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NSC

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February 2017
Vol 25 No 2

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Cover Image
52 Lime Street, London
Main client: W.R Berkley Corporation
Main contractor: Skanska
Structural engineer: Arup
Steelwork contractor: William Hare
Steel tonnage: 10,500t

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Steel tops market share survey

Nick Barrett - Editor

The latest survey of the UK market for structural frames (see News) confirms that steel solutions have the confidence of the overwhelming majority of clients, designers and contractors for buildings as diverse as multi-storey offices and single storey industrial sheds.

Steel increased its always dominant market share in these sectors in 2016, as independent research from Construction Markets shows. The market preference for steel is most marked in single storey non-domestic buildings where steel's share is a striking 88.5%, and over 98% in the industrial buildings subsector.

Investment in industrial buildings has been very strong in the past few years and steel has played a key role in providing new production and storage facilities for major development programmes by companies like car manufacturers, and for distribution facilities for online retailers.

Steel provided the frames for a rising share of the multi-storey non-domestic buildings market, over 66%. In the key offices part of the multi-storey non-domestic buildings market steel's market share rose to around 72%.

Brexit might pose a question over the prospects for 2017 and beyond but the outlook for steel frames and other steel structures looks reasonably secure. An encouraging note is struck in the latest crane survey from Deloitte (see News) which shows that activity in the offices sector has reached the levels of 10 years ago, and strong demand has spread outside London and the south east to regional centres like Birmingham, Leeds, Manchester and Belfast. There was a rise of 50% last year in the office space under construction in Birmingham, for example. All of which, as the market shares survey suggests, is good for steel.

Government has affirmed its support for the steel sector recently with procurement changes that allow proper consideration to be given to the wider social and economic impact of choice of suppliers on major infrastructure contracts. Cabinet Office minister Ben Gummer said the procurement changes create a more level playing field for UK steel sector in winning these contracts.

The government says it plans to use three million tonnes of steel in infrastructure projects by 2020, and it will publish a forward pipeline of steel projects to provide steelwork contractors and the steel supply chain generally with more clarity than ever before on public sector demand for fabricated steelwork.

Mr Gummer said he doesn't want contracts going abroad if the best value for money bid is a British bid, with all the social and economic benefits that brings, which is welcome and overdue news. Whatever the demand conditions, UK and Irish steelwork contractors will continue to provide the world-leading, best in class service demanded by the UK construction market.

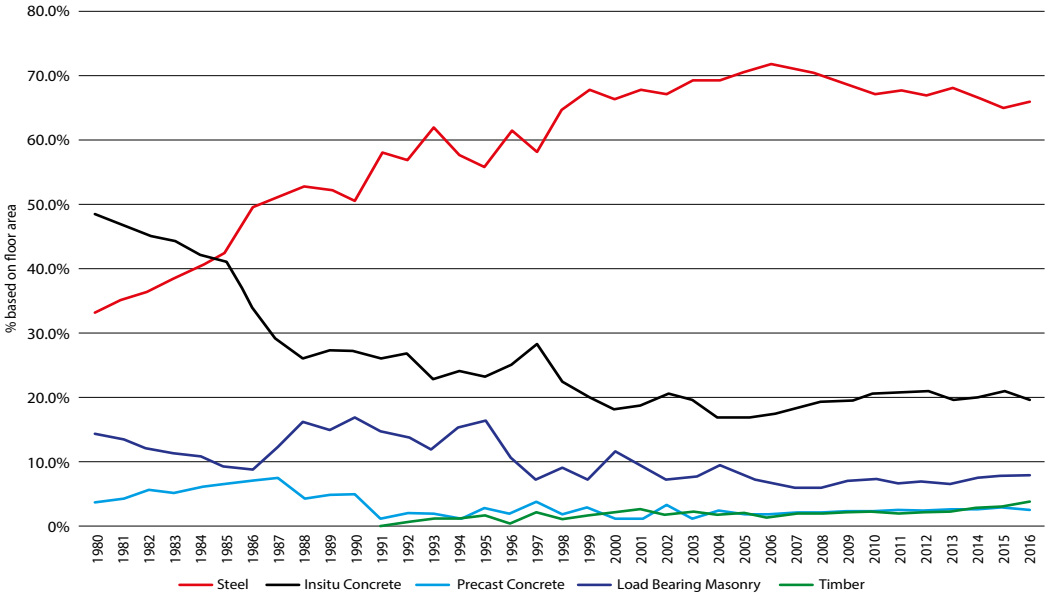
Steel dominates frames market

The UK market for multi-storey and single storey structural frames remains dominated by steel solutions according to the latest independent research by Construction Markets, which shows steel increasing market share in these key sectors last year.

The research, which has been carried out annually since 1980, shows that the overall market for multi-storey buildings fell in 2016 by 2.5%, but steel increased its share of that market by about 1%. The single storey non-domestic buildings market, where steel commands a market share of 88.5% compared to just under 87% in 2015, showed growth of over 1%.

The total market for structural frames in Great Britain is estimated at just over 41.5Mm² of floor area, a 2% rise on the previous year. Steel took the largest market share, at over 45%, with masonry at 36%, in situ concrete at less than 6%, timber 11.5% and precast concrete at just over 1%.

Multi-storey non-domestic buildings account for over 21% of the total frames market, dominated by steel with a market share of over 66% which was a rise from just over 65% in 2015 (see chart). In situ concrete held a share of under 20%, the research shows.



Market shares, total multi-storey buildings market, 1980 to 2016

In the offices segment of the multi-storey market - which accounts for almost 34% of the total multi-storey market – steel's market share rose by over 3.5% to almost 72%.

The residential buildings market rose by 5% overall and steel increased market share by 0.1%. Within the residential category the market for high-rise apartments was particularly strong during the year, rising by 46.5%, and steel's share rose slightly.

Overall, the single storey 'sheds' market saw growth of over 3% and steel's share of that market rose by just over 1%. The industrial buildings segment – which accounts for over 50% of the total 'sheds' market – saw a rise of over 11%, and steel's market share grew to 98.2%.

In the market for single storey conventional braced frames there was an overall market fall of over 10%, but steel's market share rose slightly. The key markets in this sector are education, almost 44% of the market, and leisure, almost 25%, with steel increasing its share of both.

City planners approve 36-storey tower

A new £400M 36-storey tower in the City of London has been given the green light by planners and will be built next to the historic Leadenhall Market.

The 182.7m-tall building, named 1 Leadenhall, is one of a host of new towers going up in London's financial district.

The project will be developed by Brookfield Property Partners which is also building an office block at 100 Bishopsgate, as well as a host of other projects in and around the City.

Designed by the former Foster + Partners architect Ken Shuttleworth's Make practice, 1 Leadenhall will have around 50,000m² of office space, as well as 4,600m² of shops and cafes on the ground, first and second floors.

A public terrace will overlook the roof of the adjacent Grade II-listed Victorian market.

Replacing a 1970s-built seven-storey office block, which is due to be demolished over a six month programme, construction of 1 Leadenhall is due to start next year and the building is expected to open in 2021.

A new standing terrace at National League side Maidstone United's Gallagher Stadium is quickly taking shape and is due to be open by the end of March.

The fully galvanized steel-framed structure, being erected by REIDsteel, will be able to accommodate more than 1,700 spectators. It consists of 11 double standing rows, formed with non-slip metal decking supported by a series of steel rakers.

"Using metal decking to form the terracing is more economical and gives future flexibility, as every second step can be unbolted and removed, if and when the Club wanted to convert the stand into an all-seater or partially seated structure," said REIDsteel Project Engineer Toby Hill-Cousins.

Supported by a series of 8.5m-high columns, the stand is topped by a 11m-wide cantilevering steel roof structure, which includes a 1m-high facia for advertising.

As well as fabricating, supplying and erecting the project's 80t of structural steelwork, REIDsteel is also installing decking, cladding and fixing 500m of handrails for the stand.

NSC Annual Review now available

A selection of the key project reports of the year, plus technical articles explaining the current issues affecting the steel construction sector are all contained within the latest *New Steel Construction (NSC) Annual Review*.

The publication has been distributed with *Construction News*, *Building Magazine* and *Architects Journal*, and can also be viewed online at *www.steelconstruction.info*

NSC Annual Review comprises a digest of the most important news items to appear in the magazine over the last 12 months. This is followed by a review of last year's prestigious Structural Steel Design Awards that were held at the Museum of London.

All of the major construction sectors in which structural steelwork is used are represented within the *Annual Review*.

Reports on projects such as the Met Office's new super computer facility in Exeter and an energy centre in Greenwich with a 49m-tall flue stack highlight steel construction's versatility.

Around 90% of the UK's distribution centres are constructed with a steel frame and the *Annual Review* highlights a huge Amazon warehouse built as the centrepiece for a new Midlands distribution park.

Project features on commercial schemes in the City of London and Manchester, a retail scheme in Bracknell, a school in Fife and bridges for the A1 upgrade in Yorkshire display steel's broad appeal throughout the construction industry.

A technical article on floor vibration and guidance on cost are included, as well as an article explaining why structural steelwork is the leading commercial choice. Another piece highlighting the updates and new content that has been added to *www.steelconstruction.info* completes the publication.

Fit-out on track at London Bridge Station

Due to complete in January 2018, the ongoing redevelopment of London Bridge Station is one of the country's most complex transportation projects and one reliant on steel construction.

Fit-out of the station is now under way with Bourne Special Projects (part of Bourne Construction Engineering) providing structural steelwork for new retail units, which are situated in the new concourse as well as in the east and west entrances.

The company has also fabricated, supplied and erected steelwork to create four staff accommodation blocks, three of which are under the existing Victorian brick arches and one in the new concourse area.

"This work is very complex as the site is extremely tight and manoeuvering steel under the concourse has to be done with forklifts or small items of lifting equipment," said Bourne Special Projects Divisional Director Howard Cox.

Each of the station's platforms will be served by an escalator and two staircases from the concourse. Bourne has also erected some of these staircase structures, all of which are fabricated from weathering steel as this material will require less maintenance in the future.

Bourne is also erecting a new 10m-tall × 70m-long architectural steel-framed station façade along Tooley Street.

Around 54M passengers use London Bridge Station each year and Network Rail's redevelopment, which is part of the Thameslink Programme, will provide improved facilities and two-thirds more space for passengers.

The new concourse at London Bridge will be bigger than the pitch at Wembley Stadium with new retail and station facilities unifying the station for the first time so that passengers can access all platforms from one place.

Logistics hub planned by Midlands car manufacturer

Jaguar Land Rover (JLR) has submitted plans to build a new logistics hub on land near to its plant in Solihull.

The site will be used by the car manufacturing giant to receive and store parts to supply to its production facility nearby, and the overall scheme will cover more than one million square feet.

The hub also includes 3,700m² of office space and a two-storey car park with 1,500 spaces.

A design statement supporting the application said: "Jaguar Land Rover is a strong, healthy and vibrant company, well-positioned, strategically and financially, for future growth.

"Delivery of the logistics operations centre would contribute to ensuring that Jaguar Land Rover increases its efficiencies, capabilities and overall business resilience."

The submission of the plans follows a year of major investment across JLR's operations in the West Midlands.

The company announced the creation of 250 jobs across its various divisions recently as part of a £30M investment, as well as confirming that it would split production of the new Land Rover Discovery across its Solihull and Slovakian factories.

NEWS IN BRIEF

London Stansted Airport has announced plans for a new £130M arrivals building as part of its multi-million pound expansion programme. The proposed 34,000m² building spans three levels and would be delivered inside the existing footprint of the airport. It would be located adjacent to the current terminal and the Radisson Blu Hotel.

Kloeckner Metals UK has invested £7.7M in six new state-of-the-art CNC automated tube lasers for its processing centre in Dudley.

Autodesk has launched AutoCAD for Mac 2017, which it said has been in development for the past year. Among the features is a more intuitive user interface that has new model and layout tabs, and updated status bar.

Planning permission has been granted for the £300M **Napier Gateway** leisure and residential scheme in Luton. It will comprise 685 residential apartments, hotel complex including banqueting facilities, medical centre, public realm retail and leisure piazza, public park and an iconic 65m-tall 22-storey tower.

British Steel has announced that it ended the third quarter of 2016 in profit following its first seven months of independence, and it now starts the new year in a strong position. The company, launched on 1 June 2016, said it continues to make progress against its turnaround plan and remains on track to build a business capable of delivering sustainable growth. The company has secured a series of significant contracts with long-term and new customers, including a £2M contract to supply steel for accommodation blocks at Hinkley Point.

AROUND THE PRESS

RIBA Journal
January 2017
New ship in old bottle
[Ashton Old Baths] – "We proposed a lightweight [steel] solution that would deal with the constrained access and minimise the interventions in a cost-effective way," says Kevin Gilsenan, Director of structural engineer Renaissance.

RIBA Journal
January 2017
Encore, encore
Steel recycling, as distinct from reuse, is well established, with some 95% of steel sections currently recycled into products of equivalent or higher quality.

RIBA Journal
January 2017
Radiating flexibility
[University of Cambridge Primary School] – "We wanted the minimum weight of building and didn't want to spend a lot of money in the ground," says Marks Barfield Managing Director Julia Barfield. "Steelwork helps in that respect, as well as making sure the school had future flexibility. A steel frame enables walls to be moved to create new learning layouts independent of the structure."

