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Cover Image
Ince Biomass Energy Plant
Main client: CoGen
Main contractor: MBV Energy, Ward & Burke
Structural engineer: Coyle Kennedy
Steelwork contractor: EvadX
Steel tonnage: 3,500t

NSC

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

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UK investments reflected in steel

Nick Barrett - Editor

The start of a year is a traditional time to look ahead to what the following 12 months might promise, and perhaps even hazard a prediction or two. The outlook for the economy in 2017 is fairly steady based on Bank of England forecasts, despite uncertainties over Brexit.

Making confident and detailed forecasts is always difficult; keeping abreast of what is actually happening is often challenge enough, but that is something that NSC can help with as our pages give a useful snapshot of private and public sector investment at any given time. In this issue for example we have project reports of two education buildings, an alternative energy plant and two town centre regeneration projects.

This is a fair reflection of what is happening in the UK now. School building for example looks like it is being given a new priority, after several years of sparse investment. Energy continues to be a major concern for the UK with a major nuclear building programme in the offing, as well as a raft of alternative energy solutions coming to the fore, such as the biomass plant featured in this issue of NSC.

And projects that are geographically far removed from one another – in Stockport and Slough – show that there is funding available for inner city developments across the UK, especially those with regeneration potential.

Our series of articles on Steel for Life sponsors in the steel construction supply chain is proving to be as informative and popular as we hoped, shining a light on some of the often overlooked but important contributions made by a wide variety of suppliers. This month we look at two of the key parts of the supply chain.

The bolting sector provides the structural bolts and fasteners which are employed in every steel-framed building and steel bridge and other structures. The structural components sector comprises specialist companies that tackle production of the growing number of bespoke structural elements such as transfer beams, plate girders and cellular beams.

We also have an article about Steel for Life Headline Sponsor Trimble whose Tekla software is helping place the steel construction sector at the forefront of adopting Building Information Modelling in support of government targets.

Steel construction is also at the fore of supporting investment in modern buildings and other structures such as those featured in this issue of NSC, making some of them more financially feasible. One safe forecast for 2017 is that the UK steel construction sector's class-leading support for whatever the UK's investment needs are will continue.

Sub-contractors join forces for safe ground conditions

The British Constructional Steelwork Association (BCSA), Federation of Master Builders (FMB), National Federation of Builders and Structural Timber Association (STA), have joined forces to remind the construction industry about the need for safe ground conditions on construction sites, particularly during winter.

FMB Head of Policy Andrew Dixon said: "Ground conditions could be the difference between life and death for construction site workers. We were lucky to have a dry start to Autumn. But these weather conditions did not last and with the rain comes softer ground and danger.

"Mobile plant such as cranes and mobile elevating work platforms (MEWPs) weigh many tonnes. If ground conditions are poor, they are at risk of sinking which poses a serious risk to life."

BCSA Director General Sarah McCann-Bartlett added: "It is pleasing to see that main contractors are generally providing their sub-contractors with detailed information about ground conditions at the start of a job as required by the Construction (Design and Management) Regulations.

"However, the regulations also say they must undertake ongoing monitoring of ground conditions and where the ground is disturbed, consolidate and re-test it."

A recent survey of BCSA members' Health & Safety Managers found that most main contractors provide safe site handover certificates to sub-contractors and the Temporary Works Coordinator is usually made known and available to sub-contractors. However, the CDM Principal Designer rarely liaises with sub-contractors on site conditions.

While main contractors usually provide adequate ground conditions at the start of a project, these often deteriorate as work progresses and the ground is sometimes not properly remediated and re-tested.

National Federation of Builders Head of Policy and Research Paul Bogle said: "The Strategic Forum Plant

Safety Group's *Good Practice Guide for Ground Conditions for Construction Plant* provides excellent guidance for all those working in the construction sector. The Guide aims to prevent accidents and save lives by ensuring that ground conditions are suitable for heavy lifting equipment used by sub-contractors on construction sites."

The *Good Practice Guide for Ground Conditions for Construction Plant* can be downloaded from: *http://www.cpa.uk.net/sfpsg/*

Steel completes on Birmingham Conservatoire

The main steel elements on the first music conservatoire to be built in the UK for 30 years have been completed.

Working on behalf of main contractor Galliford Try, Mifflin Construction has fabricated, supplied and erected 450t of steelwork for the project, which equates to more than 2,400 individual components.

Being built for Birmingham City University the conservatoire will accommodate five major performance spaces, a dozen group practice rooms, as well as specialist practice rooms and 50 individual practice rooms spread over six floors in the 10,500m² venue.

Acoustics are the main driver for this project as all of the performance spaces need to be totally isolated from each other and using structural steelwork was the chosen solution.

The design involves five individual steel-framed boxes for the main performance spaces, each one independent from each other and from the surrounding main frame. Each box varies in size, but is based around columns, all of which are on acoustic pads, spaced at 6m centres.

The main box houses the 400-seat Adrian Boult Hall – a concert hall that will accommodate a full orchestra. This is positioned above two smaller boxes accommodating a recital hall and an experimental music space. At the other end of the building, the other two boxes housing jazz and organ rooms are stacked on top of each other.

The project is scheduled to complete in July.

Tintagel Castle to get weathering steel footbridge

English Heritage plans to build a spectacular steel footbridge to link Tintagel Castle's mainland and island wards to improve access to one of Cornwall's most popular tourist sites.

The bridge will replace a steep winding staircase which currently prevents many visitors from enjoying the historic site and its renowned setting.

Recreating a link that once existed, the footbridge design consists of two independent cantilevers of approximately 33m length each, that reach out and touch, almost, in the middle.

For the main structure the design proposes the use of weathering steel as it does not require corrosion protection, and over time will develop a rusty red or brown patina that will reflect the rugged wildness of the site.

The intention is for each half of the bridge to be built independently as cantilevers. This technique allows construction to advance sequentially into the void from the abutments, without the need for temporary supports.

All plant and construction material required for the site would be brought in and removed using a cable crane.

Steelwork for the bridge would be delivered in four to five tonne segments and delivered directly to the appropriate location on the site using the cable crane, and lowered into position.

English Heritage is looking for a contractor and the tender will be advertised on Contracts Finder and the English Heritage Supplier Portal. For more, see *https://in-tendhost.co.uk/english-heritage*.

Eight-year high for London office construction

The volume of office construction currently under way across London has hit an eight-year high according to the latest Deloitte London Office Crane Survey.

Office construction has increased by 4% over the past six months to 1.3 million square metres, with 41% of the space currently being built already let.

One of the major trends in London has been an increase in refurbishment projects, with 28 schemes currently ongoing in the capital.

The greatest number of new starts was in the City. Construction began on 14 schemes, totaling 102,000m², a little above the long-term average.

The Southbank submarket has seen the most noteworthy rise in activity. Close to 74,000m² across nine schemes has started since the previous survey.

This is largely as a result of works commencing on 1 and 2 Southbank Place, the former (and future) Shell headquarters near to Waterloo station.

Other London areas which have seen significant rises in office construction include Docklands, White City and Kings Cross.

City of London's tallest tower gets the green light

Plans to build the tallest tower in the City of London have been given the green light by planners.

The building at 1 Undershaft, also known as the Trellis, will have 73-storeys and will be 304m-high, making it the second tallest building in Western Europe after The Shard.

Singapore-based developer Aroland Holdings has been granted planning permission for the tower by the City of London Corporation's planning and transport committee, which voted in favour by 19 votes to two.

The existing Aviva tower will be demolished to make way for the new Eric Parry-designed building, which will have a free public viewing gallery at the top - the UK's highest - and a public square at the bottom.

An estimated 10,000 workers will be housed in the building on completion.

London's Scalpel building takes shape

Eventually reaching a height of 190m, 52 Lime Street - otherwise known as the Scalpel – is rapidly taking shape in the City of London.

Joining a cluster of prestigious high-rise buildings in the square mile the structure will offer 57,900m² of internal floor area over 35 office floors and two basement levels, including retail and restaurant areas.

Designed by architects Kohn Pedersen Fox, the project also includes a public square that will include seating and planting. The realm may also provide space for public art and tables linked to a specialist ground floor coffee shop, designed as a nod to the 17th Century establishments that acted as meeting houses for London's fledgling insurance market.

Working on behalf of main contractor Skanska, William Hare will erect 10,500t of structural steelwork for the project.

The Scalpel's distinctive design features an inclined northern elevation and a 10-storey pointed attic that will accommodate plant areas.

The building is scheduled for completion in December.

NEWS IN BRIEF

Cleveland Bridge UK has reached the halfway mark of a major infrastructure project in Aberdeen that will create a 43km bypass around the western side of the city, using eight new steel bridges.

Waste management specialist **Viridor** has been given the go-ahead for a major £252M energy from waste plant in Avonmouth. The facility will boost the recovery options available to local authorities and businesses by transforming up to 320,000t of non-recyclable residual waste annually into renewable energy.

Plans to convert the former Eurostar terminal at **Waterloo Station** in London into a three-level shopping complex have got the green light. London & Continental Railways and Network Rail are planning to build over 12,000m² of retail space below the former station platforms.

The English Rugby Football Union (RFU) is to redevelop **Twickenham stadium**'s east stand to improve the match day experience for supporters. The work will double the available space in the stand, creating an additional 10,750m² to form six new levels for hospitality and conference facilities.

Steel construction is expected to play a leading role in the £1.4bn expansion of North London's **Brent Cross Shopping Centre**. Credited as the UK's first major retail mall Brent Cross is said to have radically altered shopping when it opened 40 years ago. The proposals for the Centre will see it double in size providing space for over 200 extra retail brands, 40 new restaurants, a cinema complex and a hotel.

AROUND THE PRESS

New Civil Engineer
December 2016
Space place
[One Angel Court, London] – According to Mace Project Manager for Structures, Marios Antoniades: "Steel has helped us achieve longer spans, a quicker construction programme, add one additional floor and a double-height plant enclosure to the top of the tower, while allowing us to re-use the existing core and foundations."

New Civil Engineer
December 2016
Power provider
[Greenwich Peninsula Energy Centre] - Summing up, Kier Construction Project Manager concluded: "The design has required a high degree of co-ordination between the structural design team, our cladding designers, the flue designers and the artist Conrad Shawcross. The flexibility of steel has been a great benefit in helping us to achieve a solution that is acceptable to all."

Building Magazine
25 November 2016
Severfield recovery gathers pace as pre-tax profit doubles
[Ian] Lawson flagged up recent government decisions on major infrastructure projects and said schemes such as HS2, the Hinkley Point nuclear power station and the new runway at Heathrow all had significant steel content. "This reflects a good level of activity in the UK market."

Construction News
11 November 2016
Cultural hub stages design double act
[Chester Storyhouse theatre] – The team took out the existing steel frame and installed a new steel structure, which then links back to the building's original columns to provide stability.

SCI event focuses on future design and manufacture

The Steel Construction Institute's [SCI] annual event, held at the National Gallery in London, focussed on the theme *'3D Printing – the future of design and manufacture.'*

The event attracted a diverse audience in terms of both age and profession, and attendees saw presentations from ArcelorMittal Global R&D General Manager Olivier Vassart, Intrinsys Business Development Manager Auday Alrawe and University of Sheffield Professor of Metallurgy Iain Todd.

The presentations illustrated how additive manufacture is already used in a number of sectors, particularly aerospace but also in niche areas such as the production of handlebars used by the Team GB track cycling team at the Rio Olympics.

Adoption by the construction sector is still some way off, but according to Mr Vassart work being undertaken on a bridge in Amsterdam, The Netherlands has focused on demonstrating the possibilities.

"While 'printing' a complete frame is unlikely to be commercially viable, using this technology for the connections offers benefits and may not be too far off," he said.

SCI took the opportunity to also present some recent research projects and highlight how knowledge gained is then used to solve the current problems of members and clients.

