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NSC

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January 2016
Vol 24 No 1

Bomber Command memorial

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Liverpool hospital bedded with steel

Gamechangers in their field

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Cover Image
International Bomber Command Centre, Lincoln
Main client: International Bomber Command Centre Trust
Architect: Place Architecture
Main contractor: Lindum Construction
Structural engineer: Alan Wood and Partners
Steelwork contractor: S H Structures

NSC

January 2016 Vol 24 No 1

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

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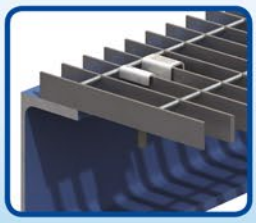

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Design guidance tradition strengthened

Nick Barrett - Editor

At the start of last year the steel construction sector was confidently reporting to clients that there was plenty of capacity in the sector to ensure that expected demand increases during 2015 would be easily accommodated. That confidence was proven to be well founded as despite tales of shortages of labour and materials affecting other sectors, steel construction prices rose modestly and there were no stresses evident along the supply chain.

Later in the year the BCSA reassured clients that the steel construction supply chain remains strong and efficient despite the problems assailing makers of raw / rolled steel.

Full support was pledged to steelmakers in their bid to combat any dumping of raw / rolled steel into the UK market and to convince government of the need for level playing fields in energy prices and carbon related taxes. The UK government has given signs that it is listening to the industry's case for help, and some action has already been taken.

The outlook for 2016 is for further modest increases in the price of fabricated steelwork, but nothing out of line with construction price inflation generally. Looking over the horizon to 2016, it is clear that the constructional steelwork supply chain will remain robust and well able to provide the world-leading service that it is recognised for internationally.

While these are interesting times for steelmakers, for most of us it has been business as usual, as we can see in this month's News pages. Providing up-to-date design guidance has been a key part of the steel sector's support for engineers and architects for over 30 years, and this tradition is strengthened by the latest design guidance that has just been released by the Steel Construction Institute, with financial support from Tata Steel and the BCSA.

All bridge engineers will want to familiarise themselves with P185 – Guidance notes on best practice in steel bridge construction (6th Issue) as they represent important updates and align guidance with the latest UK and European standards. Although aimed at bridge designers, many of the Notes offer general information that will be helpful to all designers of structural steelwork

Also of interest to structural engineers is the new web-based design tool that evaluates the frame stability of multi-storey builings in accordance with the Eurocodes – another useful addition to the ever-growing suite of software available on www.steelconstruction.info

Both represent the sort of support that designers need to have at their fingertips in their day-to-day to work, the state-of-the-art guidance that the steel sector has always been committed to providing, and which continued uninterrupted through several recessions. The forecast that can be confidently made at the start of 2016 is that this support will continue to be developed.

NSC

EDITOR
Nick Barrett Tel: 01323 422483
nick@newsteelconstruction.com
DEPUTY EDITOR
Martin Cooper Tel: 01892 538191
martin@newsteelconstruction.com
CONTRIBUTING EDITOR
Ty Byrd Tel: 01892 553143
ty@barrett-byrd.com
PRODUCTION EDITOR
Andrew Pilcher Tel: 01892 553147
admin@newsteelconstruction.com
PRODUCTION ASSISTANT
Alastair Lloyd Tel: 01892 553145
alastair@barrett-byrd.com
NEWS REPORTER
Mike Walter
COMMERCIAL MANAGER
Fawad Minhas Tel: 01892 553149
fawad@newsteelconstruction.com

NEW STEEL CONSTRUCTION IS PRODUCED BY BARRETT BYRD ASSOCIATES ON BEHALF OF THE BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION AND TATA STEEL, IN ASSOCIATION WITH THE STEEL CONSTRUCTION INSTITUTE.

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

Tata Steel
PO Box 1, Brigg Road, Scunthorpe,
North Lincolnshire DN16 1BP
Telephone 01724 404040
Website *www.tatasteelconstruction.com*
Email *construction@tatasteel.com*

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

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

New steel bridge design guides available from SCI

The Steel Construction Institute (SCI) has published two new steel bridge design publications that are now available at: *www.steelconstruction.info/Bridges#Resources*

Produced with financial support from the British Constructional Steelwork Association (BCSA) and Tata Steel, the publications are P185 - *Guidance notes on best practice in steel bridge construction (6th Issue)*, and P406 - *Determining design displacements for bridge movement bearings.*

The *Guidance notes on best practice in steel bridge construction (6th Issue)*, produced by the Steel Bridge Group (SBG), has been comprehensively reviewed and updated.

Much of the previous advice remains valid but the SBG has taken the opportunity to update and align them with new British and European Standards.

Two new Guidance Notes have been written: one provides guidance on the specification of fatigue quality, reflecting the requirements of the Specification for Highway Works; the second offers specification clauses for tension components, such as high strength bars and strands, to supplement the requirements in BS EN 1090-2.

Determining design displacements for bridge movement bearings responds to an enquiry to SCI's Advisory Desk about the inconsistent and unclear requirements in BS EN 1991-1-5 and BS EN 1993-2 for the determination of the movement ranges to be specified for bridge bearings.

With advice from the SBG, recommendations have been developed to offer a much clearer explanation of how designers should calculate the movement range, taking account of both thermal change, and uncertainty in the relative positioning of bearings on the sub- and superstructures. These are illustrated with some simple worked examples.

East Ridings's largest regeneration scheme opens

The first phase of the Flemingate mixed-use scheme in Beverley has opened its doors to shoppers.

Described as the largest development in the town since the completion of the famous minster in 1420 (see NSC October 2015), Flemingate's first phase includes three steel-framed buildings consisting of a Debenhams anchor store and two large retail blocks containing a variety of outlets.

Flemingate's steel-framed cinema has also opened, with more new shops and restaurants completing in the spring.

An 80-room Premier Inn, a 500-space steel-framed multi-storey car park, the largest in Beverley, a new campus for East Riding College, and 130 homes complete Flemingate's offer.

Wykeland Managing Director Dominic Gibbons said: "The opening of Flemingate is a key milestone. Many of the exciting new retailers and cafés, which opened on November 3, were making their Beverley debut, not least of which was Debenhams. Together, they are creating a great new destination that will bring more visitors to the town overall."

Hambleton Steel fabricated and erected 2,000t of structural steelwork for the project.

Photo: Hull Daily Mail

Plans for London mega tower revealed

A planned steel-framed skyscraper that could become London's second tallest building, overshadowing the adjacent Gherkin and matching The Shard in height, has been unveiled.

The 73-storey building at 1 Undershaft will be 309.6m tall - exactly the same height as The Shard and the maximum allowed by the Civil Aviation Authority.

Sitting between the Gherkin and Leadenhall Street's Cheesegrater, it will be the tallest in the City financial area and will join a raft of a new skyscrapers planned for the capital.

At its summit will be a free public viewing gallery, which will be higher than the same area in The Shard, as well as an education centre for school trips and a restaurant. At the base there will be a large public square.

The tower has been commissioned by Singapore-based Aroland Holdings and designed by London's Eric Parry Architects, which also created the headquarters of the London Stock Exchange in Paternoster Square.

A conceptual design by Avery Associates for the previous owner of the 1 Undershaft site proposed an angular sloping sided glass tower peaking at 270m and prompted one contractor to dub the building "The Fang".

The new design is for a more conventional office tower block with distinctive visible structural steel cross-bracing.

New steel sector education and marketing initiative

BCSA has launched Steel for Life – a new market development programme designed to ensure that steel maintains and develops its leading position as the preferred supplier of framing solutions for key sectors of the market like multi-storey buildings and single storey sheds.

Steel for Life will carry on from the work of the Tata Steel-BCSA joint market development programme that has led the sector's drive to provide information and education to the construction industry on the benefits of steel for the past five years.

Steel for Life is a wholly owned subsidiary of BCSA, with Chris Dolling leading on technical issues and Christina Gulvanessian focussed on strategic marketing.

Chris said: "Steel has earned a very high market share partly because of the efforts across the supply chain over many years to ensure the quality and cost-effectiveness of the fabricated product, and to make sure that engineers and architects have everything to hand to make designing in steel as straightforward and economic as it can be. Steel for Life will develop that legacy, drawing on the resources of the whole steel supply chain."

Christina said: "Steel for life's key purpose will be to continue to promote the advantages that steel offers to the construction sector, highlighting the key attributes of steel which make it the preferred material in key market sectors – its cost-effectiveness, speed of construction, safety on site, durability and sustainability."

BCSA Director General Sarah McCann Bartlett said: "This new industry-wide approach will provide significant benefits to clients, specifiers and main contractors. Technical materials and practical design tools will continue to be developed and the single steel construction information portal, www.steelconstruction.info will be regularly updated as a valuable resource to the broader construction industry.

By working together as an integrated supply chain for the delivery of steel-framed solutions, the constructional steelwork sector will continue to innovate, educate specifiers and clients, and market the significant benefits of steel in construction.

Steel for Life will be funded by sponsors from across the supply chain, including BCSA and industry members who supply related products and services.

Steel for Life will be overseen by an independent Advisory Board, made up of BCSA members and key sponsors to ensure a tailored and collaborative offering. Sponsors will be announced shortly.

Frame stability tool available online

A new web-based frame stability tool that evaluates the stability of multi-storey braced frames, in accordance with BS EN 1993-1-1 is now available at: *www.steelconstruction.info*

The parameter α_{cr} is determined using the combination of the Equivalent Horizontal Forces (EHF) and wind loads on the frame, in conjunction with the vertical loads.

The calculations are performed for a single vertical bracing system, which is assumed to be a vertical Pratt truss.

Beam and column members may be selected from the full range of UKB and UKC sections respectively, and bracing members may be circular or square hollow sections.

Abdul Malik of the Steel Construction Institute said: "The programme requires the user to provide the lateral and vertical loading associated with the bracing system – generally any structure will have two or more bracing systems.

"The single bracing system analysed in the tool will therefore carry only part of the lateral load and part of the vertical load."

Wind load is assumed to be distributed uniformly over the full height of the bracing and is converted into point loads applied at the nodes. In complex buildings with bracing systems of differing stiffness, it will be necessary to determine the proportion of load carried by each bracing system.

North Wales steelwork contractor continues to invest in new automated CNC equipment

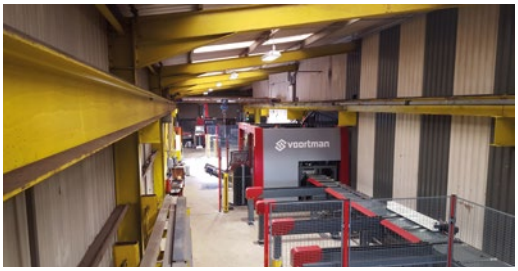
Following the installation of a new cutting and drilling line in 2014, North Wales-based EvadX has now commissioned a new Voortman V550-6 punching and shearing line to further increase its output to meet client demand.

The new Voortman machine has replaced the company's previous 12-year old unit.

EvadX Quality Manager, Robert Evans said: "This substantial investment is reflective of the company's forward thinking approach and commitment to continual improvement.

"Directly linked to our drawing office, this equipment will further streamline our operations, improve quality and enable us to continue winning some of the most prestigious and challenging steelwork projects in the UK."

The Voortman V550-6 is specially designed for punching and shearing both flat and angle profiles, and punching is possible in the horizontal and vertical plane. The drilling head as well as the



automatic tool changer with five tools are the same as all other drilling machines in the Voortman range, with carbide drilling, countersinking and thread tapping possible.

A servo driven layout marking tool, to mark the bottom side of the profile, is standard with the V550-6.

The required floor space is kept to a minimum by the innovative design of the machine according to Voortman.

NEWS IN BRIEF

The **Kaltenbach** Group of companies has announced two new co-operations with leading machine tool manufacturers Zeman and RSA. For the UK market Kaltenbach said that its Bedford facility and RSA, who has offices in Telford, will be able to work together to promote a full range of circular sawing and deburring systems.

