alone.

There looks like being a strengthened focus on workspaces that foster employee wellbeing, that contribute to sustainability and organisational resilience. Workplaces with easily delivered fresh air, natural light, low energy consumption and access to space will be at premium. Older buildings will be unable to provide the sustainability and other features needed to meet the changed demand. The flexibility of steel-framed buildings will come into its own both for the new generation of aesthetically pleasing, technologically advanced offices that will be demanded, as well as for its ability to be reconfigured and upgraded.

Development plans provide boost for City commercial sector

Plans for two high-rise office schemes have been revealed that could provide a significant boost to the commercial sector in the City of London.

Hong Kong-based developer Tenacity has unveiled updated proposals for its redevelopment of 70 Gracechurch Street, where it aims to create a new 33-storey tower (pictured left).

Adjacent to the 20 Fenchurch Street building (Walkie Talkie), the structure will provide around 55,700m² of office and retail space.

The 155m-tall scheme, to be known as The Forum, could start on site in 2022.

The landmark building will feature viewing galleries on levels 29 and 30, while green spaces will occupy the areas between the scheme's three separate elements.

Meanwhile, developer British Land has released new plans for 2 Finsbury Avenue (2FA) at Broadgate, the largest pedestrianised neighbourhood in central London.

The scheme (above), which is being designed by Danish architect 3XN consists of a 12-storey podium with a 35-storey east tower and 20-storey western tower.

In line with British Land's sustainability strategy, the building will target net-zero carbon in construction and operation as well as a BREEAM 'Outstanding' rating. To achieve this ambitious goal, the team say a series of forward-thinking environmental initiatives will be incorporated.

To ensure flexibility for current and future needs, the offices have been designed with behavioural scientists from GXN and are interspersed with healthy, green areas and terraces to inspire creative collaboration and social interaction.

Connectivity to the existing neighbourhood is said to be a central element of the design and a new public route under the building will extend Finsbury Avenue to create a route from Eldon Street to Sun Street via Finsbury Avenue Square.

British Steel launches new high-strength structural steel grade

A new high-strength structural steel grade, designed for multi-storey high-rise buildings has been launched by British Steel.

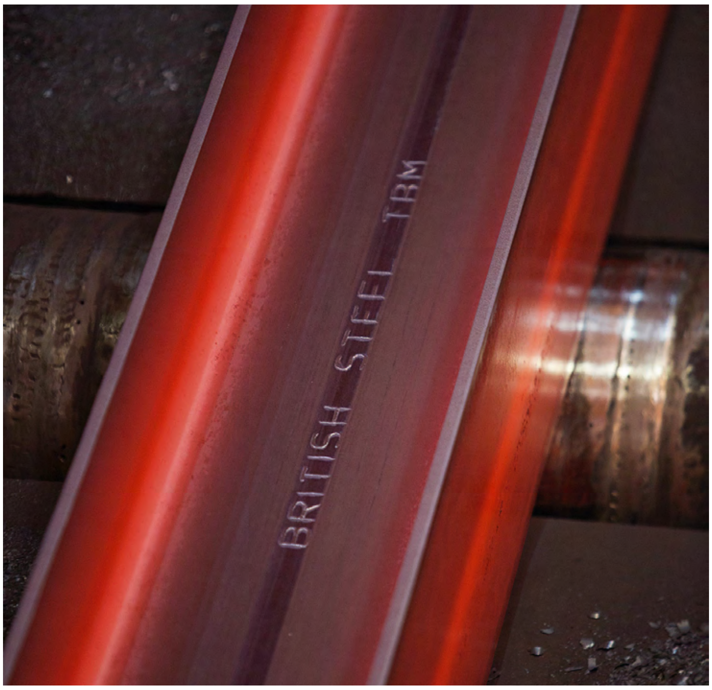
The new S460M grade, which can also be used for a wide range of other commercial and industrial uses is the result of extensive research and development by the company's metallurgy experts. It is the first product launched by British Steel since the new company was formed by Jingye Group in March 2020.

British Steel CEO Ron Deelen said: "As the UK's only manufacturer of structural steel sections, we're delighted to deliver a new high-quality steel grade at such an important time for the construction market.

"S460M provides the optimum balance between cost and weight, along with improved environmental performance – British manufacturing at its best.

"Britain is committed to building for the future and products like this, and the many others we make, mean we're well-placed to play a significant role in the economic recovery of this country."

Steel for the S460M grade is manufactured at the company's Scunthorpe steelworks before being rolled into structural sections at its Teesside Beam Mill where an extra shift, creating 40 jobs, was introduced earlier this year.



Carbon efficient schemes planned for Southwark

Paving the way for a more sustainable construction industry, CIT and Foster + Partners have revealed plans for what is said to be London's first ever net-zero carbon workplace and commercial hub at Colechurch House (pictured right), on the south bank of the River Thames.

A few hundred metres away, developer Landsec and contractor Laing O'Rourke have signed a pre-construction services agreement (PCSA) for the final design and planning of the construction of Timber Square(pictured below). This scheme is said to be 10 years ahead of UKGBC net-zero carbon targets for energy intensity reduction.

Located next to London Bridge, Colechurch House will replace a redundant 1960s office block to provide 46,200m² of mixed-use space.

The planned development will transform the public realm creating an abundance of imaginative landscaped green spaces and will bring together state-of-the-art offices; high quality, affordable, work and arts spaces; while also providing greatly enhanced connectivity from London Bridge station to the Thames riverfront and wider area.

Over 85% of the site is dedicated to open public space in the form of three distinct landscaped areas, revealing new vistas and views to the historic Southwark Cathedral and St Olaf House.

The workspaces also incorporate winter gardens towards the east and west on each level. The vegetation travels up through the winter gardens to the roof terrace, creating breakout spaces for the offices below.

Environmentally responsive façades incorporate solar shading, ventilation, light shelves, water catchments and photovoltaics.

A start date is yet to be confirmed for the £195M Timber Square scheme, which comprises around 34,300m² of mixed-use space, including 32,500m² of grade A offices, affordable workspace, roof terraces and an enhanced public realm bringing new connections and open public space to the Bankside area of Southwark.

The development will retain circa 90% of the existing building and use a hybrid steel frame and timber structure, significantly reducing embodied carbon, construction traffic, demolition waste and local air pollution. Low carbon and recycled materials will also be used across the development.

Commenting on Laing O'Rourke's appointment, Landsec's Head of Development, David Heaford, said: "We are delighted to be working with a globally-recognised contractor to deliver this exciting, sustainable development which focuses on connecting communities within a net-zero carbon scheme."

Steel rises on new Yorkshire distribution centre

Working on behalf of Caddick Construction, Caunton Engineering is fabricating, supplying and erecting 1,600t of steelwork for a £50M distribution centre near Wakefield, West Yorkshire.

Known as Wakefield 515, the distribution centre is the second to be built on a site being developed by global real estate investment manager AEW.

Caddick Construction started work on the 47,500m² facility in the first quarter of 2020, with completion set for later this year (2021).

The large portal-framed building is 130m-wide × 348m-long and consists of four internal 32.5m-wide spans, supporting a curved feature roof.

NEWS IN BRIEF

Ambitious plans to deliver a high-level pedestrian and cycle bridge across the River Wear in **Sunderland** are expected to get the go-ahead. Featuring creative lighting and augmented reality, the crossing will allow people to use their smartphone to see virtual displays that council bosses said will create an experiential bridge that will really bring to life the city's digital ambitions.

Construction work has been given the go-ahead for **York Central** after City of York Council's planning committee approved infrastructure works backed by £77M of government funding. The development will include 2,500 new homes; up to 111,000m² of commercial development and improved visitor access to the National Railway Museum.

A 2,500m² **life sciences innovation centre**, to be built as a joint project between Highlands and Islands Enterprise (HIE) and the University of the Highlands and Islands, has been given the go-ahead. Designed by multi-disciplinary design firm Austin-Smith:Lord, the centre will form part of a wider project with NHS Highland, which is developing an elective care facility on Inverness Campus.

The £40M **BioHub** project to double the size of north east Scotland's life sciences company cluster will move into its main construction phase in the coming months. The new-build, 6,400m² BioHub on the Foresterhill Health Campus will provide specialist support programmes and dedicated laboratory, collaboration and office accommodation for established and growing life sciences businesses.

Severfield's revenue has increased by 40% to £186M and its underlying profit before tax is up by 3% to £8.2M, for the six-month period ending 30th September 2020. Severfield said despite the headwinds of COVID-19, the Group has performed strongly in the period, and this is reflected in an increased UK and Europe order book as well as increased revenues and good cash generation.

PRESIDENT'S COLUMN

At the time of writing this article (7th December), we don't know whether we will have a Brexit deal or perhaps yet another transition extension. What has been pleasing is how resilient the steelwork industry has been so far to the effects of Brexit and COVID-19, and its important that furlough will still be an option for some of us in Q1 next year. I was asked by the BCSA to write an uplifting article for the end of the year. I'm sorry I couldn't, I just think it's going to be a 'right slog' next year for the vast majority. After the Christmas relaxation, we can only expect 'Lockdown 3' sometime during Q1 2021 and I don't really see much improvement until Q3 and Q4 of 2021.

Some companies are very busy, but how many of these contracts were secured at very competitive prices against a backdrop of material prices going 'North'. Steel producers need to increase prices to have viable businesses, they have armies of people working on exactly how much they think they can increase prices without tipping over the perceived pricing point to prevent that steel contract from commencing, or to push that contract to another material. Over the years I've noticed that as soon as there is any hint of a steel price increase it's headline news, the concrete industry follows suit, but their price increases seem to go under the radar. The only thing I wish, is that steel producers could give a moment's thought to other parties in the supply chain who might also need to increase their prices to cover rising overheads rather than just passing on those steel price increases.

PI insurance is going through the roof. I was told a story of one Principal Contractor whose PI was in the order of £200,000 per year. They had one claim on their PI due to a cladding sub-contractor going bust on them, leaving them to pick up a claim for a fault on the cladding. This was the extent of their claims history. Their broker approached every known PI insurer and eventually managed to place the business with a number of different insurers on the day of the renewal, despite starting the process months ahead of the renewal date, and the PI number involved seven figures. Credit markets are tightening and I'm glad we have credit cover in place going forward, as I certainly wouldn't want to be self-insuring. There has been no decision on extending the 'reverse VAT' implementation date, which is due to come in at the end of Q1 2021. All Tier 2 construction companies will be adversely affected by this loss in cash and you won't get it back until you cease trading.

One of the developments that I'm pleased about is that the steel construction industry hasn't waited for legislation from the tragic events of Grenfell Tower, but instead has pushed on and developed a specification for the design, application and inspection of intumescent coating systems. This specification is part of the 7th edition of the National Structural Steelwork Specification, which will come into force on 1st January 2021. In tandem with this BCSA has developed a Responsible Painting Co-ordinator (RPC) training course, which will be launched in the New Year. This will be a game-changer in much the same way as the introduction of the Responsible Welding Co-ordinator was and will improve competence within the industry.

Mark Denham
BCSA President

Steel projects star at 2020 BCO awards

Projects that used a steel-framed solution have won accolades at this year's British Council for Offices (BCO) annual awards.

Split into five regions covering the entire UK, the BCO awards have six categories consisting of Commercial Workspace; Corporate Workspace; Refurbished/Recycled Workspace; Fit Out of Workspace; Projects up to 1,500m²; and Innovation.

In the London region, the Brunel Building (pictured) won the Commercial Workspace category, and 160 Old Street was the winner in both the Refurbished/ Recycled Workspace and Innovation categories.

The Brunel Building is a prestigious commercial scheme adjacent to Paddington Station and Severfield erected 2,350t of steel for the project. while Bourne Steel supplied 900t for 160 Old Street.

In the Midlands & Central England region, 50/60 Station Road, Cambridge won the Commercial Workspace award. Situated in the heart of the city's CB1 masterplan, this state-of-the-art development required 2,000t of steelwork, which was erected by Billington Structures.

The Fit Out of Workspace category in the South of England and South of Wales region went to the BBC Wales building in Central Square, Cardiff. The 2,100t steel frame for this important scheme was erected by Severfield.

Forming the initial phase of the Bothwell Exchange development, 122 Waterloo Street in Glasgow, won the Corporate Workspace category in the Scotland region. BHC was the steelwork contractor for this project.

Bridge adds to Cambridge walking and cycling trail

The Abbey Chesterton Bridge has been lifted into place, completing a significant milestone in the delivery of the Chisholm Trail walking and cycling route in Cambridge.

The bridge, which was designed by Skanska and is based upon a Knight Architects concept, spans the River Cam and sits adjacent to a Network Rail line.

The new structure was lifted into place during one short overnight possession at a weekend.

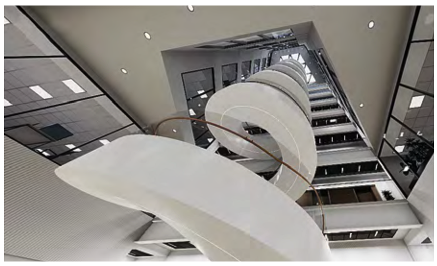
Working on behalf of main contractor Tarmac, S H Structures fabricated the 140t bridge and delivered it to site in three sections. Once assembled on land adjacent to the bridge's final installation position, a 1,200t-capacity crane was then used to lift the 44m-long × 6m-wide bridge into its final position.

"With the assembled bridge taking up significant space on site, the remaining confined environment meant the crane and its rigging only just fitted within site limits," said S H Structures Contracts Director David Perry.

"The crane's proximity to the river meant that a piled crane pad had to be provided for the lift and the bridge sits inside the curved concrete abutments with only a theoretical 50mm of clearance each side."

Once complete, the scheme will allow thousands of people to walk or cycle on a mostly off-road and traffic-free route connecting Cambridge North to Cambridge Station.