Lidl announces latest distribution centre

German supermarket chain Lidl will create 500 jobs by building a new 55,700m² distribution centre in Doncaster.

Construction of the £70M facility, which is due to start soon, has a planning application lodged for a site at Verdion's iPort logistics park in Rossington.

The project is part of a £1.5bn investment in Lidl stores and warehouses across the UK over the next three years.

Lidl UK's Head of Warehouse Expansion Adrienne Howells said: "With more British customers choosing Lidl as their family supermarket we are laser-focused on the sustainable growth of our business."

Verdion CEO Michael Hughes added: "We are delighted to announce this significant signing of another well-known name at iPort.

"Lidl is a strong operator with great confidence in the region, bringing with it many new job opportunities for Doncaster and the surrounding areas.

"Lidl will join Fellowes, Amazon and CEVA who have also taken space at iPort within Phase One."

Last year the supermarket announced that it would be relocating its warehouses in Weston-Super-Mare and Livingston to Bristol and Eurocentral respectively, as well as opening two new warehouses in Wednesbury and Exeter.

It also plans to expand its regional distribution centres in Newton Aycliffe and Runcorn.

Romford gets a new ice rink and swimming pool

Steel construction is nearing completion on the £28M Romford Ice Rink and Swimming Pool complex being erected by Billington Structures on behalf of main contractor Willmott Dixon.

The project will deliver an eight-lane competition swimming pool, fitness suite and 56m × 26m ice rink in the heart of the town centre.

The new rink will also provide a home for the local ice hockey team, London Raiders, who relocated to Lea Valley when Romford's former ice rink closed in 2013. The team plan to take up residence in time for the 2018/19 season.

The ice rink is positioned above the swimming pool and creating these two long span spaces stacked on top of each other has meant a host of unique issues concerning temperature and isolation have had to be overcome.

"The temperature differential between a hot pool and a freezing ice rink has made this building particularly challenging to design and build," said Willmott Dixon Project Manager Simon Cook.

Romford Ice Rink and Swimming Pool is due to complete in January 2018.

Large span trusses create home for ethnic fare retailer

Leicestershire-based steelwork contractor Adey Steel has completed work on a new food retail outlet in Dresden, Stoke-on-Trent for contractor Shah Builders.

Supplying the full steelwork package, the structure was said to be relatively lightweight but complex, with the most notable challenge being the roof structure.

This is supported by heavily loaded, one piece, bespoke manufactured trusses of 21m in length and almost 3m in depth to accommodate the clear open retail areas at ground floor level.

The project was erected in 12 days over 5 phases using a BIM model on site to assist with some of the connections. A culvert running beneath the site made on site works very challenging as it limited the space where a crane could be positioned.

Adey Steel Head of Contracts Iain Griffiths said: "This project reflects the commitment and skill of the entire Adey Steel team. Along with fabricating and delivering these large trusses, which in itself was a significant task, the team installed the steel frame in what were challenging site conditions."

The retail unit is now home to PAK Foods, a supplier of ethnic fare. Built on a disused plot of land, the unit sees the space, which was formerly home to a primary school, brought back to life after being unused for a decade.

Gateshead Millennium Bridge features on the last of the round pounds

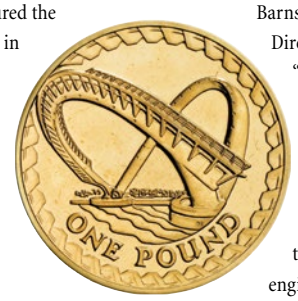
As the new 12 sided pound coin enters circulation, people in the UK will slowly see the disappearance of the round coinage over the next few years.

The change in currency is of particular note to the steel construction sector, and in particular Barnshaws Section Benders, whose work is immortalised on one of the last round pound coins as part of the 'Bridge Series' by artist Edwina Ellis.

The iconic steel tilting Gateshead Millennium Bridge is one of the country's engineering landmarks, a unique structure with a distinctly modern appearance.

Barnshaws Section Benders were contracted by Severfield to undertake the curving of the bridge sections and pressed plates for the lifting mechanism.

The Royal Mint honoured the structure by its inclusion in a series of coins that has also included the Forth Railway Bridge, Menai Bridge and Egyptian Arch Railway Bridge.



The bridge series aimed to promote the engineering pedigree of each of the four constituent parts of the United Kingdom, with 26 million Gateshead Millennium Bridge coins released into circulation.

Barnshaws Commercial Director Greg North said: "It was fantastic to be recognised by the Royal Mint for our work, and it was very positive for the industry to see the Government promoting the importance of steel engineering in major structures."

Second retractable roof for Wimbledon

Work is under way on the £70M contract to redevelop No.1 Court at Wimbledon.

The project will include new, wider seating at the court as well as two additional tiers with approximately 900 seats, and the creation of a two-level plaza in place of Court 19.

When fully completed in 2019 a new retractable roof, like the existing one at Centre Court, will allow guaranteed play irrespective of the weather.

Key features include:

- The roof is based on a concertina design with two main sections that meet in the middle.
- It will be made of transparent Gore Tenara (a type of Gore-Tex fabric), which is stretched between the steel trusses.
- The roof will cover an area of about 5,500m².
- The roof is made up of 11 steel trusses and weighs around 1,100t
- It can be deployed or retracted in around 8 minutes.

Around 220 electro-mechanical devices (including motors), along with a control system capable of working to accuracies of a fraction of a millimetre, are needed to ensure the roof operates smoothly and quietly.

The roof is divided into two sections with a total of 10 bays. Each of the bays is clamped on either side by prismatic steel trusses. The ends of each truss are supported on a wheeled bogie that moves along rails that are fixed to the new superstructure of No.1 Court.

Diary

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

Tuesday 17 January 2017
Steel Building Design to EC3
This course will introduce experienced steel designers to the Eurocode provisions for steel design. London.

Thursday 19 January 2017
Your innovation might be worth more than you realise
This 1 hour webinar will explain the opportunity R&D tax credits present and how to go about making a claim.

Tuesday 24 January 2017
Light Steel Framing
This 1 hour webinar will cover aspects of light steel framing. Available to BCSA and SCI Members only.

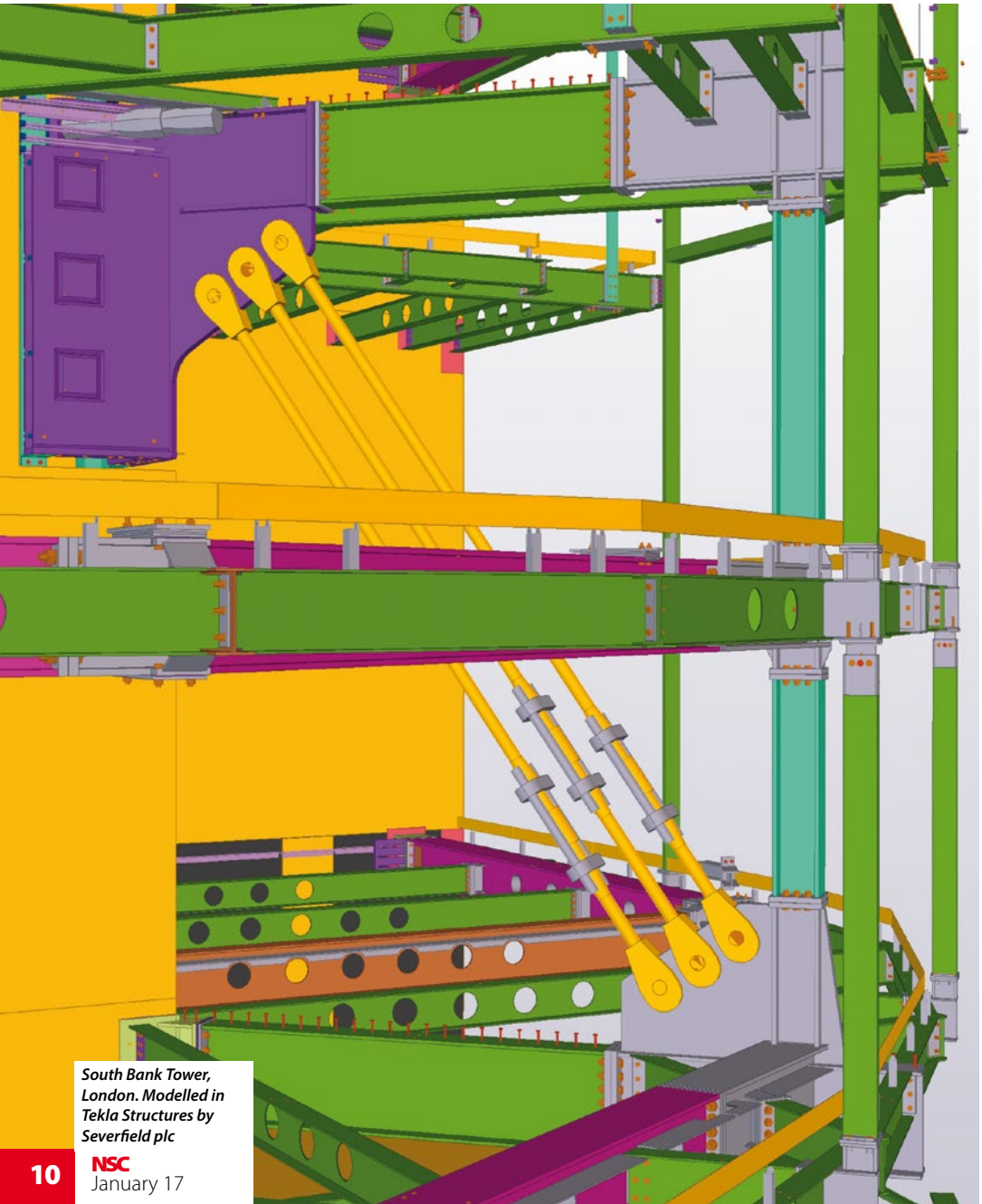
Tuesday 31 January 2017
Straight to the Point in Eurocode Design - half day course
4 hour course - Hands on member design course. Leicester.

Wednesday 1 February 2017
Straight to the Point in Eurocode Design - half day course
4 hour course - Hands on member design course. Sheffield.

Tuesday 21 February 2017
Wind Actions
This 1 hour webinar offers a clear path through the complexities of BS EN 1991-1-4 (and the UK National Annex) to determine wind actions. Available to BCSA and SCI Members only.

It's one small step into a BIM process

Just as the steel industry has developed massively over the last 20 years, so has Tekla software from Trimble. In fact, since 1966 Tekla has been providing leading solutions to the industry in order to help it work more efficiently. Over this time the modelling capabilities of its software has grown to meet the needs of the industry, which put both the constructional steelwork sector and Tekla users in a unique position to move from purely modelling to BIM.



South Bank Tower, London. Modelled in Tekla Structures by Severfield plc

Tekla Structures can create highly complex 'as-will-be-built' models for the structural elements of a building, which can be shared throughout the project's design team to meet the UK Government mandate requirements for delivering Level 2 BIM.

