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# NSC

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Vol 23 No 10 Nov/Dec 2015


Super Nova at Victoria

Kent airport expansion

Steel breathes new life into Leeds

Waltham Forest goes large on leisure


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**Cover Image**
**Nova Victoria, London**
Main client: Land Securities
Architect: PLP
Main contractor: Mace
Structural engineer: Robert Bird Group
Steelwork contractor: Severfield

BCSA

TATA STEEL

SCI Steel Knowledge


NSC

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# No crisis in structural steelwork supply

Nick Barrett - Editor

The words 'steel' and 'crisis' have been inseparable in newspaper headlines for the past couple of weeks, with good reason as the steel making industry reels under the triple whammy of steel being dumped on world markets at less than the cost of production, high carbon related taxes and a strong Sterling exchange rate. Any industry would suffer against that sort of backdrop.

It is important to stress though that the steel construction sector is not in any sort of crisis, and in fact is confidently forecast to grow by 2% next year after a creditable 5% this year. Nothing has happened or is likely to happen that affects the ability of the UK's steel construction supply chain to continue to deliver excellent buildings and bridges and other structures on time and within budget.

The price of fabricated steel – like all construction materials - faces a range of upward pressures, which is being offset by raw steel prices, so steel-framed building solutions remain at least 5% cheaper than concrete alternatives. Add on all the sustainability and other benefits in addition to cost effectiveness that come with steel and it is no surprise that around 70% of multi-storey buildings are consistently built with steel.

Steel manufacturing is far from gone in the UK and most of the administrations and plant closures that we have heard about recently were not part of the steel construction supply chain. The Scunthorpe plate mill - that has been mothballed, not necessarily permanently closed – made steel for bridges and other applications that can be substituted through the existing supply chain. Nothing new has to be created or established to ensure that procurement routes for steel construction continue as before.

The UK's major supplier of constructional steelwork, Tata Steel, has reassured its customers that production of steel sections continues unaffected by recent developments. The BCSA has given its full support to the efforts of UK steel manufacturers to combat the dumping of steel on international markets and ensure level playing fields in energy costs and carbon related taxes.

Imports of raw steel are nothing new. The UK has long used a mix of imported and home manufactured steel which the constructional steelwork industry is used to accessing through an efficient steel stockholding and distribution network. Substantial stocks are always held that would see the UK through the unlikely event of any potential disruption to supplies or quickly react to demand spikes.

The government's National Infrastructure Plan will create steady growth in the demand for construction services for years to come; it might be coming along slower than the industry had hoped, but delivering it successfully is a central plank of economic policy that will depend on a healthy and vibrant steel construction sector and assured supplies of quality steel – all of which the UK has.

The long-term average of UK structural steelwork consumption is some one million tonnes a year, but it is currently at 862,000 tonnes, so there is a latent capacity available in the industry to accommodate substantial growth.

There is little importing of fabricated steelwork in the UK, with some 98% of structural steelwork fabricated here. The advantages of this include shorter lead times, contractual security, world leading design quality and a health and safety record that is the envy of the construction industry. And you can't import that.

NSC

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# UK structural steelwork supply assured

The structural steelwork sector is in good health and remains on a growth path that will not be affected by the recently announced problems affecting some steel making in the UK.

Tata Steel and other steel manufacturers have announced plans for scaling back production of some products, with some plant being mothballed, in the face of a range of pressures including imports of steel from China, a high Sterling exchange rate and internationally uncompetitive carbon related taxes. The British Constructional Steelwork Association has responded to reassure the market that there will be no impact on the supply or availability of steelwork.

BCSA Director General Sarah McCann-Bartlett (pictured) says the UK's structural steelwork sector already uses a mix of high quality domestic and imported steel. "We have a well developed and highly efficient steel stockholding and distribution sector that supplies steelwork contractors with a balance of UK and imported steels.

"There are high levels of stocks that can quickly and easily be expanded if required. Tata Steel has confirmed that despite scaling down some operations at Scunthorpe and in Scotland production of the steel sections that we use for structures is unaffected by any of this."

SSI and Caparo, which have both gone into administration, did not supply steel to the UK's structural steelwork sector.

BCSA says its forecast for growth in the structural steelwork fabrication market of 5% this year and 2% in 2016 remains unaltered and steel-framed buildings are still 5% cheaper than concrete alternatives according to the latest cost analysis by Gardiner & Theobald.

Ms McCann-Bartlett said: "While these growth forecasts meet demand for current and planned construction and infrastructure projects, UK steelwork contractors also have the ability to increase output should demand for structural steelwork increase further.

"Structural steelwork consumption in the UK remains below the long-term average of 1 million tonnes per annum at 862,000 tonnes. But at its peak, UK structural steelwork consumption reached 1,400,000 tonnes, so there is still latent capacity in the sector."

BCSA says it fully supports the steel manufacturing industry's calls for a level playing field for UK steel manufacturing. Ms McCann-Bartlett said: "A UK supply of high quality steel creates a competitive and efficient market, and importantly supports the UK economy and UK jobs."

# Bomber Command memorial unveiled

A 31m-high weathering steel spire commemorating those who served with Bomber Command during the Second World War has been officially unveiled.

Forming the first phase of the International Bomber Command Centre (IBCC) in Lincoln, the steel structure is said to represent wing fragments. Its height is the same as the wingspan of a Lancaster Bomber; its base at 5m wide is the same width as a Lancaster's wing.

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

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

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

S H Structures fabricated the structure from 32 rolled weathering steel plates. Perforated panels, again reflecting the engineering principles used in airframe construction connect the external plates.

Built in jigs to maintain the shape during welding, the structure was fabricated in two sections – upper and lower parts - with sacrificial lifting frames to aid installation.

Further work will soon begin at the IBCC with the construction of a steel-framed visitor centre (known as the Chadwick Centre).

This will comprise an exhibition hall that will tell the story of Bomber Command through a multi-media experience, an education facility and a comprehensive multi-layered digital archive.

# Clinical Services building up at Liverpool hospital scheme

Steel erection has been completed on the Clinical Services Support Building (CSSB) at the multi-million pound redevelopment of the Royal Liverpool University Hospital with the installation of two link bridges.

Working on behalf of Carillion, Elland Steel Structures has erected approximately 850t to complete the CSSB. A further 70t was needed for the two bridges that link the CSSB to an adjacent multi-storey car park and the main hospital building.

The five-storey CSSB will accommodate storage facilities for medical supplies, laboratories and offices. It is also the hub for many of the vital services that will power the main hospital, as power duct routes from the onsite energy centre go into the CSSB's own substation and then onwards into the adjacent Acute Hospital building.

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

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

Elland Steel Structures used a 100t capacity mobile crane to lift four 2m-deep girders, spanning 20m and each weighing 17t, to form the yard's open plan space.

The CSSB forms part of phase one of the ongoing redevelopment of one of the north of England's largest hospitals.

The final phase, due to begin in 2019, will include a further 700t of structural steelwork from Elland to construct a large podium containing a ground floor car park with a public realm situated above.

# Expansion and diversification for North East fabricator

Hartlepool-based Newbridge Engineering has undergone a restructuring and expansion programme to strengthen its position in the steel construction sector.

The company recently acquired additional premises adjacent to its existing facility and invested in a new Voortman V320C plasma plate profiler and drilling machine.


"This unit can cut up to 70mm thick plate and allows us to be more efficient and productive as all our fittings are now made in-house, without the requirement for any buy-outs, making us more streamlined across our production facility in Hartlepool," said Newbridge Engineering Managing Director Phill Rose.

"Having survived the worst recession in our history, the company's background was that of a sub-contract fabricator (working for other larger fabricators), but we've now diversified and work direct with main contractors."

Newbridge Engineering is a family-owned business with a new senior management team headed by Mr Rose. He says they have transformed the business to become one of the largest structural steel fabricators in the North East by output.

"We have more than doubled the turnover of the business with the award of a number of local contracts for both regional and national main contractors."

# Shear connection rules to Eurocode 4 published by SCI


Steel Construction Institute (SCI) has published *'Minimum degree of shear connection rules for UK construction to Eurocode 4'*, guidance that was produced with British Constructional Steelwork Association (BCSA) and Tata Steel funding.

The downloadable publication is available on www.steelconstruction.info and www.steelbiz.org for registered users who are members of either SCI or BCSA.

"For many years composite construction has played a major role in the commercial success of the steel construction sector in the UK. The rules given in this new publication complement those given in Eurocode 4, and in so doing will enable valid designs to be produced for a broader range of beams," said SCI CEO Graham Couchman.

This publication presents design resistances for shear studs when used in the presence of modern forms of decking. It includes rules for the minimum number of studs that are needed on a range of beams (the minimum degree of shear connection).

In many cases this minimum is lower than would be required by EN 1994-1-1 (and BS 5950-3.1 prior to its amendment in 2010).

The combination of less onerous requirements for minimum degree of shear connection, and lower stud resistances, allows many composite beams to be designed that would not satisfy the rules given in EN 1994-1-1.

# Renovated Manchester station reopens

Manchester Victoria railway station, once labelled Britain's worst, has formally reopened following a £44M facelift.

As well as maintaining Manchester Victoria's heritage, its upgrade by Network Rail involved building a vast new roof made from the same material used at the Eden Project, giving train passengers and station users a light, spacious environment, including new shops and cafes.

The roof is formed with 15 curved steel ribs that are bolted to 4m-high buttresses at ground level and then arch over the station to be supported on 18m-high CHS columns.

Working on behalf of main contractor Morgan Sindall, Severfield erected 1,900t of structural steelwork for the project [see NSC October 2014].

The modernisation of the station, carried out while it remained operational, is part of an investment programme to boost rail capacity and connectivity together with the speed and frequency of services across the north of England.

Transport for Greater Manchester and Network Rail have worked together to incorporate the expansion of the Metrolink tram network at Manchester Victoria into the redeveloped station, which now has four new tram platforms and three new tracks.

## NEWS IN BRIEF

EMO Milan 2015 (World of Metalworking) was the launch pad for **Ficep**'s latest CNC high-speed drilling line known as Rapid. The company said the new drilling line is suitable for angles and flats, and offers high productivity, quality, flexibility, accuracy and lower production costs.

**StruM.I.S** has announced the release of the new Tekla Version 21.1 Plugin for BIMReview and StruM.I.S. The release is said to allow Tekla users a unique link with StruM.I.S and BIMReview from within the Tekla 21.1 environment.

Main contractor **Skanska** has completed the 66 Queen Square project in Bristol [see NSC Nov/Dec 2014] with KPMG taking occupancy of the majority of the building's floor space. Steelwork contractor for the project was locally-based William Haley Engineering.

**Southend United Football Club** has unveiled fresh plans that are being backed by developer British Land for a new steel-framed stadium. The latest plan will see the 21,000-seat arena complex flanked by three major apartment blocks, helping to fund the scheme at Fossetts Farm. The project will also include a 12-screen cinema, retail and restaurant floorspace together with related ancillary infrastructure.

Planning consent has been granted to **EDF Energy** for it to construct a gas-fired power station at Sutton Bridge in Lincolnshire. A project spokesperson said the job would provide 1,500 construction jobs over its three-year build, and many of the power station's buildings would be steel-framed.

## AROUND THE PRESS

**New Civil Engineer**
***5 November 2015***
**Steel in the frame**
[Three Pancras Square] – "In order to get an economic building with long spans, the structure has been designed with a steel frame utilising cellular beams for service integration on all floors," says Bam Design principal structural engineer Naresh Tailor.

**New Civil Engineer**
***5 November 2015***
**Main frame delivery**
[Royal Liverpool University Hospital] – Trust requirements had to be adhered to when choosing which material to use, but after an appraisal steel was adopted because of its speed and quality of construction," says Carillion project manager Stuart Loftus.

**Construction Enquirer**
***2 November 2015***
**Contractors told to reveal steel sources in public work bids**
Main contractors will have to reveal where they are sourcing steelwork when bidding for major projects under emergency Government plans to level the playing field for the UK industry.

**Building Magazine**
***9 October 2015***
**Victoria's super nova**
[Nova Victoria] – Steel was selected for the offices to speed construction and because it allowed the use of thinner, 150mm thick, floor slabs.

**Construction News**
***9 October 2015***
**In Anfield we truss**
[Liverpool FC's Anfield expansion] – The roof structure, including the primary truss, secondary truss and tower supports, was designed in response to the site constraints, construction phasing and aesthetic requirements.

**Construction News**
***9 October 2015***
**Mace gets hard core on steel revamp**
[One Angel Court] – Using concrete would not allow them to achieve the tight programme, with steel providing the most time efficient and safe way of completing the job.

# Manchester NOMA development expands with steel

Planning applications have been submitted for two steel-framed office buildings at the £800M NOMA development in Manchester.

The joint venture between The Co-operative Group and Hermes Investment Management, 2 and 3 Angel Square will sit alongside restored listed buildings at the heart of one of Europe's largest heritage-based regeneration schemes.

The new buildings, designed by AHR architects, will also sit next to the award-winning steel-framed 1 Angel Square, which was named one of the world's most sustainable buildings after achieving a BREEAM 'Excellent' rating.

