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# NSC

April 2015
Vol 23 No 4

Cellular solution for Leeds

Belfast gets university campus

Steel stays cost competitive

High rise in Hammersmith

Paddington's iconic fan bridge

**Cover Image**
**Ulster University**
**Belfast City Campus**
Main client:
Ulster University
Structural engineer:
Mott Macdonald
Steelwork contractor:
Walter Watson
Steel tonnage: 750t



April 2015 Vol 23 No 4



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

# Steel's performance stays high in low inflation age

Nick Barrett - Editor

News that inflation fell to zero in February for the first time since records began will have come as a pleasant surprise to many, especially those who grew up against a background of runaway inflation driven economic crisis.

Construction estimators however will quickly move to warn their marketing departments and their company's clients that these headline figures bear no resemblance to what is happening to prices in our industry. Those headlines relate to the Consumer Prices Index, which means prices at the supermarket tills are, on average, only at the level of a year ago. Prices for all major construction materials are not behaving anything like that.

Clear warnings about this can be seen in the Gardiner & Theobald cost analysis that we carry a report on in this month's issue, and which has also been reported on widely in the construction press. The G&T analysis shows that steel retains the competitive cost advantage over alternative framing solutions that it has enjoyed for over 30 years.

This advantage was maintained when prices were rising in the pre credit crisis boom years, was enjoyed by clients during the recession and persists into the current recovery. Steel has proven to be the cost-competitive solution whatever the economic background and whatever is happening to general prices or the prices of other construction materials.

Proof of the cost benefits achievable can be seen in the selection of steel for all of the case studies in this issue of NSC, along with a host of other advantages that come for no extra charge. We have a story about a rare 10-storey block in Hammersmith; as a speculatively built office-led regeneration scheme, cost along with speed of construction, flexibility and quality is key to the whole development.

With the economic recovery new commercial development is spreading to the regions, with projects like the one we report on in Leeds where re-engineering led to selection of cost-effective cellular beams, also delivering lighter foundations and programme advantages.

Ulster University is achieving its sustainability and carbon footprint targets alongside cost benefits with its new BREEAM 'Excellent' designed steel-framed campus. Costs are always crucial for the logistics industry and a new distribution centre at Stoke shows why steel commands a share of over 90% of this market.

The unique Japanese fan inspired moving bridge at Paddington Basin wasn't only delivered within budget, but probably couldn't even have been conceived in anything other than steel.

Lower consumer prices aren't irrelevant for construction activity. Allied to upward pressure on wage rates they mean that the spending power of most people is rising, which will raise the level of economic activity, which in turn feeds through to demand for more projects like shops, cinemas and distribution centres. Whatever the level of demand, steel will remain the cost-effective solution.

NSC

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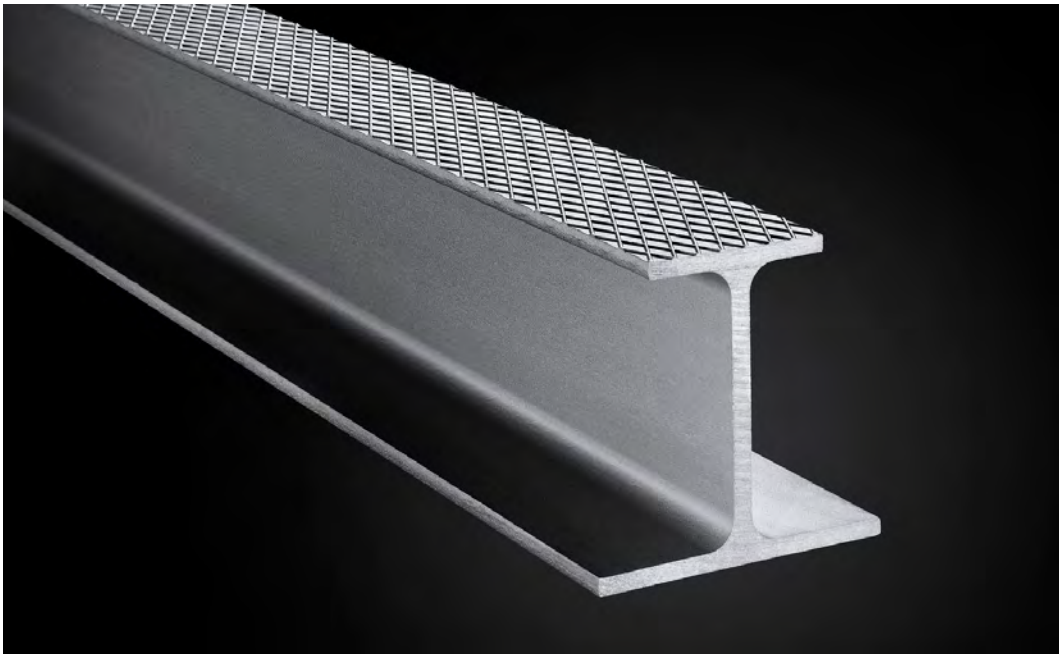
# Tata Steel Asymmetric Slimflor® Beams now more accessible



Tata Steel has relaunched its responsibly sourced Asymmetric Slimflor® Beams (ASBs) making them more accessible than ever before, with a shorter production time and improved availability.

Responding to customer feedback, the ASBs are to be produced to order, enabling accurate programming for construction projects.

Manufactured in the UK to the exacting standards required for CE marked products, and recently certified to BES 6001, ASBs are now available on a project basis from rolling campaigns for smaller minimum order quantities per serial size (>120 tonnes).

The combined shorter lead-time, typically 6-8 weeks, along with rollings that cater for smaller quantities, provides customers with greater flexibility for assured project planning.

An integral part of the Advance® sections range, ASBs have been specifically designed for use with ComFlor® 225 deep decking to create the Slimdek® system, an engineered solution that offers a service-integrated, minimal depth, cost-effective shallow floor construction ideal for car parks, residential developments, hospitals and commercial buildings where minimising floor depth, and achieving onerous acoustic and vibration criteria are key considerations.

Tata Steel Product Marketer, Construction Structures, Mike Hoare said: "We are keen to demonstrate the flexibility that ASBs can offer to construction programmes, with assured availability and shorter lead times."

"ASBs are an essential part of a cost-effective shallow floor solution. The composite action, which is assisted by the embossed surface on the upper flange of the ASB, significantly increases the structural strength of the floor."

For support and advice on the use of ASBs and the Slimdek® system contact: 01724 405060 or visit the website.

## Anfield expansion work begins

The first steel elements for the £260M redevelopment of Liverpool FC's famous Anfield stadium have been lifted into place.

More than 4,800t of steelwork will eventually be erected for the construction of a new Main Stand which will increase the stadium's capacity to 54,000 spectators.

The 21,000-seat stand's steel frame is scheduled to be completed by June, with work then starting on the construction of the new supporting roof.

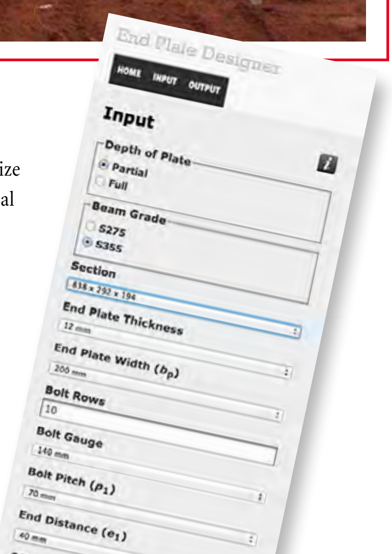
Work will then continue throughout the 2015-16 football season, with the new roof being completed above the existing stand.

Once the stand opens in time for the 2016-17 season work will then begin on expanding the Anfield Road end, taking the capacity of the stadium up to nearly 60,000.

Liverpool FC's Operations Manager Andrew Parkinson said: "Progress is on track since December when we started the foundation work. The steel frame should take shape very quickly.

The steelwork contractor for the project is Severfield.

## Upgraded end plate design tool now available




Eurocode tying rules for robustness mean that designers need connections that can carry larger tension forces than equivalent designs to the former British Standards. Full depth end plates (rather than partial depth end plates) are therefore an attractive option.

To meet this need, the steel construction sector has upgraded its flexible end plate design tool to include full depth as well as partial depth end plates. This is now available here.

The software calculates the vertical shear resistance and tying resistance of partial depth and full depth end plate connections on beams. The design resistances are calculated in accordance with BS EN 1993-1-8 and the UK National Annex, following the procedures in the 'Green Book' (P358).

Selecting the steel grade and beam size generates a set of parameters for a typical standard end plate connection.

These parameters (number of bolt rows, pitch, offset, edge distances, gauge, plate width and thickness) may subsequently be changed and the resistances re-calculated. At any stage, re-selecting the beam will generate the typical connection.

# Steel bridges adorn Royal Mail stamps

The latest collection of first class stamps from the Royal Mail celebrates advances made in UK bridge engineering, acknowledges the role steelwork has played in the sector and features two Structural Steel Design Award (SSDA) winners.

The bridges featured on the stamps are: Tarr Steps in Exmoor; Cumbria's Row Bridge; Pulteney Bridge, Bath; Craigellachie Bridge, Moray; Pont Grog y Borth (Menai Suspension Bridge); High Level Bridge, Newcastle-upon-Tyne; Royal Border Bridge, Berwick-upon-Tweed; Tees Transporter Bridge; Humber Bridge and the Peace Bridge, Derry/Londonderry.

Head of Stamps and Collectibles at Royal Mail Andrew Hammond said: "The story of Britain's engineering genius can be found in its bridges. These new stamps celebrate 10 beautiful and ground-breaking landmarks that span centuries of our history."

The most recently completed bridge to appear in the stamp series is the 2012 SSDA winning Peace Bridge that spans Northern Ireland's River Foyle.

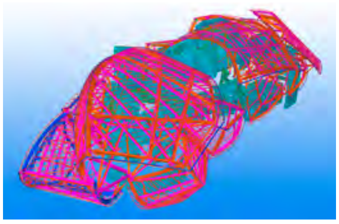
The iconic steel bridge's tall masts overlap mid-river to form a symbolic 'Handshake' symbolising the linking of two divided communities in Derry/Londonderry.

With a total length of 2,220m and a central span of 1,410m the Humber Bridge is also featured on one of the stamps. It was for many years after its opening in 1981 the longest single-span suspension bridge in the world. The steel structure, constructed by a team including Cleveland Bridge, has captured the imagination with its mighty scale, elegant minimal form and the fact that it spans one of England's great natural boundaries.

Also featured is the Tees Transporter Bridge in Middesbrough which opened in 1911 and is the longest remaining transporter bridge still in operation anywhere in the world.

The lattice-steel structure incorporates a pair of cantilevered trusses that span 259m – with a clearance above water of almost 49m – that are used to carry a 'gondola' across the river. This unique design – executed by Sir William Arrol & Co. of Glasgow – was economic to construct and ensured that the crossing would not interfere with river traffic.

# Tekla updates BIM software package



Software specialist Tekla has launched Tekla Structures 21, the latest version of its Building Information Modelling (BIM) software for the engineering and construction markets.

The company says there are a number of advancements available with the new version, including better drawing control, usability and performance.

Tekla Structures 21 is said to improve industrial and commercial construction project workflows across construction disciplines – delivering benefits to structural steel designers, detailers and fabricators.

Risto Räty, Executive Vice President, Deputy CEO of Tekla and General Manager of Trimble Buildings Structures Division said: "After a decade in use, Tekla Structures continues to further the evolution of BIM from experimental to an essential part of designing, engineering and building of all types of buildings and structures.

"Tekla Structures 21 reduces the time between concept and construction by enabling advanced project team collaboration and productivity, and allowing free flowing communication between all project stakeholders. The end result is the efficient design and building of better structures."

# Steel supports Mauritian church

REIDsteel and Wessex Galvanizing have teamed up to create a lasting legacy for a place of religious importance in Mauritius.

The work involved REIDsteel fabricating a two metre high religious cross and lantern that was installed at the shrine of French Catholic Priest and Missionary, Jacques-Désiré Laval (known as Père Laval).

Prior to the steelwork being transported to the Indian Ocean island, Wessex Galvanizing were contracted to hot-dip galvanize the cross and lantern.

REIDsteel Production and Quality Manager Andy Davies said: "We have designed, fabricated and shipped many steel structures in Mauritius so were pleased to be asked to design and supply the new features for the shrine dedicated to Père Laval.

