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NSC

Long span at St Michael's

February 2015
Vol 23 No 2

On The Curve in Slough

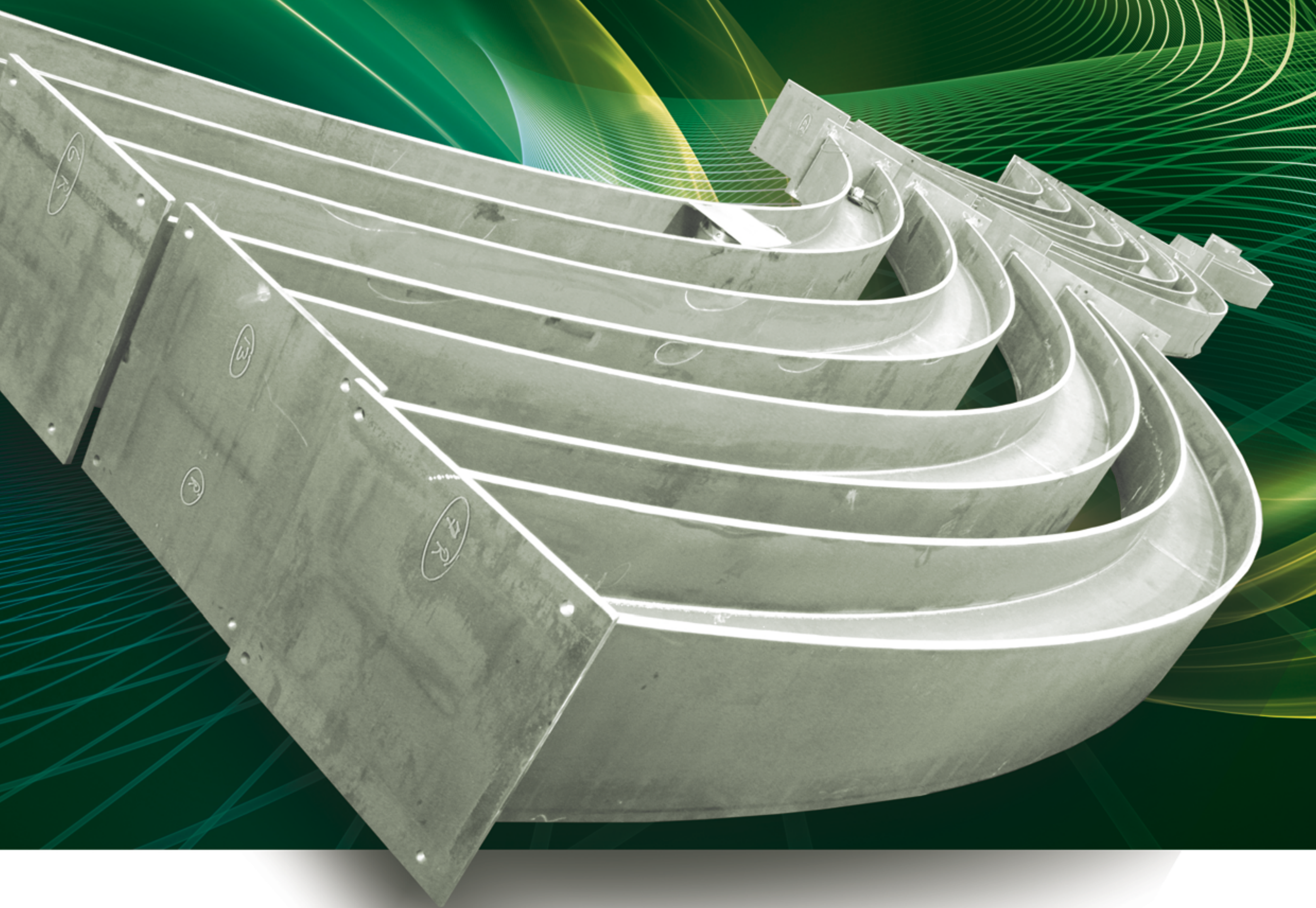
Regent Street façade retained

New phase at Longbridge

New High Wycombe hub

Flying Arches

Beautiful steel structures made by Jamestown



Capacity

Beams up to 40m in length
1.2m wide x 2.8m high
Weighing up to 2.5T per metre

Range

Plate Girders
Tee Section, Box girders
Tapered, Curved, Cambered
Assymetric, Multi-web

Finish

Black Steel, Shotblasted, Primed
Intumescent Paint
Shear Studs, End Plates
Connection Plates

Certification

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Welding to BS EN 1090-2, EXC 4
Quality Management System
to ISO 9001:2008

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Cover Image
The Curve cultural and learning centre, Slough
Main client:
Slough Borough Council
Structural engineer:
Peter Brett Associates
Steelwork contractor:
Caunton Engineering
Steel tonnage: 370t

BCSA

TATA STEEL

SCI
Steel Knowledge

NSC
February 2015 Vol 23 No 2

These and other steelwork articles can be downloaded from the New Steel Construction Website at *www.newsteelconstruction.com*

Market forecast paints a brighter picture

Nick Barrett - Editor

Our News section this month contains positive news for the steel construction supply chain as well as for its clients.

The continuing strength of steel as the favoured material for frames in all of the key sectors of the market is confirmed in our Market Share survey story.

The steel construction market forecasts that are also published this month show a near 40% rise in the amount of office space being built over the five years to 2018. The sheds market and other key sectors are also in for a period of sustained growth.

This issue of NSC shows plenty of reasons why steel is favoured in so many diverse markets. The façade retention on London's Regent Street that we visit is made possible by steel's ease of use on congested inner city sites, with offsite manufacture plus just in time delivery really coming into its own in this busy shopping and commercial area.

Just north of London in High Wycombe a new gateway development to the town is providing retail, commercial and leisure facilities. Steel's future proofing benefits mean that a mezzanine floor can be added to the centrepiece supermarket if required in the future.

Further north, regeneration of the former car manufacturing site at Longbridge has steel at its heart, with a new major Marks & Spencer store under way.

Heading west out of London we find the centrepiece of Slough's town centre regeneration is a uniquely shaped steel framed library and cultural centre – our cover story this month - made possible by steel's ability to be easily curved. The project also shows a construction team taking advantage of a BIM approach to design and construction, which the steel sector is well placed to participate in.

Further west in Bristol a church and community facility is providing a 550 seat auditorium, a complex project on a tight site made straightforward by using steel.

The sustainability benefits of steel are numerous and a continuous programme of work by the sector aims to keep steel the natural sustainability choice for building frames and bridges. One of the current areas of activity written about in NSC this month is establishing the embodied carbon footprint of the fabrication activities of steelwork contractors, which the Steel Construction Institute has investigated on behalf of the BCSA.

Stories like these now available every week, on NSC's Weekly News email alert. This is a new service that aims to bring you up to date steel sector news. Your monthly NSC will however still carry the main news stories, in more depth and with more analysis.

NSC

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Survey shows strong growth in key markets...

Steel has been confirmed as the preferred market choice as a framing solution in the 2014 Market Share survey which confirms the upward trend of demand for constructional steelwork in key markets.

The survey, by independent researchers Construction Markets, is the latest in a series that has been carried out annually since 1980. Based on interviews with 750 architects, builders and designers, the survey is the biggest of its kind in the UK.

The total market for structural frames in 2014 was estimated to be almost 38 million square metres of floor area, of which steel took the biggest share; almost as much as the total of alternative materials combined.

Steel continued to dominate the key market for office developments of over five storeys and over, where it enjoyed a market share of 70%. The research reveals that the total market for multi-storey office buildings of two storeys and over grew by almost 8%, with the total floor area accounting for steel frames increasing. The nearest rival to steel in market share was insitu concrete which fell in two of the office building height categories analysed and rose in three others.

Steel was very strong in the multi-storey retail buildings market, which grew by 1.5%, with market share ranging from over 75% for two storey structures to over 77% for six storey retail buildings. A significant shift to two storey structures, which were the main area of growth in retail, was seen in this market.

One of the strongest growing markets in 2014 was for multi-storey leisure buildings, where steel enjoyed market share of almost 70% in some segments, growing in line with the market which was driven by hotel and motel construction.

The overall floor area covered by steel frames in the public education buildings grew healthily, while strong market share growth was seen in the 'other private buildings' category that includes private education which grew strongly as a result of the free schools programme.

Steel increased its market share in public health buildings which showed strong growth of 19%, with marked dominance of the largest sector for three storey buildings.

BCSA Director General Sarah McCann Bartlett said: "The survey shows that steel is the preferred choice of the recovering construction market across all the building types analysed.

"The cost effectiveness of steel, its flexibility, speed of construction and contribution to sustainability are all factors that continue to be valued by developers, contractors, designers and building users, so we are confident that future market share surveys will continue to illustrate the dominance of steel as a framing material."

...and a brighter future for steel

UK production of constructional steelwork will continue its steady recovery from its 2013 low point over the years to 2018, and will pass the 1M tonnes a year level again in 2017, according to market forecasts carried out for Tata Steel and the BCSA.

The forecasts from market researchers Construction Markets predict demand growth in 2015 of over 9% as the key commercial and industrial sectors continue to climb out of the recession that bottomed in 2013 when output was 845M tonnes. The pace of growth is expected to slow down in following years with a rise of almost 6% over 2016 and 2017 to take output back over 1M tonnes.

Production growth will be maintained in the last year of the forecast period, 2018, at 2.5%. UK consumption however will remain below 1M tonnes a year due to some of the steel being exported.

Strong demand growth is expected in the offices market in particular, of almost 40% between 2014 and 2018, with the industrial sector also growing strongly by over 20%.

BCSA Director General Sarah McCann-Bartlett said: "By the end of the forecast period, demand for constructional steelwork will be almost back to the long term average. UK structural steelwork contractors have sufficient capacity to meet all of this demand, although we can expect to see some price increases.

"It is also good to note the strong growth forecast for market areas of traditional strength for steel, like offices and industrial buildings. We remain a strong industry with a solid foundation to build the future on."

Northampton's £20M station open for business

Northampton's new steel framed railway station building (NSC Sept 2014), designed to meet the growing number of commuters and visitors travelling to and from the town, opened in January.

"The project was always going to be a steel framed structure for efficiency," said Jacobs Project Engineer Rob Hazell. "The main challenge was fitting the station into its footprint which is bounded by railway lines and a main road on two elevations. This resulted in the building's rhomboid shape and the irregular grid pattern of the steelwork."

Long clear spans for the entrance and concourse areas were also an important consideration and another reason for using steel.

The ground floor of the building accommodates the main entrance from the drop off point and taxi rank, back-of-house facilities, ticket machines, retail zones all arranged around a 15m wide foyer.

Lifts and a main staircase give access up to the first floor, which contains another entrance from the adjacent road bridge, the main ticket office, more retail outlets, and access to all five platforms via the new footbridge and gateline.

Working on behalf of main contractor Buckingham Group Contracting, Billington Structures fabricated, supplied and erected 230t of steel for the project.

Steel frame for City of London's tallest building

Plans are being advanced to construct the City of London's tallest skyscraper at 1 Undershaft, a site currently occupied by the London headquarters of insurance giant Aviva

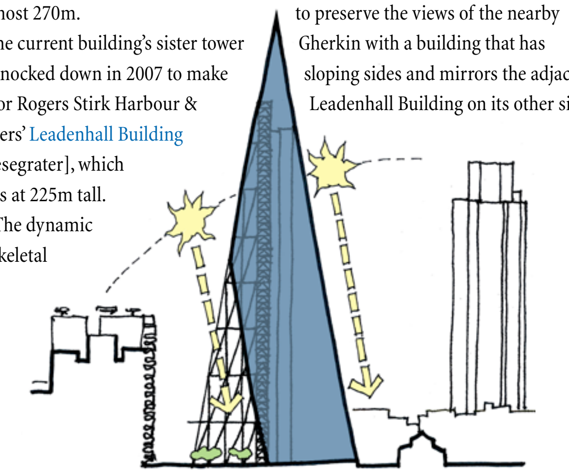
Architect Avery Associates has been working on a design that would see the site's existing 118m tall tower demolished and replaced with a steel framed sloping sided skyscraper rising to almost 270m.

The current building's sister tower was knocked down in 2007 to make way for Rogers Stirk Harbour & Partners' Leadenhall Building [Cheesegrater], which stands at 225m tall.

"The dynamic exo-skeletal structure of 1 Undershaft is designed to achieve the minimum material weight and facilitate a very rapid pre-fabricated construction programme. For this steel is the perfect material," said Bryan Avery of Avery Associates.

The plans for the building are for an office block with the potential for ground floor and basement retail units.

The architect says it has aimed to preserve the views of the nearby Gherkin with a building that has sloping sides and mirrors the adjacent Leadenhall Building on its other side.



'Can of Ham' tower to start soon

The much delayed City of London office building dubbed the 'Can of Ham' is being resurrected and according to sources will start onsite this summer – more than six years after Foggo Associates was given planning permission.

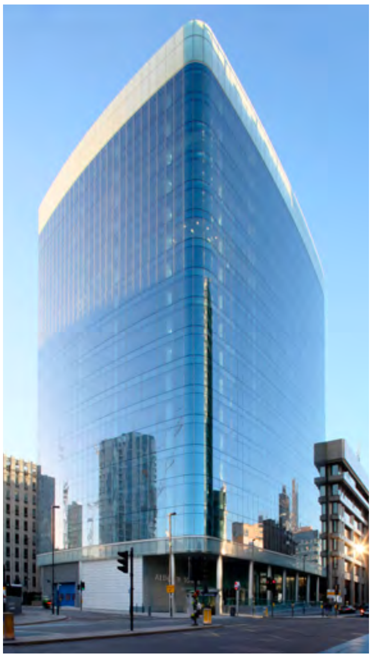
Mace has been appointed to build the steel-framed 90m-tall skyscraper at 60-70 St Mary Axe. The structure will consist of 24 floors of office space with a ground floor retail zone.