The two proposed buildings will collectively provide over 32,500m² of premium office space, over nine and 11 storeys, within the 20-acre NOMA neighbourhood. They will both feature spacious atriums and will have the flexibility to be personalised to fit the needs of major occupiers.

The developers say the buildings are likely to attract major corporates keen to relocate to one of the country's best-connected city centre locations.

# Contractor gains primary authority agreement

Kent-based Nusteel is the first major steelwork contractor to gain a direct partnership with Trading Standards Service via the primary authority route.

"It came about as a response to the requirements of BS EN1090 and CE Marking. In light of this directive, it was decided to approach the enforcing body for their assistance in developing a compliance plan," said Nusteel Managing Director Ivor Roberts.

"The plan specifically relates to the traceability of components during the manufacturing process."

Working in partnership with its primary authority and local regulator, Nusteel gained a unique opportunity to explain its business in detail to a named individual and develop a close working relationship with them.

"We can now rely on the advice provided by our primary authority officer, and on the authority's interpretation of relevant legal requirements. Provided we follow the advice, we don't need to worry about responding to conflicting advice or even facing enforcement action from another local authority that has a different interpretation of the law," added Mr Roberts.

*L-R Mike Overbeke, Head of Public Protection, Kent County Council; Ivor Roberts, Managing Director, Nusteel; Steve Rock, Head of Kent Trading Standards Service*

**What is primary authority?**

- Primary authority is a statutory scheme, established by the Regulatory Enforcement and Sanctions Act 2008, that offers businesses operating across council boundaries the opportunity to be regulated in a new way.
- It enables a business to form a legally-recognised partnership with a single local authority. The primary authority can provide the business with regulatory advice, which other local authorities will take into account in their dealings with that business.
- The process was introduced by the government in 2009 to address concerns raised by businesses about how they are regulated by local authorities in areas such as environmental health, licensing and trading standards legislation.
- The government is committed to developing primary authority and sees the scheme as playing a key role in its work to improve the way that regulations are enforced.

# RNLI Poole lifeboat centre begins operations

The Royal National Lifeboat Institution (RNLI) has officially opened its All-weather Lifeboat Centre (ALC) in Poole, Dorset.

The building's completion secures the supply of all-weather lifeboats (ALBs) for future generations of lifesavers, creating 90 new jobs in the local area and saving the charity in excess of £3M a year once the facility is fully up and running.

The ALC [see NSC March 2015] consists of two large steel-framed buildings, both approximately 85m long × 30m wide, connected by a central covered courtyard.

Long clear spans for the main areas of both buildings were an important part of the design and were the main reason behind the choice of steel as the project's framing material.

"Spans up to 20m, the requirement for various roof curves and the need for the frame to be constructed quickly, meant that a steel-framed structure was the optimum solution," says Ramboll Structural Engineer Ben Punton.

Both buildings' main production areas have been formed around 10m × 20m bays as this provides the necessary open column-free space. A slightly smaller 10m × 8m grid pattern is then used for adjoining mezzanine levels and first floor office areas.

Working on behalf of Leadbitter (Bouygues UK), H Young Structures fabricated, supplied and erected 1,000t of steel for the project.

# Feature columns support seaside development

A series of Y-shaped columns have been installed to support the centrepiece structure at a 25-acre regeneration scheme in Blackpool known as the Talbot Gateway Central Business District,

The columns were fabricated and supplied by Cleveland Bridge, while the remainder of the steel frame of the five-storey, Number One Bickerstaffe Square office block was fabricated and erected by Leach Structural Steelwork.

Weighing in at eight tonnes, each column is made up of 45 individual pieces of steel plate and required the assistance of a 60-tonne crane to lift them into position.

"The sheer scale of the steel supports meant their delivery was classed as a 'special load' - something which requires a seven day notice period to the Police. Meticulous planning was required to ensure a smooth 120-mile journey from Darlington to Blackpool," said Muse Developments Project Manager Andy Barton.

Working together with Blackpool Council, Muse Developments said it is playing a major part in transforming a neglected and under-utilised area of the town centre into a new commercial, retail and community space.

# Salford's Excellent student residences open their doors

University of Salford has officially opened its new £81M steel-framed student accommodation complex that features 1,367 en-suite bedrooms and has an on-site cinema room, gym, TV and games room, group study lounges and a launderette.

Consisting of nine individual steel-framed blocks spread over two plots, Walter Watson, working on behalf of main contractor Graham Construction, fabricated, supplied and erected 1,900t of structural steelwork for the project [see NSC November/December 2014].

"We looked at both steel and concrete options for this project and steel was best because it is quicker to erect and more efficient as it helped us design buildings with lots of structural repetition," said Cundall Principal Structural Engineer Dan Bradley.

Steelwork's speed of construction was highlighted by the fact that Walter Watson erected the entire steel package in just 16 weeks. The company worked simultaneously on both plots with two gangs each using a 60t capacity mobile crane and two MEWPs with 43m-high reaches.

As well as steel erection, Walter Watson also coordinated the installation of precast stairs, edge protection and the setting out of the metal decking packs in readiness for their installation.

# Steel supports revived Redhill scheme


A steel-framed landmark Sainsbury's shopping centre will form the centerpiece of the revived Warwick Quadrant scheme in Redhill, Surrey.

RG Group has replaced failed contractor Longcross to restart the mixed-use supermarket and hotel scheme. Billington Structures will be fabricating, supplying and erecting the steel for the project.

Over the past weeks, survey work has been carried out on the site, allowing RG Group to finalise its construction programme.

The scheme, which is being backed Aviva, will see the supermarket chain build a new store three times bigger than the current building.

Above the store will be extensive car parking on two levels, with a 98-bedroom hotel above that in a new five-storey building. The whole project is expected to cost around £20M to build.

Alan Ayres, Sainsbury's Project Manager, said: "It's good to be getting the project back on track, as RG Group takes over the reins on site.

"Since the appointment of RG Group, everyone on the development team has been working hard to ensure that the scheme could get going again as soon as possible. We are all extremely pleased to be re-starting work.

Councillor Natalie Bramhall, Executive Member for Property and Regeneration for Reigate and Banstead Borough Council, said: "It's great news that work will once again be getting under way on this scheme, which is key to the regeneration of Redhill town centre.

# Diary

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

**Tuesday 24 November 2015**
**Steel Building Design to EC3**
Making the change to Eurocode design.
Edinburgh.

**Tuesday 1 December 2015**
**Steel Frame Stability**
Frame stability concerns the significance of second-order effects and is highlighted as an essential check for all frames in BS 5950 and EC3.
London

**Tuesday 8 December 2015**
**Cold Formed Portal Frames**
Webinar

**Wednesday 9 & Thursday 10 December 2015**
**Essential Steelwork Design**
This course introduces the concepts and principles of steel building design to EC3.
Bristol.

# All change at Victoria

*The South block soars over Victoria Station*

## Phase one of Nova Victoria , which will transform a huge island site opposite the mainline railway station, is in full swing and due to complete next year, reports Martin Cooper

**FACT FILE**
**Nova Victoria, London**
**Main client:** Land Securities
**Architect:** PLP
**Main contractor:** Mace
**Structural engineer:** Robert Bird Group
**Steelwork contractor:** Severfield
**Steel tonnage:** 9,000t

A new and vibrant office, retail and residential area known as Nova is being created in Victoria, as London SW1 gets a thorough makeover, with steel construction playing a leading role.

Sandwiched between the Palace of Westminster, Buckingham Palace and the upmarket residential area of Belgravia, Victoria has always been a prime London location.

Even more so today as a number of recent office developments have seen businesses such as Channel 4, Microsoft and the Telegraph Media Group as well as high-fashion names such as Jimmy Choo, Tom Ford and Burberry make the area their home.

More high profile firms and residents are likely to follow suit as Nova, one of the largest schemes in the area, and one that will transform a 5.5 acre island site opposite Victoria Station, is due to complete next summer (2016).

The first phase started in June 2013 and consists of 44,600m² of offices, 7,500m² of retail and restaurant space, and 170 luxury modern apartments all accommodated within three landmark buildings.

This prestigious project's location has thrown up a number of challenges for main contractor Mace, as Project Director Tony Palgrave explains: "The site is surrounded by busy roads so logistics are complicated, we have theatres and hotels close by which means we have to keep noise levels down at certain times. The Victoria Underground Station upgrade works are ongoing right next to our site, while below us there is a protected zone for the forthcoming Crossrail 2 project. We also have to contend with two major sewers, one of which runs right across our site."

All of the project's challenges have been overcome and the job, including the steel construction programme, is on schedule.

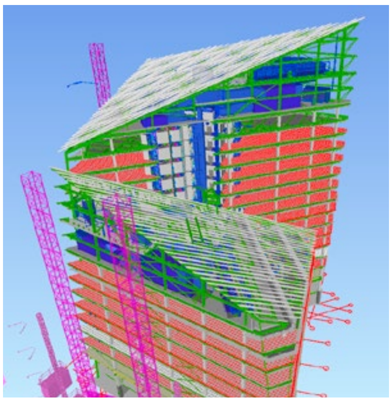
The major steel construction elements of Nova are the 15-storey North and 21-storey South office blocks. As well as Grade A office accommodation, both of these buildings will have ground and first floor retail and restaurant spaces.

"At the early design stage we had both concrete and steel alternatives for the office blocks," says Robert Bird Group Managing Director David Seel. "Steel was chosen as the best option to create the premium office space desired as it meant we could halve the number of internal columns."

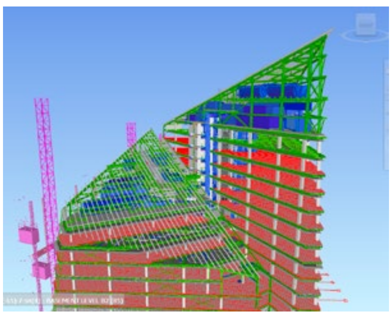
Together these steel-framed structurally independent buildings occupy just over half of the site's footprint. Interestingly, the gap between the buildings has been designed to


*The South block's feature façade*

*"Steel was chosen as the best option to create the premium office space at it meant we could halve the number of internal columns."*



*Models showing the two office block's roofs*



correspond with the Crossrail 2 exclusion zone, as piling was not possible in this area.

The erection of both blocks was staggered, which allowed steelwork contractor Severfield to make use of the project's six tower cranes for all of its unloading and lifting duties.

The superstructures' steel frames begin at ground floor level with a complex connection to the site's numerous plunge columns (see box). As many of the structural columns are inclined, Severfield has to ensure the plunge to structural column connection joined exactly.

Based around centrally positioned concrete cores, both of the steel frames were erected on a 9m-perimeter grid pattern with some internal spans of up to 16m. Each building features a mix of vertical and inclined façades and this sloping geometry has necessitated the use of bespoke fabricated box section columns, measuring up to 600mm × 300mm.

Complex inclined roofs adorn both Nova North and South, with the latter building having by far the most complex steel-framed roof as this one slopes in two opposing directions.

To erect these high-level steel lattice structures a huge piece-count of individual steel members has been lifted into place to form wedge-shaped prisms. Much of the roof steelwork is galvanized because it will be left exposed to the elements.

Nova North has an inclined roof and flat architectural featured roof grillage. The roof extends from levels 10 to 15, all of which are plant spaces with the exception of one upper floor which has some office space.

Topping Nova South are two inclined roofs, containing plant levels from 10 to 15 and then upwards from 16 into an architectural peak at level 21. Again the uppermost level of this block also contains plant areas.

"The roofs, especially the South which pitches in two directions, are made up of bespoke steel elements," says Severfield Contracts Manager Martin Clyne.


Nova South takes shape

Sloping roofs adorn both of the office/retail blocks

Two trusses add to the complexity of the South roof. The truss members were delivered to site as individual sections and lifted by the tower crane to the level 10 slab, which was used as a temporary laydown area during erection.

Each truss was built up in its final position and due to its shape, was temporarily propped with a column and jacking system from the Level 10 slab. Once the first section was securely in position, the remainder of the sections were built from it. The trusses once complete support the Level 11 and 12 plant room floors.

On the North roof, a transfer girder was designed and installed at Level 12 due to the long span between columns. The girder is 15.4m long and 1.5m in depth and weighs 25.3t. The completed girder was outside of the tower crane capacity and so to overcome this it was spliced at three points.

"A temporary propping system was installed from Level 12 down to Level 10 ahead of the delivery of the girder. The temporary system supported the individual sections during installation. Once all of the sections were bolted and restrained, the temporary propping system was removed leaving the girder self-supporting," adds Mr Clyne

A further 150t of steelwork has been erected as a rooftop plant enclosure on the residential block 3.

The first phase of Nova is scheduled to complete next August, by which time phase two, which consists of another mixed-use building that partially wraps around the nearby Palace Theatre, will have begun.

## Below ground works

A top-down construction method, whereby the basement works were undertaken simultaneously with the building of the project's superstructure, was used on Nova.

"It's all about getting the steel frame started as quickly as possible and the top-down method allows this by creating a much faster programme," says Robert Bird Group Managing Director, David Seel.