Building Magazine
13 January 2017
Surgical precision
[King's College Hospital] – The really innovative aspect of the project happens on completion of each steel truss section. At this point the jacks raise the entire truss assembly up 60mm. The truss assembly is then pulled by cables attached to two ram jacks mounted above the rails at the eastern end of the supporting structure, which is then slowly pulled along on the rails.

Construction booms in UK regions

The UK's regional cities are experiencing near-record levels of construction activity as developers invest heavily in commercial and residential real estate, according to the annual Deloitte Real Estate Crane Survey.

According to the survey, there has been a sharp upturn in urban development across a range of sectors including commercial offices, hotels, retail, and student housing.

In Birmingham, approximately 130,000m² of new office space is currently under construction – a 50% increase on the previous year. This is the highest level of activity since this crane report was first published in 2002.

Birmingham has also witnessed a 10-fold increase in residential schemes starting construction last year, totaling 2,331 units in the city centre.

Manchester's city centre has a record 22 residential projects breaking ground on site last year, as well as a host of high-spec office schemes.This was eight more than the previous high of 14 in 2007 and is scheduled to deliver nearly 7,000 units to the market.

Leeds saw 20 major construction schemes complete in 2016, including the highest level of office space delivered to market since 2007, and the city also recorded six new office starts in this survey.

Retail was dominant in Leeds as the delivery of new shopping areas doubled the average annual total of retail space with nearly 55,700m² brought forward in 2016.


Manchester city centre's Spinningfields office development

Simon Bedford, local government development partner at Deloitte Real Estate, said: "The results reflect the growth and resurgence in the regions, breaking records set more than a decade ago."

Carlisle council offices complete with steel

Cumbria County Council has moved into new £10M custom-built steel-framed offices in Carlisle city centre.

Working on behalf of Eric Wright Construction, locally-based Border Steelwork Structures erected 400t of steel for the project.

Forming an important part of an ongoing cost-saving exercise, Cumbria County Council said by moving the majority of its staff into the new premises, it will be able to sell more than 20 older offices throughout the city, saving it around £1M each year.

The state-of-the-art building will also help the Council deliver new efficient ways of working.

Located on the historic Botchergate, the headquarters building features 450 workstations and accommodates around 700 staff, with hot-desking, mobile working and modern technologies helping to further slash overheads and cut the Council's carbon output in half - from 1,546t to 826t.

The steel-framed building is configured into two connected parts, consisting of a four-storey office block arranged around a large central atrium and a two-storey element at the front, which contains the public areas and the main entrance.

As well as fabricating, supplying and erecting the steel, Border also installed metal decking in the two-storey part of the building and placed the precast planks in the office block, all of which was done with a single 50t-capacity mobile crane.

Commenting on the erection programme, Border's Senior Contracts Manager Stuart Airey said: "With over 50 loads of concrete and 20 loads of steel, the steel and concrete works had to be planned and coordinated meticulously to ensure continuity of the build. We had a 12-week programme for all of our works but achieved it in eight weeks, which was greatly appreciated by the Eric Wright Construction site team."

Ashford town centre project set to kick-off

Construction work on a town centre cinema and hotel project in Ashford, Kent is set to start in the coming months after developer Stanhope selected Lendlease to deliver the scheme.

Ashford Borough Council is funding construction of the leisure complex known as Elwick Place.

The £75M project was given planning consent in December 2015 and will transform a vacant brownfield site in the heart of Ashford town centre into a boutique cinema, family hotel, and restaurants and cafes.

The site, which was originally part of the town's cattle market, will be transformed into new leisure facilities to boost the night-time economy.

Leader of Ashford Borough Council, Cllr Gerry Clarkson said: "This investment, and our continued commercial approach, has the potential to significantly contribute to our ability to be self-reliant despite reduced government funding.

"We firmly believe that enabling this regeneration project to be brought forward quickly is in the best interests of the borough. This investment will enable services to be maintained, and will also continue the revitalisation of Ashford town centre."

Stanhope Director Gary Bourne said: "Elwick Place will play an important role in delivering genuinely outstanding regeneration that will benefit the whole town."

Government plans to use 3M tonnes of steel for infrastructure projects

The Government has highlighted its support for steel construction by unveiling plans to use 3M tonnes of steel in infrastructure projects by 2020.

Information published by Business Secretary Greg Clark and Cabinet Office Minister Ben Gummer said that changes to government procurement guidance will make it easier than ever before for UK steel manufacturers to plan and bid for upcoming government contracts.

Under the changes, government will start publishing their indicative future steel requirements on an annual basis, initially looking forward to 2020. It complements the new National Infrastructure and Construction Pipeline, which set out over £500bn worth of planned private and public investment over this Parliament and beyond.

From roads to rail, defence to nuclear, the new data will show that central government infrastructure projects will need enough steel to build the equivalent of 173 Wembley stadiums – or 3M tonnes worth of steel across 18 separate projects. The total tonnage needed includes all types of steelwork, such as structural steel, rebar and rail.

These will include the upcoming High Speed 2 rail project, the construction of Hinkley Point and for the maintenance

and upgrading of the motorway system.

British Constructional Steelwork Association Director General Sarah McCann-Bartlett said: "The release of the forward pipeline of steel projects will provide our steelwork contractors and the steel supply chain with more clarity on future demand for fabricated steelwork.

Minister for the Cabinet Office Ben Gummer said: "We will always strive to get the best value for money for taxpayers and we are going to do so in a way that strengthens our economy and bolsters the long-term prosperity of people across the country.

"I don't want contracts going abroad if the best value for money bid is a British bid with all the social and economic benefits that brings.

"By updating our procurement approach on these major infrastructure projects we are creating a level playing field for UK steel."

Steel structures for Antarctic bases

© Adam Bradley (British Antarctic Survey)

Construction company BAM has been chosen to partner with British Antarctic Survey (BAS) to modernise UK Antarctic and other research facilities, enabling British scientists to continue delivering world-class research into some of the most important issues facing our planet.

Commissioned by the Natural Environment Research Council (NERC), this long-term UK partnership will last between 7-10 years and is worth an estimated £100M.

The modernisation programme will enable a world-leading capability to ensure that Britain remains at the forefront of climate, biodiversity and ocean research in the Polar regions.

One of the first projects to be undertaken is the redevelopment of the wharf at the BAS Rothera Research Station (pictured) on the Antarctic Peninsula. This is part of the enhancement of polar facilities to accommodate the new state-of-the-art polar research vessel, the RRS Sir David Attenborough, which is currently being built.

In addition to building a new wharf and steel-framed storage and living quarters at Rothera Research Station, other Antarctic development projects that will be undertaken include modernising buildings and facilities at BAS stations in Signy (South Orkney Islands), Bird Island (South Georgia) and King Edward Point (South Georgia).

The Antarctic construction projects will present unique challenges given the continent is the highest, driest, coldest and windiest on Earth, and most construction work will need to be completed during the four-month window of the Antarctic summer. Construction workers will live and work alongside science teams in harsh and remote environments, sometimes in sub-zero temperatures.

Universities and Science Minister Jo Johnson said: "Key to the long-term success of science and innovation in the UK is ensuring our world-class research sector has the tools it needs to thrive on a global stage.

"The government's £200M investment on specialist research ships, including RRS Sir David Attenborough, underlines our commitment to this burgeoning sector and our upcoming industrial strategy will go even further, placing science and innovation at its absolute core."

Captain Tim Stockings, Director of Operations at BAS, said:

"This is an exciting moment for polar science. We are about to embark on a partnership to deliver a modernised Antarctic capability, which will involve changes to all five of our Antarctic research stations.

"This crucial work will enable our scientists to continue addressing issues of global importance. This investment means also that we can continue to improve our operational capability in the polar regions and in the UK."

The biggest building in the South West is taking shape in Avonmouth

Requiring 3,500t of structural steelwork, a 111,000m^2 warehouse for retailer The Range being built at Central Park in Avonmouth is claimed to be the biggest single building in the South West of England.

The enormous warehouse is being constructed by McLaren Construction for developer Stoford, with Caunton Engineering fabricating, supplying and erecting the steelwork on a design and build contract.

With good transportation links and close to the Second Severn Crossing, the warehouse will bring 1,000 jobs to the region and inject millions of pounds into the local economy.

Chris Dawson, founder of The Range said: "This distribution centre is a big step in the expansion plans that I have for the business; it's non-stop for us. When the warehouse is up and fully operational, it will act as a training hub for smaller distribution centres around the country."

Main contractor McLaren Construction started work on-site last year with an extensive piling programme kicking off proceedings.

As the site is close to the banks of the River Severn, the ground contains soft alluvial deposits and a total of 16,000 concrete piles have been installed to a depth of 20m, in order to support the suspended slab, the steel frame of the warehouse and its internal racking system.

To keep the programme on schedule, the construction sequence has been arranged so that Caunton Engineering erects the steelwork immediately behind the piling operation.

The sequential operation is then repeated with the cladding and roofing contractors along with the concreting team installing the ground slab following on behind Caunton's steelwork erectors.

Overall the building measures 480m in length, which equates to 60 × 8m-wide bays. It has six spans of 36.5m giving the warehouse a total width of 220m.

Marks & Spencer goes for galvanized car park

Worksop Galvanizing (part of Wedge Group Galvanizing), working on behalf of steelwork contractor James Killelea, has completed a job to galvanize 620t of steelwork for a multi-storey Marks & Spencer car park.

As well as the galvanized steelwork, the project in Longbridge required an overall tonnage of 1,200t, which amounted to 1,900 pieces of steel.

Worksop Galvanizing Commercial Manager Paul Robinson said: "Hot dip galvanizing is an environmentally-friendly finishing process to prevent corrosion, and can give decades of preservation against the elements without needing to be maintained.

"This is just one of a number of significant jobs we have undertaken in partnership with James Killelea over the past three years, which has seen our team galvanize more than 10,000t of steel – and we very much look forward to our next project together."

James Killelea Contracts Director Bob Allan, added: "Galvanizing was chosen in some areas because of its proven durability and longevity against rust and corrosion, and the overall project took 20 weeks to complete.

As on many such schemes, coordination and planning of deliveries was a major challenge, with restricted access to contend with."

NSC launches Technical Digest

New Steel Construction has launched a new Technical Digest bringing together all of the highly valued Advisory Desk Notes and Technical Articles from the steel construction sector published in NSC magazine throughout 2016.

All of these articles can also be found separately on www.newsteelconstruction.com, but the BCSA and Steel for Life have responded to requests from readers to bring them together in a separate format. The Technical Digest is intended to be published annually.

AD Notes appear in NSC each month and have always been among the magazine's most popular features. Often they are written because a question is frequently being asked of the steel sector's technical advisers.

They reflect recent developments in technical standards or new knowledge that designers need to be made aware of, and have always been recognised as essential reading for all involved in the design of constructional steelwork.

The longer Technical Articles offer more detailed insights into what designers need to know, often sparked by legislative changes or changes to codes and standards. Some are written because it is felt that it would be helpful if a lot of relatively minor changes, perhaps made over a period of time, were brought together in one place, so a technical update is needed.

The Technical Digest is available for free download as a pdf at *http://www.steelconstruction.info/Steel_construction_news*

Steel sector remembers long-standing BCSA member

Ronald Buxton, Ex-Chairman and President of H Young Structures, and a long-standing member of the British Constructional Steelwork Association (BCSA), died on 10 January aged 93.

Mr Buxton led H Young Structures from the early 1950s until he passed the chairmanship of the company to his son Peter Buxton in 2002, when he was elevated to President of the company for his lifetime.

As well as being an active member of the Institution of Structural Engineers, he was a father and grandfather, an avid pilot, accomplished organist and musician, adventurer, canoeist, churchman and fields sports enthusiast.

In the latter part of the Second World War he held the office of Captain in the Indian Electrical & Mechanical Engineers, serving in India, Vietnam, Borneo and Iraq.

During the 1950s Mr Buxton travelled throughout Africa and established steel fabrication businesses in Nigeria, Sudan, Kenya, Tanzania, Uganda, Zimbabwe and Zambia.

Contracts were secured for power stations, grain storage warehouses, food and drink processing facilities, large structures for the mining industry and a cathedral in Nigeria. Many of these contracts were joint ventures with H. Young shipping thousands of tonnes of steel to various parts of Africa.

The 1960s saw Mr Buxton's political career begin when he became the Conservative candidate for Leyton. He famously won the 1965 Leyton by-election by 205 votes, when he beat the incumbent Foreign Secretary Patrick Gordon-Walker. He was a member of parliament for less than two years, but continued to be active in politics for much longer.

Diary

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

Tuesday 21 February 2017
Wind Actions
This 1 hour webinar offers in insight into the complexities to determine wind actions. Available to BCSA and SCI Members only.

Tuesday 28 February 2017
Steel Connection Design
This course is for designers and technicians wanting practical tuition in steel connection design.
Darlington

Tuesday 7 & Wednesday 8 March 2017
Essential Steelwork Design - 2 days
This 2-day course introduces the concepts and principles of steel building design to EC3.
Manchester

Tuesday 21 March 2017
The National Structural Steelwork Specification (NSSS)
This 1 hour webinar will cover key content with helpful background to the specification clauses. Available to BCSA and SCI Members only.