"We're proud to be part of a national monument which is set to be visited by millions of pilgrims in the years to come. In Mauritius, you are never far from the coast so galvanizing was the natural choice, it requires little maintenance and it's protected from all the elements."

Wessex Galvanizing Sales Manager Richard Whiddett, said: "It was great to partner with REIDsteel once more and a real privilege to play a role in such an important structure for the people of Mauritius and those who visit each year. The project was quite different to our usual work, and really demonstrates the diversity of galvanizing as a finish."

The project was commissioned by the Society of the Holy Spirit and The Sacred Heart of Mary.

Père Laval is recognised as a champion of the poor and ill in Mauritius, and on his death in 1864 his grave at the Sainte Croix Church became a place of pilgrimage, with many people from around the world still making the journey every year on the anniversary of his death.

## NEWS IN BRIEF

Two new businesses have been launched by **Barrett Steel**, Barrett Materials Handling and Barrett Specialist Vehicles, which the company says is part of its overall growth strategy. The company has also created extra capacity with the addition of two new tube laser machines and a large diameter plasma-cutting machine.

The **Tekla UK Awards**, which focus on projects where Tekla software has been used as a part of the process for designing and modelling structures, is now open for entries. For full details on how you can enter and for more information on the awards visit: www.tekla.com/uk/awards-2015/

The **Fire and Steel Construction webinar** held on 12 March is now available as an online CPD here. Presented by the British Constructional Steelwork Association's John Dowling the topics covered include: The legislative background to fire precautions in buildings; types of structural fire protection, trends, costs, advantages and disadvantages; fire testing; an Introduction to structural fire engineering as well as a summary of relevant case studies.

**ISG** has commenced work on a £11M project to create a new National Speedway Stadium and National Basketball Performance Centre in Belle Vue, Manchester. The 6,000 capacity speedway stadium will become the home of the historic Belle Vue Aces team and will feature a 1,842-seat steel-framed grandstand, including 208 VIP seats.

## AROUND THE PRESS

**Construction News**
***27 February 2015***
**Interview: Irvine Sellar**

[Referring to the Shard] – The 87-storey skyscraper is more than just a mixed-use building, he says – there are plenty of those about. "It's a vertical town."

**New Civil Engineer**
***19 March 2015***
**Ten year journey to BIM level three begins**

The government has now begun a 10-year journey towards BIM3, which will improve the design process and make it more efficient.

**Bdaily News**
***24 March 2015***
**Steel frame of £5.6m Doncaster school development completed two months into construction**

Contractors, Wates Construction welcomed students to visit the site of a new pioneering £5.6m free school in Doncaster to see the completion of the building's steel frame. Just 11 weeks after Wates began constructing the new school, which is located next to Keepmoat Stadium on Stadium Way, the ceremonial 'bolt tightening' took place.

**Construction Enquirer**
***24 March 2015***
**Steelwork contractor Billington targets 5% margin**

Mark Smith, Chief Executive Officer, said: "For the first time in a number of years, each of Billington's divisions has contributed positively to the overall trading performance, allowing the Group to look forward with great optimism to 2015. While the economy has not yet returned to pre-recession levels, the buoyancy and gathering momentum within the industry is very encouraging and allows us to look with optimism at our future prospects."

# Severfield expands bridge capacity

Steelwork contractor Severfield has announced the recruitment of a significant number of staff from the infrastructure and bridge division of Mabey Bridge in Chepstow.

The move is said to underline Severfield's ongoing strategy to grow and diversify in expanding markets such as infrastructure.

Mabey Bridge announced last year that it was winding down its infrastructure and bridge division.

The new Severfield 'bridge team' will be based in offices in Chepstow, while all manufacturing will be carried out at the company's Lostock factory.

Commenting on the news, Severfield Chief Executive Officer Ian Lawson said: "We are delighted to recruit a large number of employees from the Mabey Bridge business. It provides us with a fantastic opportunity to enhance and expand our current bridge capabilities which is excellent news for clients."

Severfield says it has a strategic aim to grow its existing strong, sustainable business by increasing operating margins, building market share and developing new markets. The company is one of the largest structural steel businesses operating in the UK and in Europe, employing some 1,200 people at four sites in the UK and one in India.

Mabey Bridge has over the years fabricated and installed a number of high-profile bridges including the River Taff Central Link Bridge in Merthyr Tydfil (pictured), the Adur Ferry Bridge in Shoreham-by-Sea and Workington's new Northside Bridge.

# New high speed drilling line from FICEP


Italian steel processing equipment manufacturer FICEP has launched a new CNC high speed drilling line called RAPID.

Said to be suitable for angles and flats, RAPID is also said to offer high productivity, quality, flexibility, accuracy and lower production costs.

FICEP says RAPID offers faster drilling and scribing speeds at minimum cost, slotting in any direction, angle heel milling, and other machining features. With the option of using indexable carbide drilling tools it allows the machine to be one of the fastest on the market.

The CNC materials handling system loads the angles on to the conveyor track, which then automatically clamps the workpiece in position and every process then takes place sequentially.

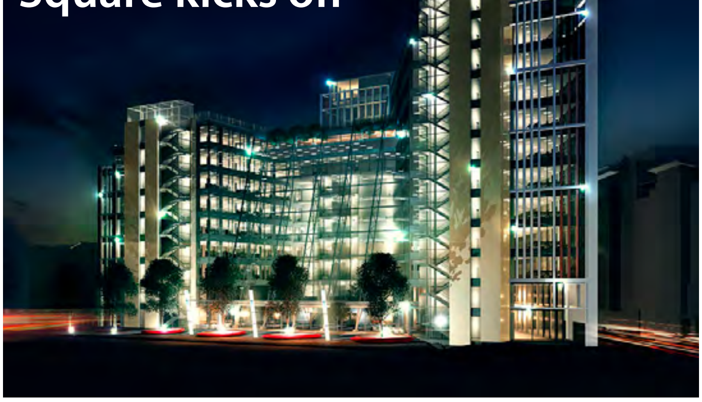
The two drilling heads are equipped with very powerful direct drive spindles and an automatic tool changer with six positions for each of the spindles.

The CNC system controls spindle positioning and feed rates and linear guides with controlled servomotors and ball screws ensure maximum precision on every axis.

The RAPID CNC drilling lines are also modular and can incorporate scribing, hard stamp marking, single or double shearing or a high-speed circular carbide saw.

Optional hard stamping CNC marking units have 8 selectable cassette types, each one including 13 characters.

# Leeds Central Square kicks off



Steel construction is due to kick off on the latest high profile project in the transformation of Leeds city centre.

Known as Central Square, the scheme has been developed in response to the market demand for high quality, sustainable office space with large individual floor plates that are currently in short supply in Leeds.

The 11-storey steel-framed commercial structure will also accommodate ground floor retail outlets, restaurants, bars, a gym and a public atrium. On the 9th floor there will be a sky garden available to all tenants, providing views across Leeds.

The project developer says this new mixed-use destination will attract members of the public throughout the day and evening to enjoy the high quality public realm, retail and leisure facilities that will be on offer.

With residential dwellings to the east and west of the building, tenants of Central Square will benefit from substantial footfall at all times of the year.

Working on behalf of Wates Construction, Elland Steel Structures will erect approximately 1,900t of steel and install 25,000m² of metal decking on the project.

# Newport regeneration in full swing

Steel construction at Newport Friars Walk, a project that will transform the South Wales city centre, is nearing completion with more than 6,000t of structural steelwork having so far been erected by Caunton Engineering.

The large steel-framed development consists of a three-storey Debenhams department store, a multi-screen cinema complex, a covered mall containing a number of two-level retail units and a basement car park.

The project team is working towards a series of phased handovers – first of which is for Debenhams in July – with the entire scheme expected to open in November. Main contractor for the project is Bowmer & Kirkland.

# Steel complete for city's first Grade A offices

Leach Structural Steelwork has completed erecting steelwork for a four-storey mixed-use development in Wolverhampton that will provide the city with its first Grade A offices.

Forming part of the Wolverhampton Interchange development, the steel-framed structure, which is aiming to achieve a BREEAM 'Excellent' rating, will accommodate ground floor retail units with offices above.

Supported on piled foundations, the steelwork is based around a regular 7.5m grid pattern that gains its stability from moment frames, bracing and a centrally positioned lift shaft.

Cross bracing is located in stairwells, inside the lift shaft and along one of the building's gable ends.

Rectangular in plan, the structure features a four-storey section facing the city's railway station approach road, and an interconnected three-storey section at the back overlooking a new bus station.

Overall, the Wolverhampton Interchange development will create a new gateway to the city, providing a new and modern transportation hub for buses and trains, as well as retail and office space.

The first phase of the project saw a new bus station and an adjoining office block completed a few years ago. As well as the four-storey mixed-use building, this latest phase also includes the refurbishment of Wolverhampton railway station, an extension to the adjoining multi-storey car park and more office and retail buildings.


Councillor Peter Bilson, Wolverhampton City Council's Cabinet Member for Economic Regeneration & Prosperity said: "The Interchange is a main gateway to the city centre and is a strategic regeneration priority for the council."

# Thames lock project completed with steel

New heavy-duty steel gates have been supplied to the historic Romney Lock on the River Thames by ECS Engineering Services.

Sub-contractor Scottish Galvanizers (part of the Wedge Group) was called upon to provide protective hot dip galvanizing treatment to the gates 28t of steel.

ECS says, due to the size of the new gates, measuring 4.7m in height, 6.2m in width and weighing 7t each, Scottish Galvanizers was contracted as it is the only galvanizing plant in the UK to have the appropriately-sized headroom facility to accommodate these fabrications.

Once galvanized the steel gates were returned to ECS Engineering in Nottinghamshire for installation.

ECS Commercial Director Clark Williamson said: "The project continues the collaboration between ECS and the Environment Agency to improve the reliability and safety of the lock complex on the River Thames, and is similar to work carried out at Grafton, Abington and Old Windsor. It's really important that these lock gates are secure and reliable, to ensure that those who spend time on the river have a safe and enjoyable experience."

Scottish Galvanizers Customer Service Manager Paul Tait said: "This was a great project to be involved with especially for its high historical and current importance. Galvanizing a structure this big takes careful consideration and due diligence, but with the facilities here we were able to coat the gates inside and outside with ease.

Romney Lock was opened in 1797 and the gates were originally built of oak. The lock has been rebuilt several times in the last 200 years and it is now regularly maintained by the EA.

# Diary

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

**Tuesday 21 April 2015**
**Light Gauge Steel Design**
This course introduces the uses and applications of light gauge steel in construction, before explaining in detail the methods employed by Eurocode 3.
Dublin
For details click here

**Tuesday 28 April 2015**
**Steel Building Design to EC3**
This course will introduce experienced Steel designers to the Eurocode provisions for steel Design.
Bristol.
For details click here

**Tuesday 5 May 2015**
**EC4 Composite Design**
This course will cover the design of composite beams and slabs with reference to Eurocode 4 for composite construction (BS EN 1994-1-1).
London.
For details click here

**Tuesday 12 May 2015**
**Fabrication Economics**
1 hour lunchtime webinar free to BCSA and SCI members, offering an overview of member design in portal frames.
1 hour webinar.

**Tuesday 19 May 2015**
**Portal Frame Design**
This course provide in-depth coverage of the major issues surrounding the analysis, design and detailing of portal frames.
Leeds.
For details click here

# Steel: the cost competitive solution

Prices for all construction materials are rising and fabricated structural steelwork is no exception, despite the background of falls in crude oil and iron ore prices, as Gardiner & Theobald warns in its latest structural steel cost analysis.

Raw steel prices have been falling under the influence of world iron ore prices, but raw steel accounts for only between 30% and 40% of structural frame costs. Other cost pressures are pushing prices for structural steelwork up from the unsustainable levels of recent years.