The project's basement covers the entire site and is four levels deep. To create this large space, early works included making sure ground movements were kept to a minimum to protect the major sewer that cuts across the site, as well as the nearby London Underground Lines and the new Victoria Station pedestrian tunnels.

A number of existing piles from previous buildings had to be located prior to the installation of 240 steel plunge columns that consist of 40 different profiles and are installed to a depth of up to 20m.

The majority of the existing piles have been left in the ground, but a few had to be extracted as their position would have hindered the project's desired 9m × 9m steel grid pattern.

Some plunge columns acted as temporary supports for the cores, allowing them to be constructed early in the programme, which in turn allowed the steelwork to start sooner.

"Using steel plunge columns gave us two advantages," adds Mr Seel. "They acted as temporary steel supports for the cores and then later they were cast in concrete to become part of the project's composite reinforcement."

In total more than 2,000t of the overall 9,000t steel tonnage supplied and fabricated by Severfield has been used below ground level at Nova.


The hangar is already in use

# Kent airport ready for take-off

## As part of a much wider development plan, a new steel-framed hangar has been completed at London Ashford Airport.

**FACT FILE**
**New Hangar, London Ashford Airport, Lydd, Kent**
**Main client:** London Ashford Airport
**Main contractor:** Civils Contracting
**Steelwork contractor:** REIDsteel
**Steel tonnage:** 50t

During the past decade London Ashford Airport [LAA] has spent £35M upgrading facilities, work that has included the installation of an instrument landing system, a new executive terminal with VIP facilities, improved passenger check-in and security, and a new departure lounge.

Now plans are afoot for further developments, primarily driven by a rise in demand for more business and general aviation facilities. This has led the Airport to start preparations for a runway extension and construct a new hangar.

A team led by Civils Contracting with REIDsteel designing, fabricating and erecting the steelwork has recently completed the 2,100m² steel-framed hangar, which measures 29m by 73m. These two companies have worked together on a number of airport hangar projects, including Bournemouth [see NSC May/June 2014].

"This £700,000 investment underlines our determination to ensure that the airport is able to meet the needs and expectations of the growing number of aviation businesses and customers who use Lydd," said an LAA spokesperson.

Built alongside the airport's existing hangars, the new structure was completed on schedule after a 19 week programme.

"Initial works included apron modifications, some earthmoving and then the installation of 800mm deep raft foundations," says Civils Contracting Project Director Nick Weaver.

The preliminary works paved the way for REIDsteel to begin its steel erection programme, which was completed by one gang of erectors using mobile cranes.

"The hangar has a slightly unusual design because it has sliding doors at either end; the majority of modern hangars only have doors at one end," says REIDsteel Project Engineer Richard Hanson.

"So with little or no room for gable end bracing, the best and most economic design solution was for a REIDsteel patented Archspan frame."

As the doors are 20m-wide, there is room for a 4.5m braced bay located at both ends of the hangar either side of the door openings.

With an Archspan frame there is less thrust to deal with, the frame needs less steel, saving the client money, and the lightweight frame requires shallower foundations.

The frame consists of simple UB columns spaced at 7.5m intervals supporting a series

Getting ready for takeoff

of truss-like Archspan frames, which span the structure's 29m width.

The upper elements of the Archspan frame, or rafters, are simple UB members, the horizontal ties are structural Tees cut from 178 UBs, while the bracings are square hollow box sections.

The triangular Archspan frames reach a maximum depth of 3m to form the hangar's central ridge. Because of their length, they were brought to site as individual steel members and then assembled on the ground before being lifted into position.

Using temporary bracing to stabilise the initial columns and frames, the hangar was erected sequentially, with the structure stabilising itself once the first bay was erected. Two mobile cranes were needed for the first bay's steelwork, while thereafter the erection process was completed by a solitary mobile crane.

The hangar doors are steel frames measuring 5m wide by 5.7m high and once delivered to site their tracks and guides were added before being lifted into place.

"Each door leaf opens into cantilever outriggers that allows both sets of sliding doors to open to the maximum 20m width," explains Mr Hanson.

REIDsteel completed its programme in 10 weeks. In addition to the main steel frame, the company also clad the roof and walls in Euroclad's trapezoidal profile cladding and installed the manually-operated hangar doors.

"Due to REIDsteel's unique capability to design and make the hangar doors as well as the steel frame and building envelope, the whole process is seamless. There is no hiatus in the construction process and no divided responsibilities between different trades, which gives clients and contractors the peace of mind that their project will run to schedule," says Mr Hanson.

After the successful completion of the project, the hangar was handed over by Civils Contracting to LAA on 16 September.

*Steel erection commences*

## Airport history

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Originally known as Lydd Ferryfield Airport, the facility opened in 1954 and was the first airport to be built in the UK following the end of the Second World War.

It was built for Silver City Airways and used initially for car carrying air ferry services using Bristol Freighters, operating principally to Le Touquet in France. Within five years of opening, it was handling over 250,000 passengers annually, making it one of the busiest airports in the UK.

During the 1980s the airport was bought by Hards Travel from Solihull, who used the airport (along with Coventry Airport) as its base for its holiday operations to Spain, Italy and Austria, using Dart Herald and Viscount aircraft flying to Beauvais in France, where customers were transferred to coaches for the remainder of the journey.

Expansion of the airport was approved in 2014, following a legal challenge by Royal Society for the Protection of Birds (RSPB) and the Lydd Airport Action (LAAG) Group. The expansion includes a runway extension of almost 300m and a new terminal building.

*The completed hangar*

# Steel supports the sporting life


*View of the swimming pool area of the leisure centre*

## Housed within a steel frame, one of London's largest leisure centres is under construction in Waltham Forest.

**FACT FILE**
**Waltham Forest leisure centre, London**
**Main client:** Waltham Forest Council
**Architect:** AFLS+P
**Main contractor:** ISG
**Structural engineer:** Furness Partnership
**Steelwork contractor:** Billington Structures
**Steel tonnage:** 650t

Waltham Forest Council is in the midst of a programme to upgrade its stock of leisure facilities. So far this work has included refurbishing three leisure centres and now work has commenced on constructing a brand new facility on the site of the former Waltham Forest Pool and Track.

Work on the refurbishment of the running track was completed 18 months ago, but the demolition of the existing 1960s pool building could not start until the other leisure centres had been completed, so as not to leave the Borough short of swimming facilities.

"We looked at a number of options for this site and the most economic one was to refurbish the running track, then demolish the old indoor pool and build a new steel-framed leisure centre," explains AFLS+P Project Architect Darren Bird.

Main contractor ISG demolished the pool structure last November, after which the groundworks programme commenced with the installation of more than 600 x 300mm-diameter piles.

Steelwork erection for the new structure started in July and Billington Structures completed the job last month (October).

With a footprint of 5,500m², the new leisure centre is said to be one of the largest in London. It is a two-storey steel braced building divided in half by a double-height street.

On the ground floor it houses a 25m-long eight-lane pool with diving facilities; a 15m-long learner pool; a four-court sports hall; an extreme sports hall, complete with climbing wall; a kids play area; activities room and changing rooms.

The first floor level accommodates a fitness suite, two dance studios, access to a seating gallery overlooking the main pool, offices and further changing rooms.

Many of these facilities require large column free spaces, such as the pool hall that has 28m-long spans, the sports and extreme sports halls that have 30m-long and 21m-long spans respectively, and the dance studios where 12m open spans provide the required space.

"Because there are so many areas containing long spans, steel was always going to be the main framing material for this job," adds Mr Bird.

Steel erection began with the pool and plant areas as these parts of the building are on the construction programme's critical path.

"The pool hall has a lot more fit-out requirements than the rest of the Centre, so once the two pools had been excavated it was essential to get this area erected first," says ISG Project Manager Ray Faulks.

Utilising a regular 7m spacing the main columns around the pool support a series of 28m-long glulam beams, which

*The extreme sports zone*


*The project has also included the renovation of the adjacent track and field*

were installed along with the steelwork by Billington. The company also installed precast planks, used to form the first floor, and terracing for the seating gallery.

Once the pool was erected, the street followed by the two-storey section of the building was next to be constructed.

"The street is the hub of the centre, it not only provides access to all of the facilities, but also allows natural daylight into the building via glazed roof voids. Its central position also means that it divides the centre into wet and dry zones, with the pools and their changing rooms on one side and the sports halls on the other," says Mr Bird.

Transparency and lots of natural light were two of the main drivers in the leisure centre's design. The front elevation of the building features full-height glazing offering pool users plenty of light and allowing people to see into the aquatics hall. Also along the same elevation, and above the main entrance, the first floor fitness suite also benefits from the full-height glazing.

"Along the glazed areas the bracing is left exposed and so we've used feature rod bracing, as opposed to the flat bracing used elsewhere," says Furness Partnership Project Engineer Mario Diaz.

Other areas where the steelwork has been left exposed include the fitness suite and the sports halls, thereby giving these facilities an industrial and/or modern feel.

The final part of the steel erection programme involved the sports hall and the adjacent extreme sports hall.

The sports hall's long clear spans are formed by a series of 21m-long cellular beams, while next door in the extreme sport hall 30m-long roof trusses positioned 90 degrees to the cellular beams have been used.

"The trusses are positioned in a different direction because of the fall in the roof and to suit the drainage," explains Mr Diaz.

"The extreme sports hall was a late addition to the scheme by the client," says Mr Bird. "Because of the nature of the sports intended for the hall (outdoor activities), it has no heating and so this part of the building is actually outside of the overall thermal envelope and structurally independent."

Another reason for the extreme sports hall being independent is the fact that the building is more than 100m long and a movement joint had to be located somewhere. To facilitate this joint, there is a double row of columns along the two elevations that separates this steel-braced box from the rest of the structure.

The new Waltham Forest Pool and Track is due to open autumn 2016.


*Steel goes up on the previously completed slab*

# Steel chips in for barn design

## With a capacity of 12,000t of boxed potatoes, steel construction has helped create one of the largest potato stores in the UK.

One of East Anglia's largest potato growers – P.J Lee & Sons – is now making full use of its recently completed steel-framed potato store and grading area at Sutton Gault, near Ely.

Not only does the store have a huge capacity, it has also helped rationalise the company's storage procedure for its annual crop of potatoes

"Previously our crop had to be distributed to various stores within a 40 mile radius. The shed was designed in a way to maximise storage until the May/June markets when we generally sell the majority of the crop," explains P.J Lee & Sons Partner Christopher Lee.

"From cladding choice to lights and ventilation systems, the project demanded high quality components to create one of the largest potato storage facilities in the UK. It is our 'flagship' store and we hope to have the opportunity to build another of similar size on-site in the next few years."

Built on the site of a former machinery storage area, the state-of-the-art building was delivered on time and on budget by a team of dedicated contractors under the supervision of Jeremy Nunn of Thurlow Nunn Standen, with A C Bacon Engineering providing the steel frame, insulated cladding and access doors.

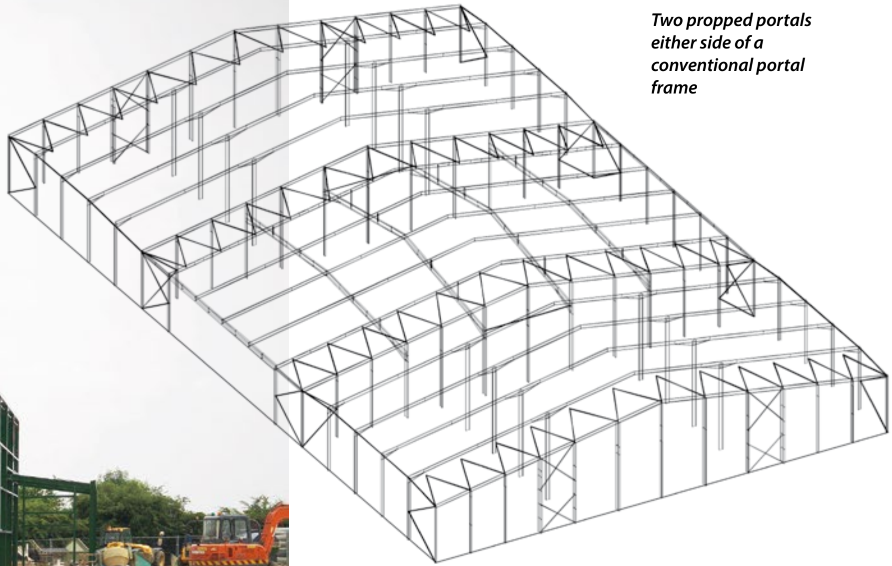
Insulation and ventilation is key to maintaining cool temperatures needed during crop storage through to the month of June, retaining high quality in the hope of achieving a premium price per tonne.

Overall the store measures 58m wide by 97m long. It consists of three spans, one central portal frame with two propped portals either side.

"Steel construction was the only solution for this project in order to get the required large open areas," explains Frith Blake Partner Jon Frith.

The building can be segregated into various storage areas, each with the ability to maintain their own climate requirements.