Tuesday 28 March 2017
Portal Frame Design
This course provide in-depth coverage of the major issues surrounding the analysis, design and detailing of portal frames.
Bristol

Tuesday 4 April 2017
EC4 Composite Design
This course will cover the design of composite beams and slabs with reference to Eurocode 4 for composite construction (BS EN 1994-1-1).
Birmingham

STEEL for life

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An introduction to Steel Bending

Curved structural steelwork is an established feature of UK design and construction as it is known to offer a range of benefits, including aesthetic appeal.

History of steel bending

Curved iron and steel has been used in structures since the mid nineteenth century, but in terms of popularity it started to increase in the late 1970s. Demand for curved steel members since then has been considerable as it lends itself easily to a large range of building types, such as offices, airport terminals, stations, superstores, industrial buildings and leisure facilities.

How is steel bent?

There are three methods of bending steel; each of these processes produces different results, depending on the member, material and radius required.

Roller bending

The majority of curved steel is curved by roller bending which is a cold process. Roller bending involves progressive bending of a section by passing the member through a set of bending rolls. The rolls are shaped to a cross section of a steel member being curved. Force is applied across opposing sets of roles and more curvature is introduced in each pass through the rolls, which is repeated until the curvature is achieved.

Induction bending

A section is passed through an electric coil which induces electric currents; this will heat up the entire cross section over a narrow band (approximately 50mm wide) to between 700 and 1050°C. Air or water cool the material immediately adjacent to the heated zone. The leading end of the section is clamped to the pivoted radius arm. As the straight section (pushed by a hydraulic ram) moves through the coil at a constant rate, the leading end follows an arc set to the length of the radius arm.

Combined induction/roller bending

The maximum bending radius possible with induction bending equipment alone is limited to the length of the radius arm. For larger radii or multi radius curves, a set of bending rolls may be used in place of the radius arm. Although the bending still occurs within the hot zone produced by the induction coil, the bending force is actually provided by rolls rather than the radius arm.

Why architects like curved steel

The principal advantage of curved structural steel is its aesthetic appeal. It allows architects and designers to express a variety of forms and makes exposed steelwork an attractive solution.

Many sporting stadia have curved steel as large span structures that avoid the use of columns and enhance the viewing experience. As well as being aesthetically pleasing, curved steel can also enhance structural efficiency for example with arches and variable depth trusses.

Many commercial properties in London have curved or cambered steel in them. For example, more than 1,000t of cambered and cellular beams have been used in the St. James's Market development and a similar quantity was used on the Walbrook building.

Will incorporating curved steel impact the cost and construction programme?

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

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

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

Did you know?

Consisting of 762 curved sections ranging from 203 UBs up to 914 UBs, the London 2012 Olympic Aquatic Centre's roof (pictured above) is an example of what can be achieved with steel bending.

The steel members were curved in the strong axis and the weak axis and they were all differing radii.

The frame is up and the cladding nears completion

Steel in tune for acoustics

Steel-framed boxes within steel-framed boxes are the order of the day for a new music conservatoire under construction in Birmingham. Martin Cooper reports.

For the first time in nearly 30 years a music conservatoire (a college teaching classical music) is being built in the UK and, according to those involved in the project, it may well be the last for quite some time.

As well as being the kind of project that only comes along once in a working lifetime, unlike a regular college building, the construction and design of a conservatoire can be fiendishly difficult and challenging.

Overall the building will accommodate five major performance spaces, a dozen group practice rooms, specialist practice rooms and 50 individual practice rooms spread over six floors in the 10,500m² venue.

"Acoustics are the main driver for this project, being a conservatoire and not an ordinary college," explains Galliford Try Senior Project Manager Keith Lilley. "All of the major performance spaces need to be totally isolated from each other and using structural steelwork was the ideal solution."

To achieve the required acoustics, the design for this project involves the performance spaces being housed in five individual steel-framed boxes, each one independent from each other and from the surrounding main frame. Each box varies in size, but is based around columns spaced at 6m centres and importantly all of them are on acoustic pads.

The biggest box houses the 400-seat Adrian Boult Hall [ABH], which will also accommodate a full orchestra. This is positioned above two smaller boxes accommodating a recital hall and an experimental music space. At the other end of the building, the other two boxes housing jazz and organ rooms are stacked on top of each other.

"Cost and buildability led us to choose a steel-framed option for the boxes, as initially the design was for a completely concrete-framed building," says WYG Senior Engineer Ian Gill.

"The construction sequence is much easier to coordinate with steel as we have multiple steel columns in some locations, as close as 20mm in places, all on pads and supporting individual boxes."

The project's construction sequence for the steel boxes initially involved setting-out the acoustic pads and the base plates for the columns to be bolted down to. Once each of the individual steel frames was up, the lids, which are either formed with precast planks or metal decking, were then installed. The holding down bolts were then removed leaving the box just resting on the acoustic pads.

In this way the team has achieved the desired box within a box design whereby all the spaces are individually isolated from each other, as each steel-framed space is separated from its neighbour by insulation and a void of at least 20mm.

Steelwork contractor Mifflin Construction used the site's two tower cranes for the steel erection and the installation of associated precast elements

and metal decking.

"We had to carefully sequence the erection process around the precast planks for the box roofs," says Mifflin Construction Project Director Nigel Jones. "The steelwork is very complex with many columns extremely close to each other and so we always had to make sure there was enough space for the planks to be lifted into position."

The ABH features a 400mm thick floor, while the ground floors of the other performance spaces have 200mm thick precast planks with a 100mm concrete topping. Above the metal decking or precast planks each space has a 300mm-thick insulation layer.

One of the reasons for the performance space being in a stacked layout was the desire for the ABH to have a high ceiling. The only way it could have its 17m-high floor-to-ceiling height was to stack it on top of other performance space boxes.

The lid/roof of the ABH is formed with precast planks supported by a series of 18m-long lattice girders that span the hall. Lattice girders were specified in the design as they will also support lighting and other equipment which will be slung from the steelwork's bottom boom.

For convenience and ease of transportation, Mifflin brought the lattice girders to site piece small and assembled the elements on the ground before erecting them as complete members.

A combination of precast planks and composite metal decking has been used to form the box roofs. Because the jazz and organ rooms are triangular in shape it was decided to opt for the composite option, as cutting metal decking to shape is easier than using precast planks.

When the project team came to install the floor slab above the organ box roof it was discovered that there was little room for formwork so the design was quickly changed to a composite metal decking option.

The ABH nears completion

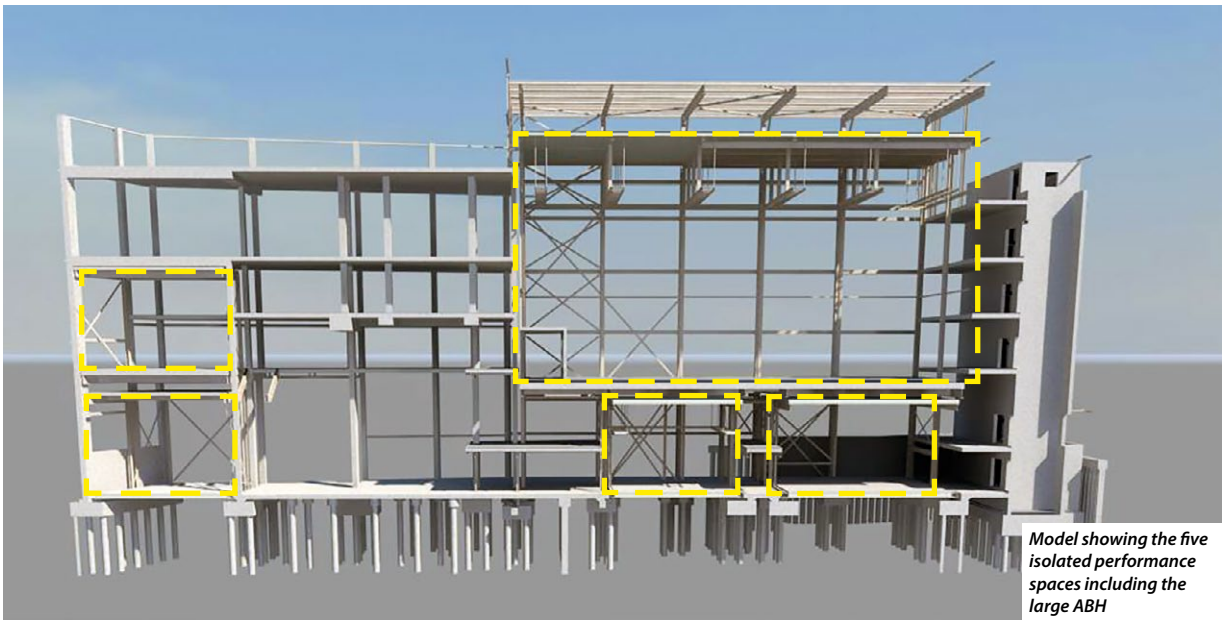
"Space was so tight that the formwork could have been installed but, once the floor was cast, it would have been impossible to get it out," comments Mr Lilley.

Wrapping around the ABH performance space there is an outer steel frame that supports the Conservatoire's roof and is formed by a series of 30m-high 610UB columns. Acting as wind posts, these columns are positioned within millimetres of the box steelwork and form the walls of the main structure in conjunction with the reinforced concrete frame of the remaining parts of the building. These main steel columns are connected to the reinforced concrete frame and are also bolted directly to the project's foundations as opposed to being on acoustic pads.

"These state-of-the-art facilities will offer current and prospective students unrivalled teaching provision. During its long history our world-renowned Birmingham Conservatoire has earned an international reputation for the excellence of its music teaching, research and performances. This new building, designed by leading architect Feilden Clegg Bradley Studios, provides us with a glorious opportunity to build on our proud history and continue to develop world-class music facilities for future generations," sums up Birmingham City University Vice-Chancellor Professor Cliff Allan.

The project is scheduled for completion in July 2017.

> *"Cost and buildability led us to choose a steel-framed option for the boxes, as initially the design was for a completely concrete-framed building."*



Model showing the five isolated performance spaces including the large ABH

FACT FILE
Birmingham Conservatoire
Main client: Birmingham City University
Architect: Feilden Clegg Bradley Studios
Main contractor: Galliford Try
Structural engineer: WYG
Steelwork contractor: Mifflin Construction
Steel tonnage: 450t

Offices armed with steel design

Keeping the buildings relatively low-rise helps them integrate into their surroundings

A renowned high-tech multinational company is expanding its Cambridge headquarters with the construction of a new office facility.

Currently under construction at the Peterhouse Technology Park on the southern outskirts of Cambridge, ARM, the multinational semiconductor and software design company, is in the process of expanding its headquarters with the construction of a new 1,900m² office facility.

Located adjacent to the company's existing HQ, the new facility will be ready for occupation this autumn and will enable ARM to increase its headcount in Cambridge to 3,000 people.

Mike Muller, Chief Technology Officer and Co-Founder of ARM, says: "We are making a significant investment at our headquarters in Cambridge to help us deliver the next phase of company growth."

"The expanded Cambridge campus will house many of the ARM engineers designing next generation processors and software that will power silicon chips supporting the rise of smart cities, for consumer devices and the communications network.

"There are 86 billion ARM-based silicon chips in the world and that number is growing as the built environment, transportation, homes and offices become increasingly connected."

Having started on site in early 2016, main contractor Kier is constructing a highly distinctive facility that will be clad with curtain walling and bespoke vertical aluminium brise soleil solar shading, which will form a 6m-high saw tooth pattern.

Early works for Kier included a lengthy groundworks scheme to prepare the previously greenfield site. This involved bulk excavation, ground stabilisation and the installation of pad foundations for the steel frame.

A large gas main runs across the site and a steel Bailey Bridge had to be installed to span this important conduit and allow cranes and other plant to drive across it.

The three-storey facility consists of two similar buildings, known as ARM A and B, that are inter-connected by a first-floor walkway bridge. ARM A will also on completion be connected to the existing ARM HQ via a ground floor covered walkway.

During the design stage a number of framing solutions were considered, but steelwork was chosen because of its speed and cost-efficiency according to Kier.

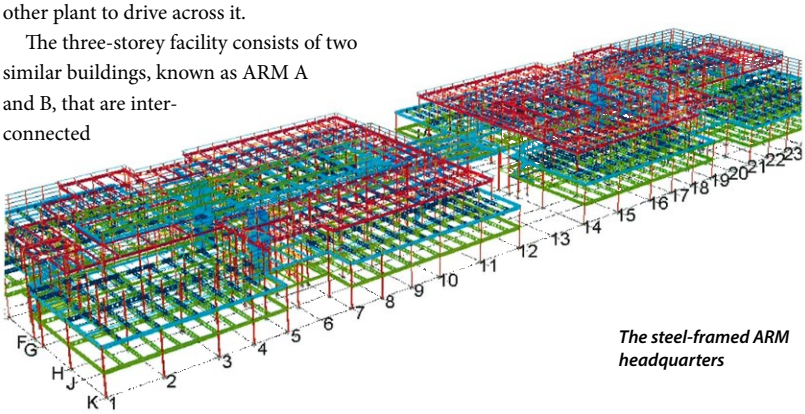
"Integrating the services within the floor depth and keeping the height of the buildings down so that they match the surrounding structures were also important criteria for the design," adds Ramboll Engineer Helen Leung.