The 'Can of Ham' so called because of its distinctive curved shape that is said to resemble a tin of meatstuff will be a glazed building designed to be extremely energy efficient.

Vertical shading fins to the curved façades and glazed double wall cladding to the end elevations will reduce solar heat gains to the offices.

Other low energy measures, such as borehole thermal energy storage, will result in a structure with very low carbon emissions.

The scheme's original developer Targetfollow went into administration in 2011, with the development then sold to a US pension fund which merged its European real estate business with investment group Henderson's Asian and European real estate businesses to create TIAA Henderson Real Estate.



New City landmark opens

The 18 storey BREEAM Excellent Aldgate Tower at Aldgate on the City fringe has opened, marking completion of a highly successful project where choice of a steel frame delivered substantial cost and programme benefits.

The new commercial block has provides Grade A office space with attractive rents at a location perched right on the edge of the City. The structure has been designed to a BREEAM 'Excellent' rating and provides 16 floors of office space, plus two uppermost levels for plant equipment.

A steel solution allowed main contractor Brookfield Multiplex to construct the building on top of an existing raft foundation originally designed to support a smaller building.

"A steel frame supporting metal decking offered us the lightweight solution we required," said Arup Project Engineer Ben Tricklebank.

A steel core starts at ground floor and sits on a transfer structure, comprising of 47t beams that distribute the loads to the raft's concrete columns.

Externally, the buildings main facades are clad with a fully glazed, full height aluminium framed curtain wall system. Two 11KVA ring main units provide electricity to the building supplemented by a roof and façade mounted photo voltaic (PV) cell generation system.

The steelwork for the project was fabricated, supplied and erected by Severfield. The construction of Aldgate Tower was featured in New Steel Construction Jan/Feb 2014.

Contractor goes Dutch

North Wales based steelwork contractor EvadX has installed the latest Voortman V630 drilling line along with a VB1050 band saw, an investment that represents the biggest single spend of its kind in the company's 30 year history.

EvadX Managing Director Simon Adams said: "The installation signals our confidence in the market and our ability to build on recent successes and continue to attract valuable major contracts."

The Voortman V630 can drill both flanges and the web at the same time, which is said to reduce working hours and operating costs.

Each drilling head has its own automatic tool changer with five tools suitable for HSS drills, carbide tipped drills, thread tapping, counter sinking, layout marking and centre point marking.

The Voortman band saw range is said to have been especially designed for cutting structural steel. It is equipped with servomotors and spindles, which the company claims will guarantee optimal cutting speeds and high quality cuts. The band saws can be installed as stand-alone machines or in combination with other Voortman equipment such as drilling lines.

NEWS IN BRIEF

Designed by Arup, the partially retractable roof of the Singapore Sport Hub is the winner of the steel category in **Tekla**'s global BIM Awards. A span of 310m makes it the largest free-spanning dome structure in the world. Collaborative design between the architectural vision, venue designers and the structural engineering team using 3D modeling techniques resulted in a highly buildable roof that is extremely efficient, lightweight and sophisticated, says Tekla.

The recently launched FIRETEX FX6000 intumescent fire protection coating from **Sherwin-Williams** is said to enable drying in one hour, speeding up projects. FIRETEX Project Development Manager for Sherwin-Williams Protective & Marine Coatings Europe, Middle East and Africa (EMEA) Rick Perkins, said: "This technology means there is a much faster throughput in the shop, less mechanical handling damage and the potential to save costs on heating in the shop."

The **Institution of Structural Engineers** has announced it will host a conference exploring Building Information Modelling (BIM) on 30 April at the Institution's new International Headquarters in Bastwick Street, London. BIM 2015 will feature talks from innovative contractors whose use of BIM in off-site manufacturing has transformed their approach to projects. It will also present sessions on potential indemnity insurance issues and other legal aspects associated with working in the BIM environment. Tickets are available by visiting the Institution website.

The sky garden topping the Rafael Viñoly designed 20 Fenchurch Street (Walkie Talkie) office building in the City of London has opened to the public. The enclosed zone at the top of Land Securities and Canary Wharf Group's 160m-high tower is said to be London's highest garden. Steelwork for the project was erected by **William Hare**.

AROUND THE PRESS

Construction News
16 January 2015
Westfield's Broadway to make debut

Some steel elements had been manufactured before the recession. "We'd already prefabricated the steel for the Debenhams and Marks and Spencer stores," Westfield's head of design and construction Keith Whitmore recalls. "We held stock in steel supplier Severfield's yard, so were able to get a very quick start."

The RIBA Journal
January 2015
Blue ribbons for Reading

A particularly challenging part of the station steelwork was the six curved jumbo sections in the new Western Gateline building. These were bent in the UK by Angle Ring to give the appearance of a continuous beam with three bends at the top and three at the bottom.

The RIBA Journal
January 2015
Austria's alpine gem

The new 700m³ geometric [chapel] building designed by Swiss architect Mario Botta, is highly sculptural, its reddish brown CorTen steel clad façade taking the form of a crystal.

New Civil Engineer
8 January 2015
Loaded lumber

Steel fabrication was simplified by the choice of steel box sections for all internal columns and beams.

Building Magazine
5 December 2014
The rising

[One World Trade Center] – Its aspirational title has replaced Ground Zero as the popular monicker for the site and is a reminder that rebuilding the World Trade Center has a far deeper significance than glass, steel and offices.

Steel boost for Belfast regeneration

Planning consent has been granted for the second steel framed building within architect Grimshaw's City Quays master plan for Belfast Harbour's Clarendon Dock.

Known as City Quays 2, the structure will be a nine-storey office development delivering over 8,800m² of category A, flexible work space, and is a key part of the on-going transformation of Belfast's waterfront area.

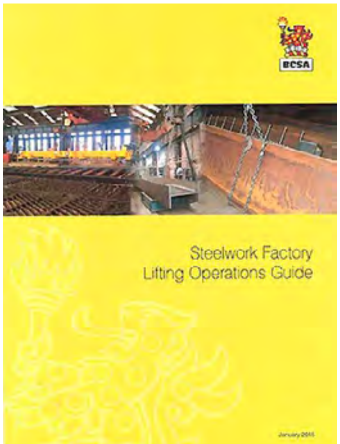
Grimshaw was appointed by Belfast Harbour to prepare a concept master plan for land to the north, west, and south of the Harbour Office. The master plan, now known as City Quays, received planning consent in July 2014 and encompasses commercial offices, retail areas, cafes, hotel space and residential accommodation.

The City Quays 2 building is located on a former ferry terminal site on the banks of the River Lagan, a few minutes walk from Belfast city centre. It is designed to meet a BREEAM 'Excellent' rating with the façade responding to orientation through an elegant system of alternating shallow and deep vertical fins, providing solar shading and articulation to all façades. The southerly faces are enhanced with a perforated aluminium shading system.

Grimshaw Partner, Ewan Jones said, "We're delighted to have gained planning consent for City Quays 2, and are working towards construction commencing later this year. The Grade 'A' office building will drive the next phase of the City Quays master plan forward, bringing new activity to Belfast's unique waterfront and continuing economic regeneration within the City.

"A steel frame was the obvious choice for City Quays 2, enabling rapid construction of large floor spans with full integration of the offices' structure and services.

BCSA publishes factory lifting guide



The British Constructional Steelwork Association (BCSA) has published a new Steelwork Factory Lifting Operations Guide for its membership.

BCSA Health and Safety committee members prepared the Guide, with the Health and Safety Executive being consulted and its comments were included during the drafting of the document.

"This guide was developed to identify the good working practices for lifting operations in the steelwork fabrication environment," said BCSA Director of Health, Safety & Training Peter Walker.

"Documenting the good practices is necessary to enable the industry to demonstrate that it is maintaining a minimum standard and will enable the practices to be reviewed and amended as improvements are identified."

The document also gives guidance on how to identify when the toppling of stockpiled fabricated steelwork may be a risk and could benefit from additional arrangements to secure the components.

First building completed at Swansea University's £450m Bay Campus

The steel-framed Institute of Structural Materials (ISM) is the first building to be completed and handed over by developer St Modwen on Swansea University's Bay Campus project.

The ISM building is a 72m long × 26m wide portal frame with a 10m wide lean-to structure positioned along either side.

It will provide a large testing facility for existing materials that are used in the aerospace and aero engine industries. The structure will also house a data centre for the new Bay Campus.

"A large open column free space was required for this building's research area and a steel portal frame offered the quickest and most economical solution," said Vinci Construction Project Director Jerry Williams.

Steelwork contractor Caunton Engineering has erected a total of five buildings for the project consisting of the £32M Manufacturing facility, the School of Management, the Great Hall, a Library, as well as ISM (see NSC Jan/Feb 2014).

All of the structures are unique due to their individual uses, and vary in degrees of complexity. Below ground they also differ due to the site's changing landscape, with the buildings either built on pad foundations or driven piles.

The largest of the buildings and the first to be erected is the 95m long × 87m wide Manufacturing facility. This three-storey structure is divided in half by a 9.5m wide street, which will be glazed at either end and spanned by a tensile fabric roof.

A further two steel framed buildings for the overall scheme have been constructed by Leadbitter.

The entire Bay Campus scheme is on schedule for the intake of students in September 2015.

Steel use on the rise for world's tallest buildings

The majority of the world's tallest buildings completed in 2014 used composite construction - a steel frame with concrete/metal decking floors - as the primary structural system.

According to a report by the US-based Council on Tall Buildings and Urban Habitat (CTBUH) 52 out of 97 (54%) worldwide structures over 200m tall were built using composite construction, up from 34% in 2013.

Europe's tallest building to complete last year was the 224m tall Leadenhall Building in London, nicknamed 'The Cheesegrater' (pictured), an example of composite construction and the UK steel industry's dominance in the high rise commercial sector.

Worldwide, the number of 200m-plus buildings hit a new record in 2014, with 60% of them constructed in China. A total of 97 new 200m-plus skyscrapers were completed in 2014, easily surpassing the previous record high of 81 completions in 2011.

Included in the report were 11 new "supertall buildings", which measure at least 300m in height. The tallest of these to complete last year was the 541m One World Trade Center in New York.

Merseyside Galvanizing, part of the Wedge Group, has galvanized 50t of steelwork used to create a walkway to access, install, and maintain new floodlighting at Everton FC's Goodison Park.

Sales Manager at Merseyside Galvanizing Richard Smetham said: "We were really pleased to assist our client on this project at Goodison Park. The stadium welcomes hundreds of thousands of supporters each year and the new floodlights will enhance their experience for years to come.

Steel bridge links Crossrail and ExCeL

A 34m-long steel box girder bridge has been installed as part of the construction of a new Crossrail station at Custom House, east London, linking the station with the ExCeL exhibition centre.

Bourne Steel, the steelwork contractor for the project, delivered the structure to site under police escort because of its length. With a combined weight of 90t, it was then lifted into place in three sections.

Project Manager for Custom House Mujahid Khalid said: "Installing this huge bridge was a vital part of our construction programme. The new station is rapidly taking shape - we expect the outline structure to be completed by the beginning of next year, after which the process of fitting out the station will begin in earnest."

When it opens in 2018 Crossrail will serve 40 stations and run more than 100km from Reading and Heathrow in the west, through 21km of tunnels below central London to Shenfield and Abbey Wood in the east.

Diary

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

Tuesday 10 February 2015
Portal Frames Design - Part 1: Preliminary Sizing & In-plane Stability
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview of connection design.

Thursday 12 February 2015
Steel Frame Stability
The course provides guidance on braced frames, continuous frames and portal frames. Leicestershire.
For details click here

Tuesday 10 March 2015
Portal Frames Design - Part 2: Member Design
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview of member design.

Thursday 12th March 2015
Fire and steel construction
This webinar will provide practical guidance on fire protection of structural steelwork and also on fire engineering of steel structures.
For details click here

Thursday 17 March 2015
Essential Steelwork Design
Introduceing the concepts and principles of steel building design, before explaining in detail the methods employed by Eurocode 3 for designing members in bending, compression and tension.
2 day course. Nottingham.
For details click here

Tuesday 24 March 2015
Portal Frames Design - Part 3: Connections and Detailing
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview of connection design.

Thursday 26 March 2015
Connection Design
For designers and technicians wanting practical tuition in steel connection design.
Bristol
For details click here

Steel construction has played a pivotal role on the entire Longbridge redevelopment

Steel puts regeneration in gear

A new town centre is being created at the former Longbridge car plant site and phase two has kicked off with the construction of the region's largest Marks & Spencer store.

FACT FILE
Longbridge town centre phase two
Main client: St. Modwen
Architect: Holder Mathias
Main contractor: Morgan Sindall
Structural engineer: Rodgers Leask
Steelwork contractor: James Killelea
Steel tonnage: 2,900t

At the heart of St. Modwen's £1 billion regeneration of the site of the former Longbridge car plant is the creation of a new town centre. The recently completed phase one of this scheme has seen shops, offices, new homes, a hotel and a college constructed alongside a park, helping a new community in south Birmingham to rapidly take shape (see NSC March/April 2013).

Phase two of the town centre scheme has now kicked off with the building of the West Midlands' largest Marks & Spencer store.

The steel-framed 13,900m² store will anchor this phase of the development, which also includes a multi-storey car park and a further 4,100m² of smaller retail units all of which are being built with steel frames.