Feature steel staircase for landmark Bristol development



A steel helical staircase, to be fabricated by Taunton Fabrications, will be a feature element of a new 7-storey commercial scheme, which forms the latest phase of Bristol's Finzels Reach redevelopment.

Known as Halo, the steel-framed office block is being built by Willmott Dixon and has been designed to achieve a BREEAM 'Outstanding' rating, while providing 10,700m² of Grade A office space.

Developer Cubex said the building will set new standards of sustainability, wellbeing and digital connectivity for offices in Bristol.

Rising from Halo's ground floor, the cantilever stair will be fabricated into transportable elements by Taunton Fabrications. The 90t structure is due to be installed this summer (2021).

Located in central Bristol and next to the floating harbour, Finzels Reach was once home to sugar refiners and brewers. Now the mixed-use development will soon be the home and workplace of over 3,300 people. The new Halo building, which is due to complete in 2022, sits on the site of the former headquarters of Avon Fire and Rescue.

Trusses span major road to support new office block

A series of 16 large trusses have been installed across the A38 Queensway dual carriageway tunnel to support the construction of a new 14-storey steel-framed commercial development in Birmingham.

Approximately 1,900t of structural steelwork has been used to fabricate the trusses, which are up to 34.6m long and weigh up 130t.

Fabricated at BHC's Lanarkshire facility, the trusses were transported to site as complete sections, measuring up to 6m-wide.

Once on site, a 1,200t-capacity mobile crane, one of the largest in the UK, erected each of the trusses.

Steel erection of the main building, known as One Centenary Way, will begin in February.

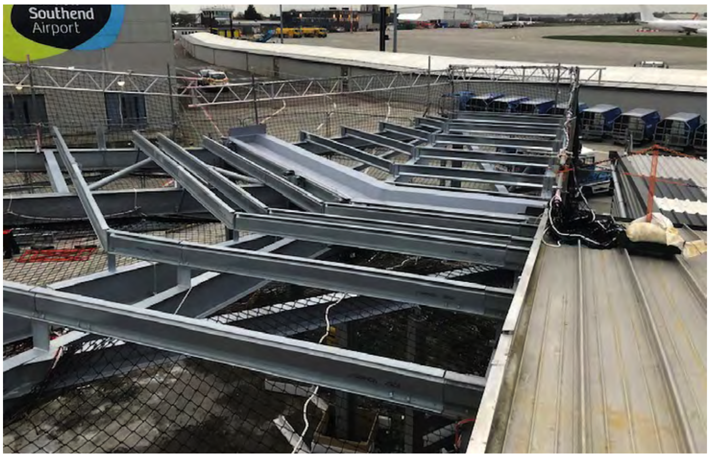
Designed by Birmingham-based Glenn Howells Architects for client Argent, the building will incorporate three-metre wide horizontal windows, encased within an exposed structural steel façade.

The innovative, structural-led design is said to be a response to the complex site location as it will overlook the transformed Centenary Square. The unique, exposed steel exoskeleton frame will provide a striking visual gateway to the area and become a major new landmark for Birmingham.

The building will offer large office floorplates of up to 2,090m² as well as retail space at ground floor level.

Working on behalf of main contractor Sir Robert McAlpine, BHC will eventually erect 6,900t of structural steelwork for the entire scheme.

New baggage hall arriving at London Southend Airport



Despite the COVID-19 pandemic and the resultant decline in air travel, Stobart Group is continuing its expansion plans at London Southend Airport. The work includes an extension to the terminal building's baggage area.

"The extension is required in order to comply with Department for Transport regulations to screen luggage using Standard 3," said XYZ Rail & Civils Senior Project Manager Roy Hill.

"As the Airport grows it needs to have the latest security X-ray equipment, so we are building an extension that wraps around the existing area on three sides to house these new machines as well as an extension to the conveyor system."

The extension consists of moment connection portal frames constructed from 254 UCs and 406UB main rafters. It abuts the existing terminal building, but there is no connection between the two steel frames, which are both structurally independent.

The project's steelwork contractor, Border Steelwork Structures has also installed the extension's cladding.

Construction work on the extension is due to complete in March and a fit-out programme is then due to begin in June, with the new and enlarged baggage area coming into full operation this summer.

Logistics hub planned for former steelworks site

Family-owned Russell Group is seeking permission to build a railhead logistics hub at Ravenscraig, central Scotland's former steelworks site.

The proposed development would serve as the company's UK headquarters, with the facility set to include a training academy while also functioning as a test bed for innovation in the transport industry.

If the plans are approved, construction work would begin towards the end of 2021 with the first phase of the development expected to be completed by early 2023. Further phases would continue to be delivered while the first section is operational, with overall completion by early 2026.

Diary

For SCI events contact Jane Burrell, tel: 01344 636500 email: *education@steel-sci.com* web: *https://portal.steel-sci.com/trainingcalendar.html*
For BCSA events contact Ana Girao-Coelho, tel: 020 7747 8127 email: *Ana.Girao-Coelho@steelconstruction.org*

Tue 12 January 2021
Update to EN 1993-1-1
General rules and rules for buildings
Webinar
This webinar will give an overview of the revisions to Part 1-1 of Eurocode 3 that has been issued for the formal 'CEN Enquiry' procedure, covering the change in scope, new sections, withdrawn sections and revisions to the key Section 5 on structural analysis.

Tue 12 January 2021
Composite Design - Part 2.
Webinar
SCI/BCSA Members only
Having established the benefits and general principles of composite construction in the first webinar, the second will focus on the latest developments and thinking.

Tue 19 & 26 January and 2 & 9 February 2021
STROBE
Online course
STROBE (Stronger Steels in the Built Environment) is a European research project developing cost-efficient design rules for structures made from high strength steels. This series of four webinars will inform engineers how to design high strength steels (HSS) in accordance with current European practice, as well as cover very recent advances in the understanding of the performance of HSS.

Tue 23, Thu 25 February and Tue 2 March 2021
Light Gauge Steel Design
Online course
This online course is delivered in 3 sessions and introduces the uses and applications of light gauge steel in construction, before explaining in detail the methods employed by Eurocode 3 for designing light gauge steel members in bending and compression and calculation of section properties.

Hybrid design transforming the site of famous London department store

A £50M high-quality commercial and retail scheme is being created on the site of the former Pontings department store at 127 Kensington High Street, in west London.

"The store was demolished and replaced with two newer structures in the 1970s and 80s. We have retained approximately 30% of these buildings and infilled and extended areas with a new steel frame, while also constructing two additional floors to the footprint," said ISG Project Director Raymond Faulks.

This hybrid design, which combines steel and concrete elements, both of which reuse the existing foundations, is said to be creating a very economical scheme.

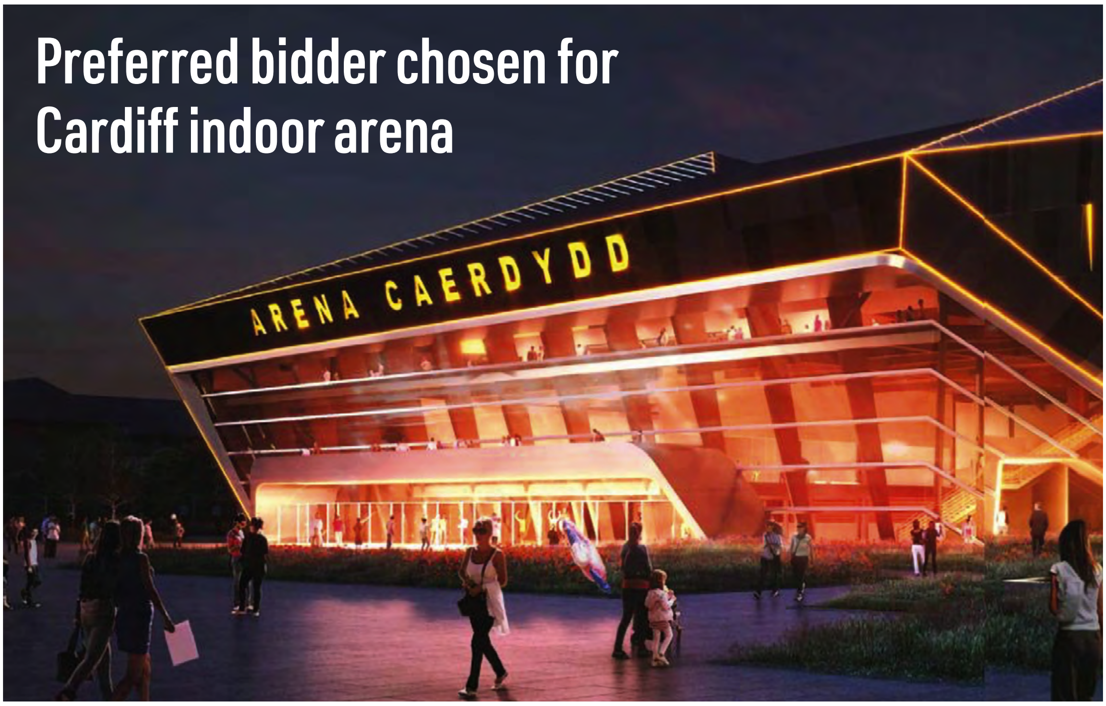
Overall, the new steel frame represents around 40% of the scheme and helps to extend part of the new building to its new five-storey height.

Targeting a BREEAM 'Excellent' rating, the scheme will accommodate commercial space on all floors, with retail taking up the majority of the ground floor.

As well as creating new floors, steelwork is also being used to restore the historic street line along both the Kensington High Street and Wrights Lane elevations. The previous buildings were set-back from the original basement walls, creating wider pavements. This unnecessary feature is being rectified with the addition of new steelwork to the retained portions of the structure. A new façade line over the original basement walls is adding 1.5m to the width of the building.

Bourne Steel is the project's steelwork contractor and the scheme is due to complete in late 2021.

Preferred bidder chosen for Cardiff indoor arena



Cardiff Council has identified Live Nation as its preferred bidder for a new 15,000-capacity indoor arena in Cardiff Bay.

The new venue will cost around £150M to build and will attract more than one million visitors and an estimated £100M into the local economy every year. It will also deliver new jobs for local people, with over 2,000 jobs created during its three-year build programme.

Cardiff Council Leader, Cllr Huw Thomas, said: "We remain committed to delivering a new indoor arena and we have taken a big step forwards.

"We believe the new arena will have a similar impact on Cardiff Bay, as St David's 2 had on the city centre. It will act as a major catalyst for the next-phase regeneration of Cardiff Bay delivering new jobs and opportunities where they are most needed."

Major West Midlands regeneration scheme set to start

One of the largest regeneration projects in the West Midlands has taken a step forward after property developer HBD exchanged contracts with Walsall Council and Homes England for the Phoenix 10 scheme.

Once the site of the James Bridge Copper Works, the 44-acre plot in Walsall has been derelict for over 20 years. It is set to become a centre for enterprise with up to 57,500m² of employment space, attracting new jobs and investment to the region.

HBD will deliver Phoenix 10, which is the largest undeveloped brownfield site in the region, on behalf of Walsall Council and Homes England, supported by funding from both partners, along with the Black Country LEP and the West Midlands Combined Authority (WMCA) which has agreed a multi-million pound funding deal to undertake the remediation works.

Office floors feature set-backs, that create terraces for the tenants.

King's Cross expands with steel

Striking a balance between future adaptability and occupier needs, combined with the requirement for slim structural floors and generous spans, meant steelwork was the ideal framing solution for the P2 Building.

Already home to numerous commercial and retail schemes, work is progressing on the latest steel-framed building on the 67-acre King's Cross development in the central London.

The P2 Building is a 12-storey structure, including two basement levels, that will primarily comprise office accommodation over nine floors. It will also include a 600-seat theatre with associated bar, and front and back of house facilities, while the ground floor on the south side will be dedicated to retail space.

Designed by Allford Hall Monaghan Morris (AHMM), the building has been described as having a defined base, middle and crown, whereby the upper floors are set back from the lower section to reduce the overall mass of the building and create a series of generous planted terraces at the fifth floor.

Working on behalf of main contractor Kier, Severfield has fabricated, supplied and erected 3,600t of steelwork and installed approximately 20,000m² of precast hollowcore planks for the project.

Typically, the upper floors comprise precast planks spanning onto steel beams internally and box sections at the perimeter. The slab structural system is then integrated by a reinforced concrete topping acting as a diaphragm. This form of construction is said to have allowed the team to achieve long spans, while maintaining a clean flat soffit throughout.

The only exception to this floor construction is a ground floor mezzanine level which, due to construction sequence requirements, is formed by a traditional metal deck with steel downstand beams. It is also hung, via Macalloy bars, from the structure above.

The soffit of the steelwork as well as the hollowcore planks and the services are all visible in the completed design, giving the building its desired industrial look, which is much sought after in today's office sector.

P2's exterior has a bespoke twin-layer design, with an inside glazing façade providing the structure with a watertight zone, while beyond this there is a second outer layer of precast panels.

"The panels form a 2m-deep exoskeleton and also create an aesthetic arrangement of shadows and depth," explains Kier Construction Manager Andrew Dewdney.

"The panels are fixed directly to the steel frame via fabricated steel brackets and consequently these extra loadings mean the columns are larger than would ordinarily be specified."

The overall building design also includes corners with no columns, which has been achieved with a double cantilevering system.

"There are cantilevering corners of variable spans reaching up to 5.3m length in each corner of the building," says AKT II Director Federica Ariu.

FACT FILE
P2 Building, King's Cross, London
Main client:
King's Cross Central Limited Partnership
Architect:
Allford Hall Monaghan Morris (AHMM)
Main contractor: **Kier**
Structural engineer: **AKT II**
Steelwork contractor: **Severfield**
Steel tonnage: **3,600t**

"The design of these fabricated beams, within tight tolerances and deflection limits, together with the detailing interface of the two cladding typologies was very challenging and could only have been achieved with steelwork."

