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NSC

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April 2016
Vol 24 No 4

Dublin pushes design boundaries

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New dynamic for City block

Fabric first design for Silsoe school

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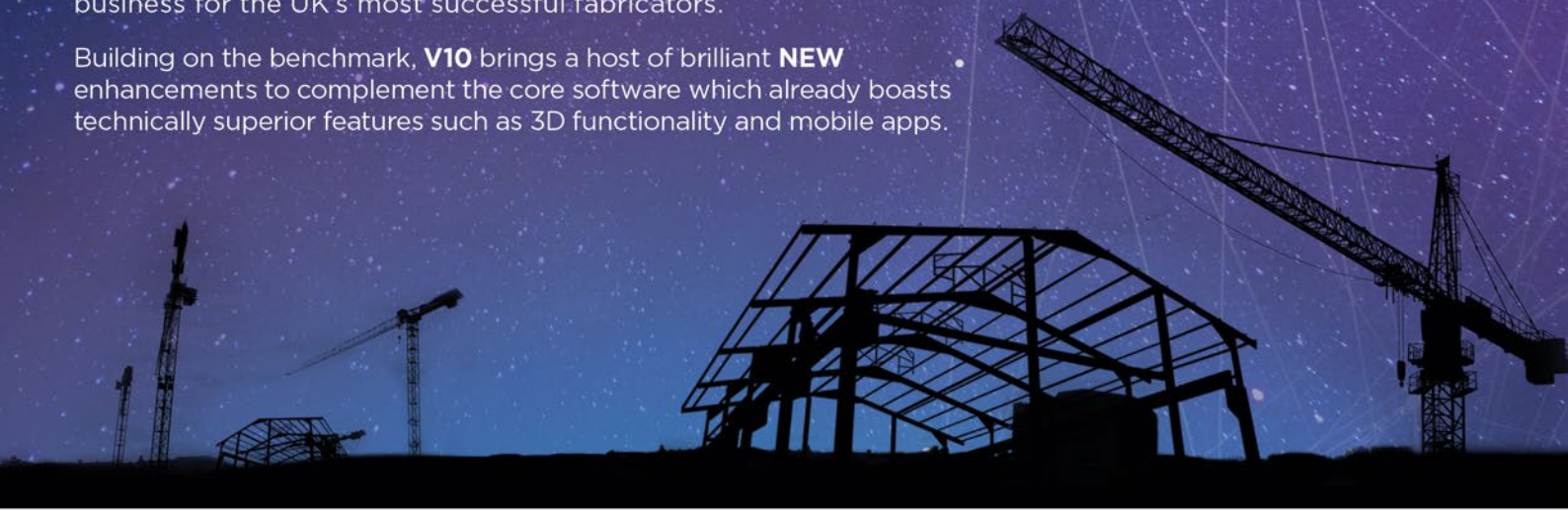

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Cover Image
Dublin Waste to Energy project
Main client: Dublin City Council
Architect: Friis & Moltke Associates
Principal contractor: Covanta
Structural engineer: PM Group
Steelwork contractor: Severfield
Steel tonnage: 4,500t

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EDITOR
Nick Barrett Tel: 01323 422483
nick@newsteelconstruction.com

DEPUTY EDITOR
Martin Cooper Tel: 01892 538191
martin@newsteelconstruction.com

PRODUCTION EDITOR
Andrew Pilcher Tel: 01892 553147
admin@newsteelconstruction.com

PRODUCTION ASSISTANT
Alastair Lloyd Tel: 01892 553145
alastair@barrett-byrd.com

COMMERCIAL MANAGER
Fawad Minhas Tel: 01892 553149
fawad@newsteelconstruction.com

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

Steel for Life Ltd
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone 020 7839 8566
Website *www.steelforlife.org*
Email *steelforlife@steelconstruction.org*

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

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

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CE BCSA SCCS UKAS

Some things just can't be imported

Nick Barrett - Editor

These are trying times for UK steelmaking, and it's no surprise that the industry's problems have sparked off a revived national debate about the balance between manufacturing and services the economy needs, and how essential the place of a domestic steelmaking industry is.

The entire steel supply chain supports the efforts of steelmakers to ensure that government backs their demands for a level playing field in the face of unprecedented levels of steel, produced as a result of overcapacity in other countries.

One positive note that is being struck in the debate surrounding these issues signals that messages about the value of having a UK based steel supply chain are getting through to government. A range of measures have now been announced that will help the UK steelmaking sector. The latest includes a ruling that the previously announced Public Procurement Note 16/15 (PPN 16/15) will now be mandatory for all government projects including National Health Service and local authority projects.

The government has also promised to publish a list of approved steel suppliers who meet the key criteria for being allowed to supply these projects. BCSA and other industry bodies are working with the Crown Commercial Services and the government's new Steel Procurement Working Group on the criteria.

Procuring constructional steelwork from a UK or Irish steelwork contractor is the best way to support UK steelmaking as UK and Irish steelwork contractors understand the government's new procurement requirements for steel, and provide the clearest route for compliance. In addition, using a UK or Irish steelwork contractor adds additional value to the economy through the whole supply chain including the fabrication of the steelwork, and the supply of other products and services such as secondary steelwork, metal decking, protective coatings and cladding.

The steel construction sector isn't asking for a ban on imported steel, far from it; having a measure of fair competition from elsewhere creates a competitive market. The key thing though is that competition is fair. There is no value to society if lower prices for imported raw steel or fabricated steelwork, which are likely to be temporary phenomena, destroy the UK's manufacturing base.

As you can read in our News section, a report from management consultants KPMG shows that UK steelwork contractors have previously made the investment needed to ensure that there is enough capacity to meet forecast demand. The KPMG report shows that steelwork contractors have between 205,000 and 406,000 tonnes of 'latent capacity' that can be brought into production if demand rises.

There is then every reason to use a UK or Irish steelwork contractor, especially one that comes with all of the accredited and audited capabilities, and familiarity with the way the UK construction industry likes to work – some things just can't be imported.

UK steelwork contractors ready to meet future demand

UK constructional steelwork contractors will have sufficient capacity to meet a forecast upturn in demand without the need for capital investment.

A report from KPMG concludes that UK steelwork contractors hold latent capacity of between 205,000t and 406,000t.

The UK's constructional steelwork capacity therefore lies between 1,142,000t and 1,343,000t against a forecast demand for constructional steelwork of 1,050,000t in 2019.

KPMG's UK Head of Infrastructure, Building and Construction, Richard Threlfall said: "UK steelwork contractors hold latent capacity which will allow them to quickly increase production to meet the forecast rise in demand from the construction industry."

The required increase in constructional steelwork output in the UK will be achieved through a combination of increasing shifts, use of agency staff, and fully utilising current production facilities, without the need for any capital investment, the report states.

BCSA Director General Sarah McCann-Bartlett said: "It is clear that with sufficient UK capacity to meet future demand for constructional steelwork, there is every reason to use a UK steelwork contractor.

"Using a UK steelwork contractor means shorter lead times, contractual security, exceptional quality of design work, better logistics on site and an excellent health and safety record."

The report also says that recent events in the wider steel-making industry do not provide a material short-term threat to the supply chain.

KPMG identified the availability of skilled staff as a risk for the sector, but concludes that the industry has made significant recent investment in apprentices in order to address this issue, including the development of a sector specific apprenticeship scheme.

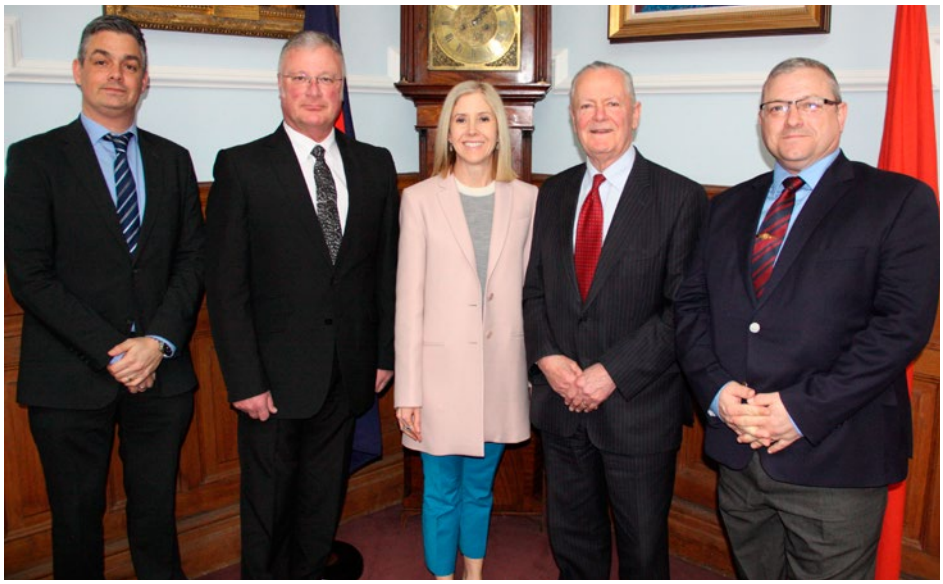
BCSA enters Primary Authority Agreement

The British Constructional Steelwork Association (BCSA) has gained a direct partnership with Trading Standards Service via the primary authority route.

Working with Kent County Council's (KCC) trading standards, the BCSA will now be able to seek clarification on the requirements of BS EN 1090 and CE Marking.

The advice will then be passed on to the entire BCSA membership, while KCC will act as a focal point for all other local authorities meaning the supplied information has a national relevance.