Jaguar Land Rover has announced plans to build a new engine factory at the i54 development on the outskirts of Wolverhampton. The 11m-high, L-shaped factory building designed by Associated Architects will almost double the size of the company's existing plant.

Metsec said it has invested in the future of manufacturing through the appointment of four new staff members, who have become the newest recruits involved with the company's apprenticeship scheme. The latest intake takes Metsec one-step closer to its ambition of achieving a 20% home-grown workforce by 2020.

Architect **Renzo Piano** and developer Sellar Property Group have unveiled plans for a steel-framed 65-storey, £1bn mixed-use scheme for Paddington, west London. The scheme at 31 London Street has already been dubbed the 'skinny Shard', as the team previously worked on the capital's tallest building The Shard.

Graitec, the BIM and CAD software developer, has announced its file collaboration and interoperability app for Revit is now available as a free download directly from its Autodesk Exchange App Store.

Joseph Ash Galvanizing has announced major expansion plans for its Chesterfield plant, following on from the acquisition of a new plant in Sittingbourne, Kent.

AROUND THE PRESS

The Structural Engineer
December 2015
Profile – Major Nick Francis
Francis spotted that the main bridge on the arterial route through West Africa linking Guinea, Sierra Leone and Liberia – a 250m span structure – had been damaged. "I used one of our local contractors to manufacture the steel box to be slotted in to effect the repair. It was all done in 96 hours."

Construction News
27 November 2015
Costs continue to bite despite record-low inflation
[Alan Hope, Midas Group] – "Steel is getting cheaper.... but on most other commodities there's a lot of cost pressure."

Construction News
13 November 2015
Office transformed for hi-tech clients
Summit House sits on an L-shaped site, with busy streets on three sides and a party wall to the east. The 1980s built five-storey office is being stripped back to the structural steel frame. The fifth floor is being removed completely, with two extra storeys added at oblique angles.

Building Magazine
13 November 2015
Top form
[Notre Dame Catholic College] – The inner structure comprises a steel frame with concrete floors and is configured to form the various internal spaces required by the school. It is based on an 8m grid which allows classrooms of up to 64m²

SCI event focuses on steel construction's evolution

The past, present and future of steel construction was the theme of the Steel Construction Institute (SCI) event, held at The Crystal in London Docklands.

SCI Chief Executive Graham Couchman reminded the attendees that the SCI is now 30 years old.

"Formed in 1985, the SCI has a long-term programme to continue to promote the effective use of steel in construction," he said.

The guest speakers were Michael Walsh, Hatch Consulting and Carl Perry, Bluescope, who both stressed the importance of steel within the wider global economy.

Mr Walsh said since 1980 global steel production has grown 4% every year on average and this is likely to continue well into the future.

"During the next decades emerging economies will provide a market even bigger than the current Chinese market," he said.

For the European steelmaking industry to survive he said a better use of resources was needed and this included the recycling of scrap, which he termed as a natural resource.

The trend towards thinner and higher strength steels and the advantages of offsite construction were two of the themes in the address delivered by Carl Perry.

More than 60% of the world's steel is used in construction and consequently changeability and technology must be embraced by the sector he said.

To highlight the benefits of modular construction, Mr Perry talked about a 120,000m² distribution centre in the USA that was erected in just 28 days.

The event concluded with a question and answer session and the SCI AGM.

New design guide from Lindapter

Lindapter has launched an updated 76-page product guide for engineers and other professionals involved in the design of structural and secondary steel connections.

"The design guide features popular products such as the Girder Clamp for quickly connecting I beams without drilling or welding, and the Hollo-Bolt, the original expansion bolt for Structural Hollow Sections (SHS)," explains Lindapter Marketing Manager Wayne Golden.

A redesign of the publication is said to make it faster for engineers to find the relevant page and select the solution to their connection requirement.

New features include a helpful product comparison table, typical applications and independently approved safe working loads. New products are also introduced such as the Type AAF high slip resistance clamp and Type ALP adjustable lifting point.

For more information go to *www.lindapter.com*

Shopping mecca ushers in new retail era

The £260M Bradford Broadway shopping centre has opened more than a decade after construction first started on the city centre site (see NSC Nov/Dec 2014).

The steel-framed project features two large anchor stores (Debenhams, and Marks and Spencer), car parking for 1,300 vehicles and more than 70 other shops, restaurants and cafes.

"As with many large retail developments, the Broadway scheme underwent a number of design changes at the request of tenants, while some even took place during the construction programme," said Keith Whitmore, Westfield Head of Design & Construction. "Steel enabled alterations to be made easily and this is why it is ideal for retail projects."

"Most of the alterations were quite small, such as re-positioning lift and escalator penetrations in the frame, but moving a steel column or two is much easier than altering a concrete wall," added Mr Whitmore.

Steelwork always contributes to a speedy construction programme and Broadway's entire 6,800t steel frame was erected in just over 25 weeks by steelwork contractor Severfield.

Billington acquires new site and assets

Billington Holdings, the structural steel and construction safety solution specialist, has announced it has conditionally agreed to acquire a new site at Shafton, near Barnsley, South Yorkshire.

The deal would see Billington pay £2.5M to Sabler Enterprises and a further £2.38M to Sherling Steel (UK) for equipment and assets.

The 25-acre site contains two industrial buildings with a combined useable area of 16,800m² and was principally engaged in steel and plate processing for the steel industry.

The planned acquisition represents the company's largest strategic investment in its history. Billington's directors believe the new facilities will significantly increase the output and complement its structural steelwork divisions located at Barnsley and Bristol.

Billington Chief Executive Officer, Mark Smith said: "It is an exciting period of change for Billington and one that the directors believe will further strengthen the company's market position through increased capabilities, capacity and product offerings."

90-year old steelwork contractor rebrands

ADEY STEEL GROUP

Loughborough-based Adey Steel Group has celebrated 90 years in the steel industry with the unveiling of a complete rebrand, which pools all of its separate companies under one name.

The company said the rebrand exercise will ensure clients can distinguish between the broad ranges of the specialist services that the steel firm has to offer.

Previously known as Adey Group, the steel company has merged its four companies under one overarching brand, the Adey Steel Group.

The Adey Steel Group consists of four areas of expertise: Adey Steel – previously Adey Steel Ltd, which is a steelwork contractor; Adey SteelShop – previously SteelShop Ltd, offering stockholding and steel processing for the UK housebuilding and construction industries; Adey Technical – previously Technical Edge Ltd, a specialist arm of the group providing structural design and steel detailing services; and Adey Transport – previously Transport24, a nationwide specialist steel transport and haulage firm.

The unveiling of the new branding was held at Loughborough Town Hall as Adey Steel fabricated the original steelwork for the clock tower in 1980.

Adey Steel Group began in 1925 as the local ironmongers in Loughborough town centre by Harry Adey and his wife. The business has been kept in the family, seeing all four generations of the Adey sons managing the business.

Newport's steel-framed Friars Walk shopping complex opens

Newport's multi-million pound new shopping complex has opened its doors to shoppers, in what is seen as a landmark for the South Wales city's regeneration (see NSC May 2015).

Friars Walk has delivered 36,000m² of steel-framed retail and leisure space consisting of three main elements: a three-storey Debenhams anchor store, an eight-screen Cineworld complex and two main blocks of 37 double-height shop units set either side of a pedestrian covered street.

Topping the street is a curved tubular steel frame that supports ETFE lightweight cladding designed to accept the building movement differentials from the main steel frame. The tubular steel beams that span the 11m wide street are seated on large concrete plinths located on the roof of the retail units.

The project also includes an undercroft 350-space car park, 13 restaurants arranged around a new public square and a new bus depot.

Working on behalf of main contractor Bowmer & Kirkland, Caunton Engineering fabricated, supplied and erected 6,000t of structural steelwork for the project.

Diary

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

Tuesday 19 January 2016
Steel Connection Design
This course is for designers and technicians wanting practical tuition in steel connection design.
Swindon.

Tuesday 26 January 2016
Moment Connections
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview on moment connections.
Webinar.

Tuesday 9 February 2016
Simple Beam & Column Design to EC3
NEW – Four hour course containing minimum theory and maximum hands-on member design – focussing on practical design using the Blue Book. The course is aimed at designers of orthodox structures where the resistance tables are the preferred way of selecting members.
Leicester.

Wednesday 10 February 2016
Simple Beam & Column Design to EC3
NEW – see previous entry for description.
Sheffield.

Tuesday 23 February 2016
Design of Portal Elements
1 hour lunchtime webinar free to BCSA and SCI members, considering design of portal elements.
Webinar.

Wednesday 24 February 2016
Portal Frame Design
This course provide in-depth coverage of the major issues surrounding the analysis, design and detailing of portal frames.
Leeds.

Tuesday 8 March 2016
Essential Steelwork Design - 2 days
This course introduces the concepts and principles of steel building design to EC3.
Birmingham.

The opening ceremony took place on 2 October

Inspiring memorial

A 31m-high weathering steel spire forms the centrepiece of a memorial to those who served with Bomber Command.

A total of 27 Bomber Command bases were located in Lincolnshire during the Second World War, more than in any other shire, and earning it the title of 'Bomber County'.

The area's flat topography has very few obvious landmarks with the exception of church spires and towers. To this end, Lincoln Cathedral provided an important marker for crews both leaving and returning from missions.

With this in mind it is fitting that, in recognition and remembrance of those that served in the Royal Air Force during the War, the International Bomber Command Centre is being constructed on an escarpment overlooking Lincoln.

Because of the hilltop location, the principal element of the Centre – the 31m-high weathering steel Memorial Spire - is visible for miles around and from many sites within Lincoln itself.

Place Architecture won the design competition for the Spire and Project Architect Stephen Palmer says the brief was for a contemporary memorial.

The steel structure is said to represent wing fragments with its height being the overall wingspan of a Lancaster Bomber with its base, at 5m wide the same width as a Lancaster's wing.

"By using weathering steel we fulfilled the brief, but we also created a multi-layered sculpture that references flight, aircraft manufacture and is also a nod to nearby Lincoln Cathedral," says Mr Palmer.

"Weathering steel also allowed us to design a sculpture with an organic feel and one that has a changing hue, which is ideal for its countryside setting."

The structure was fabricated and installed by S H Structures from 32 weathering steel plates. Perforated panels, again reflecting the engineering principles used in airframe construction connect the rolled external plates. Built in jigs to maintain the shape during welding the

Spire sections take to the road on their way to Lincolnshire

Steel sections are welded together

structure was fabricated in two sections – upper and lower parts - with sacrificial lifting frames to aid installation.

The two completed spire assemblies were shotblasted by Jack Tighe of Scunthorpe after manufacture. This ensured all fabrication marks were removed and the process allowed an even patina to form on the steel once it was exposed to the elements.

Once on site the two sections were assembled in-situ, with the base or lower section bolted down on to concrete foundations. The two sections were held with a temporary bolted connection before being fully welded together on site.

"All of the joints are expressed welded joints and by leaving them visible they add to the contemporary design of the Spire," says Mr Palmer.

The spire is surrounded by memorial walls (right) that record the names of the 25,296 aircrew that lost their lives flying with Bomber Command while serving in 1 and 5 Groups that were headquartered in Lincolnshire. These walls or panels, arranged around the Spire in concentric circles, are made from curved 20mm thick weathering steel plate. Welded on to these plates are 4mm thick steel panels with the airmen's names laser-cut into them.

