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NSC

All square at Kings Cross

October 2015

Vol 23 No 9

Royal Academy for Inverness

Wick Campus wins with steel

Crossrail train factory arrives

Regenerating Beverley

Cover Image
Inverness Royal Academy
Main client:
hub North Scotland
Architect:
JM Architects
Main contractor: Morrison Construction
[part of Galliford Try]
Structural engineer: CH2M Hill
Steelwork contractor: BHC

October 2015 Vol 23 No 9

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Crafting the future

Nick Barrett - Editor

Worries about the looming skills crisis that the construction industry faces are growing, with a forecast need for 100,000 new recruits to satisfy the demands of the National Infrastructure Plan by 2020. That ambitious plan itself will occupy some 250,000 construction workers as well as 150,000 engineers; there will also be growing demand from elsewhere in the industry for key skilled workers as well as construction professionals.

The steel sector has seen a potential skills shortage looming for some years and has already adopted a strategy to ensure that the necessary skills will be available. A key part of that is an industry specific apprenticeship training scheme called CRAFT – Competence Route of Attainment in a Fabrication Trade. The first CRAFT Structural Steelwork Fabricator-Welder Apprenticeship scheme has just reported the success of its first recruit, which you can read about in News this month.

The specialist apprenticeship scheme involves training modules supervised by workplace coaches, with the tests sat by apprentices validated by BCSA registered validators. Apprentices can be assured of being fully and methodically trained in skills that will be in high demand throughout their working lives, as can future employers.

The CRAFT scheme was launched in June 2014 and has already attracted new recruits to the industry. Before its launch there was no apprenticeship scheme that specifically addressed the needs of steel construction. Less than 2% of the workforce of BCSA members were apprentices and most of them were working for the larger steelwork contractors. Training centres that provided courses relevant to the sector, where apprentices would traditionally attend several days a week, were in dwindling supply.

CRAFT was designed to overcome this, allowing new recruits to be trained in the workplace over two years at least, becoming familiar with the systems and equipment that are used in real life work situations. Recruits are carefully selected and both employers and the recruits themselves can establish suitability for the industry.

As CRAFT training takes place in-house, the problem of the decline of external training centres is overcome. Employers get to see the potential workforce of the future in a live operating environment.

Young people are looking hard at their options these days, comparing the value of a university degree with an apprenticeship, and it seems that more than a few are prepared to choose apprenticeship over a degree. Traditionally, the apprenticeship route has been a success for many senior figures in the steel construction sector; some went on to take degrees of course, but all would agree that the base of practical knowledge gained in the workshop often gave them a head start on those with purely academic backgrounds.

Young people may not have been fully aware in the past that the apprenticeship route offered an attractive future, but a lot of work has been done with schools to get the message across. BCSA members regularly visit schools in their areas to spread the message. We are almost certain to hear a lot more about a skills crisis over the coming years but, as CRAFT shows, the sector is taking steps to ensure it doesn't hamper the UK's continuing development of the world's leading steel construction industry.

NSC

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BCSA awards first fabricator-welder certificate

The first British Constructional Steelwork Association (BCSA) CRAFT Structural Steelwork Fabricator-Welder Certificate has been awarded to Billington Structures' Alex Shaw.

Mr Shaw completed the training modules with the assistance of coaches from within his workplace. The monitoring of the training and final confirmation of the different modules' tests was validated by the BCSA Registered Validator, Jon Wright, who is also the Workshop Supervisor and Responsible Welding Coordinator for Billington Structures at its Wombwell facility.

Left to right: Jon Wright, Billington Structures; Alex Shaw, Billington Structures; Peter Walker, BCSA and Darren Kemplay, Billington Structures

BCSA Director of Health, Safety and Training Peter Walker said 'This CRAFT Structural Steelwork Fabricator-Welder Certificate is the first to be awarded, and I am pleased it has been awarded to Alex as he and Jon have been actively involved in the content of the training modules, and their suggestions have contributed to the design, measuring and monitoring of the CRAFT Apprentice Scheme.

"Credit also goes to Darren Kemplay, Billington Structures' Group HR Manager for coordinating the successful liaison between those busy working in a production environment and the BCSA, which enabled the successful piloting of the first CRAFT Structural Steelwork Fabricator-Welder Apprenticeship."

In order to combat a possible skills shortage in the steel construction sector, the BCSA, together with its members, has developed an industry specific apprenticeship training scheme that is called CRAFT (Competence Route of Attainment in a Fabrication Trade).

Grand opening for Grand Central

Birmingham's Grand Central shopping complex, which forms an integral part of the £750M New Street Station redevelopment, has opened its doors.

The complex, which sits above the station's new concourse level, includes one of the UK's largest John Lewis department stores.

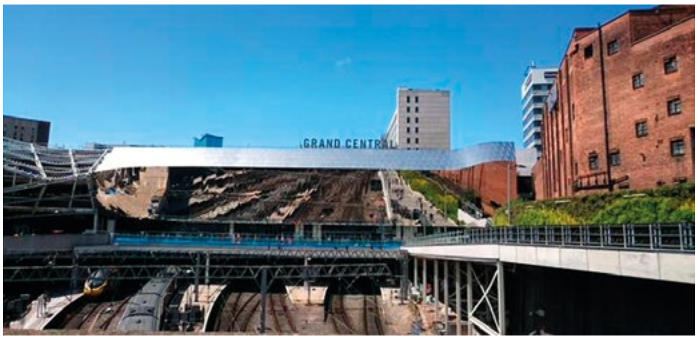
Working on behalf of main contractor Mace, Severfield erected 2,850t of structural steelwork for the four-storey shopping complex project.

Boasting an iconic new atrium over a huge passenger concourse - five times the size of London Euston's - the station opened its doors to the public a few days earlier.

With brighter, de-cluttered platforms, improved entrances, a range of new facilities and an abundance of natural light over the new concourse, Birmingham New Street, one of Britain's busiest interchange stations, is now a retail destination in its own right.

Chief Executive of Network Rail Mark Carne said: "Birmingham New Street sits right at the heart of our rail network and the transformation which has taken place here is nothing short of stunning. The station is now bigger, brighter and better able to meet the needs of the growing number of people who use it each day.

"As Britain's second city, Birmingham deserves a station of this calibre and, along with Grand Central, the investment



we have made will help support the local economy and regenerate large parts of city centre."

Andy Street, Managing Director of John Lewis and chairman of the Greater Birmingham and Solihull Local Enterprise Partnership, said: "The completion of New Street and the opening of Grand Central, including the new John Lewis couldn't come at a better time for Birmingham with employment, GDP, foreign investment, exports and visitor numbers all on the up in the area.

"One of the negatives of the previous station - aside from the appalling first impression it gave to millions of visitors to our city was that New Street effectively divided the city centre."

Swansea University's seafront campus opens

Steel construction has played a major role in the building of Swansea University's Bay Campus which has been officially opened.

Built on the site of a former BP facility, the 65-acre Campus development includes seven steel-framed structures: Engineering Central (pictured), the School of Management, the Great Hall, a Library, Institute of Structural Materials, Innovation Hub and the Energy Safety Research Institute (ESRI),

"Economics, value and flexibility were the reasons for choosing steelwork for our research, teaching and manufacturing facilities," said St. Modwen Construction Project Manager Richard Powell.

"Maximum adaptability is important for these structures as during their lifetime the usages are quite likely to change."

Working on a design and build contract for main contractor Vinci Construction, Caunton Engineering was responsible for fabricating, supplying and erecting five of the buildings which required 1,800t of steel.

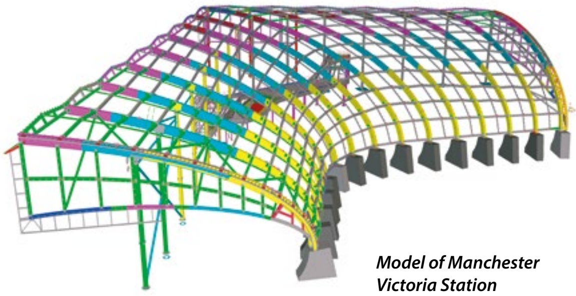
The largest of the buildings and the first to be erected was the 95m long x 87m wide Engineering Central. This three-storey structure is divided in half by a 9.5m wide street, which is glazed at either end and spanned by a tensile fabric roof.

This building will provide laboratory and teaching spaces for industrial and manufacturing research, so the steel frame is based around a regular 9m x 9m grid, which is sufficient to provide the structure with the required classroom sizes.

Steel successes at 2015 UK Tekla Model Competition

Steelwork contractors have won six categories - BIM Project, Engineering, Engineering (Analysis & Design), Steel, Miscellaneous and The People's Choice at the 10th annual UK Tekla Model Awards.

The Tekla Awards focus on projects of all shapes and sizes, which have used Tekla software as part of the process for designing and modelling structures, or where the use of Tekla software has aided collaboration.



Model of Manchester Victoria Station

Tekla Managing Director Andrew Bellerby said: "Once again our model competition has yielded some fabulous projects where the use of 3D modelling software has revolutionised the design, planning and delivery."

Expert judges from the construction industry consisted of Jason Underwood from the University of Salford; Mark Crowe, BIM Academy; Richard Ogden, Build Offsite; Jonathon Lock from AECOM; Rob Jackson at Bond Byron Associates and Greg Cork from AEC magazine.

The steel sector winners were:

- Total BIM projects - Manchester Victoria Station, Severfield
- Steel - Leeds Station, William Hare
- Engineering - The Curve, Caunton Engineering
- Engineering (A&D) - 1 Bond Street, Caunton Engineering
- Miscellaneous - Bloomberg Ramp,
- The People's Choice - Manchester Victoria Station, Severfield

SCI event to reflect on the past and the future for steel construction

Coinciding with its 30th birthday, the Steel Construction Institute (SCI) will be reflecting on the past, and looking at predictions for the future to provide an insight into the shape of steel construction in years to come at this year's Annual Event.

The Event will be held at The Crystal, Victoria Docks in east London on 12 November. To register your attendance email: education@steel-sci.com or Tel: 01344 636525

SCI CEO Graham Couchman will reflect on the rapid rise to dominance of steel construction in the UK since the decision to form an independent organisation (SCI), which was developed to promote the proper and effective use of steel as a constructional material.

He will also highlight some landmark projects and achievements for the sector, and consider how the nature of SCI has evolved over the years.

Mike Walsh of Hatch Consulting will discuss how history tells us that the future for steel is bright. He will talk about how the technologies of steel production have evolved, and what the limitations for steel products are.

Generation of revenue from producing steel, not by selling tonnage, but from differentiation and the provision of good service will also be considered.

Carl Perry of BlueScope will take a global perspective to consider how products and construction processes change to suit different economic and technical drivers.

He will highlight the trend to use less, but higher strength, steel and the other materials it must compete with. By considering different markets we can see how UK products and practice may evolve.

East Anglia's largest potato store built with steel

A steel frame, erected by A C Bacon Engineering, has helped create what is said to be the largest potato store in East Anglia.

The box potato store and grading area is located at Sutton Gault, near Ely and is owned by P J Lee & Sons.

Built on the site of a former machinery storage area, the state-of-the-art building was delivered on time and on budget by a team led by main contractor Thurlow Nunn Standen, with A C Bacon providing the steelwork, cladding and access doors.

Insulation and ventilation are key to maintaining cool temperatures which are needed during the crop storage season.

The building can be segregated into eight storage areas, each with the ability to maintain its own climate requirements. The introduction of a 250kW solar photo-voltaic system on the roof also contributes, not only to the running of the store, but also the whole site during peak production.

Twenty four lights in the 26m x 58m central grading area ensure effective grading of crop. The grading area can be converted into another storage area for a further 2040 boxes after grading has completed.

A set of 24m wide 'hangar' doors provide safe, efficient, unhindered access to the central hub from which all of the eight storage areas can be serviced.

NEWS IN BRIEF

The Met office has announced plans to build a £20M home for the final part of its new supercomputer, which will help with more accurate weather predictions. Located at Exeter Science Park, the computer will be housed in a steel-framed structure designed by architects Stride Treglown along with structural engineer WSP. Willmott Dixon has been appointed as the project's main contractor while the appointment of a steelwork contractor is imminent.