"Provided our members follow the advice, we don't need to worry about responding to conflicting advice or even facing enforcement action from another local authority that has a different interpretation of the law," said BCSA Director of Engineering Dr David Moore.



L-R: Steve Rock, Head of Trading Standards, Environment, Planning and Enforcement, Kent County Council: Ivor Roberts, Managing Director, Nusteel Structures; Sarah McCann-Bartlett, Director General BCSA; Michael Hill, Cabinet Member for Community Services, Kent County Council; Jason Reilly, CE Compliance Manager, Nusteel Structures

What is a primary authority?

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

Steel stars in BBC centre makeover

The former and historic BBC Television Centre in west London is being transformed into a new high-spec mixed-use development with steel construction playing a leading role.

At the heart of the £400M project is Plot B, the iconic circular building that once contained the majority of the BBC's studios. It is being transformed into a major mixed-use development, including a business hub for the creative industries, a hotel, cinema, gym, restaurants and cafes, as well as 950-homes.

Working on behalf of main contractor Mace, Bourne Steel is fabricating and installing 245t of structural steel to form the penthouses on top of Plot B.

With more than 250 site-welded connections and very limited use of the tower cranes, Bourne is utilising spider cranes for the installation of this first phase of the redevelopment.

Construction work on the prestigious project began early in 2015 with the first phase expected to be completed, and occupied in 2017.

David Camp,Chief Executive of developer Stanhope, said: "For the first time in 50 years, the site will be opened up enabling Television Centre to become the hub of an evolving district. Together with the BBC's continuing presence on the site and the addition of Soho House, we believe that it will be a great place to live, work and visit."

Steel-framed project is the first CCS five-star winner

The new US Embassy site in south London is the first project to achieve the top five-star accolade in the Considerate Constructors Scheme's (CCS) recently launched star ratings system.

The ratings have been created in response to contractors and clients asking for an easy way to demonstrate their considerate credentials to the public.

The site, which is being constructed by B.L. Harbert International, in conjunction with Sir Robert McAlpine, is due to open next year.

Steelwork contractor for the project is Severfield and it has fabricated, supplied and erected approximately 3,000t of steel for the job, as well as erecting a further 900t of steel sourced by the construction team via the United States.

Scheme Chief Executive Edward Hardy said: "The introduction of the star ratings system provides an easily identifiable and quantifiable way for the public, local community and workforce to understand the extent to which sites and companies are performing against the Scheme's Code of Considerate Practice.

B.L. Harbert International Project Manager Matt Goldsworthy added: "B.L. Harbert is honoured to receive such recognition. It would not have been possible without all of the hard work and dedication of all the people on site that have all contributed to make this happen."

L-R: Peter Carlson, Bureau of Overseas Buildings Operations, US Government; Matt Goldsworthy, Project Manager, B.L. Harbert International; Bob Kay, Project Manager, Sir Robert McAlpine; and Pat Kelly, Works Manager, Sir Robert McAlpine.

Sir Robert McAlpine's Project Manager Bob Kay said: "At the New London Embassy we take pride in providing a working environment that not only attracts like-minded personnel to the site, but aims to do so in a way that demonstrates our commitment not only to the site and its personnel but also to the wider community.

"Receiving such recognition from the Considerate Constructors Scheme demonstrates that we are achieving this aim."

UK certification for ArcelorMittal Long Products

ArcelorMittal Europe – Long Products has been certified under the BRE Environmental & Sustainability Standard BES 6001, a responsible sourcing certification for the UK construction market.

The certification demonstrates the division's commitment to sustainable sourcing and covers the entire portfolio of ArcelorMittal Europe – Long Products, including angles, channels, merchant bars, rails, sections, sheet piles, rebar, construction bar and wire.

Developed by the UK-registered research organisation BRE (Building Research Establishment), the standard BES 6001 requires manufacturers for the construction industry to prove that its products are made with responsibly sourced materials.

A process of third-party independent assessment, covering organisational governance, supply chain management and various environmental and social aspects, is used to verify that manufacturers meet the required criteria. Manufacturers must also demonstrate the sustainable operations of their raw material suppliers.

"With this new certification, ArcelorMittal is setting an example for the construction market in terms of sustainably sourced steel. UK construction companies prefer to buy from manufacturers who can demonstrate that their products comply with a recognised responsible sourcing scheme such as BES 6001," said ArcelorMittal Europe – Long Products, Chief Marketing Officer Amit Sengupta.

"From now on, UK contractors, designers and fabricators can choose ArcelorMittal long products with the full assurance that they comply with government insistence on sustainably sourced material."

Steel delivers giant grocery store in Kent

A large steel-framed temperature-controlled warehouse has risen up on the south bank of the River Thames at Erith, Kent for online grocery retailer Ocado.

Measuring 250m-long x 179m-wide, the single storey portal-framed building comprises six spans that rise either side of a central ridge.

Working on behalf of main contractor McLaren Construction, Caunton Engineering has fabricated, supplied and erected more than 2,300t of steelwork for the project.

The steelwork's stability is provided by tubular roof bracing and tubular vertical bracing along the building's perimeter as well as the portal action of the main frames.

Steelwork has also helped form a number of additional smaller structures, which include a main office, staff shop, a vehicle maintenance unit and a two-storey plant room.

The building is being clad in vertically spanning composite wall panels supported by cold-rolled rails to the external elevations. The wall cladding extends above the roof cladding to form a parapet.

This is Ocado's fourth distribution centre in the UK and when it opens in 2017 the company says it will have the capacity to handle in excess of 200,000 orders per week.

NEWS IN BRIEF

Billington Holdings has announced pre-tax profits of £3.1M for the period ending 31 December 2015, up by 63.2% on the previous year. Revenue increased by 25.7% as the company's main structural steelwork business delivered a host of high profile projects such as the Next distribution centre, Doncaster; Brize Norton Aircraft Hangar, and Wellington Place, Leeds.

Trimble has introduced three new versions of its Building Information Modelling (BIM) software, known as Tekla Structures 2016, Tekla Structural Designer 2016 and Tekla Tedds 2016.

AJN Steelstock has expanded its operation with the acquisition of a 17-acre industrial site in Henstridge, Somerset creating 100 new jobs. In business for over 60 years, demand for the company's steel has grown year on year for the last 15 years and in 2015 the firm recorded a record turnover of more than £50M and increased its steel sales by 21,512t (20 per cent up on the previous year.)

A recently commissioned report by **Metsec** has highlighted the benefits of using its Steel Framing Systems (SFS) ahead of other alternative solutions. As part of the testing, the report compared several different real life scenarios to see how the SFS wall would work in situ in comparison to brick, timber cladding, insulated render and rainscreen cladding.

British sports car manufacturer, **TVR**, has announced that its new production facility will be located in the Ebbw Vale Enterprise Zone in South Wales. It is currently looking at three sites within the Enterprise Zone and the company expects the facility to be a large steel-framed structure.

AROUND THE PRESS

New Civil Engineer
March 2016
City of Dreams, Macau – making the vision viable
The 42-floor twin-tower construction incorporates an irregular-form, aluminium clad structural exoskeleton with connections of such scale and complexity that they are possibly the most analytically and geometrically challenging large-scale steelwork connections ever to be built.

The Structural Engineer
March 2016
Digitally designed – Qatar Faculty of Islamic Studies
While the project posed many engineering challenges, such as its two minarets, the roof has a completely free-form geometry. The structure comprises singly-curved primary plate girders with straight purlins and profiled metal decking.

Building Magazine
11 March 2016
A breath of fresh air
[7 Air Street, London] – While strict local conservation rules meant that the façades could not be removed, the project became more complicated than a straightforward façade retention scheme. 80% of the steel frame was also retained, with floor levels rationalised and the upper two storeys demolished and rebuilt.

Construction News
11 March 2016
Tight borders for Kier on Bolton bus link
[Bolton Interchange] – Owing to the proximity of the railway, the team used fixed holding bolts for the columns. "We landed every column on to bolts that were already cast into pile caps, levelled the column, tightened the bolts and grouted it, so then it would be free-standing," Kier project director Antony Tetlow explains. This meant there were no temporary works needed, allowing the team to install a line of columns right next to the railway.

Construction Enquirer
25 February 2016
VolkerFitzpatrick wins £12m London Royal Mail job
Works undertaken by the Special Projects Division of VolkerFitzpatrick involve demolition of existing buildings before constructing a delivery office, which is designed to be BREEAM 'Excellent'. Construction of the two-storey delivery office uses a series of steel portal frames clad with a mixture of grey brickwork and Trespa panels to the top levels.

World Steel Association campaigns for steel houses

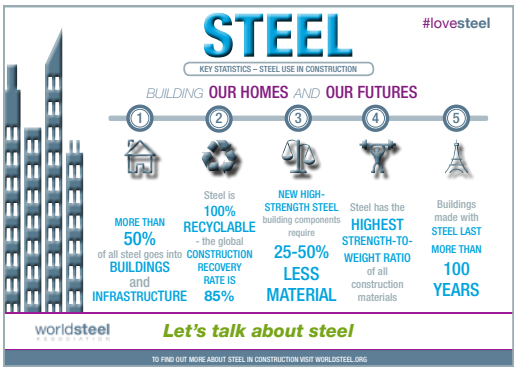
The World Steel Association (WSA) is running a campaign #lovesteel, which demonstrates how steel is the ideal material for aesthetically pleasing and sustainable residential buildings.