"So we opted for a steel composite design throughout both buildings using 600mm-deep cellular beams, to accommodate the services, supporting metal deck flooring."

The two steel-framed structures are similar in design with the only major difference being that ARM A measures 85m long × 55m wide, making it 6m longer than its neighbour.

Stability for the steel frames is derived from their braced cores, with both buildings having a main centrally positioned lift core and smaller staircase cores at either end.

"Steel erection began on these main braced core areas on each structure," explains Caunton Engineering Contracts Manager Michael Firth. "Once they were erected we



The steel-framed ARM headquarters

Car parking

The overall project also involves Kier constructing two multi-storey car parks, both of which are steel-framed structures

The first of these, providing 268 spaces over two levels, was handed over in January and was erected by Bourne Parking (part of Bourne Construction Engineering).

Requiring 400t of steel and 400 precast floor slabs, Bourne Parking completed its work in a 15-week programme. As well as steel erection and the installation of the floor slabs, the company's work also included installing two precast staircases and the cladding.

Once this structure was handed over Kier was able to close an existing on-site surface car park while still keeping sufficient parking spaces available for ARM employees during the construction programme. This plot of land is now being made ready for the construction of the second 500-space structure.

Cellular beams have been used throughout for service integration

had a rigid box and we were then able to proceed in two directions with two gangs away from this stability-giving core to complete each building."

Steel erection initially began on ARM B as groundworks were still ongoing on the other part of the site. However, within a couple of weeks Caunton Engineering was able to work simultaneously on both buildings using up to four mobile cranes.

The heavily braced cores feature UC sections as these areas of the steelwork will be hidden behind walls in the completed buildings. Elsewhere in the scheme, circular hollow sections have been used as most columns will be left exposed, with the perimeter members in full view behind the glazing.

Either side of the main lift cores, both buildings feature atriums that will be spanned by rooflights to create voids that will allow natural light to penetrate the inner parts of the buildings.

The office spaces are arranged either side of these voids on ground and first floor, with one row of internal columns either side of the atriums. The office spaces have spans of 9m and one of 10.5m, offering plenty of interior space.

Cantilevering walkways, spanning adjacent to the main lift core, provide access between the two sides of each building.

The perimeter columns are predominantly spaced at 6m centres, with the exception of the end two bays on each building where the grid increases to a 9m wide spacing.

The second-storey of each building accommodates plant areas as well as more offices, although these working spaces are set back to provide rooftop terraces.

The ARM HQ is scheduled for an early 2018 completion.

FACT FILE

ARM headquarters, Cambridge

Main client: Coal Pensions Properties
Architect: Scott Brownrigg
Main contractor: Kier
Structural engineer: Ramboll
Steelwork contractor: Caunton Engineering
Steel tonnage: 1,500t

Crowning glory for city centre office scheme

Steel construction has provided the flexible column-free spaces required for the latest pre-let commercial scheme in Glasgow. Martin Cooper reports.

FACT FILE
122 Waterloo Street, Glasgow
Main Client: HFD Property Group
Architect: Michael Laird Architects
Main contractor: Harvey & McLaughlin
Structural engineer: Woolgar Hunter
Steelwork contractor: BHC
Steel tonnage: 1,900t

The commercial property sector in Glasgow is looking up as a number of high-profile schemes are ongoing with more potentially in the pipeline. One of the most prominent city centre projects is HFD Property Group's 122 Waterloo Street, a nine-storey commercial development pre-let to Morgan Stanley.

The building forms the first phase of the Bothwell Exchange that will also include a second speculative commercial office block – currently in the planning stage - on the northern portion of the site.

Until it was demolished in 2007 the Albany Hotel, that was once famously dubbed Glasgow's home to the stars, stood on the site. More recently a Holiday Inn occupied some of the plot, although today both of these concrete structures are long gone and only parts of the basement retaining wall remain where the second building will eventually stand.

Located at the gateway to Glasgow's Central Business District, 122 Waterloo Street will provide 13,900m² of space over the basement, ground and the eight open-plan upper floors, all of which will extend to circa 1,700m².

HFD Property Group Managing Director Stephen Lewis says: "HFD is committed to sustainable development and 122 Waterloo Street aims to achieve an A rated EPC and a BREEAM 'Excellent' rating, making it one of the most energy efficient and sustainable buildings delivered into the Glasgow office market."

The project is being funded by a combination of HFD's own equity and development funding from Bank of Scotland. Alan Brennan, Relationship Director for Bank of Scotland Commercial Banking's real estate team, says: "We have worked closely with HFD's team for many years to support their growth ambitions and so we are pleased to be helping them bring forward this landmark development.

"Bothwell Exchange is an important scheme for the city that underlines its status as a location of choice for leading international corporates."

As with most high-profile, modern and desirable commercial schemes, 122 Waterloo Street features long clear column-free spans on all floors.

Michael Laird Architects' Project Architect Tim Griffin says this was one of the main reasons for choosing a steel framing solution for this job.

"Steelwork has helped us obtain the required long flexible spans with no internal columns, while the use of cellular beams has integrated the services within the structural floor zone negating the need to increase the

The building will be a prominent addition to Glasgow city centre's western gateway

height of the building."

A series of 17.25m-long UB sections, spaced at 6m centres, form the office floorplates. For the required efficiency and to accommodate all of the building's services within the structural void, steelwork contractor BHC has fabricated service penetrations into these long-span beams.

To further maximise the column-free office space, the structure's three precast cores have been offset along the north elevation, instead of being placed in a more traditional position towards the centre of the building.

Adding some extra useable space to the upper floors is a 1.5m-wide cantilever along the main south elevation overlooking Waterloo Street that extends upwards from the second floor

"Working in conjunction with the cores, the cantilevering front façade has portalised connections for added stability," explains Woolgar Hunter Project Engineer Peter Hendry. "This forms a rigid frame along this entire elevation."

All of the steel erection has been carried out with the site's two tower cranes, with the heaviest steel lift being two 9t columns that extend upwards from the basement to the first floor.

Many of the loads from the building's cantilever are directed down to the foundations via these two columns that are positioned either side of the cores.

"As well as the structural steelwork, we are also supplying and installing the precast elements for the cores together with the metal decking flooring," says BHC Project Manager Eddie Brown.

To help speed up the erection process and allow the other follow-on trades to get

"The cantilevering front façade has portalised connections for added stability."

started early, the project team has devised a sequential construction programme.

This has initially involved BHC erecting the steelwork for the entire footprint up to the second splice level, which is at floor five. Once this level was reached the metal decking was immediately installed and the floor cast to provide a safe working platform for the steel erection to continue for the uppermost levels.

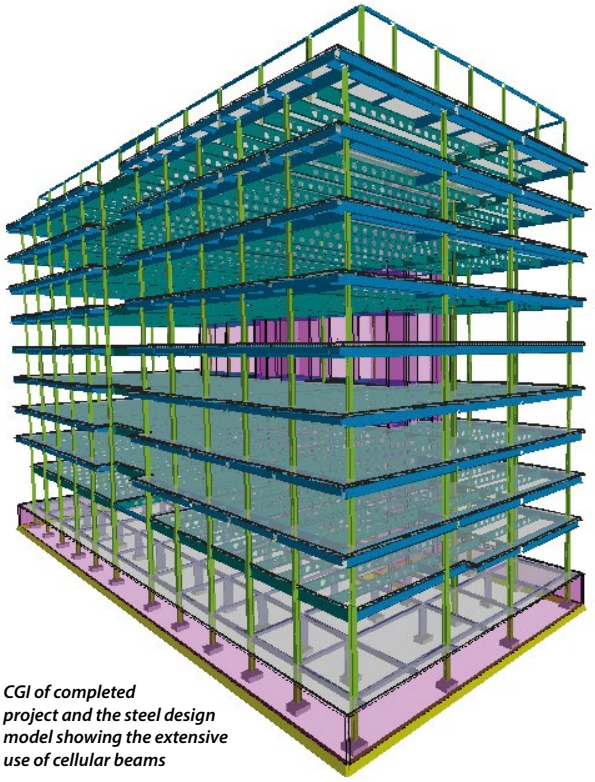
BHC then commenced erection from level five, while below work was simultaneously ongoing to install the first floor slab. Once complete, the first floor slab acted as a crash deck allowing work to be done below on the basement and ground floor, as work also simultaneously progressed above on the second, third and fourth floor slabs.

Creating an architectural top to the building, the roof level is surrounded by what the team describes as a 'crown detail'. Formed by a series of columns spaced at 6m centres this steelwork is not connected to the main steel frame, but is instead bolted to the concrete upstand as this provides better waterproofing.

The 4m-high columns are all connected by secondary members and support a black powder-coated aluminium cladding system.

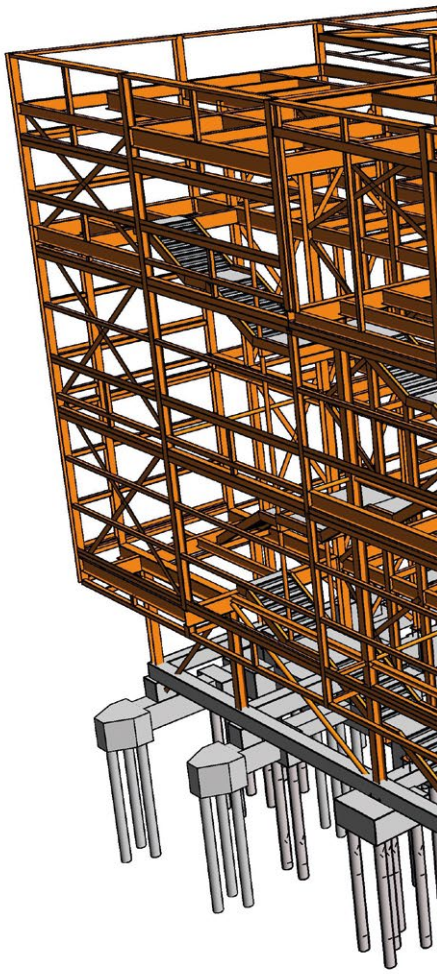
"Surrounding the entire top of the building the crown feature gives the structure a distinctive standout skyline," explains Mr Griffin.

122 Waterloo Street is due to be complete by October.



CGI of completed project and the steel design model showing the extensive use of cellular beams

The project is located in the heart of Romford town centre



Hot and cold

A swimming pool and an ice rink are being built within one large steel-framed structure in Romford, presenting several challenges.

Constructing two large column-free spaces stacked on top of each other may be a challenge in itself, but if one contains a heated swimming pool and the other an ice rink, all of a sudden a whole host of unique issues concerning temperature and isolation arise.

This is precisely what Willmott Dixon is facing at Romford where, in order to fit all of the required amenities into a tight footprint, an ice rink is being built above a swimming pool at a new leisure centre, something that is said to have only been done once before in the UK.

Working on behalf of the London Borough of Havering, the £28M flagship Romford Ice Rink and Swimming Pool complex will deliver an eight-lane competition swimming pool, fitness suite and 56m x 26m ice rink in the heart of the town centre.

The council says the long-planned development will assist the cultural renewal of Romford and will make a huge impact on the local economy by attracting new inward investment.

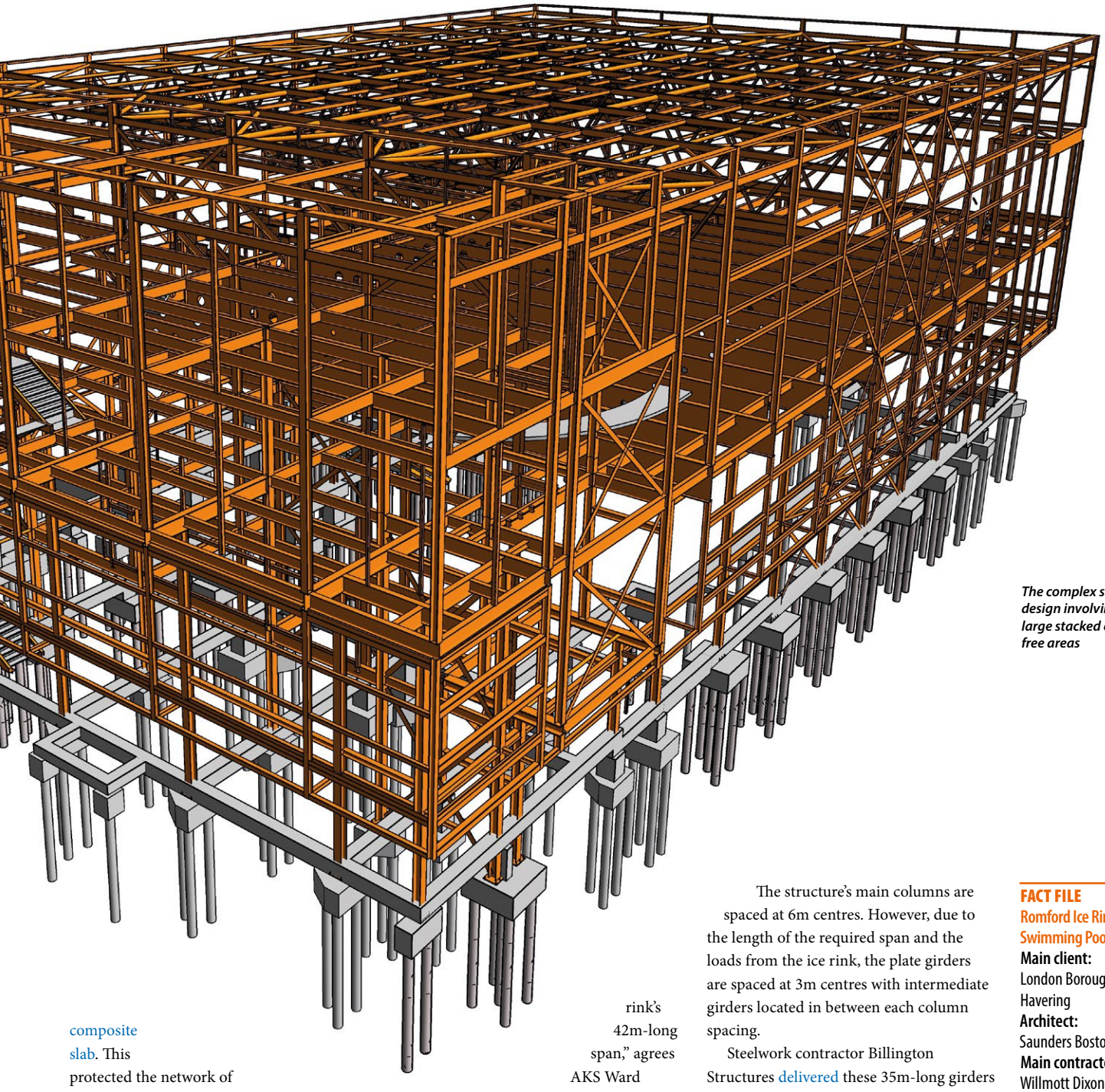
The new rink will also provide a home for the local ice hockey team, London Raiders, who relocated to Lea Valley when Romford's former ice rink closed in 2013. The team plans to take up residence in time for the 2018/19 season.