Senior development surveyor at St. Modwen, Mike Murray, says: "This flagship store is indicative of the growing confidence retailers place in the regeneration at Longbridge. Since last year, around 26,000 shoppers have visited the town centre each week, showing the potential the area has as a retail destination.

"Attracting international retailers such as Marks & Spencer is a key part of our overall aim to create business and employment opportunities in the area. Up to 350 jobs will be generated by the new store, and a further 150 will be created in the construction process."

Regional manager at Marks & Spencer, Julie Ridley, adds: "This is a major investment for Marks & Spencer and our long term lease shows our commitment to the area and the Longbridge regeneration project. We are already excited about welcoming shoppers to the store."

James Killelea, working on behalf of main contractor Morgan Sindall, is fabricating, supplying and erecting approximately 2,900t of structural steelwork for phase two.

Steel erection began on the Marks & Spencer store and the multi-storey car park late last year with the smaller retail units starting this month (February).

"Speed of construction is very important for this project as the M&S store needs to be open in time for this coming Christmas," explains St. Modwen construction manager, Mark Batchelor. "Steel construction was the only solution for this tight schedule."

Mark Watkins, senior development surveyor at St. Modwen, agrees: "We're extremely pleased to see the M&S steelwork going up so quickly. It is a visual reminder that Longbridge is an exciting retail destination."

The Marks & Spencer store is a two-storey steel braced frame based around a regular 9m × 9m grid pattern. Bracing is located around the roof's perimeter and along exterior walls in areas without glazing.

James Killelea is erecting the steelwork for the entire programme using two mobile cranes. For the M&S store this allowed the company to progress the erection sequence along two fronts at the same time.

One section of the store's roof accommodates an outdoor plant area that is shielded by an acoustic steel barrier. Designed to keep any potential noise away from neighbouring properties, the barrier is formed by a series of 2m-high column extensions spliced onto the main perimeter members.

The six level multi-storey car park will have 1,200 spaces and although it is structurally independent, it will have pedestrian links into the M&S store at both retail floors.

The car park's steel frame is based around a 15m × 7.5m grid pattern with cross bracing positioned in some internal bays

The main reason for choosing steel was speed of construction

and along the perimeter elevations.

"On one elevation a steel ramp has been erected to serve the multi-storey car park and this was much easier to construct with steel as the members were curved and bent offsite which helped with a speedier construction," explains Rodgers Leask project engineer, Kully Toor.

The final piece in phase two's steel erection programme is the 450t for the smaller retail units. The shops are divided into two adjacent blocks, containing four and five units respectively, that both face onto a 500 space outdoor car park.

Each of the units is 15m wide × 35m deep with columns located within the unit's partition walls.

"All of the units have been designed with larger steel members than necessary which will allow a mezzanine level to be added in the future if the tenants require it," explains Mr Toor. "This ability to future proof the shop's design is another advantage of using steel."

The Marks & Spencer store along with the majority of the multi-storey car park will be open in December, with the smaller retail units scheduled for a January 2016 completion.

The grand plan

The overall Longbridge regeneration project covers an area of 450 acres in south Birmingham. The site was formerly one of the largest car manufacturing plants in the world producing such famous marques as Austin and MG Rover. St. Modwen, one of the UK's leading regeneration specialists, acquired the land in 2003 from MG Rover. The car manufacturer's new Chinese owners then leased back 60 acres of the site where the new MG3 and MG6 are being assembled.

Steel construction has played an important role in the majority of St. Modwen's completed projects at Longbridge, such as phase one's 7,900m^2 Sainsbury's anchor store (NSC March/April 2013).

Explaining the store's design, Rodger Leask project engineer Kully Toor says: "There is undercroft car parking combined with the need for larger spans for the retail area above. Steel was the only material that could provide these requirements."

The town centre phase one also included smaller steel-framed retail units and offices, while a steel podium supports a hotel.

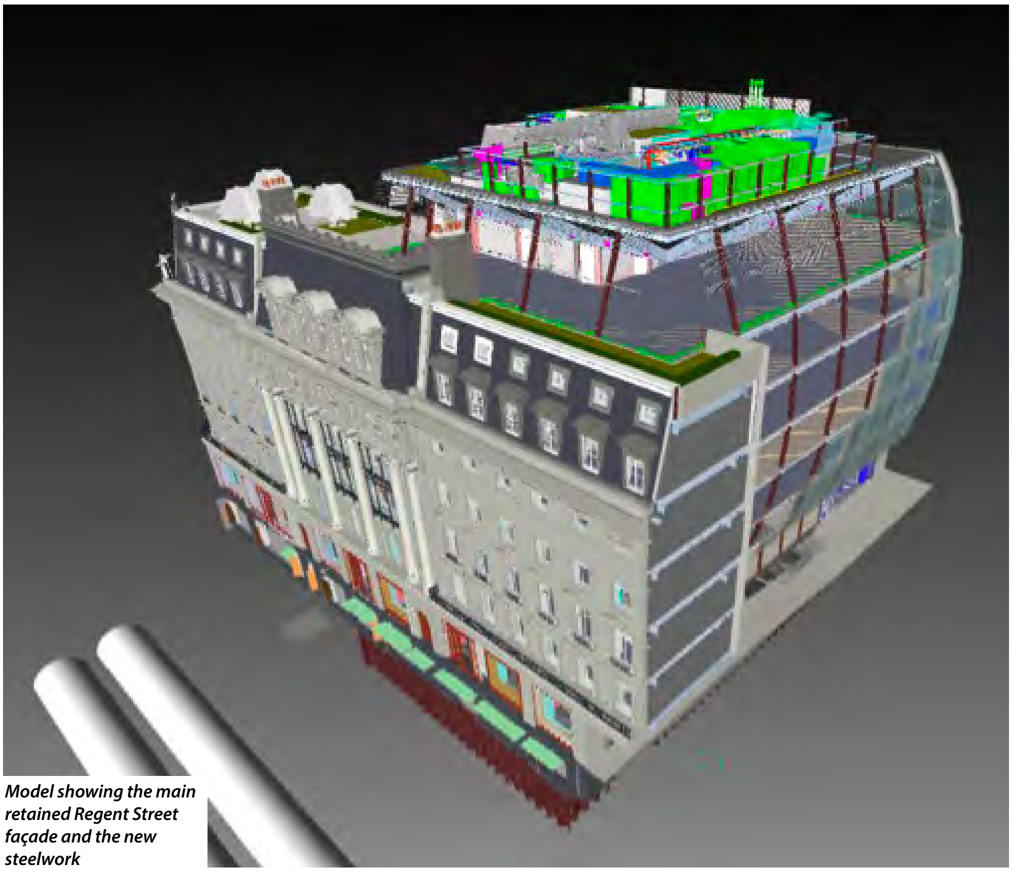
The overall redevelopment also includes the Longbridge Technology Park where Hambleton Steel, working on behalf of John Sisk, erected two three-storey office blocks. An adjacent youth centre, known as The Factory, is also steel framed.

James Killelea erects the steelwork

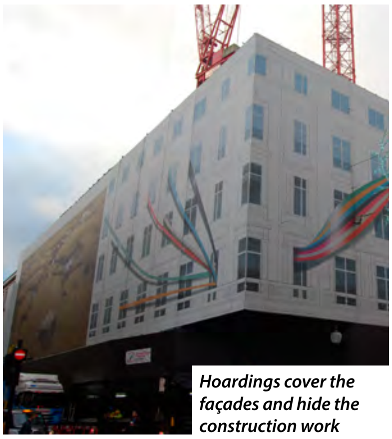
The Marks & Spencer store is the centrepiece of Phase Two

Façade retention in the frame

A new six-storey mixed-use development is taking shape behind a retained listed façade on London's world-famous Regent Street. Martin Cooper reports.



Model showing the main retained Regent Street façade and the new steelwork



Hoardings cover the façades and hide the construction work

FACT FILE
169-183 Regent Street, London
Main client: Crown Estate
Architect: Allford Hall Monaghan Morris
Main contractor: Mace
Structural engineer: Waterman
Steelwork contractor: Severfield
Steel tonnage: 1,800t

Completed in 1825 London's Regent Street is one of the world's best-known shopping thoroughfares, renowned for its high-quality retailers and its Christmas illuminations.

Named after the Prince Regent (later George VI) the street has the distinction of being one of the capital's first planned developments, built to impose order on a previously medieval street layout.

Unfortunately none of the original buildings, with the exception of All Souls Church, survived a wholesale redevelopment programme completed in 1927. Fashions in shopping had changed and the Georgian structures were not conducive to the large department stores wanted in the early Twentieth Century.

Since the turn of the Millennium, the Crown Estate has embarked on the second redevelopment of this grand street, a project that will ultimately replace many of the office and retail buildings with modern open plan flexible accommodation.

As every building along Regent Street is protected as a listed structure with at least Grade II status, all construction work involves extensive façade retention.

An example of this work is 169-183 Regent Street, also known as block W5, a major redevelopment of a plot bounded by New Burlington Street to the south and New Burlington Place to the north.

Here a number of interlinked buildings have been demolished to make way for a new open-plan six-storey office block, sitting above a ground floor retail zone with two basement levels.

The two main façades along Regent Street and New Burlington Street are being retained, with the latter also incorporating two 300-year old listed buildings that are being renovated as part of the overall project.

A structural steel frame is creating the new structure with Severfield erecting a total of 1,800t to complete its package. Using one centrally positioned core for its stability, the steelwork is based around an irregular grid with internal spans varying from 11.5m up to 16.5m.

"The two retained façades dictate the perimeter column spacing as each new steel column is placed directly behind a retained pillar to maximise internal space," explains Waterman Director, David Fung. "The façades were originally for a number of businesses and are consequently not spaced at regular intervals."

The new structure has no internal columns as long clear spans for both the retail and offices was an important client

Long clear internal spans are a key design feature

stipulation. Forming these open spans are a series of 520mm deep Fabsec plate girders with holes to accommodate the building's services.

"Using steelwork as the project's structural frame was the only solution as we were able to maximise the number of floors by incorporating all services, such as air conditioning, within the girders depth," says Mr Fung. "All the while achieving the desired long clear spans, something which could not have been done with a concrete frame."

The steelwork design has also contributed to the increase in useable floor area. Sitting on the same footprint as the old buildings, the new structure will offer approximately 15,500m² more lettable space.

The steel frame, which begins at the lowest basement level, is attached to the two retained façades from ground floor upwards. This is achieved by bolting the new frame via metal cleats to the façade's 1920s steelwork or connecting to brackets bolted into the masonry.

"The steelwork gains no stability from the façade and likewise the façade is structurally independent," says Severfield Project Manager, Adam Henshaw. "We only connect the two once we have erected two floors above this connection point and the floors have been decked, plumbed and levelled."

Above the basements the floorplan of the building consists of a ground floor with a double height floor-to-ceiling height that will accommodate retail areas, the main entrance lobby and a service yard with a vehicle turntable. Between the main core and the two retained listed buildings there is an internal open courtyard that forms a lightwell that extends from ground floor level up the full height of the structure.

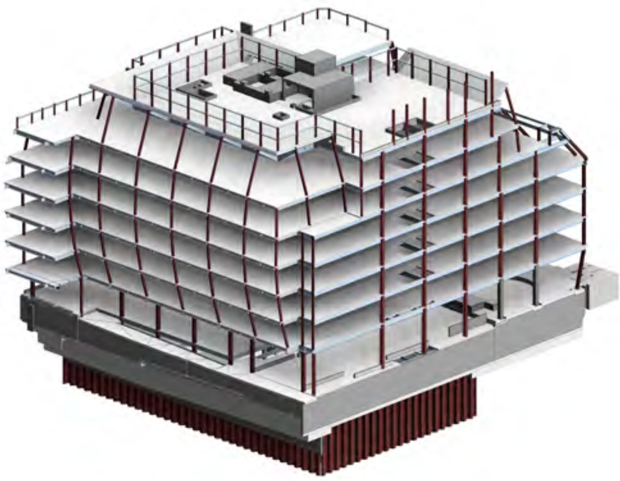
Above ground floor the office levels are similar with the exception of the topmost sixth level.

"The top floor will contain the project's premium offices and all steelwork will be left fully exposed within large fully glazed façades," says Mace Project Director, Steve Hawthorne.

The floor-to-ceiling height increases for the top floor. All other office levels are 3.6m high, while this premium floor has a sloping floor-to-ceiling height that reaches a maximum of 4.8m. Creating the roof is a series of feature box sections, chosen for their aesthetic value, as they will be left exposed within the completed building.

Severfield designed all of the frame's connections and Mr Henshaw says the most challenging aspect of this work was the New Burlington Place elevation. This side of the structure features a sloping façade that inclines inwards from the roof to the top of the third floor, meaning the upper office levels have an increase in floor area. This feature has been achieved with welded splice connections for each floor level that allows the perimeter columns to be inclined.

Severfield completed the steelwork programme in January, while the entire project is due to finish in August.



The grand plan

Work on the project began in April 2013 and, as well as a demolition programme, main contractor Mace's early works included installing façade retention systems and completing a large excavation scheme in order to accommodate the new structure's double basement.

All of the overburden that had to leave the site exited via the project's only access point, which is a former shop-front within the retained New Burlington Street façade.

Access to a site, which is either surrounded by retained façades or party walls, is not the only logistical challenge for the construction team. As the majority of the project's footprint will be built on, there is little or no room for materials to be stored on site.

"Logistics and planning are key drivers on this project," explains Mace Project Director, Steve Hawthorne. "We have one laydown area along New Burlington Street which we use for deliveries such as steelwork. Because of the lack of onsite space all steelwork has to be delivered on a just-in-time basis, which means it's lifted off the trucks and pretty much erected straight away."