The campaign states that by using steel construction homes are more sustainable, affordable, safe and beautiful. In summary:

- Buildings made with steel last more than 100 years.
- Steel has the highest strength-to-weight ratio of all construction materials.
- New high strength steel building components require 25-50% less material.
- Steel is 100% recyclable - the global construction recovery rate is 85%.

According to the WSA, more than half of the steel produced worldwide goes into steel buildings and infrastructure. Nevertheless, about 1.6BN people live in inadequate housing around the world today and an estimated 100M are homeless.

As we live in a world where we must find new ways of doing more with less, we can solve these challenges with steel. Sustainable living needs steel. It's strong, it's versatile, it's durable, it's infinitely recyclable and it's affordable.



The WSA says the top ten reasons for choosing steel are:

1. **Steel is never wasted**
2. **Steel lasts for generations**
3. **Steel is light, yet strong**
4. **Steel saves energy**
5. **Steel is climate proof**
6. **Steel is quick and easy**
7. **Steel means fewer worries**
8. **Steel protects us and our homes**
9. **Steel is creativity, applied**
10. **Steel is beautiful**

Teamwork produces agricultural buildings in Norfolk

Steelwork contractor A C Bacon Engineering, which specialises in fabricating buildings for the agriculture industry, has teamed up with Worksop Galvanizing [part of the Wedge Group] to process steel used to create two large grain stores for South Pickenham Estates in Norfolk.

"We have worked alongside the team at Worksop Galvanizing on many of our projects," says A C Bacon Engineering Buyer Andrew Willimott.

"Our most recent work weighed over 700t in total with steel used to fabricate a variety of structures including grain stores, which play a pivotal role in farming operations.

"It's important that our buildings are fabricated and galvanized to a high quality, not only protect the structure itself, but also the products stored inside. The farming environment can be a particularly challenging one, so galvanizing our steel ensures our buildings last a lifetime with no need for maintenance or servicing, which can be quite costly taking into account the size of the grain stores and the labour and resources it would require."

South Pickenham Estates, which is home to a 5,802 acre farm and vineyard, plus sporting, catering and accommodation facilities, says that it specified galvanizing as a finish for A C Bacon's steel buildings due to the quality and long-term protection that it provides.

Worksop Galvanizing Commercial Manager Paul Robinson explained: "Our team has worked with A C Bacon across a variety of projects for over 10 years and we're pleased to have played a part in this large-scale job for South Pickenham Estates."

Steel stalwart steps down as SCCS Chairman

Denver Woodward has stepped down as Chairman of the Steel Construction Certification Scheme (SCCS) after 18 years of service.

Commenting on Mr Woodward's illustrious tenure, incoming SCCS Chairman Simon Pike of Tata Steel said:

"Throughout his time Denver kept a firm hand on the tiller and helped to steer the SCCS from a fledgling organisation, to one where now we can boast over 500 clients, a wide coverage of steel construction related approvals, a turnover in excess of £1M and above all, a level of credibility in the steel construction industry that must surely ensure that we have a competent sector and safe and sustainable structures."

Mr Woodward was a founding member of the Certification Scheme (then BS 5750) set up in 1985 at the request of the Department of Trade and Industry.

In 1993 he was appointed Chairman of the QA Technical Panel. This was a body responsible for the development and maintenance of technical schedules for design, fabrication and erection within the steel construction industry.

"With such a depth of experience, it seemed only fitting that Denver be appointed Chair of the Certification Board on 3rd March 1998" said Dr Pike.

"Thereafter, the SCCS went from strength to strength, adding ISO 14001 Environmental Management System in 1991 and then OHSAS 18001, for Occupational Health and Safety Management in 2008. The scope of the scheme has continued to wider with the National Highways sectors schemes covering corrosion protection, steelwork execution and mechanical fastenings."

Steel sector remembers coatings specialist

Jack Tighe founder of the Jack Tighe specialist coatings business has died aged 85 after a long illness.

He had been in business since 1954 during which time he built numerous successful businesses, following a successful career as a national and international track cyclist, representing his country on many occasions.

In his first year in business in 1954 Jack had a turnover of £9,000, which grew to £42M in 1982 with over 2,500 employees within the Tighe Group when he sold his company to HAT Group.

A small company Independent Painting Contractors Ltd (IPC) was not part of the sale agreement, so once the restrictive clauses expired he was able to build the company again, and in 1990 he changed the name to Jack Tighe Ltd.

The current Tighe Group of Companies turnover is around £20m per annum and employs 250 people throughout the UK.

In 2009 Jack Tighe was given a lifetime achievement award by the Institute of Corrosion (ICorr) for being one of only 10 people who the Institute considered to have been the most influential in the blasting and coatings industry in the past 50 years.

David Deacon, the ICorr 50th Committee Chairman said: "Jack is probably one of the best known names in the coating industry. He was involved with many major contracts including the blast cleaning and coating of the Thames Barrier Gates at Cleveland Bridge during the 1970s, which has proved to be so successful."

Throughout his life he was also associated with the application of protective coatings to some of the most iconic structures in the UK such as the Millennium Dome, Millennium Stadium, Wembley Stadium, Kings Cross Station, Olympic Structures, The Orbit and The Kelpies.

Jack Tighe will be sadly missed by his family, friends and staff.

Funding secured for 3rd Snowhill office scheme

Three Snowhill, one of the largest ever speculative office projects outside London, has secured funding.

The £90M 39,000m² development in Birmingham city centre will be a steel-framed 14-storey high tower.

Following on from One and Two Snowhill, this is the third steel-framed office structure in the wider development of the area and forms part of Birmingham's 20-year master plan known as Vision 2030.

Working on behalf of developer Ballymore Properties, BAM Construction is the project's main contractor. So far no steelwork contractor has been appointed.

Previously, Barrett Steel Buildings and Caunton Engineering erected One and Two Snowhill respectively.

BAM will be remodelling the existing five levels of basement and cores, which serve all three phases, creating office, leisure and conference space and car parking.

The fully curtain walled development is targeting a BREEAM 'Excellent' rating and an EPC rating of at least B.

Memorial celebrates Spitfire's 80th anniversary

Steel bending specialist Barnshaws Section Benders was contracted to add its expertise in the fabrication of the Sentinel Spitfire memorial sculpture at the former aircraft factory in Castle Bromwich.

Rising high into the sky outside the once vital aircraft facility, Sentinel by sculptor Tim Tolkien recognises the efforts of the workers and pilots who helped to defend Britain from the threat of invasion during the Second World War.

Last month the Spitfire celebrated the 80th anniversary since its maiden flight on 5th March 1936

Comprising three Spitfires banking 16m into the sky, the sculpture required extensive input from Barnshaws Section Benders.

The project utilised precision cutting, fabrication and bending expertise, with all work carried out in-house. The three spitfires were plasma cut from aluminium, while the smoke trails were produced from split sections, which were then precision curved to a range of radii.

Components for the aircraft were manufactured across the UK, including the B Saxtons works in Hyde, which became part of the Barnshaws Bending Group 20 years ago, adding extra significance to the project for the company.

Very few aircraft capture the essence of British resistance like the Supermarine Spitfire, an aircraft that today epitomises the valiant efforts made by the RAF during the Second World War.

The majority of Spitfires were built at the Castle Bromwich factory, with nearly 12,000 being delivered during the production run. The plane was designed by Staffordshire born R.J Mitchell CBE, originally utilising a Rolls Royce Merlin engine and later on, the more powerful Griffon.

Diary

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

Tuesday 19 April 2016
Robustness Design for Steel Framing
1 hour lunchtime webinar
Free to BCSA and SCI members, introducing design of steel-framed buildings for robustness.

Thursday 28 April 2016
Steel Connection Design
This course is for designers and technicians wanting practical tuition in steel connection design.
London.

Tuesday 10 May 2016
Steel Building Design to EC3
This course will introduce experienced steel designers to the Eurocode provisions for steel design.
Reading.

Tuesday 24 May 2016
Steel Construction and the Circular Economy
1 hour lunchtime webinar free to BCSA and SCI members.

Wednesday 25 May 2016
Simple Beam & Column Design to EC3
NEW –Four hour course containing minimum theory and maximum hands-on member design – focusing on practical design using the Blue Book. The course is aimed at designers of orthodox structures where the resistance tables are the preferred way of selecting members.
Bristol.

Thursday 26 May 2016
Simple Beam & Column Design to EC3
NEW –Four hour course containing minimum theory and maximum hands-on member design – focusing on practical design using the Blue Book. The course is aimed at designers of orthodox structures where the resistance tables are the preferred way of selecting members.
Birmingham

The large steel frame takes shape, with the tipping hall and waste bunker the first parts to be erected

Trusses accommodate complex design

Structural steel design innovations have played a key factor in the construction of Ireland's largest waste to energy scheme. Martin Cooper reports.

FACT FILE
Dublin Waste to Energy project
Main client: Dublin City Council
Principal contractor: Covanta
Architect: Friis & Moltke Architects
Construction Manager: PM Group
Structural engineer: PM Group
Steelwork contractor: Severfield
Steel tonnage: 4,500t

"We've pushed the boundaries of structural steel design, detailing and erection on this project," says PM Group Senior Structural Engineer John Diffley, as he describes the work that has been undertaken to build the Dublin Waste to Energy facility.

"The unique geometry of the building posed significant technical design and construction challenges, such as working within a tight and confined site, which directly impacted the erection sequencing and logistics planning as well as working at height to lift large steel elements into place. All have all been overcome with a lot of design and construction coordination between PM Group and Severfield."