The first phase of the ambitious **Inverness Campus** development has been officially completed with the opening of the new Inverness College. The new steel-framed building, erected by BHC, will act as a focal point for the entire Campus as it is by far the largest single structure in the development. Spread over three-storeys, the building offers more than 20,000m² of teaching and workshop space for some 6,500 students.

The Leadenhall Building **(Cheesegrater)** is the winner of the inaugural City of London Building of the Year award. Working with main contractor Laing O'Rourke, Severfield fabricated, supplied and erected 18,000t of structural steelwork for the project. Two of the other shortlisted projects were also steel-framed jobs, 8–10 Moorgate (Severfield) and 6 Bevis Marks (William Hare).

The new **Voortman** V505-160T punching and shearing machine has been designed specifically for the steel fabrication sector and is said to offer high-speed processing and less wastage. The time required to complete a full production cycle is shortened by up to 25% in comparison to equivalent punching and shearing machines according to Voortman.

Ground works are under way for two speculative steel-framed warehouses at the £400M **iPort** development in Doncaster, South Yorkshire. iPort is a Strategic Rail Freight Interchange (SRFI) which will deliver over 570,000m² of Grade A logistics warehousing. All units will be linked with a high-specification rail freight intermodal container facility providing rail freight services with continental gauge clearance to all major UK ports and the Channel Tunnel.

AROUND THE PRESS

Building Magazine
30 September 2015
Work starts on regeneration of old municipal market building in city centre
[Brighton] – According to Cathedral - part of Development Securities - all steel will be re-used and all hard core and concrete will be kept on site to be used on the construction of the new Circus Street development. Any waste will go to a transfer station for further sorting.

Construction News
25 September 2015
Streetwise design on uber-modern school
[Levenmouth Academy] – The steel and precast solution was favoured due to its cost, its ability to meet client and architect's aspirations, being straightforward to build, and its capacity to accommodate building services and future alterations.

Platform Architecture and Design
21 September 2015
Bullet from a shooting star
[Greenwich sculpture] – A Bullet from a Shooting Star comprises 450 pieces of steel and 900 engineered connection points, all constructed from a combined length of 1186 metres of steel weighing 15 tons. The project is a marvellous feat of engineering made possible in partnership with specialist fabricators and engineers.

Construction News
11 September 2015
Kier faces bikes and bases on park job
[Princes Gate, Catterick] – Steel contractor Killelea began to put up steel frames for the 26 retail units on the site, at which point the hard surface of the car park came into play. "We had a level site which allowed large deliveries of steel to be installed efficiently," says Kier Construction Contracts Manager Stuart Leslie.

The Structural Engineer
August 2015
Conservation compendium
The turn of the 20th century saw a significant change in the construction of buildings, with the introduction of structural steel frames to support the floors and restrain the elevations of major buildings in cities throughout the UK. Early examples in London include Greycoat House in Victoria and Selfridges department store circa 1902-09, while Regent Street, reconstructed in its entirety in the 1920s, is one of the largest areas to use steel frames in this form.

Work begins on Reading Ikea store

Home furnishing retailer IKEA has officially marked the start of construction of its new Reading store.

The first to be built in the UK in seven years, the new store will bring the IKEA product range to the doorsteps of customers in the Thames Valley.

The leader of the West Berkshire Council, Cllr Gordon Lundie, joined IKEA Reading Store Manager, Johanna Heuren and IKEA UK Country Retail Manager, Gillian Drakeford, (all pictured) to ceremonially cement a steel column at the entrance of the new store, which will welcome thousands of customers when it opens in Summer 2016.

The 32,000m² steel-framed store on Pincents Lane, Calcot, will bring 350 job opportunities. Walter Watson will ultimately erect 3,500t of structural steelwork for the project that also includes a three-storey car park.

Johanna Heuren, IKEA Reading Store Manager, said: "We are delighted to officially kick-off the development of the new IKEA Reading store. Over the coming months we will be focused on finding passionate and curious co-workers to join our team and getting to know the local area better to ensure that IKEA meets the needs of both our customers and our community."

Gillian Drakeford, IKEA UK Country Retail Manager, said: "As the first new store to be built in the UK in seven years, the start of work on the IKEA Reading store is a really important milestone for our expansion plans as we look to make IKEA more accessible to many more people."

When it opens, IKEA Reading will be the 19th traditional IKEA store in the UK. The first store was opened in Warrington in 1987.

Designs announced for Liverpool Statue of Liberty

A prominent Liverpool architect has designed the city's very own version of The Statue of Liberty, to be known as the 'Homecoming'.

The steel-framed structure will comprise a 23-storey high building, perched on a five-storey nest, 100m in diameter and located on the River Mersey near Liverpool city centre.

David Backhouse, who designed the award-winning Cavern Walks and the Cavern Club in Liverpool, as well as The Gardens in Manchester said he has now turned his expertise into giving Liverpool that one stand-out building that sets it apart from the rest of the world.

Homecoming - The Statue of Liverpool takes the form of the iconic Liver Bird, standing 100m tall and nesting at the entrance to Liverpool in the River Mersey. It will be fully self-sustainable with zero energy costs as power will be provided through wind turbines within the 'wings' of the structure and tidal turbines underneath the 'nest'. The golden bird will also be covered in diamond-shaped photovoltaic cells converting solar power into energy.

The building will house an atrium on every floor and will be able to accommodate a variety of activities, ranging from a luxury hotel and apartment complex to specialised shopping outlets and creative spaces.

A split-level restaurant will be located behind the Liver Bird's eyes, offering a panoramic view of Liverpool, similar to that of the Statue of Liberty in New York or the Oriental Peal Tower in Shanghai. Numerous leisure activities including a Genealogy museum linked to New York's Ellis Island are also planned.

Architect David Backhouse said: "This is the culmination of an idea we had nearly 30 years ago now. The concept has never been

far from my thoughts throughout my years of working on many prestigious Liverpool-based projects. I'm so pleased now to finally present the idea to both the city, and the world!" His team believe that the project will become another great Liverpool landmark and a huge tourist attraction, set just downstream from the world famous 'Three Graces'.

Preparation tanks installed at Scottish Galvanizers

Scottish Galvanizers (part of the Wedge Group) has installed what are said to be some of the largest steel preparation tanks in the UK as part of a major investment at its Glasgow premises.

In order to streamline its operations, the company has invested £500,000 in the installation of two large acid pickling tanks to replace four smaller units.

The new tanks, measuring 22m long, are designed to make the preparation of steel sections easier by being able to accept larger members.

The preparation process, which removes rust, impurities and stains, allows the hot-dip galvanizing process to be undertaken.

Scottish Galvanizers Customer Services Manager Paul Tait said: "The new tanks are a fantastic addition to the facilities we already have, and will help us further speed up processes, as well as provide capacity to take on even more projects.

"As a result of this positive business growth and major investment, we're better placed for future growth and expansion, and have the facilities to cater for increasing customer demands."

Fabrication shop expansion for Hambleton Steel

Hambleton Steel says it has increased fabrication efficiency and streamlined material flow after installing a new Voortman integrated process line at its main Rotherham fabrication facility.

Utilising an area in the factory with a lower floor level and formerly used for painting and dispatch, the installation required Hambleton to erect a new 2m-high steel floor covering 1,500m².

"The new steel frame was fabricated in-house and is supported off the existing slab providing continuity to the main shop floor," said Hambleton Steel Operations Director Mike Dixon.

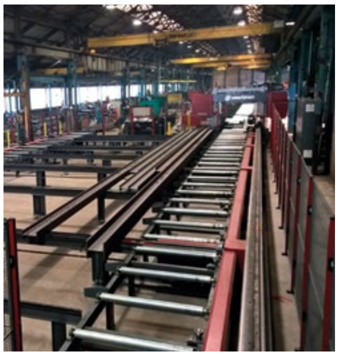
The new steelwork consists of 2m-high stub columns and UB beams that are decked with SMD R51 metal flooring and a 200mm thick slab.

The Voortman integrated process line consists of a VSB1500/4 shot blaster, a V630 multi axis drilling and scribing unit and a VB1050 band saw.

All of the machines are in a split system that is linked with fully automated rollers and cross transfer systems allowing multifunctional use.

"By rejigging our factory and installing the new machines we've increased our sawing and drilling efficiency by up to 40% and decreased our crane handling of steelwork by 50%," said Mr Dixon.

In addition to the blast/drill/saw line, the company has also procured a V550/6 punch/drilling shearing machine to process flats and angles.



Academy opening heralds Consett regeneration

Durham County Council's £44M regeneration project in Consett has reached a major milestone with the opening of the Consett Academy.

Providing a new home to 1,700 students, the new campus offers students modern and state-of-the-art facilities, and access to a range of shared use leisure facilities.

The Academy adjoins the new Consett Leisure Centre that opened last month. The Centre comprises two swimming pools, studio spaces, a fitness suite and three squash courts.

The Academy and Leisure Centre are two distinct facilities, but both are part of one large steel-framed structure, measuring more than 120m x 32m.

Both have their own main entrances at either end of the building, while internally the Academy and Leisure Centre are separated by secure lockdown doors, allowing them to either operate independently or as one large centre during academic sports times.

This dividing line which splits the steel frame in half was also chosen as the best point to locate an integral expansion joint that was needed as the frame is so long.

Working on behalf of main contractor Carillion, Harry Marsh [Engineers] erected 900t of structural steelwork for the project.

Steel makeover for Bracknell town centre begins

Construction is under way on a new retail quarter for Bracknell town centre, which has been designed by BDP for Bracknell Regeneration Partnership, a joint venture between Legal & General and Schroders along with Bracknell Forest Council.

Known as The Lexicon, the scheme is a shopping and leisure destination that promises a vibrant mix of brands and experiences, and a high quality mix of shops and leisure venues connected in a pedestrian-friendly environment.

BDP is lead consultant, architect and lighting designer for the six blocks that constitute the Northern Retail Quarter, while main contractor is Mace and Severfield is the steelwork contractor.

A spokesperson for BDP said five of the blocks are steel-framed and the material was chosen for its long span qualities and speed of construction.

The steel blocks consist of two department stores (Marks and Spencer, and Fenwicks), and three other retail units one of which incorporates a 10-screen cinema.

The project has been developed utilising a rich warm palette of materials including brick, timber, feature perforated aluminium, coloured glazing, gold/silver coloured copper cladding and green walls along with elegant street covers and canopies. A key concept for the scheme design has been 'the greening of Bracknell' to transform the character of the town.

The Lexicon is due to open in spring 2017. BDP has already completed a Waitrose supermarket in 2011, which forms one of the anchors for the scheme. Billington Structures erected the steel for the Waitrose store.

Diary

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

Tuesday 13 October 2015
Latest Developments in Composite Beam Design
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview on the latest developments of Composite Beam Design.

Wednesday 14 & Thursday 15 October 2015
Essential Steelwork Design
This course introduces the concepts and principles of steel building design to EC3.
Bristol

Tuesday 3 November 2015
Steel Building Design to EC3
This course will introduce experienced Steel designers to the Eurocode provisions for steel design.
Watford

Steel puts Crossrail rolling stock on track

Having secured a contract to manufacture trains for London's Crossrail, Bombardier is constructing a new steel-framed train inspection building.

FACT FILE
V-Shop Bombardier Depot, Derby
Main client: Bombardier
Architect: CPMG
Main contractor: Balfour Beatty
Structural engineer: Scott Hughes Design
Steelwork contractor: Border Steelwork Structures
Steel tonnage: 305t

The UK rail industry received a major boost last year when it was announced that Bombardier had been awarded the multi-million pound contract to manufacture 66 new trains for the prestigious Crossrail project [see box].

All of this rolling stock will be produced at the company's Derby facility where Bombardier is currently readying itself for the onset in 2016 of this major contract.

As part of the manufacturing process, all of the trains will be rigorously tested in a brand new 10,400m² Inspection and Showroom Building known as the V-shop.

Measuring 250m long × 40m wide, accommodating four separate railway tracks, this steel-framed structure is currently being built by a team led by main contractor Balfour Beatty.

Works including the construction of the four multi-functional train lines, each with full length overhead lines and inspection pits, and the connection into the existing test track also falls within Balfour Beatty's contractual remit.