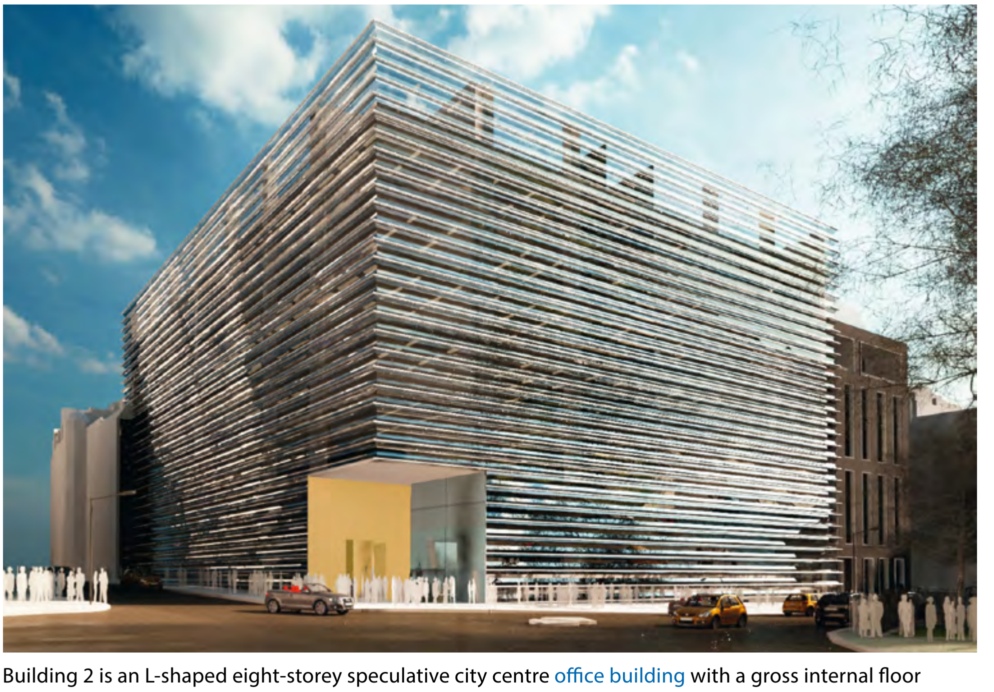
Steel producers have increased UK sections prices by £20/tonne this year against a background of rising demand and falling material prices, but still depressed margins. Independent researchers Construction Markets have forecast that UK consumption of structural steelwork will increase by 9% in 2015, following the 6% rise of 2014. Gardiner & Theobald (G&T) says further manufacturer price rises can be expected in 2015 as demand continues to improve as forecast.

G&T has incorporated new price information into an updated cost model used in 2012 for a Cost Comparison study that analysed two typical commercial buildings to provide cost and programme guidance to inform the design and selection of a structural frame (see right).

For this update of the cost model G&T increased all general cost items by 2.8% to reflect the final quarter of its 2014 forecast of 6% average tender price inflation for London, and the first quarter of a forecast rise for 2015 of 5%.

Frame rates for reinforcing bars, concrete and structural steel have also had increases applied to reflect both recorded and forecast tender price changes in Q1 2015. Main contractor direct costs have also been reviewed to reflect current tendering conditions and increased demand. They also reflect more selective contractor tendering, with two stage tendering increasingly common ▶12

Building 1 is a typical out-of-town speculative three-storey business park office with a gross internal floor area of 3,200m$^2$ and rectangular open plan floor space. Cost models were produced for four frame types developed by Peter Brett Associates to reflect the typical available framing options; steel composite, steel and precast concrete slab, reinforced concrete flat slab and post-tensioned concrete flat slab.



Building 2 is an L-shaped eight-storey speculative city centre office building with a gross internal floor area of 16,500m$^2$ and a 7.5m × 15m grid. Cost models were developed for a steel cellular composite frame and post-tensioned concrete band beam and slab, being two frame and upper floor types that could economically achieve the required span and building form.

◀ 10

as contractors shy away from single stage tenders as attitudes to risk transfer harden.

The steel composite beam and slab option remains the most competitive for Building 1, as Figure 1 shows, with the lowest frame and upper floors cost and lowest total building cost.

Figure 2 (Building 2) shows that a cellular steel composite option has both a lower frame and floor cost and lower total building cost than the post-tensioned concrete band beam option. Substructure costs and roof costs are both lower. A lower floor-to-floor height gives lower external envelope costs.

Costs shown in the structural steel frame cost table, Figure 3 (right), reflect tender price rises seen in the last quarter of 2014 and those expected in the first quarter of 2015.

G&T says typical costs are based upon the particular project being attractive to the market and the selection of an appropriate procurement route. In overheated market areas G&T warns that care needs to be taken with the procurement strategy - if it is not well thought through and doesn't respond to market conditions, the cost impact on individual tenders could be dramatic.

G&T says that a move away from single stage fixed-price procurement routes, which was seen first in London and the South East in mid-2014, is spreading to the regions, partly as the market tries to overcome a shortage of mid-range contractors.

Contractor's attitudes to risk transfer and complexity have hardened as pressure on estimating resources has grown with the rise in market demand, and as a result the number of tenders being submitted for many projects is below what would have been expected until recently.

The BCIS location factors (produced by the Building Cost Information Service of the Royal Institution of Chartered Surveyors), reflecting regional differences in construction costs, show that the gap between the City of London, the majority of regional cities and the UK mean of 100 has narrowed as the economic recovery picks up pace across the UK (see Figure 4).

G&T concludes that looking to the rest of this year and beyond, the forecast increase in demand for construction across the UK along with increased wage expectations and rising material prices mean that estimates for projects should include substantial allowances for anticipated inflation.

**Figure 1: Building 1 Cost Model (key costs per m² GIFA, City of London location)**

| | Steel Composite | Steel + Precast Concrete Slabs | Reinforced Concrete Flat Slab | Post Tensioned Concrete Flat Slab |
|---|---|---|---|---|
| Substructure | £59/m² | £62/m² | £76/m² | £70/m² |
| Frame and Upper Floors | £153/m² | £168/m² | £159/m² | £168/m² |
| Total Building | £1,683/m² | £1,713/m² | £1,770/m² | £1,752/m² |

**Figure 2: Building 2 Cost Model (key costs per m² GIFA, City of London location)**

| | Steel Cellular Composite | PT Concrete Band Beam and Slab |
|---|---|---|
| Substructure | £62/m² | £66/m² |
| Frame and Upper Floors | £210/m² | £237/m² |
| Total Building | £2,095/m² | £2,186/m² |

**Figure 3: Indicative cost ranges based on GIFA (Q1 2015)**

| TYPE | GIFA Rate (£) BCIS Index 100 | GIFA Rate (£) City of London |
|---|---|---|
| Frame 1 - low rise, short spans, repetitive grid / sections, easy access (Building 1) | 90 - 122/m² | 100 - 135m² |
| Frame 2 - high rise, long spans, easy access, repetitive grid (Building 2) | 140 - 168/m² | 155 - 185/m² |
| Frame 3 - high rise, long spans, complex access, irregular grid, complex elements | 168 - 190m² | 185 - 210/m² |
| Floor - metal decking and lightweight concrete topping | 50 - 68/m² | 55 - 75/m² |
| Floor – precast concrete composite floor and topping | 55 - 73/m² | 60 - 80/m² |
| Fire protection (60 min resistance) | 14 - 23/m² | 15 - 25/m² |
| Portal frames – low eaves (6-8m) | 55 - 73/m² | 60 - 80/m² |
| Portal frames – high eaves (10-13m) | 68 - 90/m² | 75 - 100/m² |

**Figure 4: BCIS Location Factors, as 6 February 2015**

| Location | BCIS Index | Location | BCIS Index |
|---|---|---|---|
| City of London | 110 | Leeds | 92 |
| Nottingham | 96 | Newcastle | 98 |
| Birmingham | 91 | Glasgow | 100 |
| Manchester | 99 | Belfast | 60 |
| Liverpool | 94 | Cardiff | 100 |

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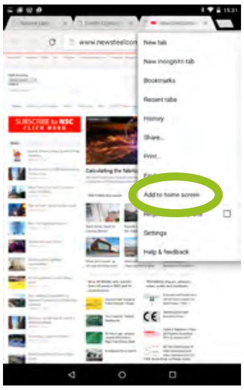
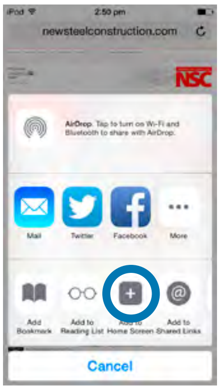

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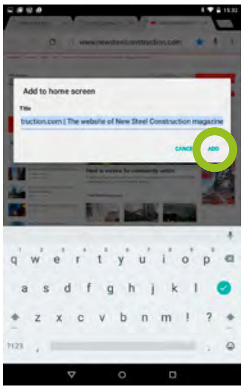


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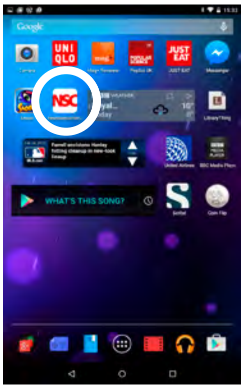
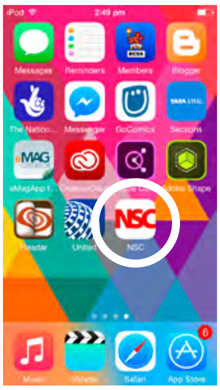

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*Forming the second part of a scheme, 12 Hammersmith Grove is slightly larger than its neighbour, No 10*

# In the grove

**FACT FILE**
12 Hammersmith Grove, London
**Main client:** Development Securities
**Architect:** Flanagan Lawrence
**Main contractor:** Wates Construction
**Structural engineer:** Pell Frischmann
**Steelwork contractor:** William Hare
**Steel tonnage:** 2,000t

## A second steel-framed multi-storey block completes an office-led regeneration scheme in west London. Martin Cooper reports.

The construction of commercial developments in the capital is on the increase, a sure sign that the industry as a whole is on the up.

An array of prestigious office schemes are currently under way in all areas of central London with a host of others in the offing. In Hammersmith, the second and final phase of Development Securities' office-led regeneration scheme is close to topping out.

The scheme consists of two similar office blocks adjacent to the Hammersmith & City Underground station. A Wates Construction-led project team completed 10 Hammersmith Grove in 2013, and the same companies are now working on the slightly larger neighbouring No.12 block.

"Both of the building's designs are of the same family, although No.12 has two more stories and larger floorplates," Pell Frischmann Director Mike Hitchens says. "Having already designed the first structure we've been able to collate project team feedback and thereby tweak the design of No.12 to make it more efficient."

The 10-storey 12 Hammersmith Grove will offer speculative Grade A office space, ground floor and mezzanine level retail space and a generous double-height entrance foyer.

Designed by architect Flanagan Lawrence, the project has been funded by Scottish Widows Investment Property Partnership Trust and is being delivered on the site of a former NCP car park.

Like its neighbour, 12 Hammersmith Grove is a steel-framed composite designed structure, utilising long-span Fabsec cellular beams throughout for economy and to allow the integration of services within the structural void.

Two centrally placed cores provide the steel frame with its stability, while the majority of the structural grid follows a 7.5m x 10m pattern throughout the building. This grid also incorporates some longer spans of up to 15m on all floors.

To incorporate the 15m long spans, make sure the beams were stiff enough to negate any footfall vibration, and have big enough holes to accept all of the services and thereby keep floor-to-ceiling heights the same, the cellular beams are all 650mm deep sections. They incorporate 450mm diameter service holes and support a metal deck with a 150mm thick slab.

"There are very few internal columns, four in total, and this maximises the desired open plan scheme the client desires," says Wates Construction Project Director Damon Cutler.

The reason for the inclusion of four internal columns on each floorplate is because the structure steps back at eighth and ninth floor levels to provide outdoor terraces.

Without these internal columns large transfer structures would have been necessary and they would have interfered with the desired constant floor-to-ceiling heights.

"Only four internal columns means we still have clear open plan floorplates along with a lighter and more cost-effective steel frame," explains Mr Hitchens.

In order to achieve a contemporary industrial-like office environment, something which has been incorporated into the design at 10 Hammersmith Grove, all of the cellular beams will be left exposed within the completed building.

Many of No.10's tenants are media companies as this part of west London, because of its proximity to the BBC studios in White City, is fast becoming a media hub.

To attract similar tenants to occupy No.12 it is considered important to have this modern design with as much exposed steelwork as possible.

"That's not to say tenants have to stick to this design," adds Mr Cutler. "There is the flexibility that they can always add a false ceiling if they want."

As the beams will be left exposed, extra care has been taken with the design's detailing and connections in order to achieve an aesthetic look, while all secondary beams are spaced at regular 3.5m centres.