The Republic of Ireland's largest waste to energy plant is being constructed at Poolbeg in Dublin, close to where the River Liffey meets the Irish Sea. Once operational it will incinerate up to 600,000t of waste per year, generating enough electricity for up to 80,000 homes.

All of the project's processes are housed within one large steel-framed structure that will minimise noise. It measures approximately 200m x 100m, rising to a maximum height of 52m (excluding the flue which will be 100m-tall).

Because the structure is so large and will be a prominent feature of the local landscape, the design of the plant has created a landmark conical-shaped building. All of the corners are rounded, while the building also curves and slopes upwards creating complex steelwork geometry. This is predominantly formed with columns positioned around a radius and then connected with faceted steel tie members.

Such a challenging shape would not have been possible without the use of BIM, according to all of the design and steelwork team members. PM Group's use of Revit and model management tool Navisworks and Severfield's use of Tekla, led by their Technical Manager Stephen Graham, facilitated a detailed co-ordinated fabrication model that was clash-free with the extensive process and services models.

The building is divided into three frames by two movement joints along its length. The individual process areas are aligned with these joint locations. The initial construction phase included the waste bunker, the administration building, tipping hall and district heating areas.

Within the waste bunker structure two overhead waste handling gantry cranes will service the plant, operating 24 hours a day seven days a week.

"Usually overhead crane beams would be symmetrically supported by large evenly spaced columns on either side. However, due to the layout requirements of the processing equipment, a space adjacent to the bunker needed to be open-plan and so columns could not be placed on one side," says Severfield Design Director Chris Durand.

As columns going down to ground level were out of the question in this area, another solution to support the building and crane

Three trusses support the waste bunker's cranes

beams on this side of the bunker was needed. The design solution adopted by PM Group was to span the building frame over the column-free space by utilising the elevational steelwork as deep trusses to support the roof.

This entailed using three 25m-deep vertical trusses to support the roof with spans of up to 30m commencing at 23m above grade level.

This approach was further complicated by the requirement to also support two large gantry cranes along the same structural framing line.

"During the design phase we identified the support of the gantry cranes, with the associated fatigue issues, on such an elevated support structure as a critical technical design challenge. This drove us to develop an innovative solution which was to install separate dedicated crane support trusses running parallel to the building frame to support the gantry cranes. This created the column-free space under the crane supports and separated the fatigue loading induced by the cranes from the main building frame." says Mr Diffley.

Three trusses supporting the cranes were designed; two were 4m deep spanning 30m and a third was 3m deep spanning 18m. The truss design was developed in conjunction with the fatigue design of the truss connections for the stress ranges derived from the cyclical loading induced from both cranes in operation at any one time.

"As the continual movement of the cranes will cause fatigue to the steelwork connections and load reversal in the truss members, an enormous amount of design work involving hand calculations was required for the truss connection designs." says Dr Durand

"Overhead cranes of this size supported on long-span trusses would not be a standard approach in the industry," suggests Mr Diffley. "Simplifying the building load paths and separating the crane induced fatigue load from the building frame was key in designing the structure."

The trusses supporting the building and cranes not only provide the required open-plan area at ground level for ancillary boiler house equipment, they also form part of a movement joint within the large structure, as they are positioned approximately one third along its entire length.

The waste bunker and its attached administration office block are a key part of the project and were the first part of the steel frame to be erected.

As well as the crane supporting trusses, Severfield also had to erect a series of 37m-long × 3m-deep roof trusses that span over the waste bunker.

The concrete waste bunker measures 25m × 75m and its walls are 23m-high, and forms part of the support system for the structural steelwork.

"Getting all of the trusses installed up and above the concrete bunker would have ordinarily required the use of some large and expensive crawler cranes, positioned outside of the structure's footprint," says Severfield Project Manager Michael Moore.

"However, a large ground level opening was left in one of the bunker's concrete walls, through which materials and cranes could enter. This meant we could assemble all of the surrounding trusses on the bunker's floor and then erect them as complete pieces, lifted by one 500t-capacity mobile crane which was also positioned inside the bunker."

Working from inside the bunker and within the project's footprint saved time and money, and eliminated any obstructions to work going on outside the structure.

Once the bunker steelwork was completed along with the office block, which also contains a control room, the next area to be erected was the tipping hall.

Occupying one end to the overall structure, the tipping hall, as the name suggests, is where trucks will deliver the waste and tip it into the adjacent bunker. The hall is raised 7m-above ground level and to create the necessary large open-plan area a series of 36m-long trusses have been installed.

These trusses were delivered to site in two welded assemblies, then lifted with two cranes into position and bolted together in the air at their final location. A series of 17m-high raking columns forms the tipping hall's perimeter elevations.

After this area of the steel frame was erected Severfield then began erecting the other end of the building, working their way northwards from the waste bunker.

Sloping columns up to 48m in length form a lean-to structure that encloses the plant's boiler and turbine halls. The building's main roof falls from the waste bunker all of the way over the turbine hall to the back of the flue gas hall, which has an eaves level of 39m above ground.

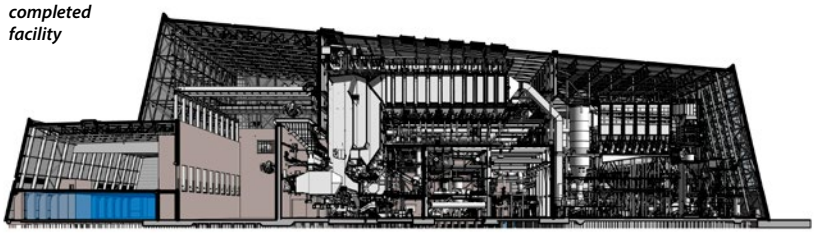
All of the steelwork around and over the boiler and turbine processing equipment is being installed once the majority of the equipment is in place.

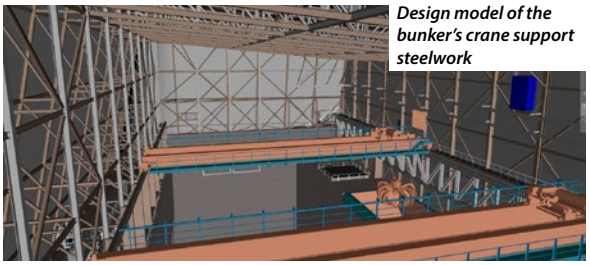
"The processing equipment is key to the entire project and so the boiler house and turbine hall had to be fitted out before the surrounding steelwork could be erected," adds Mr Diffley.

Interestingly, under separate contract to Severfield's, a further 6,000t of steel is being installed to support all of this vital processing equipment.

Building work is scheduled for completion early in December 2016 and the Dublin Waste to Energy facility will be operational in 2017.

Inside the completed facility





Design model of the bunker's crane support steelwork

Steel nears completion on the project's cinema block

Essex gets retail therapy

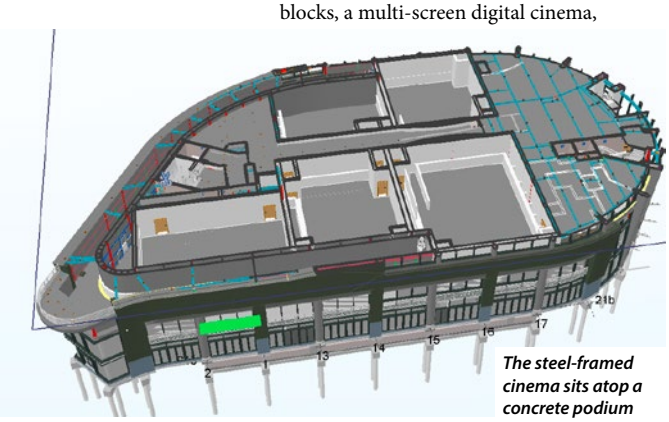
A large steel-framed retail and leisure development is set to invigorate Chelmsford city centre.

FACT FILE
Bond Street development, Chelmsford, Essex
Main client: Aquila
Architect: WCEC Architects
Main contractor: Bowmer & Kirkland
Structural engineer: Mott MacDonald
Steelwork contractor: Caunton Engineering
Steel tonnage: 1,800t

The Bond Street retail and leisure development will transform Chelmsford city centre when it opens later this year, adding new traditional shopping streets that will integrate with the rest of High Street area.

Nestled on the banks of the River Chelmer, the scheme forms phase two of a much larger city centre regeneration scheme that previously included the construction of three blocks of riverside apartments (see NSC November 2007).

This latest development comprises a large John Lewis (the first in Essex) anchor department store, three other mixed retail blocks, a multi-screen digital cinema, landscaped public spaces and a 275-space underground car park that covers nearly half of the project's entire footprint.



The steel-framed cinema sits atop a concrete podium

Steel construction is playing a leading role in the building of the Bond Street scheme, as all of the structures are steel-framed with the exception of the cinema block, which is a hybrid building. It consists of a two-level concrete lower part, which will house restaurants, supporting a steel-framed upper level accommodating the cinema complex.

The site was previously occupied by a large city centre surface car park and so, when work began early last year, there was no demolition required. Instead a large earthmoving programme kicked off the development as the underground car park was excavated.

Working in areas that had previously been excavated and piled, design and build steelwork contractor Caunton Engineering began the erection process with the John Lewis store.

The 11,148m² John Lewis store consists of three trading levels – ground, first and second. For ease of programme this steel-framed structure was the first to be erected.