Commenting on the project's unique features, Willmott Dixon Project Manager Simon Cook says: "The temperature differential between a hot pool and a freezing ice rink has made this building particularly challenging to design and build."

The difference in temperature creates the potential for surface condensation due to warm, moist air hitting a very cold slab above the pool.

As most ice rinks are built on the ground this is not an everyday problem, but the solution was relatively straightforward. A thick layer of carefully detailed insulation was installed below the 200mm thick

The upper-level ice rink under construction



The complex steel design involving two large stacked column-free areas

composite slab. This protected the network of ice rink cooling pipes encased in the super-flat concrete slab which had to be constructed to a surface tolerance of +/- 3mm. Below this, steelwork supporting metal decking was punctured with 300mm diameter holes through the webs to increase air circulation.

As well as isolating the ice rink from the pool, the other big challenge was creating the large spans for each of these two distinct facilities.

"Due to the extensive spans we required, and because of the unique challenges of constructing an ice rink over a swimming pool, our preferred approach was to use a steel frame solution," explains Saunders Boston Architects Director Nathan Swift.

"Steel was the obvious choice to accommodate the 25m-long span competition pool, an array of water balancing tanks, a learner pool and the ice rink's 42m-long span," agrees AKS Ward Engineer Sophie Onoufriou.

"Both vertical and horizontal deflections of the structure were also very tight and difficult to achieve due to the large open spaces and double height voids. Locating steel cross bracing at the right places was a challenge."

Spanning the ground floor swimming pool are a series of 35m-long by 1.55m-deep plate girders. Supported by perimeter columns and one internal column line, the girders create two spans, one 25m-wide zone for the pool and another 10m-wide zone primarily taken up by changing rooms.

Because of the high humidity levels expected inside the pool area, the girders and their supporting columns are protected for the chlorinated environment by means of a high quality paint system suitable for a C4 environment.

The structure's main columns are spaced at 6m centres. However, due to the length of the required span and the loads from the ice rink, the plate girders are spaced at 3m centres with intermediate girders located in between each column spacing.

Steelwork contractor Billington Structures delivered these 35m-long girders to site in three sections. Two sections were bolted together on the ground to form one long member, which was then lifted into place using a mobile crane. The third section was lifted separately and the final splice completed mid-air.

Creating the roof of the leisure centre and the large 42m-long span over the ice rink is a series of trusses. These were also brought to site in three sections and erected in a similar fashion.

The ice rink will have spectator terrace seating on either side, with the highest bank of eight tiers on the western elevation of the facility formed with steel rakers bolted to the main steel frame supporting precast seating units.

Exerting more loads on to the project's steelwork, and another reason why the plate girders are spaced at 3m centres, the ice rink's floor will also have to support an

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FACT FILE
Romford Ice Rink and Swimming Pool
Main client: London Borough of Havering
Architect: Saunders Boston
Main contractor: Willmott Dixon
Structural engineer: AKS Ward
Steelwork contractor: Billington Structures
Steel tonnage: 1,200t

▶20 8t ice surfacing machine.

This vehicle cleans and smooths the surface of the ice sheet and a rink operator will generally use its machine a couple of times a day.

A steel-framed storage space beside the terrace seating has been erected, as well as a large ice pit where ice shavings are dropped into warm water before being drained away.

Summing up, Mr Cook says the project's other main challenge has been the logistics of working on such a tight site.

"Prior to steelwork starting on-site we piled the site and then excavated the pool, as this would have been very difficult to do once the frame was up."

"This means once the steelwork programme is nearing completion we can then start concreting the pool and ground floor slabs, working inside the footprint and around the erected columns."

Romford Ice Rink and Swimming Pool is due to complete in January 2018.

Roof trusses spanning the ice rink

Splice connections

David Brown of the SCI discusses splices in long-span members.

The long spans at the Romford leisure centre meant that splices were required in both the plate girders supporting the ice rink and in the trusses above the rink. Generally, slip in splices must be avoided, but this was particularly important in the plate girders supporting the ice rink where deflection was tightly controlled. Any slip in the connection could lead to deflection making the rink unusable due to cracked ice. Preloaded assemblies were used to prevent slip. Decking was supported on the top flange of the girders, so external flange plates could not be used – countersunk bolts were specified and internal flange plates. BS EN 1993-1-8 has particular rules for the design of splices in beams, in clause 6.2.7.1(16). This clause requires that the web connection must be designed to transmit the proportion of moment carried by the web – even if it has been assumed that the flanges alone carry the moment. The assumption that all the moment is carried by the flanges – and the flange plates and bolts designed for the forces – has been UK practice for many years, so the Eurocode represents a significant change. The design resistance of preloaded assemblies is straightforward, but depends on the slip factor (coefficient of friction) between the mating ('faying') surfaces. The key requirement is to ensure that the faying surfaces meet the assumptions made in design – inadvertent painting of surfaces specified as bare steel in the connection design will lead to a significant reduction in the slip factor.

The roof trusses at the leisure centre are formed from hollow sections, fabricated into three sections and bolted together on-site. In any truss, the strength of the joints is a key design requirement so that expensive strengthening is avoided by judicious selection of members and geometry. Checking joint resistance in accordance with BS EN 1993-1-8 can be laborious, but software is freely available from Tata Steel. Splices between hollow sections are often achieved by end plate details, sometimes called 'pipe flange' connections, where end plates are extended outside the hollow section and bolted together. This detail was used at Romford for both truss chords and internal members at the splice locations.

Romford leisure centre is particularly notable because there is a comprehensive time lapse archive of the construction, at *www.romford.photosentinel.com.au*. Plate girders can be seen bolted together on the ground and assembled on 4 October, pm. A truss can be seen being assembled and erected on 13 October, pm. There are three high-quality photos taken every hour which provide a fascinating resource.

celebrating

excellence in steel

Call for entries for the 2017 Structural Steel Design Awards

The British Constructional Steelwork Association and Steel for Life have pleasure in inviting entries for the 2017 Structural Steel Design Awards.

The Awards celebrate the excellence of the United Kingdom and the Republic of Ireland in the field of steel construction, particularly demonstrating its potential in terms of efficiency, cost-effectiveness, aesthetics and innovation.

The Awards are open to steel-based structures situated in the United Kingdom or overseas that have been built by UK or Irish steelwork contractors. They must have been completed and be ready for occupation or use during the calendar years 2015-2016; previous entries are not eligible.

To find out more and request an entry form visit www.steelconstruction.org/resources/design-awards or call Gillian Mitchell of BCSA on 020 7747 8121

Closing date for entries:
Friday 24th February 2017

BCSA

STEEL for life

FACT FILE
52 Lime Street, London
Main client: W.R Berkley Corporation
Architect: Kohn Pedersen Fox
Main contractor: Skanska
Structural engineer: Arup
Steelwork contractor: William Hare
Steel tonnage: 10,500t

The City's dramatic addition

Eventually reaching a height of 190m, 52 Lime Street is the City of London's latest standout commercial development. Martin Cooper reports.

Featuring a dramatic architectural shape with asymmetric facets and a pointed attic roof structure, 52 Lime Street has from its inception been dubbed the Scalpel, a name that has since been adopted as the official moniker.

Joining a cluster of other prestigious high-rise buildings in the square mile, the project will offer 36,966m² of internal floor area over 35 office floors, retail and restaurant areas.

Designed by architects Kohn Pedersen Fox, the project also includes a public square. The realm may also provide space for public art and tables linked to a specialist ground floor coffee shop, designed as a nod to the 17th century establishments that acted as meeting houses for London's fledgling insurance market.

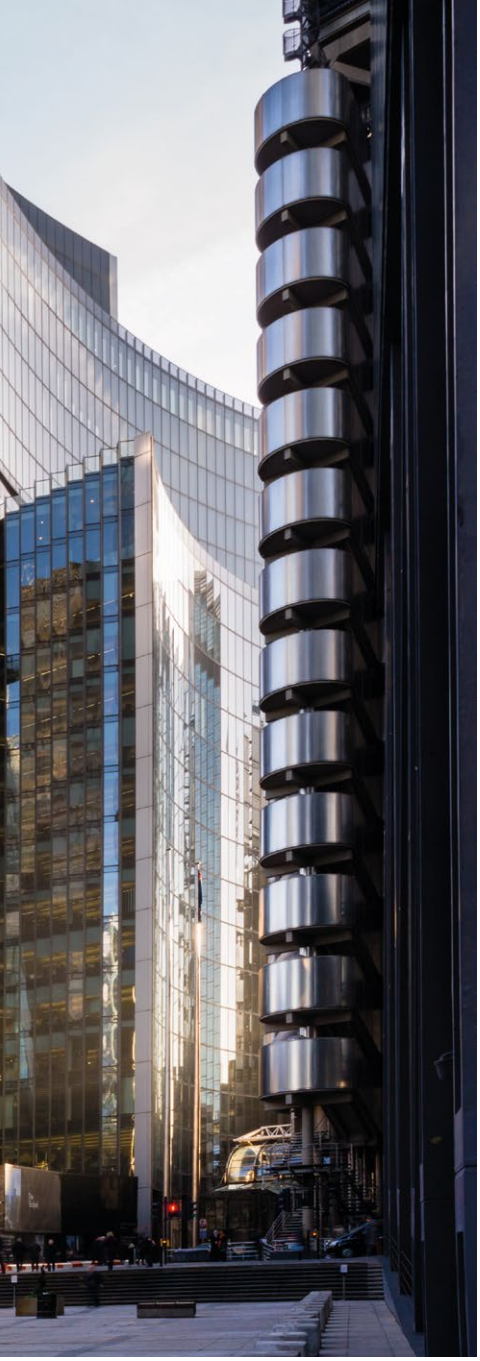
Setting it apart from its neighbours, the Scalpel features an inclined northern façade, which has a diagonal fold line running from top to bottom giving the building its distinctive look and name.

This façade is formed with a series of cranked plate girder columns, spaced at 6m centres. For the double-height ground floor these columns are vertical, but from the first floor they are cranked and slope inwards all the way to the building's pointed top.

Elsewhere, the structural frame consists of a composite design with steelwork supporting metal decking and a concrete slab. All of the floor beams are 670mm-deep fabricated plate girders with holes in the web to allow service integration within the structural floor zone.

Commenting on the decision to use a steel framing solution Skanska Project Director Ian Perry says: "Using steelwork is the most efficient option for this type of construction project as buildability and speed of construction are vital on a city centre job."

Cost also plays an important role in any construction project and the use of a BIM model on this scheme has helped the team



Steel erection progresses within the tight and confined site

ensure the steelwork frame is as efficient as possible.

"We've made a considerable weight saving as all of the beams have varying flanges and webs depending on the relevant loadings," explains Arup Project Engineer Steve McKechnie. "All of this was worked out automatically via the BIM model."

Scheduled for a late 2017 completion, main contractor Skanska is well on with its 160-week construction programme.

Having taken possession of the site once the demolition of the previous building to ground floor level had been completed, Skanska's initial task was to complete the basement works prior to the steelwork erection starting.

A third of the existing basement was partially deepened and, to keep the construction programme on schedule, the ground floor slab was cast early. This allowed the basement construction to be done in a top-down method, while the steel erection was able to carry on above simultaneously.

Early works also included constructing the

No time to take in the view as steel erectors complete a bolted connection

building's main concrete core. Once this had reached its halfway point at level 17, the steel erection programme was kicking off at ground floor.