"The design of these fabricated beams, within tight tolerances and deflection limits, together with the detailing interface of the two cladding typologies was very challenging and could only have been achieved with steelwork."

Within Severfield's overall steel tonnage the largest elements were some of the first to be erected. Four fabricated girders, measuring 20m-long x 2.9m-deep and 1.1m-wide were installed at level one to form the roof of the theatre. Creating the desired column-free space, the 50t girders span one half of the project's footprint and connect to the north face of the centrally-positioned core.

"For most of the steelwork erection we used the project's tower cranes, but for the installation of the transfer girders we had to utilise space in the loading bay, with minor hoarding modifications, and bring a large mobile crane to site. All four lifts were carried out in one weekend, which minimised traffic disruption to the surrounding streets," says Severfield Project Manager Kyle Fletcher.

Working in conjunction with the cranes, Severfield used a variety of MEWPs. Ordinarily the company would utilise a deck rider over the top flanges of the steel, or a MEWP frame supported by the steelwork. However, on this project the company used wheeled machines running on top of the grouted precast planks, that acted monolithically with the torsion resistance of the supporting steelwork. The company says this was the first time it had ever used this method, which proved to be a quicker and easier solution, while also being a business first, and potentially an industry first.

The theatre is a concrete structure independent of the main steel frame and designed as a box-in-box. Approximately 15m-high, the theatre encompasses the structure's ground floor and two basement levels. It also includes two steel-framed mezzanine floors, to be used for back-of-house areas.

As well as the ground floor and theatre mezzanines, the building has a further one at level nine. This mezzanine level has been formed with precast planks spanning onto steel beams kept within the depth of the slab. But, to enable double height areas in the office penthouse this level is also supported via Macalloy cables hanging from the roof structure.

The building's roof structure is formed by steel fabricated cranked beams spanning approximately 12m and also supporting the mezzanine floor below.

"Beyond the evident stiffness demand, a further challenge was imposed by the requirement of a minimum structural depth, inclusive of services penetrations, to maximize the mezzanine floor-to-ceiling height," adds Mr Ariu.

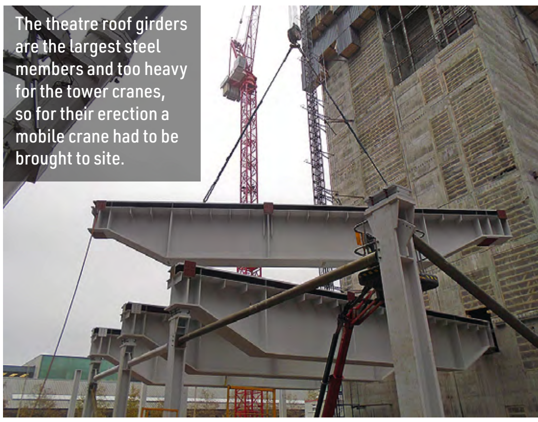
The cranked roof elements, measuring 12m-long x 4m-high and weighing 12t each, were made by Severfield as complete pieces, which required meticulous detailing and onerous fabrication tolerances to ensure the design specification was adhered to.

Summing up the project design, Federica Arui says: "A quite complicated load path driven by the transfer requirements, hanging floors and long spans demanded high attention in the calculation of the expected deflections. A detailed structural analysis was essential to inform the different pre-camber requirements adopted across various structural levels."

A BREEAM 'Excellent' rating is expected to be attained by the building, which is due to be completed in summer 2021. ■

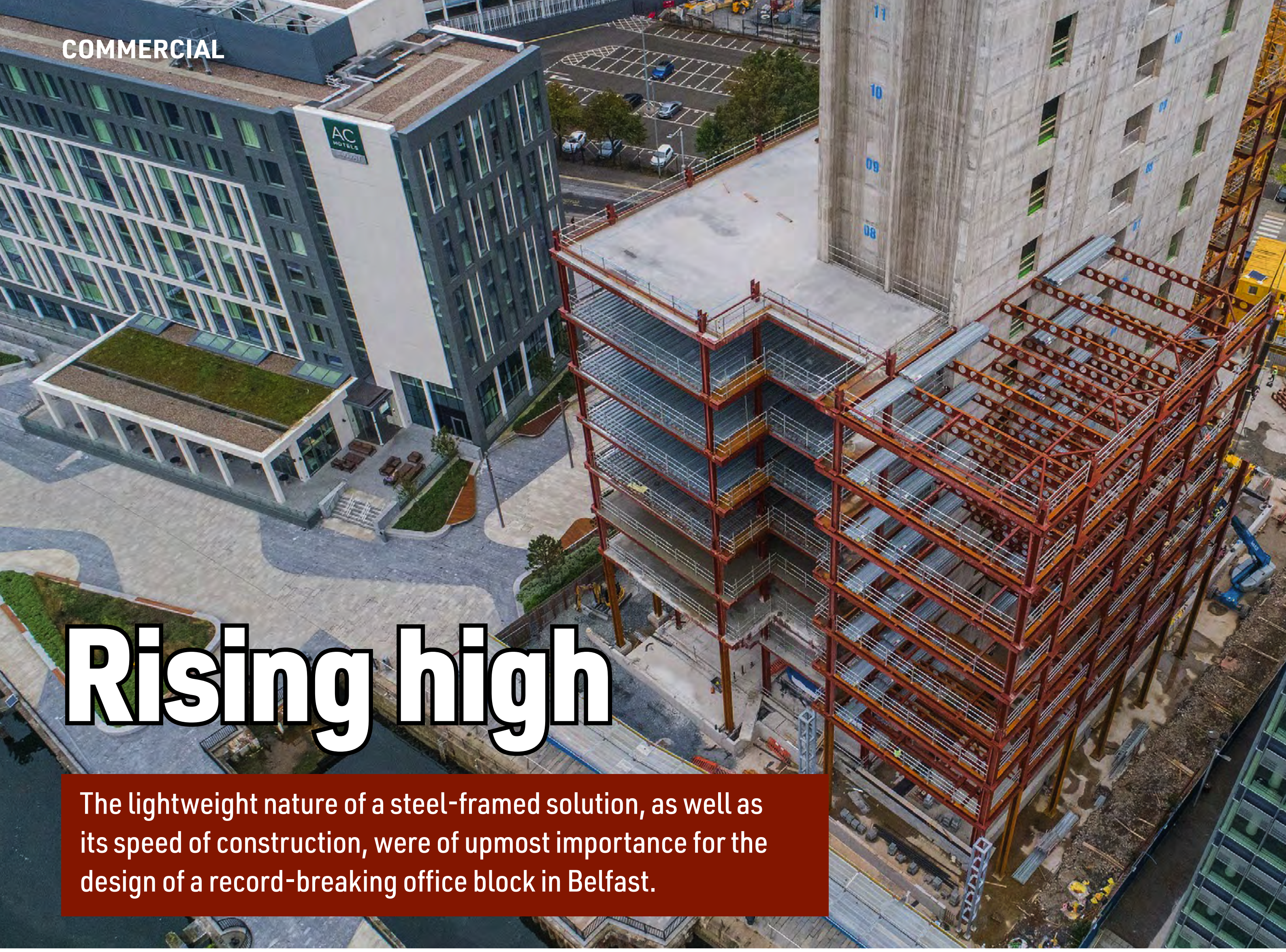

Visualisation of the completed building.


Four large girders span one half of the footprint at first floor level to create the roof of the theatre.


The theatre roof girders are the largest steel members and too heavy for the tower cranes, so for their erection a mobile crane had to be brought to site.


Cranked beams for the building's roof structure.


Once complete, P2 will be another landmark within the fast-expanding King's Cross development.



Rising high

The lightweight nature of a steel-framed solution, as well as its speed of construction, were of upmost importance for the design of a record-breaking office block in Belfast.

The commercial sector in Belfast is set to receive a significant boost when Northern Ireland's tallest-ever office block completes.

Known as City Quays 3, it is the fifth building in a much-wider city centre development and the third office block.

Topping out at 16-storeys, the steel-framed structure will offer more than 23,000m² of office space.

Structural steelwork has played a leading role in the overall development, as the completed City Quays 1 and 2, which are five-storeys and nine-storeys high respectively, are also steel-framed, as is the adjacent multi-storey car park.

Belfast Harbour's Chief Executive, Joe O'Neill, describes the project as one of the largest strategic investments ever undertaken by Belfast Harbour.

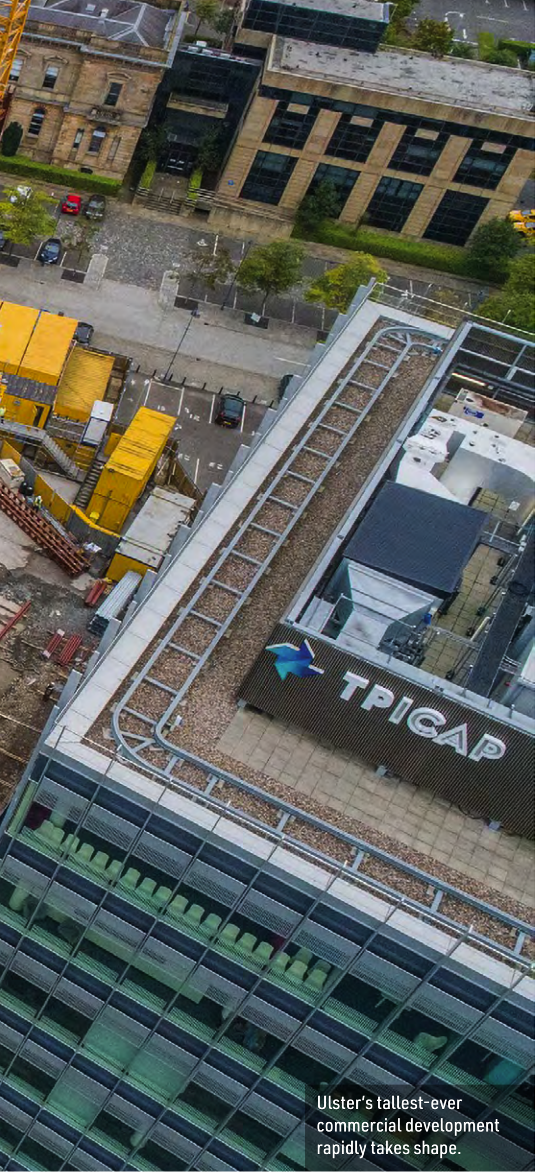
"In addition to supporting 500 local construction jobs, the office will build upon City Quays' success by providing strategic accommodation to meet demand for Grade A, city-centre office space.

"In just five years, City Quays has emerged as an iconic waterfront destination for sectors including legal, media, IT and financial services. Our experience of developing in advance of market demand, and the subsequent success in securing occupiers, has led us to progress City Quays 3. This investment will assist both indigenous and new market entrants and we have already had

Overlooking the city waterfront, the wider City Quays development has used steel to form two previous office blocks and a car park.

FACT FILE
City Quays 3, Belfast
Main client: **Belfast Harbour**
Architect: **RPP Architects**
Main contractor: **Farrans**
Structural engineer: **Doran Consulting**
Steelwork contractor: **Walter Watson**
Steel tonnage: **1,500t**

"Initially the building frame was to be constructed using reinforced concrete, however this was changed to steelwork in order to assist both the speed of construction and also to reduce the self-weight of the building, leading to a more economical foundation solution."



Ulster's tallest-ever commercial development rapidly takes shape.

very positive early discussions with a number of potential occupiers."

Upon completion, the building, which overlooks the River Lagan, will be able to accommodate around 1,800 office workers.

Because of its riverfront location, extensive groundworks had to be undertaken by the main contractor, as Farrans Project Manager Noel Cosgrove explains: "A hundred years ago or so the site was actually part of a much wider river and so the land is made-ground which was more recently used to accommodate warehouses.

"We had to do a soil improvement programme and then install more than 480 piles to support our concrete raft foundations."

Situated approximately 1.2m below ground level, the raft is 1.7m-thick and supports the building's core and steel frame.

Interestingly, the 750mm-diameter CFA piles, which are up 34m deep, are said to be the longest CFA's ever installed in Ireland and if the scheme had of gone with its original design plan, they would have been even deeper.

"Initially the building frame was to be constructed using reinforced concrete, however this was changed to steelwork in order to assist both the speed of construction and also to reduce the self-weight of the building, leading to a more economical foundation solution," says Doran Consulting Engineer Raymond Kinnaird.

Steel beams radiate outwards from a centrally-positioned concrete core to the perimeter columns, creating spans of up to 11.3m. There are no internal columns, so the building offers column-free space throughout.

As well as providing stability to the steel frame, the core accommodates six lifts, two stairwells and the building's washrooms and toilets.

The structure's internal beams are typically 600mm-deep Westok cellular sections, chosen because they offered the most efficient solution for accommodating the many building services within their depth.

The design also includes a composite floor solution, with the Westoks supporting metal decking and a concrete topping.

The Westok's are spaced at 3m centres, supported by the perimeter beams and the perimeter columns, which are on a 6m grid pattern.

Kloecker Metals UK Westok Design Team Manager, John Callanan says: "It's fantastic to continue our work at City Quays with the design and provision of Westok cellular beams at City Quays 3.

"The scheme is a classic clear-span steel-framed office development, with the provision of a full string of cells in the pre-cambered Westoks, providing the ultimate freedom for M&E service routes today and into the future."

The perimeter columns are 356UC sections from the ground floor up to level three, partly due to the fact that the lowest floor of the building is a double-height space as it contains the lobby and there are greater loads for the steelwork to carry.

Weighing 10t and measuring 16m-long, these steel columns were the largest single elements of the steelwork package.