"We've used a combination of intumescent and non-intumescent white paint for the beams, because they will be on view in the completed building. Any minor handling damage to the coating system has been remedied onsite," says William Hare Project Director Pat Egan.

*The steel frame nears completion*

Steelwork contractor William Hare began its steel erection programme in October 2014 and completed the job last month (March). It is due back on site later this summer to install a steel BMU (Building Maintenance Unit) and a plant grillage on the building's roof.

Prior to the company starting onsite, Wates had completed the enabling works, which included the installation of piles to a maximum depth of 30m.

All of the steelwork was erected using the site's two tower cranes with two floors erected at a time before the metal decking was installed.

Both of the scheme's buildings will eventually share a common service yard, but during construction all steelwork and other deliveries arrives on site from No.10's service yard entrance.

Once the project is complete, this service yard access route will be paved over and turned into a pubic realm between the two structures. Access to the shared service yard will then be via a new roadway, which is incorporated into the ground floor area of No.12.

This service road is located within the ground floor perimeter columns along two elevations. Consequently the floorplate for the ground floor is smaller as the office areas above span over the road. Columns along these two perimeter lines will be encased in concrete for impact security.

12 Hammersmith Grove is due to be completed in early 2016, and is aiming to achieve a BREEAM 'Excellent' rating.

*The structure features clear open plan office spaces*

*The building occupies a plot adjacent to an underground station*


# On budget with cellular design

The latest phase of an on-going commercial development in Leeds has reaped the benefits of using a steel-framed solution incorporating cellular beams.

**FACT FILE**
6 Wellington Place, Leeds
**Main client:** MEPC
**Architect:** CJCT
**Main contractor:** Shepherd Construction
**Structural engineer:** Arup
**Steelwork contractor:** Billington Structures
**Steel tonnage:** 700t

Leeds city centre has seen a number of changes in recent years as new commercial and residential schemes alter the landscape of former industrial sites on either side of the River Aire.

One such commercial scheme, known as Wellington Place, is located five minutes walk west of the city centre. Here a number of medium-rise commercial, retail, leisure and residential blocks are planned for a site once occupied by Leeds Central Station.

The station closed in 1967 and all that remains of the site's transportation heritage is a wagon hoist tower, once used to lift goods, and the viaduct over the River Aire and Leeds and Liverpool canal.

Developer MEPC envisages turning the site into a prestigious new multi-use quarter and so far it has completed one commercial block (10 Wellington Place), started on 6 Wellington Place, with another building (No.5) about to kick off in the coming months.

All three buildings have different designs and footprints but one thing they do have in common is that they all have steel frames.

6 Wellington Place is a six-storey (including ground floor) structure with a basement car park offering 9,600m² of Grade A office and retail space.

The structure is wedge shaped in profile, with four elevations. From the widest south facing elevation the building tapers down to the narrowest northern façade.

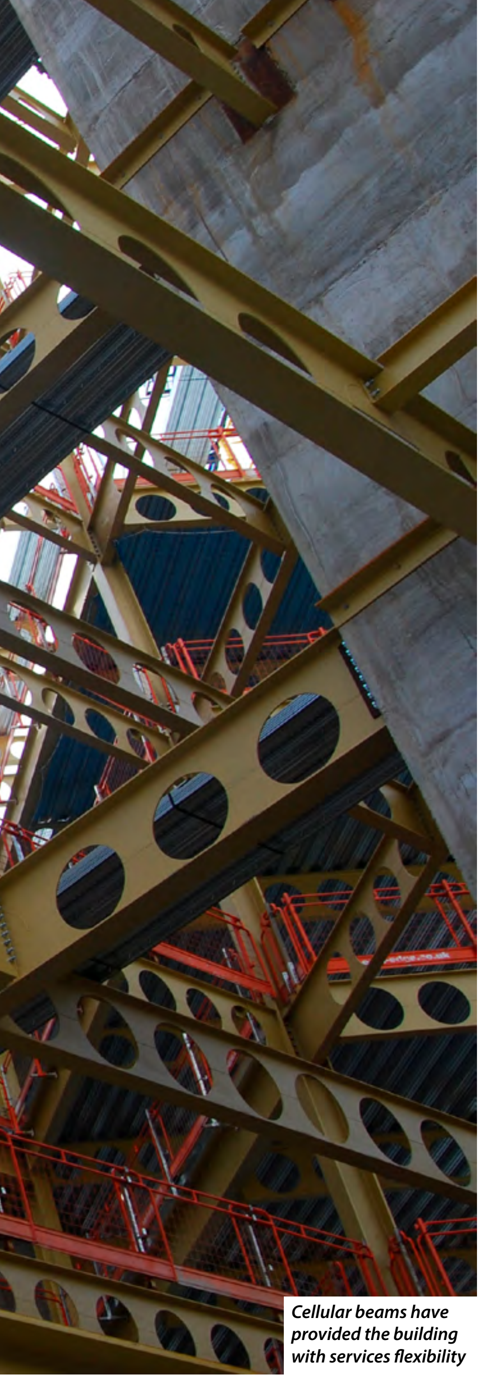
The roof slopes down from the southern façade and conceals a plant deck, while the rooftop of the narrowest part of the wedge accommodates an outdoor terrace for the topmost offices.

Arup did the original concept design for No.6, and this was then value engineered by the Shepherd Construction-led project team to make it as efficient as possible (see above right).

"By using cellular beams throughout the building we've made the steel frame lighter and more cost-effective," says Shepherd Construction Project Manager Dan Miller. "A lighter frame requires shallower foundations which means we have a quicker programme."

Prior to Billington Structures starting its steel erection programme Shepherd had completed the project's early works. These included digging out the basement car park, constructing the concrete retaining walls and installing CFA piled foundations.

Two main concrete slip-formed lifts cores, along with three smaller stair cores, provide the steel frame with its stability.



Cellular beams have provided the building with services flexibility

# Cellular solution

ASD Westok engineers worked closely with Shepherd Construction and Billington Structures to value engineer the frame.

The floor beam solution comprises 11.8m span Westok floor beams spaced at 3.75m centres. The architect had placed a 700mm depth limit on the beams, and so Westok provided a minimum 500mm diameter cell hole across the full width of each floor beam. This ensures the current service requirements are met, and also provides for maximum flexibility in future-proofing the service needs of the building.

ASD Westok Design Team Leader John Callanan comments: "This is a very good example of the return of the commercial office sector. As we move out of recession, we've noticed a significant upturn in steel-framed office developments."

6 Wellington Place forms part of a rapidly expanding city centre business and residential scheme

The steel columns begin at basement slab level and a regular grid pattern, based around columns spaced at 7.5m and 11.8m centres, extends upwards to roof level.

A slightly higher floor-to-ceiling height of 5.5m is accommodated within the ground floor, which will house the office entrance foyer and some retail units. Another prominent feature is the centrally positioned full-height atrium that will allow natural light to penetrate the building's inner zones.

The majority of the project's steelwork has been erected using the on site tower crane working in conjunction with two MEWPs, each with a 40m-high maximum reach.

"The only exception was a 6.5t transfer beam at first floor level supporting two 24m high, five-storey columns across the 10m-wide opening required for the basement car park entrance," says Billington Structures Project Manager Dave Higgins.

This was the heaviest steel member erected for the job and it required Billington to bring a 60t-capacity mobile crane to site.

However this wasn't the largest piece of craneage needed for the steel programme. As the majority of the steel frame was erected from within the building's footprint, there came a point when the company had to complete the final grids from outside the footprint.

The MEWPs gained access onto the basement slab via a temporary ramp, but as the job progressed this had to be removed. This left the MEWPs, which weigh more than 20t each, with no way out other than being lifted.

"The MEWPs are very large and were chosen for their reach which proved to be invaluable during the erection programme, but to get them out of the basement we had to use a 220t-capacity mobile crane," says Mr Higgins.

Billington Structures completed the steel programme in February and, as well as erecting 700t of steelwork, the company also installed 3,000m of its easi-edge safety barriers and 14,000m² of metal decking.

6 Wellington Place is scheduled for completion in December.

The building offers six floors of modern office space

# Steel passes university challenge

Structural steelwork is playing a pivotal role in the construction of Phase one of Ulster University's new city centre campus.

**FACT FILE**
**Ulster University Belfast City Campus**
**Main client:** Ulster University
**Architect:** Fielden Clegg Bradley Studios
**Main contractor:** McLaughlin & Harvey
**Structural engineer:** Mott MacDonald
**Steelwork contractor:** Walter Watson
**Steel tonnage:** 750t

Phase one of Ulster University's ambitious plans to move from its 1970s suburban Jordanstown campus into Belfast city centre is rapidly taking shape.

By 2018 the university will have completed its £250M project with three new buildings providing 73,000m² of academic space in Belfast's Scotch and Cathedral Quarter – an important emerging cultural district.

Project architect Fielden Clegg Bradley Studios' vision for the scheme envisages the new campus stitching into the historic fabric of the city to combine social, retail and flexible learning spaces around new and enhanced streets and squares.

Aiming to achieve a BREEAM 'Excellent' rating the buildings will house six faculties positioned one next to another in order to spark creative debate and innovation between disciplines.

Block B occupies a plot on a prominent intersection

Explaining the reason behind the relocation, Ulster University Acting Vice Chancellor Professor Adair says: "The Jordanstown campus no longer meets our sustainability and carbon footprint targets so we are relocating to exemplar buildings."

"The new campus buildings will act as a catalyst for regeneration, as well as reaching out to the community by being inclusive with public thoroughfares and amenities."

The initial structure to be built is known as Block B and straddles the busy intersection of Great Patrick Street and York Street. It recently topped out and is due to open this September. It is being built next to the university's existing Belfast School of Architecture, which is currently known as Block 82, although it will be renamed Block A to fit into the overall development programme.

Aiming to achieve a BREEAM 'Excellent' rating, Block B is an eight-storey steel-framed compositely designed building which will house the University's School of Art Design and the Built Environment.

A steel frame best suited the needs for this project as it is a utilitarian building incorporating a number of flexible teaching spaces," explains Mott MacDonald Project Engineer Derek Burnside.

Block B is split into a five-storey base that reflects the heights along York Street and adjacent Block 82, and topped with a cantilevering three-level studio box/lantern.

The protruding upper space is said to reflect the new and emerging architecture that is starting to adorn Belfast's cityscape, while at the same time harking back to the Victorian turrets and towers that many prominent street corners once had.

The cantilevering lantern will house the University's sculpture, painting and design studios. A three-storey void at one end of the lantern will accommodate an exhibition area for student's work.

"The large open-plan adaptable spaces will create a unique and exciting environment for our creative industry and

built environment student and teaching community, and also provides splendid views over Belfast," says Ulster University Project Director Paul Spray.

Although the cantilevering three-storey lantern was the last element of the steel frame to be erected by steelwork contractor Walter Watson, it involved the most challenging part of the erection programme.

The upper three floors cantilever out by 1.5m at both the front and rear elevations, while the eastern elevation overhangs by 10.5m at one end and by 4.5m at the other end forming a wedge shape.

To form the lantern, storey-high trusses positioned at roof level have been erected - a 10.5m-long and a 4.5m-long truss at each end of the structure with a 7.5m-long truss located half way between the two. The eighth floor is within the trusses' depth, while the two floors below (6th and 7th) are hung from the trusses.

The trusses had to be installed in erectable sections, while the upper floors were temporarily braced. As the three

*The building is topped by a feature cantilevering three-storey lantern*

*"The large open-plan adaptable spaces will create a unique and exciting environment…"*

cantilevering floors are hung and supported from the trusses, the temporary steel was only removed when the floors were complete and stability guaranteed.

The aim of providing adaptable and flexible 21st Century teaching spaces throughout the building is evident on all floors of Block B.

Most of the structure's teaching floors can be reconfigured with ease, thereby creating areas suitable for specific needs.

The lower floors of Block B will accommodate a two-level library on the ground and first floors, computing suites, a student hub housing more adaptable teaching spaces, printworks, a sculpture department with kilns as well as woodwork and metal workshops.

Floors two, three and four of the building will connect into the existing Block 82. These mid-levels combine workshop, studio and office space for the Faculty of the Built Environment.

Although it connects into and is adjacent to an existing building, Block B is a structurally independent steel-framed building. It has been erected around a typical grid pattern of 9.75m × 6m with the steel frame getting its stability from concrete lift and stair cores.