Leading with experience

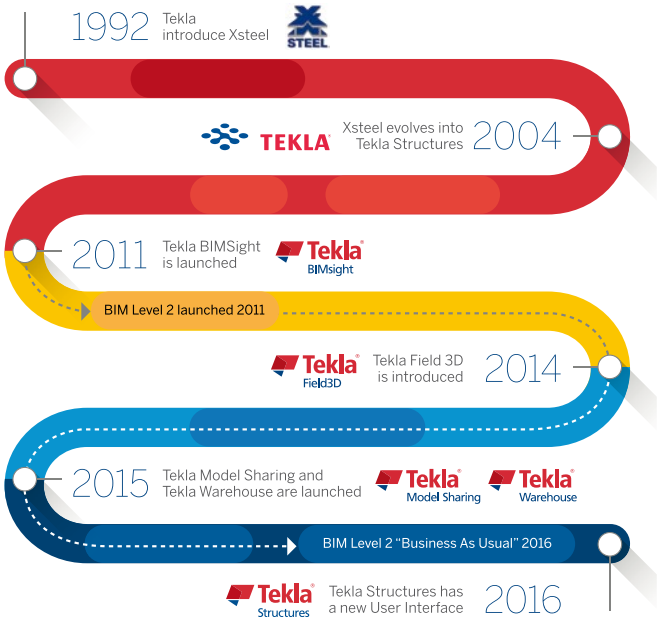
Duncan Reed, Digital Construction Process Manager at Trimble, says the constructional steelwork sector has an extensive track record in adopting technology and delivering projects using 3D processes. This was being done even before the term BIM came into being. So while the steel sector has been modelling projects for decades, this gives them the advantage of being just one small step away from implementing and leading the wider BIM processes within a project. "Strictly speaking, modelling alone isn't BIM but sharing a model with the rest of the project is heading that way and a big advantage that can offer massive savings," says Duncan. "BIM is a process that can, and will, bring efficiencies to companies' existing processes – like those who already use models – in order to deliver projects quickly, competently and more reliably for clients.

"As such, the steel sector can take the chance to grab the opportunities that working digitally on projects presents by collaborating and sharing their expertise and experience in what is now seen as best practice. Every business can benefit from the adoption of BIM – no matter whereabouts in the construction chain they lie – they just first need to understand what that opportunity is for them."

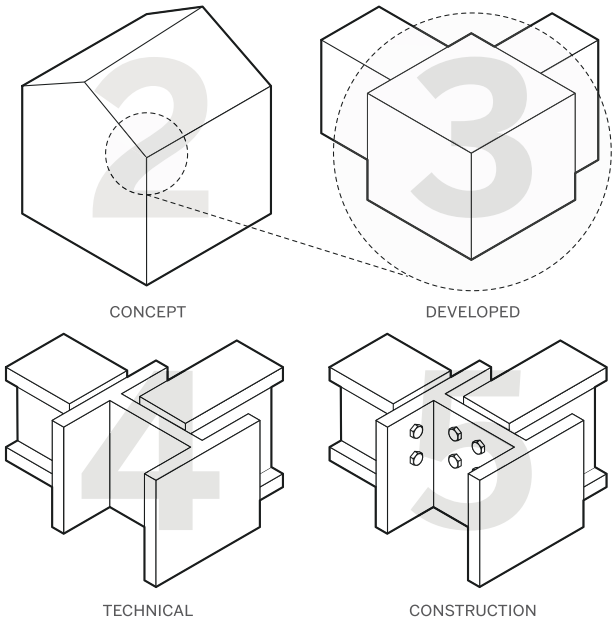
There are many benefits to adopting a BIM process, however one of the key drivers is driving out waste through collaboration, which ensures efficient working. Collaborative working is considered by many to be essential, particularly if design and construction teams are to consider the whole lifecycle of the construction process[1]. By implementing BIM at the start of a project, it is possible for everyone in the design and construction team to collaborate and find the best solution available for a project. When it is done well, up-to-date and, more importantly, appropriate information is available, providing constructible information to the delivery team.

Duncan continues: "By taking a collaborative approach, the right information, in the right format delivered to the right people, at the right time – saves time and money spent on a project. The

1 Shelbourn, M., Bouchlaghem, N.M., Anumba, C. and Carrillo, P. (2007) 'Planning and implementation of effective collaboration in construction projects', Construction Innovation: Information, Process, Management, 7(4), pp. 357–377. doi: 10.1108/14714170710780101.



Evolution of Tekla Structures for Steel



Aligning steel design to the Digital Plan of Works

processes and procedures outlined in the recent UK BIM documentation encourage collaborative behaviours to help project teams to arrive at the right solution for their customers more quickly.

"Additionally, these values are also closely aligned to the UK Government's Construction 2025, which sets out the long-term vision for how the industry and Government will work together to put Britain at the forefront of global construction."

The 2025 report builds on some themes raised in the Latham and Egan reports, and the strategies set out in the 2011 Government Construction Strategy, which called for 'a profound change in the relationship between public authorities and the construction industry'. It ambitiously proposed a 33% reduction in the whole-life cost of built assets, and 50% reduction in the overall time, from inception to completion, for the delivery of new build and refurbished assets.

The right information at the right time

"With this in mind, it has never been more important to view BIM as a great opportunity to reach these targets. Using a 3D model, like most of the steel industry is already doing, can save time and money on a project, but by sharing the model, details and data with other members of the project team for agreed purposes, will certainly help to reduce the time spent on a project and the costs of construction further," says Duncan.

To maximise the efficiencies, each member of the project team must understand clearly what and how much information is required for each different stage of a project; too little information and risks may not be effectively managed – whilst too much information can lead to waste being added into the process.

This is where the BIM term Level of Definition (LOD) comes into play, and, Duncan says, potentially where the confusion begins too. Level of Definition is a UK BIM term defined in PAS 1192-2:2013 and is made up of two distinct requirements.

> *3.30 Level of Definition*
> *Collective term used for and including "level of model detail" and the "level of information detail". NOTE: The "level of model detail" is the description of graphical content of models at each of the stages defined. The "level of model information" is the description of non-graphical content of models at each of the stages defined.*

In essence, LOD refers to both the amount of graphical and non-graphical detail that may be required at different stages of a project, so a clear understanding of its meaning and purpose is important. This is considerably different to the term LOD that is used in the United States, in the document published by the American Institute of Architects. In that document, LOD means Level of Development, and principally deals with graphical detailing of models.

"Fortunately it is very easy to determine whether a project is using the US or UK terminology," Duncan says. "Here in the UK, Level of Definition is aligned to the Digital Plan of Work (DPoW), created by the UK BIM Task Group, which provides the UK construction industry with an eight-stage (zero – through to seven) design, construction and operation plan that can be used to define the information requirements throughout the whole life of an asset."

In contrast, the US system principally defines just the stages of increased model development – as more detailed graphical representations - using the terms LOD100, LOD200, LOD300, LOD350, LOD400 and LOD500.

Using software that is capable of delivering a model to the required levels of definition and one that can be shared with all parties is therefore vital. Tekla software contains accurate, reliable and detailed information required for successful BIM and construction execution.

Duncan explains: "Here at Trimble we continue to support our customers and the industry to become more proficient in modelling and the BIM process. Modelling capabilities are advancing at a pace and, with the likes of machine control and robotic assembly now taking place, we are working alongside our customers continuously to push the boundaries and find new solutions to the complex and fast moving needs of the industry."

"The development of each piece of Tekla software has had 'the end' in mind and so it very much aligns with the requirements of a BIM process. Our design and modelling software allows every party to do their job more efficiently and to share data seamlessly along the lifecycle of an asset, from early conceptual design through to assembly of a steel structure on site."

Trimble Solutions (UK) is a headline sponsor of Steel for Life

Town centre regenerates with steel

Steelwork erection began with the cinema

Structural steelwork is playing a central role in a large-scale regeneration programme that will further enhance Stockport as a popular destination for shoppers and businesses alike. Martin Cooper reports.

Big changes are currently taking place in Stockport as a major investment and regeneration programme that will see around £1bn ploughed into projects in the town centre and the surrounding areas gets under way.

One of the largest of the ongoing projects is Redrock Stockport, a £45M leisure development that will transform an area in the heart of the town centre.

Complementing the existing retail area, Redrock Stockport consists of 6,900m² of leisure and retail development, including a 10-screen cinema, restaurants, retail and a 360-space multi-storey car park.

Main contractor Wates Construction began its 65-week construction programme last April, but prior to starting on-site a value engineering exercise was carried out to refine the project's steel design.

Structural steelwork is playing a leading role in the development as both of the main structures – cinema and car park - are steel-framed.

The biggest refinement to the steel design was the alteration of the design of the multi-storey car park.

"We decided to change its design to a Vertical Circulation Module (VCM) car park as this required less steel, which saved money, and gave us more parking spaces – 364 instead of 340," explains Wates Construction Project Director Paul Harris.

Hill Cannon, the structural engineer that originally patented the VCM system was contracted to design the car park.

"VCM's are ideal for tight confined inner city plots like the Redrock site," explains Hill Cannon Project Engineer Steve Vollar. "There are no external ramps between floors as all of the circulation is via slopes within the floors and this creates more parking spaces."

The VCM incorporates a composite design with steelwork supporting pre-stressed hollowcore precast planks with a structural topping laid on top of this.

Steelwork for the car park consists of perimeter columns spaced at 7.5m centres, allowing enough room for three parking bays between columns, with internal columns creating spans of 15.8m, which accommodates two rows of bays and a central vehicular route.

The four level VCM car park is sat above a ground floor retail level, which has a generous 7m-high floor-to-ceiling height. This will allow retail or restaurant outlets the option to install a mezzanine level during their fit-out programme.

Because of this ground level retail zone, the new car park will be accessed from road level via a steel-framed spiral ramp located on the opposite side of the road. This will then link to a steel bridge that will carry vehicles back across the road and into level one of the VCM car park. Another adjacent bridge will connect the new car park to Stockport town centre's existing car park that spreads out over the roofs of several store buildings.

The spiral ramp has been designed as a series of portalised frames perpendicular to the curve, supporting precast units to avoid the need for formwork.

The car bridge has two intermediate feature piers, formed by pairs of braced 457mm CHS columns, creating one 28m-long span and a second 20m-long span. This 9m-wide bridge will be formed by a pair of plate girders, each measuring up to 1.5m deep.

Structural design of the ramp, bridges and the cinema block is being carried out by BDP and its Project Engineer Kieran Geoghegan says: "Steelwork was the preferred frame material throughout because of the rapid construction programme and the ease at which it could achieve the various long spans, despite the significant cinema acoustic build-ups and onerous accidental loading on the bridge."

FACT FILE
Redrock Stockport
Main client: Stockport Metropolitan Borough Council
Architect: BDP
Main contractor: Wates Construction
Structural engineers: BDP, Hill Cannon
Steelwork contractor: Billington Structures
Steel tonnage: 1,770t

Stockport Exchange

Adjacent to Stockport railway station another large steel construction project has recently been completed.

Known as the Stockport Exchange, the £145M scheme will create a new gateway for Stockport town centre and consists of a four-storey steel-framed office block erected by Billington Structures working on behalf of Eric Wright Construction, and a 115-bed steel-framed hotel.

An earlier phase, completed by main contractor Morgan Sindall, saw a four-level steel composite VCM car park erected.

The cinema structure is over 120m-long and consequently a thermal movement joint is created by a double row of columns.

Overall the steel grid pattern for this building is quite irregular because of the differing sizes of the first floor cinema auditoria."

The cinema is a large braced frame, with some sway frames located in the ground floor area where large glazed areas prevented the installation of bracing. Bracing was easier to install within the cinema due to the lack of windows.

Sitting above a ground floor retail area, also featuring a high floor-to-ceiling height to potentially accommodate mezzanine floors if required by the tenants, there are 10 cinema auditoria with the largest screen measuring 23m × 17m. The auditoria above influenced the ground floor steel grid pattern as did the need to provide large versatile commercial units with spans of up to 12m.

Locating screens on the upper floors in close proximity to each other meant acoustics was an important issue during the design stage. In order to isolate each seating terrace, acoustic bearings have been positioned between the first floor structure and raked steelwork supporting the seating.

BDP Acoustic Consultant Joseph Hardy says: "One advantage of using a steel frame and precast concrete terrace design, instead of a timber frame design, is that the natural frequency requirements of the terrace acoustic isolators can be achieved under dead load without having to prestress the pads, to avoid large deflections under live load."

Overall the cinema block is 20m-high including parapets which shield the building's rooftop plant areas. The structure has a sloping façade along its elevation overlooking the busy M60 and this architectural feature acts as a signpost to the development.