Unlike many commercial buildings, the Scalpel's main core is offset and positioned along the south elevation, which provides shade from solar gain. In this way, the structure's available floor space has been maximised and internal spans of up to 20m have been achieved.

Having an offset core coupled with an inclined north elevation means that the loads on the building are eccentric from the main stability-giving core. To counteract this, the north elevation, as well as the east and west facades, have been designed as large perimeter moment frames to add stiffness to the building.

The core houses three banks of lifts, one for the lower levels (1 to 12), one for the mid-levels (13 to 24), and one for the upper levels (25 to 35). This means the core decreases in size towards the top as only one bank of lifts is accommodated at the upper levels. Again, this has helped the project further maximise the available floor space.

Because of the building's inclined northern elevation, floor areas decrease from 1,466m² on the second floor to 614m² on level 35, the uppermost office floor. Up to level 21 the building has one row of internal columns, but as the floorplates decrease these are no longer needed and by level 24 there are none.

Topping the building is a 10-storey triangular attic that will house plant and maintenance walkways. A high piece count would have ordinarily been expected for this structure so, in order to make the erection process as easy as possible and iron-out any snags, William Hare will trial erect this portion of the building at its fabrication yard.

"Once it has been trial erected the attic structure will be dismantled and then brought to site in the largest pieces that can be transported and erected by the on-site tower cranes," explains Mr Perry.

The attic is a complex steel structure designed to be erected floor level by floor level, with each level immediately stable upon erection. Designing the attic in this way was vital as there is no core this high up the building to give stability and no internal floors to provide any diaphragm action.

The steelwork programme is due to be completed in the summer and the Scalpel will be handed over at the end of the year.

"We've made a considerable weight saving as all of the beams have varying flanges and webs depending on the relevant loadings. All of this was worked out automatically via the BIM model."

Visualisation of the completed structure

Wind protection

Because of the building's triangular-like shape and the prevailing south-westerly winds that will hit the structure's narrowest point, a total of seven viscous dampers have been installed within the north elevation steelwork.

Viscous dampers are hydraulic devices that dissipate the kinetic energy of the building and stop the build-up of uncomfortable side to side accelerations in a wind storm.

Because they are built into the stability system of the building they provide damping at a fraction of the cost and take up less space than the more traditional "Tuned Mass Damper" or TMD.

M_{cr} Calculation software

David Brown and Ibrahim Fahdah of the SCI introduce the new design tool on *www.steelconstruction.info*

Most designers working in accordance with the Eurocodes will have met the elastic critical buckling moment, M_{cr}. This moment is needed as an essential step on the way to calculate the lateral torsional buckling (LTB) resistance of a member. The non-dimensional slenderness $\bar{\lambda}_{LT}$, which is needed to calculate the LTB resistance is given by:

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}}$$

M_{cr} can be determined by calculation, using the following expression:

$$M_{cr} = C_1 \frac{\pi^2 EI_z}{L^2} \sqrt{\frac{I_w}{I_z} + \frac{L^2 GI_t}{\pi^2 EI_z}}$$

This expression is straightforward to use, but is limited to uniform members with "fork end" supports and loads assumed to be applied at the shear centre. Other more involved expressions are available that deal with loads not applied at the shear centre (stabilising or destabilising loads) and different end conditions. The only real uncertainty is the value of C_1 which depends on the shape of the bending moment diagram. For linear and non-linear bending moment diagrams, expressions are available to calculate C_1[1].

Many real design situations become complex. An irregular loading pattern may make the bending moment diagram quite unorthodox. Some loads may be applied at the shear centre, whilst others on the same member may be applied elsewhere within (or outside) the section depth. Restraints may be intermittent, to one flange, or the other, or outside the section depth, at different locations along the member. The numerical expressions for M_{cr} are unable to deal adequately with these types of situations and software must be used.

Previous articles in New Steel Construction have discussed the use of software[2,3] and a design tool to calculate M_{cr} has been available on *steelconstruction.info* for a considerable period. The design tool on *steelconstruction.info* has been replaced with a new software, substantially increasing the scope, features and output; this article offers advice on how the software should be used.

Interface

Users will note that the interface looks markedly different from other design tools available on the *steelconstruction.info* website. The new software has a wider scope, with many opportunities for the user to define sections, beams, loading and restraints, which demands a flexible and comprehensive interface (Figure 1). In general, users work from one tab to the next, saving data at each step. The saving of data is important, as it triggers a refresh of any graphic, a re-ordering of any tabulated data and makes subsequent tabs available.

Although the software has been developed to assess beams, it may also be used to analyse steel members subjected to bending and axial loading.

Input Data

The first step when using the software is to create a project, which is a collection of one or more beams. Material types and cross sections are defined for the project, which are then used when beams are added to the project. Because the software allows a number of different beam arrangements (sections, length, loading, restraints etc) to be defined and analysed at one time, perhaps grouped because they are all part of one single project, a number of sections might be selected at this stage.

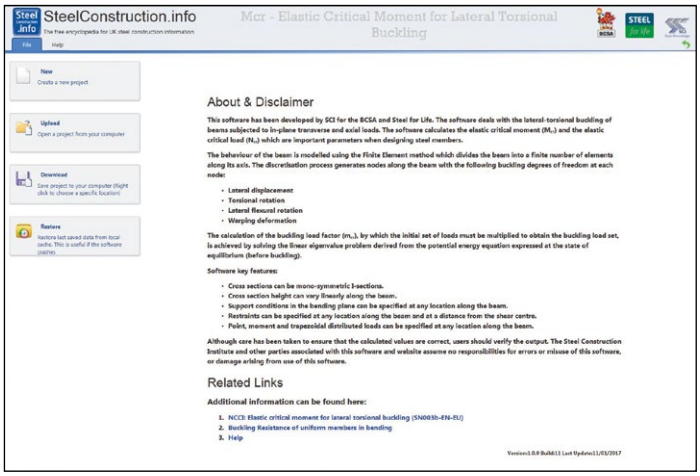


Figure 1: M_{cr} software interface

The "Section Definitions" tab, shown in Figure 2, allow users to add + modify and delete cross sections. The software allows users to add standard sections (UB and UC) or non-standard sections defined by their dimensions or their properties.

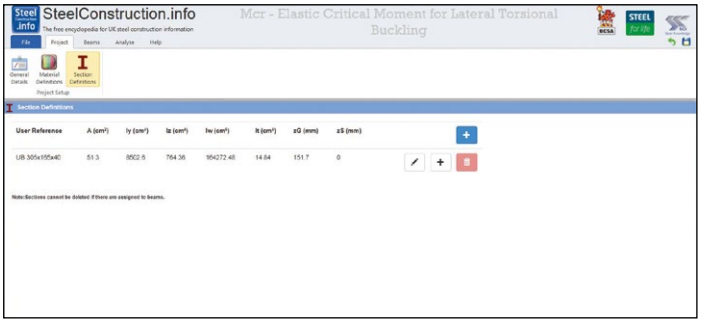


Figure 2: Sections Definitions – initial view

Users then visit the "Beams" tab (Figure 3) to work with the beams in the project. Beams may be added, duplicated or deleted. The currently selected beam is indicated in the drop down box at the top left corner of the tab. By default the remaining input tabs for a beam are greyed out. These tabs will be enabled as the user visits them working from the left to the right.

Figure 3: Beams input tabs

[1] Calculating the C_1 factor for lateral torsional buckling. NSC Nov/Dev 2013
[2] Getting the best out of LTBeam, NSC, May 2009
[3] Use of LTbeamN, NSC, January 2015

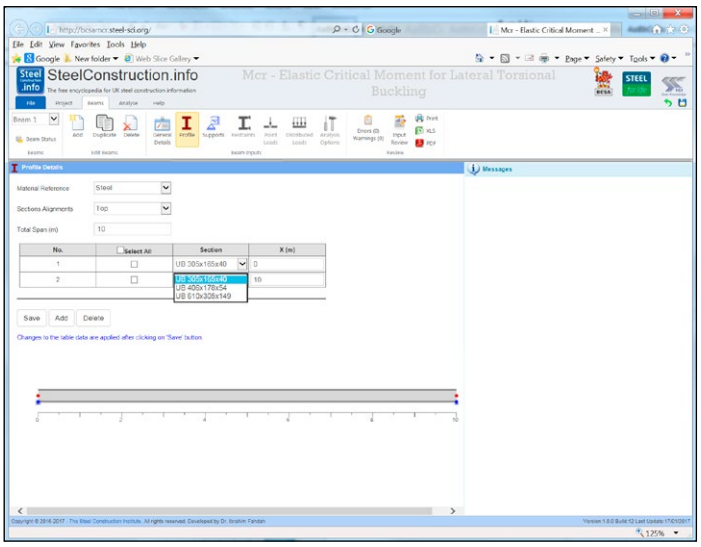


Figure 4: Profile input

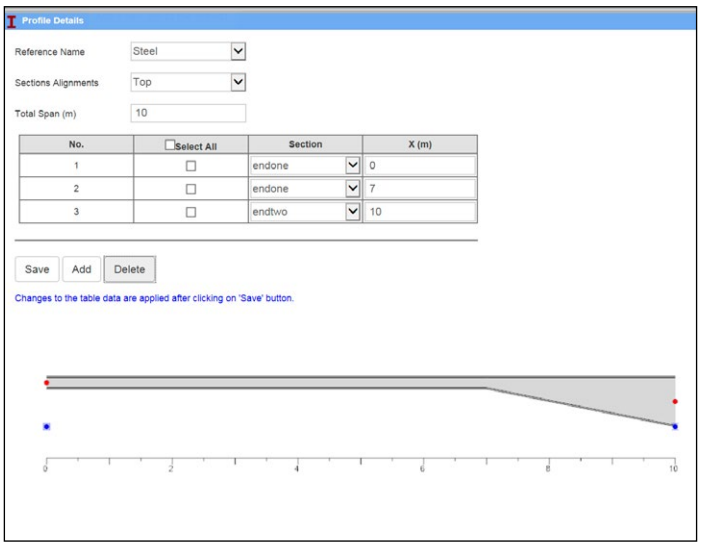


Figure 5: Part tapered beam

Figure 4 shows the "Profile" input. This screen shows the length of beam (the default is 10 m) and invites the user to define the cross-section at each end of the beam. Only the cross-sections previously defined are available. The data should be saved, which will update the graphics. In general, the cross-section will be identical at each end of the beam. The software allows a beam to be made up a number of different sections, using the "add" option. This may be used if part of the beam is tapered and part has a uniform cross-section. Tapered beams must be defined by dimensions, so the cross-section at each end of the section must be defined and selected on this "Profile" input. Only the depth of the beam can be varied on a tapered beam. The use of cross-sections defined by dimensions and a beam comprised of two sections allows the user to investigate beams which are tapered over part of their length, as shown in Figure 5.

Supports may now be selected, with default locations at each end of the beam. By default, both supports (shown in blue) are pinned and fixed vertically, one end is fixed laterally. These defaults can be changed by the user, and intermediate supports added if required.

Restraints may now be added. The default restraint condition is of "fork ends" at each end of the beam, which is laterally fixed, warping free and the restraints are located at the shear centre. All of these defaults may be changed and additional restraints may be specified. Normally, restraints might be discreet 'point' restraints, but the user can select a length of continuous restraint if required. Restraints may be specified at any point with respect to the top of the section, bottom or shear centre. Figure 6 shows a beam with intermediate restraints (red dots), one above the top flange, and one on the top flange. Note that saving the data is always required to refresh the graphics.

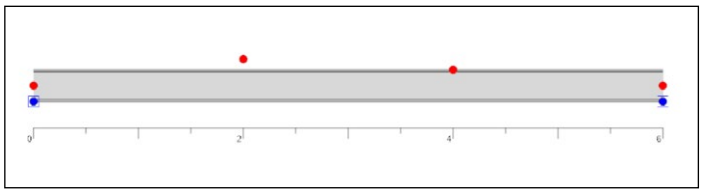


Figure 6: Illustration of restraint options

Having amended (or at least viewed) and saved the restraint data, loading data is now available. The default inputs are empty, so loads are introduced by the "add" button. Point loads, point moments, axial loads, distributed loads and varying loads may all be added, with the position of load application anywhere within (or outside) the section depth. This allows users to deal readily with destabilising (above the shear centre) and stabilising (below the shear centre) loads.

Figure 7 shows some of the possibilities available to the designer when defining loads.

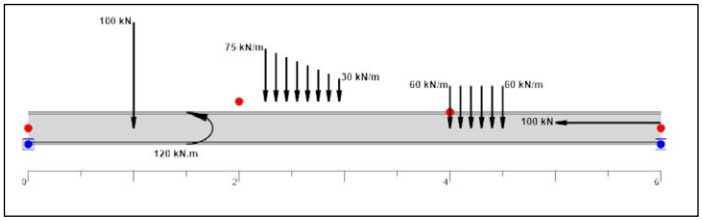


Figure 7: Load arrangements

The last view on the beam inputs group is "Analysis Options" view. The analysis options of a beam allow the user to vary the number of the finite elements used to represent the beam – more elements may improve the accuracy of the result marginally. The default of 100 elements is recommended.