"Beams connect to the cores via shear connectors and as part of our steel package we were responsible for the coring and fixing of these connectors," explains Walter Watson General Manager Structural Division Trevor Irvine.

"Overall this was a very challenging site for us as the building's footprint takes up almost the entire site. We have existing buildings on two sides and busy main roads on the other two sides, so bringing materials to site was difficult and had to be done on a just-in-time basis," sums up Mr Irvine.

# Phase two

Phase two of Ulster University's campus is about to kick off on an adjacent plot and consists of two more new buildings (Blocks C and D).

The two buildings will have eleven and eight storeys respectively and house the Centre for Sustainable Technologies, lecture theatres, exhibition space, eateries and wide circulation routes, many of which will be accessible to the general public.

A steel footbridge, spanning York Street, will be erected to connect Phase two with Block B.

*Screwfix is enlarging its current distribution centre*

# Steel supplies DIY merchant

One of the country's leading DIY and building trade suppliers is expanding one of its distribution centres with steel construction.

**FACT FILE**
**Screwfix Distribution Centre, Stoke-on-Trent**
**Main client:** Screwfix
**Developer:** St Modwen
**Architect:** RPS
**Main contractor:** Winvic Construction
**Structural engineer:** RPS
**Steelwork contractor:** Caunton Engineering
**Steel tonnage:** 1,270t

Building work is under way to expand Screwfix's Trentham Lakes depot in Stoke-on-Trent.

Screwfix, which is part of the Kingfisher group, supplies trade tools, accessories and hardware products.

The expansion will double the size of the existing facility to approximately 58,500m$^2$; and create more than 100 full-time positions as well as safeguarding 421 existing jobs on the site. The company has also said a further 200 jobs could be created in the future.

Trentham Lakes is recognised as a premier distribution, industrial, and mixed-use business park in Stoke-on-Trent. It is home to Stoke City FC's Britannia Stadium, as well as a hotel, restaurants, car showrooms, and major distribution and manufacturing companies.

Screwfix Chief Executive Andrew Livingston says: "The current building has been here for around a decade and holds 40,000 different products. This expansion allows us to hold more products to help keep up with the demand.

"Stoke-on-Trent is a great area for distribution because of where it is located. It allows us to deliver to stores and customers in Scotland as well as all the way to the south of the country."

St Modwen Development Manager Euan Lindsay says the expansion had been planned for years.

He comments: "It is a very exciting development considering we have been in discussion with the company since November 2011.

"The investment demonstrates the fact that there is a general feeling of economic recovery and we are hopeful this will be a catalyst for other businesses coming here."

Working on behalf of Winvic Construction, (the company that also built the existing depot) Caunton Engineering has supplied 1,270t of structural steelwork for the project, a total that includes 200t of cold rolled steel.

The overall steel frame for the extension is a stand-alone structure with its nearest line of columns 3m away from the existing distribution centre.

"This means the new steel frame is structurally independent, as it gets stability from its own vertical bracing systems and doesn't impose any loads on the older building," says Caunton Engineering Project Designer Colin Winter.

The new steel frame cantilevers from its last line of columns to within 50mm of the existing building, with cladding details then creating a seamless join between the two

*The structure features three storeys of mezzanines*



The portal frames near completion

*"The investment demonstrates the fact that there is a general feeling of economic recovery and we are hopeful this will be a catalyst for other businesses coming here."*

steel frames and thereby forming one large building.

In total the extension is 18m high, 246m long and 122m wide. It is a twin propped portal frame with two 61m spans. Perimeter columns are spaced at 8.5m centres, while internally columns are spaced at 17m, with every other member omitted in a 'hit and miss' design configuration.

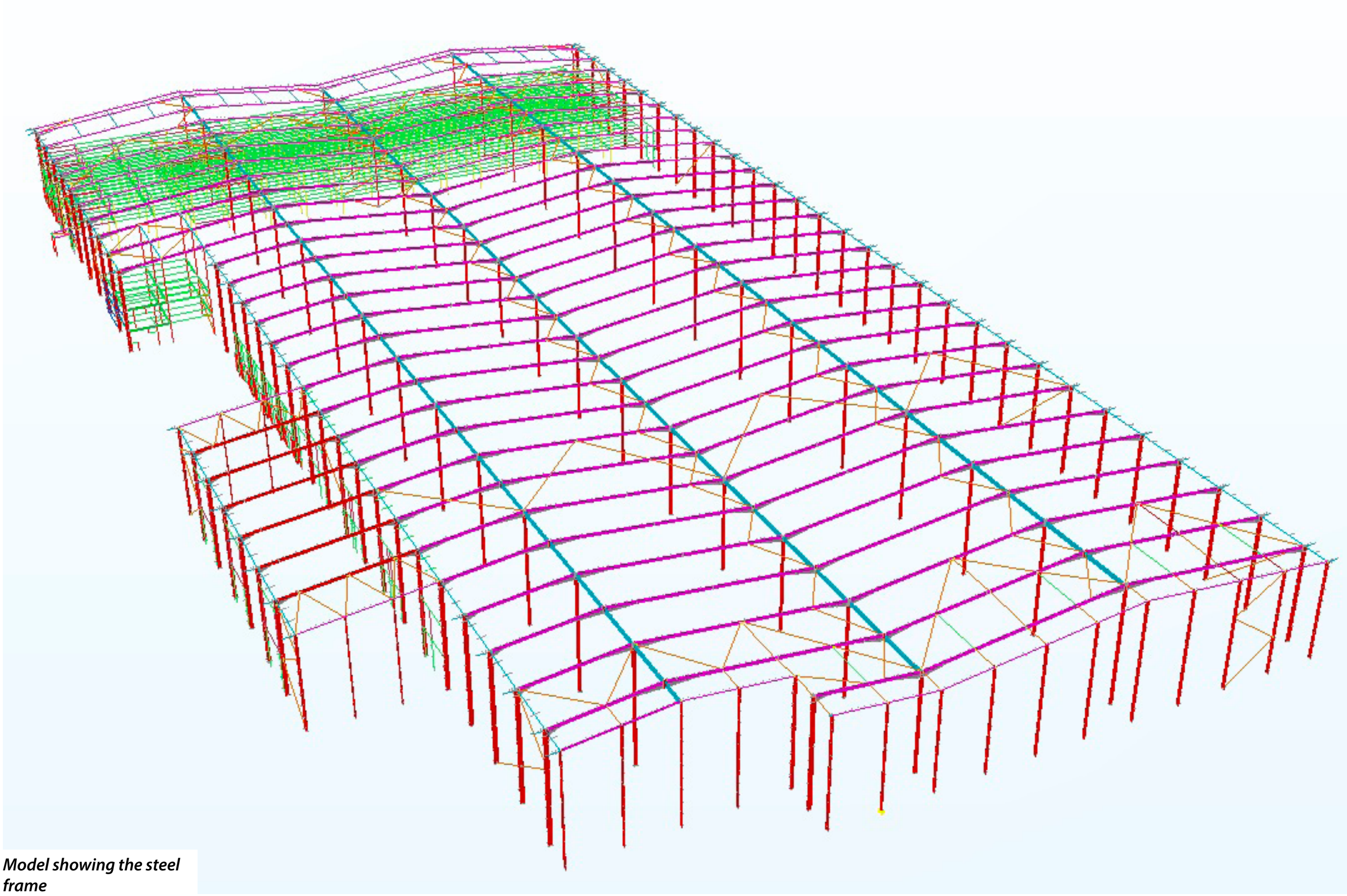
"The roof rafters have a heavily haunched connection and were brought to site in 15m lengths," adds Mr Winter.

Once bolted into 30m sections two mobile cranes lifted the rafters into position in a tandem operation.

Three bays of the extension accommodate three internal mezzanine levels. Two of these compositely formed floors cover the entire width of the building, while the third level is slightly smaller and only covers approximately two-thirds of the width.

For ease of programme, Caunton Engineering erected the main frame of the extension first and then proceeded to install the mezzanine levels afterwards.

The distribution centre is scheduled for completion by the end of the year.



*Model showing the steel frame*

# Portal Frames

Dr Richard Henderson of the SCI

In 2014, approximately 45% of the UK consumption of constructional steelwork in the UK was used in single-storey buildings for industrial, retail and leisure use. In this market sector, portal frames are the most common structural form in pitched roof buildings. This type of building is lightweight, structurally efficient and familiar to UK designers in both design and detailing.

The structural form offers flexibility in building arrangement and functionality. The basic form of the single-span pitched portal frame can be easily extended to include multiple spans; hit and miss frames to reduce the incidence of internal columns; apex props to reduce fabrication and increase the roof area without using valley gutters and internal rainwater down pipes; EOT (Electric Overhead Travelling) cranes on runway beams supported on brackets or lattice columns.

Portal frames are continuous structures with rigid joints which are necessary to provide stability in the plane of the structure. This feature differentiates the structural form from that with which engineers are most familiar: namely braced frames of simple construction. In this form of construction, beam-to-column joints are assumed to carry shear only and lateral stability is provided by braced or concrete cores. Portal frames with pinned feet only require two hinges in the frame to form a mechanism in the plane of the frame. This fact means that the plastic design of portal frames is relatively straightforward. Plastic design is efficient where strength is the limiting criterion because redistribution of load after the formation of one plastic hinge means that the material is used more efficiently than for elastic design.

The design of steel portal frames was comprehensively covered in BS 5950-1 which devoted a whole section to advice on portal frame design. BS EN 1993-1-1 does not cover portal frames in such depth; design principles and general application rules are provided, not detailed and exhaustive design rules. Software packages based on the detailed treatment in BS 5950-1 have been used for many years and this means most computer-designed portal frames are based on BS 5950-1.

The SCI is soon to publish a document on portal frames to Eurocode 3 which will provide guidance to designers and assist software developers to write software to carry out design verification to BS EN 1993-1-1:2005.


*The bridge in its fan-like open position*

# Bridgework is steel fan

Since officially opening last year the Merchant Square Footbridge has quickly become a local landmark especially when the spectacular opening occurs.

**FACT FILE**
**Merchant Square Footbridge, London**
**Main client:** European Land & Property
**Architect:** Knight Architects
**Main contractor:** Mace
**Structural engineer:** AKT II
**Steelwork contractor:** S H Structures
**Steel tonnage:** 140t

Located in west London's Merchant Square, a mixed-use waterfront site at Paddington basin, a landmark movable footbridge has recently opened to the public.

The structure has instantly become a local icon because when it opens its steel deck beams unfurl individually like a Japanese hand fan, presenting onlookers with a unique event.

Connecting the office buildings that are situated on either side of the Grand Union Canal at Merchant Square, the bridge was designed by Knight Architects working alongside structural engineers AKT II.

The bridge replaces a redundant crossing and the project was a planning requirement.

Inspiration for the fan-like design came from the desire to have an easy to maintain structure, one that was not too challenging to build and which would become a landmark.

The client also wanted a bridge that would reflect the quality of the surrounding offices, as well as improving the connectivity across the basin.

European Land & Property CEO Richard Banks, said: 'Bridges are a crucial element of the built environment at Merchant Square and, therefore, it was important for the new footbridge crossing the canal to enhance the public realm, not only practically but visually."

The bridge's location is near the very end of Paddington Basin with only permanently moored business barges beyond it, so it is not expected that the structure will need to accommodate through marine traffic.

However, the Canal & River Trust stipulated that bridges in the area should not obstruct any vessel navigation, which is why it is necessary that the bridge can be raised.

Knight Architects Project Architect


*Steelwork leaves S H Structures' facility*

*Steel was delivered to site by barge*

Bart Halaczek, says: "Our competition-winning design concept is both simple and spectacular. A lifting bridge was the only realistic option for this tight footprint as there is no room for pedestrian ramps."

Choosing the correct material for the bridge was an important consideration. The design team says it looked at a number of materials and steel was finally chosen, as it is relatively lightweight and easy to fabricate.

Steelwork contractor S H Structures fabricated, supplied and erected the bridgeworks.

Five tapered 600mm wide fabricated steel beams form the deck of the structure. Each beam varies in depth and section depending on its position in the opening sequence – although they all span roughly 17m.

The beams all operate independently and are attached to a feature counterweight. The opening relies on a pivot point with a bearing at the end of each beam that allows them to be lifted in sequence by a hydraulic ram.