On the design of the building, CPMG Senior Architect Martin Ford says: "The building has been designed around the specific needs of Bombardier as it has to accommodate four lines of 10 carriages."

In order to construct a building around these requirements, a twin-portal was deemed to be the best choice.

"Steelwork was then chosen primarily for its speed and efficiency," he adds. "As well as its simplicity in constructing these types of large sheds."

The new building is located on a brownfield site within the large Derby train manufacturing yard. Over the years, the land has played host to workshops, a railway turntable and most recently a staff car park.

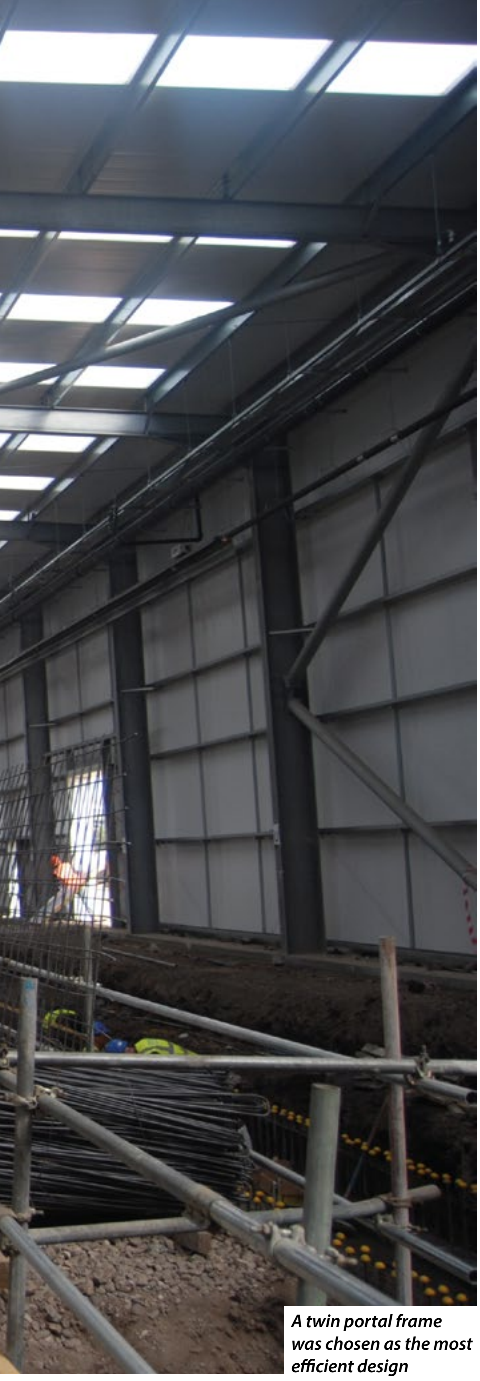
One of the first tasks Balfour Beatty had to do on site was to rip up the old foundations in order to prepare the ground for the installation of piles and then the steel frame.

"There is a lot of made-ground of varying depths on this site and so a ground improvement programme involving compaction was undertaken," explains Scott Hughes Design Director Colin Riches.

Pad foundations were then installed to a maximum depth of only 1.6m, much shallower than would have been required if the ground had not been improved.

As structural steelwork was always the material of choice for this job, Mr Riches adds that no other framing solution could afford the building's required 20m clear spans, while spreading the loads efficiently.

Once the project's architect and



A twin portal frame was chosen as the most efficient design

The structure houses four rail lines

structural engineer had completed an initial design for the client and main contractor, the steelwork part of the job was then handed over to Border Steelwork Structures (BSS).

BSS then refined the steelwork design by repositioning some vertical bracing and designing the frame's connections.

As well as designing, fabricating, supplying and erecting the steelwork, BSS have also installed all of the roof and wall cladding for the building.

Using a variety of mobile cranes and MEWPs, BSS phased the steel erection programme into three parts.

"Due to the length of the building, splitting the erection sequence into thirds allowed the follow-on trades to get started sooner," explains BSS Senior Contracts Manager Stuart Airey.

The follow-on trades working behind the steel erection gang included the excavation of four inspection pits that run the length of the structure beneath the rail lines. This work followed the steel erection as it would have hindered and limited the amount of space where BSS could have put its cranes and MEWPs.

The cladding team following on immediately behind the steel erection meant the excavation work for the inspection pits was mostly done in a watertight environment, which in turn negated the possibility of the trenches flooding in the event of rain.

All steel columns are spaced at 8.3m centres as this was decided as the most efficient grid pattern and one where cladding panels would not have to be too large.

Each of the portal spans is formed with two 12m-long rafters that were bolted together on the ground and lifted into place as one complete 24m-long roof section.

The south west corner of the building has an attached two-level office block that measures 24m-long × 9m wide.

The ground floor will accommodate staff canteen, toilets and changing facilities, while the upper floor will have offices and a boardroom with a viewing platform overlooking the workshop.

'The two rail lines and trenches closest to the office block and the viewing area will serve as sales and inspection pits, where the completed trains will be presented and viewed by Crossrail representatives," explains Mr Ford.

"The viewing platforms serve a useful purpose while being the visual connection between offices and workshop."

Meanwhile the other rail lines and their inspection pits will serve as testing areas for the trains' electrics and as areas for the painting work to be finished off.

The V-shop is scheduled to be completed in April 2016.

Crossrail trains

Rail technology leader Bombardier Transportation has signed a contract with Transport for London for the provision of 66 new trains for the flagship London Crossrail project.
The new trains, to be built at Bombardier's Derby site, will support 840 UK manufacturing jobs including 80 apprenticeships.

The state-of-the-art Aventra trains for Crossrail will be over 200m in length and will be able to carry up to 1,500 passengers. Key features of the new high-capacity trains include air-conditioning and interconnecting walk-through carriages.

On-train passenger information systems will deliver real-time travel information to allow passengers to plan their onward journeys. The trains have been designed with an emphasis on energy-efficiency and the use of intelligent on-train energy management systems.

The corner cantilever is hung from the rooftop

FACT FILE
One New Street Square, London
Main client: Land Securities
Architect: Robin Partington & Partners
Main contractor: Skanska
Structural engineer: Waterman Group
Steelwork contractor: Severfield
Steel tonnage: 4,000t

Hanging cantilever

A 17-storey cantilevering section of the building is hung from a large rooftop girder to create a column-free entrance area for a City of London office scheme. Martin Cooper reports.

The construction of London commercial schemes seems to be continually in full-swing with a raft of developments forever changing the capital's skyline. During the last five or six years, while the majority of the UK suffered a severe slowdown in major building schemes, the City of London has remained buoyant.

One of a number of City schemes currently under construction is One New Street Square, located just north of London's former newspaper hub of Fleet Street, and a stone's throw from the new Crossrail station at Farringdon.

Occupying a tight plot bounded on three sides by roads, the scheme consists of what appears to be on plan two interlinked wedge-shaped structures rising to 12 and 16 floors respectively.

Inclined roofs, sloping in opposite directions and accommodating plant areas, top both wedges.

However, in reality there is no structural split and the floorplates are continuous across the entire footprint up to floor 11, after which the floorplates reduce with terraces up to level 12. Thereafter one half of the building rises to structure's maximum height.

"The flat iron plan forms were generated by the alignment of the lateral assessment area of the Primrose Hill viewing corridor towards St. Paul's Cathedral, and the site's dramatic position within the local townscape, in particular its appearance from Ludgate Circus, Temple Gardens and adjacent streets," explains Robin Partington & Partners Architect Niall Monaghan.

Aside from one ground floor retail unit, the scheme will offer more than 20,000m² of prime City office space.

The building's main entrance will be on its southeastern corner along Shoe Lane. This part of the scheme features the standout element of the development as a 14-storey high cantilever ensures there are no perimeter columns obstructing the entrance.

To accommodate this feature the entire corner of the building's steel frame is supported by a hanging column suspended from the underside of floor 15 down to first floor level.

"This proved a challenge as the first to 14th floors had to be erected prior to the installation of the transfer girder at 15th floor level which supports the cantilever," explains Severfield Contracts Manager Martin Clyne.

"We worked closely with Waterman and Skanska to develop the hanger detail as this was a critical area on the project."

A number of design workshops were convened to focus on this important detail, before a compound plate girder was decided on as the best option.

This plate girder was fabricated, and will be delivered to site this month (October), as five individual sections. Once on site, these members will be craned into position and bolted together in the final rooftop position to form one 20m-long 37.5t girder.

As there is no permanent column from ground floor to first floor at this corner of the structure, an additional transfer system had to be developed to temporarily prop 14 floors of cantilevering structure.

"We had to design and install a

The transfer grillage will remain in situ until the steel frame is complete

temporary column with a jacking system to support the 14 floors until the hanging column was finally connected at floor 15 to the plate girder," adds Mr Clyne

As there are no foundations under the temporary column, a ground floor transfer grillage was fabricated and installed to support the temporary column and transfer the loads back into the adjacent basement foundations.

The grillage weighs 21.5t and measures 11.7m long by 1.9m wide and 3m high. It was fabricated and delivered to site as one assembly and lifted into position by one of the site's three tower cranes. This operation was carried out on a Saturday to minimise disruption to traffic and operations on site.

The remainder of the steel frame is a fairly typical commercial structure featuring Fabsec cellular beams throughout to accept all of the building's services. Perimeter columns are spaced at 12m centres, aligned with a 1.5m space planning grid, while internally the spans to the centrally positioned core are up to 13.5m long.

The vast majority of the steel frame begins at ground floor level, with the perimeter columns supported by the site's retaining wall.

However there are eight internal steel columns that punch through the ground floor and are founded on the two-level deep basement's lowest slab. These steel members are located within the lower 12-storey high part of the building and are necessary as this area has one zone that extends northwards either side of a party wall.

The perimeter columns here are too far from the core to accommodate one column-free span, so intermediate members had to be designed into the overall structural design. There is no ground level retaining wall to support these columns, which are located within the floorplates, so they had to extend down to the basement.

Summing up, Mr Monaghan says: "Both concrete and steel primary frame options were considered, however, to minimise foundation loads and given the long spans required, a steel frame solution with composite metal deck slab and composite steel beams with integrated services was considered most suitable."

One New Street Square is due to be completed in June 2016.

The upper office floors provide views across the City

Site works

The plot of One New Street Square was previously occupied by two buildings, one an office block, the other the International Press Centre. Both were demolished under a separate contract prior to Skanska starting on site late in 2014.

"Our initial task was to dig out the two-level basement, which required underpinning, propping the entire site and installing a new retaining wall," says Skanska Project Director Tim Halford. "Approximately 400t of steelwork was used for the extensive propping system."

The concrete works that form the two subterranean levels and the core were then completed prior to the steel erection programme kicking off.

Because the site is so confined, Skanska decided that scheduling the major trades one after the other was the best option so as not to have too many workers on site at any one time. This tactic also ensured the tower cranes could be used pretty much all the time by the concrete contractor and then by steelwork contractor Severfield.

As the site has three tower cranes, Severfield used two for the erection process, while the third and largest tower with a 32t lifting capacity was used primarily to unload deliveries from trucks parked in the project's pit lane located along Shoe Lane.

"Working in this way Severfield has been able to erect the steel as planned on a just-in-time basis and with no road closures," says Mr Halford.

The project team has had to overcome challenges associated with the site's confined plot

Steel school provides community resource

A multi-million pound project in Wick will deliver first-class educational and community facilities, all housed within two steel-framed structures. Martin Cooper reports.

FACT FILE
Wick Community Campus
Main client: hub North Scotland
Architect: Ryder Architecture
Main contractor: Morrison Construction [part of Galliford Try]
Structural engineer: BuroHappold Engineering
Steelwork contractor: BHC
Steel tonnage: 1,230t

Replacing three existing schools (one secondary and two primary) in one of Scotland's most northerly towns, the £48M Wick Community Campus is set to deliver educational and sports facilities fit for the 21st Century for pupils and the local populace alike.