The five degree sloping façade has been formed by additional steelwork bolted to the main frame. This consists of Metsec cold-formed horizontal side rails spanning between the inclined posts.

Steelwork contractor Billington Structures began the erection process with the cinema block and gradually worked westwards along the site finishing the steel programme with the car park, ramp and bridges during December.

As well as the steel erection, Billington was also responsible for the installation of precast planks in the car park, and metal decking and precast terrace units in the cinema building. The company also installed the project's two precast lift cores, one in the car park and the other in the cinema.

Redrock Stockport is scheduled to open in November 2017.

The cinema will reinvigorate Stockport town centre

Steel provides energy solution

Construction work is progressing on a 21.5MW steel-framed waste wood biomass plant at Ince in Cheshire.

The need to deliver alternative sources of energy production has seen many biomass facilities built throughout the UK in recent times.

A renewable and sustainable source of generating electricity, the most common materials used as fuel in the process are either straw or wood.

A £100M biomass plant under construction at Ince near Ellesmere Port in Cheshire will use the latter and harness 'Advanced Gasification Technology' to process up to 170,000t per year of recovered waste wood, enough to power around 40,000 homes per year. All of the fuel will be sourced from the local economy and a timber processing plant is also being built on a nearby site in order to safeguard supply.

Construction is being undertaken by contractor MBV Energy – a joint venture between global engineering firm MWH Treatment and US-based Black & Veatch – while Finland-based technology firm Outotec Energy Products is the main technology subcontractor.

MBV has in turn engaged Ward & Burke on a design and build contract to undertake the civils works on the site. As well as extensive groundworks this programme also includes the construction of the project's large steel-framed structures; the main process building and a fuel reception building.

Taking the lead role in the design of the steel-framed structures, Ward & Burke subsequently contracted EvadX to fabricate, supply and erect the steelwork.

Because of the height of the main process building, which reaches a maximum of 40.3m-tall, and the large column-free spans required, steel was chosen as the most cost-effective framing solution for the project.

However, prior to steelwork arriving on-site a huge preparatory scheme was undertaken, which included the installation of very deep piles.

"The site is founded on up to 10m of peat, which is very soft ground," explains Ward & Burke Contracts Director Alan Bruton. "In places the piled foundations are up to 36m-deep in order to support the facility."

The foundations support concrete slabs and hard-standing areas which have a thickness of up to 650mm in places. The concrete thickness is required because of the huge loadings of up to 2,000t per m^2 that will be exerted by the facility's processing equipment.

The early completion of the slabs and hard-standing areas was a boost to the steelwork programme as EvadX had a clean hard surface to operate its MEWPs and cranes on, as well as plenty of space to temporarily store materials.

With cast in bolts in place within the concrete slab, steel erection began in July 2016 and was completed in November.

EvadX initially erected a large fuel reception structure which is where the wood chip will be stored before being delivered into the process building via a conveyor system.

This large portal-framed building measures 70.6m-long × 36m-wide and reaches a height of 9.8m to the underside of its eaves.

With delivery trucks entering and exiting at one end of the building and a large storage area positioned at the other end, a large column-free portal frame structure was the best possible design solution for this building.

Spaced at 8m centres the 838UB perimeter columns support a series of spliced rafters to form the 36m clear span. The rafters were brought to site in 18m lengths, bolted

Cladding proceeds on the main process building

The fuel reception building is a large portal frame structure

Steel erection started on the main process building once the fuel reception structure (left) was completed

together on the ground before being lifted into place by EvadX's on-site 80t-capacity mobile crane.

Having erected the fuel reception building, EvadX began the work to construct the adjacent main process structure. This building has a highly architectural design consisting of two sloping roof sections, separated by a high-level valley. One roof section peaks at a height of 43m, while the adjacent section has a maximum height of 32m.

"Because of the height the building had to be a large steel-framed braced structure, and because there are very few windows positioning bracing in every bay was not a design problem," says Mr Bruton.

The process building's columns are a combination of 838 and 914UB sections, that had to be delivered to site in three and four sections in order to construct the required building heights.

Large column sections were designed into the frame as they have to support various internal high-level walkways and plant decks – all of which are being installed during the fit-out phase – as well as the 28.5m-long roof rafters.

"Most of the roof rafters were delivered to site in two pieces, one 18.5m-long and the other 10m-long," explains EvadX Contracts Manager Steve Morris. "With just one splice at a third point in the rafter there are fewer deflection issues than if we'd fabricated the beams in three equal pieces or put the splice in the middle."

The main process building's roof accommodates one of the project's most interesting steel design features. Many biomass and energy facilities are constructed around the previously installed process boilers and turbines. However, on this project, that was not possible as the concrete slabs and groundworks on which this equipment sits were extensive and time-consuming and consequently not ready in time.

To keep the project on schedule the steel frames are being erected first, followed by the equipment installation and fit-out programme.

"The completed roof has two panels, each measuring 15m × 15m, which can be unbolted and lifted off with a crane to allow the boiler equipment to be installed through the roof," explains Mr Bruton.

"The alternative would have been to leave a large gap in the steel frame and EvadX would have had to make a return visit to fill it in after the installation was complete. Our solution was more cost-effective and quicker."

The final parts of the steel erection programme involved the construction of an administration and turbine building that adjoins the northern elevation of the main processing structure.

The structure for this building is a structurally independent braced steel frame which is separated from its larger neighbour by a double column line movement joint.

This structure is 49m-long – 15m-wide and is 20m at its highest point. Divided in half, the administration part of the building has two-storeys, while the turbine hall is a single storey open plan area.

The project team had a similar conundrum with how to install the large turbine into an already completed steel frame.

"We adopted a similar design to the main process building, but here we have altered the orientation of one roof rafter. This creates a large enough opening into which the turbine, which is delivered in parts, can be lifted through," explains Mr Bruton.

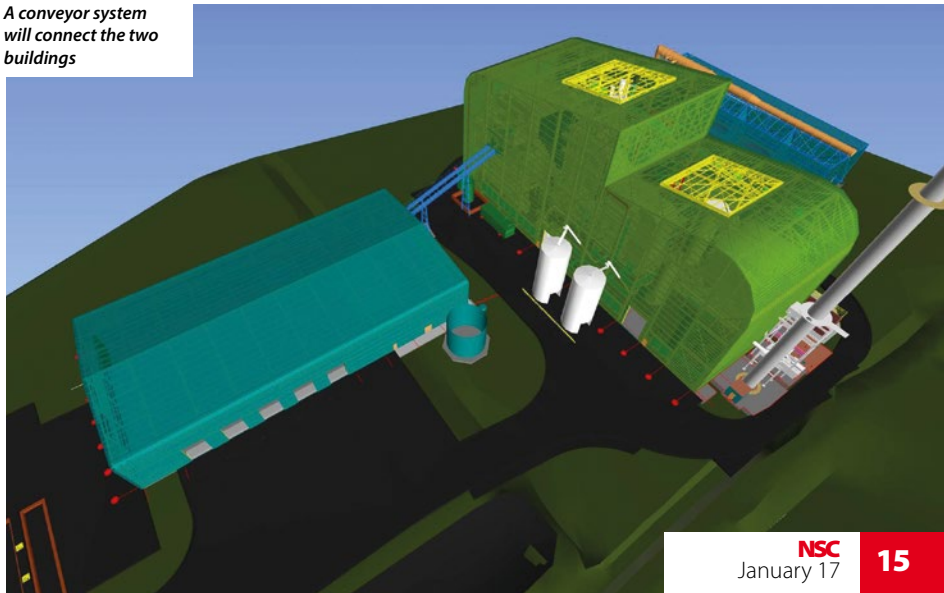
Once the turbine is installed the structure's purlins will be added and the roof will be clad.

All of these design features have kept the project on schedule to meet its completion date of March 2017. The equipment installation and fit-out programme will then begin, with the biomass facility expected to start operation in 2018.

FACT FILE
Ince Biomass Energy Plant
Main client: CoGen
Main contractor: MBV Energy, Ward & Burke
Structural engineer: Coyle Kennedy
Steelwork contractor: EvadX
Steel tonnage: 3,500t

A section of the roof can be removed to allow boiler installation

A conveyor system will connect the two buildings



Historic hangar takes off, again

Highlighting steelwork's longevity, a 1930s-built aircraft hangar is being converted into an education and training centre for the aviation industry. Martin Cooper reports.

FACT FILE
International Aviation Academy - Norwich
Main Client: NPS Group/Aviation Skills Partnership
Architect: Hamson Barron Smith
Main contractor: RG Carter
Structural engineer: Hamson Barron Smith
Steelwork contractor: A C Bacon Engineering
Steel tonnage: 310t

A £12.5M academy, specialising in education and skills in aviation is being built at Norwich International Airport inside a refurbished historic steel-framed hangar.

Said to be the first of its kind in the UK, the facility will support training for up to 500 students and delegates at any one time, including up to 80 degree-level engineering students per year, as well as degree-level and further and higher education courses in airport operations and cabin crew training.

Mark Pendlington, Chairman of New Anglia LEP, one of the project client partners said: "This innovative project is the centre-piece of all our ambitions to make Norwich International Airport a centre of global excellence. The academy will bring a whole new world of opportunities for local students to train and build careers in this exciting and specialist industry. It will be a powerful draw for further inward investment and will give our region a strong competitive advantage over other key European locations."

Known as Hangar 5, the structure was built in the late 1930s when an RAF airfield was established at Horsham St Faith near Norwich.

The hangar was used throughout the Second World War and was subsequently converted in the post-war period into a light industrial unit when the RAF base was decommissioned and Norwich's commercial airport created.

Measuring 91.44m-long × 45.72m-wide, the project's design involves retaining the existing 1930s steel lattice truss roof structure and columns, which are encased in concrete up to a height of 6m, but discarding all the cladding and the hanger doors.

The retained steel structure has been refurbished and the external walls and roof are being re-clad. The roof profile has changed from the original 'saw tooth' design to a dual pitch profile, and is clad with a new composite panel roof deck (Kingspan Topdek).

"An extensive survey was carried out and apart from a little bit of rust and a few bolts that needed to be replaced, the original steelwork, especially the roof trusses, was all in excellent condition considering its age," says RG Carter Senior Contracts Manager Kevin James.

Prior to stripping-back the hangar's original cladding and roof fabric, the exposed steelwork was all shot-blasted and repainted. This work left the steel in a 'good-as-new' condition and revealed the stamp marks showing the steelwork was manufactured at the Middlesbrough Dorman Long works.

To create the new roof profile a series of new steel rafters span the entire width

The roof trusses have all been refurbished

of the hangar. A series of steel stubs were bolted along the length of the top boom of each truss to accept these new rafters. Using one mobile crane positioned alongside the hanger, the new rafters were then lifted into place as complete sections and bolted to the stubs.

The conversion plans divide the hangar into two distinct parts – one half being an 'Emulation Zone' housing a live operational Boeing 737, helicopter and workshops for use by aviation students, the other half being 'The Academy' with learning accommodation arranged around a central atrium.

Approximately 250t of new structural steelwork, fabricated, supplied and erected by locally-based A C Bacon Engineering is being used for the project, plus a further 60t of cold-rolled sections. As well as the new roof steelwork the company has erected mezzanine levels for the classrooms.

In 'The Academy' the steel-framed mezzanines are arranged around a central void/atrium forming two levels of classrooms, ground floor and first floor. Composite metal decking has been used to form the first floor and an internal roof over the classrooms.

New steel mezzanines will accommodate classrooms

The mezzanines are supported by their own new pad foundations as well as being bolted to the existing perimeter columns for extra stability.

"As the perimeter columns are concrete-encased we had to bolt our new steel members to a steel collar that is bolted to and goes around the concrete," explains A C Bacon Engineering Commercial Director Barry Tipple.