The steel frame takes shape

Steel in service for community centre

A steel frame has given a local church and its parishioners the community facility they were praying for.

FACT FILE
St Michael's Church and Community Centre, Stoke Gifford, Bristol
Main client: St Michael's Church
Architect: CPL Architects
Main contractor: Bray & Slaughter
Structural engineer: AR Associates
Steelwork contractor: MJ Patch Structures
Steel tonnage: 105t

Church and community groups in Stoke Gifford, Bristol will soon have a new Church and Community Centre, replete with a multi-purpose auditorium seating up to 550 people, seminar spaces and offices at their disposal.

Adjacent to the village green, close to the parish church of St Michael's and abutting the existing St Michael's Old School Rooms (a new facility seating up to 200 people, with a coffee shop and meeting rooms), the new facility has been built on recently acquired land formerly occupied by derelict barns.

This latest project enhances the aim of St Michael's of serving the local community. The new building also seamlessly fits into its surroundings by incorporating two retained walls and using locally sourced blue lias stone cladding for the majority of the façades.

The Centre is a mixture of two-storey and single-storey elements that wrap around an auditorium in a C-shaped three sided configuration. Two sides are two-storey and accommodate meeting rooms and offices, while the third single-storey side consists of a crèche, resource centre and storage room. "It's a very complex project located on a very tight and confined site," explains Bray & Slaughter Site Manager, Kalvin Smith. "Early works involved underpinning one of the retained walls and demolishing and rebuilding the other as it wasn't in such good condition."

Once the preparatory programme had been completed the steelwork package was able to commence. Structural steelwork has been used to form the building as this was seen as the most economical and cost effective solution.

"We wanted a structural frame that was quick to construct and one which would easily incorporate the 21m-long spans we have in the auditorium. Steel was the obvious choice," says Phil Winch, CPL's Project Architect.

The church says the building has to be flexible for use by a large multi-use church congregation. In the space provided by the large steel beams, services of worship and church community events can be greatly enhanced and young people will have a creative space to experiment with how their Christian faith can be worked out in the wider world.

Steelwork abuts and goes over the single-storey high retained walls, meaning they are incorporated into the new structure but structurally independent.

The majority of the steel frame is braced for stability, with the exception of the single-storey element which is rigid frame gaining all of its stability from the connections.

"This was the most economical solution for the building," explains AR Associates Project Engineer, Ali Ramezan. "Bracing for the single-storey part of the building was not needed as it does not have any

The new building will seamlessly blend into its village environment

The auditorium

significant spans."

Elsewhere in one of the seminar rooms some Macalloy bracing has been added to three bays. This is an architectural feature, as it will be left exposed within the completed building, as opposed to the rest of the structure's bracing which is hidden in wall cavities.

Collaboration was a key element for the design of the structure. Using the architect's initial drawings and the engineer's structural design, steelwork contractor MJ Patch created its own 3D model in order to design the steel frame's connections. This helped with the design process and meant that MJ Patch was able to begin the steel erection programme on time.

One 100t capacity mobile crane was used to erect the entire steel package with the auditorium being the final part to be constructed.

"As the auditorium forms the central core of the building it would have been good to erect it first but site logistics dictated otherwise," explains MJ Patch Project Draughtsman, Phil Brunskill.

With the crane positioned in the middle of the site on the auditorium's footprint, the C-shaped part of the Centre was erected first in a phased programme that also allowed the floor slabs to be installed.

"Once this part of the steel was up we had to move our site cabins to create enough space for the crane to be repositioned. This then allowed the auditorium to be erected," adds Mr Smith.

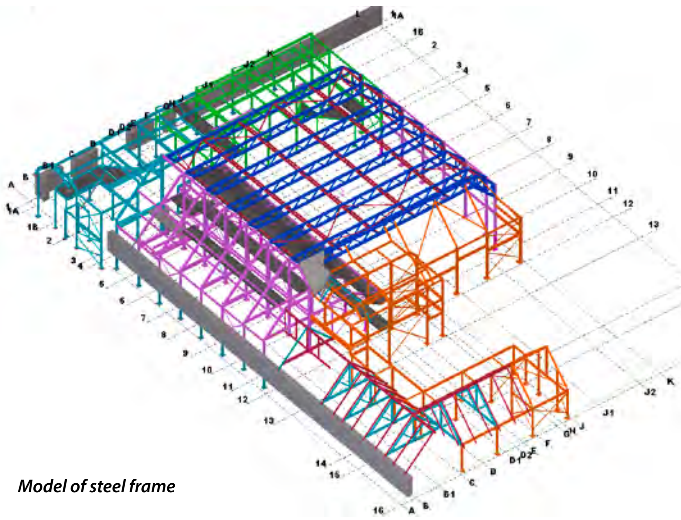
Forming the double height space of the auditorium is a series of 21m-long SHS trusses. The sections were chosen because they can incorporate services within their depth and offered the client a cost saving on more traditional cellular beams.

Using SHS sections was also a lighter option, which meant it was the economical way to go as far as the design team was concerned, as there was less deflection with these members.

The trusses were fabricated and delivered to site in two sections, 14m and 7m long respectively. These were bolted together on site and then lifted into place as one section. Completing the architectural design of the auditorium, the shorter 7m lengths have a fabricated crank that forms a chamfer in the roof's edge.

The trusses are set at 2.8m spacings and this grid then forms the pattern for the majority of the surrounding ground floor areas of the building.

The St Michael's Church and Community Centre shell is complete and Bray & Slaughter is now involved in the building's fit-out which is expected to be finished in April.



Model of steel frame

The 21m long trusses that form the auditorium

The project's challenging shape required a steel frame solution

FACT FILE
The Curve cultural and learning centre, Slough
Main client: Slough Borough Council
Architect: Bblur
Main contractor: Morgan Sindall
Structural engineer: Peter Brett Associates
Steelwork contractor: Caunton Engineering
Steel tonnage: 370t

Steel lends itself to curving library

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

More than 10 years of planning work are coming to fruition as a multi-million pound regeneration scheme is now beginning to transform Slough town centre.

The Heart of Slough project has already delivered a new iconic bus station and the scheme will eventually revitalise the town with new office and residential developments as well as infrastructure improvements to make the area more pedestrian friendly.

The scheme's flagship development is the Curve cultural and learning centre, currently under construction and scheduled for completion this autumn (2015).

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

The three level building is 89.7m long, 15.5m high and has a width, which is 34m at its maximum and 16.5m at its narrowest. With an overall floor space of 4,500m^2, the centre will include a library, café, office space and a 280-seat performance space.

Constructing a building with this kind of complex shape brings with it a whole host of geometry and setting out challenges. The use of a BIM model, shared between the entire project team, made the design process less onerous.

"Our expertise in BIM and 3D modelling using Tekla software has been a great benefit on this project, enabling us to integrate the original architect's model with our own," says Caunton Engineering Contracts Manager, Phil Ratcliffe.

Peter Brett Associates Project Engineer, Mark Way adds: "BIM was the best solution as it allowed everyone to see the same model and this made it possible to detect any possible problems well in advance.

Referring to why structural steelwork was chosen as the project's framing material he adds: "Using steelwork made it much easier to design and form such a challenging shape."

"Our expertise in BIM and 3D modelling using Tekla software has been a great benefit on this project, enabling us to integrate the original architect's model with our own,"

Initially the Curve was to be built with reinforced concrete, but a redesign of the project, instigated by main contractor Morgan Sindall and involving Peter Brett Associates, resulted in the frame changing to structural steelwork.

Not only did this make the project quicker to build it also made the overall frame lighter, saving the client money as shallower piled foundations were needed.

Once foundation installation and groundworks were completed the steelwork programme began in August and was completed in November.

Caunton Engineering erected the structure from east to west but, before the programme reached the final few bays, the company realised as the site is quite confined the partially complete frame would begin to obstruct the only access point for steel deliveries.

This could have been a logistical headache if it were not for the fact that there was just enough space for Caunton to stockpile the final 30t or so of steel.

"Once we had the steel stockpiled we also had just enough room to position our 50t capacity mobile crane," says Mr Ratcliffe.

Stability for the frame is derived from bracing located in stairwells and the lift cores. Early in the erection programme, temporary bracing was also installed to add further stability while the frame was being erected. These temporary props were only removed once the first and second floor concrete toppings had been cast, as this then provided the necessary composite stability/action.

The structure's perimeter columns are spaced at 7.5m intervals, but internally this grid pattern has not been adhered to because of two large atriums that pierce the first and second level floor plates. Most of the internal columns are CHS members, chosen for aesthetic reasons, as they will remain exposed within the completed building.

"The atriums mean we have some beams spanning up to 12m and so we had to limit movement due to wind effects by installing tie beams at first floor level," explains Mr Way.

Creating the feature north façade of the building are a series of curved rib ▶18

Entrance truss

The Curve will have public entrances at both ends, with the western end also incorporating a 7m-high void to allow vehicles to access a service yard located at the rear of the building.

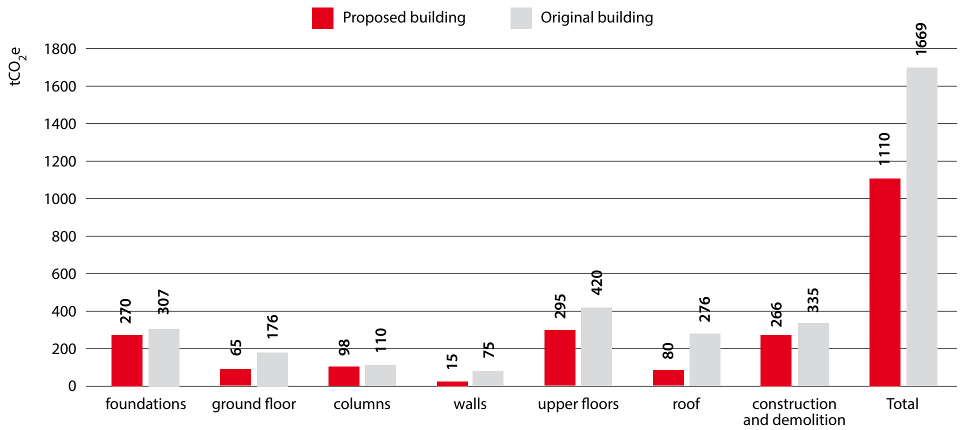
To create this open space a 6m high Vierendeel truss, supported on a V-shaped galvanized oval section column, is positioned along the perimeter of the building.

The truss had to be brought to site piece small, as it would have been too large to transport to site fully assembled. Once at the project the truss was erected piece by piece as there was not enough room on site to assemble it on the ground.

The Curve is an integral part of Slough's regeneration plans

Redesign of project

Peter Brett Associates carried out an embodied carbon calculation to test the assumption that they had improved the amount of embodied energy contained within the structural frame in relation to the original design. As the graph shows they calculated that a saving of 35% of CO_2e emissions has been made as a result of the building and frame being redesigned in steel instead of reinforced concrete.



Offices occupy the top floor

◀ 17 columns supported off of a curving 323mm diameter tubular member.

This main supporting tubular beam curves its way along the entire 89m-long façade, supported on sloping RHS columns. Below the tubular section the façade will be predominantly glazed and consequently tolerances were a challenge on this part of the job.

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

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

The southern façade is less complex and straight in plan, although it does have a bullnose feature where the perimeter columns curve at the top (similar to large hockey sticks) to form the connection with the roof.

"The interface between the roof and the façade steelwork was one of the main design challenges as the roof pitches at three angles," explains Mr Way.

Summing up, Morgan Sindall Senior Project Manager, Alistair Kendall says: "Morgan Sindall is working within Slough Borough Council's Local Asset Backed Vehicle and a key project within this is The Curve. We are well versed in delivering complex and innovative structures, the latest of which is this new library and community centre for Slough. The design of The Curve will make it a local landmark and we're very excited to be leading such an iconic project."

Embodied carbon

Michael Sansom (SCI)

As new buildings become more energy efficient in operation, greater attention is turning to the embodied carbon of construction products and materials. As a reminder, embodied carbon is the summation of all the global warming gases emitted as a consequence of winning, transporting and processing construction materials.

Although methodologies for assessing and comparing embodied carbon impacts are still evolving, better and more comprehensive data are enabling more robust and comprehensive assessment of buildings – such as was done by Peter Brett Associates on the Curve project.

In keeping with the need to move towards a more circular economy, more thought is being given to what happens to buildings when they are deconstructed so that more materials are retained within the economy rather than lost to landfill or downcycled into low grade applications. This is being done by including the impacts of demolition, transport and processing of demolition waste and the disposal or beneficial reuse and recycling of products and materials.

All construction materials are not equal in this aspect. Steel is unmatched in terms of its inherent recyclability and, in the case of structural steel, its potential reusability. These future benefits are real, are consistent with circular economy principles and should be factored into embodied carbon assessments.

Data to enable practitioners to undertake whole life embodied carbon comparisons for the most common structural materials are already available. Advice and data are available in the Life cycle assessment and embodied carbon article on SteelConstruction.info. The timber sector has published environmental product declarations (EPDs) on common timber products and the concrete sector is due to publish comparable data shortly.

The Curve project also demonstrates the knock-on embodied carbon benefits that are achievable by choosing a steel frame. Undertaking an holistic assessment of the whole building, rather than just comparing different framing options, consequential benefits in terms of speed of construction, fewer deliveries to site, lighter foundations, etc. are accounted for. In addition to cost savings, these benefits reduce the overall embodied carbon of the project – as shown in the graph in the main article.