The central 35m wide span is one large open area used as the company's potato grading area. Either side of the span, the two outer portals, both measuring 31m wide,



*Two propped portals either side of a conventional portal frame*

**FACT FILE**
**Potato store and grading area, Sutton Gault, Ely**
**Main client:** P.J Lee & Sons
**Architect:** Thurlow Nunn Standen
**Main contractor:** Thurlow Nunn Standen
**Structural engineer:** Frith Blake
**Steelwork contractor:** A.C Bacon Engineering
**Steel tonnage:** 200t

are each divided into three separate storage areas.

The building was constructed to enable the grading area to be converted into a storage area for a further 2,040 boxes after sorting has been completed.

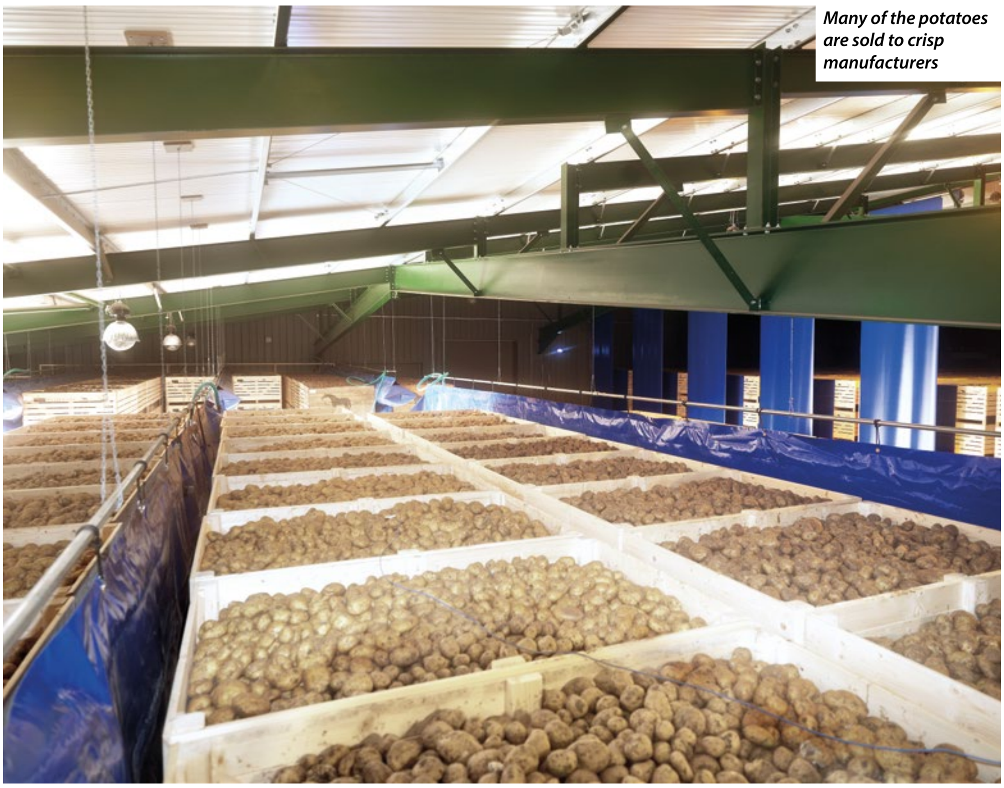
Boxes at the front of the grading/additional storage area can be removed, within an afternoon, allowing a grader to be set up.

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

The introduction of a 250kW solar photovoltaic system on the roof contributes not only to the running of the store but also the whole site during peak production.

The photovoltaic system also played an important part in the overall design of the steel frame.

"It's a bespoke steel frame because in order to have a large expanse of south facing roof onto which the solar panels could be fitted, we twisted the layout around so that the three spans run across the width of the



*Many of the potatoes are sold to crisp manufacturers*

*Large open spans were a design requirement*

structure instead of the usual length-wise format used in similar sheds," said Thurlow Nunn Standen Partner Jeremy Nunn.

For the construction programme, the initial stage involved the installation of 998mm diameter × 11.5m-deep concrete piles, arranged around a tight 2.5m grid pattern because of the Fens' extremely soft ground.

The concrete slab was then installed and this gave the steel erectors a flat and hard surface for their MEWPs.

Using two mobile cranes, the steel frame was erected during a six week programme with the main central span installed first. All of the columns are spaced at 6m centres and the tallest of these members are 8m-high sections located in the middle of the building.

Roof rafters were brought to site in two sections (each 15.5m for the outer spans and 17m sections for the mid-span), bolted together on the ground and then lifted into place as one member.

"The roof was covered and watertight in seven days using Kingspan 2m wide by 115mm thick insulation panels which were 15.5m long and craned individually into position," explains A C Bacon Engineering Construction Manager Karl Larkman.

Once the main frame was erected A C Bacon Engineering then retrofitted a further 20t of internal steelwork to support the store's fans and chillers.

"This was a successful project with a unique steel frame at the heart of it," sums up Mr Nunn. "There were a few challenges to overcome, such as noise levels and being mindful of neighboring properties, but we completed the project on time and to the client's satisfaction."

## Portal framed potato barn

**by SCI's David Brown**

The Sutton Gault potato store is certainly unique, as described by Mr Nunn. Ordinarily, portal frames have purlins that run in the perpendicular direction to the portal frames, but at Sutton Gault, the purlins run the direction parallel to the main frames. The main frames are spaced approximately 15m apart, and secondary rafters span between the main frames. At each frame, the secondary rafters are generally at a level aligned with the apex of the primary frames, meaning that towards the eaves of the primary frames, the secondary rafters are supported on stools a significant distance above the primary rafter.

With this arrangement of steelwork, careful attention must be paid to the essential restraint to both secondary and primary rafters. The secondary rafters are restrained conventionally – the purlins are connected to the top flange and at certain locations, inner flange restraints (sometimes called "fly bracing") are provided. These restraints to the inside flanges ensure that that compression flange is restrained when subject to wind uplift.

The purlins cannot be used to restrain the inside flanges of the primary frames, so substantial bracing to the inside flange of the primary rafters is provided from each secondary rafter. As the difference in height between the two rafters increases, this bracing becomes larger and forms a significant feature of the structure.

This admittedly complicated description of the arrangement of restraints – and the careful attention paid to these restraints in the structure itself - serves to emphasise the critical importance of inner flange restraints. In conventional portal frames, some of the inside flange of the rafter will be in compression under normal gravity loads and the situation will reverse under wind uplift. These restraints are safety critical elements in portal frames - particularly in the haunched length, where the compression force in the flange is largest with the associated tendency to buckle. The inside flange at the haunch/column junction is the most critical location of all and designers should ensure that this point is restrained adequately.

The design of portal frames is described in SCI Publications P397 and P399, which cover portal frame design to BS EN 1993-1-1. SCI publication P252 covers the design of portal frames in accordance with BS 5950. In each publication, the importance of inner flange restraints is discussed at length.

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# Expanding sector gets steel boost

A large mixed-use scheme known as Central Square is the latest project to highlight the strengthening Leeds property market.

**FACT FILE**
**Central Square, Leeds**
**Main client:** Roydhouse Properties and Marrico LLP
**Architect:** DLA Design
**Main contractor:** Wates Construction
**Structural engineer:** WSP Parsons Brinckerhoff
**Steelwork contractor:** Elland Steel Structures
**Steel tonnage:** 2,000t

A stone's throw from Leeds railway station, a new mixed-use scheme, known as Central Square, has risen up on the plot previously earmarked for the Lumiere, a 54-storey tower that would have been the tallest residential building in the UK outside of the capital.

The Lumiere project went into liquidation in 2010 after banks stopped property lending. Now the steel-frame of the multi-million pound Central Square has risen up on the site and is set to breathe new life into an area benefiting from the upturn in the city's commercial property sector.

"The cranes that currently dot Leeds city centre's skyline are a marker of the growing investment and confidence in the commercial market, a resurgence that is also creating a strengthening upward curve in the construction industry," says Wates Construction North Managing Director Phil Harrison.

Central Square is strategically situated between Whitehall Road and Wellington Street with a high profile presence. It is a 20,400m² development, which provides 18,700m² of Grade A offices with 1,700m² of retail, leisure and health/fitness.

The scheme provides office accommodation on 10 floor levels. The offices are said to provide the largest floorplates available in the city and are also arranged so that they can be subdivided, providing the occupier with both flexible and highly efficient floor space.

Occupiers will also benefit from an outdoor sky garden on the ninth floor, providing entertainment opportunities and views across the city.

Sitting above a two-level concrete basement, the steel-frame forms a U-shaped structure with the central void occupied by a fully glazed winter garden.

This prominent glazed feature of the scheme will accommodate numerous retail and leisure opportunities in the form of bars and restaurants, together with a gym, at first floor and ground levels for the benefit of the tenants and general public.

The glazing for the winter garden slopes down from the underside of level eight within the central portion of the structure. Five 27m-long bowstring trusses, that were delivered to site in two pieces, form this indoor zone.

"There are heavy loadings on the trusses and so they are pin connected to one tonne bases a ground level," says Elland Steel Structures Site Manager Mark Wingrove.

These trusses were the longest elements to be erected by Elland, but because of their position they were some the final bits of steel to be erected, as steelwork had to be erected above level eight before the trusses could be installed.

*Bowstring trusses form the front of the winter garden*

## BIM project

Collaborative 3D modelling has been utilised from feasibility and planning stages through to construction on Central Square. DLA Design says it was essential that all disciplines in the design team used compatible 3D modelling packages, and in turn developed models to a required level of detail for each building element.

The site had been previously partially developed (ahead of the Lumiere project) and an extensive network of piled foundations existed at basement level. It is here the proposed building sits. It was important that the structural engineers modeled existing features, which enabled coordination of the architectural model with the existing site constraints.

The implementation of BIM has enabled the creation of life-like 3D animations for client presentations, engaging with them and potential tenants, whilst providing realistic representations of the end building image throughout the design development stages.

During the detailed design and construction stages, the individual discipline building models are shared on a regular basis. Meetings are also undertaken to review the federated models in Navisworks, evaluating the degree of coordination achieved at regular intervals throughout the project.

This level of coordination leads to the ability to review a virtual building model when specialist sub-contractors are on board for on-site installations, which enhances site coordination through to the fabrication of elements.

*Level nine's sky garden overlooks Leeds city centre*

*Sitting above a two-level basement, the steel frame forms a U-shaped structure with the central void occupied by a fully glazed winter garden.*

The largest steel element on the job is a 43t, storey-high, Vierendeel truss that supports level eight's balcony that overlooks the winter garden.

The Vierendeel truss was brought to site in individual sections that were then assembled on the ground before being lifted into place by a 300t capacity mobile crane.

The majority of the steelwork was erected using the site's tower cranes, with Elland employing two erection gangs that divided the structure in half and erected the frame three floors at time.

Each of the U-shaped structure's tips contains one of the building's three cores and this gave each erection gang an ideal point to start.

From the stability-giving outer cores each of Elland's erection gangs worked their way to the centre of the structure, meeting up at the third centrally positioned core.

Above the lower levels of retail and leisure, the offices begin at floor two and extend upwards to level 12. Floors two up to seven are identical, with a central portion positioned inside the winter garden.

The reception for the offices is positioned at first floor level and accessed via a feature escalator, with the upper floors being accessed by a number of lifts including two glass-clad wall climber lifts, which overlook the Winter Garden.

Floor eight features a large balcony overlooking the winter garden and is the last full office floorplate within the development. Offices occupy the eastern half of the building on the floor above, while the other half is occupied by the outdoor sky garden.

From here upwards, the three topmost levels (10, 11 and 12) only occupy the eastern half of the structure.

Central Square is aiming for a BREEAM 'Outstanding' rating and is due to be completed in May 2016.

# Design of composite beams with a reduced level of shear connection

Dr Graham Couchman considers SCI's new publication P405 Minimum degree of shear connection rules for UK construction to Eurocode 4.

## Background

Developments in decking products and UK construction practice have, in some cases, resulted in shear stud resistances dropping below the values that were traditionally used in design. Compared to re-entrant shapes of similar depth, trapezoidal decking has increased spanning ability and therefore permits wider spacing of secondary beams. These benefits result from the lower volume, and weight, of concrete that is needed. However, a downside of reducing the volume of concrete can be that there is less concrete around the shear studs on the supporting composite beams, and this reduces the resistance of the shear connection (which for typical building applications is governed by a failure surface of concrete). It is worth adding that the stud resistances given in EN 1994-1-1 (and for that matter BS 5950-3.1) are based on test results. The testing on which the current Eurocode rules are based was carried out over twenty years ago, self-evidently using products that were available at that time. The rules in BS 5950-3.1, prior to its amendment in 2010, are even more inappropriate when some forms of modern decking are used. Figure 1 shows the very ductile behaviour that can be achieved when a stud is placed in decking that runs transversally to the beam, and shows the impact of deck geometry. Failure is governed by the concrete, with two plastic hinges having formed in the stud.