"It's the furthest from the site's access point and so it made our job less challenging to work on this building first and then work our way out of the site by way of the other buildings," says Caunton Engineering Contract Manager Adrian Downing.

Caunton's erection sequence was also dictated by the groundworks programme, as excavation and piling work had to precede the steelwork. Another reason behind this store being erected first is the fact that it is the development's anchor and potentially it will need the longest fit-out programme before it is ready to open.

The store is based around a 9m × 10.2m grid pattern for all of its levels except the uppermost retail floor where alternate rows of columns have been omitted to give a more open-plan area.

Forming a pitched roof over this top retail floor are two rows of 21m-long × 1,800mm deep trusses. Caunton brought the trusses to site in two pieces and then after bolting them together they were lifted into place using one 50t-capacity mobile crane.

Block One, which houses 10 double-height retail units and is structurally attached to the John Lewis store forming one large braced frame, was the next structure to be erected.

The same 9m × 10.2m grid is also used to form Block One as well as the adjacent Block Two retail building. This grid was deemed to be the most efficient for both the retail buildings and the underground car park, which sits beneath all of these blocks.

"The piece count was so high because there is a complicated cantilevering roof feature that wraps around the bull nose."

The majority of the columns forming the car park extend up into the retail floors, however there are a number of instances where this is not possible. For example, many of the Block One and Block Two columns above basement level have been relocated into partition walls to create an open-plan shop area.

This means a number of large transfer beams have been installed at ground floor level. Typically these transfer beams are 914UB section sizes of various weights, and some span up to 18m and support two columns up to roof level.

An uncovered pedestrian mall separates John Lewis/Block One from Block Two, while another mall, positioned at right angles to the first, separates these buildings from the cinema structure.

"The position of these malls and the fact that they do not run perfectly straight also meant that we had to install a number of transfer structures within the ground floor area," says Caunton Engineering Project Engineer Gavin Christie.

The cinema was possibly the most complex steel frame to be erected and required more than 1,000 individual sections. Sitting atop two concrete levels, the steelwork is based nominally on a 6m-perimeter grid, although this changes slightly to accommodate the structure's shape that incorporates a bull-nose feature at one end and a rounded point at the other.

"The piece count was so high because there is a complicated cantilevering roof feature that wraps around the bull-nose," explains Caunton Engineering Senior Structural Engineer Colin Winter. "It slopes and widens to a maximum depth of 3m and required a lot of secondary steelwork."

The steelwork for the cinema is tied into a couple of stair cores, as installing bracing was not an option due to the lack of areas in which to put it. Both ends of the cinema feature mezzanine levels, while in-between the five cinema auditoria vary in size with the largest requiring roof rafters with a span of 16m.

The steel erection programme was completed by the end of February and the last structure to be erected was retail Block Three. This stand-alone braced frame houses further double-height outlets and is separated from Block Two by the car park ramp and the development's service yard.

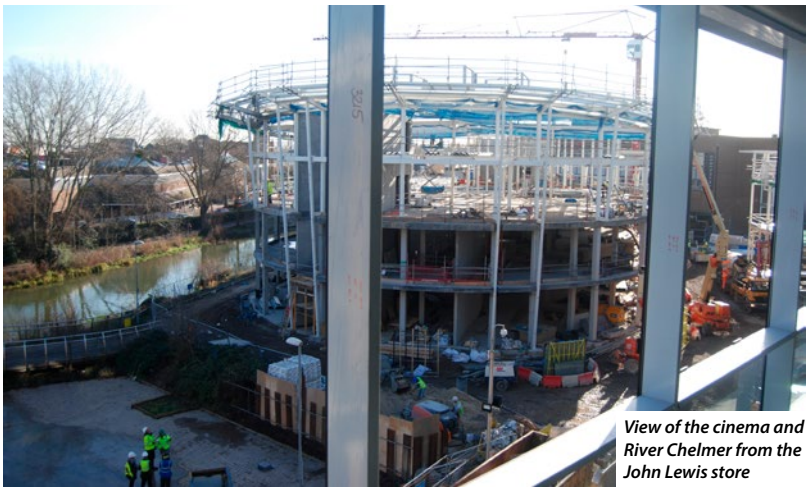
The Bond Street development is scheduled to open before Christmas.

Time consuming elevations

The project's elevations consist of a number of different and complicated cladding types including masonry, render, stone and aluminium panels.

The retail units along the mall and Bond Street also feature an 800mm wide coping stone at parapet level. These are generally offset from main columns and this led to an intricate secondary steelwork framing system being required to support the coping stone and also the cladding system.

"As each retail unit has a unique set-out, the design of these elements was a time-consuming process. Utilising the combined architect and steelwork 3D model proved extremely beneficial in speeding up design, by aiding set-out and helping to visualise support requirements," explains Caunton Engineering Project Engineer Gavin Christie.



View of the cinema and River Chelmer from the John Lewis store

The upper floor of the John Lewis store features a larger open-plan grid pattern

Steel insures City tower

A steel-framed 19-storey office development is the latest high-rise addition to the City of London's insurance district. Martin Cooper reports.

Creechurch Place rises up in front of three City landmarks

The construction of new commercial office space in the City of London shows no sign of slowing down. An array of tower cranes on the City skyline is proof that a mini-building boom is in full swing and likely to continue into the near future.

Plans are afoot in the square mile for grander schemes, with one 73-storey development recently seeking planning permission. This kind of statement structure is far from the norm in London as the majority of new office developments are usually around 20 storeys high.

An example is Creechurch Place, a 19-storey T-shaped office development currently being built close to 30 St Mary Axe (The Gherkin) in an area of the City dubbed the insurance district because of the abundance of underwriters.

The site occupies an important position in the City of London and the aim is to deliver a new, modern, flexible and efficient office building of the highest quality. The construction will deliver a structure comprising two levels of basement, ground floor and 17 upper storeys, plus rooftop plant, providing 25,350m² of flexible, Grade A commercial office space and 284m² of retail/café space.

Below ground floor the structure's basement is formed with a concrete frame within a perimeter secant piled wall. From ground floor slab upwards the building is steel-framed.

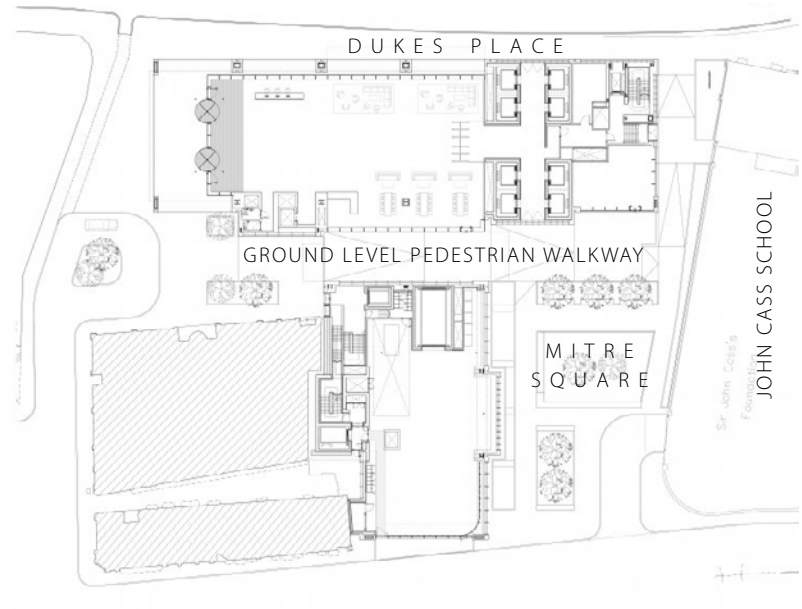
"The design for the majority of the tower was always a steel building as the material enables the structure to have long clear spans, which would not have been possible with concrete," says Ramboll Project Engineer Rebecca Archer.

"The first floor along the main elevation is set-back and hung from the floor above via CHS sections, creating a column-free entrance area. This important design feature would also not have been possible in any other material than steel."

Ground floor has a higher floor-to-ceiling height throughout, and as well as accommodating the building's frontage and main entrance lobby along the top of the T-shape, the other part of this level has back-of-house and refuse collection areas. Interestingly, the ground floor is the only part of the scheme that does not extend over the site's entire footprint, as the top part of the T is split from the upright stem section because the building spans over a pedestrian thoroughfare. This walkway has been temporarily closed during the construction programme, but has to be reinstated as part of the scheme's planning conditions.

Main contractor Skanska started on site in August 2014, following the completion of the demolition programme.

"One of our initial tasks was to deepen



City logistics

City centre construction projects always throw up logistical challenges and Creechurch Place is no exception. As the building occupies the entire site footprint there is little or no room for material storage, so steelwork is delivered to site on a just-in-time basis.

Along the main Dukes Place elevation the project has a pit lane that can accommodate two trucks for unloading.

None of the other elevations of the building are suitable for deliveries as they are either party walls, narrow roads or pedestrianized zones such as Mitre Square. However this means the neighbouring buildings, including the John Cass School are very close

"Keeping the neighbours happy is very important and we have a number of quiet times on site that correspond with the school's playtimes," explains Skanska Project Director Paul Davies.

the existing basement by 12m to give us the required two underground levels," says Skanska Project Director Paul Davies. "The concrete basement floors, ground floor slab and two slip-formed cores were then completed in readiness for the steelwork erection to begin last August."