Higher up the structure these columns decrease in size to 305UCs and then 254UCs for the uppermost six floors.

Steelwork contractor Walter Watson erected the first eight storeys using an 80t-capacity mobile crane. Because of site logistics and in order to work around the project's other trades, from level eight to the top, the steelwork erection was able to switch over to the use of the project's tower crane.

"Bringing steel to site is always a challenge when working in a city centre," sums up Mr Cosgrove. "We are working between two existing and occupied buildings, so we have to be fully aware of our neighbours. One of the ways we do this is to keep deliveries to a minimum and steelwork is brought to site on a just-in-time basis and erected immediately, as there is no room for material storage." ■


Overlooking the River Lagan; how the completed scheme will look.

FACT FILE
HS2 precast manufacturing facilities
Main client: **HS2**
Main contractor:
ALIGN JV (Bouygues Travaux Publics, Sir Robert McAlpine, and VolkerFitzpatrick)
Steelwork contractor: **Caunton Engineering**
Steel tonnage: **2,400t**

Large, quick to erect steel frames have proven to be the ideal solution to aid HS2's tunnelling and bridgeworks.

HS2 precast manufacturing facilities

Structural steelwork is playing a pivotal role in the HS2 project, forming the all-important facilities that will enable the construction of the Chiltern tunnels and the Colne Valley Viaduct.


HS2's steelwork being fabricated at Caunton's Moorgreen facility.

Europe's largest infrastructure project, High Speed 2 (HS2) is a publicly-funded scheme which is kick-starting a major upgrade of the nation's rail network.

Phase one of the project will link London and Birmingham on 140 miles of dedicated track. It will pass through more than 51km of tunnels and over 16km of viaducts, delivering quicker journeys on more trains with more seats. Phase one is scheduled to open between 2029 and 2033.

The initial phase of construction for this huge project includes the work currently being undertaken north west of London and just inside of the M25 motorway. Here a number of temporary steel-framed buildings are being erected, which will produce precast sections for the nearby 16km-long Chiltern tunnels and the 3.4km-long Colne Valley Viaduct.

Working on behalf of Align JV - a joint venture made up of three companies: Bouygues Travaux Publics, Sir Robert McAlpine, and VolkerFitzpatrick - steelwork contractor Caunton Engineering is responsible for designing, fabricating, supplying and erecting a total of 15 buildings.

The largest structures are a precast factory that will produce the concrete lining for the Chiltern tunnels and another facility, which will manufacture large precast sections, weighing between 100t and 140t, for the construction of the viaduct.

"Our large site for these new facilities is conveniently close to the tunnel's south portal and the northern end of the viaduct, and we also have our own dedicated slip road off the M25," explains Align Head of Communications Rob Hutchison. "This means we will be able to cast all the precast segments on site and avoid putting extra HGVs onto local roads, while the delivery of the required 2,400t of steelwork is also relatively straightforward."

The steel-framed precast tunnel lining factory is a large U-shaped structure on plan, with two 125m-long outer parts, that feature 35m-wide clear spans, reaching a maximum height of 15m. Completing the U-shape is a 30m-long link building, that will be used as a storage area.

Structurally the factory is a portal-framed building, that supports two overhead cranes – one in each side of the U-shape. Consequently, it needed to have a sturdy design as the frame supports crane beams.

The steel design for the largest buildings had to take crane movements into account as they accommodate overhead lifting equipment.

"Because of the crane movements in the completed building, we needed to keep deflections under control, so we designed the frame with larger columns than we'd ordinarily use and bigger base plates with more holding-down bolts, all of which provided the required stiffness," explains Caunton Engineering Project Designer Ervin Sisak.

More than 100,000 precast segments, weighing up to 8t will be produced in the factory.

The facility will feed two giant tunnelling machines – named Florence and Cecilia – which are due to launch next year. The 170m-long, 2,200t machines will spend more than 3 years underground using the segments to line the tunnels and moving at a speed of approximately 15m a day.

A second precast plant will be used to produce sections for the nearby Colne Valley Viaduct. This structure is rectangular in shape, measuring 105m-long × 40m-wide × 28m-high. Internally, the building features a clear span of 35m, for the main production area, which is serviced by two overhead cranes.

As the steel frame of this structure also supports crane beams and will also be subject to deflections, due to the movements of the lifting equipment, the perimeter columns are attached to a second series of crane beam-supporting members, forming a stiff vertical truss around the entire structure.

As well as these two main factories, the remaining steel-framed buildings are also quite substantial and sizeable buildings.

For instance, there are three aggregate storage sheds, measuring 80m × 20m, 36m × 20m and 28m × 20m respectively. All three of these braced frames, consist of steel columns sat on top of 5m-high concrete bunker walls. Each has three clad sides, leaving one elevation open to allow trucks to enter and exit.

Other portal-framed structures serving the precast facility and its tunnelling works, are a TBM warehouse measuring 35m-long × 9.5m-wide × 8m-high; a general warehouse measuring 30m-long × 20m-wide × 7m-high, which also includes a 10m-wide lean-to structure; and one TBM workshop which also includes an overhead gantry crane.

Completing the total of 15 structures are three further warehouses and four large sheds for de-sanding operations, filter presses and other spoil treatment activities. The portal frames for the latter are all single-span 20m-wide structures with a combined length of over 400m.

Explaining the choice of steel for the temporary buildings, Laurent Auvinet, Align Package Manager, Precast says: "We looked at a couple of options, including the use of supported tarpaulins, but steel-framed buildings are the most effective, because once the work is complete, they can be disassembled and reused or sold."

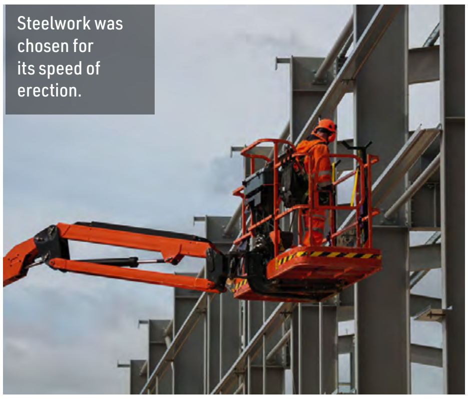
Once the precast plants are no longer required and have been disassembled, the whole site will be landscaped with material excavated from the tunnels and trees planted in order to blend it in with the surrounding countryside.

Summing up, Matthew Shimwell, Caunton Engineering Managing Director says: "We are thrilled to be working with the Align team in helping to deliver this key part of infrastructure work. The project is an excellent example of how early engagement with the supply chain brings real value to a project.

"This collaborative approach has helped to optimise the design of the buildings to more fully benefit from an informed DfMA (Design for Manufacture and Assembly) approach."

The buildings for the tunnelling works will be operational by May 2021, while the viaduct precast facility will start up production in October 2021. ■

"We looked at a couple of options, including the use of supported tarpaulins, but steel-framed buildings are the most effective, because once the work is complete, they can be disassembled and reused or sold."



Steelwork was chosen for its speed of erection.

The large site, adjacent to the M25, will supply materials for the Chiltern Tunnels and Colne Valley Viaduct.

Each roof truss was installed using a tandem lift

Flexibility spans the frame

The construction of a new state-of-the-art aquatics centre in the West Midlands has benefited from using structural steelwork in its design. Martin Cooper reports.

The construction of a facility that includes a swimming pool which conforms to Olympic regulations is not an everyday occurrence. Although the UK may have plenty of 50m-long swimming pools, there are currently only 10 that meet the requirements to hold international events.

That role of honour will increase when the Sandwell Aquatics Centre completes in 2022, and opens to the public the following year.

As well as an Olympic-sized 50m-long competition pool, the Centre will also include a 25m diving pool, a smaller studio pool and 1,000 permanent spectator seats along the western elevation.

Alongside the swimming facilities, there will be a dry-dive facility, 108-station gym, a 25 station ladies-only gym, three activity studios, a pair of four-court sports halls, indoor cycling studio, sauna/steam room, changing rooms and a café. Externally, a new urban park will feature a children's play area.

Being built on a former playing fields site, the Centre is founded on continuous flight auger (CFA) piled foundations with a suspended ground floor slab, due to relatively poor shallow ground conditions and high groundwater levels.

With an overall footprint of 120m-long × 70m-wide, the structure is a large steel braced frame. The choice of a steel-framed solution for the project was driven by the long span roof, which for the most part is supported by no internal columns.

The curved roof trusses span the width of the building accommodating both the sports hall and the pool hall.

A number of structural solutions were considered early in the design and a structural steel frame was found to be most effective.

This impressive span of 70m is created by a series of 14 roof trusses, which were erected in a phased programme.

According to Billington Structures, due to their size, each truss was fabricated in four pieces, which allowed them to be transported to site.

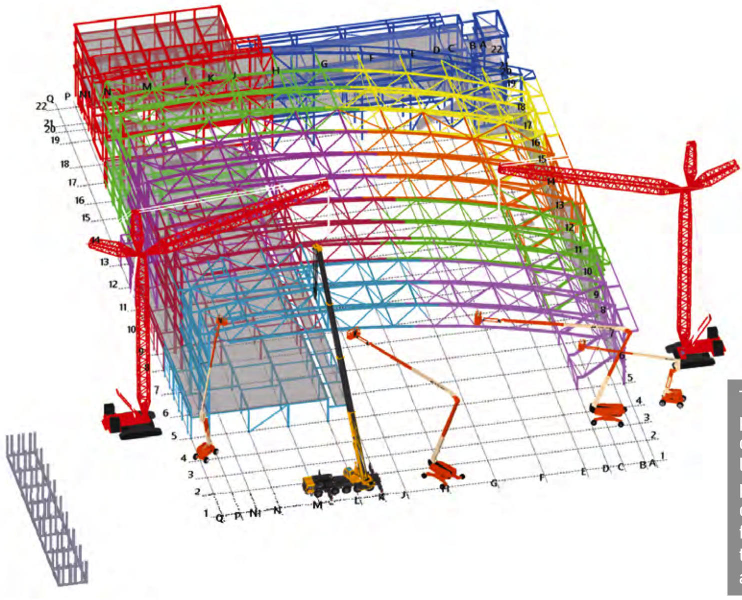
Once the truss sections were delivered to site, Billington used two laydown and assembly areas on either side of the building, where the steelwork was bolted together to form two halves of the entire roof truss.

Each half was lifted into position with a tandem lift using two 250t-capacity crawler cranes that brought the two pairs together in mid-air and this is where the final connections were made.

Once this final connection was completed, the entire truss was then manoeuvred to its final position, and the bolted connections to the perimeter columns were made with the aid of a

"The building has been designed to function as a venue for an international swimming competition without compromising the primary objective, which is to provide a legacy leisure and aquatic centre for the local community."

FACT FILE
Sandwell Aquatics Centre
Main client:
Sandwell Metropolitan Borough Council
Architect: **Roberts Limbrick Architects**
Main contractor: **Wates Construction**
Structural engineer: **Arup**
Steelwork contractor: **Billington Structures**
Steel tonnage: **1,800t**



Two cranes, positioned either side of the building, each lifted a truss half into place, while a third crane, sat within the footprint, helped with the final manoeuvring and connections.

90t-capacity mobile crane positioned within the footprint of the structure.

Supporting the trusses is a series of 22m-high columns positioned along the eastern elevation and a series of 13m-high columns on the opposite façade.

As an architectural feature, much of the project's steelwork will remain exposed within the completed project. But as a swimming pool can be a corrosive environment because of the chlorinated water, a total of eight different paint specifications, including both intumescent and corrosion protection systems, have been applied to the steelwork offsite.

"The structural design for the building has been particularly complex due to two distinct phases of construction," explains Arup Associate Mike Wood.

"The building has been designed to function as a venue for an international swimming competition without compromising the primary objective, which is to provide a legacy leisure and aquatic centre for the local community in Sandwell."

The roof trusses are curved and form a feature sloping roof. The geometry of this roof curvature has been optimised to provide sightlines for a 5,000-seat temporary seating terrace that is to be installed on a steel-framed upper floor along the eastern side of the swimming pool (which has the 22m-high columns). ▸20

The completed aquatics centre will have a feature sloping roof.

Truss sections are assembled into halves before being erected.

Steel has proven to be the right choice to form the Centre's 70m-long clear span.

▸19

"This innovative solution to accommodate the temporary seating within the envelope of the building minimised both time and cost by reducing the extent of the conversion works for legacy mode," adds Mr Wood.

Using steelwork for the project has provided the scheme with a number benefits, alongside the ease of creating the Centre's span and speed of construction, flexibility has also been designed into the steel frame.

After the building has been used as a competition venue this area of the building, used for the temporary seating terrace, becomes the zone that accommodates the sports halls along with changing rooms and fitness studios.

Additional steel-framed floors will be installed within the building envelope, with new steelwork spliced onto columns below and also located onto transfer beams.

Metal deck composite floors have been detailed for these legacy floors to minimise the weight of components that need to be lifted within the building.

Summing up, Councillor Maria Crompton, Acting Leader of Sandwell Council with the responsibility for leisure says: "We are excited that the main building work on this landmark leisure centre has started. The aquatics centre will give us an international-standard venue for the local community, replacing ageing leisure facilities with a modern hub designed to promote health and wellbeing across the district."

Sandwell Aquatics Centre is set to complete in spring 2022, with final handover to Sandwell Council in May 2023, when the building will be open to the public. ■

David Brown of the SCI discusses

The importance of corrosion protection in swimming pools

As soon as the words "swimming pool" are mentioned, all designers should think carefully about the corrosion protection required. Swimming pools are classified as corrosivity category C4 in BS EN ISO 12944-2, which is "high corrosivity". The atmosphere in an indoor swimming pool is one of the most aggressive to be found in a building environment, due to the products from chlorine-based disinfectants, the higher temperature and humidity.