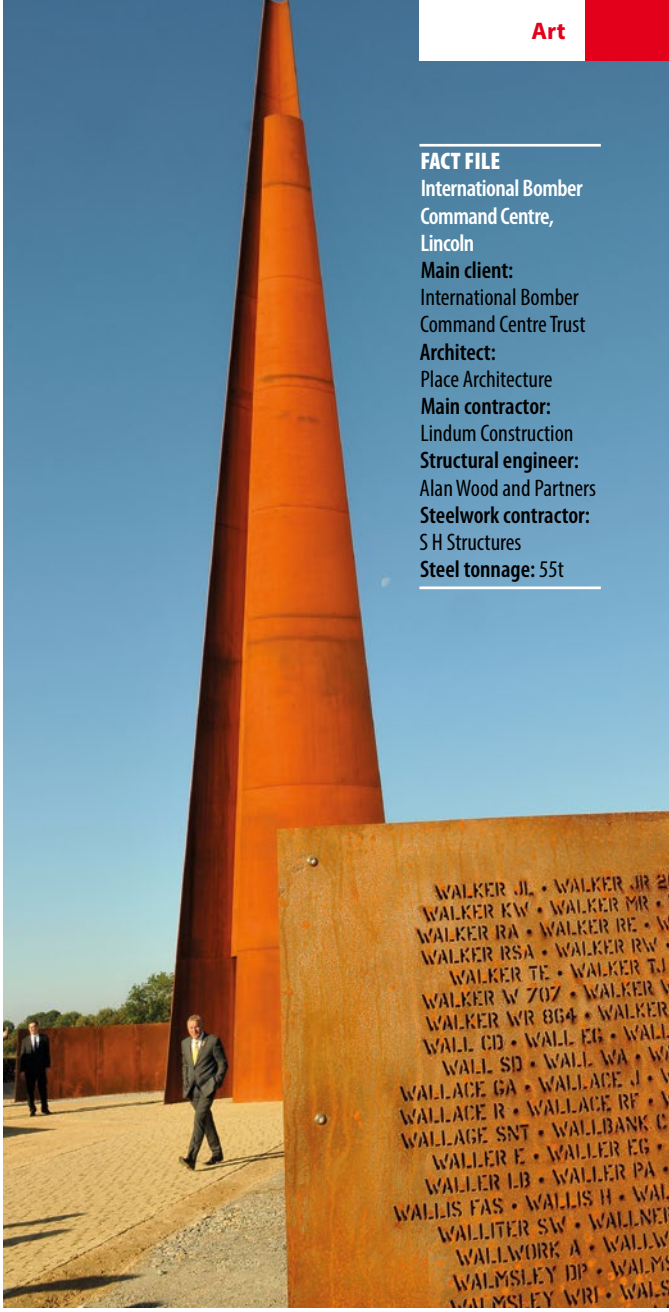
In a second phase of work further panels are to be added around the spire commemorating the airmen that flew from other UK Bomber Command bases. These additional panels will bring the total of named individuals to more than 55,500.

"It is a great privilege to work on projects like this and contribute to what will undoubtedly become a lasting legacy to the memory of those who gave their lives serving in Bomber Command," says S H Structures Sales and Marketing Manager Tim Burton.

"We were fortunate enough to be visited by one of the surviving veterans during our involvement in the scheme. Ex- Flight Lieutenant RAFVR Roy Hill arrived with his wife and daughter on the morning we were loading out the completed sections of the spire. Roy was kind enough to relate some of his experiences during his visit and it really brought home the significance of the project."

International Bomber Command Centre Project Director Nicky Barr comments: "The Memorial Spire dominates the skyline as a fitting tribute to the efforts of all in Bomber Command, both who lost their lives and those who survived."

"The project is already making a huge impact within Lincolnshire and with the planned interpretation building, the Chadwick Centre, will provide an educational facility and tourism centre attracting international audiences."



FACT FILE
International Bomber Command Centre, Lincoln
Main client: International Bomber Command Centre Trust
Architect: Place Architecture
Main contractor: Lindum Construction
Structural engineer: Alan Wood and Partners
Steelwork contractor: S H Structures
Steel tonnage: 55t

The overall scheme

The Memorial Spire was officially unveiled last October and represents the first phase of the International Bomber Command Centre.

As well as Memorial Gardens, the scheme will also contain a visitor centre (known as the Chadwick Centre) comprising an exhibition hall that will tell the story of Bomber Command through a multi-media experience, an education facility and a comprehensive multi-layered digital archive.

These facilities will be housed in a two-storey 13,000m² steel-framed structure that is due to be constructed later this year.

Bomber Command in numbers

125,000 aircrew served with Bomber Command in World War Two.

364,514 operational sorties flown

55,573 aircrew killed in action

25,296 killed flying from 1 and 5 Groups, headquartered in Lincolnshire

70% of aircrew were killed, taken prisoner or injured

The CSSB takes shape quickly with the aid of steel construction

Rebuild for Merseyside hospital

Structural steelwork is playing a crucial role in the redevelopment of one of the largest hospitals in the north of England.

Currently under construction, the new Royal Liverpool University Hospital will boast 646 beds all in single ensuite rooms, 18 theatres, 23 wards and units, and one of the largest emergency departments in the north west.

Being built on land adjacent to the existing hospital, this multi-million pound project is vital in regenerating and transforming an area that acts as a gateway into Liverpool city centre.

Overall the project has been divided into three phases; the first and current phase includes the building of a new Acute Hospital building, a separate Clinical Services Support Building (CSSB) and two link bridges, one spanning between the Acute and CSSB and the other linking the CSSB to an existing multi-storey car park. The new buildings are scheduled to be complete by early 2017. Phase two will then kick off with the hospital decamping its services into the completed new structures, allowing demolition of the existing 1960s hospital to commence.

Once demolition has been carried out, phase three will begin and this consists of constructing a large steel-framed public realm and car park (see box).

A hybrid design has been chosen for the first phase of the redevelopment. The new Acute Hospital building is being constructed with an insitu concrete frame, although there are a number of internal steel elements within this 150m-long structure, as plant enclosures, screens and one internal atrium are created using structural steelwork.

The largest steel element of phase one is the five-storey CSSB and its two link bridges, a contract that has required Elland Steel Structures to fabricate, supply and erect more than 900t of structural steelwork.

"Trust requirements had to be adhered to when choosing which material to use, but after an appraisal steel was opted for on the CSSB because of its speed and quality of construction," says Carillion Project Manager Stuart Loftus.

The CSSB will accommodate storage

Right: One of the 20m-long service yard girders

Far right: Level 5 steps back but could be infilled in the future to create more usable space

FACT FILE
Royal Liverpool University Hospital
Main client: Royal Liverpool and Broadgreen University Hospitals NHS Trust
Architect: NBBJ; HKS
Main contractor: Carillion
Structural engineer: TPS
Steelwork contractor: Elland Steel Structures
Steel tonnage: 1,770t

facilities for medical supplies, laboratories and offices. It is also the hub for many of the vital services that power the main hospital. Many of the power duct routes from the onsite energy centre go into the CSSBs own substation and then onwards into the Acute Hospital building.

The CSSB has a footprint measuring 60m × 40m and the steelwork has ben erected around a regular 9.9m × 6.6m grid pattern.

Two structural steel masonry lined cores provide the majority of the steelwork's stability, along with bracing. The main core was installed as part of the first steel erection phase, as this then provided the steel erectors with sufficient temporary stability which all other areas of the structure could be erected from. Five phases, working to the full height of the building were needed to complete the structure.

A large part of the ground floor of the CSSB incorporates a double height service yard. This part of the erection programme involved the project's heaviest steel members.

Elland Steel Structures used a variety of different mobile cranes for the job. The biggest capacity crane was a 100t unit used to lift four 2m-deep girders, spanning 20m and each weighing 17t, that form the yard's open plan space.

A series of 10m-high, 559mm diameter CHS sections, with 25mm thick walls, support the girders. Once each CHS section was installed, Carillion had to concrete fill each member to add to the overall robustness of the column supports.

Level two of the CSSB wraps around the loading yard, and so the first floorplate to cover the entire footprint is level three. This floor accommodates laboratories and the connections to the two link bridges (see box).

Level four is more or less identical to level three, while five steps back and only occupies half of the CSSB's footprint.

"We've added some flexibility into the structure as extra steelwork could be added in the future to complete level five if the hospital wants to expand the building," says Mr Loftus.

The entire project (including phase three) is due to be complete by 2020.

Phase three

Once the existing hospital has been demolished a steel-framed podium, accommodating a ground level car park with a public realm above will occupy the large cleared space.

Founded on pad foundations, the steel podium will measure 110m-long × 90m-wide, with a series of 305 UC columns erected around a 7.5m × 7.8m grid pattern. This column spacing, with a floor-to-ceiling height of 4.5m is considered to be ideal and the most efficient for the car park.

Spanning the columns, a series of 610 UBs supporting precast planks will form the roof.

"The steelwork has been designed around the heavy loadings generated by the podium's deep landscaping build-up," explains TPS Structural Engineer Duncan Gray.

The public realm on top of the podium will be formed with a 700mm fill within which there will be numerous plants and trees, many of which will be in large planters.

Paths, leading to and from the surrounding buildings, will crisscross the realm and public access will be via a flight of stairs. Because of the site's sloping topography, the CSSB will overlook the realm and will be linked to it via a ramp.

Gardens will provide solitude and a relaxing environment, while a café situated in the middle of the realm will offer drinks and snacks.

Elland Steel Structures will erect approximately 700t of galvanized steelwork for this phase, with work due to begin in 2019.

Link Bridges

Connecting the CSSB to the Acute Hospital is a 42.7m-long x 5.7m wide steel link bridge. The structure is supported by a single 10m-high V-shaped column, positioned slightly off-centre due to a service road that runs beneath the bridge.

The steelwork for this bridge was brought to site in individual sections, which were then assembled on site using temporary support frames to minimize crane requirements.

Also on level three, linking the CSSB to the adjacent multi-storey car park, is another 21m-long bridge.

Steel passes college test

The second of the two teaching wings is erected

A steel-framed college campus forms a major element of Sunderland city centre's regeneration. Martin Cooper reports.

FACT FILE
Sunderland College, Holmside Vocational Campus
Main client: Sunderland College
Architect: Red Box Design
Main contractor: BAM Construction
Structural engineer: WSP Parsons Brinckerhoff
Steelwork contractor: Harry Marsh [Engineers]
Steel tonnage: 900t

A multi-million pound steel-framed vocational campus is being built in the heart of Sunderland to accommodate up to 2,000 students and more than 120 staff.

Covering 12,500m², the state-of-the-art City Campus will house vocational courses, transferred from the nearby Hylton Campus, including advanced engineering, manufacturing, construction trades, automotive trades, travel and tourism, and catering and hospitality.

The well-equipped campus will also feature hair, beauty and barbering facilities; a spa; a bakery; a travel agency; restaurant and a car repair service, all of which will be accessible to the public.

Principal at Sunderland College Anne Isherwood says: "The City Campus has been designed to combine industry-standard facilities and outstanding teaching for our vocational and apprenticeship students, and will equip them with the skills and practical experience they need for their future careers.

"As well as providing a wide range of professional and technical courses, it will also be home to the college's commercial ventures and we are looking forward to welcoming members of the public to these facilities. We are confident that our flagship campus will enhance the vibrancy of the city centre and will be of benefit to Sunderland for many years to come."