*Figure 1: Failure of a shear stud placed in transverse decking (photo courtesy of University of Luxembourg)*

Lower stud resistances can result in composite beam designs (that were previously possible) becoming impossible, not because insufficient force can be transferred between steel and concrete to generate the necessary moment resistance, but because the maximum number of studs that can be accommodated on a beam is often less than the number of studs needed to satisfy rules for minimum degree of shear connection. A pilot study carried out by SCI in 2013 identified that beams with transverse trapezoidal decking, of nominal height 80 mm, were a particular issue. This is a form of decking that is particularly beneficial from a composite slab point of view.

## The need for a minimum degree of shear connection

When a beam is designed with full shear connection it means that there are sufficient shear connectors present to either fully exploit the steel section in tension or, as is more often the case in buildings, fully exploit the concrete slab in compression. A reduced number of shear connectors may be used, giving partial shear connection, when less force transfer between the steel and concrete is sufficient to achieve the necessary composite beam moment resistance.

However, it is important to recognise that a minimum degree of (partial) connection is absolutely necessary, in order to ensure there are sufficient studs present on a beam. 'Sufficient' has traditionally been taken as the number of studs needed to provide a collective stiffness to limit the slip between steel and concrete elements at the ultimate limit state to a certain amount. It is a resistance check to indirectly check stiffness, making it a rule that is easy to apply but difficult to understand.

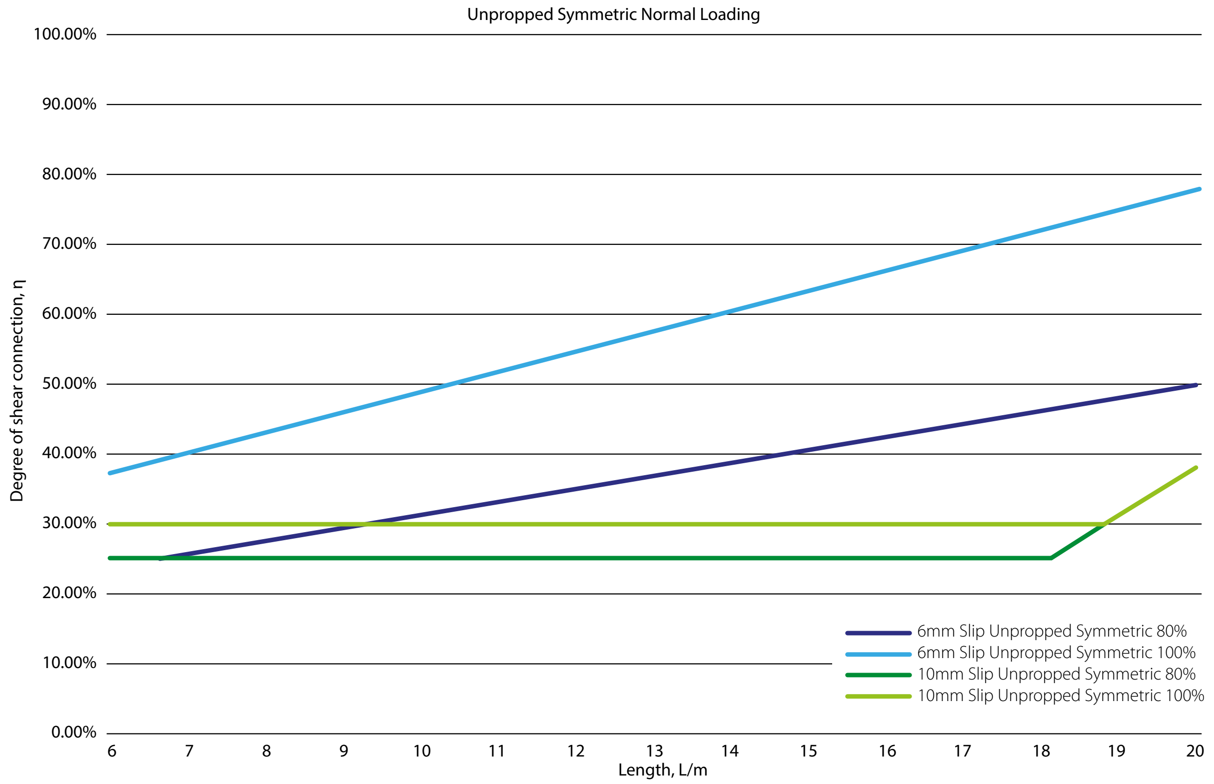
In striving for reduced values of minimum degree of connection, it was necessary for SCI to consider an additional definition of 'sufficient', namely the number of studs needed to ensure that the connection remains elastic under serviceability levels of loading. A danger of this criterion not being satisfied would be that, under the unlikely event of repeated loading up to SLS levels, a 'shakedown' of the shear connection would occur (leading to cumulative and irreversible deflections).

## Variables that affect the minimum degree of shear connection

The rules given in EN 1994-1-1 recognise that the minimum degree of connection is a function of steel strength, beam span, and any asymmetry of the beam flanges. However, a number of other variables affect the minimum degree, sometimes substantially. Recent work by SCI has considered; whether the beam is propped or unpropped, the slip capacity of the studs (which is greater when they are placed in transverse trapezoidal decking than the 6 mm assumed by EN 1994-1-1), and the type of loading. Consideration has also been given to beams with regularly spaced, large circular web openings (cellular beams), and beams that are only part utilised in bending.

Quantifying the effect of each of these variables, in order to develop design rules that allow for them, has been a major undertaking for SCI and has taken several years. The guidance that appeared on www.steel-ncci.co.uk (document PN002a-GB) in 2010 represented an interim step that has been extended by more recent work as presented in the new publication, SCI P405. Given the prohibitive cost of full scale physical testing of a large number of beams, finite element analysis has been used to perform comprehensive parametric studies. To calibrate the models, comparisons were made with work from independent research teams, and where possible beam tests. Of particular note in terms of beam tests are a 10 m span test carried out for SCI at Cambridge University in 2006, and two tests recently undertaken at the University of Bradford as part of a joint research project.

*Figure 2: Minimum degree of shear connection vs span for unpropped symmetric beams – slip capacity of the shear connection either 6 mm or 10 mm, composite beams either 100% or 80% utilised in bending*




**New rules for minimum degree of connection**

The new rules developed by SCI, examples of which can be seen in Figures 2 and 3, may be considered to complement those given in EN 1994-1-1 by covering more alternatives than the simpler 'cover all' rules in the code (which as noted earlier only consider three variables). Before considering the rules it is important to recognise that they must be used in conjunction with; more onerous detailing rules for maximum stud spacing than are presented in EN 1994-1-1 (in particular with transverse decking there must be at least one stud per trough), and a requirement to consider the increased beam flexibility that results from a low degree of connection. The latter can be achieved using a rule taken from BS 5950-3.1 (Clause 6.1.4). All the rules have a practical, but limited scope. It is important that this is respected (see SCI P405 for full details).

Figures 2 and 3 show minimum degree of shear connection as a function of span for unpropped symmetric and asymmetric (bottom flange three times the area of the top steel flange) beams respectively. For levels of asymmetry less than three it is acceptable to interpolate between the asymmetric and corresponding symmetric curves. The curves that are labelled as '10 mm slip' should only be used when a beam has transverse trapezoidal decking. Some of the curves exhibit an absolute lower bound (that is independent of span), and this reflects the minimum connection needed to maintain elastic behaviour of the shear studs under service loading. Where the degree of connection varies with span it shows the requirement is needed to limit the maximum slip at the ultimate limit state.

Both figures include curves for beams that are 100% utilised in bending and 80% utilised in bending. This is a very important concept, which has major implications, and will be a useful tool for designers. Utilisation in bending is defined as the factored applied moment divided by the design moment resistance of the

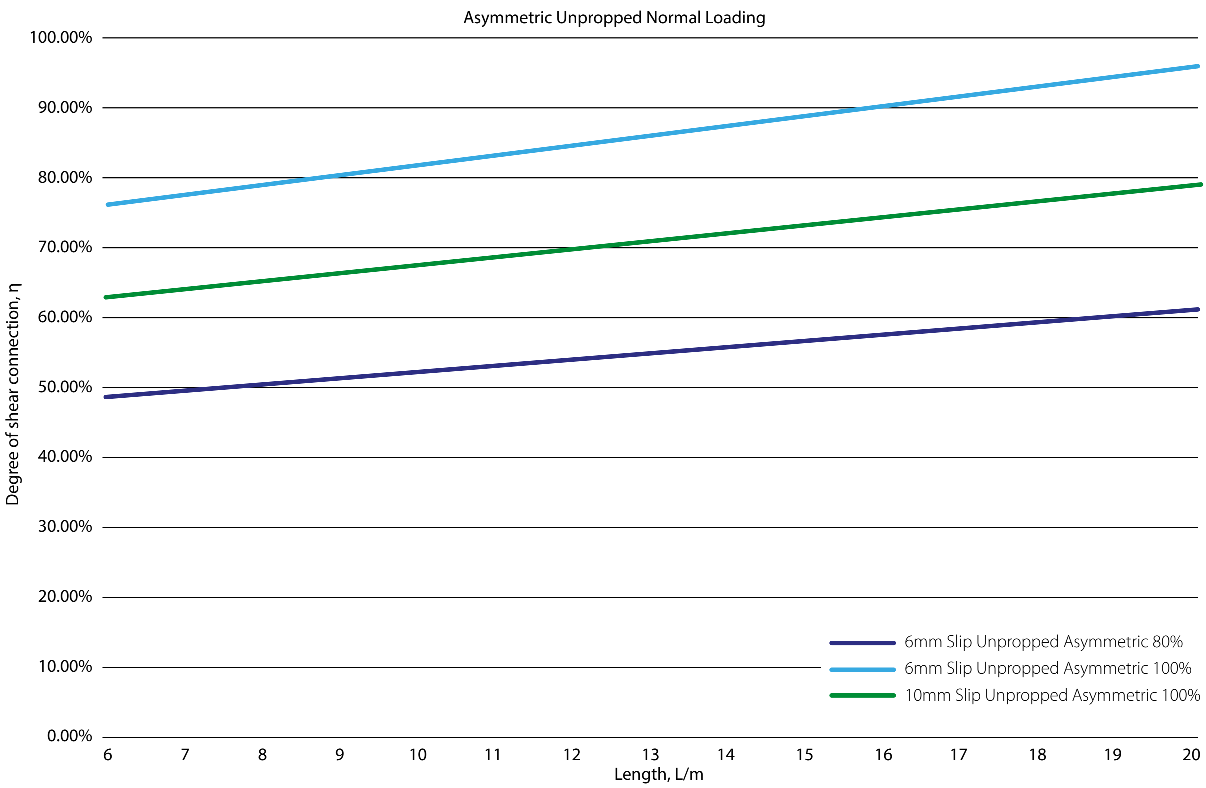



***Figure 3: Minimum degree of shear connection vs span for unpropped asymmetric (1:3) beams – slip capacity of the shear connection either 6 mm or 10 mm, composite beams either 100% or 80% utilised in bending***

composite beam. Clearly this could be less than 100% if the design is governed by serviceability requirements, or if an oversize steel beam has been specified for some reason (including because the number of studs needed to meet minimum degree of connection requirements for a fully utilised beam cannot be accommodated). Because steel is a non-linear material, and the load-slip behaviour of shear studs is non-linear, reducing the utilisation of the beam (and so the stresses in the top flange) can have a disproportionate impact on interface slip and therefore the number of studs needs to limit this slip.

Studies have shown that the minimum degree of connection needed to limit slip at the ultimate limit state can be reduced as a function of the beam utilisation squared (this can be clearly seen in Figure 2, where the gradients of the 'curves' for 80% utilised beams are equal to $0.8^2 = 0.64$ times those for fully utilised beams). Slip at serviceability loading is directly proportional to the utilisation (so in Figure 2 the horizontal part of the 'curve' for an 80% utilised beam is simply at 0.8 times the limit for the fully utilised beam). The findings concerning beam utilisation lend justification to, and in many case improve upon, the method that has been used by many designers of assuming an S355 beam is S275 in order to reduce the minimum degree of connection requirement to a level that can be satisfied.

The curves shown in Figures 2 and 3 apply to solid web beams. When regularly spaced, large circular openings are present in the beam web, less onerous rules may be used. This is because the strains in the top steel flange, which affect slip, are less than they would be in a corresponding situation with a solid web beam.

For full details of the scope within which these rules can be used, and indeed the comprehensive set of rules, reference should be made to SCI publication P405. It includes complementary guidance on shear stud resistance and detailing.

# AD 392: Frame stability tool on www.steelconstruction.info

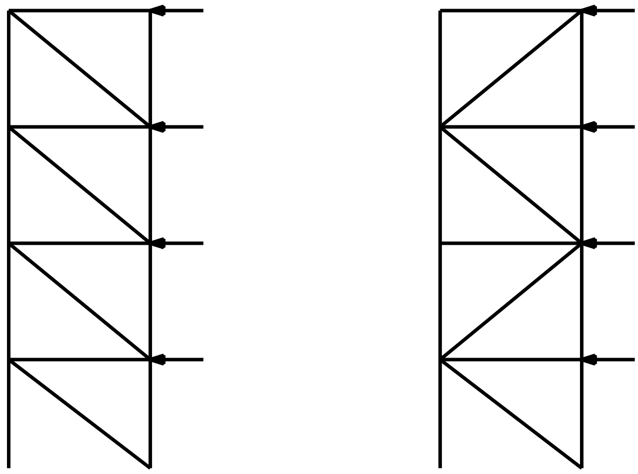
This Advisory Desk note gives background information on the frame stability tool, recently added to www.steelconstruction.info. The tool determines $\alpha_{cr}$ in accordance with BS EN 1993-1-1, 2005 clause 5.2.1(4)B.