Steelwork contractor William Hare was involved in the design of the project early in the process and this helped improve efficiency.

"Not only was a value engineering process undertaken, but we also had the majority of the steelwork fabricated and painted ahead of programme, which eliminated the possibility of delays later in the construction sequence," says Mr Davies.

The steel frame is based around a regular grid offering open-plan office space with column-free spans of up to 16.5m-long. Only two internal columns are present throughout the entire structure.

William Hare has installed Fabsec cellular beams throughout the majority of the structural frame to allow the building's services to be accommodated within the structural void.

Despite the long spans, the use of cellular beams was not an issue for the floor vibrations. Ramboll used its experience of in situ testing to demonstrate that through careful consideration of the layout and ▶16

Large impact-resistant columns are positioned on the main elevation's corners

All of the steelwork has been erected by tower crane

FACT FILE
Creechurch Place, London
Main client: Helical Bar/HOOPP
Architect: Sheppard Robson
Main contractor: Skanska
Structural engineer: Ramboll
Steelwork contractor: William Hare
Steel tonnage: 3,500t

▶15 interactions between the cellular beams, they could still be used efficiently, without having to adopt the more traditional method of using heavier beams to increase the stiffness.

"This would generally add weight and cost to a project," says Ms Archer.

For the steel erection William Hare split the structure into four zones for its erection programme. This allowed two gangs to work their way up the building, two floors at a time, in a staggered methodology along with the metal decking installers.

"All of the steelwork has been erected by the site's two tower cranes," says William Hare Project Manager Ivo Garcia. "It's all been within the tower crane's lifting capacity, including the project's heaviest members – two ground floor column sections each weighing 14t."

The members are 1,350mm × 350mm box sections and they are larger than the other columns along the front elevation because they are unrestrained, positioned on corners and have been designed to absorb vehicle impact loadings. From second floor upwards the section sizes decrease.

"The first floor along the main elevation is set-back and hung from the floor above via CHS sections, creating a column-free entrance area. This important design feature would also not have been possible in any other material than steel."

The principal cladding system is a unitised, interactive double skin - a double-glazed inner layer, single-glazed outer layer and an operable blind in the cavity between.

This is said to allow control of solar gain and optimises natural daylight within the offices. Anodised aluminium vertical fins of varying colours and spacing, improving the façade performance and adding vertical emphasis, enhance this system.

The building will be completed in September and is aiming for a BREEAM 'Excellent' rating and a B-rated Energy Performance Certificate.

Visualisation of the completed building

Dynamic performance of the Creechurch Place office floors.

by Dr Richard Henderson, SCI

The office floors at Creechurch Place are largely column-free spaces because the narrow floor plates allow secondary beams to span across the full width of the floor. The composite Fabsec cellform beams at centres varying between 3m and 3.25m are 725mm deep and span up to 16.5m. Perimeter columns support primary beams spanning up to 10.5m that carry as many as three secondary beams. In some parts of the floors the secondary beams cantilever beyond the primaries.

The floor slabs are nominally 130mm thick normal weight concrete and consequently give better dynamic performance than would have been achieved with lightweight aggregate concrete. The higher mass of the floor slab results in lower accelerations for a given input force (such as footfall excitation) and therefore lower response factors. The effect on dynamic performance of the higher stiffness of the normal weight concrete is not significant.

Dynamic analysis of the floors was carried out using Robot structural analysis software to perform a modal analysis followed by a time history analysis with moving footfall input. Finally the response factors of the floors were determined and compared with acceptance criteria. Ramboll have found it an effective arrangement to introduce a line of tertiary beams spanning between the secondaries to reduce the tendency of secondary beams to vibrate on their own. The size and position of the tertiary beams along the span are adjusted iteratively to determine their most effective arrangement. This approach has been found to be 15% more efficient than achieving a satisfactory result merely by increasing the size of the secondary beams.

The damping ratios normally assumed in composite floor construction are 1% of critical damping for an as-constructed floor with no fit out, and 3% of critical for a fitted out office floor. (These values are recommended in SCI publication P354 Design of floors for vibration: a new approach). A lower damping ratio was used in the analysis of the Creechurch Place floors (with potentially higher responses) because in-service measurements by Ramboll have shown that for a number of lightweight fit out arrangements the actual damping ratio achieved was between 2% and 2.5% of critical, ie less than the value of 3% often used in analysis.

Full height internal partitions are known to affect the damping ratio in floors so where they are present in the fit out, 3% damping remains a reasonable upper-bound value.

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Walking high

A steel walkway that transports visitors through the forest canopy will open this month at the UK's National Arboretum. Martin Cooper reports.

FACT FILE
Stihl Treetop Walkway, Westonbirt National Arboretum, Gloucestershire
Main client: Forestry Commission
Architect: Glenn Howells Architects
Main contractor: Speller Metcalfe
Structural engineer: Buro Happold
Steelwork contractor: S H Structures
Steel tonnage: 180t

Famous for its picturesque Victorian landscape and internationally important tree and shrub collection, the National Arboretum at Westonbirt in Gloucestershire will shortly open an attraction that will give visitors a whole new woodland experience.

Reaching a maximum height of 13m, the Stihl Treetop Walkway will transport visitors into the tree canopy to experience a high-level perspective of the arboretum and give them the opportunity to learn more about trees and how they live.

The walkway project has a history that goes back seven years when a concept design first came to light, but it was put on hold while the arboretum focused on fundraising and completing phase one, a new Welcome Building and car park.

However, after a three-year fundraising campaign by the arboretum's partner charity Friends of Westonbirt Arboretum, and a refined and more cost-effective design in place, the project was able to start on site last May.

"We made a few tweaks to the design, such as changing the walkway support spine from timber to steel," says Buro Happold Project Engineer Joe Darcy.

"Steel was chosen as it is more durable and will give the walkway a longer lifespan, while we also needed a material to give us a stiffer deck to provide lateral stability."

Westonbirt Arboretum Project Manager Sophie Nash adds: "We have used two primary materials to construct the walkway, steel and timber. Steel has been used to support the deck of the walkway, which enabled us to slim down its profile, reducing the visual impact on the Westonbirt landscape.

"Using steel to create a support spine for the timber deck also allowed us to create more gentle, swooping curves. We did utilise steel in other areas of the project to reduce maintenance requirements."

The 300m-long S-shaped walkway winds its way through the Arboretum's woodland starting at the recently opened Welcome Building. It is supported on 57 cigar-shaped raking timber columns and so one of the first tasks of the project was to position their foundations.

Column placings were very important, as a route for the walkway avoiding a number of important trees had already been mapped out. The foundations had to avoid damaging any tree roots and so a few columns had to be moved slightly off grid.

The walkway's route was selected to make the most of the contours of the landscape and for its choice of canopy. Some pruning was carried out for the safety of the trees when erecting the walkway structure.

Once the concrete foundations had been completed steelwork contractor S H

Structures was able to begin its work in October. As well as fabricating, supplying and erecting the steel walkway spine and balustrades, the company also erected the raking timber columns.

The columns are arranged in pairs and are connected to the ground and to the walkway steel spine via pin connections. As the walkway route passes over varying topography the main columns vary in height up to a maximum of 12m-high.

The walkway spine's main girders are fabricated from Tata Steel hot rolled RHS sections, while the cross members are CHS. As most of the spans are curved in order to form the S-shape of the structure, The Angle Ring Company was sub-contracted by S H Structures to do the section bending before the fabrication process began.

Either end of the walkway features sloping access ramps; to support these areas column heights descend down to 2m-high members.

The walkway steelwork was fabricated and brought to site in 10.5m long × 1.6m wide sections that correspond to the distance between supporting columns. "Once on site we bolted the balustrades to the spine's main girders before lifting the complete sections into place," explains S H Structures Project Manager Shane Marsh. "Each spine section weighed 4.5t."

Working in and around a collection of important trees meant S H Structures had to use a combination of four cranes for the erection programme. A mobile tower crane was brought to site as it could reach over any trees, while three mobile cranes were used at different times with the largest having 350t capacity.

"Using these four cranes we were then able to erect the entire walkway by positioning cranes on just four prepared crane bases," explains Mr Marsh. "In this way we caused minimal damage to the forest floor and avoided damaging trees."

The erection followed a routine sequence once the first walkway section and its columns had been installed.

The first columns had to be propped until the walkway section had been bolted into place. From here on each span and its supporting columns were erected sequentially, with the previous span offering temporary support during the installation.

Along the walkways length there are two notable features, a viewing platform and a crow's nest that wraps around a tree.

The viewing platform's original design envisaged it also wrapping around a large tree, but unfortunately the tree died and had to be removed.

"The platform's design was consequently refined to be formed from one large deck section measuring 3.5m in diameter. Because it is connected to the walkway by a rope bridge it is structurally independent and supported by six columns."