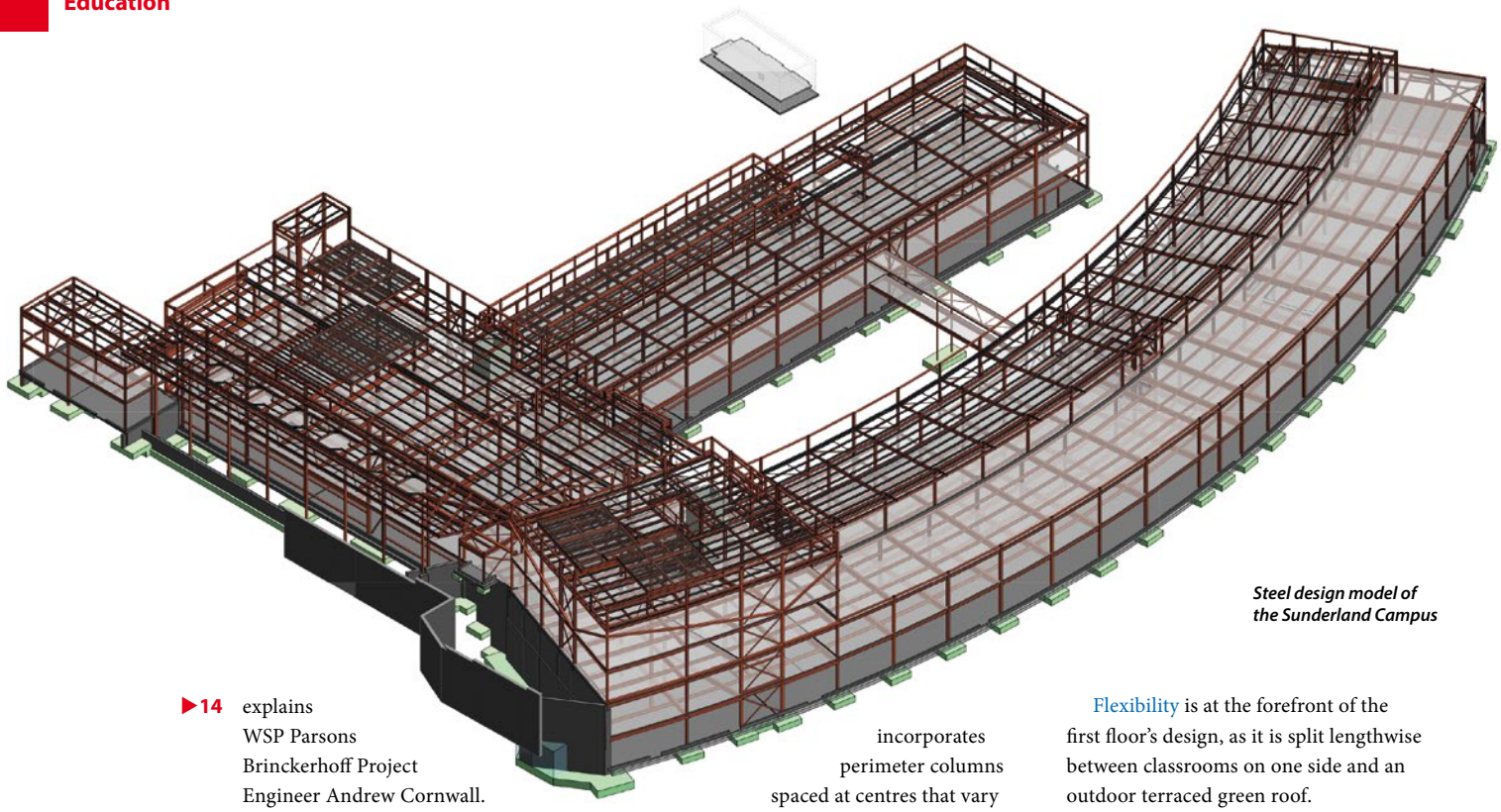
In order to achieve these aims, the Campus building's design not only had to stand out within its urban surroundings but also maximise the space within its confined plot.

Stone walls, polished blockwork and metal cladding will give the Campus a modern exterior, while to utilise the plot a steel-framed structure incorporating a 120m-long retaining wall was chosen as the best design choice.

The retaining wall allows the steel-framed structure to adapt to the site's tricky topography and thereby include a basement level along the entire south facing classroom block.

"A steel-framed solution was selected for a number of reasons such as programme and cost. However the main driver was the flexibility that this provided for services distribution and for modification in the future. Many of the classrooms and workshops are heavily serviced and these require extensive ductwork for specialist equipment. If the location of these changed in the future, openings in floors and walls could be accommodated more easily with a steel-frame than a concrete structure," ▶16

An adjacent railway line dictates that the main college façade is curved



Steel design model of the Sunderland Campus

▶14 explains WSP Parsons Brinckerhoff Project Engineer Andrew Cornwall.

The steel-framed Campus consists of two teaching wings. Along the southern elevation there is the three and two-storey high classroom block, while to the north there is a two-storey Learning Resources Centre (LRC). Both of these wings are joined at the western end by a three-storey high entrance building that also incorporates an atrium.

Because the Campus is essentially one large braced steel-framed building, a movement joint has been placed along the line where the LRC meets the entrance wing.

Bracing, located in stairwells, along with the diaphragm action of the composite floor slabs, give the steel frame its stability.

Predominantly, the steel frame has been erected around a fairly standard grid that incorporates perimeter columns spaced at centres that vary from 6.5m up to 7.5m. Internal spans vary depending on the classroom or workshop's ultimate use, with the longest span measuring 10m.

The classroom block is the largest section of the Campus. Filling up the southern portion of the plot, it curves – via a faceted steel frame - along the site's boundary adjacent to railway lines.

This wing incorporates workshops and classrooms spread over basement, ground, first, and second floor levels.

A 5m-high retaining wall wraps along the wing's north elevation, incorporating the site's slope and because of this the basement level workshops are at ground level along the south elevation and have windows overlooking the railway lines.

Flexibility is at the forefront of the first floor's design, as it is split lengthwise between classrooms on one side and an outdoor terraced green roof.

"The terrace has been designed so in the future, if the college needs more teaching space, it could be roofed over and converted into classrooms," says BAM Project Manager Jason Kelly.

During the design stage the foundations and the columns in this part of the structure were future-proofed by being designed to accept the extra loadings the additional columns and a roof would exert.

The western corner of the classroom block incorporates a second-storey, which then wraps around to the entrance block, which is entirely three-storeys high.

As well as constructing the College, BAM Construction is also responsible for the fit-out which will be completed by the end of the summer, in time for the Campus to open in September 2016.

Logistics and erection

Photo © Amy Bell

Railway lines along one elevation and a city centre pedestrianized zone along another mean there is only one access route into the site for all materials.

On a tight and confined site such as this, logistics are a key factor in successfully completing a project and Sunderland College is no exception.

"Ideally we would have started the steel erection at the farthest end from the site's entry point, which is the entrance block, and worked our way out," says BAM Project Manager Jason Kelly.

"However due to some design changes, we've had to sequence the erection programme and erect the furthest point of the structure last. We then bring our cranes out via the central courtyard before finally erecting a footbridge that links to the two teaching wings."

With little or no room for materials to be stored on site, especially towards the end of the steel erection programme, steelwork contractor Harry Marsh [Engineers] has delivered steel to site in 20t loads, which were generally erected in one day.

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STEEL BRIDGE GROUP GUIDANCE NOTES (P185) UPDATED

The set of 60 Guidance Notes produced by the Steel Bridge Group, and published by SCI with financial support from BCSA and TATA Steel, has just been comprehensively reviewed and updated. The Notes offer guidance on best practice in steel bridge construction, explaining many construction processes and their influence on design and specification. Although aimed at bridge designers, many of the Notes offer general information, for example on welding processes, that will be helpful to all designers of structural steelwork.

This is the sixth issue of the Guidance Notes. Much of the previous advice remains valid but the Steel Bridge Group has taken the opportunity to update and align them with new British and European Standards. Two new Notes have been written: one provides guidance on specification of fatigue quality, reflecting the requirements of the Specification for Highway Works to specify only a fit-for-purpose quality for welded details; the second offers specification clauses for tension components, such as high strength bars and strands, to supplement the requirements from BS EN 1090-2. Holders of the previous issue are strongly encouraged to download this latest issue to ensure that they have reference to current requirements and recommendations.

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Steel construction gets the red carpet

One of Europe's largest retained façades is being incorporated into a new steel-framed mixed-use development on London's famous Leicester Square. Martin Cooper reports.

Retaining London's listed façades has become a widespread feature of construction projects in the capital during the last decade.

Recent examples include Oxford Street's ongoing redevelopment which is largely being carried out behind retained façades, while the busy thoroughfare of Kingsway and the City's Finsbury Circus have both seen major developments that have incorporated retained elements.

Whether projects involve partial or complete façade retentions, the importance of keeping these historic, and quite often listed, street frontages is vital in maintaining London's traditional streetscape.

Developers and tenants alike want modern spacious offices and the best way of attaining this on a plot, which has a listed façade, is to demolish the buildings innards while propping and retaining the perimeter walls. A new modern structure can then be built behind the walls and incorporate the historic or listed façade.

One of Europe's largest retained façades is currently being incorporated into the redevelopment of LSQ London in central London.

Formerly known as Communications House this 1920s building, which overlooked one of London's most famous squares, was said to have many attractive features. However over the past 90 or so years it has been enlarged several times and had become inefficient in terms of maximum utilisation of space.

The new frame rises up within the retained façades

Visualisation of the completed LSQ London

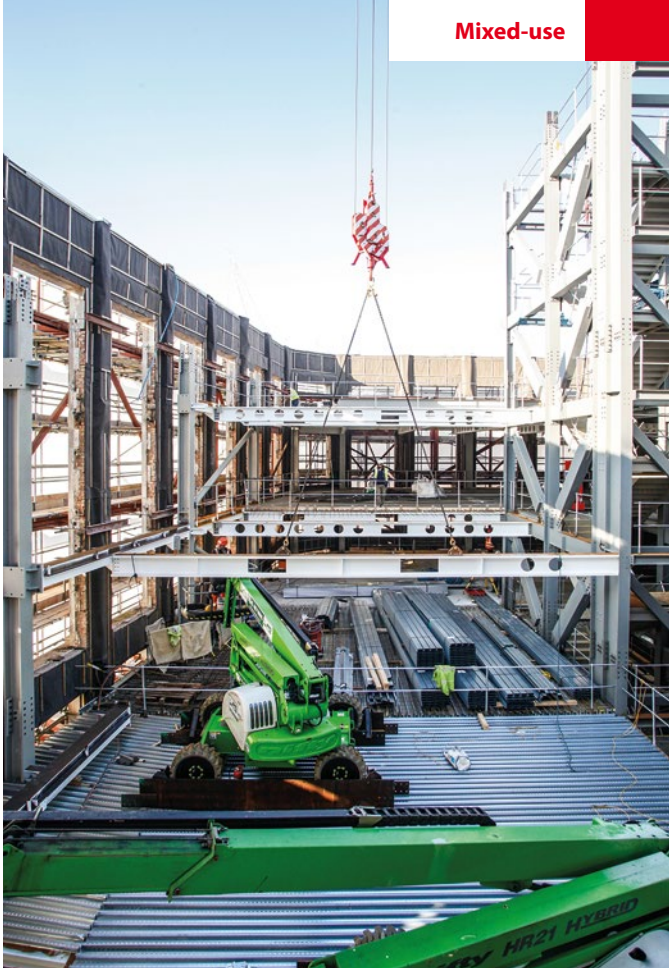
Steel to steel connections

The steel-framed façade at LSQ London mostly dates from the 1920s and 1930s, however some areas, were added during the 1960s.

The steel columns are all encased in Portland stone and consequently in good condition. However, steelwork originating from various decades required extensive laboratory tests to determine its make-up prior to making the welded connections for new brackets.

"We've installed a total of 250 brackets that connect the new steel-frame to the retained façade's steel-framed columns," explains Bourne Steel Divisional Manager Kevin Springett.

"The lab tests allowed for a trouble-free onsite welding process and as we were sure of the existing columns make-up it meant works onsite ran smoothly and efficiently," adds Brookfield Multiplex Project Director Asif Hashmi.



"Our brief was to create a high-spec office building and we felt that the goal was not just to reimagine but reinvent, while also retaining the look and feel of the original building, which is liked and admired by so many people," says Make Lead Architect Frank Filskow.

"Our design makes the best of the existing building by retaining the historic façades, and sensitively restoring them to maintain the integrity of the original architectural features and details.

"The design of the building naturally leant itself to using steel for the primary structural elements. The design of the new steel structure introduced a new central core, and enabled clear, open-plan floorplates, improving the office spaces within the building."

Waterman Structures Director Jody Pearce agrees and says: "One of the key aspects of a façade retention scheme is the alignment of new floors with existing window openings. We promoted the use of a steel frame as it offered the flexibility needed to suit the various interfaces that occur with the existing façade."

"By integrating the suspended services within the structural downstand beam zone, the depth of the floor zone against the façade was minimised, thus assisting the alignment of new floors with existing windows further."