The use of BIM was key to the success of the Curve project. Work is under way to integrate embodied carbon data within BIM models and looking ahead, this will enable embodied carbon assessments to be undertaken more quickly and accurately by design teams.

Calculating the fabrication footprint

The Steel Construction Institute was recently commissioned by the British Constructional Steelwork Association to carry out a study to audit a number of its members, to quantify the carbon footprint of the fabrication process for hot rolled structural steelwork.

As the construction industry becomes more aware of the importance of sustainability, one of the leading areas of concern that has emerged is that of carbon emissions. These can be either embodied or operational. Operational carbon emissions are being reduced via changes to Approved Document L and this has turned attention to how to measure and account for embodied emissions.

This has led to demands for high quality and comprehensive embodied carbon data from construction product manufacturers. However, although the steel construction sector has good data on the environmental impacts of steel production, there has until now been a gap in terms of the downstream impacts of steel-based construction systems, in particular with regard to steelwork fabrication.

Having been commissioned by the British Constructional Steelwork Association (BCSA) to audit some of its steelwork contractor members, the Steel Construction Institute (SCI) collated the results with data returned by steelwork contractors within the BCSA Sustainability Charter scheme, to derive a robust average UK carbon footprint for steelwork fabrication.

The organisation in Europe responsible for standards development, CEN, has recently published a standard (EN 15804) which provides rules for the calculation of embodied carbon for construction products. This standard divides the lifetime of the products into modules, where (for fabricated structural steelwork), module A1 covers steel production, A2 covers transport to the fabricator, A3 covers fabrication and A4 covers transportation to site. The study carried out by SCI covers modules A2, A3 and A4. Data for other modules can be found in a recently published Environmental Product Declaration (EPD).

The weighted average of the carbon emissions from the fabrication of hot rolled structural steelwork was divided into Scope 1, 2 and 3 emissions as defined in the Greenhouse Gas Protocol. Scope 1 emissions are defined as Direct GHG (greenhouse gas) emissions that occur from sources that are owned or controlled by the company.

Examples of this are emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc. Scope 2 emissions are those from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the company.

Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities are: extraction and production of purchased materials (e.g. welding rods or paint); transportation of purchased fuels; and use of sold products and services. These scopes are separately defined so that companies can report their own company footprint and to avoid double counting. For company carbon reporting, it is only mandatory for companies to report Scope 1 and 2 emissions.

The total average product carbon footprint for structural steelwork (Scope 1, 2 and 3 for modules A2, A3 and A4 collectively) based on a weighted average of all the steelwork contractors assessed is 284 $kgCO_2e$ /tonne fabricated steel. The weighted average for the three separate modules is:

- Module A2 - 24 $kgCO_2e$ /tonne
- Module A3 - 247 $kgCO_2e$ /tonne
- Module A4 - 13 $kgCO_2e$ /tonne

The average Scope 3 impact (weighted average) is 154 $kgCO_2e$/tonne of fabricated steel, which gives an average company carbon footprint (Scope 1 and 2) of 130 $kgCO_2e$ /tonne.


The Waitrose store steelwork seen through the leisure centre's frame

Steel gets heads up for hub development

A supermarket and leisure centre will form part of a new gateway hub to the Buckinghamshire town of High Wycombe. NSC reports.

Conveniently located adjacent to Junction 4 of the M40, the Handy Cross Hub development will ultimately create a new retail, commercial and leisure destination on the outskirts of High Wycombe.

The project's first phase will consist of a new sports and leisure centre, a Waitrose supermarket, a multi-storey car park and a coachway park and ride facility. Further phases to this multi-million pound scheme will include a hotel and office blocks.

Main contractor for the development's first phase is Willmott Dixon and currently it is constructing the sports and leisure centre along with the adjacent Waitrose store.

The company has been on site since April and preliminary works included a large earthmoving programme that involved excavating areas for the scheme's swimming pools.

"No overburden has left the site as it's all been used to raise the ground level in readiness for the two building's steel frames to be erected," explains Willmott Dixon Construction Manager, Stuart Rooney.

Steel erection began late last year (2014) with the leisure centre contract kicking off a couple of weeks ahead of Mifflin Construction's package to erect the store.

Using steel for both of these structure's was always on the cards according to Curtins Project Engineer, David Sandbrook.

"Since project concept these two buildings were designed to be built with steelwork, mainly for its versatility and the need for long clear spans."

The Waitrose store is a 65m wide x 80m long rectangular shaped building, designed with a braced frame, chosen instead of a portal frame for its efficiency.

"With a braced frame we have used smaller sized columns than we would have with a portal frame, and that was important as larger columns would have eaten into the store's valuable sales

floorspace," says Mr Sandbrook.

In order to make the internal spans manageable the store is divided in half by one row of internal columns spaced at 12m centres, creating two roughly equal clear column zones of over 30m. This has meant minimal intrusion into the sales area and allowed Waitrose to maximize the options for the store layout.

Flexibility has also played a key role in the store's design as provision has been made for a mezzanine floor to be retrofitted if required in the future.

The Waitrose store is expected to open by the end of the year.

FACT FILE
Handy Cross Hub, High Wycombe
Main client: Wycombe District Council
Architects: Richard Markland Architects, AFLS+P, Corstorphine + Wright
Main contractor: Willmott Dixon
Structural engineer: Curtins
Steelwork contractor: Mifflin Construction
Steel tonnage: 250t

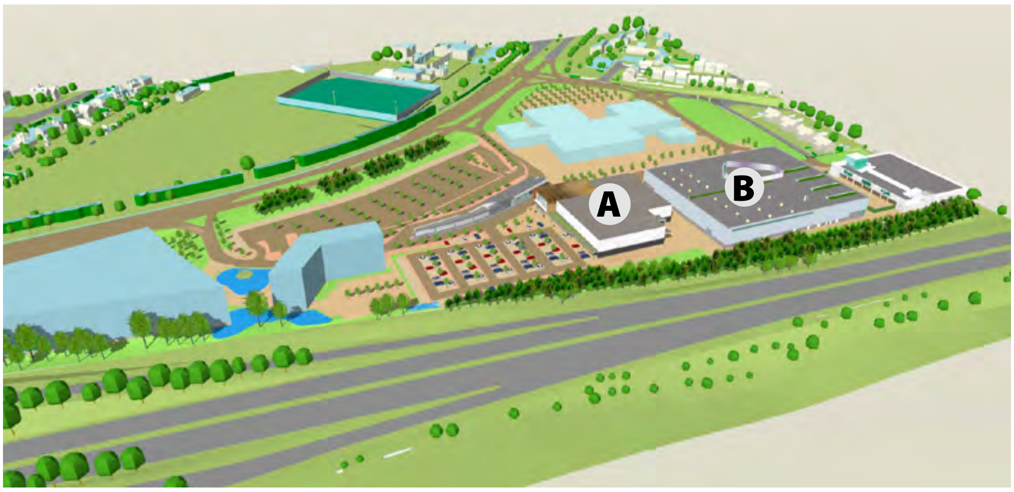
Waitrose Store (A)

With more than 2,300m² of trading space, the new store will sell a full range of Waitrose and branded products. It is anticipated that it will create around 160 new jobs in High Wycombe.

Waitrose Director of Development, Nigel Keen, says: "This is an exciting opportunity to provide High Wycombe with the full offer from the John Lewis Partnership.

"Waitrose will complement the existing department store, delivering our very latest range of goods and services, more choice and creating a significant number of jobs for local people."

Cllr Tony Green, Cabinet Member for Economic Development and Regeneration at Wycombe District Council adds: "This is a real boost for High Wycombe's retail offer given the new employment Waitrose will bring and the increased consumer choice that the branch will provide. These are exciting times for the district and the Handy Cross Hub development is set to play a positive role in its future.



Sports and Leisure Centre (B)

The steelwork for the Sports and Leisure Centre is being fabricated, supplied and erected under a separate contract from the Waitrose store.

The Sports and Leisure Centre will eventually replace the site's existing sports centre when it opens in 2016. Designed by AFLS+P architects, the 10,750m² rectangular centre will be clad in copper and aluminium panels that have four different finishes.

The steel framed structure will have a host of facilities including an eight lane 50m-long pool with moveable floor and sub-aqua dive pit; a 20m-long learner pool; a toddlers pool; a 150 station gym, a dance studio, 12 court sports hall, a bowls centre, two squash courts, and a café.

Most of these facilities require long clear spans and this was the main reason why the project team chose steel as the framing material.

A series of 31m-long trusses span the main pool hall, a distance that covers not only the width of the pool, but also walking areas and an area of spectator seating.

Trusses were chosen for the pool for aesthetic reasons, as they will be left exposed within the completed building. This was not such an important consideration for the other large open plan areas and so spliced 35m long cellular beams form the sports hall, and 24m-long cellular beams span the bowls centre.

Specifying the right Execution Class

Dr David Moore explains the concept of Execution Class and provides guidance on selecting the right level of quality and assurance controls needed to ensure a structure meets the engineer's design assumptions.

During the development of BS EN 1090-2 'Execution of steel structures and aluminium structures: Part 2 – Technical requirements for the execution of steel structure' it was decided to rationalise how the standard would deal with selecting project-specific requirements.

This resulted in a normative Annex A which groups some of the more important requirements in to four classes to facilitate a consistent selection. These classes are called 'Execution Classes' and are defined as 'classified sets of requirements specified for the execution of the works as a whole, of an individual component or of a detail of a component'.

BS EN 1090-2 includes an Informative Annex B that 'provides guidance for the choice of execution classes with respect to those execution factors that affect the overall reliability of the completed works.'

Execution class is a relatively new concept. However in recent months the constructional steelwork industry has become more aware of it, particularly, with the establishment of the Construction Products Regulation on 1st July 2013 and the introduction of the harmonised standard, BS EN 1090-1, Execution of steel structures and aluminium structures: Part 1 – Requirements for conformity assessment of structural components' a year later on the 1st July 2014 and the mandatory CE Marking of fabricated steel and aluminium components.

BS EN 1090-2 lists four execution classes which range from Execution Class 1 which gives the lowest set of requirements to Execution Class 4 which gives a higher, more stringent set of requirements. Annex B of BS EN 1090-2 gives a relationship between Consequences Class, Production Category and Service Category for determining the Execution class of a particular structure (see Table 1).

Consequences classes		CC1		CC2		CC2	
Service category		SC1	SC2	SC1	SC2	SC1	SC2
Production categories	PC1	EXC1	EXC2	EXC2	EXC3	EXC3[a]	EXC3[a]
	PC2	EXC2	EXC2	EXC2	EXC3	EXC3[a]	EXC4

[a] EXC4 should be applied to special structures or structures with extreme consequences of a structural failure as required by national provisions

Table 1 – Recommended matrix for determination of execution class (from BS EN 1090-2: 2008+A1: 2011)

Service Categories are used to consider

Reliability Class (RC) or Consequences Class (CC)	Type of loading	
	Static, quasi-static or seismic DCL[a]	Fatigue[b] or seismic DCM or DCH[a]
RC3 or CC3	EXC3[c]	EXC3[c]
RC2 or CC2	EXC2	EXC3
RC1 or CC1	EXC1	EXC2

[a] Seismic ductility classes are defined in EN 1998-1, Low=DCL; Medium = DCM; High = DCH
[b] See EN 1993-1-9
[c] EXC4 may be specified for structures with extreme consequences of structural failure

Table 2 – Choice of execution class (EXC) (from Annex C of BS EN 1993-1-1: 2005 A1: 2014)

the risk from the actions to which the structure and its parts are likely to be exposed to during construction and use, such as static, fatigue and the likelihood of seismic actions. SC1 relates to static, quasi-static and regions of low seismic actions while SC2 is for fatigue actions according to BS EN 1993-1-9 and regions with medium or high seismic activities.

The Production Categories are used to identify the risk associated with fabrication. PC1 is related to non welded components or welded components made using steel grades below S355 while PC2 is for welded components made using higher grade steels, welding on construction sites, hot forming and thermic treatments during manufacture and components of CHS lattice girders requiring end cuts.

Complete definitions of both Service Category and Production Category are given in Annex B of BS EN 1090-2.

Applying these recommendations to a range of structures leads generally to the following relationship between Execution Class and type of structure:

- Execution Class 1 – Farm buildings
- Execution Class 2 – Buildings in general
- Execution Class 3 – Bridges
- Execution Class 4 – Safety critical structures with a high consequence of failure

Execution Class is used in two ways. Firstly by steelwork contractors to put in place a set of manufacturing process controls that form part of a certified factory production control system for CE Marking fabricated steelwork. This has the effect of dividing the fabrication industry into companies with one of four sets of quality control processes.

These limit the type of structures that each steelwork contractor is allowed to fabricate – e.g. A steelwork contractor with an Execution Class 2 certified FPC system can only fabricate Execution Class 1 and 2 structures. Clients, specifiers and main contractors can use Execution Class to identify steelwork contractors with the correct level of quality and assurance controls.

Secondly Execution Class is a design issue and is used by designers/specifiers to determine the controls required during fabrication to meet their design assumptions. This second issue is less well known and understood by specifiers and engineers. This is partly because the recommendations on the determination of Execution Class are in the fabrication standard BS EN 1090-2 and partly because the concept is a new one.

To redress this situation the European Committee for Standardisation (CEN) recently issued an amendment to BS EN 1993-1-1: 'Eurocode 3: Design of steel structures – Part 1.1: General rules and rules for buildings.' The amendment includes a new Annex C 'Determination of Execution Class' which makes it clear that it is the specifier's responsibility to determine the Execution Class. Annex C also recommends Table 2 (above) for the selection of Execution Class.