"The accuracy of the fabrication and installation tolerances were critical to the success of this project so the dimensional control required throughout the build process was of paramount importance," says S H Structures Sales & Marketing Manager Tim Burton.

One of the bridges's key architectural features are the counterweights which are formed from rolled plate to form 'blade' like elements which slowly rotate with the fingers as the bridge is operated and lie flush with ground level when the bridge is fully open. S H Structures says the finish of these elements was critical to the overall aesthetic of the bridge.

The counterweights assist the bespoke mechanism that includes hydraulic rams, to reduce the energy required to move the structure.

Balustrades, formed from twin rows of inclined stainless steel rods, protect pedestrians using the bridge deck.

These handrails contain continuous LED down lighting that both illuminates the structure's walking surface and presents a vibrant display of light.

The site's location presented the construction team with a number of challenges, especially when it came to installing the steelwork.

"Access to the site for deliveries and conventional crane operation was not possible which meant that the fabricated elements had to be loaded onto a barge further up the canal and then towed to site for installation," explains Mr Burton.

"Lifting operations were restricted to the use of a barge-mounted crane that only had limited capacity, so the installation was challenging but in the end went very well."

Photo: Peter Cook

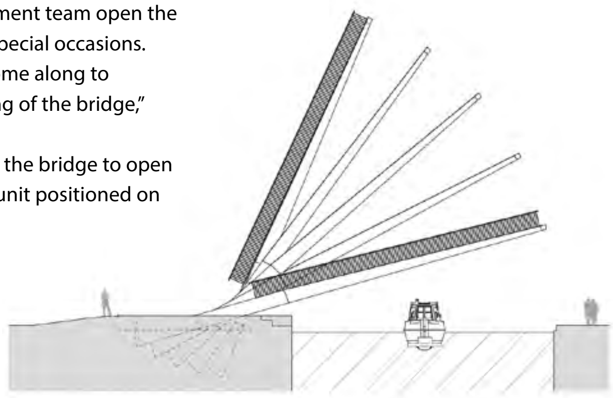
## Controls

Members of the Merchant Square management team open the bridge every Friday at noon, as well as on special occasions.

"It's become a local event and people come along to specifically watch the opening and unfurling of the bridge," says Mr Halaczek

It takes approximately three minutes for the bridge to open and it is operated manually from a control unit positioned on a stainless steel plinth 15m away from the bridge.

Behind the bridge there is a pit for the hydraulic rams, while in an adjacent car park there is a facility for the structure's pumping gear.



# Design of cold-formed portal frames

David Brown of the SCI discusses some of the issues to be considered when designing portal frames constructed from cold-formed steel.

## Background

Though apparently simple, all portal frames exhibit challenging forms of structural behaviour, including second-order effects and reversing combinations of loading.

Portal frames constructed from cold-formed steel members (typically back-to-back C sections, less than approximately 3 mm thickness) have additional effects from flexible connections at the eaves and apex. Many such frames are provided for the agricultural sector and are designed to BS 5502-22[1]. Frames designed to this Standard fall outside the Building Regulations and are not subject to any independent checks (the situation in Scotland may be different).

Cold-formed steelwork may be particularly attractive for modest span frames, being lightweight, accurately produced on numerically controlled machinery, requiring no welding and producing a cost-effective solution.  Some suppliers are able to provide designs, details, (including cladding, doors, windows etc), a complete material listing, manufacturing information and a final cost immediately a structural outline is conceived.

When cold-formed portal frames first made a significant appearance in the UK, the technology was largely imported from Australia, incorporating many of the cross-sectional profiles and details. Preliminary investigations by SCI in 1996 led to an article in *New Steel Construction*[2], pointing out the very significant concerns with merely transferring designs from Australia to the UK.

In the winter of 2009-2010, a number of structures in Scotland collapsed under snow loading. Confidential reports indicate over 400 agricultural buildings collapsed. OneEngineer with extensive experience in the design and construction of agricultural buildings commented:

> *"All of the snow affected buildings which I have seen have had problems of compression or lateral torsional buckling failure or distress of either the rafter, the rafter haunch bottom flange or the inside flange of the upper section of the Columns. Attention to detailing in these areas, particularly with respect to web/morris stiffeners, rafter and side rails stays, which give designed torsional buckling stability to the rafters and columns require highlighting to the agricultural steel frame supply industry."*

Public resources from 2011 reported that over the previous two winters, 4000 buildings collapsed under the weight of snow[3]. In 2013, the insurer, NFU Mutual, noted in April 2013 that the collapses were split about 50:50 between modern farm buildings and more traditional farm buildings.[4] NFU mutual also commented that "there is an ongoing concern that the specifications that are in place for farm roofs are good enough".  There is nothing in these comments to indicate cold-formed portals are particularly badly designed; the same good engineering is required for all structures.

## Connection flexibility

Typically, eaves and apex connections in cold-formed portals are detailed with a steel plate sandwiched between the two back to-back channel sections. The channel sections are bolted through the plate, or screwed to the plate. Because the channel sections are thin, (and the plate between may be thin) there is considerable deformation of the material under load, which results in very significant connection flexibility.

Connection flexibility has been investigated by several researchers, including Lim and Nethercot in 2002[5]. Lim and Nethercot note that there will be considerable redistribution of bending moment around the frame as a result of the connection flexibility.

Lim and Nethercot provide a dramatic illustration of the effect of connection flexibility by providing results for the vertical deflection at the ridge, for the two frames they studied. Figure 1 is a representation of Figure 11 from Lim and Nethercot, showing apex deflection.

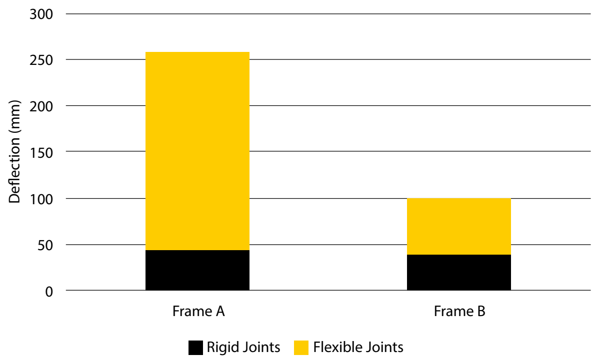



***Figure 1: Apex deflection***

In Figure 1, the deflection coloured black is the deflection assuming a rigid frame. The deflection coloured gold is the deflection due to bolt-hole deformation – in effect the flexibility of the connection. In Frame A, the apex deflection assuming rigid joints is approximately 45 mm. When the effects of connection flexibility are added, the deflection increases to approximately 260 mm.

In order to examine the effects of connection flexibility on the bending moments around the frame, and on in-plane stability, SCI modelled Frame A (tested by Lim and Nethercot), under the same loading, with identical member stiffness. The connection flexibility was also modelled and calibrated against the test results.

## Connection flexibility and bending moment

Modelling Frame A with rigid joints produces an apex deflection of 42 mm. This seems to correspond well with Figure 1.

With rigid joints, the bending moment diagram is shown in Figure 2.

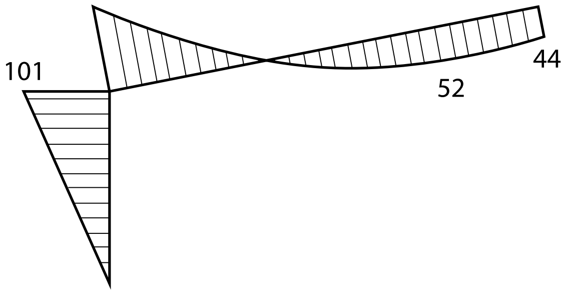



*Figure 2: Bending moment diagram with rigid joints (kNm)*

When the connection flexibility is allowed for, the deflection at the apex was 234 mm. This seems to correspond reasonably well with Figure 1.

Accounting for connection flexibility, the bending moment diagram is shown in Figure 3.

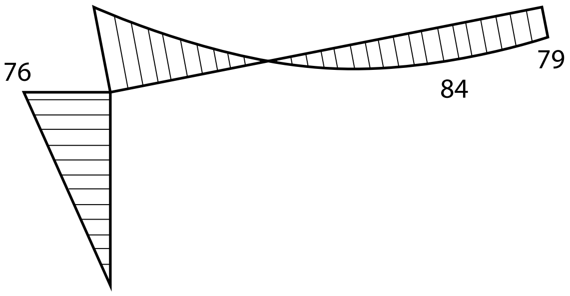



*Figure 3: Bending moment diagram with flexible joints (kNm)*

With flexible joints, the maximum sagging moment has increased by 60%. This is not the final design moment, because as will be seen in the next section, second-order effects become significant and the bending moments shown in Figure 3 must be amplified to allow for this effect.

## Connection flexibility and in-plane stability

The assessment of in-plane stability followed the procedure given in *Eurocode 3 and the in-plane stability of portal frames*[6].

### Rigid joints

With rigid joints, the lateral deflection at the top of the column was 0.74 mm

$$\text{Thus} \quad \alpha_{cr} = \frac{3000}{200 \times 0.74} = 20.2$$

No base stiffness was considered in this calculation, as the typical details are considered to be pinned.

$N_{cr}$ was calculated to be 772 kN. From the analysis, $N_{ed}$ = 40 kN.

$$\text{Thus} \quad \alpha_{cr,est} = 0.8\left[1 - \frac{40}{772}\right] \times 20.2 = 15.3$$

Because $\alpha_{cr}$ is greater than 10, second-order effects are small enough to be ignored; no amplification is necessary.

### Flexible joints

With flexible joints, the lateral deflection at the top of the column was 2.65 mm

$$\text{Thus} \quad \alpha_{cr} = \frac{3000}{200 \times 2.65} = 5.66$$

$$\text{Thus} \quad \alpha_{cr,est} = 0.8\left[1 - \frac{40}{772}\right] \times 5.66 = 4.29$$

Because $\alpha_{cr}$ is less than 10, second-order effects must be allowed for.

$$\text{The amplification} = \frac{4.29}{4.29 - 1} = 1.3$$

Applying this amplifier to the bending moments shown in Figure 3, the design bending moments are shown in Figure 4.

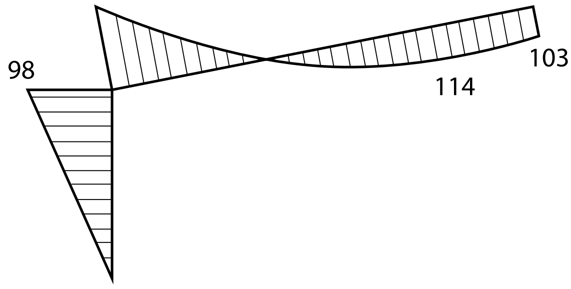



*Figure 4: Amplified bending moment diagram with flexible joints (kNm)*

Allowing for connection flexibility has increased the design moment in the sagging zone from 52 kNm to 110 kNm. Allowing for the connection flexibility has resulted in a frame where second-order effects are very significant; these are small enough to be ignored if rigid joints are assumed.

## Member verification

All member verifications are carried out between restraints. Unless these are specifically provided for, it cannot be assumed that the inside flange is restrained. Purlin and side rail positions on the outside flange cannot be assumed to provide restraint to the inside flange.

## Conclusions

1. Connection flexibility must be allowed for in design. The bending moment diagram changes dramatically, with the potential that members are verified for only 50% of the design moment. The apex joint is likely to experience a moment around twice that predicted by a rigid frame analysis. In the Lim and Nethercot study, the frames failed at the apex joint, which had a resistance higher than required for a rigid-jointed frame.
2. Connection flexibility must be allowed for when assessing in-plane stability. Connection flexibility will reduce the in-plane stability significantly. In the frame considered in this article, the assessment of the frame changed from apparently very stiff (αcr = 15.3) to one where second-order effects are very significant (αcr = 4.29)
3. The member verification checks must be compatible with the actual details of restraint. It is not appropriate to assume that every purlin or rail provides restraint to the inside flange, unless such restraints (straps, braces or other detail) are provided and installed.