The options to ignore bending effects and ignore axial effects demand some explanation. When verifying beams using expressions 6.61 and 6.62 of BS EN 1993-1-1, the lateral torsional buckling resistance is determined assuming there is no axial load, and the axial resistance is determined assuming there is no bending; the interaction is accounted for within the expressions. The opportunity to ignore one type of load allows the user to readily determine the values of M_{cr} and N_{cr} in the absence of axial force and bending respectively. The values of M_{cr} and N_{cr} will be different if calculated with both types of load applied simultaneously.

One warning

It may be very helpful to use this software to determine N_{cr} and thus the buckling resistance of a beam under axial load – particularly if the restraints are to one flange only, or perhaps to both flanges but at different locations along the beam. This version of the software only reports the value of N_{cr} in the minor axis direction. It would be possible to restrain the beam in the minor axis so effectively that major axis flexural buckling becomes the critical behaviour – which is not investigated by the software.

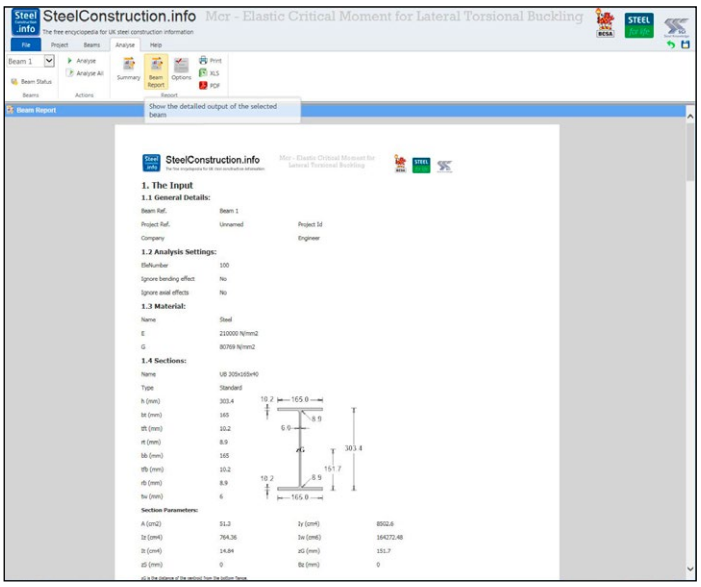


Figure 8: Detailed beam report

Finally, the analysis and output!

The "Analyse" tab allows the user to move to the analysis stage. Users can carry out the analysis and review the analysis results for the currently selected beam, or all beams in the project. The default report is a simple summary of M_{cr} and N_{cr} values, but much more detail can obtained by selecting the "Beam Report" (Figure 8). The reports can be exported to pdf, or Excel, or printed. The reported "buckling factor" is the amplifier by which the actual loads must be multiplied to obtain the elastic critical buckling moment. As a trivial example, a beam of 6 m span and 20 kN/m UDL results in a midspan bending moment of 90 kNm. If the value of M_{cr} is 109.9 kNm, the buckling factor is 109.9/90 = 1.221. A buckling factor less than 1 indicates an immediate problem – a larger beam is required.

AD 404: Columns in simple construction

SCI has received reports that some designers are disregarding the rules for the design of columns in braced frames (simple construction). In some cases the columns have been designed for an axial load only - even when the loading from the beams is not symmetrical. In another case with a fin plate connection the assumed eccentricity from the face of the column was the actual dimension to the bolt line, rather than the nominal 100 mm.

The rules governing the design of columns in simple construction are given in clause 4.7.7 of BS 5950-1 and – for design to the Eurocodes, NCCI document SN048, available at *http://www.steel-ncci.co.uk/*.

Whatever style of nominally pinned connection is to be used, the nominal moment is calculated based on an eccentricity from the face of the column of 100 mm, even if the physical dimension to the assumed location of the pin is different. A net moment will result if the beam reactions are different on either axis; the moment is distributed to the column lengths above and below. The rules for this type of column design, including the apparently arbitrary nominal eccentricity from the column face of 100 mm have reassuring provenance – they were described in BS 449 and had been successfully used for decades. Designers should not depart from these rules without careful consideration.

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Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates December 2016 and January 2017

BS EN PUBLICATIONS

BS EN 10027-1:2016
Designation systems for steels. Steel names
Supersedes BS EN 10027-1:2005

BS EN ISO 17638:2016
Non-destructive testing of welds. Magnetic particle testing
Supersedes BS EN ISO 17638:2009

BRITISH STANDARDS UNDER REVIEW

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

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

16/30342991 DC
BS EN ISO 13918 Welding. Studs and ceramic ferrules for arc stud welding
Comments for the above document were required by the 3rd December, 2016

BRITISH STANDARDS UNDER REVIEW

ISO 148-1:2016
(Edition 3)
Metallic materials. Charpy pendulum impact test. Test method
Will be implemented as an identical British Standard

ISO 148-2:2016
(Edition 3)
Metallic materials. Charpy pendulum impact test. Verification of testing machines
Will be implemented as an identical British Standard

ISO 148-3:2016
(Edition 3)
Metallic materials. Charpy pendulum impact test. Preparation and characterization of Charpy V-notch test pieces for indirect verification of pendulum impact machines
Will be implemented as an identical British Standard

ISO 17638:2016
(Edition 2)
Non-destructive testing of welds. Magnetic particle testing
Will be implemented as an identical British Standard

NEW WORK STARTED

EN ISO 4014
Hexagon head bolts. Product grades A and B
Will supersede BS EN ISO 4014:2011

EN ISO 4015
Hexagon head bolts. Product grade B. Reduced shank (shank diameter approximately equal to pitch diameter)
Will supersede BS EN 24015:1992

EN ISO 4016
Hexagon head bolts. Product grade C
Will supersede BS EN ISO 4016:2011

EN ISO 4017
Fasteners. Hexagon head screws. Product grades A and B
Will supersede BS EN ISO 4017:2014

EN ISO 4018
Hexagon head screws. Product grade C
Will supersede BS EN ISO 4018:2011

SteelConstruction.info

The free encyclopedia for UK steel construction information

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Technical information: covering best practice on a range of topics including design, fire engineering, corrosion protection, acoustics, floor vibrations, sustainability, fabrication, construction and CE marking.

Design software: and tools to aid designers with the efficient and economic design of steel-framed buildings and bridges, encompassing member design, connection design and carbon footprinting.

Eurocode guides: from the Steel Construction Institute containing detailed design guidance and worked examples, e.g. the Blue Book, the Green Books, Braced Frames and Composite Construction to name but a few.

Free Online CPD: for all construction professionals to help you meet your training needs, covering a range of design and construction topics with in-built quiz and certificate generation functionality.

Sector information: bringing together the key issues and considerations for steel construction in offices, industrial buildings and the retail, health, leisure, education and residential sectors.

Cost data: from Gardiner and Theobald, updated quarterly, to assist you with accurate estimates and cost planning through the design stages. Understand the key cost drivers for steel construction.

Case studies: of over 200 steel building and bridge projects, this year's Structural Steel Design Award winning projects, and video interviews with key participants' buildings.

Construction news: including features from New Steel Construction magazine, and regular steel construction supplements that appear in the construction press.

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Billingham Forum

The Forum at Billingham, Co. Durham, groups together in a single structure facilities for a whole series of sports and entertainments and in this respect is unique. The only other comparable project is Crystal Palace, which is on a much bigger scale and directed at training the expert and staging national and international events. In contrast, Billingham Forum is very much an everyman's place, although some major sporting events will take place there from time to time.

The range of activities catered for is wide and varied, the accommodation including (1) an ice rink with seating for 1,000 spectators; (2) 110-ft long swimming pool and a smaller learner's pool, with seating for 500 people; (3) Sauna baths; (4) 120-ft by 60-ft sports hall for indoor tennis; (5) small sports hall, 40 ft by 40 ft, for judo, table tennis etc; (6) three squash courts; (7) rifle range, to be used also for cricket practice and archery; (8) indoor bowling green to E.B.A. standards, and (9) a theatre seating an audience of 675 people. There is also a restaurant seating 500, a licensed bar, kitchens and changing accommodation, dressing rooms etc for each main activity group.

The Council's philosophy in commissioning this building was simply that having built the equivalent of a new town and attracted people and new industry to the area their responsibility did not end with merely providing shopping areas, services etc. People need entertainment and the Forum is intended to fulfil this function. They felt, too, that it was not a place to produce Olympic athletes, although serious training can obviously be done there, but a place where everyone in the family can find an activity to enjoy. In an effort to overcome the segregation of activity groups the communal facilities of the bar and restaurant are common to, and overlook, all the areas. It is hoped that this will create interest in the other activities in the building: swimmers can watch ice skating, theatre goers can see indoor games being played and so on.

The building is planned as a square measuring approximately 300 ft by 300 ft with the main activity groups situated at each corner. The circulation area is around a central open court and serves all groups: it is on two levels giving access to changing rooms at ground floor and the restaurant and facilities for spectators at first floor. Flexibility of use in as many areas as possible was an important consideration when designing the Forum. For instance the theatre can be used proscenium, open stage, Elizabethan or 'in the round' form: it has full 35 mm cinema equipment, and is suitable also for conferences, lectures and recitals. Seating is arranged not in tiered rows but in columns of individual boxes on the lines of an Italian opera house.

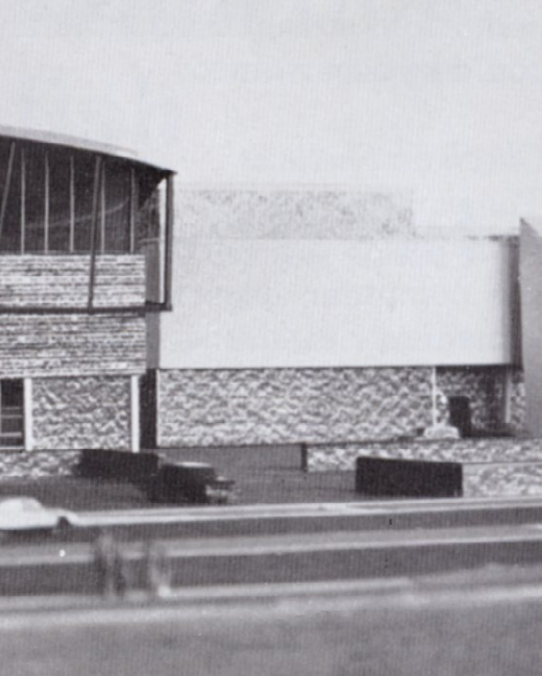
The ice rink has the biggest seating capacity in the building and in addition to holding ice spectacles, it will be used for other large-audience attractions such as professional tennis or championship events for basketball etc. This has been made possible by the provision of special flooring under the rink which gives a perfect playing surface when the ice is removed. The ice can be removed, a 12-hour event held and the ice refrozen in a 24-hour period. It is proposed also to hold large orchestral concerts in the rink and with temporary seating an audience of 3,000 could be accommodated: the hall is large enough to allow the use of a 70-piece orchestra.

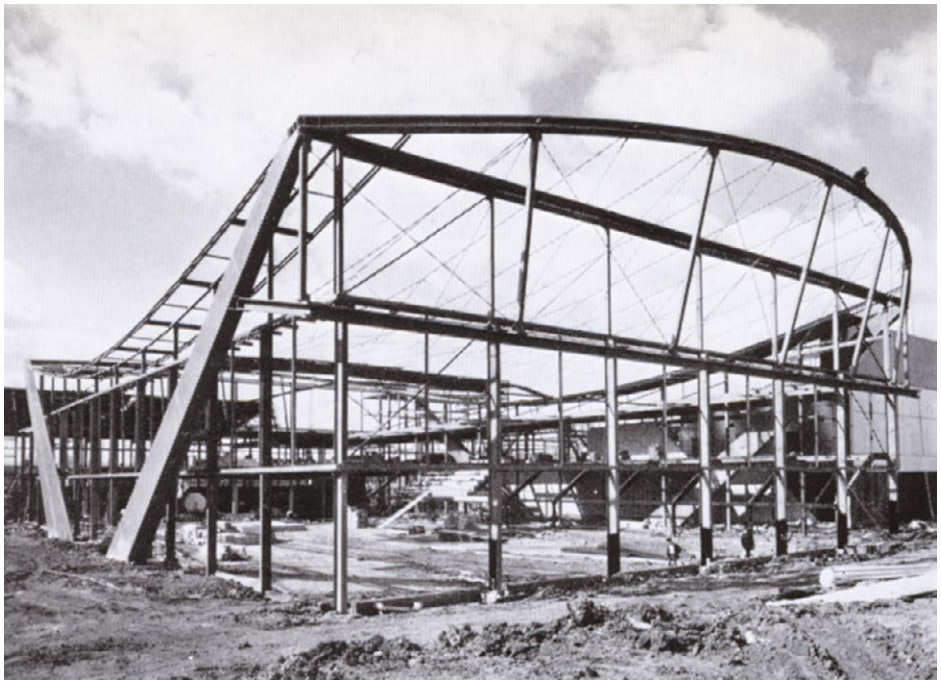
Construction Details

With the exception of the theatre auditorium the structure of the building is all steel. The sports facilities, swimming pool, stage tower, communal and circulation areas are conventional beam and post construction on a 20-ft grid. Precast flooring and proprietary metal roof decking spans 10 ft between intermediate members and purlins.