This table is different to the one given in Annex B of BS EN 1090-2. Service Category has been replaced by 'Type of loading', Production Category has been removed and Execution Class 4 is reserved for 'structures with extreme consequences of structural failure'.

The other major difference is that the Annex C of BS EN 1993-1-1 is normative and must be used whereas Annex B of BS EN 1090-2 is informative and allows specifiers the freedom to base execution class on their own experience.

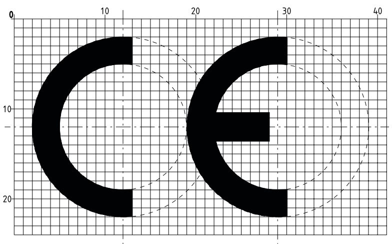
Annex C of BS EN 1993-1-1 allows member states to either use Table 2 or recommend an alternative approach in a National Annex. Currently BSI committee CB/203 is discussing the approach to be adopted in the UK National Annex.

Finally both the design standard BS EN 1993-1-1 and the fabrication standard BS EN 1090-2 apply to a much wider range of activities than the harmonised (CE Marking) standard BS EN 1090-1. Consequently, Execution Class also applies to a much wider range of activities and is not limited to those structures that fall within the scope of BS EN 1090-1. For example Execution Class also applies to site activities such as erection, assembly, repairs and modifications.

The concept of Execution Class is relatively new to the majority of the construction industry but it offers the industry a common approach to selecting the right level of quality and assurance controls needed to ensure the structure meets the engineer's design assumptions.

Further information on how the steel construction sector has been working behind the scenes towards achieving CE Marking is available from the recently updated Steel Construction – CE Marking publication. This spells out in detail what it will mean for the rest of the construction sector and what specifiers need to do to comply with the Construction Products Regulations.

This is available free at: www.steelconstruction.info/Steel_construction_news



Eurocode verification of a runway beam subject to wheel loads – Part 1

Dorota Koschmidder-Hatch of the SCI describes the design of runway beams carrying an underslung hoist or crane to BS EN 1993-6 – in particular the verification of the bottom flange at ULS and SLS. Part 1 describes the requirements of the Standard. Part 2 will include a worked example.

Before the Eurocodes were introduced, BS 2853 covered design and testing of overhead runway beams. Following revision in 2011, BS 2853 now only provides guidance on testing overhead runway beams. BS EN 1993-6:2007 (EC3-6) covers the design of steel crane supporting structures, which includes overhead runway beams, while guidance on determining actions induced by cranes is given in BS EN 1991-3.

This article focuses on crane runway beams supporting either a monorail hoist block travelling on the bottom flange (see Figure 1) or an underslung crane, which is also supported on the bottom flange of the beam. The guidance in this article covers beams with parallel flanges, though EC3-6 also includes information for beams with tapered flanges.

The bottom flange is subject to a complex state of stress, experiencing direct stresses from the global bending, but also local stresses around the wheel positions, which vary with the proximity of the hoist to the end of the beam. Figure 2 shows a typical situation, with a four wheeled hoist. The local resistance of the flange is based on nominal yield lines, shown in the plan.

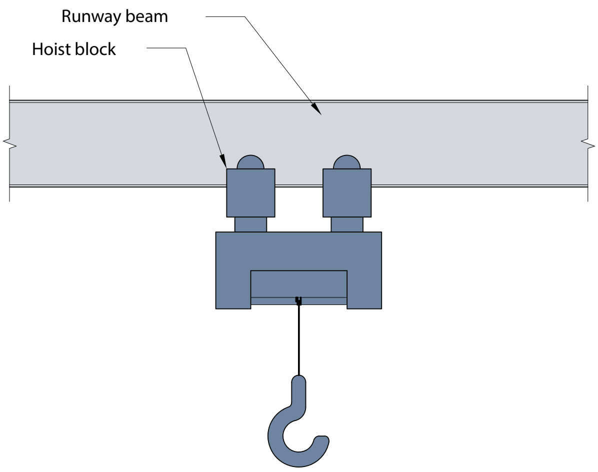


Figure 1: Crane runway beam supporting a monorail hoist block

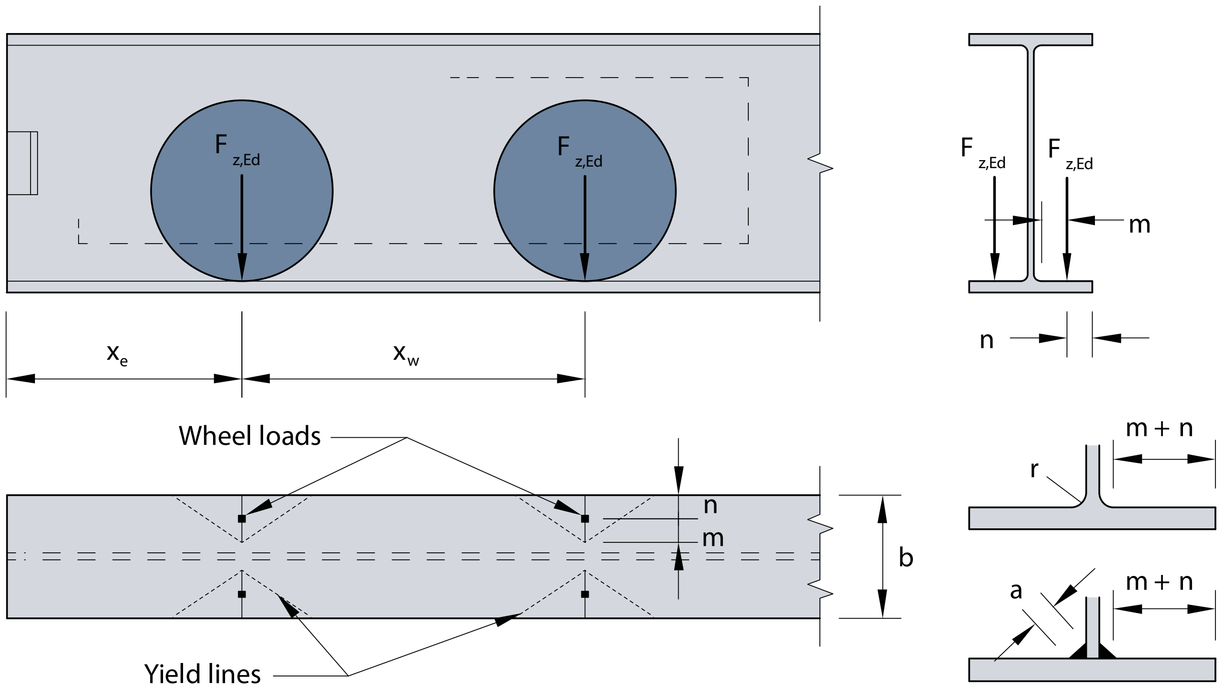


Figure 2: Four-wheel hoist

1. ULTIMATE LIMIT STATE

At the ultimate limit state (ULS), runway beams must be verified for bending due to vertical loads in combination with the effect of lateral loads. Because the lateral loads are applied eccentrically to the shear centre of the beam, they cause minor axis bending, but also apply a torque to the section. EC3-6 clause 6.3.2.3(1) recommends that the combination of lateral torsional buckling, minor axis bending and torque be verified using an interaction expression given in Annex A. The UK National Annex to EC3-6 endorses this approach.

In a runway beam with an underslung hoist or crane, the vertical loads are applied below the shear centre, at the bottom flange. This is a stabilising load, as the vertical loads act in opposition to the movement of the compression flange. Clause 6.3.2.2(3) allows this benefit to be taken, but requires that the loads should be assumed to be applied no lower than the top surface of the bottom flange. This limit is because a swinging load could reduce the beneficial effect of the stabilising load.

To calculate M_{cr} for a stabilising load, the free software *LTBeam*[1] could be used, or the formula given in NCCI document SN003[2]. It is conservative to ignore the beneficial stabilising effect.

In addition to the usual ULS checks, clause 2.7(2) requires that the bottom flange of the beam be verified. The bottom flange experiences a combination of direct stresses from overall bending, combined with local stresses from the wheels. Clause 2.7(2) directs designers to clause 6.7 to verify the bottom flange.

1.1 Verification of bottom flange at ULS

Clause 6.7 provides expression 6.2 to verify the bottom flange, as shown below.

$$F_{t,Rd} = \frac{l_{eff} t_f^2 f_y / \gamma_{M0}}{4m}\left[1 - \left(\frac{\sigma_{f,Ed}}{f_y / \gamma_{M0}}\right)^2\right]$$

The resistance is based on the length of a yield line, l_{eff}, which is given in Table 6.2 of EC3-6 for various locations of a wheel. Wheels close to a free end have a lower effective length; wheels adjacent to a 'welded closer plate' (a full depth end plate) have a higher effective length and consequently a greater resistance.

Designers should note that the resistance is based on the plastic modulus, $\frac{l_{eff} t_f^2}{4}$, which means that a check of the flange at SLS is also necessary. The influence of the direct stress is seen in the reduction factor $\left[1 - \left(\frac{\sigma_{f,Ed}}{f_y / \gamma_{M0}}\right)^2\right]$, where $\sigma_{f,ed}$ is the tensile stress at the midline of the flange. The reduction may be considerable, but because runway beams are subject to relatively onerous deflection limits (which may dominate the design), the bending stress may be lower than usually found in ordinary beams.

2. SERVICEABILITY LIMIT STATE

EC3-6 has a series of deflection limits, for the runway beams and the supporting structure, vertically and horizontally to minimise vibrations and to avoid an excessive slope for the hoist when travelling along the runway beam.

In addition, clause 2.7 requires that the stresses in the bottom flange be checked at SLS. Because the ULS check of the flange uses the plastic modulus, a check at SLS is particularly important.

The SLS checks of the bottom flange are covered in clause 7.5, which combines direct stresses, shear stresses and local stresses.

2.1 Local stresses due to wheel loads

Local stresses are to be determined from clause 5.8, which provides a simple approach to calculate local longitudinal and transverse stresses at three locations in the flange, as shown in Figure 3

Stresses are to be determined at:
Position 0, at the junction between the flange and the root radius
Position1, under the wheels, and
Position 2, at the tip of the flange.
The local longitudinal and transverse stresses are given by:

$\sigma_{ox,Ed} = c_x F_{z,Ed} / t_1^2$ (for local longitudinal bending stress)

$\sigma_{oy,Ed} = c_y F_{z,Ed} / t_1^2$ (for local transverse bending stress)

In the formulae, coefficients c_x and c_y are taken from tables, depending on the lateral spacing of the wheels with respect to the flange width. The formulae are valid as long as the wheels are more than 1.5*b* from the end of the beam (*b* is the flange width). Expressions are given to calculate c_x and c_y, (which appear to be the result of curve fitting) for both parallel and tapered flanges. In the common case, when the wheels are located close to the tips of the flanges (the lateral spacing of the wheels is 90% of the beam width) the expressions are replaced with single values for c_x and c_y – but these values are simply the product of the rather more complicated expressions. The results are valid if the wheels are spaced no less than 1.5*b* longitudinally; if closer the calculated stresses must be superposed.

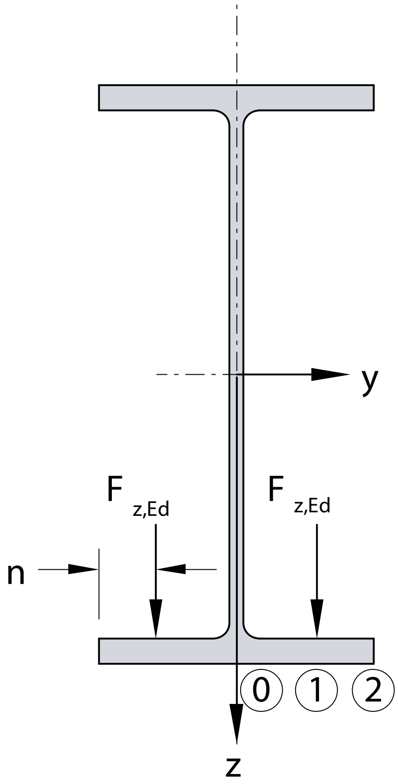


Figure 3: Flange locations for SLS stress verification

The situation is more complicated close to the end of a beam (within 1.5*b*), where there is no continuity of the flange. An expression is offered, or the alternative of reinforcing the flange as shown in Figure 4.