Due to open in the autumn of 2016, the campus will feature classrooms, staff rooms, offices, a sports hall, a library, swimming pool and a fitness suite alongside three outdoor sports pitches that complete the scheme.

hub North Scotland Chief Executive Angus Macfarlane says his organisation is committed to delivering a first class facility that will be an integral part of the Wick community for generations to come.

The project is divided into two structures, one solely for pupils and other a shared pupil and community space.

The main school structure's design is based around a three-fingered teaching block (two for the secondary pupils and one for the primary school) all interconnected at one end by a 120m-long circulation 'street' block that also connects into a sports hall.

The adjacent pupil/community building houses the shared facilities consisting of a swimming pool, library and fitness suite.

Both of these large buildings have been built with structural steelwork, with the team citing a number of reasons for this design choice.

"The location and logistics played a key role in choosing steel for this project. All materials have to arrive via a long road journey and steel is easily transported," says hub North Scotland Project Director Ian Leslie.

"In an area prone to strong winds it was also important to choose a material that is quick to erect as there is usually only a very short window of good weather."

As well as suiting the location, a steel design offered further benefits to the overall scheme, which includes a couple of areas (the pool and sports hall) with long spans that are much easier to construct with steel.

A steel frame is also lighter than a concrete frame, which meant shallower foundations were needed, which in turn made the scheme more economic.

Construction work began in September 2014 on the previously greenfield site, which is close to Wick High School – one of the schools that will decamp into the new building.

"One of the first tasks we completed onsite, alongside installing the pad foundations, was constructing the school's tarmac car park," says Morrison Construction Project Manager Craig Struthers.

"This gave us a hard surface on which to place our accommodation units, while at the same time we laid gravel around the site for access and pedestrian routes, all of which has helped us maintain a clean and dry site throughout the programme."

Programming and design work dictated that steelwork contractor BHC began its steel erection programme with the teaching blocks. More design work was required with the more complex pool/library structure and Morrison Construction also wanted the pool

The steel frame erection programme gets under way

Wick wins International competition

Wick Community Campus recently claimed gold in the 'Best Education Project' category at the 2015 Partnerships Awards.

Recognising the best in public private partnerships (PPP), the Partnerships Awards are now in their 17th year and reward companies for working on new projects as well as on operational schemes.

hub North Scotland Chief Executive Angus Macfarlane said: "We are delighted to have received this recognition from the Partnerships Awards, which is a tremendous endorsement for the team responsible for delivering the Wick Community Campus for local residents. It is not only a reflection on the quality of the project, but also underlines the benefits and strength of the hub model – which has partnership at its core."

"The location and logistics played a key role in choosing steel for this project. All materials have to arrive via a long road journey and steel is easily transported."

to be dug out prior to the steel frame being erected.

Using two mobile cranes, BHC erected steel for the main two-storey teaching block in approximately three months. This work also included installing precast slabs and lift shafts, and stairs.

Steelwork for the teaching blocks and the connecting 'street' is based around perimeter columns predominantly spaced at 8.1m centres. Bracing for the school teaching blocks is mostly located in stairwells and lift shafts, instead of the classroom partitions, which means these walls could easily be removed in the future to create larger spaces if necessary.

Although the majority of the 'street' is two-storey, accommodating staff rooms and offices on the upper level, there are some double height spaces for circulation routes and dining areas.

Both of the two-storey teaching finger blocks for the secondary pupils are 72m-long, while the primary block is slightly longer at 113m.

"The last 30m of this block is single-storey," explains BuroHappold Engineer Kathleen Higgins. "There is a large outcrop of rock in this area so a retaining wall replaces the lower level of the structure which negated a lot of excavation work."

As well as the sports hall, which has maximum spans of 19m, the other area of the project with this kind of steel usage is in the separate school/community block.

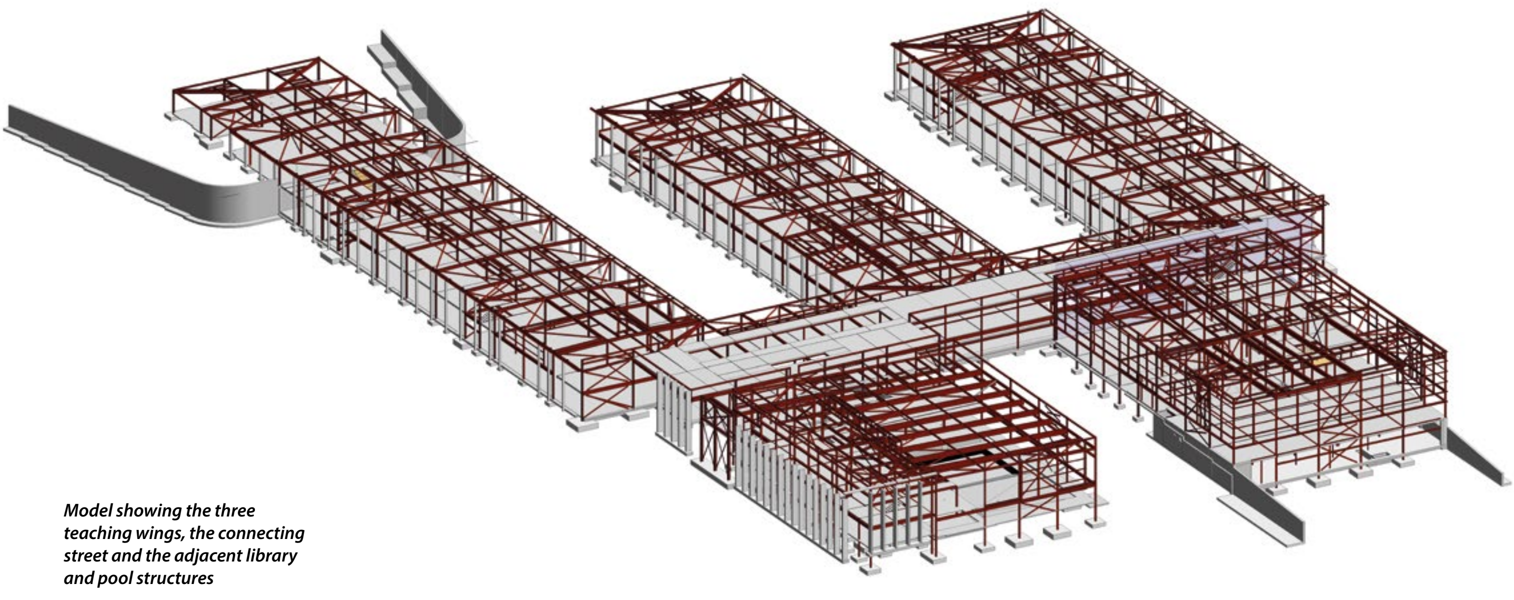
This structure, separated from the school by a distance of 5m, has a two-storey element housing the library on both floors, and a fitness suite situated on the upper level above a ground floor plant area.

Adjacent to this area, the steel braced structure accommodates a large 25m wide double height space for the swimming pool.

As with the sports hall, BHC installed deep spliced UB sections for these long span roof areas. This made the steel members transportable for their long journey from BHC's central belt fabrication yard.

One of the teaching wings incorporates a retaining wall

A clean and dry site has been maintained throughout the project by Galliford Try



Model showing the three teaching wings, the connecting street and the adjacent library and pool structures

The steel frame will house two sports halls

Steel supports sporting facilities

Utilising steel construction is providing Inverness Royal Academy with its desired indoor sporting facilities.

FACT FILE
Inverness Royal Academy
Main client: hub North Scotland
Architect: JM Architects
Main contractor: Morrison Construction [part of Galliford Try]
Structural engineer: CH2M Hill
Steelwork contractor: BHC
Steel tonnage: 240t

Two games halls housed within a 50m-long steel-framed braced structure will provide the indoor sporting facilities for the new Inverness Royal Academy that is currently under construction on a site adjacent to the existing school.

The steel structure will also house changing rooms, a dance studio and a gymnasium, with the majority of these facilities also open to the local community once the project is completed.

"Steelwork was chosen for this part of the project because it provided the most economical way of forming the hall's 19m-long spans," says Morrison Construction Senior Project Manager Finlay Black.

Separating the halls is a 2m wide zone that will accommodate storage areas and a plant zone. Either side of this area and around the two hall's perimeters, the columns, supporting the two rows of roof rafters, are spaced at 3.5m centres.

The sports halls adjoin the main concrete teaching block of the school and there will be direct access between the two, however the steel-framed sports building is an independent structure.

"There is an 18mm cavity between the two structures' columns," says Mr Black. "This won't be visible once the cladding is installed and the two will then look like one building."

The part of the steel frame that is closest to the teaching block accommodates a mezzanine level. The ground floor has interconnecting doors between the sports area and the teaching block, as well as changing rooms. Above on the first floor there will be a gym and a dance studio.

Steelwork for the project was fabricated, supplied and erected by BHC. Once the steelwork was delivered to site, the company used a variety of MEWPs and one mobile crane for the erection programme.

The steel erection programme started later than the main concrete works as it is quicker material to erect. In order to allow the concrete works on the main teaching block to be completed unhindered, BHC started erecting the steel frame from the furthest point and then worked its way towards the school building.

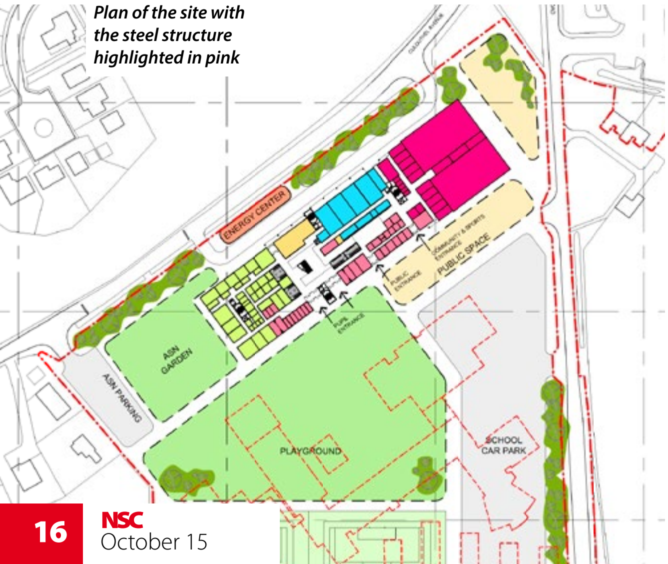
"We had to erect the steel in this direction so as to avoid the temporary works the concrete team had assembled," explains BHC Contract Manager Eddie Brown.

Prior to steelwork erection beginning, Morrison Construction had already cast the sports hall's concrete slab. This allowed BHC to erect the frame from inside its footprint with the MEWPs working off of a smooth and even surface.

The new Inverness Royal Academy will have a pupil capacity of 1,420 pupils; up from 1,153 at its current building, in order accommodate housing growth within the catchment area.