Stainless steel is often considered as an appropriate material in this environment, although stress corrosion cracking must be considered. The risk of stress corrosion cracking increases when susceptible grades of stainless steel are specified, in the presence of a tensile stress and a specific aggressive environment – all three conditions must occur. More information on this is provided by the HSE[1] and the British Stainless Steel Association[2].

For the Sandwell Aquatics Centre, carbon steel was used, which of course needs careful consideration of the protection system. The Steelconstruction.info website offers standard protection systems specifically for steelwork in swimming pools. One system is galvanized with a further paint coating system, and two systems are built up from paint alone. Including the primer and site applied top coat, both paint systems result in a total thickness of 340 µm. This compares to a total thickness of 240 µm or 180 µm for the less aggressive C3 – medium risk environments.

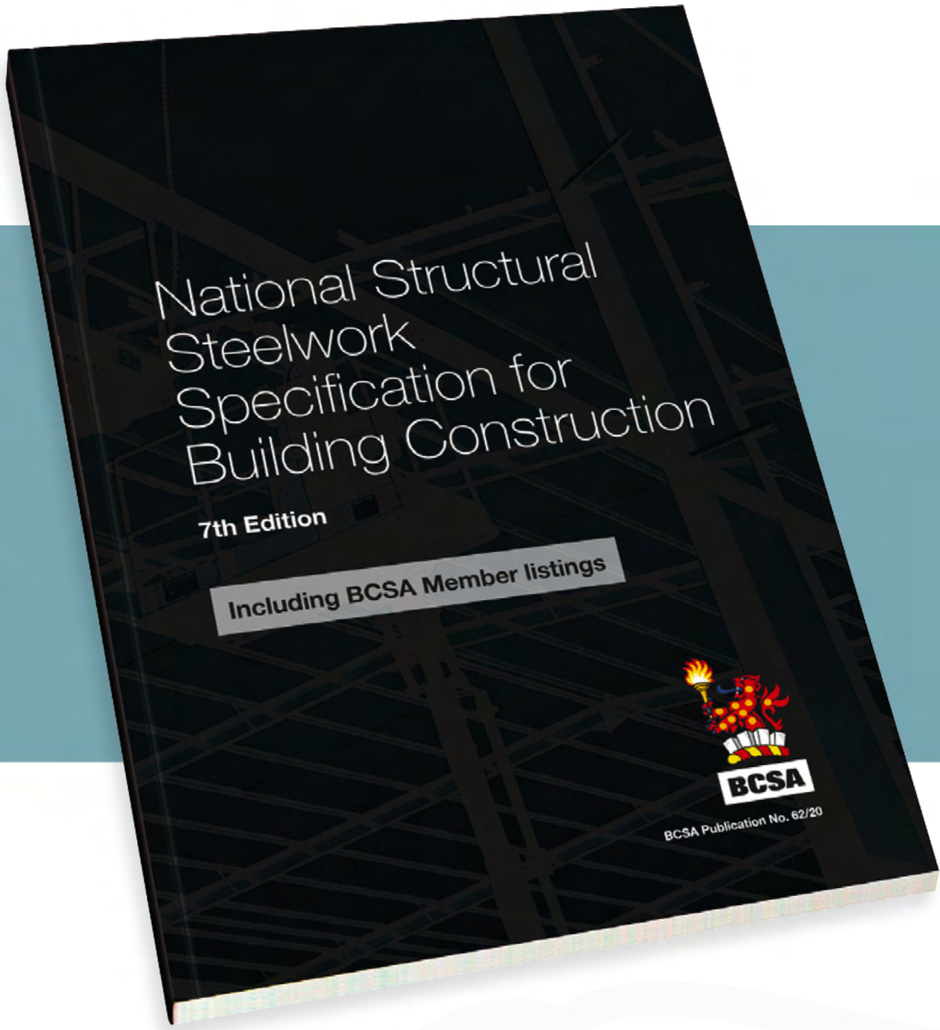
The notes to the table suggest that the life of the total protection system without maintenance should exceed 25 years, though it is anticipated that for aesthetic reasons, maintenance will be carried out more frequently.

In an aggressive environment such as a swimming pool, designers should also pay attention to the corrosion of components – such as bolts – which are often visible to the pool users and should be protected properly. Some usually hidden components, such as profiled steel sheet for decking, may be equally exposed to the atmosphere and therefore need additional protection. AD 247 has further advice on the protection of decking, proposing additional paint protection to the steel sheet, and offering suggestions on the protection of the top surface of steel beams which – in normal construction - are left unpainted.

In summary, all aspects of material selection and corrosion protection demand special attention when the structure is an indoor swimming pool.

1 https://www.hse.gov.uk/foi/internalops/sims/cactus/5_02_18.htm
2 Stainless steels for swimming pool building applications – selection, use and avoidance of stress corrosion cracking (SCC) – British Stainless Steel Association (bssa.org.uk)

NATIONAL STRUCTURAL STEELWORK SPECIFICATION



7TH EDITION PUBLISHED AND NOW ON SALE

The National Structural Steelwork Specification (NSSS) is an essential tool for structural engineers. The 7th edition has been extensively updated and represents the biggest change since its introduction over 20 years ago.

Key changes include:

- The inclusion of a new section on intumescent paint systems.
- A mandatory requirement for all steelwork contractors to put in place a third-party certified welding quality management system to relevant part of BS EN ISO 3834.
- An annex giving the requirements for Execution class 3 for static structures.
- An annex giving general guidance on Execution class 3 for building subject to fatigue such as crane supporting structures.

The 7th edition of the NSSS came into force on 1st January 2021

Copies of the 7th edition of the NSSS which now includes BCSA member listings can be obtained from www.steelconstruction.org and are priced at £20 for BCSA members and £25 for non members.

British Constructional Steelwork Association
4 Whitehall Court, Westminster, London SW1A 2ES
email: postroom@steelconstruction.org • Tel: 020 7839 8566

BCSA

Up the junction

Weathering steel has proven to be the ideal choice for a new 142m-long bridge forming an integral part of Highways England's A19 Testo's Junction Improvement Scheme.

The largest crane available was used in order to speed up the steelwork installation.

"Using a large crane meant we were able to complete the installation with the crane positioned in just two locations."

A multi-million-pound scheme, which aims to ease congestion and cut journey times at one of the busiest junctions in the North East has reached a significant milestone with the completion of the steel erection for its all-important flyover bridge.

Testo's roundabout is a major junction connecting the A19 with the A184 in South Tyneside. The work being undertaken will raise the A19 onto a flyover and build new slip roads to connect it to the A184 via the roundabout below, thereby allowing through-traffic on the busy trunk route to flow freely.

New routes will also be provided through the junction for pedestrians, cyclists and horse riders.

The A19 Testo's upgrade is a significant part of the government's five-year £15bn plan to improve the national road network. The improvements to the junction are being conducted with an investment of some £124.5M.

Currently, Testo's Junction suffers severe congestion at peak times, with delays of up to four minutes per vehicle. Traffic flows through the junction are expected to reach 83,400 vehicles every day by 2033. The scheme aims to improve journey times (savings of around four minutes by 2036) and increase capacity.

The centrepiece flyover bridge is a 142m-long weathering steel structure, fabricated, supplied and erected by locally-based Cleveland Bridge.

Weathering steel was chosen as it does not require

The completed junction will help to alleviate congestion along the busy A19.

any future maintenance or repainting. This is an important consideration for a bridge sat in the middle of a busy roundabout, where any maintenance work could cause significant traffic disruption.

In contrast to other steels, which usually look their best immediately after being erected, weathering steel is said to improve after a couple of years exposure to the elements. This is why architects increasingly specify it for use on buildings in a design where it is fully exposed.

"The colour of weathering steel can change from orange brown to a dark brown," explains Cleveland Bridge Head of UK Projects Andy Limbert.

"It takes about five years for the material to reach its ultimate patina, which generally looks aesthetically pleasing and surprises many people."

Prior to Cleveland Bridge delivering the first steelwork to site, Highways England's main contractor Costain had completed the foundations for the bridge using more than 130 concrete piles. This work was carried out over a series of weekend road closures and also included the construction of the supporting abutments and the bridge's two intermediate piers.

FACT FILE
A19 Testo's Junction Improvement Scheme, Tyne and Wear
Main client: **Highways England**
Main contractor: **Costain**
Structural engineer: **Jacobs**
Steelwork contractor: **Cleveland Bridge**
Steel tonnage: **1,393t**

To achieve the architectural vision for the scheme, the viaduct has been constructed with weathering steel.

The bridge has three spans, with the longest being the 54m-long central one between the two piers. Either side of the piers, there are two identical 44m-long outer spans from the north and south abutments.

The main bridge steelwork elements were fabricated as a series of 25 paired girders, complete with their connecting cross members. The longest pair of girders was 33m-long and the heaviest pair weighed in at around 60t.

A trial assembly took place at Cleveland Bridge's Darlington factory, which helped ensure a smooth and efficient final installation on site.

Along the length of the bridge there are five rows of paired girders, and these were erected in five phases. The connections between the girders had to be in the most optimum position.

A conventional span and cantilever erection sequence was adopted such that the connection between the span girders and pier girders could be made close to the point of contraflexure. This is where the loads on the girder are at a minimum and is usually about one quarter distance along each span.

The first two phases of the erection programme consisted of the first span from the south abutment and the girders positioned over the first pier. The third and fourth phases saw the steelwork span the second pier, and the fifth and final phase reached the north abutment.

A series of temporary trestles were used to support the steelwork during the erection programme, and these were only removed once the installation was complete and the bridge's permanent bearings had been grouted.

The steelwork was transported to site and erected over two weekends. All of the work was carried out while the busy roundabout was still in use, which added to the complexity of the lifting operations. All of the girders had to be lifted and installed straight from the delivery trucks, as there was no room for material storage. A 1,000t-capacity mobile crane was used to install the steelwork.

"Using a large crane meant we were able to complete the installation with the crane positioned in just two locations," says Mr Limbert. "This allowed for a quicker programme."

As well as the main paired girders, the steelwork erection also included bracing between the individual pairs, K-bracing elements at each abutment and two diaphragm beams.

Each of the diaphragm beams, like the bracings, add rigidity to the structure. They are positioned at 90 degrees to the main girders and span across each of the two piers.

Summing up, Highways England Project Manager Liam Quirk says: "Reaching the integral milestone of erecting the steel bridge beams – 99% of which were produced in the UK – is exciting.

"It's fantastic that people are now able to see this huge structure taking shape which, when ready, will reduce journey times for drivers and create safer and more free-flowing journeys.

"Putting the beams into place and completing this critical step of the scheme has been a huge collaborative effort from so many people, and I'd like to say a massive thank you to all involved. I'd also like to pass on my thanks to drivers and residents for their patience while we carry out the work."

The Testo's Junction scheme is due to complete in summer 2021. ■

U-Frame action design according to Eurocodes

Ricardo Pimentel of the SCI discusses the consideration of U-Frame action to restrain members susceptible to flexural and lateral torsional buckling according to Eurocodes.

Introduction

Buckling phenomena frequently govern the design of steel members under compression or for elements partially compressed. To achieve a good compromise between steel tonnage and performance, discrete restraints along the compressed member (or along the compressed part of the member) can be used. However, for certain cases, introducing restraints as part of an orthodox bracing system is not feasible and designers must use other options to achieve a capable structural solution. The use of U-frame action offers this opportunity.

U-Frame action general principles

The classic U-Frame action example can be found in "half-through" railway bridges[1],[2] or pedestrian bridges. The key concept of the U-frame action is illustrated in Figure 1a. The two longitudinal girders are subjected to a sagging bending moment, which causes compression in the top flanges. At certain locations along the bridge span, a continuous U-shaped frame is formed from the horizontal deck beams and vertical elements in the main girders – usually full depth stiffeners welded to the web. There is a stiff connection between the end of the deck beam and the vertical elements, so that an appropriate bending stiffness between the vertical elements and the floor beams is achieved. The flexural stiffness of the U-frame provides discrete spring restraints to the compressed beam flanges. These elastic restraints increase the resistance of the girders to lateral torsional buckling. The same principle can be applied to a trussed solution (Figure 1b). If the vertical posts of the truss are connected to the adjacent floor beam, the top compressed chords will have spring restraints, which will increase the out-of-plane flexural buckling resistance of the chord. The concepts described may be extended to other forms of construction based on the same principles.

Although the concept of U-frame action is often related to "half-through" railway bridges or pedestrian bridges, the concept may be also used when designing conventional downstand composite bridge beams during the construction stage or to prevent lateral torsional buckling of the compressed bottom flanges near the bridge internal supports. The typical configuration shown in Figure 1a may not suffice and bracing elements (typically forming a "K" shaped bracing arrangement) or haunched cross beam solutions may be provided to increase the stiffness and effectiveness of the restraints, to provide an effective torsional bracing or simply to establish clear segments for the beam buckling verification.

Structures such as portal frames[3],[4], multi-storey buildings with continuous composite beams or arched bridges may also rely on U-frame action to provide restraint against buckling.

General advice and design principles

The stiffness of the U-frames is the key for the structural behaviour and design. Care must be taken not only while selecting the members sizes but also while undertaking the connections design and detailing.

Semi-rigid connections will decrease the stiffness of the U-frame, which in turn will decrease the stiffness of the point restraints and therefore the buckling resistance of the restrained elements. The joint stiffness classification can be assessed based on EN 1993-1-8[5]. The stiffness of semi-rigid joints must be used while assessing the U-frame behaviour.

In addition to the stiffness of the elements forming the U-frame, the resistance of the elements must also be checked including second order effects. Guidance on the design is provided in references [6], [7], [8] and [9].