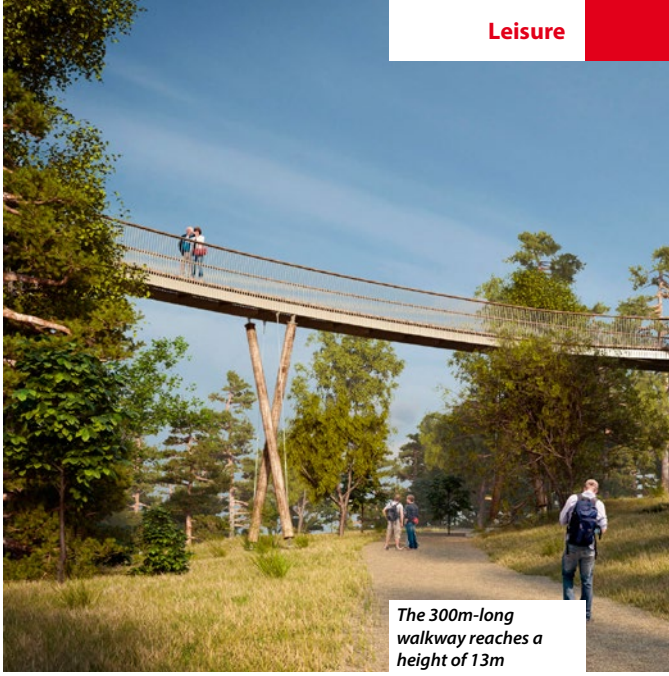
The platform is one of many educational zones spread along the walkway's length where visitors will be presented with representations on how trees live and grow.

One wrap-around feature does remain and this is known as the crow's nest (main picture). Connected to the walkway by a staircase, the crow's nest wraps around one of the Arboretum's Black Pine trees.

Two circular sections, each weighing 2.5t, were bolted together insitu. A steel spine beam carrying the steps from the main walkway holds the cantilevering platform in place, while two propped columns also support it.

"This feature will be dynamically exciting as it will move slightly, giving visitors a 'treetops feeling'," sums up Mr Darcy.

The Stihl Treetop Walkway will open to the public this month (April).



The 300m-long walkway reaches a height of 13m

Smaller columns are positioned to support ramps at either end of the walkway

The erection process had to avoid damaging trees

The walkway winds through the forest

FACT FILE
Silsoe Church of England Lower School, Bedford
Main client: Central Bedfordshire Council
Architect: David Turnock Architects
Main contractor: Ashe Construction
Structural engineer: Peter Dann
Steelwork contractor: SDM Fabrication
Steel tonnage: 118t

Project puts faith in steel

An intricate steel-framed school is rapidly taking shape on land formerly occupied by Cranfield University's agricultural campus in Bedfordshire.

The design brief for the new Silsoe Church of England Lower School required a building that showed clear reference to its faith base, was an inspiring place to learn and once complete it had to be a prominent part of a new housing development.

The school's atrium takes shape

The school's layout also needed to provide a compact building plan to keep construction costs to a minimum, while a fabric first approach to the building design led to energy-efficiencies in all aspects of the design.

In order to tick all of these boxes, a structural solution based on the use of a steel frame with lightweight steel infill panels was the chosen method of construction.

"We've designed a number of schools and they always have a steel frame for ease and speed of construction," says David Turnock Architects' Leon Delegate.

"The extensive use of insulation also helps to keep the U-values as low as possible," adds Central Bedfordshire Council Principal Project Manager Helen Konstantinidi.

This led to a building design incorporating single and two-storey elements, generating an interesting interplay of volumes at the north eastern corner of the site, with the major elevation to the main estate road.

Separating these two elements is a 50m-long central atrium that runs down the spine of the school, allowing access from the main entrance to most areas of the school.

From a width of 12m at the main entrance the atrium narrows wedge-like down its entire length. It also slopes from a double-height space at the entrance to a single storey space at the opposite end.

"Designing the atrium was one of the project's main challenges due to its complex geometry," explains Peter Dann Senior Engineer Alan Lloyd.

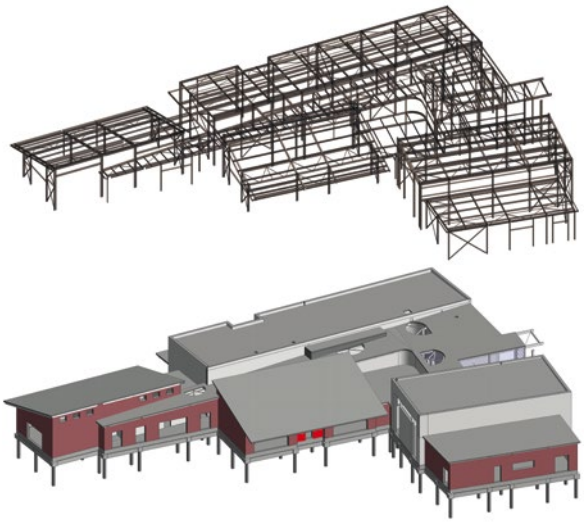
"The atrium is extremely important to the whole building as it is not only forms the main circulation route, but it also provides break-out spaces and informal teaching areas beneath a series of steel trees, that not only support the roof but are also highly architectural." [See box].

The steel trees symbolise an outdoor park landscape and form an integral element of the school's faith-based design as Mr Delegate adds: "Near the entrance there will be a cross, and from here the trees will lead pupils into the school, with each year group having their own bespoke tree."

The school's classes are grouped in pairs either side of the circulation/atrium space. The majority of the steel-framed structure features bracing for stability, with most of

The school is a mixture of one- and two-storey elements

A steel solution was chosen for cost-effectiveness and ease of construction



it hidden in partition walls and external elevations.

"The only exception is the two-storey elevation which has been designed as a sway frame, because cross bracing wasn't an option here as it would have interfered with the windows," says Mr Lloyd.

Attached to the single storey part of the school is a 10.5m-wide column-free hall. A sliding partition, positioned two-thirds along its length, allows this large space to be divided in two. Adjacent to the hall is a steel-framed lean-to accommodating plant rooms.

Reinforcing the school's importance and creating a community focal point, a variety of cladding materials will be used including brickwork, render and timber cladding.

Silsoe Lower School is scheduled to open its doors to students in September.

Steel trees support lights

SDM Director Richard Melton says: "As far as the steel construction was concerned, the biggest challenge was the complex fabrication of the five steel trees as each one is bespoke and required a lot of intricate design work."

Manufactured from CHS sections, each tree is formed from a main tubular trunk and three smaller tubular branches.

The branches have been designed aesthetically to not only provide the structural support for the atrium's roof lights, but also to give the atrium the feel of a woodland walk. The circular roof lights placed at the top of the "trees" allow light to flood down into the space below.

As the atrium slopes from a double-height space down to a single storey high zone, so correspondingly each tree has a different height with the tallest standing at 6.85m.

The trees were manufactured and assembled at SDM's facility and delivered to site complete with the three structural branches already welded in place.

The design of tee sections in bending

Although tees might not be an ideal choice to resist bending, sometimes they are selected for their architectural merit. To assist when tees must be used, David Brown of the SCI describes the design approach to BS 5950-1 and to BS EN 1993-1-1.

If members are subject to bending, structural engineers will probably recommend beams with flanges, or hollow sections. Tees used to resist bending are unlikely to appear as a preferred solution, but if they *must* be used, they must be verified to the design Standard. This article looks at the verification of a Tee used as a cantilever, perhaps as the exposed steelwork supporting a canopy. Especially with Tees cut from universal beams, the long narrow web means that the section is Class 4. The focus of this article is lateral-torsional buckling, assuming that cross-sectional checks have been completed. Numerical examples are presented, considering Class 3 and Class 4 sections.

Structural model

In the scenario considered, the cantilever Tee section is fixed to a supporting steel column, by a bolted connection. Although the connection is considered continuous, and thick plates, large welds and large bolts have been utilised in the connection, the thoughtful engineer will observe that there is still some (unquantified) flexibility – the connection is not truly "built in". The cantilever Tee has lateral restraint at the tip – perhaps by some member attached to the tip of several cantilevers and braced back at some point to the support. The lateral restraint has a pinned connection to the Tee, so provides no torsional benefit. In this example, the applied loads are considered to be a UDL, even if in practice they may be applied via point loads from members acting as purlins. The stem of the tee is in compression and the loads are assumed to be applied on the top surface of the flange. In the first two examples, the loads are considered to be destabilising – that is they can move with the member as it buckles. The general arrangement is shown in Figure 1.

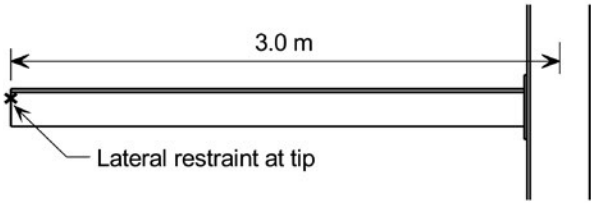


Figure 1: General arrangement of cantilever tee

Design to BS 5950

BS 5950 provides comprehensive coverage for the design of Tees, with Section B.2.8 providing rules for the lateral-torsional buckling resistance. Helpfully, some of the more involved terms have been calculated and presented in the "Blue Book".

The first challenge is the slenderness and designers must refer to Table 14. Some engineering judgement is required in our example. The tip is laterally restrained, but the support is not encastré. Row 'c' of Table 14 has therefore been selected, which means that with destabilising loads, $L_E = 2.5L$.

Example 1a – BS 5950

In this example, the selected section has been chosen to be Class 3, simply to avoid the complications of Class 4. In practice, it seems unlikely that such a heavy section might be chosen.

The selected section is 191 × 229 × 81 in S355 steel and 3 m long. The flange is 32 mm thick, so the design strength is 345 N/mm².

Considering the classification limits of Table 11, the limiting D/t ratio for the stem of a Tee is 18ε. If the design strength is 345 N/mm², then ε = 0.893 and the limiting ratio is 16.07. The actual d/t ratio (note the difference in nomenclature) is 13.7, so the stem is Class 3.

The limiting ratio for the flange is 13.38, and the actual is 3.12, so the section is Class 3.