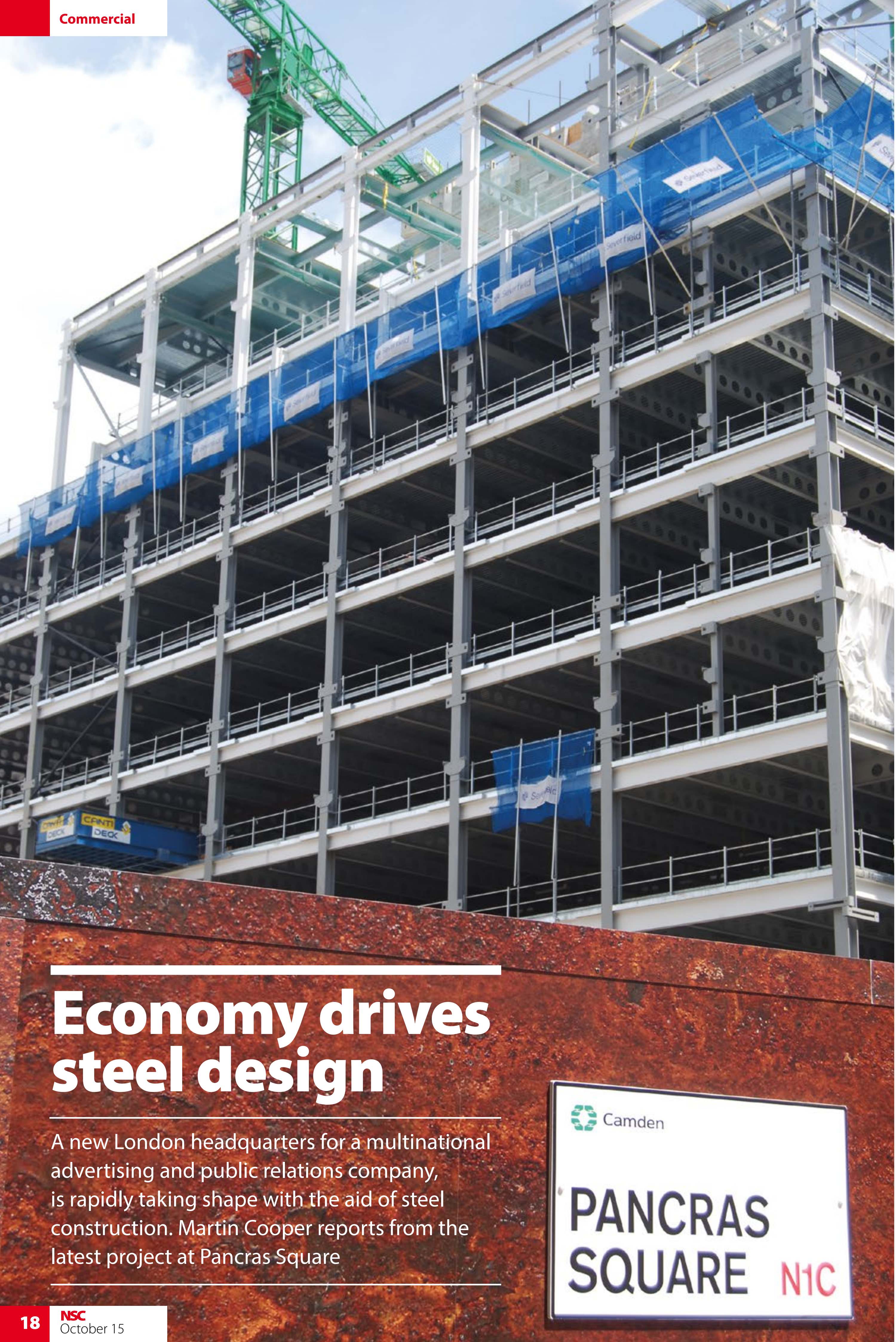
Construction work on the new build is scheduled for completion by next summer, after which the school will decamp into its new facilities in time for the 2016 autumn term.

Morrison Construction will then begin demolishing the old school buildings and turn the area into a new school car park and sports pitches.



Plan of the site with the steel structure highlighted in pink

How the completed Academy will look



Economy drives steel design

A new London headquarters for a multinational advertising and public relations company, is rapidly taking shape with the aid of steel construction. Martin Cooper reports from the latest project at Pancras Square

The future tenant has made design changes which have been easily incorporated into the overall steel design

One of Europe's largest regeneration schemes is radically transforming the once rundown industrial zone north of King's Cross Station into a new and vibrant neighbourhood.

Described as a new piece of London and boasting a brand new postcode, London N1C will eventually include 50 new buildings, 2,000 new homes, 20 new streets and 10 new public squares spread over 67 acres.

One of the initial phases of this huge and ambitious development is Pancras Square. Located between the busy rail terminals of King's Cross and St Pancras International, the scheme will consist of seven retail and commercial buildings positioned around a wedge-shaped public square.

Interestingly Pancras Square's central landscaped realm sits on top of a steel podium deck (see NSC January 2013) that accommodates an underground, shared delivery space for all of the buildings.

Five of Pancras Square's buildings have been completed so far, with the final two - both of which are steel-framed - currently at different stages of construction.

The more advanced of the two is Three Pancras Square, where the steel frame topped out last month (August).

This 11-storey 15,230m² building will offer generous office floor plates of 1,700m² over the 10 upper levels, while the ground floor will house a double height reception area as well as retail units.

"This is a classic steel frame design, with a central stability concrete core and long clear spans radiating out on all four sides," says BAM Design Principal Structural Engineer Naresh Tailor.

"In order to get an economic building with long spans, the structure has been designed with a steel frame utilising cellular beams allowing an integrated services solution on all floors."

According to BAM Construction, the choice of steel as the framing material suited the programme, particularly the installation of the exterior glazing, which is much easier with steel.

Initially the structural design envisaged numerous tenants, possibly one on each floor, within the completed building.

Steelwork contractor Severfield's design team spent a considerable amount of time early in the project coordinating design with BAM Design, in advance of its construction drawings being issued.

This proved to be beneficial even though things changed early in the programme when Havas, the international advertising and public relations company, secured the lease for the entire buildings for its new London headquarters.

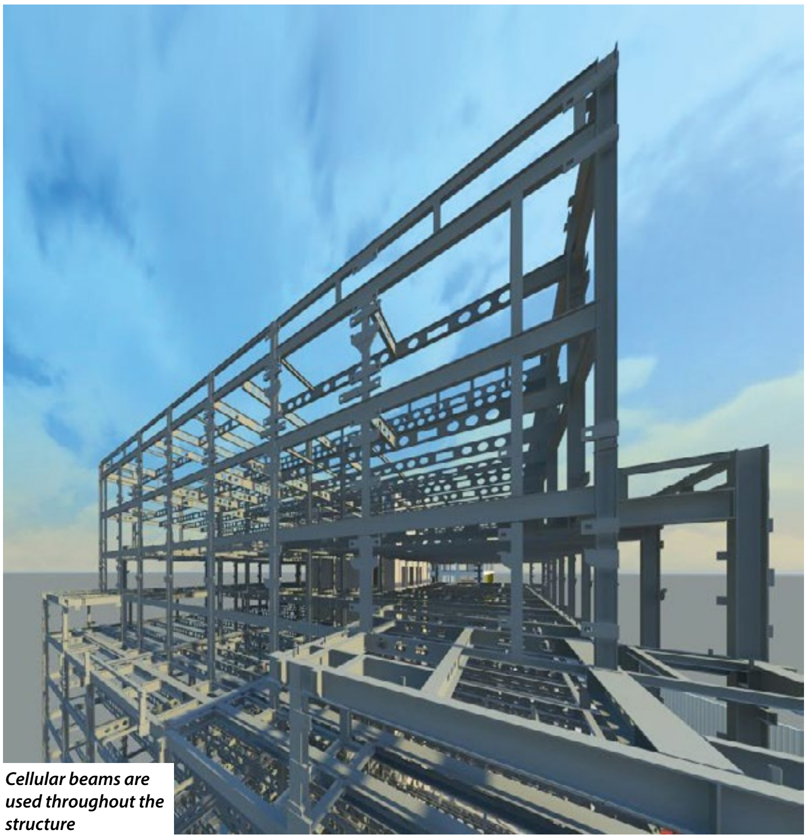
"Havas wanted to change the design and add two atria within the building to allow light to penetrate the inner office space and to allow the installation of a feature staircase leading up from the reception area to tenth floor level," explains BAM Construction Project Manager Geoff Hall.

Here, once again, the choice of steel helped the project team enormously as design changes were easily absorbed into the structural design as steelwork contractor Severfield was still in the early stages of its fabrication programme.

Sitting atop a two-level reinforced concrete basement that connects into the shared podium, the building measures approximately 58m × 36m and it is 46m high to fit into the overall height scheme of the Square.

Steel starts at ground floor level and columns are generally spaced at 6m centres around the perimeter, with splices occurring on every second floor.

Fabsec cellular beams have been used throughout the project and these span up to 13.5m. This creates a near column-free internal space on every office floor. However as the main core is positioned slightly off



Cellular beams are used throughout the structure

FACT FILE
Three Pancras Square, London

Main client:
Argent

Architect:
Porphyrios Associates

Main contractor:
BAM Construction

Structural engineer:
BAM Design

Steelwork contractor:
Severfield

Steel tonnage: 1,900t

centre, there is one row of internal columns spanning the north elevation, as a single beam would have been too deep and heavy to span more than 20m.

The project's beams were also subject to a design change, albeit in the very early stages of the programme.

"We redesigned all of the cellular beams to our own Fabsec design as this offered the best and most economical solution," explains Severfield Project Manager Glen McCleery.

As well as accommodating all of the building's services within their depth, some of the project's cellular beams have to double up as transfer structures.

On floors seven and nine the building steps back to accommodate outdoor terraces and so larger beams were required on these levels.

"On floor seven some of the beams are supporting three floors to create the terraces and on floor nine they are holding up two," explains Mr Tailor. "For this reason, in these areas the cellular beam sizes had to be increased from 600mm deep sections – used throughout the building – to 750mm deep sections."

So as to keep the floor-to-ceiling heights the same on the floors with the deeper Fabsec sections, the slabs have been cast around the flange of the beams instead of on top of the steelwork.

Next door to 3 Pancras Square, one more steel-framed structure has just begun construction

Severfield fabricated these cellular beams with an internal shelf plate, stiffened at nominal centres to accept the metal decking within their depth.

The main concrete core, which accommodates lifts and stairs, is positioned off-centre so a steel-framed secondary core could be added to accommodate toilets. This secondary steel-framed core gets all of its stability from the attached concrete core.

"Because there were a lot of individual steel members in the core we split the erection between the two onsite tower cranes so we could erect the main frame at the same time," explains Mr McCleery.

As the building takes up the majority of the project's footprint there was no room for positioning mobile cranes and so all of the steel erection was carried out via the two onsite tower cranes.

"None of the steel sections could be heavier than 14t in order to not exceed the tower crane's lifting capacity," says Mr Hall. "Even the deeper Fabsec beams have been designed economically and only weigh 11.5t each."

Prior to steelwork erection commencing, the concrete basement, ground floor slab and core had all been completed. The cast slab gave the steelwork erectors a good working surface to put their MEWPs on.

Severfield's steel erection sequence consisted of erecting the first three floors from the ground floor slab. From then on the company erected two floors at a time, using man-riders, working off of the previously installed metal decking surface.

Three Pancras Square is aiming to achieve a BREEAM "Excellent' rating and is scheduled for completion in July 2016.

Cellular beams

Dr Richard Henderson discusses the use of cellular beams at Pancras Square

Cellular beams are a particularly attractive option when integration of services is important to minimise construction depth, in combination with long spans. The regular spacing of large holes allows flexibility in the location of services under the composite floor.

Cellular beams can be engineered to provide a very structurally efficient solution; asymmetric beams may be fabricated from two rolled sections, or cellular beams may be fabricated from plate, allowing both flanges and the web to be chosen to suit the solution. In design terms, a cellular beam is really a Vierendeel truss, so the web posts (the material remaining between holes) are subject to bending moments, as are the top and bottom tees.

In addition to the global bending resistance, several local failure modes must be assessed, including web post bending, buckling and shear. Openings can be arranged asymmetrically within the beam depth, or elongated; these details may require stiffening locally. The presence of openings also affects the serviceability limit state due to the loss of flexural stiffness at the openings and the additional deflection due to Vierendeel bending. The ULS and SLS

verifications can become complex, so the design of cellular beams is best suited to bespoke software, which may also include assessment of the resistance under fire conditions

Although design will undoubtedly be carried out using software, guidance is available in SCI Publication P355 *Design of composite beams with large web openings*. This publication describes the design model for beams with web openings and despite the title, the design model may be applied to non-composite beams. The publication presents guidance in accordance with Eurocodes 3 and 4, and includes a numerical example – although design verification by software is encouraged!

The design of cellular beams is not explicitly covered in the Eurocodes – an early draft was never included in the published documents. This is one technical area which is currently being addressed – it is anticipated that when the Eurocodes are revised in 2019/2020, rules covering the design of cellular beams will be included.

General guidance on structure-services integration may be found in SCI Publication P166 *Design of steel framed buildings for service integration*. This publication presents layouts of ducts and terminal units for Fan coil and VAV air-conditioning systems in various forms of long-span steel construction.

Town centre renaissance

A new shopping and leisure destination takes shape in Beverley

Steel is playing a leading role in the biggest regeneration scheme of its kind in the East Riding of Yorkshire.