The objective when considering U-frame action is to address the elastic stability problem of the elements that are being restrained – typically the elastic critical buckling force for the compression element restrained by intermediate spring supports. Designers will then use typical buckling resistance verifications based on buckling curves according to Eurocode 3. Even for U-frame action in composite structures, the lateral torsional buckling resistance will still be based on the buckling curves from EN 1993-1-1[10] section 6.3.

U-Frame action in composite structures

Typical UK composite practice assumes simply supported beams, which offers a good compromise considering structural capacity, slab detailing and straightforward analysis and design. For certain cases – due to say high loading or atypical requirements for serviceability floor performance – a continuous solution may be utilised. The unrestrained steelwork of a continuous composite beam experiences compression over the supports and therefore is susceptible to local and member buckling. To avoid the unattractive practice of introducing restraints to the beam bottom flange, U-frame action may be considered, achieved by the combined behaviour of two adjacent parallel floor beams and the slab. The restraint to buckling is based on the stiffness k_s (Figure 2), which accounts for the stiffness of the

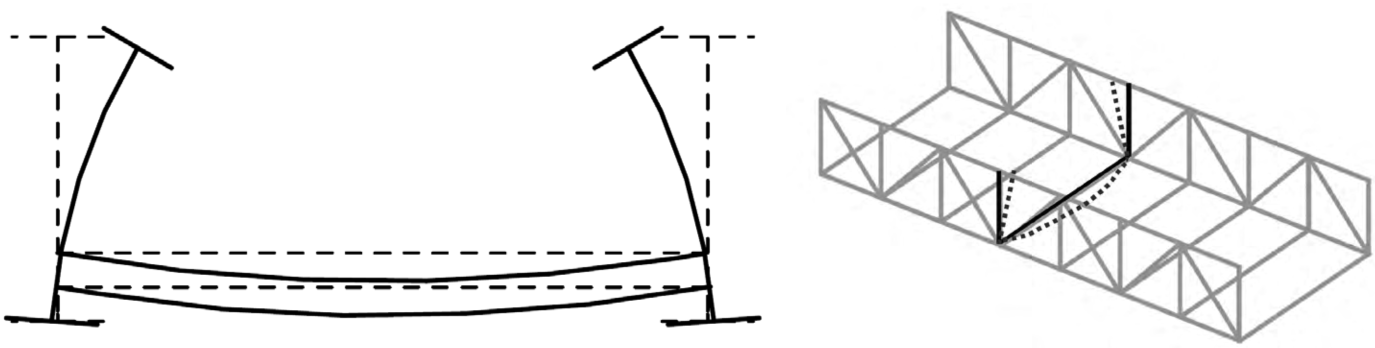


Figure 1: U-Frame action a) I-shaped girders – addressing lateral torsional buckling b) Trussed solutions – addressing flexural buckling

beam web and the slab. The design is covered by Eurocode 4[11] and further guidance on the buckling resistance of continuous composite beams can be found in reference [12].

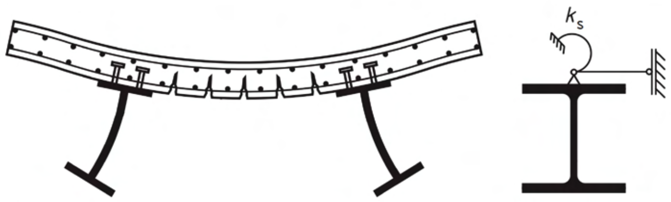


Figure 2: U-Frame action in a continuous composite beam

U-frame stiffness and design

For the typical U-frame configurations such as the ones presented in Figure 1, the stiffness C_d can be calculated from EN 1993-2[6] Table D.2 as follows:

$$C_d = \frac{E\,I_v}{\dfrac{h_v^{\,3}}{3} + \dfrac{h^2 b_q I_v}{2 I_q}}$$

Eq. (2)

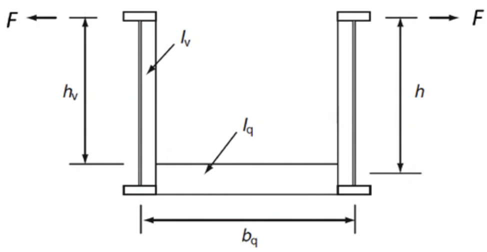


Figure 3: Generic model for U-frame stiffness calculation

where:

- I_v is the second moment of area of the vertical stiffeners;
- I_q is the second moment of area of the cross/horizontal member;
- h is the distance between the centroid of the compressed flange and the centroid of the cross member;
- h_v is the distance between the centroid of the compressed flange and the top of the cross member;
- b_q is the spacing of the main girders.

I_v may be calculated assuming the contribution of a web width equal to $t_s + 30\,\varepsilon\,t_w$[13], where t_s is the thickness of the vertical stiffener, t_w is the thickness of the web, $\varepsilon = \sqrt{(235 / f_{y,w})}$ and $f_{y,w}$ is the yield strength of the web. If flange plates are welded to the vertical stiffeners, the inertia I_v can be calculated based on the obtained equivalent "I" section. Higher stiffnesses can be achieved by specifying two double "T" shaped stiffeners on each side of the main girder web, which can each be cut from a standard "I" or "H" section. The stiffness of the connections between cross beams and verticals may be accounted for in equation 2 by adding the term h^2EI_v/S_j in the denominator, where S_j is the stiffness of the connection[2].

The assessment of U-frame stiffness may seem straightforward for the orthodox configuration shown in Figure 3. However, for certain cases the designer may wish to prepare a simple FE model from which the stiffness can be calculated. The stiffness can be calculated by applying a pair of forces "F" (Figure 3) in the U-frame, measuring the deflection at the tip of the flange and dividing the load by the measured deflection. The stiffness (C_d) may then be used to assess the elastic critical force of a top chord of a truss or for a compressed flange of a beam susceptible to lateral torsional buckling.

The elastic critical buckling force can be calculated based on an analytical approach or determined from FE models. The analytical approach, based on a beam supported by an elastic foundation, can be undertaken as follows, based on EN 1993-2 section 6.3.4.2 (6):

$$N_{crit} = mN_E \qquad \text{Eq. (3)}$$

where:

$N_E = \dfrac{\pi^2 EI}{L^2}$, where L is the distance between rigid braces;

$m = \dfrac{2}{\pi^2}\sqrt{\gamma} \geq 1$ where $\gamma = cL^4/EI$ and $c = C_d/l$, in which l is the distance between U-frames.

From equation (3), the buckling length of the compressed member can be obtained from:

$$l_{crit} = \sqrt{\frac{\pi^2 EI}{N_{crit}}}$$

Equation (3) assumes that the end frames are rigid, which will not be the case for most practical cases. The influence of the flexibility of the supports may be considered by replacing the variable "m" in Equation (3) by[14], [7]:

$$m_e = \frac{\sqrt{\gamma}}{\left(\dfrac{\pi}{\sqrt{2}} + \dfrac{0.69}{X + 0.5}\right)^2}, \text{ where } X = \frac{C_e}{\sqrt{2}}\left(\frac{l^3}{C_d^{\,3} EI}\right)^{0.25}$$

and C_e is the stiffness of the end frame according to equation (2).

The stiffness of the end supports will only have an influence in the design of critical segments close to the supports. The influence of the stiffness of the supports may be neglected for segments located at least $2.5 \times l_{crit}$ from the supports[7].

Design for flexural buckling according to Eurocode 3

Consider a 20 m span pedestrian bridge with two 1575 mm deep longitudinal warren trusses with additional vertical members as shown in Figure 4. The trusses are 3 m apart and the verticals spaced at approximately 1.67 m. Five U-frames are provided in the structural solution: 2 end frames and 3 interior equally spaced frames (5 m between U-frames). The axial loads in the chords are estimated as 550 kN at midspan. The design will be based on EN 1993-1-1 section 6.3.2.4 (1) or EN 1993-2 6.3.4.2.

A hot finished SHS 150 × 150 × 6.3 was selected for the preliminary design, which gives a buckling resistance of 673 kN for a 5 m buckling length and $\gamma_{M1} = 1.10$. The cross beams at U-frame locations have the same cross section (SHS 150 × 150 × 6.3: $I = 1220\ cm^4$).

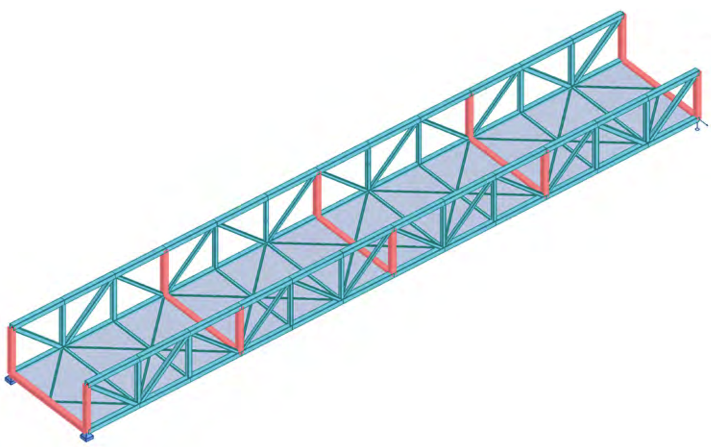


Figure 4: Trussed pedestrian bridge with 20 m span

The stiffness of the U-frames can be calculated as follows, using equation (2):

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$$C_d = \frac{210 \times 10^6 \times 1220 \times 10^{-8}}{\frac{1.35^3}{3} + \frac{1.425^2 \times 3 \times 1220 \times 10^{-8}}{2 \times 1220 \times 10^{-8}}} = 662.69 \text{ kN/m}$$

A simple FE model with bar elements was completed to compare the calculated U-frame stiffness. Rigid links were used to model the distance h_v. Forces with opposite directions represent the critical mode (producing higher deflection). From the analysis results, the deflection is 1.507 mm under opposing forces of 1 kN. The spring stiffness can be obtained as follows:

$$C_{d,FEM} = \frac{1}{1.507 \cdot 10^{-3}} = 663.57 \text{ kN/m}$$ which is very close to the value of 662.69 kN/m previously calculated (See Fig. 5).

Having calculated the U-frame stiffness, the elastic critical force can be determined:

$$c = \frac{C_d}{l} = \frac{662.69}{5} = 132.54 \text{ kN/m}^2$$

$$\gamma = 132.54 \times 20^4/(210 \times 10^6 \times 1220 \times 10^{-8}) = 8277.16$$

$$m = \frac{2}{\pi^2} \times \sqrt{8277.16} = 18.44$$

$$N_E = \frac{\pi^2 \times 210 \times 10^6 \times 1220 \cdot 10^{-8}}{20^2} = 63.21 \text{ kN}$$

$$N_{crit} = 18.44 \times 63.21 = 1165.44 \text{ kN}$$

The benchmark buckling resistance of the chord assuming a buckling length between U-frames is:

$$N_{E,5m} = \frac{\pi^2 \times 210 \times 10^6 \times 1220 \times 10^{-8}}{5^2} = 1011.44 \text{ kN}$$

It can be concluded that the U-frames are of benefit in restraining the chord if the end restraints were rigid, as the critical load (1165.44 kN) is higher in comparison with the value obtained (1011.44 kN) considering the distance between U-frames for the chord buckling length.

As the end restraints are also U-frames (and therefore flexible), the values calculated previously are not accurate. The flexibility of the end supports needs to be considered as follows:

$$X = \frac{662.69}{\sqrt{2}} \left(\frac{5^3}{662.69^3 \times 210 \times 10^6 \times 1220 \times 10^{-8}} \right)^{0.25} = 1.69 \text{ m}$$

$$m_e = \frac{\sqrt{8277.16}}{\left(\frac{\pi}{\sqrt{2}} + \frac{0.69}{1.69 + 0.5} \right)^2} = 14.13$$

$$N_{crit} = 14.13 \times 63.21 = 893.50 \text{ kN}$$

The chord effective length can be back-calculated as follows:

$$l_{crit} = \sqrt{\frac{\pi^2 \times 210 \times 10^6 \times 1220 \times 10^{-8}}{893.50}} = 5.32 \text{ m}$$

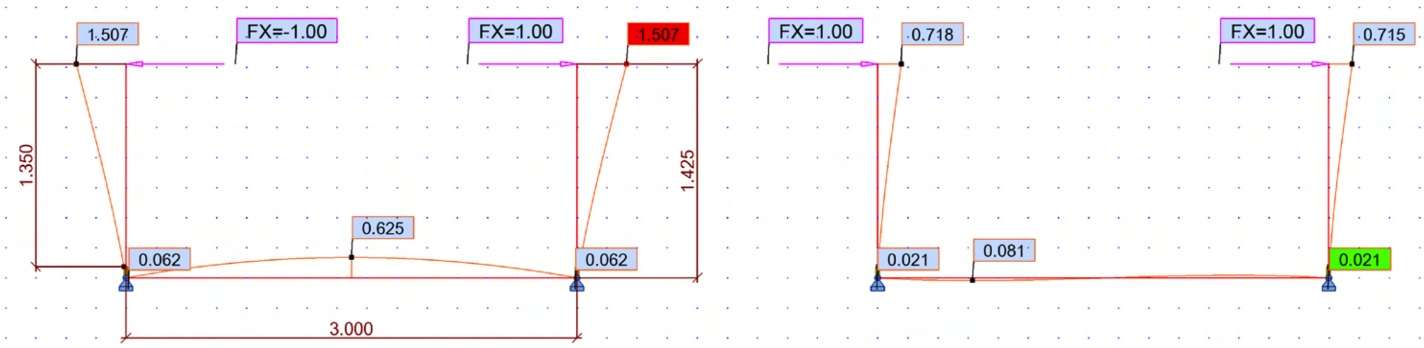

Figure 5: U-Frame stiffness based on a simple FE model[17]

The buckling length is shown to be a little longer than the system length.