## References


1 BS5502-22
Buildings and strictures for agriculture – Part 22: Code of practice of design, construction and loading. BSI, 2013

2 Brown, D. G.
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New Steel Construction, May 2006

3 http://www.stackyard.com/news/2011/04/buildings/01_snow_collapse.html

4 http://www.yorkshirepost.co.uk/news/rural/farming/insurer-counting-the-cost-of-farm-building-roof-collapses-1-5586285

5 Lim, J. B. P. and Nethercot, D. A.
Design and development of a general cold-formed steel portal framing system
The Structural Engineer, November 2002

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Eurocode 3 and the in-plane stability of portal frames
The Structural Engineer, November 2005


# Lanchester College of Technology

The Lanchester College of Technology, Coventry, named after F. W. Lanchester the famous local engineer and motor car designer, has considerably grown and broadened its horizons since 1958, following the increased national emphasis on advanced technical education. The College occupies an important urban position in the centre of the town close to the east side of the new Cathedral and, when completed, will constitute a major part of an interesting educational and civic precinct, which includes the Central Swimming Baths, an Art College, and Art Gallery and Museum.

The earlier building phases of the college have concentrated on providing teaching, laboratory and workshop accommodation in four buildings on the site. The last phase has been concerned with the provision of two buildings, one housing the Students' Union and the other the administration and main lecture theatre for the College. These two buildings, lying close to the cathedral, require to be of a quiet and dignified expression but also truly representative of technology.

In order to achieve a coherence of design between the two college buildings and 80-in planning module has already been adopted elsewhere on the site and expressed as vertical steel joint mullions. These factors led to the investigation of using steelwork and precast concrete floors in the construction of the two last buildings and, when impartially considered on costs relative to other forms of construction, it was found that a steel frame offered the most economic solution.

The Students' Union building (Block E) contains the main assembly hall of the College, the Students' Union offices and the College dining rooms and kitchens. Structurally, the principal requirement was for a clear span hall measuring 60 ft. by 106 ft. by 22 ft. high, with car park below and dining room above on the top floor. In general the principal stanchions lie just within the external walls and the beams extend outwards to carry horizontal channels to which the 8 in. by 5½ in. steel joist mullions are fixed at 6 ft. 8 in. centres. These also serve to carry the steel glazing and pressed steel sandwich infill panels fixed to the rear flange by means of stud bolts welded on before delivery to the site.

The hall is spanned by inverted Warren girders at 20-ft. centres. The beech slat finish of the ceiling follows the contours of the underside of the trusses, thereby increasing the area of natural lighting. The mezzanine floor is suspended between the upper ground floor and the first floor to contain the lavatory facilities for the dining and common rooms.

Block F houses the administrative offices in addition to the 6,000 sq. ft. library on the ground floor and a raked lecture theatre on the first floor, rising

above the roof: it seats 276 persons. In this block the steel frame is carried from internal stanchions to the external steel joist mullions, again at 6 ft. 8 in. centres, which also serve to support the steel glazing fixed in the manner described earlier. In order to avoid the problems involved in taking the external steelwork into the ground, the mullions have been stopped off just below the suspended ground floor and tied back to a perimeter beam which is situated on the plinth wall round all sides of the building.

The lecture theatre was constructed in 20-ft bays with cambered castellated beams spanning 60 ft. - the splayed shape of the auditorium being attained by building up blockwork walls within this framework. Large steel raking joists carry transverse angles for the support of permanent steel shuttering for the in-situ concrete tiering to which the seats are fixed. Externally, the steelwork was cleaned and given one coat of red lead primer, in addition to the manufacturer's primer, and finished with two coats of oil paint.

The architect for this project was Arthur Ling, B.A., F.R.I.B.A., M.T.P.I., then City Architect and Planning Officer; and the consultant engineer was Granville Berry, M.Inst.C.E, M.Inst.Mun.E, A.M.I.W.E, City Engineer and Surveyor.


# The 'Sunday Times' builds in Steel

In 1937 a steel frame building for the *Daily Sketch* was constructed in Gray's Inn Road, London. It was erected only up to second floor level, with allowance for the addition of four more storeys at a future date. The war brought the scheme abruptly to a halt.

Subsequently Thomson Newspapers acquired the property and in 1960 decided to complete the building by adding five storeys instead of four allowed for in the original scheme. This was accomplished by reducing the superimposed floor loading, through employing lighter forms of construction and making use of the higher stresses now accepted. The weight of the steelwork involved in this part of the scheme is in the region of 650 tons.

The design of the original structure was of a traditional nature, which was abandoned when the work was recommenced. It was, however, necessary to follow up the original stanchion lines, which one would have preferred to avoid had it been possible. The difficulty was overcome by carrying the curtain walling outside the stanchions so they do not appear on the exterior except at ground level.

An interesting feature is the way in which steel has been employed to give a clear span in the basement housing the 30-ft. high presses. There is, in fact, a clear span of 69 ft. To achieve the necessary strength the upper floors are carried on 30 plate girders 59 in. deep each weighing 25 tons. There is a complete absence of stanchions, so allowing the presses with their conveyors and switch-gear to be installed in straight lines, without the need for manoeuvring around roof supports.

As mentioned earlier, the design of the building differs completely from that originally planned. It was felt that the time had come to make the curtain walling much more interesting than in the past. This was made by a leading window manufacturer and 'mock-ups' were carefully studied at their works before commencing production. Glass with a sealed copper backing was used for finishes and set in aluminium frames. Black granite panels set in similar frames were selected in lower parts of the building to give contrast to the area above. Around the top is a parapet of coloured plastic coated steel.

# Steelwork contractors for buildings

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

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

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

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

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

**QM** Quality management certification to ISO 9001
**SCM** Steel Construction Sustainability Charter
(● = Gold, ● = Silver, ● = Member)

**Notes**

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

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

| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A C Bacon Engineering Ltd | 01953 850611 | | | ● | ● | | ● | | | | | | | | | | 2 | | Up to £2,000,000 |
| A & J Stead Ltd | 01653 693742 | | | ● | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £100,000 |
| Access Design & Engineering | 01642 245151 | | | | ● | ● | | | ● | ● | ● | | | ● | ● | ✔ | 2 | | Up to £4,000,000 |
| Adey Steel Ltd | 01509 556677 | | | | ● | ● | ● | ● | | ● | ● | | | ● | ● | ✔ | 3 | Silver | Up to £2,000,000 |
| Adstone Construction Ltd | 01905 794561 | | | ● | ● | ● | ● | | | | | | | | | ✔ | 2 | Silver | Up to £3,000,000 |
| Advanced Fabrications Poyle Ltd | 01753 653617 | | | | ● | ● | ● | ● | ● | ● | ● | | | | ● | | 2 | | Up to £800,000 |
| AJ Engineering & Construction Services Ltd | 01309 671919 | | | ● | ● | | | | | ● | ● | | | ● | ● | ✔ | 4 | | Up to £1,400,000 |
| AKD Contracts Ltd | 01322 312203 | | | | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £100,000 |
| Angle Ring Company Ltd | 0121 557 7241 | | | | | | | | | | | | ● | | | ✔ | 4 | | Up to £1,400,000 |
| Apex Steel Structures Ltd | 01268 660828 | | | ● | ● | ● | ● | | | ● | ● | | | ● | | | 2 | | Up to £1,400,000 |
| Arminhall Engineering Ltd | 01799 524510 | ● | | | ● | ● | | ● | | ● | ● | | | ● | ● | ✔ | 2 | | Up to £400,000 |
| Arromax Structures Ltd | 01623 747466 | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | 2 | | Up to £800,000 |
| ASA Steel Structures Ltd | 01782 566366 | | | ● | ● | ● | ● | | | ● | ● | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| ASD Westok Ltd | 0113 205 5270 | | | | | | | | | | | | ● | | | ✔ | 4 | | Up to £6,000,000 |
| ASME Engineering Ltd | 020 8966 7150 | | | | ● | ● | | | | ● | ● | | | ● | ● | ✔ | 3 | Silver | Up to £1,400,000 |
| Atlasco Constructional Engineers Ltd | 01782 564711 | | | ● | ● | ● | ● | | | | ● | | | ● | ● | ✔ | 2 | | Up to £1,400,000 |
| Austin-Divall Fabrications Ltd | 01903 721950 | | | ● | ● | | ● | ● | | ● | ● | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| B D Structures Ltd | 01942 817770 | | | ● | ● | ● | ● | | | | ● | ● | | ● | | ✔ | 2 | | Up to £800,000 |
| Ballykine Structural Engineers Ltd | 028 9756 2560 | | | ● | ● | ● | ● | ● | | | | ● | | | | ✔ | 4 | | Up to £1,400,000 |
| Barnshaw Section Benders Ltd | 01902 880848 | | | | | | | | | | | | ● | | | ✔ | 4 | | Up to £1,400,000 |
| BHC Ltd | 01555 840006 | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | | ● | ● | ✔ | 4 | | Above £6,000,000 |
| Billington Structures Ltd | 01226 340666 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✔ | 4 | Gold | Above £6,000,000 |
| Border Steelwork Structures Ltd | 01228 548744 | | | ● | ● | ● | ● | | | | ● | | | | ● | | 2 | | Up to £3,000,000 |
| Bourne Construction Engineering Ltd | 01202 746666 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✔ | 4 | Gold | Above £6,000,000 |
| Briton Fabricators Ltd | 0115 963 2901 | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ✔ | 4 | | Up to £3,000,000 |
| Builders Beams Ltd | 01227 863770 | | | | ● | | | | | ● | | | | ● | ● | ✔ | 2 | | Up to £1,400,000 |
| Cairnhill Structures Ltd | 01236 449393 | ● | | | ● | ● | ● | ● | ● | ● | | | | ● | ● | ✔ | 4 | Gold | Up to £3,000,000 |
| Caunton Engineering Ltd | 01773 531111 | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | ● | ● | ✔ | 4 | Gold | Up to £6,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✔ | 4 | Gold | Above £6,000,000* |
| CMF Ltd | 020 8844 0940 | | | | ● | | ● | ● | | ● | ● | | | | ● | ✔ | 4 | | Up to £6,000,000 |
| Cook Fabrications Ltd | 01303 893011 | | | | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £800,000 |
| Coventry Construction Ltd | 024 7646 4484 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| D H Structures Ltd | 01785 246269 | | | ● | ● | | ● | | | | ● | | | | | | 2 | | Up to £100,000 |
| Duggan Steel Ltd | 00 353 29 70072 | | ● | ● | ● | ● | ● | ● | | | ● | | | | | ✔ | 4 | | Up to £4,000,000 |
| ECS Engineering Services Ltd | 01773 860001 | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ✔ | 3 | | Up to £2,000,000 |
| Elland Steel Structures Ltd | 01422 380262 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✔ | 4 | Gold | Up to £6,000,000 |
| EvadX Ltd | 01745 336413 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ✔ | 2 | Gold | Up to £3,000,000 |
| Four Bay Structures Ltd | 01603 758141 | | | ● | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Fox Bros Engineering Ltd | 00 353 53 942 1677 | | | ● | ● | ● | ● | ● | | | ● | | | | ● | | 2 | | Up to £2,000,000 |
| Gorge Fabrications Ltd | 0121 522 5770 | | | | ● | ● | ● | ● | | ● | | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| Gregg & Patterson (Engineers) Ltd | 028 9061 8131 | | | ● | ● | ● | ● | ● | | | | ● | | ● | | ✔ | 3 | | Up to £2,000,000 |
| H Young Structures Ltd | 01953 601881 | | | ● | ● | ● | ● | ● | | | ● | | | ● | ● | ✔ | 2 | | Up to £2,000,000 |
| Had Fab Ltd | 01875 611711 | | | | ● | | | | ● | ● | ● | | | | ● | ✔ | 4 | | Up to £3,000,000 |
| Hambleton Steel Ltd | 01748 810598 | | ● | ● | ● | ● | ● | ● | | | | ● | | ● | | ✔ | 4 | Silver | Up to £2,000,000 |
| Harry Marsh (Engineers) Ltd | 0191 510 9797 | | | ● | ● | ● | ● | | | | ● | ● | | | ● | ✔ | 2 | | Up to £1,400,000 |
| Hescott Engineering Company Ltd | 01324 556610 | | | ● | ● | ● | ● | | | ● | | | | ● | ● | ✔ | 2 | | Up to £3,000,000 |
| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |

| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersteels Ltd | 01322 337766 | | | | ● | ● | ● | ● | | | | | ● | | | ✔ | 3 | | Up to £2,000,000 |
| J & A Plant Ltd | 01942 713511 | | | | ● | ● | | | | | | | | | ● | | 2 | | Up to £200,000 |
| James Killelea & Co Ltd | 01706 229411 | | ● | ● | ● | ● | ● | | | | | ● | | ● | | | 4 | | Up to £6,000,000* |
| John Reid & Sons (Strucsteel) Ltd | 01202 483333 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✔ | 4 | | Up to £6,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✔ | 4 | ● | 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 |
| Mabey Bridge Ltd | 01291 623801 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ✔ | 4 | ● | Above £6,000,000 |
| Mackay Steelwork & Cladding Ltd | 01862 843910 | | | ● | ● | | ● | | | ● | ● | | | ● | ● | ✔ | 4 | | Up to £800,000 |
| Maldon Marine Ltd | 01621 859000 | | | | ● | ● | | ● | ● | ● | | | | | ● | ✔ | 3 | | Up to £1,400,000 |
| Mifflin Construction Ltd | 01568 613311 | | ● | ● | ● | ● | ● | | | | ● | | | | | | 2 | | Up to £3,000,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | | | ● | | ● | | | | ● | | | | ● | ✔ | 4 | | Up to £1,400,000 |
| Newbridge Engineering Ltd | 01429 866722 | ● | | ● | ● | ● | ● | | | | ● | | | | ● | ✔ | 3 | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | | | | | | ● | ● | ● | ● | | | | | | ✔ | 4 | | Up to £4,000,000 |
| Overdale Construction Services Ltd | 01656 729229 | | | ● | ● | | ● | ● | | | ● | | | | ● | | 2 | | Up to £400,000 |
| Painter Brothers Ltd | 01432 374400 | | | | | | | | ● | | ● | | | | ● | ✔ | 2 | ● | 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 £3,000,000 |
| SDM Fabrication Ltd | 01354 660895 | ● | ● | ● | ● | ● | ● | | | | ● | | | ● | ● | ✔ | 4 | | 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 |
| 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 |