FACT FILE
Flemingate, Beverley
Main client: Wykeland Group
Architect: The Harris Partnership
Main contractor: Willmott Dixon
Structural engineer: Curtins
Steelwork contractor: Hambleton Steel
Steel tonnage: 2,000t

The construction of Flemingate, a large mixed-use scheme in Beverley, is said to be the biggest and most important project in the town since its famous Minster was completed in 1420.

The project includes a Debenhams anchor store, a five-screen cinema, a Premier Inn hotel, multi-storey car park and a host of other retail outlets.

Located on the opposite side of the railway tracks to the historic town centre, Flemingate has the potential to invigorate Beverley by creating a new shopping and leisure destination.

Covering an area of 11-acres, the site has a long history of use as it was previously occupied at various times by a tannery, chemical works and a museum.

Overall the scheme consists of six individual blocks of varying sizes and all of them are braced steel-frames with the exception of block G (an 80 room Premier Inn), which has a steel ground floor podium supporting two timber-framed upper floors.

The initial design for the Flemingate development was done by architect The Harris Partnership and structural engineer Curtins.

The structural steelwork was then designed, fabricated, supplied and erected by Hambleton Steel, as part of a specialist design and build contract.

"Using structural steel for the project was the only way to go for buildability and the necessary speed of construction," explains The Harris Partnership Architect Andrew North.

Speed is of the essence for this project as the scheme is due to open at the end of this month (October). Consequently, the steel erection programme started as early as possible with the erection gangs following on immediately behind the piling and foundation workers.

Prior to Willmott Dixon beginning its construction programme, demolition work had already been completed and the site remediated.

"It's a big town centre site and logistics are a significant challenge on this job, as well as coordinating all of the onsite trades," says Willmott Dixon Project Manager Russ Parks. "We also had four entry points to allow materials onto the site to continually feed our five mobile cranes."

The Debenhams anchor store (block C) is the driver for the scheme, so it was the first part of the job to be piled and then have its steel frame erected. This then allowed the client the maximum amount of time to complete its own internal fit-out programme.

The two-level Debenhams store has been constructed around a steel grid pattern of

9m × 5m, which is the same as the other two retail blocks on the scheme (blocks A and E).

Block A was the second to be erected. Incorporating a five-level multi-storey car park and 122m-long outdoor shopping mall, this is by far the largest of the project's structures.

"Approximately half of the project's steel tonnage was needed for block A," says Hambleton Steel Contracts Manager Doug Willis. "If you put all of its steel members end to end they'd stretch 18km!"

The multi-storey car park is based around a large 10m × 16m grid pattern, which incorporates cambered cellular beams and galvanized external steelwork.

Although the attached retail mall's multiple units have been constructed around the same grid pattern as the Debenhams store, these shops are all double height spaces that can incorporate mezzanine levels in the future if the clients so wish.

"Future-proofing the retail units is one

"Future-proofing the retail units is one of the reasons steel was chosen."

of the reasons steel was chosen, as adding mezzanine levels will be an easier task with steel," says Mr Parks.

Steel has also proven to be beneficial on block E, where more than 30% of this structure's retail zones have been subject to design changes requested by the clients.

Hambleton incorporated many of the changes into the steel design, prior to the steelwork arriving onsite, however some have had to be done retrospectively.

"One of these changes has involved us extending block E by an extra couple of bays," says Mr Willis. "While extra steelwork has been added to link this block to the adjacent cinema structure (block B)."

Block B, which is another large braced steel frame, accommodates a six-screen cinema complex situated above a ground floor series of restaurants. This structure was initially going to house five screens, but with some nifty designing, an extra sixth and smaller screen was fitted into the same area.

For acoustic performance reasons all of the cinema seating support columns have been founded on acoustic pads. The internal seating rafters, although designed by Hambleton, were omitted during the steel erection programme.

The rationale behind this decision was that they did not want to obstruct the work of all the follow-on trades, so the seating steelwork was delivered to site and erected by the client's fit-out team towards the end of its programme.

The final structure to be erected was block D, a two-storey office building. This structure was initially designed to accommodate restaurants but the change of use was easily incorporated into the steel design before any of the material reached site.

"The entire internal layout changed," says Mr Willis. "Even though the change was late in the day, we were able to redesign the structure before any of the material was due onsite."

Around 700 new permanent jobs will be created by the Flemingate project, giving the town of Beverley a huge economic boost.

Wykeland Managing Director Dominic Gibbons adds: "The retail element of Flemingate will attract shoppers who might otherwise head for York, Leeds and Meadowhall (Sheffield), while the combination of new restaurants, additional car parking and job creation will enhance Beverley's already excellent reputation as a major shopping and tourist destination."

The five-level multi-storey car park

The Minster overlooks the Flemingate development

Block D, office development

Visualisation of the completed scheme

The two-level Debenhams anchor store

The local effects of beam cranks and long notches

Richard Henderson of the SCI considers the effects of accommodating building services on the shear in beam webs.

Services integration is a necessary activity in the design of most structures. In comfort-cooled office buildings various approaches are adopted, depending on the design strategy that has been adopted for the building services. Cellular beams with frequent circular openings allow the passage of pipework and medium-sized circular ductwork. Lattice trusses provide the opportunity to introduce a rectangular opening at mid-span where the shear force in a uniformly loaded beam is small.

Ductwork from central air-handling plant is largest where it enters a floor, before branches are taken off. Such ducts may be routed next to columns where the bending moments in simply supported beams are lower and allow reductions in the beam depths to be made to allow ducts to pass underneath. The elevations of these beams vary depending on their manufacture: fabricated beams can have varying depths; rolled sections can be notched to produce an extended shallower section.

At the change in the depth of the beam, the bottom flange changes direction or position and the effects of the change on the internal forces in the beam must be dealt with somehow. Two possible approaches immediately present themselves:

- Maintain the continuity of the flange and crank it down to the deeper section;
- Continue the flange to the shallow section horizontally and overlap it with the flange of the deeper section.

The effect on the internal forces in the beam from these two options will be considered.

Cranked bottom flange

At the point where the bottom flange changes direction and the beam starts to get deeper, there is a vertical component of the flange force. At the deeper section where the flange becomes horizontal again, the vertical component is in the opposite direction. The forces on the flanges and web can be simply illustrated by assuming the flanges take all the bending and the web takes all the shear. The forces are shown in Figure 1, below.

It is instructive to substitute some realistic values and examine the shear stresses in the beam. Consider a non-composite primary beam of 9.0 m span supporting 9.0 m span secondary beams at third points. The ultimate load per square metre is 11.7 kPa; the reaction and shear force is 316 kN and the design bending moment is 948 kNm. A 600 mm deep beam is adopted in steel grade S355. The beam is reduced to 300 mm deep over a length of 1.2 m from one end to accommodate a major duct. The depth of the beam is increased to 600 mm over a transition length.

At 1.2 m into the span the bending moment is 40% of the maximum value; at 1.5m it is 50% and at 1.8m 60%. The values are 379 kNm, 474 kNm and 569 kNm respectively. Assuming h_1 = 285 mm and h_2 = 585 mm, the flange forces and shear forces in the web can be calculated. The depth is increased from 300 mm to 600 mm over a length of 600 mm ie a slope of 1 in 2. The results are presented in Table 1.

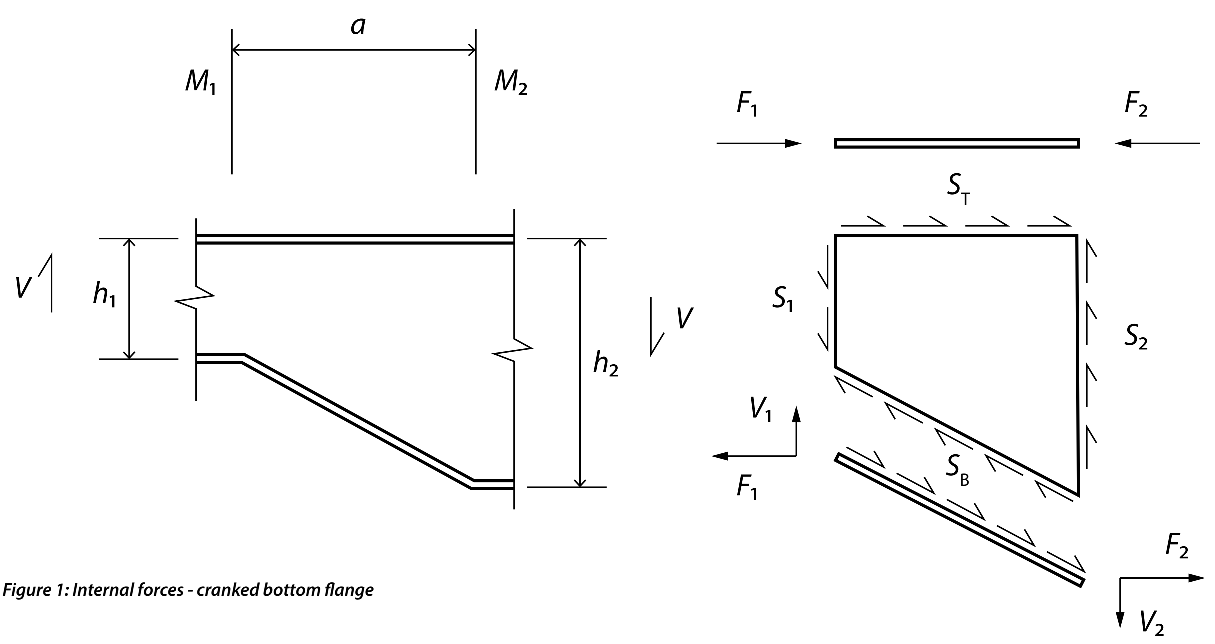


Figure 1: Internal forces - cranked bottom flange

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Parameter		Section 1	Section 2
Spacing (mm)	$a = 600$		
Height (mm)		$h_1 = 285$	$h_2 = 585$
Moment (kNm)		$M_1 = 379$	$M_2 = 569$
Flange force (kN)		$F_1 = 1330$	$F_2 = 972$
Vertical component (kN)		$V_1 = 665$	$V_2 = 486$
Shear force on web (kN)		$S_1 = 349$	$S_2 = 170$
Average shear/mm (kN/mm)		$s_1 = 1.22$	$s_2 = 0.29$
Horizontal shear at top of web (kN)	$S_T = 358$		
Horizontal shear at bottom of web (kN)	$S_B = 400$		

Table 1: 1 in 2 slope

The vertical component of the flange forces results in an average shear force over the web height of 1.22 kN/mm at the shallower section and 0.29 kN/mm at the deeper section. These values compare with 0.54 kN/mm at the deeper section and 1.11 kN/mm at the support. For a 10 mm thick web (at the bottom end of the range for a 600 mm deep rolled section), the approximate average shear stresses on the web are between 29 MPa and 122 MPa respectively. The average shear stress in an unmodified beam would be 54 MPa.

Were the designer to choose to slope the bottom flange down at 45 degrees so the beam depth increases to 600 mm over a length of 300 mm, the values would be as shown in Table 2.

Parameter		Section 1	Section 2
Spacing (mm)	$a = 300$		
Height (mm)		$h_1 = 285$	$h_2 = 585$
Moment (kNm)		$M_1 = 379$	$M_2 = 474$
Flange force (kN)		$F_1 = 1330$	$F_2 = 810$
Vertical component (kN)		$V_1 = 1330$	$V_2 = 810$
Shear force on web (kN)		$S_1 = 1014$	$S_2 = 494$
Average shear/mm (kN/mm)		$s_1 = 3.56$	$s_2 = 0.85$
Horizontal shear at top of web (kN)	$S_T = 520$		
Horizontal shear at bottom of web (kN)	$S_B = 735$		

Table 2: 1 in 1 slope

The vertical component of the flange forces results in an average shear force over the web height of 3.56 kN/mm at the shallower section and 0.85 kN/mm at the deeper section. The approximate average shear stress at the shallower section on a 10 mm thick web is 356 MPa – well in excess of the limiting shear stress of $f_y/\sqrt{3}$ = 205 MPa. Problems with shear resistance in rolled section beam webs are so rarely an issue that this overstress may catch out the unwary.