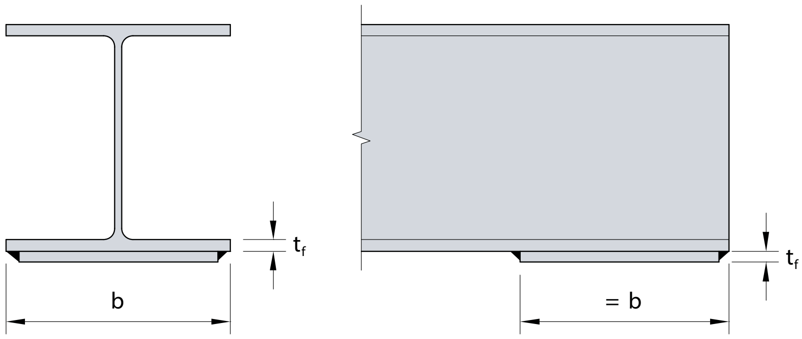


Figure 4: Reinforced beam end

2.2 Combined stresses

Clause 7.5 provides five expressions to verify combined stresses at SLS. The local stresses must be included in the verifications. In the following expressions (taken from EC3-6), the stresses $\sigma_{x,Ed,ser}$ and $\sigma_{y,Ed,ser}$ are the sum of the global stress and local stress.

$$\sigma_{Ed,ser} \le f_y / \gamma_{M,ser}$$

$$\tau_{Ed,ser} \le \frac{f_y}{\sqrt{3}\gamma_{M,ser}}$$

$$\sqrt{(\sigma_{x,Ed,ser})^2 + 3(\tau_{y,Ed,ser})^2} \le f_y / \gamma_{M,ser}$$

$$\sqrt{(\sigma_{x,Ed,ser})^2 + (\sigma_{y,Ed,ser})^2 - (\sigma_{x,Ed,ser})(\sigma_{y,Ed,ser}) + 3(\tau_{y,Ed,ser})^2} \le f_y / \gamma_{M,ser}$$

where $\sigma_{x,Ed,ser} = \sigma_{global,x,Ed,ser} + \sigma_{ox,Ed,ser}$
and $\sigma_{y,Ed,ser} = \sigma_{global,y,Ed,ser} + \sigma_{oy,Ed,ser}$

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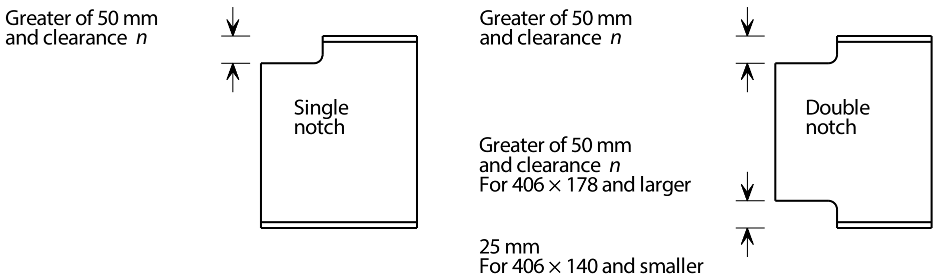
AD 386
Clarification of notch dimensions and shear resistances in SCI P358 (Green Book on Simple Joints)

On page T-4 of SCI P358[1], Table G.1 Note 4 states that for double notched beams, the remaining depth of web is taken as the end plate length. This is misleading and provides no information on single notched beams. This AD explains what notch dimensions were assumed and how the quoted shear resistances were calculated for single and double notched beams.



Notch dimensions in the Green Book

Notch dimensions

For single notched beams, the notch depth was taken as the larger of 50 mm or the clearance *n* as given in SCI P363[2] (Blue Book). For most beams therefore, the notch aligns with the top of the end plate, set 50 mm below the top of the beam. For large beams, where the thickness of the flange plus root is greater than 50 mm, it is assumed that the end plate is lowered to clear the root, and the notch depth is correspondingly increased.

For doubly notched beams, the upper notch follows the rules given above for single notches. The lower notch similarly follows these rules for large and medium sized beams. For 406 × 140 and smaller, the lower notch depth is simply taken as 25 mm. The rules are given in the figure above.

Calculation of shear resistance

When compiling the resistance tables (Tables G.4 & G.5), the first step was to determine the maximum notch length which could accommodate the shear resistance quoted for the beam without a notch. In many cases, the maximum notch length was zero, or some small dimension which had no practical benefit. In these cases, a reasonable notch length was set as 100 mm and the resistance back-calculated (using an iterative process) for this geometry. In this process, the applied shear was increased until the applied moment at the notch equalled the moment resistance. An iterative process was required as the moment resistance is reduced in the presence of high shear; the reduction varies with the applied shear.

In the resistance tables, if the maximum length is quoted as 100 mm, it will be associated with a reduced shear resistance, indicating that the process above has been followed. For lengths longer than 100 mm, the resistance will be that for an un-notched beam. Occasionally for double notched beams, where 'N/A' is shown in the shear resistance column, it indicates that after the notches have been removed (following the guidance given above) the remaining depth of web is less than the depth of the end plate. In these cases the resistance of a non-standard connection will have to be determined by calculation.

In many cases, the dimensions of the supporting beam may dictate the size of the notch. In these cases the resistance will have to be determined by calculation.

References:
[1] SCI P358 Joints in Steel Construction: Simple Joints to Eurocode 3. (2014)
[2] SCI P363 Steel Building Design: Design Data. (Updated 2013).

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Eurocode verification of a runway beam subject to wheel loads – Part 1

◀ 25

$\gamma_{M,ser}$ is to be taken as 1.1, according to the UK National Annex.

EC3-6 does not indicate where precisely stresses should be checked at positions 0, 1 and 2. At the extreme fibres on the underside of the flange, the global bending stress $\sigma_{x,Ed,ser}$ is at a maximum, as is the local transverse bending stress $\sigma_{oy,Ed,ser}$, but the shear stress is zero. At other locations, the shear stress will be combined with a reduced global bending stress. It is conservative simply to combine maximum stresses, especially as the shear stress based on clause 6.2.6 of BS EN 1993-1-1 is likely to be small.

2.3 Vibration of the bottom flange

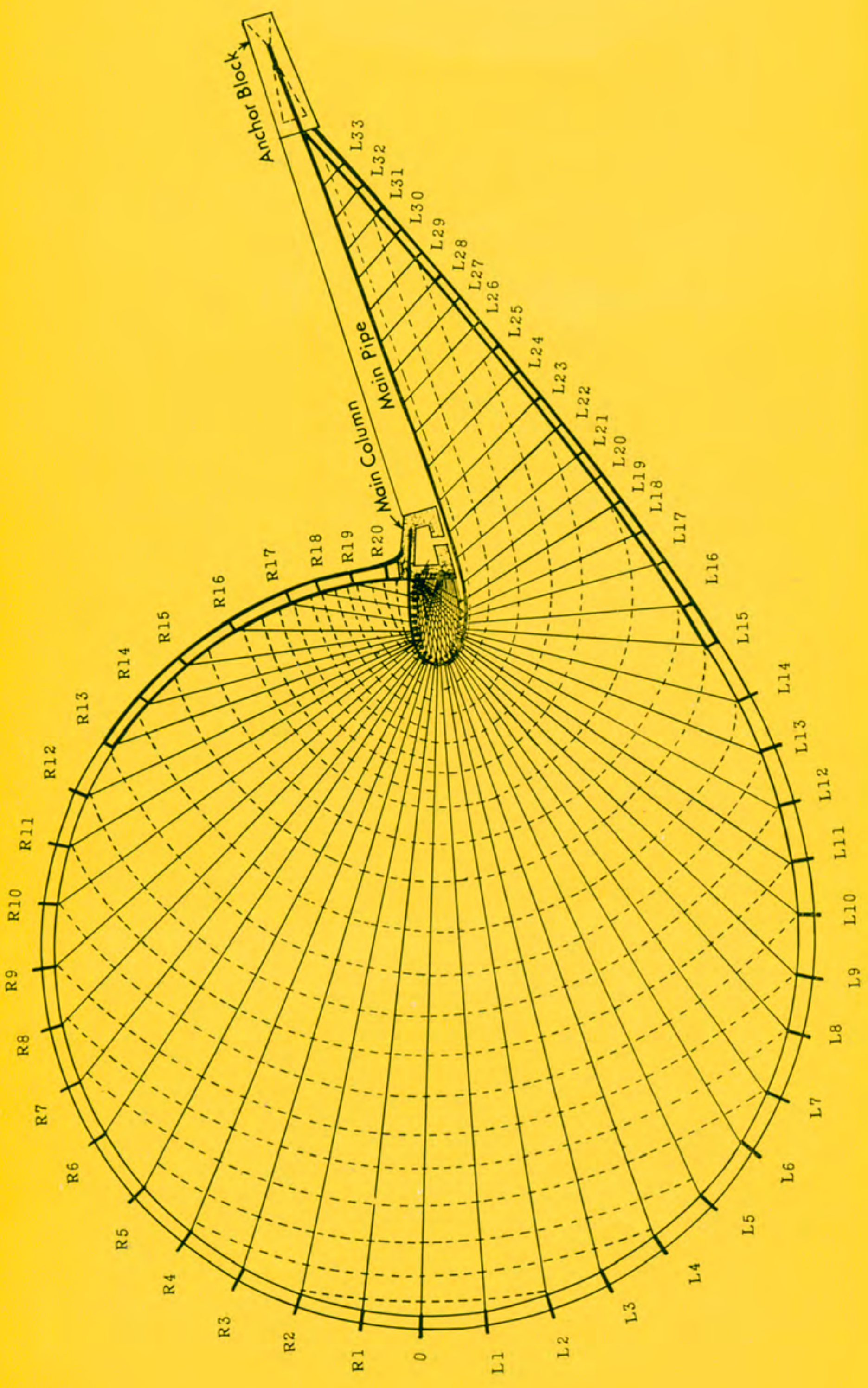
A further serviceability requirement concerning runway beams is the need to avoid noticeable lateral vibration of the bottom flange. Clause 7.6 of EC3 6 recommends that the slenderness ratio of the bottom flange L/i_z should be limited to 250, where i_z is the radius of gyration of the bottom flange and L is the distance between lateral restraints.

1. LTBeam software, available from www.cticm.com
2. SN003 Elastic critical moment for lateral torsional buckling, available from www.steel-ncci.co.uk

Unusual Roof design at Tokyo Olympic Village

FROM BUILDING WITH STEEL NOV 1964

Diagrammatic view of hanging trusses



Japanese architects provided some unusual and rather daring roof designs for several of the buildings in the Olympic village in Tokyo. One of these structures is the Gymnasium for National Indoor Games, a 200-ft. circular building seating 4,000.

The roof consists of $^{3}/_{16}$-in. thick steel plate shingles supported on hanging steelwork trusses spanning across from the main tubular spine to the vertical columns of the circular spectators' stand. The outside surfaces of the shingles are coated with a heat-reflecting silver-coloured paint and the underside is sprayed with 1-in. thickness of asbestos: below this are rock wool batts wrapped in polyethylene and a ceiling of expanded aluminium sheet.

The spine itself spirals down, rather like the contour of a snail's shell, from the top of the 100-ft. high fabricated main column or mast to a massive anchor, to which it is connected by a tie beam. Both the column and tie beam are pre-stressed to resist the considerable pull of the spine which, under dead load, reaches a maximum in the region of 355 tons. The total pre-stress for the column is 1,500 tons, and 1,900 tons for the tie bar.

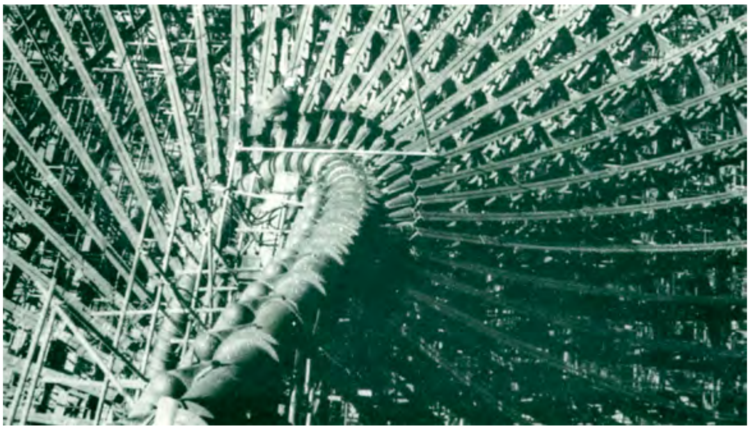
Because the trusses hang between the spine and the perimeter of the arena they assume a shape closely resembling catenary and the bending stresses are therefore insignificant. Thus it has been possible to keep them very slender, considering the fact that they span instances of up to 197 ft. Each is, however, designed to act as a reverse arch truss against buoyancy created by wind loading.

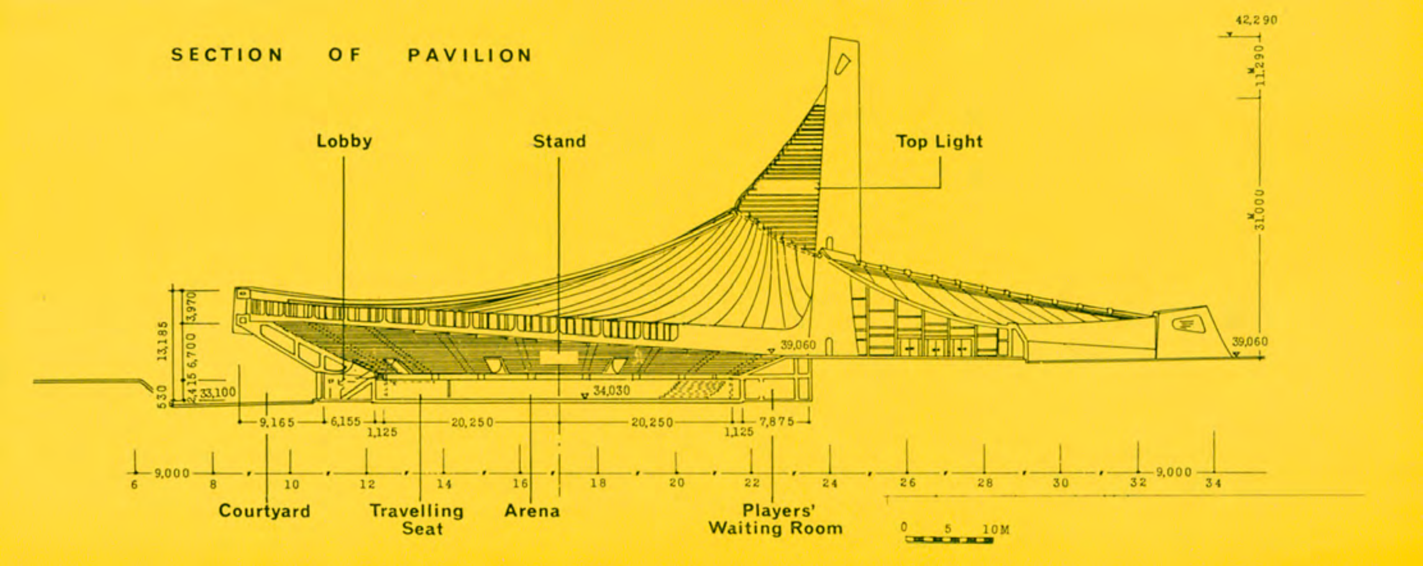
The trusses are, in effect, light riveted lattice girders constructed from angles in lengths of 32 to 40 ft.: each truss differs both in length and contour.