The frame stability tool is a analysis program that calculates the lateral deflections of a vertical truss with point loads applied at the nodes. It is no different to any other analysis software; for a given set of loads, geometry and members, the results should be identical.

**Bracing layout.** The program assumes that the bracing is arranged as a Pratt truss, as shown in Figure 1(a), with all the lateral loads applied at the "far" end of the horizontal members, which is a conservative assumption. The deflections of this form of truss are larger than a Warren arrangement, shown in Figure 1(b). With the Pratt truss, all the horizontal members carry axial force, which increases towards the base.

**Loading.** The program requires the user to provide the lateral and vertical loading associated with the bracing system – generally any structure will have two or more bracing systems. The single bracing system analysed in the tool will therefore carry only part of the lateral load and part of the vertical load. Wind load is assumed to be distributed uniformly over the full height of the bracing and is converted into point loads applied at the nodes. In complex buildings with bracing systems of differing stiffness, it will be necessary to determine the proportion of load carried by each bracing system.

**Equivalent horizontal forces.** These have been calculated as 1/200 of the vertical loads. The $\alpha_h$ and $\alpha_m$ factors given in BS EN 1993-1-1 clause 5.3.2 have been set to 1.0, which is conservative. This conservatism has no significant impact on the calculation of $\alpha_{cr}$. It may be advantageous to include $\alpha_h$ and $\alpha_m$ when calculating the ultimate forces in the bracing system, since factors less than 1.0 will reduce the contribution of the EHF.



(a) Pratt truss (assumed in frame stability tool)

(b) Warren truss

*Figure 1: Bracing arrangements*

**Combinations of actions.** The stability tool considers combinations of actions using expression 6.10 of BS EN 1990. Two combinations are considered – firstly imposed vertical load leading and secondly wind load leading. From Table NA.A1.1 of the UK National Annex, $\psi_0$ is taken as 0.7 for vertical loads and 0.5 for the lateral loads.

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

# New and revised codes & standards

**From BSI Update September 2015**

### CORRIGENDA TO BRITISH STANDARDS

**BS EN ISO 3452-5:2008**
Non-destructive testing. Penetrant testing. Penetrant testing at temperatures higher than 50 degrees C
CORRIGENDUM 1

**BS EN ISO 3452-6:2008**
Non-destructive testing. Penetrant testing. Penetrant testing at temperatures lower than 10 degrees C
CORRIGENDUM 1

### BRITISH STANDARDS REVIEWED AND CONFIRMED

**BS ISO 17194:2007**
Structural adhesives. A standard database of properties

### BRITISH STANDARDS UNDER REVIEW

**BS EN 10132-1:2000**
Cold rolled narrow steel strip for heat treatment. Technical delivery conditions. General

**BS EN 10132-2:2000**
Cold rolled narrow steel strip for heat treatment. Technical delivery conditions. Case hardening steels

**BS EN 10132-3:2000**
Cold rolled narrow steel strip for heat treatment. Technical delivery conditions. Steels for quenching and tempering

**BS EN 10132-4:2000**
Cold rolled narrow steel strip for heat treatment. Technical delivery conditions. Spring steels and other applications

### NEW WORK STARTED

**NA to EN 1991-1-3**
UK National Annex to Eurocode 1. Actions on structures. General actions. Snow loads
*Will supersede NA to BS EN 1991-1-3:2003*

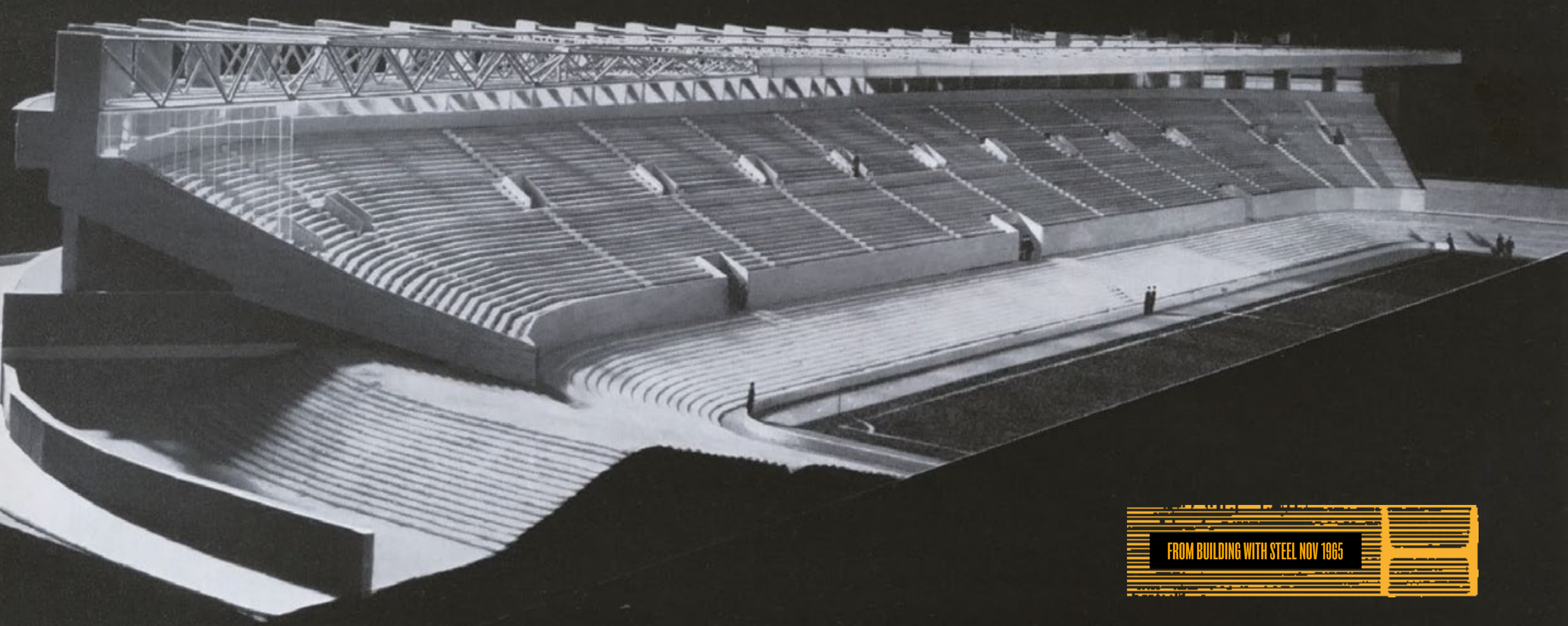
### DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

**15/30289876 DC**
*BS EN ISO 148-1* Metallic materials. Charpy pendulum impact test. Test method.
*Comments for the above document are required by 6 October, 2015*

### ISO PUBLICATIONS

**ISO 9934-1:2015**
(Edition 2)
Non-destructive testing. Magnetic particle testing. General principles
*Will be implemented as an identical British Standard*

# Football Stand for 1966 World Cup Series




By R. M. Threlfall, B.Sc., A.M.I.C.E., A.M.I.StructE

The directors of Manchester United Football Club had for some time been thinking in terms of developing the north side of the ground but it was not until late in 1963 that they instructed their architects to go ahead with a definite scheme.

This was to accommodate 10,500 seats without reducing the capacity of the ground and was achieved by building out over the ground level concourse at the back of the existing terraced bank as far as the boundary wall. As the scheme also included the unique feature of private boxes with rear entrance at the back of the stand and necessitated a cantilever roof it presented a difficult structural problem in the limited space available for counterbalancing the cantilever.

**A Problem Solved**

Many structural forms were explored, particular efforts being made to devise a stayed cantilever solution. The lack of space coupled with reversal of forces by wind uplift defeated such a scheme and the form adopted is basically the simplest possible. Various materials of construction were considered and several subjected to cost test by tender. It became very evident that maximum economy would be achieved by choosing the cheapest and lightest satisfactory roof sheeting – 18 gauge long length aluminium trough section – and designing the roof structure around that.

Initially it was felt that sections of tubular steelwork would prove economical and the first truss design was based on them. Tenders showed, however, that the fabrication, erection and protection factors outweighed the saving in material and therefore standard steel sections were used instead, with Universal columns for the top and bottom booms, starred angles for the latticing members and Universal beams for the purlins. Mild steel was adopted in preference to high yield stress steel in order to limit deflections. Welding runs along the main axis have been used for shop connections and high strength friction grip bolts for site fixing. Welds were satisfactorily subjected to radiographic examination. Protection of the steel work was achieved by blast cleaning followed immediately by weldable zinc-rich epoxy priming and later by micaceous iron oxide finishing paint.

The roof decking has been placed at the bottom of the truss for several reasons – compression boom restraint for the natural gravitational condition, internal appearance, easy access for maintaining the majority of the steelwork and natural roof drainage. These outweigh the major disadvantage of leaving most of the steel exposed to the weather. As wind uplift can almost completely reverse the maximum stress distribution the top boom also required buckling restraint. Locally high wind pressure from gusting is spread by the fascia and two inclined transverse stiffening girders. The fascia also breaks up laminar

*Stages in the erection of the new Stand for Manchester United Football Club are illustrated on the page opposite. Top to bottom these show:*

*Twin pairs of channel shear connectors embedded in tops of concrete columns*

*Lifting the first section of the truss by tower crane*

*Hinge connecting bottom boom to concrete column*

*The first quadrant of the Stand erected.*

wind flow and reduces air pressure on the roof.

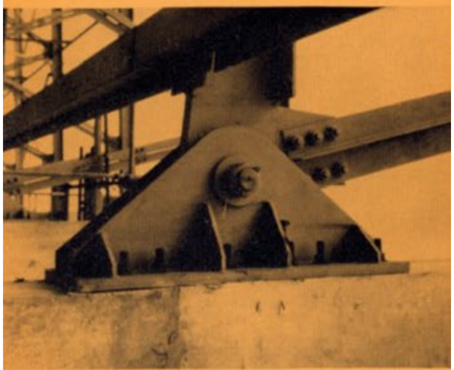
Upstand trusses created a minor problem in sheeting. To hang this below the bottom boom meant either double purlins or a complicated buckling brace and also left flashing difficulties around the hangers. To run the sheeting over the boom presented impossible flashing details around the lattice members. The solution adopted at Old Trafford was to bolt the purlins to the underside of the I boom and run the sheeting under the protective cover of the top flange of the boom. Each bay of sheeting was therefore independent and easily flashed, except at the hinge connection with the concrete columns where a rather complicated capping piece was required.

**Changes in Material**

The vertical member supporting the cantilever and the raking beam which stabilizes it and carries the upper level of terracing were both initially considered in steel plate girder section. As the steel would have required fire protection it was found to be cheaper to cast them in reinforced concrete. Whatever material ha been adopted there would have remained a difficulty in connecting it to the cantilever (a) because of the solid form of the one and the lattice form of the other and (b) in order to allow adjustments in position in order to level up the trusses.

The change in material simplified the detailing of this connection, particularly as the bending forces in the truss are about six times as great as the shear forces. The bottom boom is hinged the concrete column, allowing easy rotation and a small amount of vertical and horizontal movement, whilst the top boom slots between two pairs of steel channels embedded in the top of the column. The truss was made in two parts, the first being lifted over by tower crane with the hinge completely attached to the truss.

The hinge was bolted on to the column while the crane held the truss and the top



boom was temporarily cleated to the back pair of channels. This released the crane to bring over the front half of the truss which was bolted over the back half. Temporary jacking cleats were then fixed to the top boom between the two pairs of channels and twin jacks fitted between these cleats and the front pair of channels. The jacks were simultaneously operated to take the load off the back pair of channels and onto the front, at the same time raising the truss to the correct level. The permanent rear cleats were then fitted, side drilled, packed off the rear channels and friction grip bolted after which the jacks were released and the load re-transferred to the back channels. The jacking cleats were removed and permanent ones fitted between the boom and the front pair of channels. The whole assembly was then encased in concrete. Prior to this capping, the boom loads were transferred to the concrete by the channels working as brackets but, for loads applied after capping, the concrete cap dealt with the bending forces and the channels only had to be designed for the shear forces.

The remainder of the steelwork was bolted into position, the majority being within reach of the tower crane but the fascia and front two purlins being lifted by derrick. Erection proved to be very straightforward and a full scale overload test of one truss demonstrated its behaviour to be as intended.

Credit is due to the main contractor, who worked very efficiently in very limited working space – having to keep as much of the ground open as possible during Manchester United's successful and well attended 1964/65 season – and to the steelwork sub-contractors. Some 8,000 seats were taken over by the club at the beginning of this 1965.66 season and the whole project should be completed by the end of 1965, the construction period having been about 18 months and the total cost approximately £300,000.