For both arrangements, the vertical component of the inclined flange force on the flange itself must also be considered. It acts across the full width of the flange, downward where the bottom flange turns downward. The web is incapable of sustaining the local tension and the force must therefore be transferred to the web through stiffeners. The flange will also tend to bend downward away from the web which acts as a central support. In the second case where the depth transition is more rapid, a stiffener must also be provided to carry the shear force across the trapezoidal web panel because the shear resistance of the web alone is insufficient. The actions at the point where the flange becomes horizontal are in the opposite sense.

Overlapping bottom flanges

If the bottom flange of the shallower portion of the beam is continued along the web to overlap with the bottom flange, the force in the flange sheds through the web into the top and bottom flanges. There is no vertical component of the flange force. The forces are shown in Figure 2.

The length *a* of the overlap can be chosen to suit the size of weld between the flange and web and the stress in the web panels. The web panel between the overlapping bottom flanges sustains a horizontal shear stress resulting from the flange force from the shallower section transferring across to the flanges of the deeper section. The forces on the different parts of the beam are shown in Table 3.

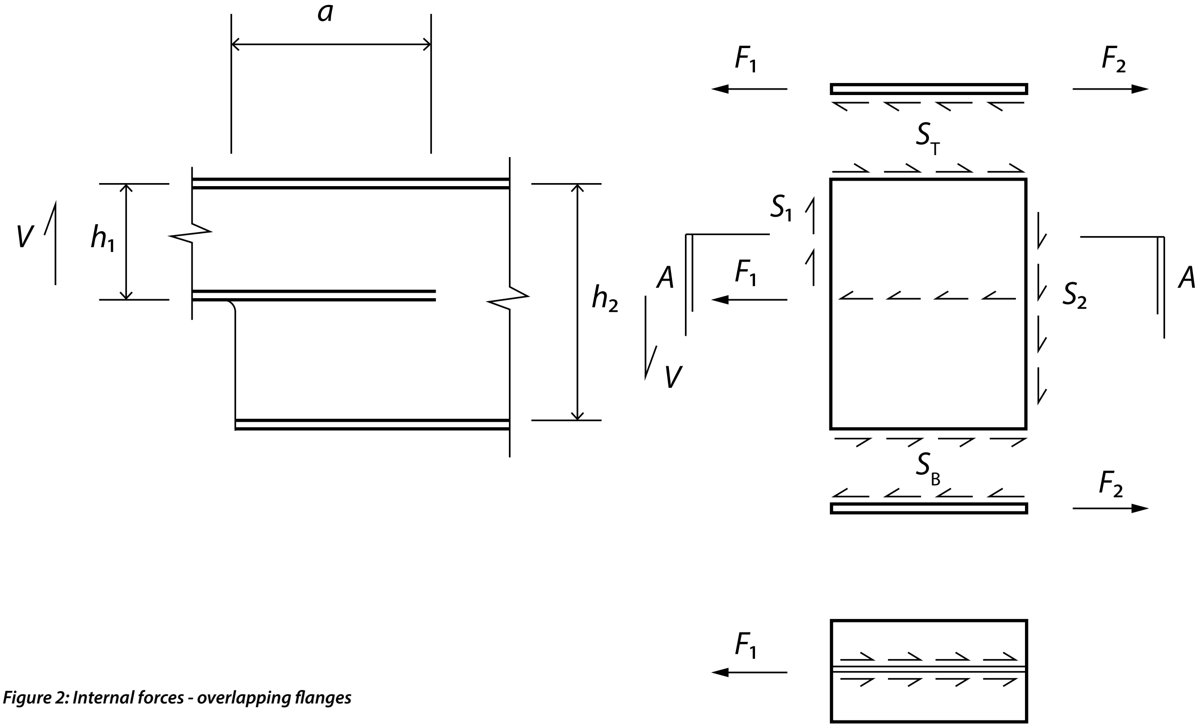

Figure 2: Internal forces - overlapping flanges

Parameter		Section 1	Section 2
Spacing (mm)	$a = 500$		
Height (mm)		$h_1 = 285$	$h_2 = 585$
Moment (kNm)		$M_1 = 379$	$M_2 = 537$
Flange force (kN)		$F_1 = 1330$	$F_2 = 918$
Shear force on web (kN)		$S_1 = 316$	$S_2 = 316$
Average shear/mm (kN/mm)		$s_1 = 1.11$	$s_2 = 0.54$
Horizontal shear at top of web (kN)	$S_T = 412$		
Horizontal shear at bottom of web (kN)	$S_B = 918$		

Table 3: Overlapping flanges

In the simple model for the force distribution on the section which is being adopted for this illustration, the web does not experience any direct stress. In the bottom panel, the average horizontal shear force/mm is 1.84 kN/mm. On a 10 mm thick web, the shear stress is 184 MPa ie less than 355/√3 = 205 MPa.

Both these approaches can potentially result in arrangements where the shear resistance of the web is exceeded. In the case of the cranks in the flange, the vertical components of the flange force require stiffeners to carry the flange bending about the web and a further stiffener may be required to carry the shear across the trapezoidal panel if the depth transition is too abrupt. If the bottom flanges are overlapped, there is no vertical component of flange force which is therefore conceptually simpler and the length of overlap merely needs to be made long enough to reduce the average shear over this length sufficiently.

AD 391: Lateral Torsional Buckling of rectangular plates in accordance with BS EN 1993-1-1

BS EN 1993-1-1 does not explicitly cover LTB of rectangular plates. This AD note provides guidance for calculating the design buckling resistance moment ($M_{b,Rd}$) that can be used for BS EN 1993-1-1. To calculate $M_{b,Rd}$ it is necessary to determine the non-dimensional slenderness $\bar{\lambda}_{LT}$. This AD note gives two methods of calculating $\bar{\lambda}_{LT}$ for a plate. The first method is from first principles, using the formula for the elastic critical moment M_{cr} of a plate; the second is by using the formula for the equivalent slenderness λ_{LT} of a plate given in Appendix B, clause B.2.7 of BS 5950-1.

For BS 5950-1, AD note 310 (Staircases with flat stringers) discusses the design of steel stairs with flat plate stringers. It suggests the design of the stringers can be carried out by determining the buckling resistance of the stringer over a buckling length equal to the tread spacing, assuming the stringer is class 3.

Method 1 to determine $\bar{\lambda}_{LT}$:

Starting from first principles, the non-dimensional slenderness of a plate can be determined as follows:

The standard moment for the elastic critical moment of an I section is:

$$M_{cr} = C_1 \frac{\pi^2 E I_z}{l^2}\sqrt{\frac{I_w}{I_z} + \frac{l^2 G I_T}{\pi^2 E I_z}}$$

Under uniform moment, C_1 = 1.0. For a plate, there is no term involving the warping constant I_w because the section has no flanges and it is assumed axial stresses due to warping are not developed. The formula for a plate therefore reduces to:

$$M_{cr} = \frac{\pi}{l}\sqrt{E I_z G I_T}$$

Making the substitutions $I_z = \frac{dt^3}{12}$, $I_T = \frac{dt^3}{3}$ and $G = \frac{E}{2(1+\nu)}$

where ν is Poisson's ratio and equals 0.3 for steel.
t and d are the thickness and depth of the plate respectively.

Therefore $$M_{cr} = \frac{dt^3}{6}\frac{\pi E}{l}\sqrt{\frac{1}{2.6}} \qquad \text{(Equation 1)}$$

Assuming a class 3 cross-section, the non-dimensional slenderness is given in BS EN 1993-1-1 (clause 6.3.2.2 (1)) by the formula:

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_{el} f_y}{M_{cr}}} \qquad \text{(Equation 2)}$$

where $W_{el} = d^2t/6$

Method 2 to determine $\bar{\lambda}_{LT}$:

Substituting for M_{cr} from equation 1 and $W_{el} = d^2t/6$ into equation 2, leads to:

$$\bar{\lambda}_{LT} = \sqrt{\frac{f_y \times 1.0 \times \sqrt{2.6}}{\pi E}\frac{ld}{t^2}} = \sqrt{\frac{f_y}{\pi^2 E}\frac{1.0\pi \times \sqrt{2.6}}{1}\frac{ld}{t^2}} \approx \sqrt{\frac{f_y}{\pi^2 E}} \times 2.8\sqrt{\frac{0.667ld}{t^2}}$$

The quantity $\sqrt{\frac{\pi^2 E}{f_y}}$ is denoted λ_1 in BS EN 1993-1-1 and is the slenderness at which the Euler load equals the squash load.

Starting from the formula in BS 5950 -1, clause B.2.7 the equivalent slenderness is given as:

$$\lambda_{LT} = 2.8\sqrt{\frac{\beta_w ld}{t^2}} \qquad \text{(Equation 3)}$$

For a class 3 section, β_w = 2/3 = 0.667.

Therefore for design to BS EN 1993-1-1, the non-dimensional slenderness $\bar{\lambda}_{LT}$ of a plate can be stated as:

$$\bar{\lambda}_{LT} = \frac{\lambda_{LT}}{\lambda_1} \qquad \text{(Equation 4)}$$

For $f_y = 275$, $\lambda_1 = \pi \times \sqrt{\frac{210000}{275}} = 87$

for $f_y = 355$, $\lambda_1 = 76$

The design buckling resistance $M_{b,Rd}$ can then be calculated from clause 6.3.2.1 (3) (equation 6.55) assuming a class 3 cross-section. The reduction factor χ_{LT} is calculated from clause 6.3.2.2 (1) (equation 6.56) based on curve d (i.e imperfection factor $\alpha_{LT} = 0.76$)

The non-dimensional slenderness $\bar{\lambda}_{LT}$ may be determined from equation 2 or 4 above.

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

New and revised codes & standards

From BSI Update September 2015

BS EN PUBLICATIONS

BS EN 10338:2015
Hot rolled and cold rolled non-coated products of multiphase steels for cold forming. Technical delivery conditions
No current standard is superseded.

BS EN 10346:2015
Continuously hot-dip coated steel flat products for cold forming. Technical delivery conditions
Supersedes BS EN 10346:2009

BRITISH STANDARDS UNDER REVIEW

BS ISO 4992-1:2006
Steel castings. Ultrasonic examination. Steel castings for general purposes.

BS ISO 4992-2:2006
Steel castings. Ultrasonic examination. Steel castings for highly stressed components

NEW WORK STARTED

BS 7668
Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
Will supersede BS 7668:2004

EN ISO 17660-1
Welding. Welding of reinforcing steel. Load-bearing welded joints
Will supersede
BS EN ISO 17660-1:2006

EN ISO 17660-2
Welding. Welding of reinforcing steel. Non load-bearing welded joints.
Will supersede
BS EN ISO 17660-2:2006

NA to EN 1993-1-4
UK National Annex to Eurocode 3. Design of steel structures. General rules. Supplementary rules for stainless steels.

'Fair Face Steelwork'

FROM BUILDING WITH STEEL AUGUST 1965

By John G. Fryman, A.R.I.B.A.

The Farnsworth House, U.S.A. (Architect: Mies van der Rohe)

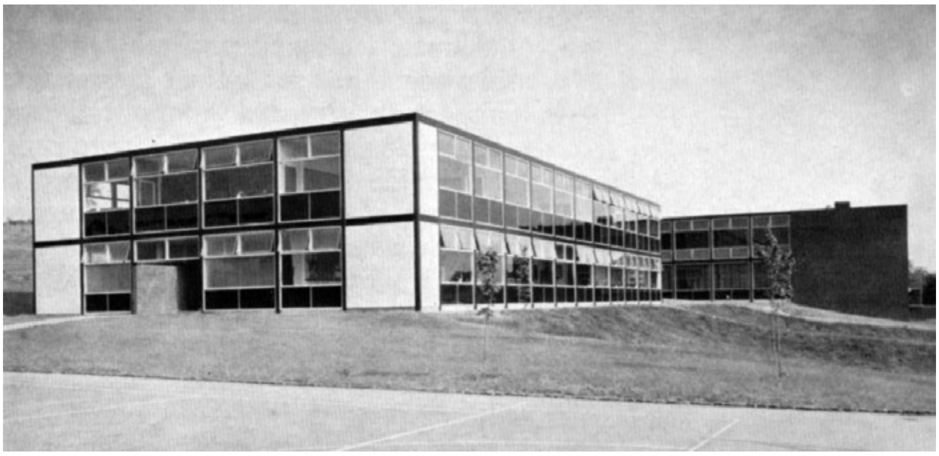
It is regrettable that the nineteenth century momentum for exploiting the aesthetic value of structural steelwork has to some extent declined. This is partly due to the need to reduce fire risks and maintenance costs and to technological developments in alternative materials. The early use of cast iron, and later wrought iron, produced some of the finest examples of clear structural thought combined with architectural quality. Subsequently these materials were superseded by or used in conjunction with steel and, from the mid-nineteenth century onwards, classic examples of unified steelwork and architecture emerge; notably Eiffel's tower and the Machine Hall built for the Paris International Exhibition.