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

# Associate Members

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

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

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

**SCM** Steel Construction Sustainability Charter
(Gold) = Gold, (Silver) = Silver, (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 | | | | | | | | ● | | D/I | |
| Behringer Ltd | 01296 668259 | | | | | ● | | | | | | |
| BW Industries Ltd | 01262 400088 | ● | | | | | | | | | M | |
| Cellbeam Ltd | 01937 840600 | ● | | | | | | | | | M | |
| Cellshield Ltd | 01937 840600 | | | | | | | ● | | | N/A | |
| Cleveland Steel & Tubes Ltd | 01845 577789 | | | | | | | | ● | | M | |
| CMC (UK) Ltd | 029 2089 5260 | | | | | | | | ● | | D/I | |
| Composite Profiles UK Ltd | 01202 659237 | ● | | | | | | | | | D/I | |
| Cooper & Turner Ltd | 0114 256 0057 | | | | | | | | | ● | M | |
| Cutmaster Machines (UK) Ltd | 01226 707865 | | | | | ● | | | | | N/A | |
| Daver Steels Ltd | 0114 261 1999 | ● | | | | | | | | | M | |
| Duggan Profiles & Steel Service Centre Ltd | 00 353 56 7722485 | ● | | | | | | | ● | | M | |

# Steelwork contractors for bridgeworks

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

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

**FG** Footbridge and sign gantries
**PG** Bridges made principally from plate girders
**TW** Bridges made principally from trusswork
**BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
**CM** Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
**MB** Moving bridges
**RF** Bridge refurbishment
**AS** Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
**QM** Quality management certification to ISO 9001
**FPC** Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1 2 – Execution Class 2
3 – Execution Class 3 4 – Execution Class 4
**SCM** Steel Construction Sustainability Charter ((Gold) = Gold, (Silver) = Silver, (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] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Briton Fabricators Ltd | 0115 963 2901 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | | Up to £3,000,000 |
| Cairnhill Structures Ltd | 01236 449393 | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | | Gold | Up to £3,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ✓ | Gold | Above £6,000,000* |
| Four-Tees Engineers Ltd | 01489 885899 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 3 | | ✓ | Member | Up to £2,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | | ● | | ● | | | ● | ● | ✓ | 4 | | | Gold | Up to £3,000,000 |
| Mabey Bridge Ltd | 01291 623801 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ✓ | Gold | Above £6,000,000 |
| Millar Callaghan Engineering Services Ltd | 01294 217711 | ● | | | | | | ● | ● | ✓ | 4 | | | | Up to £800,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | ● | ● | | | | | ● | ✓ | 4 | | | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ✓ | | Up to £4,000,000 |
| Painter Brothers Ltd | 01432 374400 | ● | | ● | | | | | ● | ✓ | 2 | | | Gold | Up to £6,000,000 |
| S H Structures Ltd | 01977 681931 | ● | | ● | ● | ● | ● | | ● | ✓ | 4 | | ✓ | Silver | Up to £3,000,000 |
| Severfield (UK) Ltd | 01204 699999 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | Gold | Above £6,000,000 |
| **Non-BCSA member** | | | | | | | | | | | | | | | |
| Allerton Steel Ltd | 01609 774471 | ● | ● | ● | ● | | | | ● | ✓ | 4 | | ✓ | | Up to £4,000,000 |
| Centregreat Engineering Ltd | 029 2046 5683 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 4 | | | | Up to £400,000 |
| Cimolai SpA | 01223 350876 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | | | Above £6,000,000 |
| Concrete & Timber Services Ltd | 01484 606416 | ● | ● | ● | ● | ● | ● | | ● | ✓ | 4 | | | Member | Up to £800,000 |
| Donyal Engineering Ltd | 01207 270909 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | Member | Up to £1,400,000 |
| Francis & Lewis International Ltd | 01452 722200 | | | | | | | ● | ● | ✓ | 2 | | ✓ | Gold | Up to £2,000,000 |
| Harland & Wolff Heavy Industries Ltd | 028 9045 8456 | ● | ● | ● | ● | ● | | ● | ● | ✓ | 3 | | | | Up to £2,000,000 |
| IHC Engineering (UK) Ltd | 01773 861734 | ● | | | | | | | ● | ✓ | 3 | | ✓ | | Up to £400,000 |
| Interserve Construction Ltd | 0121 344 4888 | | | | | | | ● | ● | ✓ | 3 | | | | Above £6,000,000* |
| Interserve Construction Ltd | 020 8311 5500 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 3 | | | | Above £6,000,000* |
| Lanarkshire Welding Company Ltd | 01698 264271 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | | Member | Up to £2,000,000 |
| P C Richardson & Co (Middlesbrough) Ltd | 01642 714791 | ● | | | | | | ● | ● | ✓ | N/A | | | | Up to £3,000,000 |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| easi-edge Ltd | 01777 870901 | | | | | | | ● | | | N/A | ● |
| Fabsec Ltd | 0845 094 2530 | ● | | | | | | | | | N/A | |
| FabTrol Systems UK Ltd | 01274 590865 | | ● | | | | | | | | N/A | |
| Ficep (UK) Ltd | 01942 223530 | | | | | ● | | | | | N/A | |
| FLI Structures | 01452 722200 | ● | | | | | | | | | M | ● |
| Forward Protective Coatings Ltd | 01623 748323 | | | | | | ● | | | | N/A | |
| Goodwin Steel Castings Ltd | 01782 220000 | ● | | | | | | | | | N/A | |
| Graitec UK Ltd | 0844 543 8888 | | ● | | | | | | | | N/A | |
| Hadley Group Ltd | 0121 555 1342 | ● | | | | | | | | | M | ○ |
| Hempel UK Ltd | 01633 874024 | | | | | | ● | | | | N/A | |
| Highland Metals Ltd | 01343 548855 | | | | | | ● | | | | N/A | |
| Hilti (GB) Ltd | 0800 886100 | | | | | | | | | ● | M | |
| Hi-Span Ltd | 01953 603081 | ● | | | | | | | | | M | ○ |
| International Paint Ltd | 0191 469 6111 | | | | | | ● | | | | N/A | ● |
| Jack Tighe Ltd | 01302 880360 | | | | | | ● | | | | N/A | |
| Jamestown Cladding & Profiling Ltd | 00 353 45 434288 | ● | | | | | | | | | M | |
| John Parker & Sons Ltd | 01227 783200 | | | | | | | | ● | ● | D/I | |
| Joseph Ash Galvanizing | 01246 854650 | | | | | | ● | | | | N/A | |
| Jotun Paints (Europe) Ltd | 01724 400000 | | | | | | ● | | | | N/A | |
| Kaltenbach Ltd | 01234 213201 | | | | | ● | | | | | N/A | |
| Kingspan Structural Products | 01944 712000 | ● | | | | | | | | | M | ● |
| Lindapter International | 01274 521444 | | | | | | | | | ● | M | |
| Murray Plate Group Ltd | 0161 866 0266 | | | | | | | | ● | | D/I | |
| National Tube Stockholders Ltd | 01845 577440 | | | | | | | | ● | | D/I | |
| Peddinghaus Corporation UK Ltd | 01952 200377 | | | | | ● | | | | | N/A | |
| PPG Performance Coatings UK Ltd | 01773 814520 | | | | | | ● | | | | N/A | |
| Prodeck-Fixing Ltd | 01278 780586 | ● | | | | | | | | | D/I | |
| Rainham Steel Co Ltd | 01708 522311 | | | | | | | | ● | | D/I | |
| Sherwin-Williams Protective & Marine Coatings | 01204 521771 | | | | | | ● | | | | M | ○ |
| Sika Ltd | 01707 384444 | | | | | | ● | | | | M | |
| Simpson Strong-Tie | 01827 255600 | | | | | | | | | ● | M | |
| Structural Metal Decks Ltd | 01202 718898 | ● | | | | | | | | | M | ● |
| Tata Steel | 01724 404040 | | | | ● | | | | | | M | |
| Tata Steel Distribution UK & Ireland | 01902 484000 | | | | | | | | ● | | D/I | |
| Tata Steel Ireland Service Centre | 028 9266 0747 | | | | | | | | ● | | D/I | |
| Tata Steel Service Centre Dublin | 00 353 1 405 0300 | | | | | | | | ● | | D/I | |
| Tata Steel Tubes | 01536 402121 | | | | ● | | | | | | M | |
| Tata Steel UK Panels & Profiles | 0845 3088330 | ● | | | | | | | | | M | |
| Tekla (UK) Ltd | 0113 307 1200 | | ● | | | | | | | | N/A | |
| Tension Control Bolts Ltd | 01948 667700 | | | | | | ● | | | ● | M | |
| voestalpine Metsec plc | 0121 601 6000 | ● | | | | | | | | | M | ● |
| Wedge Group Galvanizing Ltd | 01909 486384 | | | | | | ● | | | | N/A | |
| Yamazaki Mazak UK Ltd | 01905 755755 | | | | | ● | | | | | N/A | |

# New and revised codes & standards

From BSI Updates March 2015

## BS EN PUBLICATIONS

**BS EN 10293:2015**
Steel castings. Steel castings for general engineering uses
*Supersedes BS EN 10293:2005*

## BS IMPLEMENTATIONS

**BS ISO 4997:2015**
Cold-reduced carbon steel sheet of structural quality
*Supersedes BS ISO 4997:2007*

## PUBLISHED DOCUMENTS

**PD CEN ISO/TR 14745:2015**
Welding. Post-weld heat treatment parameters for steels
*No current standard is superseded*

## SPECIAL ANNOUNCEMENTS

**NA to BS EN 1993-1-1:2005+A1:2014**
National Annex to Eurocode 3: Design of steel structures. General rules and rules for buildings
Comments for the above document are required by 27th March 2015
Contact: Keely Andrews
Email: keely.andrews@bsigroup.com
CB/203

## BRITISH STANDARDS UNDER REVIEW

**BS EN ISO 2566-1:1999**
Steel. Conversion of elongation values. Carbon and low alloy steels

**BS EN ISO 2566-2:2001**
Steel. Conversion of elongation values. Austenitic steels

**BS EN ISO 11666:2010**
Non-destructive testing of welds. Ultrasonic testing. Acceptance levels

**BS EN ISO 17640:2010**
Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels and assessment

**BS ISO 4986:2010**
Steel castings. Magnetic particle inspection

**BS ISO 4987:2010**
Steel castings. Liquid penetrant inspection

## NEW WORK STARTED

**EN 1090-2**
Execution of steel structures and aluminium structures. Technical requirements for steel structures
*Will supersede BS EN 1090-2:2008+A1:2011*