For the classroom floors A C Bacon has also installed cold-rolled steel joists as these were preferred to timber members on this job.

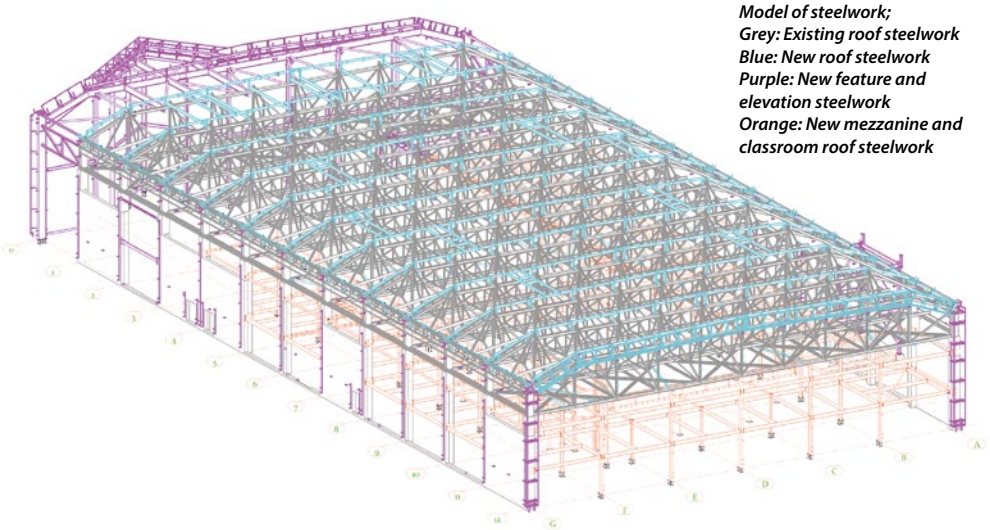
Although the majority of the 'Emulation Zone' will accommodate an aircraft, one elevation does contain another new steel mezzanine housing a first floor classroom block that overlooks the maintenance area, with a ground floor workshop area below. On the opposite elevation a further two bays of mezzanine level have been added for more classes.

Some new elevational steelwork has been added to the hangar structure, including new columns to accept the roof's new profile and window frames along the main elevations. One end of the hangar has also been extended by one bay to allow a Boeing 737 to be accommodated within the structure.

This new western gable end of the hangar has been designed to be demountable so it can be removed approximately once every five years, when the 737 will be replaced with a newer aircraft.

It is expected that KLM will move its existing aviation students teaching facility, currently located elsewhere on the Airport Industrial Estate, into the new facility alongside varied clients from across the aviation industry, nationally and internationally. Also, local training companies will establish a full range of courses making this a truly unique project.

The facility is scheduled to open in a phased programme during the coming months, with the 'Academy' half of the building due to be handed over first.



Model of steelwork;
Grey: Existing roof steelwork
Blue: New roof steelwork
Purple: New feature and elevation steelwork
Orange: New mezzanine and classroom roof steelwork

High speed rail college set to arrive

Doncaster's industrial heritage is represented in the building's roof design

In anticipation of the construction of high-speed rail infrastructure, a national college to train specialist engineers is being built. Martin Cooper reports from Doncaster.

Double doors in the eastern end of the workshop will allow access for two railway lines

The workshop's rail tracks are overlooked by classrooms

As one of the UK's historic railway manufacturing centres it is fitting that Doncaster is one of two sites chosen to house the National College for High Speed Rail (NCHSR).

With another sister college building under construction in Birmingham the NCHSR is described as one college on two sites.

It will train the thousands of new engineers needed to deliver billions of pounds worth of rail contracts over the coming decades, including the new HS2 high speed rail line.

Transport Minister Robert Goodwill said: "We're going to need 25,000 people to build this railway. We're going to need a lot of technical skills and this college is all about equipping our people with the skills they'll need, so we don't have to bring them in from elsewhere."

The ultra-modern steel-framed facility at Doncaster is located within walking distance of household names in the rail industry like DB Schenker, Volker Rail and Hitachi. The location is said to offer easy access for employers and students from across the UK.

The Doncaster college will comprise 7,600m² of teaching and workshop space and includes significant specialist rail equipment such as 150m of external track and catenary.

The college building is topped with a saw-toothed roof, which is a nod to Doncaster's industrial heritage and also a way to install sustainability. The southern slopes of the saw-tooth ridges will have solar panels, enough to supply a high percentage of the college's electricity needs, while the northern ridges will have roof lights allowing natural light to flood into the interior of the building.

According to project structural engineer Curtins, this innovative roof design required careful design and detailing to get the structure to perform within the deflection criteria for the building.

Main contractor for the project is Willmott Dixon and it started work on the previously greenfield site in January 2016. Early works included the installation of piles in preparation of the steel frame being erected.

Hambleton Steel fabricated, supplied and erected the project's structural steelwork along with installing metal decking, precast flooring planks and precast stairs.

Within the 120m-long structure there is a 1,900m² workshop area containing dual railway tracks accessed via a double door in the eastern elevation.

The workshop is a double-span area with one 16m clear span accommodating two railway tracks and a second 8m-wide span housing rail maintenance areas.

"The long spans required for the workshop, as well as other areas within the college, was the main reason why steel was chosen for the project," says Willmott Dixon Construction Manager Roger Morton.

Columns for the workshop and the entire building are predominantly based around a grid pattern of 8m centres. Columns are mostly 305 × 305 × 118 UC sections, however along the workshop's outside elevation larger 610 UB sections have been used.

"These larger members add stiffness to the structural frame," says Richard Osbond, Curtins Technical Director. "The structure is a braced box and this works really well for the teaching areas, but as the workshop area is 14m-high the columns needed to be stiffer for overall stability."

Crane loadings also had to be taken

▶21

FACT FILE
National College for High Speed Rail, Doncaster
Main client: Doncaster Metropolitan Borough Council
Architect: Bond Bryan Architects
Main contractor: Willmott Dixon
Structural engineer: Curtins
Steelwork contractor: Hambleton Steel
Steel tonnage: 760t

The eastern elevation during construction and after completion

▶20

into account as the columns within the workshop also support crane rails that will allow a gantry crane to operate within the building.

Bracing for the workshop is located at the gable end and in some bays.

Forming an L-shape, three-floors of teaching spaces wrap around two sides of the workshop. In this part of the structure the bracing is mostly located in partition walls and around the lift and stair cores.

The teaching spaces will include classrooms, informal learning areas, open project spaces, a 120 seat capacity lecture area, seminar and meeting rooms and an atrium social area open to the public.

Within the atrium there will be a coffee area on the ground floor and a catering kitchen on the second floor with seating for about 200 people enjoying views out of the building and across the workshop.

A combination of metal decking and precast planks have been used for the building's floors. The metal decking solution was deemed a better option for the longer spans, such as over the atrium and other circulation areas. Within the teaching spaces, Willmott Dixon chose to use precast planks as they were considered to be a better way to aid service integration within the floors.

Willmott Dixon was chosen by Doncaster Metropolitan Borough Council through Scape Group's National Major Works framework to the NCHSR.

Summing up, Mark Robinson, Scape Group Chief Executive says: "HS2 is essential to rebalancing our economy and creating a Northern Powerhouse. A project of this scale requires a fresh pool of talent equipped with a wide range of skillsets. Over 2,000 apprenticeships will be created by HS2 with 25,000 employed during its construction, which will be a substantial boost to our industry talent pool. We're excited to be playing a crucial role in a project to rekindle a sense of pride in careers in construction as well as helping to create a consistently strong UK PLC."

The NCHSR is scheduled to open its doors for the first intake of students in September 2017.

David Brown of the SCI discusses

The design of crane girders

The key design criteria for crane girders is often deflection, in both directions. In addition to vertical deflection, lateral forces from the crane operation cause lateral deflections. A traditional approach to the design of crane girders was to weld a second component to the top flange - either a plate or a channel (toes pointing down, over the flange).This additional member was designed to resist the lateral bending, and the crane girder designed for the vertical forces. A further design requirement with crane girders is to control the spread between the two rails, which is often a challenge when crane girders are connected to portal frames – the portal columns spread under vertical load. In the NCHSR, columns supporting the crane girders span from floor to roof and are braced at roof level, so the spread between crane rails is controlled by the bending resistance of the columns.

Crane girders demand onerous tolerances, so provision of adjustment is important. In the NCHSR crane girders are supported on brackets welded to the column flange. Opportunity for adjustment vertically and laterally is provided at the connection between the bracket and the crane girder by allowing for packs.

Within the Eurocode suite of Standards, guidance is provided both for the crane loading and the structural resistance. BS EN 1991-3 covers actions induced by cranes. This Standard covers lateral, longitudinal and vertical loads and is not simple. Some crane manufacturers provide

data in a format directly compatible with BS EN 1991-3, which is a significant advantage for the structural designer. The resistance of crane girders is covered in BS EN 1993-6. Crane girders are obviously unrestrained between supports, with the vertical load applied to the crane rail, above the top flange. Although this would normally be a destabilising load, if the crane rail is fixed directly to the crane girder (as is the case at the NCHSR), the wheel loads actually apply a restoring moment if the girder starts to twist. The Standard allows this benefit to be included in design. The Standard is also notable for an expression covering the interaction of lateral torsional buckling, minor axis buckling and the torsional moment.

A comprehensive example of crane loading can be found by an internet search for "design example actions induced by cranes and machinery sedlacek". A numerical example of crane girder resistance can be found in Example 2 of P385 – *Design of steel beams in torsion*. Guidance on the fatigue design of crane beams is anticipated to be published by BCSA in 2017.

Steel checks in for town centre redevelopment

FACT FILE
The Porter Building, Slough
Main client: Landid Property/ Brockton Capital
Architect: tp bennett
Main contractor: Bowmer & Kirkland
Structural engineer: Cundall
Steelwork contractor: Leach Structural Steelwork
Steel tonnage: 1,432t

The building is located opposite the railway station

The steel-framed Porter Building is one of the most prominent schemes in the wide-ranging redevelopment of Slough town centre. Martin Cooper reports.

With the arrival of Crossrail set for 2019, major changes are taking place in Slough as the town regenerates the area around the railway station to create a modern gateway to welcome passengers and visitors alike.

The most visible development to those arriving by train is the Porter Building, a five-storey office scheme under construction directly in front of the main entrance to Slough railway station.

Scaffolding has been erected to allow the installation of the cladding system

The 10,600m² landmark development, designed by architects tp bennett, will transform a previously vacant office site on Station Plaza into contemporary offices for creative, digital and professional businesses.

Landid has significant expertise in delivering vibrant, new commercial-led regeneration projects and it wanted a design that would fulfil both the aesthetic and functional needs of today's occupier.

"The design called for an aesthetic based on the idea a "modern warehouse conversion". This is carried through to the detail of the scheme with expressed columns, beams and exposed soffits," says tp bennett Director David Blair.

"Combining these with large floor-to-ceiling windows enabled the floorplates, which are up to 18m deep in places, to benefit from a sense of space and quality of daylight far beyond the norm for speculative office developments."

The building has been designed as a steel-framed structure based around a regular grid pattern of 9m × 9m. The building features a double-height ground floor that accommodates a large column-free entrance lobby, a retail outlet and a business suite.

Steel-framed plant enclosures occupy the roof

The entire southern half of the ground floor is occupied by a 100-space car park that incorporates a mezzanine deck to create a two-level facility.

Although the overall grid pattern is not entirely ideal for a car park, the offices dictated the design. For efficiency, the whole building is on the same grid as changing the car park to a more traditional 7.5m × 7.5m would have meant installing costly transfer structures on the underside of the first office floor.

Above ground floor there are four floors of offices constructed around a central atrium that will have a glazed roof. The building's rooftop will contain plant areas and a roof terrace entertainment space.