Architect: Mather & Nutter. Consulting Engineers: Ove Arup & Partners.

# 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 & J Stead Ltd | 01653 693742 | | | ● | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £200,000 |
| A C Bacon Engineering Ltd | 01953 850611 | | | ● | ● | | ● | | | | | | | | | | 2 | | Up to £3,000,000 |
| A&J Fabtech Ltd | 01924 439614 | ● | | | ● | | ● | | | | ● | | ● | | | ✔ | 3 | | Up to £400,000 |
| Access Design & Engineering | 01642 245151 | | | | | ● | | | ● | ● | ● | | | ● | ● | ✔ | 2 | | Up to £4,000,000 |
| Adey Steel Ltd | 01509 556677 | | | | ● | ● | ● | ● | | ● | ● | | | ● | ● | ✔ | 3 | 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 | | | ● | ● | ● | ● | | | ● | ● | | | ● | ● | ✔ | 4 | | 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 £2,000,000 |
| BHC Ltd | 01555 840006 | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | | ● | ● | ✔ | 4 | | Above £6,000,000 |
| Billington Structures Ltd | 01226 340666 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✔ | 4 | Gold | Above £6,000,000 |
| Border Steelwork Structures Ltd | 01228 548744 | | | ● | ● | ● | ● | | | | ● | | | | ● | | 2 | | Up to £3,000,000 |
| Bourne Construction Engineering Ltd | 01202 746666 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✔ | 4 | Gold | Above £6,000,000 |
| Briton Fabricators Ltd | 0115 963 2901 | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ✔ | 4 | | Up to £4,000,000 |
| Builders Beams Ltd | 01227 863770 | | | | ● | | | | | ● | | | | ● | ● | ✔ | 2 | | Up to £1,400,000 |
| Cairnhill Structures Ltd | 01236 449393 | ● | | | ● | ● | ● | ● | ● | ● | | | | ● | ● | ✔ | 4 | Silver | Up to £3,000,000 |
| Caunton Engineering Ltd | 01773 531111 | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | ● | ● | ✔ | 4 | Gold | Up to £6,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✔ | 4 | Gold | Above £6,000,000* |
| CMF Ltd | 020 8844 0940 | | | | ● | | ● | ● | | ● | ● | | | | ● | ✔ | 4 | | Up to £6,000,000 |
| Cook Fabrications Ltd | 01303 893011 | | | | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Coventry Construction Ltd | 024 7646 4484 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| D H Structures Ltd | 01785 246269 | | | ● | ● | | ● | | | | ● | | | | | | 2 | | Up to £100,000 |
| Duggan Steel Ltd | 00 353 29 70072 | | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | | ● | ✔ | 4 | | Up to £4,000,000 |
| ECS Engineering Services Ltd | 01773 860001 | ● | | | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ✔ | 3 | | Up to £3,000,000 |
| Elland Steel Structures Ltd | 01422 380262 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ✔ | 4 | Gold | Up to £6,000,000 |
| EvadX Ltd | 01745 336413 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | ✔ | 3 | Gold | Up to £3,000,000 |
| Four Bay Structures Ltd | 01603 758141 | | | ● | ● | | | | | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Fox Bros Engineering Ltd | 00 353 53 942 1677 | | | ● | ● | ● | ● | ● | | | ● | | | | ● | | 2 | | Up to £2,000,000 |
| Gorge Fabrications Ltd | 0121 522 5770 | | | | ● | ● | ● | ● | | ● | | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| Gregg & Patterson (Engineers) Ltd | 028 9061 8131 | | | ● | ● | ● | ● | ● | | | | ● | | ● | | ✔ | 3 | | Up to £2,000,000 |
| H Young Structures Ltd | 01953 601881 | | | ● | ● | ● | ● | ● | | | ● | | | ● | ● | ✔ | 2 | Member | Up to £2,000,000 |
| Had Fab Ltd | 01875 611711 | | | | ● | | | | ● | ● | ● | | | | ● | ✔ | 4 | | Up to £3,000,000 |
| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |

| Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | FPC | SCM | Guide Contract Value (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hambleton Steel Ltd | 01748 810598 | | ● | ● | ● | ● | ● | ● | | | | ● | | ● | | ✔ | 4 | ○ | Up to £2,000,000 |
| Harry Marsh (Engineers) Ltd | 0191 510 9797 | | | ● | ● | ● | ● | | | | ● | ● | | | ● | ✔ | 2 | | Up to £1,400,000 |
| Hescott Engineering Company Ltd | 01324 556610 | | | ● | ● | ● | ● | | | ● | | | | ● | ● | ✔ | 2 | | Up to £3,000,000 |
| Intersteels Ltd | 01322 337766 | | | | ● | ● | ● | ● | | | | | ● | | | ✔ | 3 | | Up to £2,000,000 |
| J & A Plant Ltd | 01942 713511 | | | | ● | ● | | | | | | | | | ● | | 2 | | Up to £200,000 |
| James Killelea & Co Ltd | 01706 229411 | | ● | ● | ● | ● | ● | | | | | ● | | ● | | | 4 | | Up to £6,000,000* |
| John Reid & Sons (Strucsteel) Ltd | 01202 483333 | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✔ | 4 | | Up to £6,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ✔ | 4 | ● | Up to £3,000,000 |
| Leach Structural Steelwork Ltd | 01995 640133 | | | ● | ● | ● | ● | ● | | | ● | | | | | ✔ | 2 | ○ | Up to £4,000,000 |
| Legge Steel (Fabrications) Ltd | 01592 205320 | | | ● | ● | | ● | | ● | ● | ● | | | ● | ● | | 3 | | Up to £400,000 |
| Luxtrade Ltd | 01902 353182 | | | | | | | | | ● | ● | | | | ● | ✔ | 2 | | Up to £800,000 |
| M Hasson & Sons Ltd | 028 2957 1281 | | | ● | ● | ● | ● | ● | ● | ● | ● | | | | ● | ✔ | 4 | | Up to £2,000,000 |
| M J Patch Structures Ltd | 01275 333431 | | | | ● | | | | | ● | ● | | | ● | | ✔ | 2 | | Up to £800,000 |
| M&S Engineering Ltd | 01461 40111 | | | | ● | | | | ● | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Mackay Steelwork & Cladding Ltd | 01862 843910 | | | ● | ● | | ● | | | ● | ● | | | ● | ● | ✔ | 4 | | Up to £800,000 |
| Maldon Marine Ltd | 01621 859000 | | | | ● | ● | | ● | ● | ● | | | | | ● | ✔ | 3 | | Up to £1,400,000 |
| Mifflin Construction Ltd | 01568 613311 | | | ● | ● | ● | ● | | | | ● | | | | | | 2 | | Up to £3,000,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | | | ● | | ● | | | | ● | | | | ● | ✔ | 4 | | Up to £1,400,000 |
| Newbridge Engineering Ltd | 01429 866722 | ● | | ● | ● | ● | ● | | | | ● | | | | ● | ✔ | 3 | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | | | | | | ● | ● | ● | ● | | | | | | ✔ | 4 | | Up to £4,000,000 |
| Overdale Construction Services Ltd | 01656 729229 | | | ● | ● | | ● | ● | | | ● | | | | ● | | 2 | | Up to £400,000 |
| Painter Brothers Ltd | 01432 374400 | | | | | | | | ● | | ● | | | ● | ● | ✔ | 2 | ● | Up to £6,000,000 |
| Pencro Structural Engineering Ltd | 028 9335 2886 | | | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ✔ | 2 | | Up to £2,000,000 |
| Peter Marshall (Steel Stairs) Ltd | 0113 307 6730 | | | | | | | | | ● | | | | | ● | ✔ | 2 | | Up to £800,000* |
| PMS Fabrications Ltd | 01228 599090 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | ✔ | 2 | | Up to £1,400,000 |
| R S Engineering SW Ltd | 01752 844511 | | | | ● | | | | | ● | ● | | | ● | ● | ✔ | 2 | | Up to £100,000 |
| Rippin Ltd | 01383 518610 | | | ● | ● | ● | ● | ● | | | | | | ● | ● | | 2 | | Up to £1,400,000 |
| S H Structures Ltd | 01977 681931 | ● | | | | | ● | ● | ● | ● | ● | ● | | | | ✔ | 4 | ○ | Up to £2,000,000 |
| SDM Fabrication Ltd | 01354 660895 | ● | ● | ● | ● | ● | ● | | | | ● | | | ● | ● | ✔ | 4 | | Up to £1,400,000 |
| Sean Brady Construction Engineering Ltd | 00 353 49 436 4144 | | | ● | ● | ● | ● | | | ● | ● | | | ● | ● | | 2 | | Up to £800,000 |
| Severfield plc | 01845 577896 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✔ | 4 | ● | Above £6,000,000 |
| Shaun Hodgson Engineering Ltd | 01553 766499 | ● | | ● | ● | | | | | ● | ● | | | ● | ● | ✔ | 3 | | Up to £800,000 |
| Shipley Structures Ltd | 01400 251480 | | | ● | ● | ● | ● | | ● | ● | ● | | | ● | ● | | 2 | | Up to £1,400,000 |
| Snashall Steel Fabrications Ltd | 01300 345588 | | | ● | ● | ● | ● | ● | | | ● | | | | ● | | 2 | | Up to £1,400,000 |
| South Durham Structures Ltd | 01388 777350 | | | ● | ● | ● | | | | ● | ● | ● | | | ● | | 2 | | Up to £800,000 |
| Southern Fabrications (Sussex) Ltd | 01243 649000 | | | | ● | | | | | ● | ● | | | ● | ● | ✔ | 2 | | Up to £800,000 |
| Taziker Industrial Ltd | 01204 468080 | | | | | | | | | ● | | | | ● | ● | ✔ | 3 | | Above £6,000,000 |
| Temple Mill Fabrications Ltd | 01623 741720 | | | ● | ● | ● | ● | | | | ● | | | ● | ● | ✔ | 2 | | Up to £400,000 |
| Traditional Structures Ltd | 01922 414172 | | | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ✔ | 2 | ○ | Up to £2,000,000 |
| TSI Structures Ltd | 01603 720031 | | | ● | ● | ● | ● | | | | | | | | | | 2 | | Up to £1,400,000 |
| Tubecon | 01226 345261 | | | | | | ● | ● | ● | ● | | | | ● | ● | ✔ | 4 | ● | Above £6,000,000* |
| Underhill Engineering & Building Services Ltd | 01752 752483 | | | | ● | | ● | ● | ● | ● | ● | | | ● | ● | ✔ | 4 | | Up to £3,000,000 |
| W & H Steel & Roofing Systems Ltd | 00 353 56 444 1855 | | | ● | ● | ● | ● | ● | | | | | | ● | ● | | 4 | | Up to £2,000,000 |
| W I G Engineering Ltd | 01869 320515 | | | | ● | | | | | ● | | | | | ● | ✔ | 2 | | Up to £200,000 |
| Walter Watson Ltd | 028 4377 8711 | | | ● | ● | ● | ● | ● | | | | ● | | | | ✔ | 4 | | Up to £6,000,000 |
| Westbury Park Engineering Ltd | 01373 825500 | ● | | ● | ● | | ● | ● | ● | ● | ● | | | | ● | ✔ | 4 | | Up to £800,000 |
| William Haley Engineering Ltd | 01278 760591 | | | ● | ● | ● | | | ● | ● | ● | | | ● | | ✔ | 4 | ○ | Up to £4,000,000 |
| William Hare Ltd | 0161 609 0000 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ✔ | 4 | ● | Above £6,000,000 |

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

# Corporate Members

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

| Company name | Tel |
|---|---|
| Balfour Beatty Utility Solutions Ltd | 01332 661491 |
| Bluefin Group | 020 3040 6723 |
| Griffiths & Armour | 0151 236 5656 |
| Highways England Company Ltd | 08457 504030 |
| Kier Construction Ltd | 01767 640111 |
| PTS (TQM) Ltd | 01785 250706 |

| Company name | Tel |
|---|---|
| Roger Pope Associates | 01752 263636 |
| Sandberg LLP | 020 7565 7000 |
| Structural & Weld Testing Services Ltd | 01795 420264 |
| SUM Ltd | 0113 242 7390 |
| Welding Quality Management Services Ltd | 00 353 87 295 5335 |

# Industry Members

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

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

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

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

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AJN Steelstock Ltd | 01638 555500 | | | | | | | | ● | | M | |
| Albion Sections Ltd | 0121 553 1877 | ● | | | | | | | | | M | |
| Arcelor Mittal Distribution - Scunthorpe | 01724 810810 | | | | | | | | ● | | D/I | |
| ASD metal services | 0113 254 0711 | | | | | | | | ● | | D/I | |
| Ayrshire Metal Products (Daventry) Ltd | 01327 300990 | ● | | | | | | | | | M | |
| BAPP Group Ltd | 01226 383824 | | | | | | | | | ● | M | |
| Barrett Steel Services Limited | 01274 682281 | | | | | | | | ● | | M | |
| Behringer Ltd | 01296 668259 | | | | | ● | | | | | | |
| BW Industries Ltd | 01262 400088 | ● | | | | | | | | | M | |
| 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:**