The project's main contractor Brookfield Multiplex started on site during November 2014, by which time the demolition work had been completed leaving four propped façades surrounding a cleared site.

"Our first task was to construct a secant piled wall and the main central bearing piles. Then we excavated and enlarged the existing basement into a two-level deep facility, removing 13,000m³ of overburden in the process," explains Brookfield Multiplex Project Director Asif Hashmi.

Once this preliminary work and construction of the two main raft slabs were completed, steelwork contractor Bourne Steel was able to begin erecting the new steel frame that begins at lower basement level.

"Getting the steel-frame erected and subsequently tied into the existing façade is vital, and it is one of the main drivers of the scheme," adds Mr Hashmi.

"Once the frame connecting into the retained façade was erected and the concrete floors cast, we were able to begin removing the extensive façade retention steelwork that surrounds the site and start work on renovating the original stonework and installing new windows."

The new steel frame is structurally independent and gains its stability from two steel braced cores. Once the temporary propping was removed the new steel frame supports and restrains the four retained façades, and so before the propping could be removed a large number of connecting brackets had to be installed [see box].

The project's new steel frame forms two basement levels and a ground floor, which will accommodate high-end retail outlets and a main entrance lobby.

Above the ground floor there are seven floors of office accommodation, five of which are incorporated into the retained façade.

An elegant new curved roof will enclose

FACT FILE
LSQ London
Main client: Linseed Assets
Architect: Make
Main contractor: Brookfield Multiplex Construction Europe
Structural engineer: Waterman Structures
Steelwork contractor: Bourne Steel
Steel tonnage: 2,000t

The new feature roof rises up above the retained elements

Temporary props support the basement while the new frame is erected

the two uppermost floors, offering a unique 21st Century interpretation of the traditional London mansard style.

The steelwork has been erected around a regular grid pattern with internal office spans of up to 15m. Cellular beams have been utilised throughout for service integration and to minimise the structural void between floors.

The new fifth floor will be clad with Portland stone to integrate with the retained façade below. This floor level's steelwork is topped with a ring beam that goes around the entire perimeter of the building.

The ring beam is formed from jumbo box sections measuring 650mm × 450mm with a 25mm thickness. The sections were brought to site in 3.5m-long sections each weighing 3t.

"The box section ring beam performs two functions," says Bourne Steel Divisional Manager Kevin Springett. "The columns for the feature roof are supported by the beam as these are not aligned with the main columns for the rest of the building, and the stone cladding for the sixth floor is also hung from the beam."

The steel feature roof slopes outwards from the two centrally positioned cores and is formed with a cranked steel frame, which in turn supports a lightweight aluminium frame and glazing.

This new and elegant curved mansard roof encloses the building and offers a modern interpretation of the traditional mansard style where arch geometry sits atop a classical base.

"This respectful, contemporary addition to the building composition reduces the existing top-heavy visual mass. The curve also seeks to ensure the building blends in seamlessly with the surrounding buildings of Leicester Square," sums up Mr Filskow.

LSQ London is scheduled for completion in the third quarter of 2016.

Site welding – to existing steelwork

by SCI Associate Director David Brown

The façade retention at 48 Leicester Square demonstrates that when properly thought through, site welding is an entirely appropriate technique – and also demonstrates the adaptability of steelwork structures. Site welding is sometimes thought of as slightly suspicious, but this notion is misguided – the proposition should be that with proper consideration, site welding has the same high quality results as welding in the workshop. In other parts of the world, site welding is very common.

When welding existing material, the original material must be investigated and tested. For this project, the original dates of around 1920 makes it very likely that the material was steel – slightly older and there would be a possibility that the beams were of wrought iron rather than steel. The key to successful welding (there being no difference between shop and site) is to demonstrate that a successful test weld can be produced in circumstances that very closely reflect the 'final' weld. A preliminary welding procedure specification will be developed, fully describing the material, all the electrical parameters, the consumables, the joint type and welding orientation. The material used in the test should be that encountered in the real situation – in this case the steel from the façade. The test piece is subject to a number of tests, which if successful, demonstrate that the procedure is appropriate and can be used with confidence.

The site welding must follow, in every aspect, the parameters, consumables, welding position etc. that were proved by the welding procedure specification. Welding must only be carried out by properly qualified personnel – for the welding process, material, joint type and welding position. In some circumstances it is necessary to make special arrangements for site welding. Safe access is an obvious issue, but it may also be necessary to provide protection from the weather.

Non-destructive testing should follow the completion of the welding as the final operation to assure the quality of the welding. The National Structural Steelwork Specification is recommended as the default acceptance criteria for both shop and site welding.

Although site welding to existing steelwork may not be common, it can be completed safely and with confidence in the final result. For designers, there is a range of support resources that cover material and section sizes likely to be found in existing buildings, with guidance on the design assumptions at the time that may assist in any assessment of the existing structure. Specific guidance is available covering site welding.

Resources:

- Historical Structural Steelwork Handbook, BCSA
- Appraisal of Existing Iron and Steel Structures, SCI
- Guide to Site Welding, SCI
- Typical Welding Procedure Specifications for Structural Steelwork, BCSA
- National Structural Steelwork Specification, (Fifth Edition, CE Marking Version), BCSA

GUIDANCE ON MOVEMENT RANGES FOR BRIDGE BEARINGS (P406)

Bridges are usually constrained against horizontal displacement by providing a fixed bearing at one support and movement bearings that permit linear displacement of their upper parts relative to their lower parts at other supports. Such displacements occur principally due to thermal expansion and contraction. A recent enquiry to SCI's Advisory Desk highlighted the inconsistent, contradictory and unclear requirements in BS EN 1991-1-5 and BS EN 1993-2 for the determination of the movement ranges to be specified for structural bearings in bridges.

The apparent intent of the rules was considered and with advice from the Steel Bridge Group, and financial support from BCSA and TATA Steel, recommendations were developed so as to offer a much clearer explanation of how designers should calculate the movement range, taking account of both thermal change and uncertainty in the relative positioning of bearings on the sub- and superstructures. These recommendations are published as a new SCI Publication (P406) which also comprises some simple worked examples.

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Storey-high trusses support 2 London Wall Place's cantilever over the adjacent road

Cantilevering London Wall

Transfer structures supporting cantilevers abound on this City of London commercial development, reports Martin Cooper.

How the multiple cantilevers will look on 1 London Wall Place

London Wall Place will be a new destination in the City of London, offering an acre of landscaped public realm set between two landmark office buildings with more than 46,000m² of Grade A office space. The realm features remains from the Roman City Wall and a Saxon church, surrounded by gardens, water features and suspended walkways.

The project covers an area of more than 15,000m², on a plot previously occupied by numerous buildings including the 1960s built 20-storey high St Alphage House.

Work started on site in 2013 with main contractor Brookfield Multiplex demolishing all of the existing buildings, while protecting the historic structures, and then enlarging the site's existing basement to create a two-level deep zone.

A portion of the high-level pedestrian walkways, known as the Barbican and City Highwalks, originally crossed the site and were removed as part of the demolition programme. These will be reinstated with a series of new weathering steel bridge-like walkways as part of the overall scheme (see box).

Both buildings, to be called 1 and 2 London Wall Place are steel-framed structures rising to 12 and 16 storeys respectively. Structurally independent they will however be linked by one of the weathering steel walkways that will eventually span the centrally positioned public realm.

The steelwork frame starts at ground floor level atop the concrete ground floor slab. Both buildings comprise a steel frame with composite concrete floors stabilised by concrete cores that incorporate the stairs and lift shafts.

"A number of alternate structural systems were considered during the design phase," says Brookfield Multiplex Project Director Phil Clarke. "But it had to be a steel solution to meet the structural demands of the cantilevers."

Providing more than 27,000m² of floorspace, the 12-storey 1 London Wall Place is the largest, in terms of volume, of the two structures.

The final shape of the external envelope has been driven by the rights to light afforded to the adjacent Barbican and St Paul's Cathedral viewing corridor. Consequently the structure sets back at a number of areas to create terraces at the upper levels in order to reflect the planning requirements.

"To maximise floor space this building cantilevers out over adjacent roads on two of its main elevations," explains WSP Parson Brinckerhoff Senior Technical Director Stephen Jackson.

1 London Wall Place cantilevers by up to 8m along the London Wall elevation and by up to 3.5m along Fore Street.

Deep fabricated beams up to 1.95m in depth have been incorporated into the level 2 transfer structure to achieve the longest cantilevers. Other local transfers are also incorporated within the building at every floor to achieve changes in column grid as the envelope sets back floors and terraces.

Overall this structure's floor framing typically consists of primary beams spanning 9m with secondary beams, spaced at 3m centres, spanning up to 16.5m and in some locations up to 18m.

Steelwork contractor William Hare is installing numerous fabricated sections to act as transfer structures as standard rolled sections do not provide the required capacity.

"The heaviest fabricated beam we have installed is 70t and, like many of these large beams, it had to be lifted into place by a 160t capacity crawler crane we have on site for the early part of the steel programme," says William Hare Project Director Alex Smale.

Having such a large crawler crane onsite has been a challenge in itself. Because the basement extends below most of the site's footprint and the slab would not ordinarily be able to support such a large crane, more than 300 temporary props have been used to support the slab while the crane is onsite.

Once the main transfer structure is complete the crawler crane will be removed and the large transfer beams further up the frame will have to be lifted into place by tower crane.

"At this stage all of the heaviest pieces will be brought to site in two or three sections and then bolted together once they are in place. In this way the members will be within the tower crane's capacity," adds Mr Smale.

On the adjacent 16-storey 2 London Wall Place, the floor framing, from level two upwards, typically consists of primary beams spanning 7.5m and secondary beams provided at 3.75m centres with spans of up to 13.5m and in some locations up to 15m.

This structure also features cantilevers, which have again been introduced to maximise the floor area, although on this building the cantilevers are approximately 11m beyond the nearest internal column.

Along the south east corner of 2 London Wall Place the building cantilevers out over the main thoroughfare of London Wall, creating one of the project's main features and something of a structural steel highlight.

A series of single-storey high trusses have been installed to form these long cantilevers and to help limit the potential for high deflections.

The chord members of the trusses are 640mm deep fabricated sections that form part of the main floor framing. The diagonal bracing elements are universal column sections enhanced with plates welded across the flanges to provide the necessary strength and stiffness.

Supporting 15 floors of the building, the truss members and their supporting columns are heavy and large requiring each truss to be brought to site in two or three sections so they are transportable by trailer. Once onsite they were bolted together and then lifted into place by a 500t capacity mobile crane, again sited on the ground floor slab and supported by extensive back propping through the deep basement.

The trusses rely on the main core walls and the tying action of the concrete floor slabs to assist in limiting deflection.

London Wall Place is due to complete in 2017.

High-level walkways

A unique feature of the London Wall Place project will be the reinstated walkway structures, or Highwalks, that will cross the site to re-establish links to other parts of the City's high-level walkways.

Seven walkway structures fabricated from weathering steel will be installed as part of William Hare's steel package.

Three of the structures are reinstated bridges, one crossing London Wall and the other two spanning Fore Street, while a fourth will create a new high-level pedestrian bridge across Wood Street. The other structures crisscross the site below and around the new buildings linking all of the bridges together.

Crossing London Wall, Walkway 1 is the longest structure and it will be lifted into place, as one piece, during the coming Easter weekend. It is a steel footbridge that will re-instate the north-south connection to the nearby Bassishaw highwalk.

The 1 London Wall Place building frame will support the bridge as it cantilevers more than 30m out over the London Wall carriageway. A 20m high stainless steel pylon with a series of suspension stays will be used to support the far side of the new bridge and transfer the loads back into the building foundations and the structure at level 4.

1 London Wall Place's cantilevers are up to 8m long

FACT FILE

London Wall Place, London

Main client: Brookfield, Oxford Properties
Architect: Make
Main contractor: Brookfield Multiplex
Structural engineer: WSP Parsons Brinckerhoff
Steelwork contractor: William Hare
Steel tonnage: 8,500t

Hybrid modular systems using a steel-framed podium

Mark Lawson of the SCI discusses some of the recent research and developments in modular construction.