"Steelwork supporting metal decking was the best solution for this scheme as it satisfied all of our client's requirements," says Cundall Structural Engineer Emma Kent.

"It provided the column spacings to create the large open modern offices and it is a light form of construction that only required pad foundations; an economical option compared to other piling solutions."

As the project is a speculative build, flexibility was also a consideration and another reason for opting for a metal decking composite construction solution.

"In the future tenants may wish to add staircases to link floors or extra risers may need to be installed. Creating the necessary openings is much easier in metal decked flooring," adds Ms Kent.

Work on this building began in January 2016, with main contractor Bowmer & Kirkland (B&K) inheriting a cleared site as demolition of the previous office block was already completed under a separate contract.

"It's a very tight site with very little storage space for materials," says B&K Project Manager Carl Woolley. "We are surrounded by roads on two sides and another construction project on the other sides [see box], while the proximity of the railway means our crane capabilities are reduced."

Steelwork contractor Leach Structural Steelwork commenced its 18-week steel erection programme in May. The company's work also included the installation of precast stairs and metal decking.

"Planning at an early stage was paramount due to access restrictions, the confined site location and the fact that the structure fills up the entire project footprint," comments Leach Structural Steelwork Director Eric Leach.

Using the site's tower crane and one mobile crane, working in conjunction with various sized MEWPs, all of the steel was erected by machinery positioned on the ground floor.

However, in order to give this machinery enough space to manoeuvre around the site, all of the pad foundations had manhole rings installed on to their tops and the space in between was then backfilled to create a level surface.

'Without this work there would have been a serious lack of space as the protruding pads are all 4m in diameter and spaced at 9m centres," says Mr Woolley.

Leach then erected the building in a phased sequence, completing the front elevation first and then working around the block in a clockwise manner. In this way entire elevations were freed up for follow-on trades, while Leach worked on the next phase.

As the building is designed around a regular column grid pattern that runs throughout the structure, including the car park, the only elevation that differs is the front.

To create a large clear entrance area one perimeter column has been omitted along with two internal members, and a series of 18m-long plate girder transfer beams have been installed.

To reduce the loadings and deflections imposed on the frame by the project's panelised masonry cladding, all of the perimeter columns are 500mm × 300mm rectangular hollow sections, while elsewhere 533 UB sections have been used.

Summing up Mr Blair says: "The selection of the steel frame provided a number of benefits that enabled the project to meet demanding programme, cost and efficiency constraints.

"From an architectural perspective the use of a steel frame provided a unique opportunity. From the outset, it was an aspiration that the building design and branding articulate the rail heritage of the site."

The Porter Building is expected to complete in August 2017.

Two Brunel Place

On an adjacent plot to the Porter Building, another commercial development in rising up as part of Slough town centre's redevelopment.

Under a separate contract from the Porter Building, Bowmer & Kirkland has subcontracted Billington Structures to fabricate, supply and erect approximately 1,150t of steelwork for the 10-storey high Two Brunel Place.

Constructed around a steel braced core, the steel-framed structure begins at basement level and comprises internal spans of up to 16m.

For service integration and efficiency Billington has used cellular beams throughout the project, utilising both Westok produced members as well as its own fabricated beams.

Fasteners and bolts

Structural bolts are one of the key elements of a steel frame and their manufacturers and suppliers form an important part of the steel construction supply chain

Structural bolts play a vital role in steel construction, as the majority of steelwork projects will always have an abundance of bolted connections. For this reason, bolts or fasteners are considered to be one of the key structural elements in a steel frame and vital to a structure's safety and speed of completion.

To keep the UK and Irish markets adequately supplied with structural bolts requires an extensive network of manufacturers, suppliers and distributors spread throughout the British Isles. This important supply network also has tentacles that stretch around the globe as many of the products are manufactured and sourced from overseas.

There are a variety of preloaded fasteners in common use including; preloaded bolts, tension control bolts and direct tension indicators.

The most popular bolt sizes in the UK and Irish markets are typically M20 (20mm diameter) up to M24 (24mm diameter) units, with lengths between 50mm and 100mm. However, the product range also includes diameter sizes up to and beyond 100mm and suppliers can manufacture and procure bespoke sized bolts for a particular project.

Bolt suppliers will also stock, and in some cases manufacture, various associated products such as nuts, washers, machine screws and studs.

Advancements in the sector have included colour coding. In a safety critical industry, such as steel construction, the colour coding of bags has also meant a safer work place as it has lessened the chances of someone using the wrong bolt. The practice of putting one size of bolt only in a unique coloured bag is now nearly universal and has helped erectors and project teams identify the correct item more quickly.

The BCSA has an established Working Group for Fasteners. Its aim is to support suppliers and manufacturers of bolts to spread best practice throughout the steel construction supply chain.

One of the aims of the Working Group is to assure specifiers of bolts that they are buying products from companies with strict quality control procedures in place. By purchasing bolts from BCSA industry members, customers can also be assured that the products are of the highest standard and CE Marked.

Bolt suppliers' UK premises are all certified for CE Marking, while having ISO 9001 means strict quality control is in place and guaranteed from point of manufacture all the way to the construction site. Regular contact and visits to overseas facilities means companies' factories are producing bolts to the highest standards, wherever they are located.

In regard to future advancements the European standard for the manufacture of both non-preloaded and preloaded fasteners are being revised [see box]. The harmonised (CE Marking) standard for preloaded bolts, BS EN 14399-1, has been updated and cited in the Official Journal of the European Union (OJEU). Bolt manufacturers have until the 8th April 2017 to put in place the necessary factory production control system for CE Marking as this is when the cited standard will become mandatory.

Other parts of BS EN 14399 'High-strength structural bolting assemblies for preloading' are also being revisited and these include:

- BS EN 14399-7 – Part 7: System HR, Countersunk head bolt and nut assemblies
- BS EN 14399-8 – Part 8: System HV, Hexagon fit bolt and nut assemblies
- BS EN 14399-9 – Part 9: System HR or HV, Direct tension indicators for bolt and nut assemblies
- BS EN 14399-10 – Part 10: System HRC, Bolt and nut assemblies with calibrated preload.

The standards for non-preloaded bolts are also being revised including the harmonised (CE Marking) Standard BS EN 15048-1. This standard has been approved by the CEN Committee but has not been cited in the OJEU. However, it is anticipated that it will be cited in April 2017.

Bespoke Steelwork

One of the many benefits of steel is its limitless possibilities for the manufacture of bespoke structural components.

Steelwork destined for Leicester Tigers' rugby stadium

Construction design, coupled with ever more creative architectural modelling and engineering software, has seen a diversification away from routine and standard components towards more uniquely designed structural elements. Items such as transfer beams, plate girders, fabricated member trusses and cellular beams are now to be seen in a host of building types.

Many of these items, although made from steel plate or sometimes from steel sections, are often outside the scope and capability of conventional steelwork contractors, or those who specialise in one type of product only.

Generally, once structural components are of a size/weight which exceeds the range of normal mill rollings then steel plate becomes the base material from which structural components are made.

In order to produce bespoke sections from plate, the producer needs the capability and capacity to deal with long plate lengths (up to 20m in some cases). All associated equipment such as offloading fork trucks, profile cutting beds, overhead craneage, shot blasting and automatic welding needs to be appropriate to the specific requirements demanded by heavy structural components.

When considering a supplier of bespoke structural components, the buyer needs to be very aware of the detail and specification level which the project demands.

It may be the case that a project calls for supply of 60t trusses comprising top and bottom boom and infill members, which are all fabricated plate girder sections.

There may be a specification which details:

- Execution Class 3 steelwork, but calls for Execution Class 4 testing on specific joints within the components or structure.
- There may be specific requirements for unique traceability or a nominated external NDT supplier.
- There may be a complex sequence of assembly and a requirement for inspection at specific stages of the component build process.

There are numerous examples of bespoke steel components to be found in all construction sectors. One of the most widely used examples is the cellular beam, most often used in commercial buildings to allow the accommodation of services within the structural void, and/or achieve efficient long spans.

Cellular beams, which are usually I-section beams with regularly spaced holes, are generally produced by specialist companies and then further fabricated by steelwork contractors into elements for a particular project.

Cellular beams can also offer a solution for curved roof applications, combining a considerable weight saving compared with plain sections.

Car parks also make use of cellular beams as they offer a lightweight and more cost-effective section for the long spans needed in these structures, while the holes provide the otherwise dark car park with a lighter environment.

STEEL for life

Sponsors Structural Components

Headline: Jamestown Cladding & Profiling Ltd
Bronze: Kloeckner Metals UK

"In the past decade a number of very capable and strong suppliers of heavy bespoke structural components have emerged. Steelwork projects can now benefit from this new level of management skill and manufacturing capability which our industry now offers," ***Jamestown's Managing Director Fiacre Creegan.***

Bournemouth Pier

Leeds station arches

Restraint to chords

BS 5950 indicates that purlins can be assumed to provide out-of-plane restraint to trusses. David Brown of the SCI discusses the intended scope of the advice and warns against straying outside the intended application.

Clause 4.10 of BS 5950 covers members in lattice frames and trusses. The clause contains a series of assumptions that designers may adopt, notably about buckling lengths, joint fixity and approximate bending moments in the rafters. The subject of this article is part (a) of that clause, which notes that the out-of-plane (buckling) lengths may be taken as the distance between purlins. It is tempting for designers to apply this guidance to all types of trusses, not appreciating that the original intent was relatively lightweight roof trusses.

In long span roofs, it is relatively common to provide a truss solution, perhaps with secondary trusses spanning onto primary trusses, so that internal column-free space is maximised. Some of the larger trusses carry significant loading and may therefore be fabricated with UC section chords (typically), or sometimes UB section chords, if other steelwork members connect to the chord. The eventual solution may be something like that shown in Figure 1. The chords are both UC members and the internal members are hollow sections. The exact details are immaterial – the key point is that there are purlins at the node points, and because of the proposed geometry and member selection, there are purlin connections at intermediate positions between the nodes.

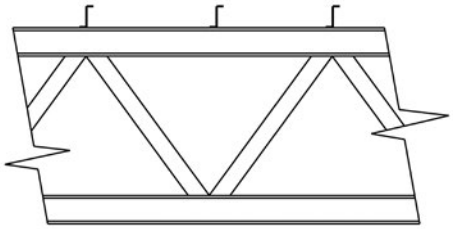


Figure 1: Assumed truss arrangement

Assuming that the top chord is in compression, the buckling resistance must be calculated, demanding an assessment of the buckling lengths in each axis. Designers may refer to clause 4.10 of BS 5950 and conclude from that clause that the out-of-plane buckling lengths may be taken as the spacing of the purlins. But is a connection to only one flange providing the assumed restraint, particularly at the intermediate location? Would the restraint be satisfactory for a UC section? Would it be equally satisfactory for a UB section, if one had been chosen?

The original intent of the clause

Colin Taylor, the primary drafter of BS 5950 has been consulted and his advice is acknowledged with gratitude. Colin comments that the clause was intended to be applied to small roof trusses (note the word "rafter" used in the clause) and similar triangulated lattices. The members themselves would have typically been angles, back-to-back angles or tees. At the time of drafting, purlins were angles, channels or even hollow sections. The use of light gauge purlins came later. Colin also notes that designers would have naturally provided restraint to the "inside" flange of compression chords.

It is interesting to look back even further, at the provisions in BS 449. Diagrams are provided giving the buckling lengths for stanchions, including those with tie beams attached to one flange only. Figure 14 from BS 449 is reproduced below as Figure 2, and the "diaphragms" shown providing restraint to the inside flange a clearly an important feature.