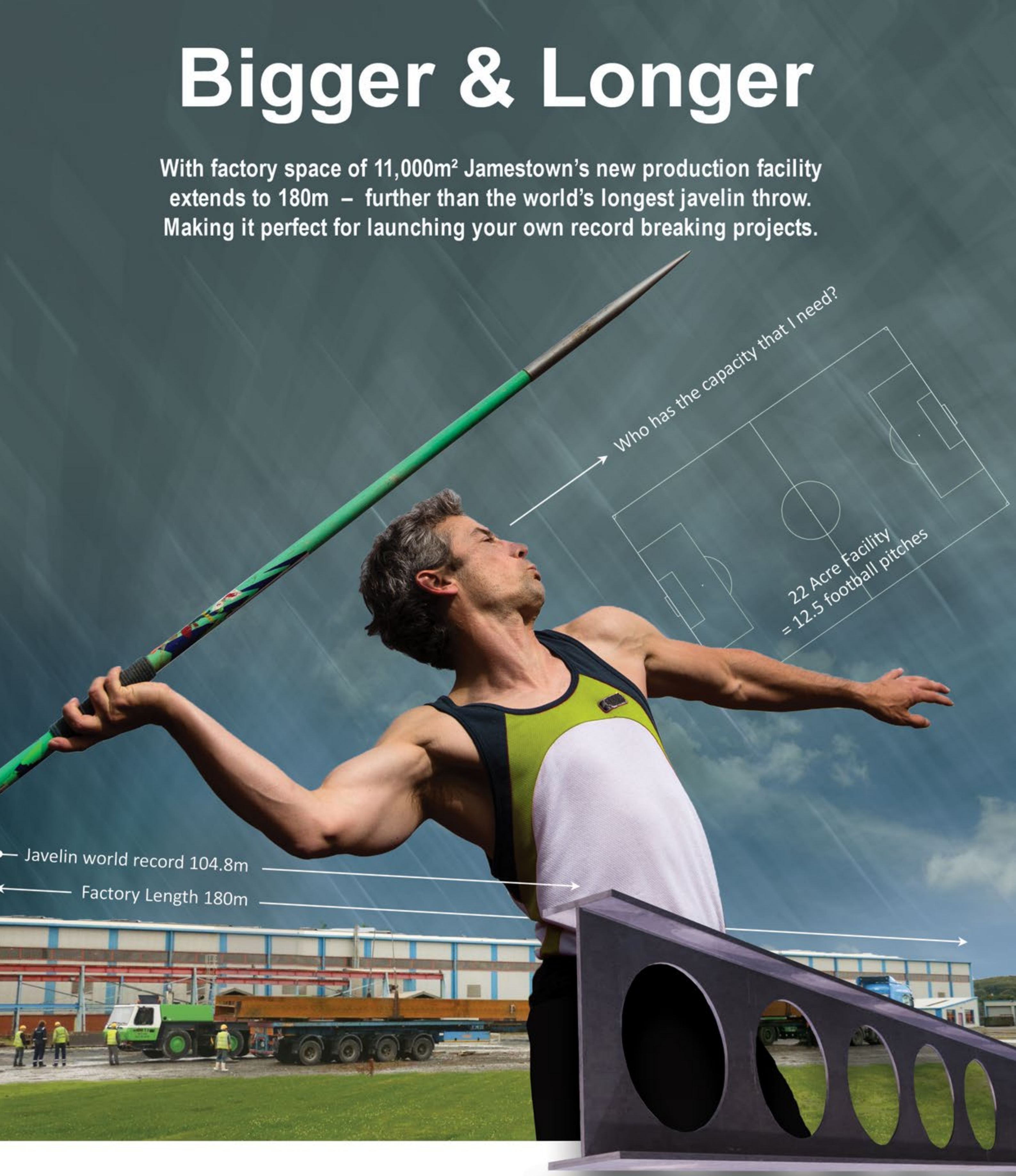
- **FG** Footbridge and sign gantries
- **PG** Bridges made principally from plate girders
- **TW** Bridges made principally from trusswork
- **BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
- **CM** Cable-supported bridges (eg cable-stayed or suspension) and other 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, ● = Silver, ● = Member)

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

| BCSA steelwork contractor member | Tel | FG | PG | TW | BA | CM | MB | RF | AS | QM | FPC | NHSS 19A | NHSS 20 | SCM | Guide Contract Value [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A&J Fabtech Ltd | 01924 439614 | ● | ● | | ● | | | | ● | ✓ | 3 | | | | Up to £400,000 |
| Bourne Construction Engineering Ltd | 01202 746666 | ● | ● | ● | | | | ● | ● | ✓ | 4 | | | Gold | Above £6,000,000 |
| Briton Fabricators Ltd | 0115 963 2901 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | | Up to £4,000,000 |
| Cairnhill Structures Ltd | 01236 449393 | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | ✓ | Silver | Up to £3,000,000 |
| Cleveland Bridge UK Ltd | 01325 381188 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | ✓ | Gold | Above £6,000,000* |
| Donyal Engineering Ltd | 01207 270909 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | Member | Up to £1,400,000 |
| Four-Tees Engineers Ltd | 01489 885899 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 3 | | ✓ | Member | Up to £2,000,000 |
| Kiernan Structural Steel Ltd | 00 353 43 334 1445 | ● | | ● | | | | ● | ● | ✓ | 4 | | ✓ | Gold | Up to £3,000,000 |
| Millar Callaghan Engineering Services Ltd | 01294 217711 | ● | | | | | | ● | ● | ✓ | 4 | | | | Up to £800,000 |
| Murphy International Ltd | 00 353 45 431384 | ● | ● | ● | | | | | ● | ✓ | 4 | | | | Up to £1,400,000 |
| Nusteel Structures Ltd | 01303 268112 | ● | ● | ● | ● | ● | | ● | ● | ✓ | 4 | ✓ | ✓ | | Up to £4,000,000 |
| S H Structures Ltd | 01977 681931 | ● | | ● | ● | ● | ● | | ● | ✓ | 4 | | ✓ | Silver | Up to £2,000,000 |
| Severfield (UK) Ltd | 01204 699999 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | ✓ | Gold | Above £6,000,000 |
| Taziker Industrial Ltd | 01204 468080 | ● | | | | | | ● | ● | ✓ | 3 | ✓ | ✓ | | Above £6,000,000 |
| Underhill Building & Engineering Services Ltd | 01752 752483 | ● | ● | ● | ● | | | ● | ● | ✓ | 4 | | | | Up to £3,000,000 |
| **Non-BCSA member** | | | | | | | | | | | | | | | |
| Allerton Steel Ltd | 01609 774471 | ● | ● | ● | ● | | | | ● | ✓ | 4 | | ✓ | | Up to £4,000,000 |
| Centregreat Engineering Ltd | 029 2046 5683 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 4 | | | | Up to £400,000 |
| Cimolai SpA | 01223 836299 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | | | Above £6,000,000 |
| Concrete & Timber Services Ltd | 01484 606416 | ● | ● | ● | ● | ● | ● | | ● | ✓ | 4 | | | Member | Up to £800,000 |
| 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 |
| HS Caristeel Engineering Ltd | 020 8312 1879 | ● | ● | | | | | ● | ● | ✓ | 3 | | ✓ | | Up to £400,000 |
| IHC Engineering (UK) Ltd | 01773 861734 | ● | | | | | | | ● | ✓ | 3 | | ✓ | | Up to £400,000 |
| Interserve Construction Ltd | 0121 344 4888 | | | | | | | ● | ● | ✓ | 3 | | | | Above £6,000,000* |
| Interserve Construction Ltd | 020 8311 5500 | ● | ● | ● | ● | | ● | ● | ● | ✓ | 3 | | | | Above £6,000,000* |
| Lanarkshire Welding Company Ltd | 01698 264271 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | ✓ | | Member | Up to £2,000,000 |
| P C Richardson & Co (Middlesbrough) Ltd | 01642 714791 | ● | | | | | | ● | ● | ✓ | N/A | | | | Up to £3,000,000 |
| Total Steelwork & Fabrication Ltd | 01925 234320 | ● | | | | | | ● | ● | ✓ | 3 | | ✓ | | Up to £3,000,000 |
| Victor Buyck Steel Construction | 00 32 9 376 2211 | ● | ● | ● | ● | ● | ● | ● | ● | ✓ | 4 | | | Silver | Above £6,000,000 |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| easi-edge Ltd | 01777 870901 | | | | | | | ● | | | N/A | ● |
| Fabsec Ltd | 0845 094 2530 | ● | | | | | | | | | N/A | |
| FabTrol Systems UK Ltd | 01274 590865 | | ● | | | | | | | | N/A | |
| Ficep (UK) Ltd | 01942 223530 | | | | | ● | | | | | N/A | |
| FLI Structures | 01452 722200 | ● | | | | | | | | | M | ● |
| Forward Protective Coatings Ltd | 01623 748323 | | | | | | ● | | | | N/A | |
| Goodwin Steel Castings Ltd | 01782 220000 | ● | | | | | | | | | N/A | |
| Graitec UK Ltd | 0844 543 8888 | | ● | | | | | | | | N/A | |
| Hadley Group Ltd | 0121 555 1342 | ● | | | | | | | | | M | ○ |
| Hempel UK Ltd | 01633 874024 | | | | | | ● | | | | N/A | |
| Highland Metals Ltd | 01343 548855 | | | | | | ● | | | | N/A | |
| Hilti (GB) Ltd | 0800 886100 | | | | | | | | | ● | M | |
| Hi-Span Ltd | 01953 603081 | ● | | | | | | | | | M | ○ |
| International Paint Ltd | 0191 469 6111 | | | | | | ● | | | | N/A | ● |
| Jack Tighe Ltd | 01302 880360 | | | | | | ● | | | | N/A | |
| Jamestown Cladding & Profiling Ltd | 00 353 45 434288 | ● | | | | | | | | | M | |
| John Parker & Sons Ltd | 01227 783200 | | | | | | | | ● | ● | D/I | |
| Joseph Ash Galvanizing | 01246 854650 | | | | | | ● | | | | N/A | |
| Jotun Paints (Europe) Ltd | 01724 400000 | | | | | | ● | | | | N/A | |
| Kaltenbach Ltd | 01234 213201 | | | | | ● | | | | | N/A | |
| Kingspan Structural Products | 01944 712000 | ● | | | | | | | | | M | ● |
| Lindapter International | 01274 521444 | | | | | | | | | ● | M | |

| Company name | Tel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | CE | SCM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Longs Steel UK Ltd | 01724 404040 | | | | ● | | | | | | M | |
| Murray Plate Group Ltd | 0161 866 0266 | | | | | | | | ● | | D/I | |
| National Tube Stockholders Ltd | 01845 577440 | | | | | | | | ● | | D/I | |
| Peddinghaus Corporation UK Ltd | 01952 200377 | | | | | ● | | | | | N/A | |
| PPG Performance Coatings UK Ltd | 01773 814520 | | | | | | ● | | | | N/A | |
| Prodeck-Fixing Ltd | 01278 780586 | ● | | | | | | | | | D/I | |
| Rainham Steel Co Ltd | 01708 522311 | | | | | | | | ● | | D/I | |
| Sherwin-Williams Protective & Marine Coatings | 01204 521771 | | | | | | ● | | | | M | ○ |
| Sika Ltd | 01707 384444 | | | | | | ● | | | | M | |
| Simpson Strong-Tie | 01827 255600 | | | | | | | | | ● | M | |
| Structural Metal Decks Ltd | 01202 718898 | ● | | | | | | | | | M | ● |
| StruMIS Ltd | 01332 545800 | | ● | | | | | | | | N/A | |
| Tata Steel Distribution UK & Ireland | 01902 484000 | | | | | | | | ● | | D/I | |
| Tata Steel Ireland Service Centre | 028 9266 0747 | | | | | | | | ● | | D/I | |
| Tata Steel Service Centre Dublin | 00 353 1 405 0300 | | | | | | | | ● | | D/I | |
| Tata Steel Tubes | 01536 402121 | | | | ● | | | | | | M | |
| Tata Steel UK Panels & Profiles | 0845 3088330 | ● | | | | | | | | | M | |
| Tekla (UK) Ltd | 0113 887 9790 | | ● | | | | | | | | N/A | |
| Tension Control Bolts Ltd | 01948 667700 | | | | | | ● | | | ● | M | |
| voestalpine Metsec plc | 0121 601 6000 | ● | | | | | | | | | M | ● |
| Wedge Group Galvanizing Ltd | 01909 486384 | | | | | | ● | | | | N/A | |
| Yamazaki Mazak UK Ltd | 01905 755755 | | | | | ● | | | | | N/A | |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With factory space of 11,000m² Jamestown's new production facility extends to 180m – further than the world's longest javelin throw. Making it perfect for launching your own record breaking projects.
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22 Acre Facility
= 12.5 football pitches
Javelin world record 104.8m
Factory Length 180m