Modular construction has established itself in the UK for medium and high-rise residential buildings, such as student residences and hotels, in which there is often need to provide open plan space at the ground floor level and for basement car parking. The structural system generally adopted is to support the modules on a steel-framed podium or transfer structure in which the beams align with the load-bearing walls of the modules and columns are placed at multiples of the module width. This article reviews some of the design considerations in planning modular buildings when supported by a steel framework and is based on the results of a recent research project called MODCONS, which was carried out with support from the European Commission.

Modules supported by a steel-framed podium

The modules are relatively lightweight and so the steel structure can be designed to support the vertical loads from the modules. For modular buildings of six to eight storeys, long span cellular beams may be used to provide open plan space below, as shown in Figure 1. The columns are placed at 7.5m spacing which means that the modules are 3.7m wide allowing for a gap between the modules. This is the optimum solution for both the modular system and the open plan space below.

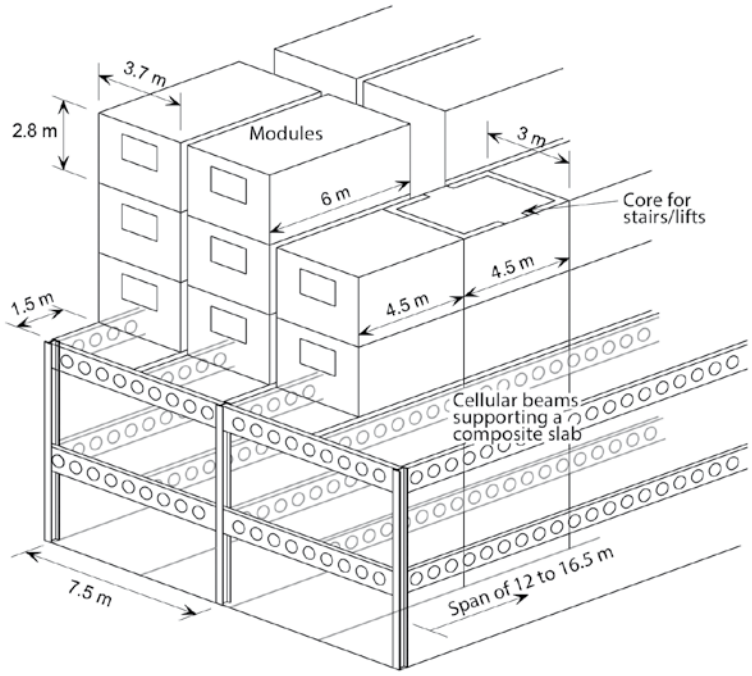

Figure 1: Support to modules by steel-framed podium structure

For taller buildings, it is efficient to 'cluster' the modules around a braced steel or concrete core, which provides the overall stability of the building. In this building form, the modules transfer vertical loads. A configuration of modules using this principle is illustrated in Figure 2 in which 8 apartments comprising 16 modules are placed around the core. Access to each apartment is provided from the central core.

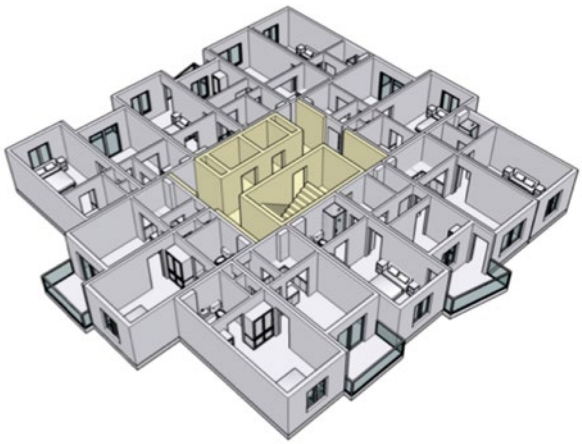

Figure 2: Typical layout of modules in high-rise buildings (courtesy HTA Design)

Analyses of modular systems on a steel-framed podium

In the recently completed European Commission Framework 7 project called MODCONS, the Steel Construction Institute worked with modular manufacturer, Futureform and partners from Spain, Portugal and Finland. The behaviour of these hybrid structural systems were analysed when subject to various actions including seismic effects and loss of supports to take account of potential robustness (avoidance of disproportionate collapse) scenarios. The cases considered used two lines of modules with a braced corridor between the modules. Studies were made of four-storey and six-storey high groups of modules supported on a floor grid of 7.5m square and 8.8m × 7.5m including the corridor and also a 16.3m × 7.5m long span grid. The objective was to evaluate the deflections of the hybrid system for various actions, and the forces in the supporting frame and in the connections between the modules. An example of these analyses is shown in Figure 3, overleaf.

Planning guidelines

The following information may be useful in planning a modular project supported by a steel-framed structure:

- A typical light steel module weighs 3 to 3.5 kN/m^2 floor area, or 10 Tonnes for a module of 30m^2 floor area. The weight will be higher if the modules are supplied with a concrete floor instead of a light steel joisted floor.
- The module sizes are limited mainly by transportation, an external width of 4.2m can be transported without escort. Module lengths may include the corridor.
- Constraints of local roads and permitted times of working

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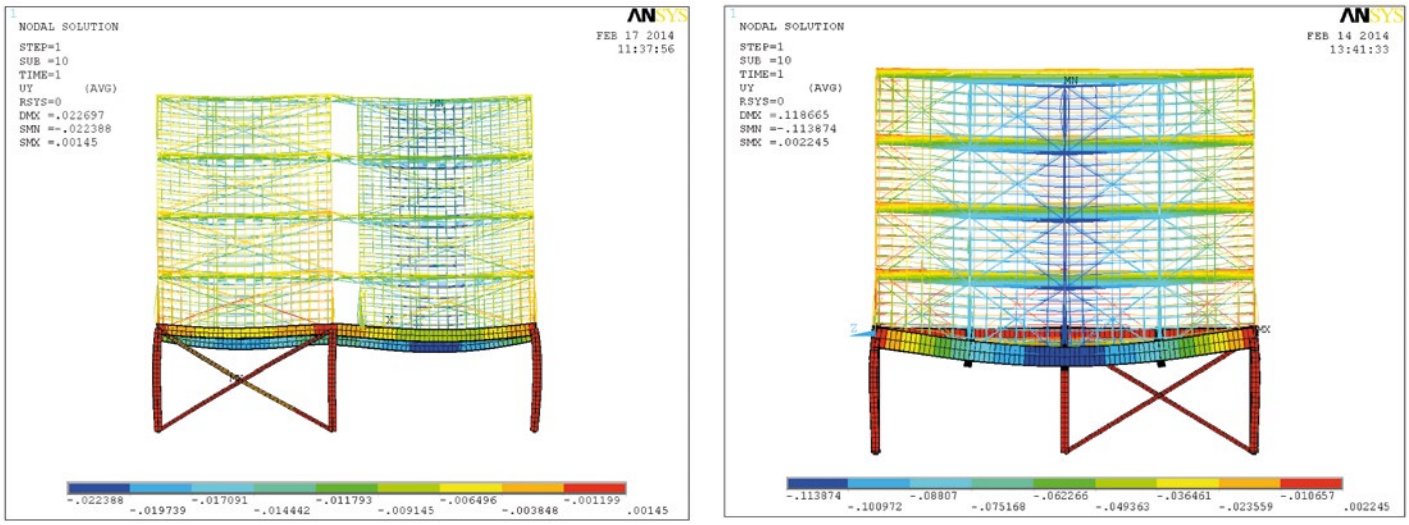


(a) Deflection (exaggerated) of steel frame supporting modules

(b) Deflection when internal column is removed to simulate robustness

Figure 3: Analyses of structural frame supporting 4 levels of modules above

should be agreed at the planning stage as they will influence the optimum design solution.

- For internal planning purposes in residential buildings, an internal module width of 3.3m to 3.9m is efficient. Openings in the side walls of modules can be introduced, depending on the loads that are transferred.
- A combined wall width of 300mm and a combined floor and ceiling depth of 450mm should be allowed for in the planning of modular systems although these dimensions may reduce for some modular systems.
- A rigid welded frame often using RHS sections can be introduced at the ends of the modules if a fully glazed façade or large patio doors are required. These RHS members can also be used to provide support to balconies.
- Installation rates of 6 to 8 modules per day may be used in planning, although times of working, bad weather and winter working will influence this rate.
- Beams at the transfer level should support a composite floor slab (also needed for diaphragm action) and should align with the load bearing walls of the modules.
- A characteristic line load of 15 kN/m per module wall and per storey may be used for scheme design to determine the loads acting on the beams at the podium level.
- Columns should be placed at typically twice the module width along the building façade. A spacing of 7.5m to 8.0m would provide for 3 car park spaces below.
- Beam spans equal to the room length plus the corridor width will usually be most efficient (typically 7.5m to 10m span).
- The modules will also act to stiffen the beams and so the actual deflection response will be 20% to 30% less than for the beams acting alone. The deflection of the beams under the weight of the modules and imposed loads should be limited to span/360 but not exceeding 30mm to avoid damage to the finishes to the modules.
- The vertical services within the modules are often distributed horizontally at the podium level through web openings in the beams. A separate service zone may be required above the podium level in cases of mixed tenure, such as housing above a supermarket.

Figure 4: Completed modular hotel on Lavington Street, Southwark showing the use of a first floor steel podium structure

Case example

A good example of this form of construction is a hotel near the busy Southwark Street on London's south bank which consists of 192 rooms and corridors integrated within the Futureform modules of 15m length. The completed hotel is shown in Figure 4. The modules are supported by a single storey steel frame with the hotel reception and restaurant at ground floor.

A fully glazed façade wall was created by a welded frame using 80 x 40 RHS sections. This rigid frame provides resistance to horizontal loads acting on the five-storey assembly of modules, and also provides the attachment points between the modules. Modules were lifted into place at an average rate of 6 per day by a 500T mobile crane with a long boom positioned on the roadside at Lavington Street. The installation of the modules took only 5 weeks out of a nine-month construction programme, saving an estimated 6 months relative to more traditional concrete-framed construction. This led to estimated savings of 1% of the construction cost per month for the hotel operator.

From a sustainability view point the impact of the construction operation on noise and local traffic was much reduced as modules were delivered 'just in time' for lifting directly from the lorry into position. The number of workers on site was reduced to one third of those required in more traditional concrete frame construction. SCI also carried out an embodied carbon study of the modular system and found it had 20% less embodied carbon than a concrete frame with blockwork infill walls.

Acknowledgements

The information presented in this article is only a small part of the work undertaken during the MODCONS project. The project was funded under the European Commission Framework Programme 7 (FP7) for support to SMEs and was coordinated by SCI. The other partners in the project were Futureform Ltd, HTA Design (both UK), Tecnalia, AST and IA3 (all Spain), University of Coimbra and Cool Haven (Portugal), NEAPO and Technical University of Tampere (Finland). Further information about the project is provided at www.modcons-research.eu.

AD 393:
Minimum requirements for column splices in accordance with Eurocodes.

Clause 6.2.7.1(14) of BS EN 1993-1-8:2005 specifies minimum requirements for component in bearing type splices. The Standard specifies splice material to be provided to transmit at least 25% of the maximum compressive force in the column. This requirement can be satisfied relatively easily in medium rise structures. For very large structures, accumulating load from a number of storeys, the compression in the column can be very significant, resulting in large and expensive splice details.

It is understood that the requirements in the Eurocode are to provide a degree of continuity of stiffness about both axes. Previously, UK designers would have observed the recommended detailing practice in the Green Books, where minimum component sizes were specified to achieve this continuity of stiffness.