As an alternative approach, a FE model was also completed to evaluate the elastic critical buckling load of the chord. The spring supports of 663.57 kN/m were modelled (including end frames). The buckling shape obtained for the cord is represented in Figure 6. Each bar was subdivided in 10 segments for accuracy[15],[16]. For simplicity, the axial load was considered constant along the chord, which is conservative. The analysis reports an elastic critical buckling resistance of N_{crit} = 985.42 kN.

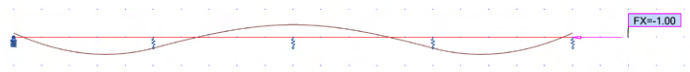

Figure 6: Chord elastic critical buckling load - flexible supports[17]
10 FE per par. Critical multiplier: α_{crit} = 985.42, N_{crit} = 985.42 kN

The effective length for the chord based on the FE analysis is therefore:

$$l_{crit} = \sqrt{\frac{\pi^2 \times 210 \times 10^6 \times 1220 \times 10^{-8}}{985.42}} = 5.07 \text{ m}$$

A FE model was also completed to evaluate the impact of the axial load gradient in the compressed chord. The results are shown in Figure 7. The model with constant axial force shows a lower resistance, as the less stable end segments had a higher axial force. The analysis reports an elastic critical buckling resistance of N_{crit} = 1193.99 kN.

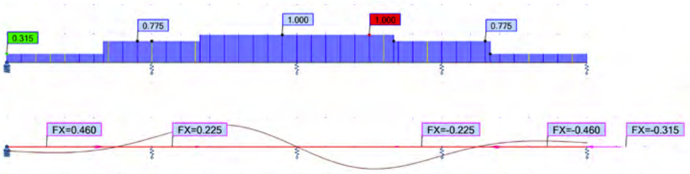

Figure 7: Chord elastic critical buckling load - flexible supports with axial load gradient[17]
10 FE per par. Critical multiplier: α_{crit} = 1193.99, N_{crit} = 1193.99 kN

The new effective length for the chord based on the FE analysis is therefore:

$$l_{crit} = \sqrt{\frac{\pi^2 \times 210 \times 10^6 \times 1220 \times 10^{-8}}{1193.99}} = 4.60 \text{ m}$$

It can be concluded that both analytical and numerical approaches show a good agreement. The chord member could then be checked against EN 1993-1-1/EN 1993-2 rules for member stability using the back-calculated effective buckling length.

More sophisticated analyses may be undertaken where the elastic critical buckling load is obtained directly from 3D FE models. The designers must ensure that the internal bar releases and support conditions are correctly modelled to obtain a realistic behaviour of the structure. Such models may be completed using bar elements or with shell elements. The elastic critical buckling loads may differ from the more simplistic models due to the three-dimensional structural behaviour. Shell element models can be also used to more accurately obtain the U-frame stiffness as shown in Figure 5, which may also include the stiffness of the connections. The simple model represented in Figure 5 may also account for joint stiffness by including spring internal bar releases at the joints.

Design for lateral torsional buckling according to Eurocode 3

To illustrate the process applied to an "I" beam, consider a half-through bridge with a 42 m span. The main girders are spaced apart by 9 m. At a preliminary design stage, the top flanges were defined as 1000 × 120 mm plates, the bottom flanges 1500 × 70 mm and the webs 2810 × 20 mm. All plates were S460 (yield strength of 390 MPa for the top flange and 440 MPa for the web). The cross girders are spaced at 3.5 m centres along the bridge span and have a total depth of 700 mm, a centroid at half depth and a major axis second moment of area of 4.50×10^9 mm^4. The vertical "I"-shaped posts of the U-frame have a second moment of area of 1.20×10^9 mm^4, which comprises a gusset of 400 × 15 mm perpendicular to the web, an end plate of 425 × 40 mm and a web contribution of $\sqrt{(235/440)} \times 30 \times 20 + 15 = 453.50$ mm.

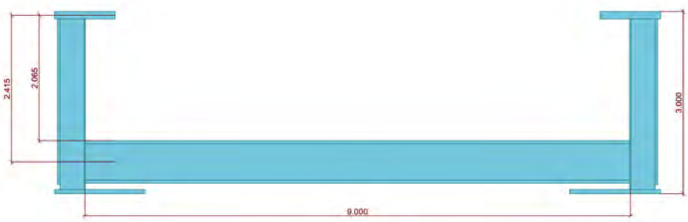

Figure 8: Half-through bridge with plated girder worked example geometry

The challenge of the worked example is to check the main beam for lateral torsional buckling accounting for the contribution of the U-frame action provided by the cross beams and vertical stiffeners. The design will be

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▸27 undertaken based on EN 1993-1-1 section 6.3.2.4(1) / EN 1993-2 6.3.4.2. The process will be analogous to the one described in the previous worked example, but for this case an equivalent compression strut needs to be defined for the process. EN 1993-2 clause 6.3.4.2(7) states that the area of the equivalent strut may be assumed the area of the compressed flange plus 1/3 of the compressed web area, accounting for the effective web area due to local plate buckling. The main beam cross section is class 4 under sagging bending moment due to the slender web. The effective cross section area is represented in Figure 9. In this example, the effective area of the equivalent strut is therefore $A_{eff} = 1000 \times 120 + 20 \times (373.85 + 560.77) / 3 = 126230.80$ mm². The equivalent strut out of plane second moment of area is based on the flange plate (ignoring the small contribution of the web), which has a value of $I = 1.0 \times 10^{10}$ mm⁴.

According to Figure 3, the example comprises the following data:

I_v [mm⁴]	1.20×10^9
I_q [mm⁴]	4.5×10^9
h_v [mm]	2065
h [mm]	2415
b_q [mm]	9000
C_d [kN/m]	25367.74
C_e [kN/m]	25367.74
C [kN/m²]	7247.92
γ	10739.68
m	21.00
X [m]	0.60
m_e	12.77
N_e [kN]	11749.53
N_{crit} [kN]	150035.68
A_{eff} [mm²]	126230.80

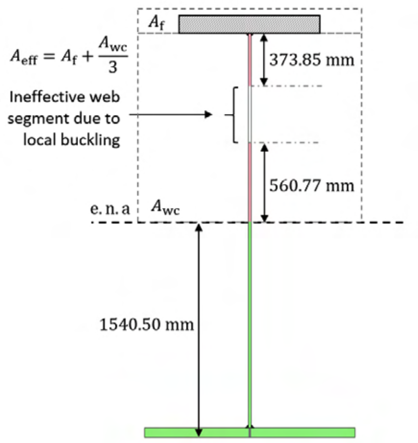

Figure 9 : Main beam effective area[18]

The normalized slenderness to calculate the lateral torsional buckling resistance of the girder can be calculated as follows – EN 1993-2 section 9.3.4.2(4):

$$\bar{\lambda}_{LT} = \sqrt{\frac{A_{eff} \times f_y}{N_{crit}}} = \sqrt{\frac{126230.80 \times 390 \times 10^{-3}}{150035.68}} = 0.57$$

As $\bar{\lambda}_{LT} > 0.20$ the beam is susceptible to lateral torsional buckling. With the value of $\bar{\lambda}_{LT}$, the buckling verification according to EN 1993-1-1 section 6.3 can be undertaken.

Similar FE models could be used to evaluate the elastic critical buckling resistance as described for the previous pedestrian bridge worked example.

The calculations presented above assume that the flange is subjected to a constant bending moment. The bending moment gradient for the segment under analysis may be allowed for according to EN 1993-2 section 6.3.4.2 (7) Note.

For the cases where the concrete deck is effectively connected to the beam webs, the stiffness I_q may be considered as the second moment of area of the deck (see reference [12]) and $I_v = t_w^3/12(1 - v^2)$, where v is Poisson's ratio[19].

Conclusions

1. U-frame action is present in many forms of construction, from single- and multi-storey buildings to bridges, related with steel or composite structures;
2. U-frame action may be used to provide elastic (spring) restraints to elements which at first sight may look like an unrestrained component, such as a compressed chord susceptible to flexural buckling or a flange of a "I" girder susceptible to lateral torsional buckling;
3. The stiffness of the connections between U-frame elements is important if the stiffness of the U-frame is to be correctly calculated;
4. U-frame action is used with elastic stability calculations, so that N_{crit} and then $\bar{\lambda}$ may be calculated for elements susceptible to flexural buckling.
5. For members subject to lateral-torsional buckling, a non-dimensional slenderness $\bar{\lambda}_{LT}$ may be calculated.
6. U-frame action can be accounted for by undertaking an analytical procedure based on available guidance or based on a more general method using FE analysis; in the examples shown, a good agreement between the two possible design routines was achieved.

References

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AD 455: Design resistances for bespoke components in P358 (Green Book)

A reader has questioned the design resistances tabulated for bespoke components in P358 – the Green Book for nominally pinned joints to Eurocode 3.

The specific question related to the difference between the values quoted for Hollo-Bolts in Table G.60 and the data provided by the manufacturer.

The manufacturer provides *characteristic* resistances in their data for use with Eurocode designs. The Green Book tabulates *design* resistances, which are the characteristic resistance divided by the γ_{M2} factor, which in the UK National Annex is specified as 1.25

Typical values of the characteristic resistances provided by the manufacturer are 124 kN in tension and 211 kN in shear for an M20 Hollo-Bolt.

The design resistances in Table G.60 are 99.2 kN and 169 kN respectively, being the characteristic resistance divided by 1.25

Designers should note that the Green Book was first printed in 2014 and contains data appropriate at that time. It is quite possible that manufacturers may have subsequently changed material specification or component geometry, so checking with the manufacturer's latest data is advised.

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New and revised codes and standards

From BSI Updates November 2020

BS EN PUBLICATIONS

BS EN ISO 1460:2020
Metallic coatings. Hot dip galvanized coatings on ferrous materials. Gravimetric determination of the mass per unit area
supersedes BS EN ISO 1460:1995

BS EN ISO 2409:2020
Paints and varnishes. Cross-cut test
supersedes BS EN ISO 2409:2013

BS EN ISO 2810:2020
Paints and varnishes. Natural weathering of coatings. Exposure and assessment
supersedes BS EN ISO 2810:2004

BS EN ISO 15792-1:2020
Welding consumables. Test methods. Preparation of all-weld metal test pieces and specimens in steel, nickel and nickel alloys
supersedes BS EN ISO 15792-1:2008+A1:2011

BS EN ISO 15792-2:2020
Welding consumables. Test methods. Preparation of single-run and two-run technique test pieces and specimens in steel
supersedes BS EN ISO 15792-2:2008

BS EN 10210-3:2020
Hot finished steel structural hollow sections. Technical delivery conditions for high strength and weather resistant steels
no current standard is superseded

CORRIGENDA TO BRITISH STANDARDS

BS EN 10219-3:2020
Cold formed welded steel structural hollow sections. Technical delivery conditions for high strength and weather resistant steels
Corrigendum, October 2020

BS EN ISO 14002-1:2020
Environmental management systems. Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area. General
Corrigendum, September 2020

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS EN 10034:1993
Structural steel I and H sections. Tolerances on shape and dimensions

BS EN 10279:2000
Hot rolled steel channels. Tolerances on shape, dimension and mass

NEW WORK STARTED

EN XXX
Sustainability of construction works. Environmental product declarations. Horizontal rules for business-to-consumer communication
will supersede None

EN ISO 11124-5
Preparation of steel substrates before application of paints and related products. Specifications for metallic blast-cleaning abrasives. Steel cut wire shot
will supersede BS ISO 11124-5:2019

EN 1991-2
Eurocode 1. Actions on structures. Traffic loads on bridges and other civil engineering works
will supersede BS EN 1991-2:2003

EN 1993-1-8
Eurocode 3. Design of steel structures. Design of joints
will supersede BS EN 1993-1-8:2005

EN ISO 15611
Specification and qualification of welding procedures for metallic materials. Qualification based on previous welding experience
will supersede BS EN ISO 15611:2003

EN ISO 15613
Specification and qualification of welding procedures for metallic materials. Qualification based on pre-production welding test
will supersede BS EN ISO 15613:2004

FROM
Building with Steel
November 1970

Clad in Cor-Ten

In this article Valerie and John Winter describe the house they designed for themselves and their family. It is interesting as being the first application of Cor-Ten to a private house in the UK.

This is the second house we have designed for ourselves, and experience of living in the first one taught us to know what we wanted - lots of space, lots of light and outlook, yet privacy. During the seven years that elapsed between the designs of the two houses we had three children, and it is largely on their account that the second house is three and a half times the size of the first.

Site

The site is the north part of the garden of a house originally built for the Superintendent of Highgate Cemetery, and the great stone capped brick wall which surrounds the cemetery goes round our site, giving us privacy and acting as a retaining wall for the garden which is six feet higher than the road. The western part of the garden has mature apple trees, and although these now touch the house, the builders were careful and the trees were not damaged in the building process.

Planning

Fine views from the top and the need to keep as much garden as possible led to a three-storey house; and as the roof terraces of the previous house had been a source of worry with the children, the upper floors of the new house were to be sealed. Requirements for two living-rooms, dividing activities on a quiet/noisy basis determined the internal layout.

Only the ground floor relates to the garden, and this is emphasized by an earth-coloured quarry-tile floor at the same level as the outside ground. Two-thirds of the ground floor is the place where it all happens - record playing, cycling, model making, eating, cooking, shouting, music practice and the rest; in good weather the floor is opened out on to the garden, which because of the surrounding wall becomes part of the house. Also on the ground floor, and with its own outside door, is the spare room with adjacent bathroom which can be au pair's room, granny flat, teenagers' den, or rented off as the need arises.

The middle floor is the sleeping floor and acts as a buffer between noisy ground floor and quiet top floor. The bathroom is large and doubles as a laundry; children's clothes are stored here and sorted on a long low bench under the window.