The ice rink construction, however, is of a more interesting nature because the roof is supported by a Swedish system of stressed wire ropes. This system was adopted because it provided a simple method of obtaining a clear area of 200 ft by 140 ft without columns. The basic principle of this form of construction involves the use of nine wire trusses spaced at approximately 10-ft or 11-ft centres. These consist of a 39 mm upper and 25 mm lower wire stressed in opposition to each other by means of diagonal tension rod ties to roughly a diabolo shape. The roof decking is attached directly to the wires.

One of the problems associated with this type of roof is the anchorage of the ends of the cables. The usual methods are either to anchor to heavy beams or the structure or alternatively to use the tent guy rope principle, but neither scheme was attractive to the architect and consultants, who in consequence developed a system of bow string trusses laid almost flat, to which the upper and lower cables are stressed. Where the ice





rink abuts the main part of the building at the end, the lower cables are anchored to the main steel structure, which has been suitably braced. Box frame struts keep the bow string trusses apart. The reactions at the ends of the trusses are transmitted to the ground by four raking tapered box frame columns set back at about 38 degrees to the horizontal: the columns are 1 ft 6¾ in wide and taper from 8 ft deep at the base to 3 ft at the head. The foundations to each column consist of two tension piles taking about 350 tons uplift and a compression pile taking about 500 tons downward thrust. A reinforced concrete compression beam underground keeps the two pairs of foundations apart. The side wall cladding is carried on a separate steel structure.

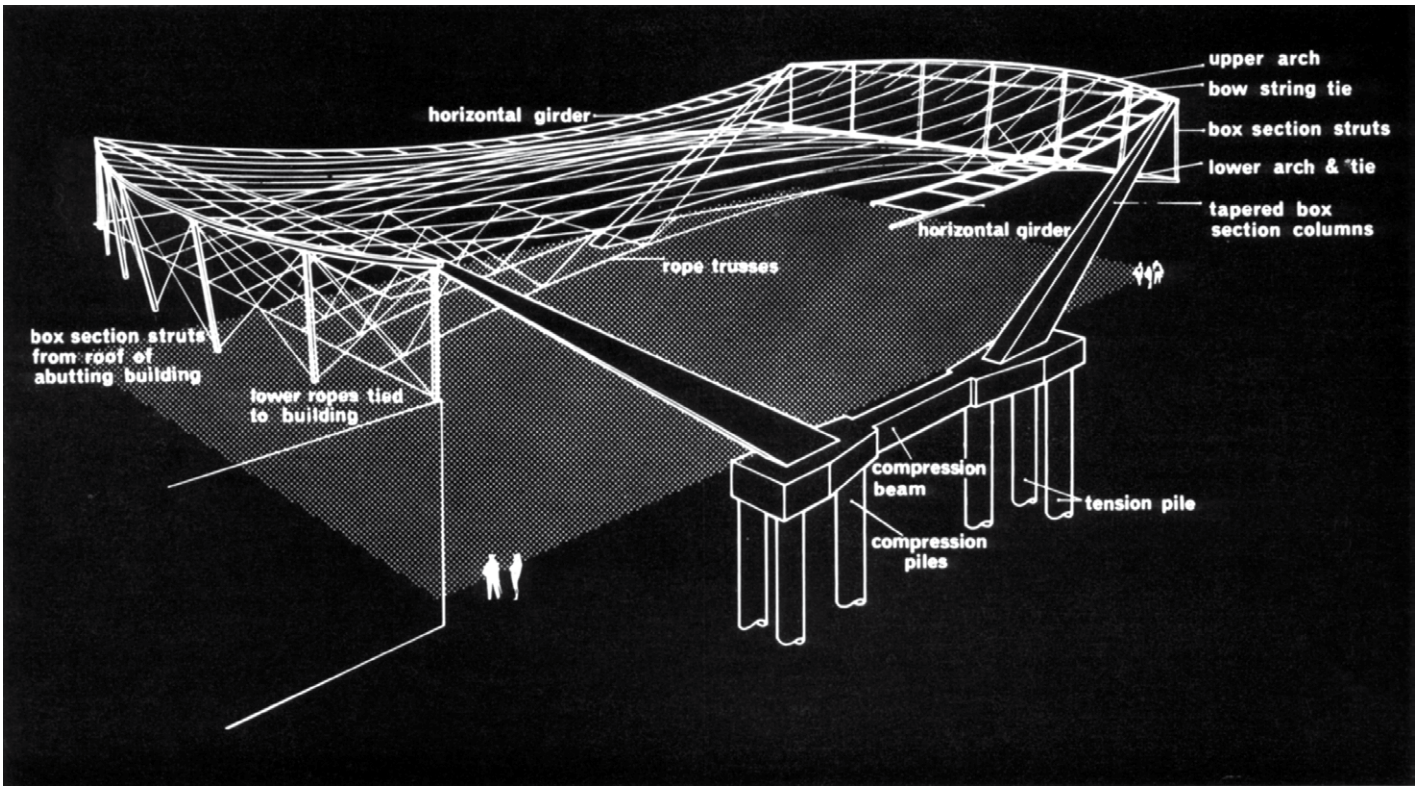
Heat for the building is from Billingham's district heating system: Billingham was the first authority in the country to adopt district heating from a central boiler house. In general, heat losses are covered by radiators and pipe coils and comfort conditions maintained by a plenum system.

Architects – Elder & Lester: Structural Engineers – Blyth & Blyth.

The Jarwerth system of rigid cable roof construction illustrated diagrammatically below made possible an unobstructed area of 200 ft by 140 ft.

Steelwork for part of the anchoring system is seen on the right.

The model illustrated on the first page shows the Forum when finished.



Steelwork contractors for buildings

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

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

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

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

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

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		2			Up to £200,000
A C Bacon Engineering Ltd	01953 850611			●	●	●	●				●			●			2			Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●					●		●	●	●		●	●		✔	3			Up to £400,000
Access Design & Engineering	01642 245151					●				●	●			●	●	✔	2			Up to £4,000,000
Adey Steel Ltd	01509 556677	●		●	●	●	●	●	●	●	●			●	●	✔	3		●	Up to £2,000,000
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AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4			Up to £2,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2			Up to £2,000,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2			Up to £400,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2			Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	4			Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	4		●	Up to £2,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●				●			●	●	✔	2			Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●	✔	2			Up to £800,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●		✔	2			Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4			Up to £1,400,000
Barnshaw Section Benders Ltd	0121 557 8261												●			✔	4			Up to £2,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		●	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4			Up to £6,000,000
Builders Beams Ltd	01227 863770			●	●	●	●			●	●			●	●	✔	2	✔		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		●	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Up to £6,000,000
Cementation Fabrications	0300 105 0135	●			●			●			●		●		●	✔	3		●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4		●	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 £800,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £100,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●		●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072		●	●	●	●	●	●	●		●	●			●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	✔	●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3		●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899												●		●	✔	3		●	Up to £2,000,000
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
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		●	Up to £2,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		○	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●			●	●				●	✔	2			Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2			Up to £3,000,000
Intersteels Ltd	01322 337766				●	●	●	●					●			✔	3			Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		4			Up to £40,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●				●	●		●			4			Up to £6,000,000*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●	●	✔	4			Up to £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Up to £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		○	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3			Up to £800,000
Luxtrade Ltd	01902 353182									●	●				●	✔	2			Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4			Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●			●	●	✔	2			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £1,400,000
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			●	●	●	●				●						2			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 £1,400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✔	4			Up to £4,000,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		2			Up to £400,000
Painter Brothers Ltd	01432 374400								●		●			●	●	✔	3			Up to £6,000,000*
Pencro Structural Engineering Ltd	028 9335 2886			●	●	●	●	●	●		●			●	●	✔	2			Up to £2,000,000
Peter Marshall (Steel Stairs) Ltd	0113 307 6730									●					●	✔	2			Up to £800,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		2			Up to £1,400,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●		2			Up to £1,400,000
S H Structures Ltd	01977 681931	●			●		●	●	●	●	●	●				✔	4	✔	○	Up to £2,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4			Up to £2,000,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2			Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		●	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £800,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●		●			●	●			●	●	✔	3			Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2			Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●	●	●	●			●				●		2	✔		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		2			Up to £800,000
Southern Fabrications (Sussex) Ltd	01243 649000				●	●				●	●			●	●	✔	2			Up to £800,000
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 £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✔	4		●	Above £6,000,000*
Underhill Engineering Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4			Up to £3,000,000
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		4			Up to £2,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2			Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4			Up to £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●		●	●	●	●	●				●	✔	4			Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●			●		✔	4		●	Up to £4,000,000
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)

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
A Lamb Associates Ltd	01772 316278
Balfour Beatty Utility Solutions Ltd	01332 661491
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Kier Construction Ltd	01767 640111
PTS (TQM) Ltd	01785 250706
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390

RQSC
The Register of Qualified Steelwork Contractors Scheme

Steelwork contractors for bridgeworks

BCSA

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

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

- **FG** Footbridge and sign gantries
- **PG** Bridges made principally from plate girders
- **TW** Bridges made principally from trusswork
- **BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
- **CM** Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
- **MB** Moving bridges
- **RF** Bridge refurbishment
- **AS** 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	FG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●	●	●	●				●	✓	3					Up to £400,000
Bourne Construction Engineering Ltd	01202 746666	●	●	●				●	●	✓	4	✓		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4			✓	●	Up to £3,000,000
Cementation Fabrications	0300 105 0135	●	●						●	✓	3				●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000*
D Hughes Welding & Fabrication Ltd	01248 421104	●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3			✓	●	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●	●	●	●		●		●	✓	3					Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3			✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4			✓	●	Up to £6,000,000
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		✓	✓		Up to £4,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4	✓		✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4			✓	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499							●	●	✓	3					Up to £800,000
Taziker Industrial Ltd	01204 468080	●	●	●	●			●	●	✓	3		✓	✓		Above £6,000,000
Underhill Engineering Ltd	01752 752483	●	●	●	●			●	●	✓	4			✓		Up to £3,000,000
Non-BCSA member																
Allerton Steel Ltd	01609 774471	●	●	●	●	●		●	●	✓	4			✓	●	Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●	●	●	●	●	✓	4					Up to £1,400,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			✓	●	Up to £800,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	4			✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879	●	●					●	●	✓	3			✓		Up to £40,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3			✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500							●	●	✓	N/A					Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A					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		✓	✓	●	Above £6,000,000

Industry Members

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

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

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
AJN Steelstock Ltd	01638 555500								●		M		
Albion Sections Ltd	0121 553 1877	●									M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I		
Autodesk Ltd	01252 456893		●										
AVEVA Solutions Ltd	01223 556655		●								N/A		
Ayrshire Metals Ltd	01327 300990	●									M		✓
BAPP Group Ltd	01226 383824									●	M		
Barrett Steel Services Limited	01274 682281								●		M		
Behringer Ltd	01296 668259					●					N/A		
British Steel	01724 404040				●						M		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
Composite Profiles UK Ltd	01202 659237	●									D/I		
Cooper & Turner Ltd	0114 256 0057									●	M		
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A		
Daver Steels Ltd	0114 261 1999	●									M		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	●	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	●	
Forward Protective Coatings Ltd	01623 748323						●				N/A		
Graitec UK Ltd	0844 543 8888		●								N/A		
Hadley Group Ltd	0121 555 1342	●									M	●	
Hempel UK Ltd	01633 874024						●				N/A		
Highland Metals Ltd	01343 548855						●				N/A		
Hilti (GB) Ltd	0800 886100									●	M		
Hi-Span Ltd	01953 603081	●									M	●	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
International Paint Ltd	0191 469 6111						●				N/A	●	
Jack Tighe Ltd	01302 880360						●				N/A		
Jamestown Cladding & Profiling Ltd	00 353 45 434288	●									M		
John Parker & Sons Ltd	01227 783200								●	●	D/I		
Joseph Ash Galvanizing	01246 854650						●				N/A		
Jotun Paints (Europe) Ltd	01724 400000						●				N/A		
Kaltenbach Ltd	01234 213201					●					N/A		
Kingspan Structural Products	01944 712000	●									M	●	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lindapter International	01274 521444									●	M		
MSW UK Ltd	0115 946 2316	●									D/I		
Murray Plate Group Ltd	0161 866 0266								●		D/I		
National Tube Stockholders Ltd	01845 577440								●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A		
Pipe and Piling Supplies Ltd	01592 770312	●									M		
PPG Performance Coatings UK Ltd	01773 814520						●				N/A		
Prodeck-Fixing Ltd	01278 780586	●									D/I		
Rainham Steel Co Ltd	01708 522311								●		D/I		
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				M	●	
Structural Metal Decks Ltd	01202 718898	●									M	●	
StruMIS Ltd	01332 545800		●								N/A		
Tata Steel Distribution UK & Ireland	01902 484000								●		D/I		
Tata Steel Ireland Service Centre	028 9266 0747								●		D/I		
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		D/I		
Tata Steel Tubes	01536 402121				●						M		
Tata Steel UK Panels & Profiles	0845 3088330	●									M		
Tension Control Bolts Ltd	01948 667700						●			●	M		
Trimble Solutions (UK) Ltd	0113 887 9790		●								N/A		
voestalpine Metsec plc	0121 601 6000	●									M	●	
Wedge Group Galvanizing Ltd	01909 486384						●				N/A		
Yamazaki Mazak UK Ltd	01905 755755					●					N/A