Since the turn of the century, however, apart from special purpose buildings and major long-span structures, the steel frame has tended to become more often concealed. This is inevitable with some buildings for the reasons already stated but it often seems to be forgotten that many types of building need not necessarily conceal their structural form.

It would perhaps be useful here to clarify the term 'fair face steelwork'. The objective is to show that steelwork, when performing a purely structural function, may additionally be designed to make a major contribution to the architecture. It follows that exposed steelwork used as decoration in mullions, rails, or cladding does not fit this context.

Possibly the best known living exponent of fair face steelwork is Mies van der Rohe. The Farnsworth House is a very sophisticated example whereas the work at the Illinois Institute of Technology is more relevant to these arguments. It will be found that British examples of fair face steelwork in the purest sense are rare, although the post-war schools programme produced good light steel structures. Regrettably, however, many architects seem to have carefully designed out the structural frame. In many instances additional members, frames, mullion covers or casings have been needlessly added to conceal the structure, the paradox being that these components were often used to express the building architecturally.

In accepting the reasoning of the preceding paragraphs it is logical to consider any difficulties that may emerge in practice. A decision to design a framed building which integrates the qualities of the structure with the architecture makes essential early discussion with a sympathetic engineer or steel fabricator who understands the objective. The design process will be found to be more than simply assembling suitable sections - it will require meticulous care in three dimensional thought.

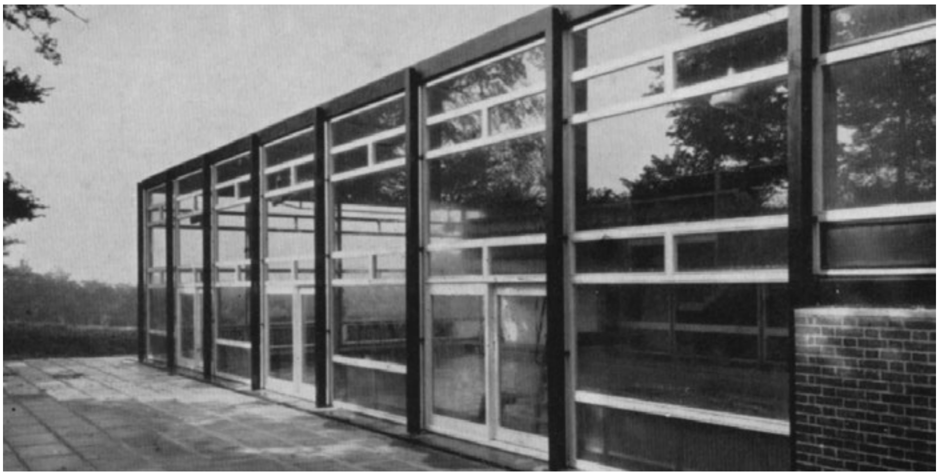


In addition a greater precision of execution than normally demanded will be vital. Furthermore, the use of welding may be considered either from the point of view of weathering or assembly. It will be found, however, that economical bolted structures can be designed which, in themselves, present an opportunity for detailing which ultimately makes a worthwhile architecture. It is also essential to consider the choice of structural section most carefully. For instance, in horizontal members the existing tapered flanges make a useful weathering contribution. The welding of continuous angle drips, stops and waterbars presents no difficulty and may be economically achieved. The crucial point at the design stage, however, is to explore, three-dimensionally, all the junctions and weathering surfaces so as to translate crisply the basic design into reality.

Waterproofing or sealing site assembly joints may be simply accomplished with the use of lead shims placed between joints at the assembly stage. The use of fibre washers at bolted connections may also be considered advantageous. These design techniques demand most careful attention to eliminate maintenance problems. It is essential that all surfaces be adequately cleaned, preferably by shot-blasting.

The use of a first-class paint is important, preceded by applications of zinc-rich paint or other self-protective media. The best treatment, however, consists of a sprayed zinc coating not less than 0.003 in. thick followed by a normal painting specification. Damage to the protective coating on site must be guarded against. Although experience shows that some damage is inevitable during erection. This may, however, be easily rectified by touching up on site with zinc-rich paint. Great attention must be paid to the termination of the external frame at ground level where it enters either plinths or casings, and here prevention of standing water is essential.

Apart from the architectural satisfaction that may be derived from fair face steelwork, the designer has a built in discipline and a design tool which may add considerably to the mobility of the surrounding cladding design. It is to be hoped that this form of skeletal design will commend itself more generally for appropriate buildings. The examples shown in the accompanying text are from recent buildings in the United Kingdom, together with Mies Van der Rohe's American examples: Farnsworth House and Crown Hall, Illinois Institute of Technology, Chicago.



Top Row: *West Stourbridge Secondary School, Worcs. (Architect: Yorke, Rosenberg and Mardell)*

Middle Row: *Bromsgrove College of Further Education, Worcs. (Architect: Yorke, Rosenberg and Mardell)*

Far Left: *Crown Hall, Illinois Institute of Technology, U.S.A. (Architect: Mies van der Rohe)*

Left: *House at Knotty Green, Beaconsfield, Bucks. (Architect: J. G. Fryman A.R.I.B.A.)*

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Gillian Mitchell MBE, Deputy Director General, BCSA, 4 Whitehall Court, London SW1A 2ES
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QM Quality management certification to ISO 9001
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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.

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Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)
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A C Bacon Engineering Ltd	01953 850611			●	●		●										2		Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●			●		●				●		●			✔	3		Up to £400,000
Access Design & Engineering	01642 245151					●			●	●	●			●	●	✔	2		Up to £4,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●	✔	3	Silver	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	Silver	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●	●	●	●				●	✔	2		Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4		Up to £1,400,000
AKD Contracts Ltd	01322 312203				●					●	●			●	●		2		Up to £100,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4		Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2		Up to £1,400,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2		Up to £400,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2		Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	2		Up to £800,000
ASD Westok Ltd	0113 205 5270												●			✔	4		Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	3	Silver	Up to £1,400,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●				●			●	●	✔	2		Up to £1,400,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●	✔	2		Up to £800,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●		✔	2		Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✔	4		Up to £1,400,000
Barnshaw Section Benders Ltd	01902 880848												●			✔	4		Up to £1,400,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●	●	✔	4	Gold	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●				●				●		2		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4		Up to £4,000,000
Builders Beams Ltd	01227 863770				●					●				●	●	✔	2		Up to £1,400,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4	Silver	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	Gold	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4	Gold	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4		Up to £6,000,000
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D H Structures Ltd	01785 246269			●	●		●				●						2		Up to £100,000
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ECS Engineering Services Ltd	01773 860001	●			●	●	●	●	●	●	●			●	●	✔	3		Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	Gold	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3	Gold	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●					●	●			●	●		2		Up to £1,400,000
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
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Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4		Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4	Silver	Up to £2,000,000
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)
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 £400,000
Luxtrade Ltd	01902 353182									●	●				●	✔	2		Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4		Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●			●		✔	2		Up to £800,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		2		Up to £1,400,000
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 £200,000
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*
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
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
PTS (TQM) Ltd	01785 250706
Roger Pope Associates	01752 263636
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) = Gold, (Silver) = Silver, (Green) = Member

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
AceCad Software Ltd	01332 545800		●								N/A	
Albion Sections Ltd	0121 553 1877	●									M	
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I	
ASD metal services	0113 254 0711								●		D/I	
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●									M	
BAPP Group Ltd	01226 383824									●	M	
Barrett Steel Services Limited	01274 682281								●		M	
Behringer Ltd	01296 668259					●						
BW Industries Ltd	01262 400088	●									M	
Cellbeam Ltd	01937 840600	●									M	
Cellshield Ltd	01937 840600							●			N/A	
Cleveland Steel & Tubes Ltd	01845 577789								●		M	
CMC (UK) Ltd	029 2089 5260								●		D/I	
Composite Profiles UK Ltd	01202 659237	●									D/I	
Cooper & Turner Ltd	0114 256 0057									●	M	
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A	
Daver Steels Ltd	0114 261 1999	●									M	
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M	

Steelwork contractors for bridgeworks

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

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

FG Footbridge and sign gantries
PG Bridges made principally from plate girders
TW Bridges made principally from trusswork
BA Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
CM Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
MB Moving bridges
RF Bridge refurbishment
AS Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
QM Quality management certification to ISO 9001
FPC Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1 2 – Execution Class 2
3 – Execution Class 3 4 – Execution Class 4
SCM Steel Construction Sustainability Charter
((Gold) = Gold, (Silver) = Silver, (Green) = 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			Gold	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4		✓		Up to £4,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4		✓	Silver	Up to £3,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4	✓	✓	Gold	Above £6,000,000*
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3		✓	Member	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4		✓	Gold	Up to £3,000,000
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		✓	Silver	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4		✓	Gold	Above £6,000,000
Taziker Industrial Ltd	01204 468080	●						●	●	✓	3	✓	✓		Above £6,000,000
Non-BCSA member															
Allerton Steel Ltd	01609 774471	●	●	●	●				●	✓	4		✓		Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●		●	●	●	✓	4				Up to £400,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4				Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			Member	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3		✓	Member	Up to £1,400,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	2		✓	Gold	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3				Up to £2,000,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3		✓		Up to £400,000
Interserve Construction Ltd	0121 344 4888							●	●	✓	3				Above £6,000,000*
Interserve Construction Ltd	020 8311 5500	●	●	●	●		●	●	●	✓	3				Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4	✓		Member	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A				Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●						●	●	✓	3		✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	✓	4			Silver	Above £6,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
easi-edge Ltd	01777 870901							●			N/A	●
Fabsec Ltd	0845 094 2530	●									N/A	
FabTrol Systems UK Ltd	01274 590865		●								N/A	
Ficep (UK) Ltd	01942 223530					●					N/A	
FLI Structures	01452 722200	●									M	●
Forward Protective Coatings Ltd	01623 748323						●				N/A	
Goodwin Steel Castings Ltd	01782 220000	●									N/A	
Graitec UK Ltd	0844 543 8888		●								N/A	
Hadley Group Ltd	0121 555 1342	●									M	○
Hempel UK Ltd	01633 874024						●				N/A	
Highland Metals Ltd	01343 548855						●				N/A	
Hilti (GB) Ltd	0800 886100									●	M	
Hi-Span Ltd	01953 603081	●									M	○
International Paint Ltd	0191 469 6111						●				N/A	●
Jack Tighe Ltd	01302 880360						●				N/A	
Jamestown Cladding & Profiling Ltd	00 353 45 434288	●									M	
John Parker & Sons Ltd	01227 783200								●	●	D/I	
Joseph Ash Galvanizing	01246 854650						●				N/A	
Jotun Paints (Europe) Ltd	01724 400000						●				N/A	
Kaltenbach Ltd	01234 213201					●					N/A	
Kingspan Structural Products	01944 712000	●									M	●
Lindapter International	01274 521444									●	M	
Longs Steel UK Ltd	01724 404040				●						M	
Murray Plate Group Ltd	0161 866 0266								●		D/I	
National Tube Stockholders Ltd	01845 577440								●		D/I	
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A	
PPG Performance Coatings UK Ltd	01773 814520						●				N/A	
Prodeck-Fixing Ltd	01278 780586	●									D/I	
Rainham Steel Co Ltd	01708 522311								●		D/I	
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				M	○
Sika Ltd	01707 384444						●				M	
Simpson Strong-Tie	01827 255600									●	M	
Structural Metal Decks Ltd	01202 718898	●									M	●
Tata Steel 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	