The top floor is open with a central fireplace separating the living area from the place where we both work. This floor is basically a calm quiet area for us, but it serves, like a Victorian parlour, as a place which is usually civilized, no matter what noisy entertaining is being carried on elsewhere.

Garden

The site always had that quality of a slightly abandoned Victorian country garden; we have tried to keep that ambience but amend it to work better for children - areas paved with old bricks, rough grassy banks with the indigenous bluebells and cow-parsley growing in profusion. An outside table and benches enable instant use to be made of any good weather and saves having to clear up after children's meals - the foxes come and polish off the scraps! The site includes a partly filled-in tunnel through which Karl Marx, Herbert Spencer and all the others were carried to their graves in the east part of the cemetery; now abandoned and overgrown, it is a magical adventure playground, officially out of bounds to children, but sneaked into to bring back caches of marble chippings once intended to decorate a tomb.

Construction

We built in steel because we wanted some open floor areas, because we might want to change the internal layout, because we feel fenced in by solid walls and because of the discipline it gives to a plan. For a house of this size and quality, the cost of a steel building was about the same as a brick building because the budget had to carry research costs (no one knew of a glazing mastic that worked with Cor-Ten). Also we often had to design with the materials we could get, not with the materials we wanted. Costs should be lower with steel as experience widens and materials become more readily available.

The twelve-foot-bay size relates to the 4ft width of so many building materials, to the standard sliding doors on the ground floor and to the maximum span of the channel reinforced wood wool roofing slabs.

In England, unlike America, the cold season is a damp one, so steel structures will run with condensation unless they are either wholly external or wholly within the heated envelope of the building. Our structural frame is internal, it has three 20ft x 12ft bays, with 6in x 6in columns and 10in x 4in beams which in some cases have short lengths of mild steel channels welded to their top flanges so that they form the tension boom of a composite beam with the concrete floor slab as compression boom - an arrangement which keeps the floor beams shallow and enables similar depths of beam to be used everywhere without the lightly loaded edge beams being unduly oversized. Outside the mild steel structural frame is 2in insulation and then ¼in Cor-Ten A plates welded together to form a continuous cladding system to the frame. Double-glazed panels and fixed wall panels are theoretically interchangeable and the wall panels consist of 12 gauge Cor-Ten A sheet steel bonded to Asbestolux panels, and, like the glass, these panels are pressed in behind the steel facings to the frame, set in Rubboseal mastic and secured internally with a mild steel angle.

Ventilation to the upper floors is by storey height flaps of 12 gauge Cor-Ten A-faced polyurethane foam panels set in galvanized universal steel window sections closing on to a neoprene strip, these flaps are centre pivoted so that the widest opening is 5in and no child can fall out and no intruder can get in. Cor-Ten is surely the first modern building material that stands up to the rough use a building gets; it is left to weather, and to prevent the weathering becoming too uneven all projections and recesses have been kept to within ½in. A splayed quarry-tile plinth at the base of the house accepts the stained run-off water before the Cor-Ten has developed its final patina.

The top floor of our previous house was of lightweight construction and we had experienced some discomfort from rapid solar heat gain and from condensation. To obviate this situation we needed a thermal flywheel inside the insulation so whenever the choice was open we have chosen mass-screeded roof, concrete floors, concrete-block partitions, massive fireplace, and all external wall panels are backed with 1 ½in polyurethane foam, then 4in concrete block; the ambient internal temperature now changes slowly, and enables off-peak electricity to be used for heating, coupled with a fan-assisted booster on the top floor controlled by an external thermostat.

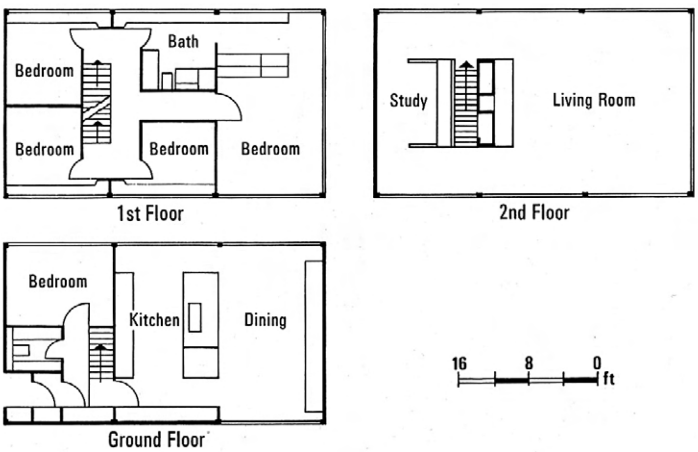
Furnishing

Finishes on the ground floor are tough, for, apart from family wear and tear, our downstairs living-room serves as a play group for twenty toddlers every Thursday.

Interior on the first floor

Interior on the ground floor. Note exposed steel

Cor-Ten cladding



The carpet begins at the bottom stair and signifies that the upstairs environment is to be treated with more respect; children's rooms have cork walls for pin-ups and a bench across the window so that things do not get piled against the glass. The top floor living-room has the most beautiful furniture we could find.

Curtains everywhere are white terylene, and are not seamed so that they can be washed in manageable armfuls and drip dried; the curtain tracks are fixed to the underside of the steel to emphasize the frame.

In choosing the furniture, as in the design of the house itself, we have tried to avoid anything trendy, and to make decisions which will still seem right when the mortgage is paid off in 1994.

Architects: John Winter & Associates.
Structural Engineer: Herbert Heller

Steelwork contractors for buildings

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

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

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

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

FPC Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1   2 – Execution Class 2
3 – Execution Class 3   4 – Execution Class 4

BIM BIM Level 2 assessed

QM Quality management certification to ISO 9001

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

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3		Silver	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●							●		✔	2	✔	Gold	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●		●		●	●	●			●	●	✔	4		Silver	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000*
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £800,000
Arromax Structures Ltd	01623 747466			●	●	●	●	●	●	●	●				●		2			Up to £800,000
ASME Engineering Ltd	020 8966 7150			●	●	●		●		●	●			●	●	✔	4		Gold	Up to £4,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●			●	●			●	●	✔	2			Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●	●	✔	2	✔	Silver	Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●			●	✔	4		Silver	Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4	✔	Silver	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Group Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●		●	●	●	✔	4			Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		Gold	Up to £4,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	Gold	Above £6,000,000
Cementation Fabrications	0300 105 0135	●			●		●	●	●	●	●		●	●	●	✔	3		Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		Gold	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011			●	●		●			●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £1,400,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £40,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●	●	●	●		●	●	●	✔	4			Up to £400,000
Duggan Steel	00 353 29 70072	●	●	●	●	●	●	●	●		●				●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	4		Gold	Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	✔	Gold	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●		●	●	●			●	✔	3		Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●			●		●	●	●	●	●		●	●	●	✔	3		Member	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●		●	●				●		2			Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
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
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			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 640133			●	●	●	●	●			●					✔	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 £3,000,000
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 £1,400,000
Newbridge Engineering Ltd	01429 866722	●	●	●	●	●	●	●			●	●				✔	4		●	Up to £2,000,000
North Lincs Structures	01724 855512			●	●					●	●				●		2			Up to £800,000
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									●					●	✔	2			Up to £1,400,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		3			Up to £1,400,000
Robinson Structures Ltd	01332 574711			●	●	●	●				●				●	✔	3			Up to £2,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●	●	●	●	●	●			●	✔	4	✔	●	Up to £3,000,000
SAH Luton Ltd	01582 805741			●	●	●				●	●			●	●		2			Up to £800,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £200,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●				●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £2,000,000
South Durham Structures Ltd	01388 777350			●	●	●				●					●		2			Up to £800,000
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
Taunton Fabrications Ltd	01823 324266				●					●	●				●	✔	2		●	Up to £2,000,000
Taziker Industrial Ltd	01204 468080	●		●	●		●			●	●		●	●	●	✔	3			Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●			●	●			●	●	✔	2			Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	3	✔	●	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 Haley Engineering Ltd	01278 760591				●	●	●									✔	4		●	Up to £6,000,000
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, ● = Member)

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

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

BCSA steelwork contractor member	Tel	FB	CF	SG	PG	TW	BA	CM	MB	SRF	FRF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
AJ Engineering & Construction Services Ltd	01309 671919	●			●	●	●	●	●			●	✓	4				Silver	Up to £3,000,000
Billington Structures Ltd	01226 340666	●		●	●	●	●					●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Bourne Group Ltd	01202 746666	●			●	●				●		●	✓	4	✓		✓	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●	●	●	●		●	●	●	✓	4			✓	Gold	Up to £4,000,000
Cementation Fabrications	0300 105 0135	●		●	●	●	●					●	✓	3			✓	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Above £6,000,000
D Hughes Welding & Fabrication Ltd	01248 421104	●		●		●			●	●	●	●	✓	4			✓		Up to £400,000
Donyal Engineering Ltd	01207 270909	●		●						●	●	●	✓	3			✓	Silver	Up to £1,400,000
ECS Engineering Services Ltd	01773 860001	●			●	●	●		●			●	✓	3				Gold	Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●		●	●	●	●		●	●	●	●	✓	3			✓	Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●			●	●				●	●	●	✓	4	✓		✓	Gold	Above £6,000,000
M Hasson & Sons Ltd	028 2957 1281	●	●	●	●	●	●	●	●	●		●	✓	4			✓	Member	Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●	●	●	●	●	●	●	●	●	●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●	●	●	●	●	●					●	✓	4			✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £6,000,000
S H Structures Ltd	01977 681931	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓		✓	Gold	Up to £3,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499											●	✓	3					Up to £800,000
Structural Fabrications Ltd	01332 747400	●		●	●	●	●			●	●	●	✓	3				Silver	Up to £1,400,000
Taziker Industrial Ltd	01204 468080	●		●	●	●	●	●	●		●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●	●	●	●	●				●	●	●	✓	4	✓		✓		Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●		●	✓	4	✓	✓	✓	Gold	Above £6,000,000
Non-BCSA member																			
Allerton Steel Ltd	01609 774471	●		●	●	●	●	●			●	●		4	✓				Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●		●	●	●	●	●	●	●	●	●	✓	4					Up to £2,000,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓		Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●	●	●	●		●	✓	4			✓	Member	Up to £1,400,000
Ekspan Ltd	0114 261 1126	●				●			●	●	●	●	✓	2					Up to £400,000
Eiffage Metal	00 33 388 946 856	●	●		●		●	●	●			●	✓	4					Above £6,000,000
Francis & Lewis International Ltd	01452 722200											●	✓	4			✓	Gold	Up to £2,000,000
Harrisons Engineering (Lancashire) Ltd	01254 823993			●	●	●	●	●	●	●		●	✓	3		✓			Up to £1,400,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879									●	●	●	✓	3			✓		Up to £200,000
IHC Engineering (UK) Ltd	01773 861734											●	✓	3			✓		Up to £200,000
In-Spec Manufacturing Ltd	01642 210716									●	●	●	✓	4			✓		Up to £800,000
Kelly's Welders & Blacksmiths Ltd	01383 512 517											●	✓	2			✓		Up to £200,000
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Gold	Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●		●		●				●	●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	●	●	●	✓	4		✓	✓	Silver	Above £6,000,000

Corporate Members

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

Company name	Tel
Gene Mathers	0115 974 7831
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Inspire Insurance Services	02476 998924
Keiths Welding Limited	07791 432 078
Paul Hulme Engineering Ltd	07801 216858
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

BCSA

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,
🟢 = Member

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			
Fabsec Ltd	01937 840641		N/A				
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		**Headline**
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	2			
Stud-Deck Services Ltd	01335 390069		D/I				
Tata Steel – ComFlor	**01244 892199**		M				**Silver**
voestalpine Metsec plc	**0121 601 6000**	✓	**M**	4		🟤	**Gold**

Computer software

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
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				
Tata Steel – Tubes	01536 402121	✓	M				

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**				**Bronze**
Ficep (UK) Ltd	**01924 223530**		**N/A**				**Gold**
Kaltenbach Ltd	**01234 213201**		**N/A**				**Silver**
Lincoln Electric (UK) Ltd	0114 287 2401	✓	N/A				
Peddinghaus Corporation UK Ltd	**01952 200377**		**N/A**				**Silver**

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**				**Bronze**
Highland Metals Ltd	01343 548855	✓	N/A				
International Paint Ltd	0191 469 6111	✓	N/A				
Jack Tighe Ltd	**01302 880360**	✓	**N/A**		**19A**		**Silver**
Joseph Ash Galvanizing	01246 854650	✓	N/A				
PPG Architectural Coatings UK & Ireland	01924 354233	✓	N/A				
Sherwin-Williams Protective & Marine Coatings	**01204 521771**	✓	**N/A**			⚪	**Bronze**
Vale Protective Coatings Ltd	01949 869784		N/A				
Wedge Group Galvanizing Ltd	**01909 486384**	✓	**N/A**				**Gold**

Safety systems

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
easi-edge Ltd	01777 870901	✓	N/A			🟤	

Steel stockholders

Company name	Tel	QM	CA	FPC	NHSS	SCM	SfL
AJN Steelstock Ltd	**01638 555500**	✓	**M**	**4**			**Bronze**
Arcelor Mittal Distribution - Scunthorpe	01724 810810	✓	D/I	4	3B		
Barrett Steel Services Limited	**01274 682281**	✓	**M**	**4**	**3B**		**Headline**
British Steel Distribution	01642 405040	✓	D/I	4			
Cleveland Steel & Tubes Ltd	**01845 577789**	✓	**M**	**3**			**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**		**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		
Henry Venables Products Ltd T/A Blind Bolt	01299 272955		M				
Lindapter International	01274 521444	✓	M				
Tension Control Bolts Ltd	**01978 661122**	✓	**M**		**3**		**Bronze**

Welding equipment and consumables

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