Figure 15 of BS 449 is equally instructive. In that Figure, a single storey stanchion has a number of intermediate angle side

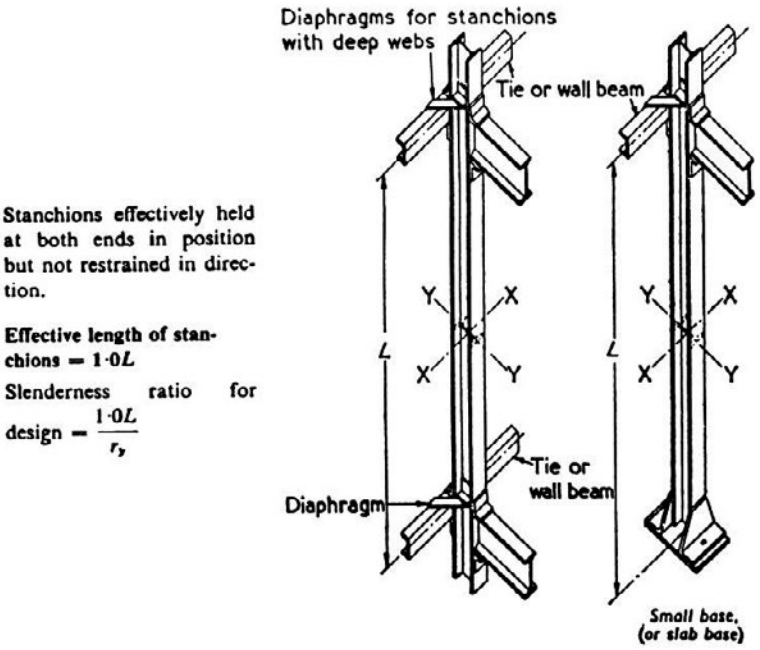


Figure 2: Figure 14 from BS 449 – Stanchion with tie beams attached to one flange

rails, attached to one flange only. The out-of-plane effective length is specified as 0.75L, where *L* is the overall height of the column, despite the intermediate angle rails.

Perhaps we might say that those provisions were unduly conservative, but it is clear that much more attention was paid to restraining both flanges, rather than assuming restraint to one side only was sufficient to produce pure flexural buckling in the minor axis. This article aims to encourage designers to think carefully about such arrangements and consider how the member will buckle.

But how *does* the member behave?

Jumping forward from BS 449 to today, designers have a range of tools which can be used to investigate structural behaviour. Colin Taylor mentions making Perspex models, but today's solution is invariably software.

For the second part of this article, the software *LTBeamN* has

celebrating

excellence in steel

Call for entries for the 2017 Structural Steel Design Awards

The British Constructional Steelwork Association and Steel for Life have pleasure in inviting entries for the 2017 Structural Steel Design Awards.

The Awards celebrate the excellence of the United Kingdom and the Republic of Ireland in the field of steel construction, particularly demonstrating its potential in terms of efficiency, cost-effectiveness, aesthetics and innovation.

The Awards are open to steel-based structures situated in the United Kingdom or overseas that have been built by UK or Irish steelwork contractors. They must have been completed and be ready for occupation or use during the calendar years 2015-2016; previous entries are not eligible.

To find out more and request an entry form visit www.steelconstruction.org/resources/design-awards or call Gillian Mitchell of BCSA on 020 7747 8121

Closing date for entries:
Friday 24th February 2017

BCSA

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been used, as this tool allows restraints to be placed anywhere within (or outside) the member depth and allows the fixity (both laterally and rotationally) to be specified. To investigate the behaviour in a truss, a member has been modelled with fork ends at the nodes. At the intermediate purlin position, a lateral restraint can be modelled. Specifying full lateral and rotational fixity in the software will produce the results for a fully effective lateral and torsional restraint – the chord buckling will be minor axis flexural bending between the purlin positions. The "real" situation can also be modelled, with a lateral restraint some distance outside the flange (assumed to be the centre of the bolt group to the purlin) and a varying degree of rotational fixity. The software reports the elastic critical buckling load, $N_{cr,}$ but also gives a useful graphical output of the buckling mode.

Buckling examples

The following examples are based on a 254 UC 89, arbitrarily chosen as a typical section. The nodes are at 4 m centres, and a single restraint is provided at the mid-point.

With no intermediate restraint, the member (as expected) buckles in the minor axis, between the supports. The buckled form is shown in Figure 3

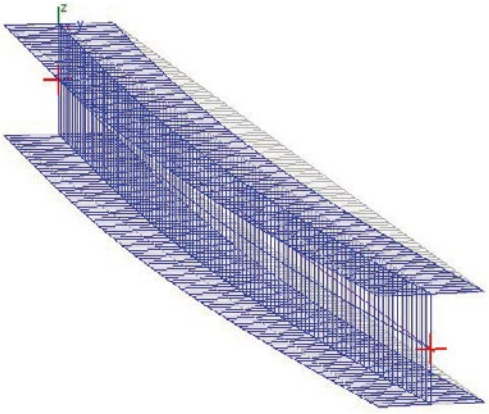

Figure 3: Buckling between supports

For the arrangement in Figure 3, N_{cr} is given as 6264 kN. For those interested, the intermediate steps and the buckling resistance in S355 are as follows: $\lambda = 0.789$; $\chi = 0.669$; $N_{b,z,Rd} = 2610$ kN

If a midspan restraint is introduced with full torsional fixity, the result is shown in Figure 4.

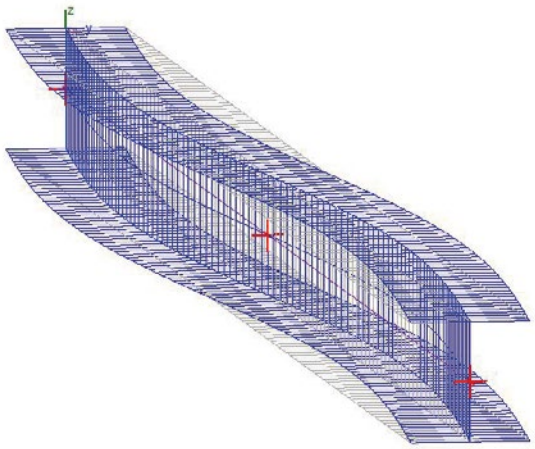

Figure 4: Buckling with lateral torsional support at midspan

For the arrangement in Figure 4, N_{cr} is given as 25069 kN. The intermediate steps and the buckling resistance in S355 are as follows: $\lambda = 0.394$; $\chi = 0.9$; $N_{b,z,Rd} = 3510$ kN

The values of 2610 kN and 3510kN can be confirmed in the Blue Book.

If a midspan restraint is provided 100 mm outside one flange only, with no torsional fixity, the result is shown in Figure 5

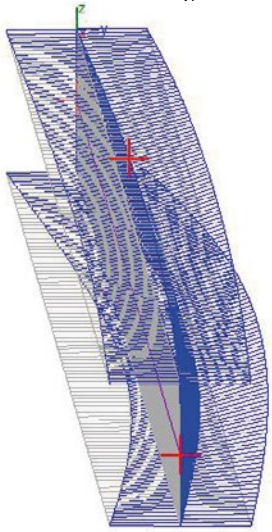

Figure 5: Buckling with lateral support at midspan, 100 mm outside the flange

In this case, both flanges have buckled laterally, not the double curvature bending shown in Figure 4 that one might have hoped for. In the case illustrated in Figure 5, N_{cr} is given as 7273 kN. The intermediate steps and the buckling resistance in S355 are as follows: $\lambda = 0.732$; $\chi = 0.705$; $N_{b,z,Rd} = 2747$ kN, which is significantly less than the resistance with an effective lateral torsional restraint.

The benefit of stiffness at the connection

The buckling form in Figure 5 resulted from a lateral restraint which was modelled to provide zero rotational stiffness. It could be argued that there is some rotational stiffness delivered by the secondary member. If this case is to be made, designers must credit the connection itself with stiffness and the ability to transfer moment, as this provides the torsional fixity to the main member. Without doing any analysis, it seems rather brave to credit a connection to a light gauge steel member with too much stiffness, as the bolts are in oversize holes and the material is thin.

With a secondary member each side of the chord, with lengths L_1, L_2 and Inertias I_1 and I_2, the stiffness can be calculated as

$$4E\frac{I_1}{L_1}+\frac{I_2}{L_2}$$

With a typical purlin length taken as 7m and a typical purlin inertia of 175 cm^4, the stiffness at the joint is calculated as 420 kNm/radian. Assuming the joint itself is infinitely stiff (which must be too optimistic, as discussed above) the midspan restraint can be credited with some rotational stiffness.

Figure 6 shows the results for the identical situation described in Figure 5, but with rotational stiffness at the restraint of 420 kNm/radian.

In fact, even with some degree of stiffness, the buckling form has not changed significantly. In this case, N_{cr} is given as 12079 kN. The intermediate steps and the buckling resistance in S355 are as follows: $\lambda = 0.568$; $\chi = 0.804$; $N_{b,z,Rd} = 3135$ kN

It may be observed that the resistance (3135 kN) appears to be approaching that when a fully effective lateral torsional restraint is provided (3510 kN). However, the rotational stiffness must be increased from 420 kNm/radian to 1660 kNm/radian before double curvature bending results. In other words, the secondary members must be around four times as stiff as is typical, before the assumption of a lateral torsional restraint is realised – and that still depends on the unlikely assumption that the connection itself is infinitely stiff.

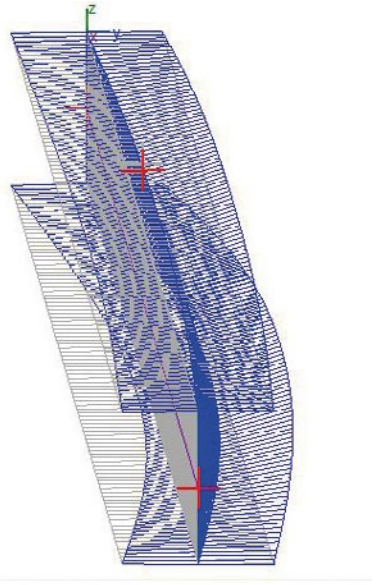

Figure 6: Buckling with lateral and rotationally stiff support at midspan, 100 mm outside the flange

Conclusion

It is hoped that this article has illustrated that restraints to only one flange of compression members should not be assumed to provide effective torsional restraint, unless carefully assessed. The advice in clause 4.10 of BS 5950 should not be used to justify such an assumption for large, heavily loaded members, as it is clear that the intended scope was limited to quite different forms of construction. If there is uncertainty about the effectiveness of the restraint, freely available software may be used to examine the behaviour of the member, modelling the location and fixity of the connecting steelwork.

AD 403: Steel strengths for fabricated haunches

This AD is a simple reminder that the steel strength selected for haunches must match that assumed in the design calculations. As S355 is now the common steel strength for rolled sections, it is highly likely that the calculations for the haunch have also assumed S355 steel – it is important that rolled sections or plate used for the haunch matches the higher grade, unless design calculations have verified a lower strength steel.

In the UK, S275 rolled sections are no longer readily available, with S355 being the common steel strength. For the design of portal frames, the increase in strength is not always beneficial – the opportunity to select smaller sections means that deflections will increase and second order effects (which are calculated based on deflections) will be more significant.

Most haunches are cut from rolled sections, so will normally be the higher grade steel. The potential for a mistake is increased with haunches fabricated from plate. Plate (particularly in the form of flats) is available in S275 steel, so connection designers need to be careful to specify the appropriate steel strength clearly.