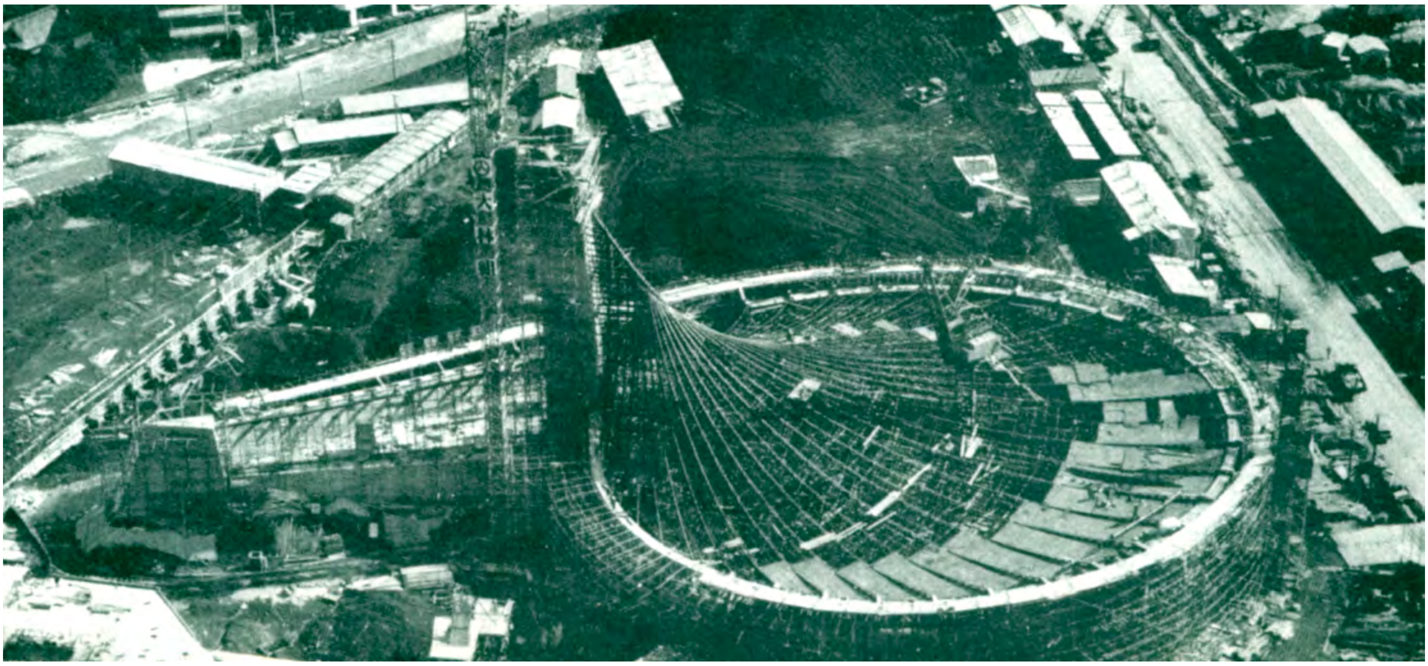
Considerable thought was given to the design and construction of the 32-in. diameter circular-section spine, which is a precision engineering job. It is 262 ft. long and constructed in three sections, each made from material of different thickness and quality to suit the variations in stress imposed throughout its length. These were factory made to the designed curvature and then welded together on site, using low hydrogen electrodes to eliminate any chance of weld cracking. These latter joints were all checked by gamma radiography and then annealed with induction heating equipment.

Another, much larger, building employing a very similar roof design is the National Stadium, which houses two swimming pools. In this case, however, the circular-section spine is replaced by two supports, each formed from thirty-one 2-in diameter steel cables. The roof and hanging trusses are of the same design as those for the smaller building.

The architect Kenzo Tange and the structural engineer Yoshikatsu Tsuboi together designed both of these buildings.







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

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

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

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

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	SCM	Guide Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●										2		Up to £2,000,000
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		2		Up to £100,000
Access Design & Engineering	01642 245151				●	●			●	●	●			●	●	✔	2		Up to £4,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●	✔	3	Silver	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	Silver	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●	●	●	●				●		2		Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4		Up to £1,400,000
AKD Contracts Ltd	01322 312203				●					●	●			●	●		2		Up to £100,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4		Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2		Up to £1,400,000
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			●	●	●	●			●	●			●	●	✔	2		Up to £800,000
ASD Westok Ltd	0113 205 5270												●			✔	4		Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	3	Silver	Up to £1,400,000
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	01902 880848												●			✔	4		Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✔	4	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		2		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4		Up to £3,000,000
Builders Beams Ltd	01227 863770				●					●				●	●	✔	2		Up to £1,400,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4	Gold	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4	Gold	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	2		Up to £6,000,000
Cook Fabrications Ltd	01303 893011				●					●	●			●	●		2		Up to £800,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	2		Up to £800,000
D H Structures Ltd	01785 246269			●	●		●				●						2		Up to £100,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●					✔	4		Up to £4,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3		Up to £2,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	Gold	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	2	Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●					●	●			●	●		2		Up to £1,400,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●				●		2		Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●		✔	2		Up to £800,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3		Up to £2,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●			●	●	✔	2		Up to £2,000,000
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4		Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4	Silver	Up to £2,000,000
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

Company name Tel C D E F G H J K L M N Q R S QM FPC SCM Guide Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)
Intersteels Ltd	01322 337766				●	●	●	●					●			✔	3		Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		2		Up to £200,000
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	● (orange)	Up to £3,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2	● (grey)	Up to £4,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		2		Up to £400,000
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 £800,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		2		Up to £1,400,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●	●	●		✔	4	● (orange)	Above £6,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4		Up to £800,000
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	●		●	●	●	●				●				●	✔	3		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								●		●				●	✔	2	● (orange)	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
R S Engineering SW Ltd	01752 844511				●					●	●			●	●	✔	2		Up to £100,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●		2		Up to £1,400,000
S H Structures Ltd	01977 681931						●	●	●	●		●				✔	4	● (grey)	Up to £3,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4		Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	● (orange)	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●					●	●			●	●	✔	3		Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2		Up to £1,400,000
Snashall Steel Fabrications 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
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●			●	●	✔	2		Up to £200,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●	●		●	●	✔	2	● (grey)	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●										2		Up to £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✔	4	● (orange)	Above £6,000,000*
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	● (grey)	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	● (orange)	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	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
Balfour Beatty Utility Solutions Ltd	01332 661491
Bluefin Group	020 3040 6723
Griffiths & Armour	0151 236 5656
Highways Agency	08457 504030
Kier Construction Ltd	01767 640111

Company name	Tel
PTS (TQM) Ltd	01785 250706
Roger Pope Associates	01752 263636
Sandberg LLP	020 7565 7000
SUM Ltd	0113 242 7390
Welding Quality Management Services Ltd	00 353 87 295 5335

Associate Members

Associate Members are those principal companies involved in the direct supply to all or some Members of components, materials or products. Associate 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) = Gold, (Silver) = Silver, (Member) = Member

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
AceCad Software Ltd	01332 545800		●								N/A	
Albion Sections Ltd	0121 553 1877	●									M	
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I	
ASD metal services	0113 254 0711								●		D/I	
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●									M	
BAPP Group Ltd	01226 383824									●	M	
Barrett Steel Services Limited	01274 682281								●		D/I	
Behringer Ltd	01296 668259					●						
BW Industries Ltd	01262 400088	●									M	
Cellbeam Ltd	01937 840600	●									M	
Cellshield Ltd	01937 840600							●			N/A	
Cleveland Steel & Tubes Ltd	01845 577789								●		M	
CMC (UK) Ltd	029 2089 5260								●		D/I	
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	
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M	

Steelwork contractors for bridgeworks

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

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

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

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

BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4		✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4			Gold	Up to £3,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4	✓	✓	Gold	Above £6,000,000*
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3		✓	Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445		●		●			●	●	✓	4			Gold	Up to £3,000,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	✓	4	✓	✓	Gold	Above £6,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●	●	✓	4				Up to £800,000
Murphy International Ltd	00 353 45 431384	●	●	●					●	✓	4				Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●	●	●	●	✓	4	✓	✓		Up to £4,000,000
Painter Brothers Ltd	01432 374400	●		●					●	✓	2			Gold	Up to £6,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4		✓	Silver	Up to £3,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4		✓	Gold	Above £6,000,000
Non-BCSA member															
Allerton Steel Ltd	01609 774471	●	●	●	●				●	✓	4		✓		Up to £2,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●		●	●	●	✓	4				Up to £400,000
Cimolai SpA	01223 350876	●	●	●	●	●	●	●	●	✓	4				Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			Member	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3		✓	Member	Up to £1,400,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	2		✓	Gold	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3				Up to £2,000,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3		✓		Up to £400,000
Interserve Construction Ltd	0121 344 4888							●	●	✓	3				Above £6,000,000*
Interserve Construction Ltd	020 8311 5500	●	●	●	●		●	●	●	✓	3				Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4	✓		Member	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A				Up to £3,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
easi-edge Ltd	01777 870901							●			N/A	●
Fabsec Ltd	0845 094 2530	●									N/A	
FabTrol Systems UK Ltd	01274 590865		●								N/A	
Ficep (UK) Ltd	01942 223530					●					N/A	
FLI Structures	01452 722200	●									M	●
Forward Protective Coatings Ltd	01623 748323						●				N/A	
Goodwin Steel Castings Ltd	01782 220000	●									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	
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	●
Lindapter International	01274 521444									●	M	
Murray Plate Group Ltd	0161 866 0266								●		D/I	
National Tube Stockholders Ltd	01845 577440								●		D/I	
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A	
PPG 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	○
Sika Ltd	01707 384444						●				M	
Simpson Strong-Tie	01827 255600									●	M	
Structural Metal Decks Ltd	01202 718898	●									M	●
Tata Steel	01724 404040				●						M	
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	
Tekla (UK) Ltd	0113 307 1200		●								N/A	
Tension Control Bolts Ltd	01948 667700						●			●	M	
voestalpine Metsec plc	0121 601 6000	●									M	●
Wedge Group Galvanizing Ltd	01909 486384						●				N/A	
Yamazaki Mazak UK Ltd	01905 755755					●					N/A	

New and revised codes & standards

From BSI Updates December 2014 & January 2015

BRITISH STANDARDS

BS 3692:2014
ISO metric precision hexagon bolts, screws and nuts. Specification
Supersedes BS 3692:2001

BS 4190:2014
ISO metric black hexagon bolts, screws and nuts. Specification
Supersedes BS 4190:2001

BS EN PUBLICATIONS

BS EN ISO 1891-2:2014
Fasteners. Terminology. Vocabulary and definitions for coatings
No current standard is superseded

BS EN 10088-1:2014
Stainless steels. List of stainless steels.
Supersedes BS EN 10088-1:2005

BS EN 10088-2:2014
Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
Supersedes BS EN 10088-2:2005

BS EN 10088-3:2014
Stainless steels. Technical delivery conditions for semi-finished product, bars, rods wire, sections and bright products of corrosion resisting steels for general purposes
Supersedes BS EN 10088-3:2005

BRITISH STANDARDS UNDER REVIEW

BS EN ISO 14713-1:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. General principles of design and corrosion resistance

BS EN ISO 14713-2:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. Hot dip galvanizing

BS EN ISO 14713-3:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. Sherardizing

NEW WORK STARTED

ISO 14343
Welding consumables. Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels. Classification
Will supersede BS EN ISO 14343:2009

ISO 17607
Steel structures

ISO 18276
Welding consumables. Tubular cored electrodes for gas-shielded and non-gas-shielded metal arc welding of high-strength steels. Classification
Will supersede BS EN ISO 18276:2006

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

14/30280974 DC
BS EN ISO 4759-3 Tolerances for fasteners. Washers for bolts, screws and nuts. Product grades A, C and F
Comments for the above document are required by 20 March, 2015

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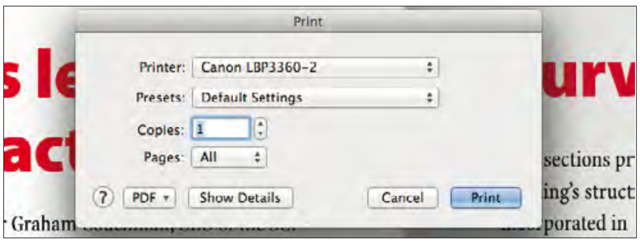

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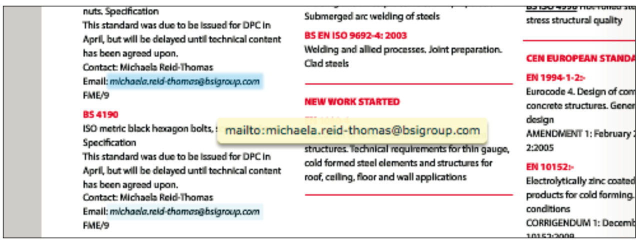

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