SCI recommend that if the Eurocode rules lead to splices which are significantly larger than previous practice, the issue should be discussed between the connection designer and the Engineer with responsibility for the overall design. It may be that agreement can be reached to detail the splices in a way which meets the essential requirements, which are:

- To provide a connection capable of carrying the design forces. The design forces should include the second order effects described in Advisory Desk notes 243, 244 and 314;
- To ensure the members are held accurately in position relative to each other;
- To provide a degree of continuity of stiffness about both axes;
- To provide sufficient strength and stiffness to hold the upper column shaft during erection;
- To provide resistance in tension, if the structure is to be designed for vertical tying.

As many designers will be aware, the Eurocodes are to be revised; this clause, and 6.2.7.1(13) covering non-bearing splices, have been proposed for revision. Unfortunately, any revisions are some years away, so to wait for the revised Standard is not a solution.

Contact: **Abdul Malik**
Tel: **01344 636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates November and December 2015

BS EN PUBLICATIONS

BS EN ISO 9934-1: 2015
Non destructive testing. Magnetic particle testing. General principles.
Supersedes BS EN ISO 9934-1:2001

BS EN ISO 9934-2:2015
Non-destructive testing. Magnetic particle testing. Detection media.
Supersedes BS EN ISO 9934-2:2002

BS EN ISO 9934-3:2015
Non-destructive testing. Magnetic particle testing. Equipment.
Supersedes BS EN ISO 9934-3:2002

BS IMPLEMENTATIONS

BS ISO 4990:2015
Steel castings. General technical delivery requirements.
No current standard is superseded

BS ISO 4993:2015
Steel and iron castings. Radiographic testing.
Supersedes BS ISO 4993:2009

BS ISO 9477:2015
High strength cast steels for general engineering and structural purposes
No current standard is superseded

BS ISO 13521:2015
Austenitic manganese steel castings
No current standard is superseded

BRITISH STANDARDS UNDER REVIEW

BS EN ISO 544:2011
Welding consumables. Technical delivery conditions for filler material and fluxes. Type of product, dimensions, tolerances and markings

BS EN 1330-2:1998
Non-destructive testing. Terminology. Terms common to the non-destructive testing methods

BS EN 1330-3:1997
Non-destructive testing. Terminology. Terms used in industrial radiographic testing

BS EN ISO 8504-1:2001
(BS 7079-D1:2000)
Preparation of steel substrates before application of paints and related products. Surface preparation methods. General principles

BS EN ISO 8504-2:2001
(BS 7079-D2:2000)
Preparation of steel substrates before application of paints and related products. Surface preparation methods. Abrasive blast cleaning

BS EN 12668-1:2010
Non-destructive testing. Characterization and verification of ultrasonic examination equipment. Instruments

BS EN 12668-2:2010
Non-destructive testing. Characterization and verification of ultrasonic examination equipment. Probes

BS EN 14127:2011
Non-destructive testing. Ultrasonic thickness measurement

BS EN ISO 16276-1:2007
Corrosion protection of steel structures by protective paint systems. Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating. Pull-off testing

BS EN ISO 16276-2:2007
Corrosion protection of steel structures by protective paint systems. Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating. Cross-cut testing and X-cut testing

BS EN ISO 18275:2012
Welding consumables. Covered electrodes for manual metal arc welding of high-strength steels. Classification

BS EN ISO 26304:2011
Welding consumables. Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels. Classification

NEW WORK STARTED

EN 10210-1
Hot finished structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements
Will partially supersede BS EN 10210-1:2006

EN 10210-2
Hot finished structural steel hollow sections. Technical delivery conditions
Will partially supersede BS EN 10210-1:2006

EN 10210-3
Hot finished structural steel hollow sections. Tolerances, dimensions and sectional properties
Will supersede BS EN 10210-2:2006

EN 10219-1
Cold formed welded structural steel hollow sections. General
Will partially supersede BS EN 10219-1:2006

EN 10219-2
Cold formed welded structural steel hollow sections. Technical delivery conditions
Will partially supersede BS EN 10219-1:2006

EN 10219-3
Cold formed welded structural steel hollow sections. Tolerances, dimensions and sectional properties
Will supersede BS EN 10219-2:2006

EN 14399-7
High-strength structural bolting assemblies for preloading. System HR. Countersunk head bolt and nut assemblies
Will supersede BS EN 14399-7:2007

EN 14399-8
High-strength structural bolting assemblies for preloading. System HV. Hexagon fit bolt and nut assemblies
Will supersede BS EN 14399-8:2007

EN 14399-9
High-strength structural bolting assemblies for preloading. System HR or HV. Direct tension indicators for bolt and nut assemblies.
Will supersede BS EN 14399-9:2009

EN 14399-10
High-strength structural bolting assemblies for preloading. System HRC. Bolt and nut assemblies with calibrated preload
Will supersede BS EN 14399-10:2009

ISO PUBLICATIONS

ISO 9018:2015
(Edition 2)
Destructive tests on welds in metallic materials. Tensile test on cruciform and lapped joints.
Will be implemented as an identical British Standard

ISO 17641-2:2015
(Edition 2)
Destructive tests on welds in metallic materials. Hot cracking tests for weldments. Arc welding processes. Self-restraint tests
Will be implemented as an identical British Standard

Steel framed domestic dwellings

One of the most important social problems facing this country at the present time is the acute shortage of living accommodation. The problem is so urgent and vital that its solution has become one of the major political issues of the day. The Government target for domestic dwellings - both houses and flats - is 400,000 per annum, and it is estimated that 25% of the approvals given so far for public projects (Local Authorities, New Town Development Corporations etc.) are for dwellings to be built by industrialised methods.

To meet the above target a 55% increase in total output by the construction industry over the next ten years is necessary and this will have to be achieved with an increased labour force estimated at only 2%. It is to make this project really possible that greater use of industrialised building techniques is being encouraged. Many of these systems for single and two-storey houses incorporate the use of steel frame construction

Flexibility in Construction and Design

The flexibility in this type of 'system' building makes possible, within certain minor structural limitations, alterations of the basic design both external and internal before and after erection. For example, it is a simple matter for the architect to alter the layout of the rooms, the position of the staircases or the design of the roof to meet individual requirements.

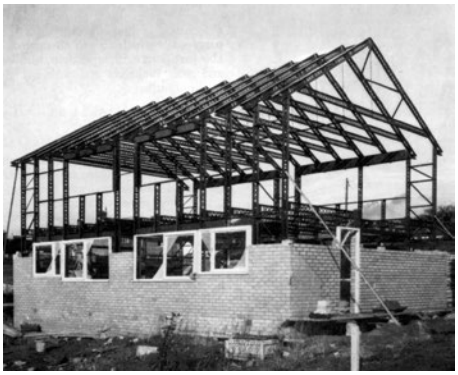
To make industrialised building an economic proposition houses must be ordered in quantities sufficiently large to warrant the expense of installing plant and equipment for producing the various standard units on a 'mass production' basis. To bring this about Local authorities are being encouraged by the Ministry of Housing and Local Government to form development groups so that large single contracts can be placed on behalf of the Group instead of a series of small orders by individual Authorities, perhaps placed at different times.

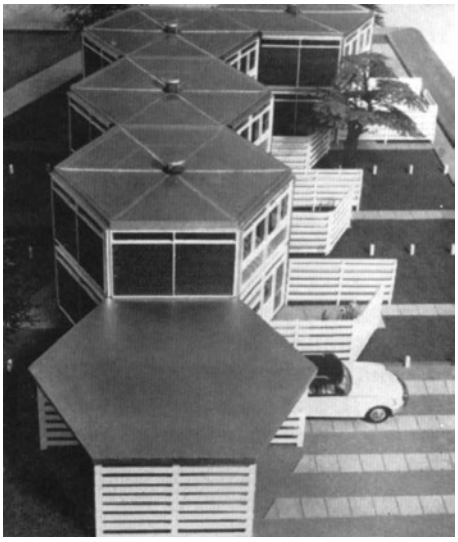
The 5M Flexible House

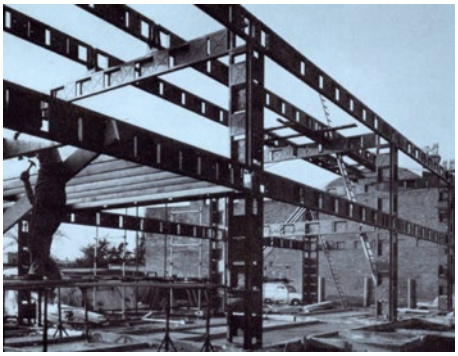
The basic principles of this type of house are to be found in practically all industrialised systems used today: the name '5M' indicates a system based on a planning grid of 1 ft. 8 in., i.e. five times the module of 4 in. The system is not based on type plans but on a series of standard components which, as mentioned earlier, can be used by architects to produce house plans of practically any design.

A timber and steel composite frame is erected on a lightly reinforced site slab without normal strip foundations. The frame allows roofing and walling to follow quickly after erection, creating covered workshop conditions on site at an early stage for the following trades. The frame also acts as a jig for the placing of other components. Wind forces are transferred to ground through floor and roof diaphragms and thence through the portal connection of the perimeter beams and through diagonal braces in the party walls to stanchions. The choice of cladding is wide and may be timber, clay, concrete tiles, panels and other materials.

The most significant innovation is the change in the construction of the party walls which are, in effect, movable partitions to incorporate







wardrobes and storage shelves and with a high quality finish.

Steel-framed Houses

5M was the prototype design but in many later systems frames are now all steel. The factory-made frames require no special skill to erect and the structure is dimensionally accurate.

Stress calculations can be made with accuracy and the greater strength of steel work has a number of advantages, an important one being its ability to withstand unequal ground subsidence. Reduced fire hazard, freedom from distortion with age and freedom from insect and fungoid attack are other features.

In some cases the frames are supplied to site as completely rigid bolted or welded structures, though the normal practice is to deliver as separate components to be assembled on site: these are suitably marked to withstand unequal ground subsidence. Reduced fire hazard, freedom from distortion with age and freedom from insect and fungoid attack are other features.

In some cases the frames are supplied to site as completely rigid bolted or welded structures, though the normal practice is to deliver as separate components to be assembled on site: these are suitable marked to facilitate quick erection by unskilled labour. This makes unnecessary the need for heavier cranes as two men can normally handle all items without difficulty.

Columns and girders vary somewhat from company to company and in some cases are of patented design. Considerable use is being made of square, rectangular and circular hollow steel sections in the construction of frames and for columns, floor beams, rafters, bracings and certain architectural details.

In general the external walls are made up of panels of standard sizes, in many cases steel framed. However, as will be evident from the accompanying illustrations, many types of cladding are available. The modular sized windows are normally available in a variety of designs, a feature which permits variation of the external appearance. Some systems offer a choice of roof styles and other features giving individuality to the houses and avoiding the 'factory made' look.

As a rule the steelwork is supplied to the site suitable treated against corrosion. For instance, in one system the parts are first degreased and then immersed on a red oxide/zinc chromate paint and stoved. A second similar treatment is given after fabrication into major components. The amount of steelwork naturally varies with the design of the system but figures ranging up to two tons per house are typical.

Erection times vary according to the size and design of the house but as a guide it may be mentioned that one firm claims that the complete structural cladding assembly for one pair of their semi detached houses can be erected and temporarily waterproofed in 10 hours and completed in 21 days at the most. Another states that in 14 days six men can put up a pair of their semi-detached houses ready for occupation. A third firm claims that, on prepared foundations, the frame, walls and roof can be erected in one day by a team of six men and that the total construction time per house can be as little as two weeks. Prices compare advantageously with the more orthodox type of dwelling.

To meet the rapidly increasing demand for industrialised buildings a number of firms have laid down production lines which in some cases are comparable in efficiency with those of the automobile industry. One organisation in the north of England already has three such lines capable of producing a total of 1,000 steel-framed dwellings a year and by the end of the year will have in operation a new factory with an annual output of 6,000 of their 'system' buildings as well as large quantities of components for the building industry in general.

For general utility value and to supply a gaping need this type of dwelling will be in great demand. Constant care must be applied to ensure that good design is always in step with and even ahead of utility.