Contact: **Richard Henderson**
Tel: **01344636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates November 2016

BRITISH STANDARDS

BS 7668:2016
Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
Supersedes BS 7668:2004

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

16/30343618 DC
BS EN ISO 14731 Welding coordination. Tasks and responsibilities
Comments for the above document were required by 26 November, 2016

16/30345944 DC
BS EN ISO 22825 Non-destructive testing of welds. Ultrasonic testing. Testing of welds in austenitic steels and nickel-based alloys
Comments for the above document were required by 5 November, 2016

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BUILDINGWITHSTEEL

Britain's first commercial monorail

It is well recognised that one solution to easing transport problems in Britain's densely populated towns and cities lies in the overhead monorail: for this reason particular interest attaches to the monorail system that came into operation last season at the Blackpool Pleasure Beach. It embodies the facilities which will be necessary in a major monorail system such as automatic safety devices, stations with controlled platform entries and exits and a service station into which trains can be switched on to self-propelled rail sections to stock or service bays. Furthermore, the system has been designed for fully automated operation, to be introduced after a suitable running-in period. Another point of interest is that this is said to be the first commercial project of its kind in the country: it is in fact a self-supporting, profit-making proposition.

The problem of mass transportation within the grounds of the Pleasure Beach had been a matter of concern for some time past, chiefly for two reasons, (*a*) because of continued expansion some form of transportation was obviously required to improve traffic flow and (*b*) on their first visit most people like to have an overall idea of the layout of the Pleasure Beach and the amenities available. These requirements are met by an overhead monorail transport system, which has the additional advantage of occupying minimum valuable ground space, of being speedy yet quiet, offers minimum obstruction to viewing and is in keeping with the progressive image of the Pleasure Beach.

There are four 105-ft long trains on the mile-long continuous track, these having 15 carriages each holding four persons in comfort: when all four trains are in use a capacity of 4,000 passengers an hour can be attained. Provision has been made for a further three trains should this be found necessary. Speeds of up to 12 ft/sec are possible, but because of the high ratio of curved to straight track they are usually kept below this figure in order to give smooth running.

The carriages are of glass fibre and aluminium construction: their height has been kept low because the trains pass through various buildings and also in order to offer minimum resistance to winds which in gales may be as high as 100 mph. One train has

Reprinted from Volume 4 No. 5
February 1967

totally enclosed carriages, two have semi-enclosed carriages suitable for all conditions but the most severe weather and the fourth is completely exposed. Each train is driven by twelve 1½-hp motors and for the sake of quietness and comfortable riding all wheels are rubber tyred.

The 5,200-ft long track is carried on 170 supports spaced 35 ft apart on straight sections and 25 ft on curves. The steepest gradient is 1 in 7½ and track height varies from ground level to 35 feet.

The track is constructed from two 12-in by 4-in steel channels turned toe inwards and spaced to give a 4-in gap between them. The curves are widely varying types such as transition curves, parabolic curves, spiral curves and circular curves: the lightest curves are 50-ft radius. Track sections are matched in pairs and secured with welded diaphragms and turnbarrel bolts. For spans up to 45 ft in length reinforcement is provided by heavy angles bolted to the underside of the track. In the case of 75-ft and 100-ft spans over the main road dividing the Pleasure Beach the track is supported on welded box girders of trapezoidal section, the channels being welded to the top surface.

There are several types of support columns, including straight universal column sections ranging from 10 in by 10 in to 14 in by 14½ in, welded portal frames and cantilever supports from existing structures. To minimize corrosion caused by the marine atmosphere the whole of the track and its supports are galvanized and the bolts sheradized, followed by a suitable painting sequence.

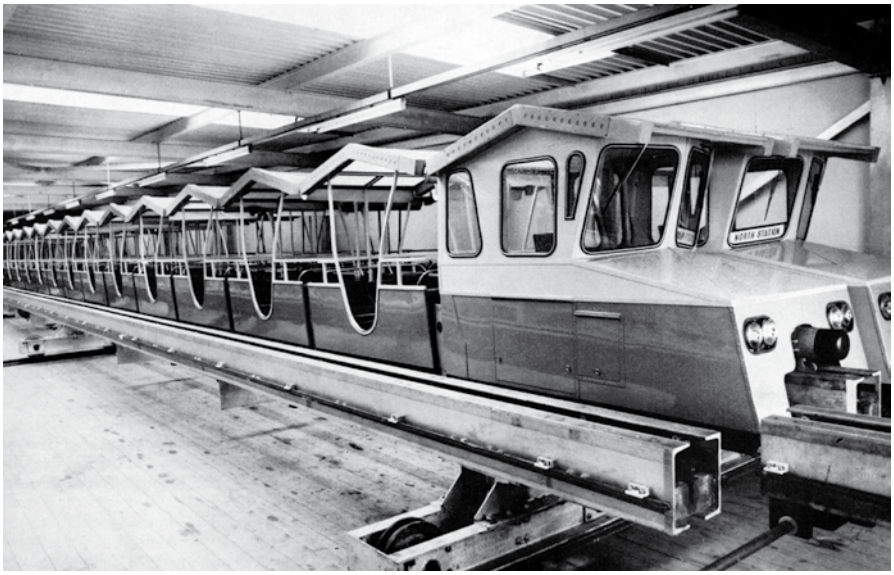
The various assorted buildings, ie the two stations giving passenger access to the trains and the service station and adjacent train storage bay are all steel framed structures clad with aluminium sheeting.

A Swiss firm designed the above monorail system and erection was under the supervision of F. E. Wright, General Manager Blackpool Pleasure Beach Ltd.

Facing page: Train of 15 semi-enclosed glass fibre/aluminium carriages on a section of track carried by straight universal column supports.

Above: Here the track passes over a wide roadway and to provide maximum strength the longer span is supported on welded portal frames.

Below: When not required for long periods or if servicing is necessary the trains are run ito the station, which has 105-ft long track sections. Three of these may be moved sideways to permit close storage of the trains and the fourth is designed to facilitate maintenance.



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

BIM BIM Level 2 assessed
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	BIM	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		●	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	✔	●	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●		●	●			●	●	✔	2			Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4			Up to £2,000,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4			Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2			Up to £2,000,000
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
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	4		●	Up to £2,000,000
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	0121 557 8261												●			✔	4			Up to £2,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●	●			●	●		●	●	✔	4		●	Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●	●	✔	4		●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		4			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	✔	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4			Up to £6,000,000
Builders Beams Ltd	01227 863770			●	●	●	●			●	●			●	●	✔	2	✔		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4		●	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	✔	●	Up to £6,000,000
Cementation Fabrications	0300 105 0135	●			●			●			●		●		●	✔	3		●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4		●	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●	✔	4			Up to £6,000,000
Cook Fabrications Ltd	01303 893011				●					●	●			●	●		2			Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	4			Up to £800,000
D H Structures Ltd	01785 246269			●	●		●				●						2			Up to £100,000
D Hughes Welding & Fabrication Ltd	01248 421104				●	●	●	●		●	●		●	●	●	✔	4			Up to £800,000
Duggan Steel	00 353 29 70072		●	●	●	●	●	●	●		●	●			●	✔	4			Up to £6,000,000
ECS Engineering Services Ltd	01773 860001	●		●	●	●	●	●	●	●	●			●	●	✔	3			Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	✔	●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3		●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●	●	●	●		●	●			●	●		2			Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899												●		●	✔	3		●	Up to £2,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●				●		2			Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2			Up to £1,400,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●		●		✔	3			Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●		●	●			●	●	✔	2		●	Up to £2,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**BIM**	**SCM**	**Guide Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	BIM	SCM	Guide Contract Value (1)
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4			Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4		○	Up to £6,000,000
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				●	●									●		4			Up to £40,000
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 £6,000,000
Kloeckner Metals UK Westok	0113 205 5270												●			✔	4			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●					✔	2		○	Up to £6,000,000
Legge Steel (Fabrications) Ltd	01592 205320			●	●		●		●	●	●			●	●		3			Up to £800,000
Luxtrade Ltd	01902 353182									●	●				●	✔	2			Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✔	4			Up to £2,000,000
M J Patch Structures Ltd	01275 333431				●					●	●			●	●	✔	2			Up to £1,400,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3			Up to £1,400,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4			Up to £1,400,000
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	●	●	●	●	●	●	●	●		●			●	●	✔	4		●	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
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 £2,000,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2			Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4		●	Above £6,000,000
SGC Steel Fabrication	01704 531286				●					●				●	●	✔	2			Up to £800,000
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 Co 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			●	●	●	●	●	●		●			●	●	✔	3	✔	○	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**	**BIM**	**SCM**	**Guide Contract Value (1)**

Corporate Members

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

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

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

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
- **BIM** BIM Level 2 compliant
- **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	BIM	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●	●	●	●				●	✓	3					Up to £400,000
Bourne Construction Engineering Ltd	01202 746666	●	●	●				●	●	✓	4	✓		✓	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4			✓		Up to £6,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4			✓	●	Up to £3,000,000
Cementation Fabrications	0300 105 0135	●	●						●	✓	3				●	Up to £6,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000*
D Hughes Welding & Fabrication Ltd	01248 421104	●		●			●	●	●	✓	4			✓		Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3			✓	●	Up to £1,400,000
ECS Engineering Ltd	01773 860001	●	●	●	●		●		●	✓	3					Up to £3,000,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3			✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4			✓	●	Up to £6,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●				●		●	●	✓	4			✓		Up to £1,400,000
Murphy International Ltd	00 353 45 431384	●	●	●	●				●	✓	4					Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	4		✓	✓		Up to £4,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4	✓		✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4			✓	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499							●	●	✓	3					Up to £800,000
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 £1,400,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000
CTS Bridges Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			✓	●	Up to £800,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	4			✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3					Up to £2,000,000
Hollandia Infra BV	00 31 180 540 540	●	●	●	●	●	●	●	●	✓	4					Above £6,000,000*
HS Carlsteel Engineering Ltd	020 8312 1879	●	●					●	●	✓	3			✓		Up to £40,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3			✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500							●	●	✓	N/A					Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A					Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●						●	●	✓	3			✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	✓	4		✓	✓	●	Above £6,000,000

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	BIM
AJN Steelstock Ltd	01638 555500								●		M		
Albion Sections Ltd	0121 553 1877	●									M		
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I		
Autodesk Ltd	01252 456893		●										
AVEVA Solutions Ltd	01223 556655		●								N/A		
Ayrshire Metals Ltd	01327 300990	●									M		✓
BAPP Group Ltd	01226 383824									●	M		
Barrett Steel Services Limited	01274 682281								●		M		
Behringer Ltd	01296 668259					●					N/A		
British Steel	01724 404040				●						M		
BW Industries Ltd	01262 400088	●									M		
Cellbeam Ltd	01937 840600	●									M		
Cleveland Steel & Tubes Ltd	01845 577789								●		M		
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		
Daver Steels (Bar & Cable Systems) Ltd	01709 880550	●									M		
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M		
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M		
easi-edge Ltd	01777 870901							●			N/A	●	
Fabsec Ltd	01937 840641	●									N/A		
Ficep (UK) Ltd	01924 223530					●					N/A		
FLI Structures	01452 722200	●									M	●	
Forward Protective Coatings Ltd	01623 748323						●				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	●	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM	BIM
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	●	
Kloeckner Metals UK	0113 254 0711								●		D/I		
Lindapter International	01274 521444									●	M		
MSW UK Ltd	0115 946 2316	●									D/I		
Murray Plate Group Ltd	0161 866 0266								●		D/I		
National Tube Stockholders Ltd	01845 577440								●		D/I		
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A		
Pipe and Piling Supplies Ltd	01592 770312	●									M		
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	○	
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		
Tension Control Bolts Ltd	01948 667700						●			●	M		
Trimble Solutions (UK) Ltd	0113 887 9790		●								N/A		
voestalpine Metsec plc	0121 601 6000	●									M	●	
Wedge Group Galvanizing Ltd	01909 486384						●				N/A		
Yamazaki Mazak UK Ltd	01905 755755					●					N/A		

STRUMIS V10.1

NEW FEATURES
GREATER FLEXIBILITY
FOR ALL STEEL FABRICATORS

A WORLD LEADING STEEL FABRICATION MANAGEMENT INFORMATION SOFTWARE, USED WORLDWIDE TO REDUCE COSTS WHILE MAXIMISING PRODUCTIVITY AND INCREASING PROFITABILITY.

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