Steelwork contractors for buildings

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

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

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

- **C** Heavy industrial platework for plant structures, bunkers, hoppers, silos etc
- **D** High rise buildings (offices etc over 15 storeys)
- **E** Large span portals (over 30m)
- **F** Medium/small span portals (up to 30m) and low rise buildings (up to 4 storeys)
- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
- **K** Towers and masts
- **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
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  - **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 & J Stead Ltd	01653 693742			●	●					●	●			●	●		2		Up to £200,000
A C Bacon Engineering Ltd	01953 850611			●	●		●										2		Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●			●		●				●		●			✔	3		Up to £400,000
Access Design & Engineering	01642 245151					●			●	●	●			●	●	✔	2		Up to £4,000,000
Adey Steel	01509 556677				●	●	●	●		●	●			●	●	✔	3	●	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	●	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			●	●	●	●			●	●			●	●	✔	4		Up to £800,000
ASD Westok Ltd	0113 205 5270												●			✔	4		Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	3	●	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 £2,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●				●				●		2		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4		Up to £4,000,000
Builders Beams Ltd	01227 863770				●					●				●	●	✔	2		Up to £1,400,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4	●	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4	●	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●			●	●	✔	4		Up to £6,000,000
Cook Fabrications Ltd	01303 893011				●					●	●			●	●		2		Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	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 £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3	●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●					●	●			●	●		2		Up to £1,400,000
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
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)
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4	○	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
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	●	Up to £3,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2	○	Up to £4,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3		Up to £800,000
Luxtrade Ltd	01902 353182									●	●				●	✔	2		Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4		Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●	●				●	●				●	✔	2		Up to £800,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		2		Up to £1,400,000
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	●	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	○	Up to £2,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4		Up to £1,400,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2		Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
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
Taziker Industrial Ltd	01204 468080									●				●	●	✔	3		Above £6,000,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●			●	●	✔	2		Up to £400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●			●	●	✔	2	○	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●										2		Up to £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✔	4	●	Above £6,000,000*
Underhill Engineering & Building Services Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4		Up to £3,000,000
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		4		Up to £2,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2		Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4		Up to £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●		●	●	●	●	●				●	✔	4		Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●			●		✔	4	○	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)

Corporate Members

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

Company name	Tel
A Lamb Associates Ltd	01772 316278
Balfour Beatty Utility Solutions Ltd	01332 661491
Bluefin Group	020 3040 6723
Griffiths & Armour	0151 236 5656
Highways England Company Ltd	08457 504030
Kier Construction Ltd	01767 640111

Company name	Tel
PTS (TQM) Ltd	01785 250706
Sandberg LLP	020 7565 7000
Structural & Weld Testing Services Ltd	01795 420264
SUM Ltd	0113 242 7390
Welding Quality Management Services Ltd	00 353 87 295 5335

Industry Members

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

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

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
AJN Steelstock Ltd	01638 555500								●		M	
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								●		M	
Behringer Ltd	01296 668259					●						
BW Industries Ltd	01262 400088	●									M	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
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	
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		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, ● = Silver, ● = Member)

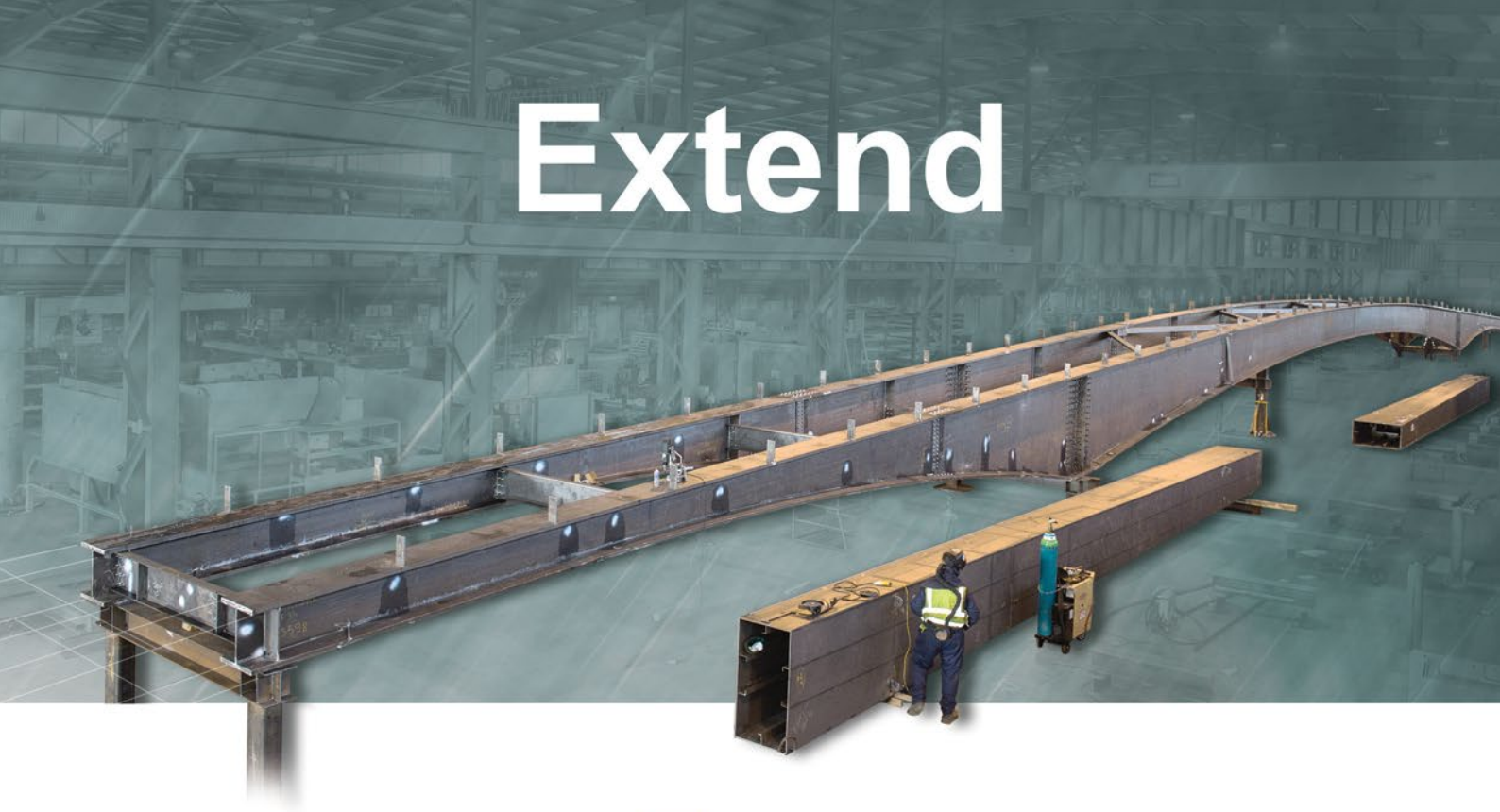
Notes
(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year,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

BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●	●		●				●	✓	3				Up to £400,000
Bourne Construction Engineering Ltd	01202 746666	●	●	●				●	●	✓	4			●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4		✓		Up to £4,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4		✓	●	Up to £3,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4	✓	✓	●	Above £6,000,000*
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3		✓	●	Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3		✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4		✓	●	Up to £3,000,000
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
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4		✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4		✓	●	Above £6,000,000
Taziker Industrial Ltd	01204 468080	●						●	●	✓	3	✓	✓		Above £6,000,000
Underhill Building & Engineering Services Ltd	01752 752483	●	●	●	●			●	●	✓	4				Up to £3,000,000
Non-BCSA member															
Allerton Steel Ltd	01609 774471	●	●	●	●				●	✓	4		✓		Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●		●	●	●	✓	4				Up to £800,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4				Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			●	Up to £800,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	2		✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3				Up to £2,000,000
HS Carlsteel Engineering Ltd	020 8312 1879	●	●					●	●	✓	3		✓		Up to £400,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3		✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500							●	●	✓	N/A				Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4	✓		●	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A				Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●						●	●	✓	3		✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	✓	4			●	Above £6,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M	
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	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
Longs Steel UK Ltd	01724 404040				●						M	
MSW (UK) Ltd	0115 946 2316	●									D/I	
Murray Plate Group Ltd	0161 866 0266								●		D/I	
National Tube Stockholders Ltd	01845 577440								●		D/I	
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A	
PPG 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	●
StruMIS Ltd	01332 545800		●								N/A	
Tata Steel Distribution UK & Ireland	01902 484000								●		D/I	
Tata Steel Ireland Service Centre	028 9266 0747								●		D/I	
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		D/I	
Tata Steel Tubes	01536 402121				●						M	
Tata Steel UK Panels & Profiles	0845 3088330	●									M	
Tekla (UK) Ltd	0113 887 9790		●								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	

Extend



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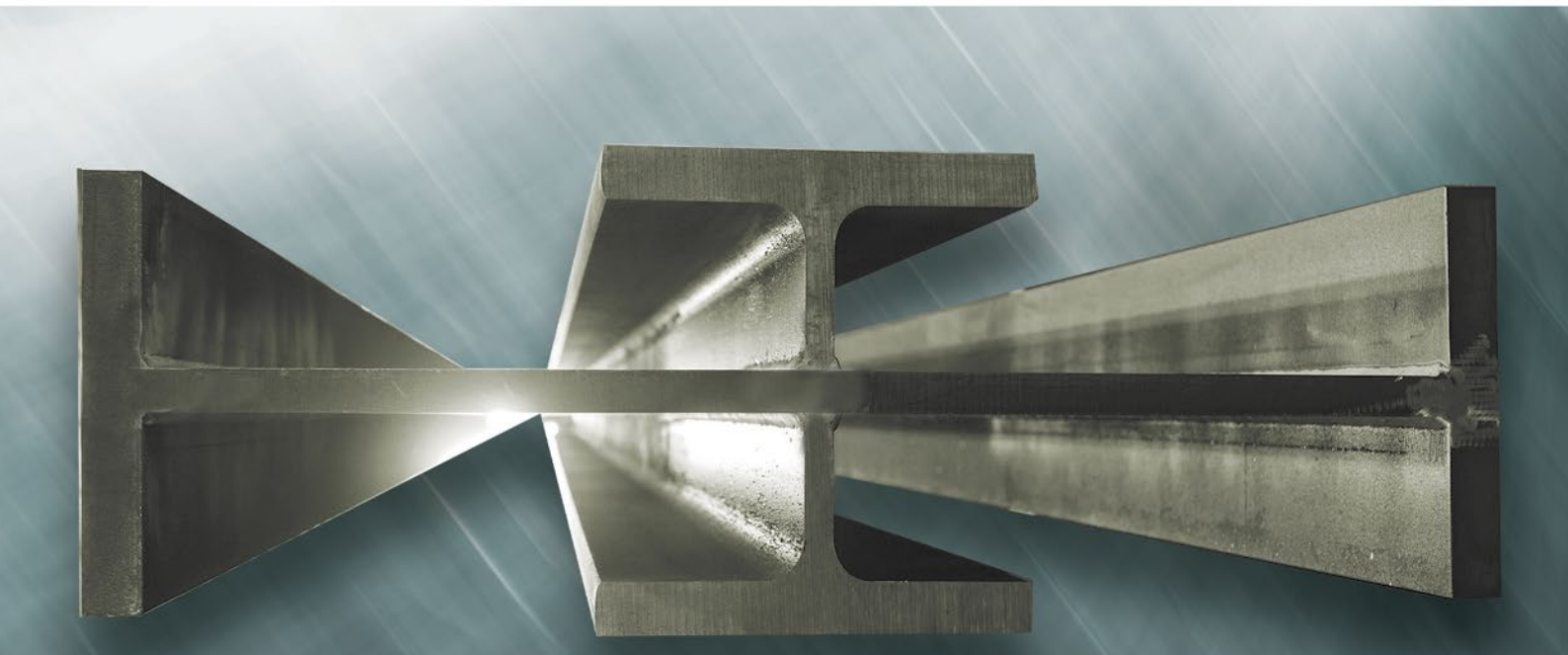

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