Following the guidance in B.2.8, the calculated values are as follows:

$\gamma = 0.587$

$u = 0.573$

$x = 8.3$

$w = 0.0134$

$\psi = -0.699$ (note that this value is given in section property tables as the monosymmetry index, but should be taken as negative when the flange of the Tee section is in tension.)

$\lambda = 7500/45.5 = 165$

$v = 0.512$

$\beta_w = 281/507 = 0.554$ (note that Z_{xx} is taken as the modulus for the stem)

Therefore, $\lambda_{LT} = uv\lambda\sqrt{\beta_w} = 0.573 \times 0.512 \times 165 \times 0.744 = 36$

The bending strength p_b is determined from Table 16 as 331 N/mm² and the LTB resistance as $M_b = 331 \times 281 \times 10^{-3}$ = 93 kNm

Note that B.2.8.2 specifies that the equivalent uniform moment factor m_{LT} should be taken as 1.0.

Example 1b – BS EN 1993-1-1

The determination of lateral-torsional buckling commences with the calculation of M_{cr}. Fortunately, the software *LTBeamN* allows designers to consider a wide variety of cross-sections, loading scenarios and restraint conditions, making the calculation of M_{cr} straightforward – assuming some familiarity with the software. The following screenshots illustrate the main settings for this example.

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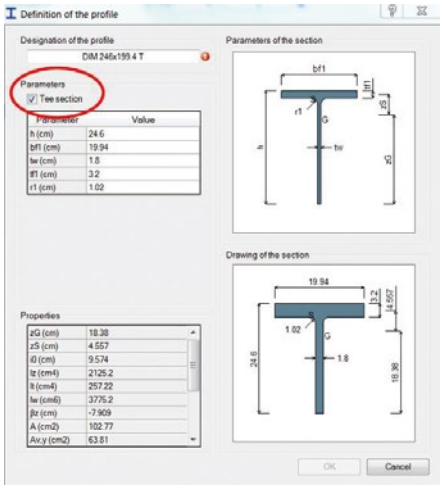
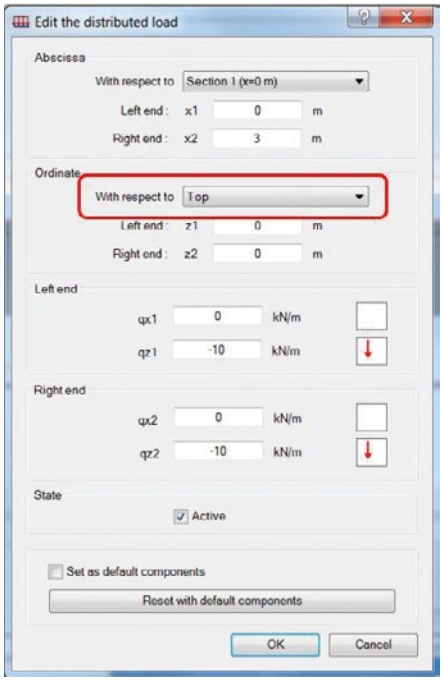
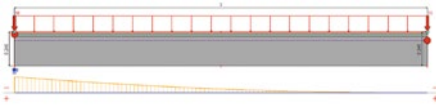
A cross-section must be defined at both ends of the member. Selecting the mono-symmetric option and choosing to "add" a definition, allows the option of a "Tee section" to be checked, and data entered. Helpfully, section properties are then calculated – which may be compared with the Blue Book values if required to confirm correct data entry.



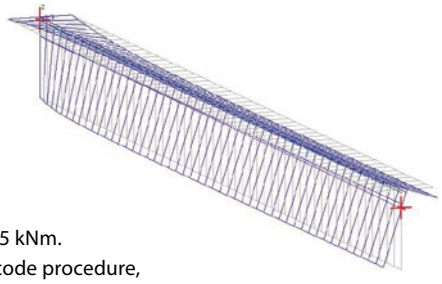
Loading can be applied at any point, but in this example, the load has been applied at the top of the section. This is a destabilising load, as it is above the shear centre.



The support has been fixed at the left hand end (as drawn), and a lateral restraint introduced at the tip.



LTBeamN can then calculate M_{cr}, and present a 3-D view of the buckled shape.



In this example, $M_{cr} = 1085$ kNm.

Following the usual Eurocode procedure,

$$\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}} = \sqrt{\frac{281 \times 10^3 \times 345}{1085 \times 10^6}} = 0.299$$

Only the "General case" of 6.3.2.2 may be used, so from Table 6.4, curve 'd' is selected, which means in Table 6.3, $\alpha_{LT} = 0.76$.

Completing the maths, $\chi_{LT} = 0.924$

Therefore, $M_b = 0.924 \times 281 \times 10^3 \times 345 \times 10^{-6} = 89.6$ kNm – which compares well with the value of 93 kNm according to BS 5950.

Example 2a – BS 5950

In this example, the chosen section is 191 × 229 × 45 in S355 steel and 3 m long. The flange is 17.7 mm thick, so the design strength is 345 N/mm².

The *d/t* ratio for this section is 22.1, so the stem is Class 4. Advisory Desk note AD 311[i] gives advice for Class 4 sections, recommending the calculation of a reduced design strength – effectively making the section Class 3.

$$\text{The reduced design strength} = 345 \times \left(\frac{18 \times 0.893}{22.1}\right)^2 = 182.5 \text{ N/mm}^2$$

Following the same process as outlined in example 1a:

$\gamma = 0.612$

$u = 0.576$

$x = 14.1$

$w = 0.00486$
$\psi = -0.706$
$\lambda = 7500/42.9 = 175$
$v = 0.682$
$\beta_w = 152/269 = 0.565$

Therefore, $\lambda_{LT} = uv\lambda\sqrt{\beta_w} = 0.576 \times 0.682 \times 175 \times 0.752 = 51.7$

The bending strength p_b is determined by calculation from Annex B.2.1 as 169 N/mm² and the LTB resistance as $M_b = 169 \times 152 \times 10^{-3} = 25.7$ kNm

Example 2b – BS EN 1993-1-1

Introducing the revised cross section into *LTBeamN*, yields $M_{cr} = 231$ kNm

According to Table 5.2 of BS EN 1993-1-1, the limiting outstand for elements in compression is 14ε for a Class 3 section, where ε = 0.825. Thus the limiting length of web in compression is 14 × 0.825 × 10.5 = 121 mm from the neutral axis, making an overall depth of 175.7mm. The effective cross section is shown in Figure 2.

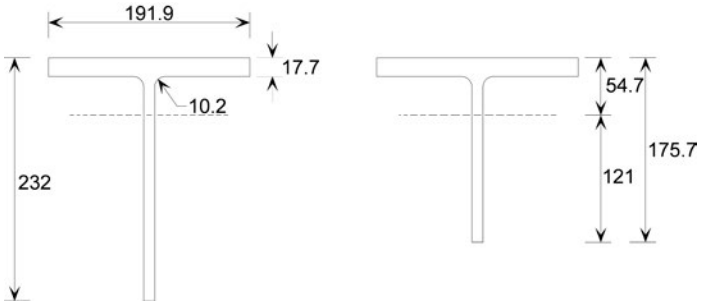


Figure 2: Gross and effective cross sections

The modulus of this reduced cross section can be determined by hand, or *LTBeamN* can be used to calculate the properties of the revised section. Simply reducing the overall depth of the section to 175.7 mm in *LTBeamN* gives the revised elastic modulus as 88.0×10^3 mm³.

Proceeding in the usual way, $\bar{\lambda}_{LT} = \sqrt{\frac{W_y f_y}{M_{cr}}} = \sqrt{\frac{88.0 \times 10^3 \times 345}{231 \times 10^6}} = 0.363$

Completing the maths, $\chi_{LT} = 0.877$

Therefore, $M_b = 0.877 \times 88.0 \times 10^3 \times 345 \times 10^{-6} = 26.6$ kNm – which compares with the value of 25.7 kNm according to BS 5950.

Example 3a – BS 5950

Example 3 is the same as example 2, but the loads are not destabilising. From Table 14, $L_E = 0.9L$.

Following the same process as outlined in example 2a:
γ, *u*, *x*, *w*, ψ, β_w all as example 2a
$\lambda = 2700/42.9 = 62.9$
$v = 1.392$

Therefore, $\lambda_{LT} = uv\lambda\sqrt{\beta_w} = 0.576 \times 1.392 \times 62.9 \times 0.752 = 37.9$

At this short slenderness, there is no reduction for lateral-torsional buckling, so the bending strength is the reduced design strength, 182.5 N/mm².

The LTB resistance is therefore $M_b = 182.5 \times 152 \times 10^{-3} = 27.7$ kNm

Example 3b = BS EN 1993-1-1

With the loads applied at the shear centre, *LTBeamN* gives $M_{cr} = 235$ kNm, which leads to $M_b = 26.7$ kNm

Observations

The contrast between examples 2 and 3 is possibly the most surprising, as the huge difference in the effective length does not result in a significant difference in the resistance. Although the effective length varies in the BS 5950 approach, the influence of the factor *v* means that the slenderness for lateral-torsional buckling does not change so significantly. Within the Eurocode approach, the difference between the two examples is simply the location of the applied loads, which only varies by 9 mm. The loads are only slightly destabilising, so the limited change in lateral-torsional buckling resistance is to be expected.

Conclusions

As expected, both design Standards give a reasonably consistent result. With access to appropriate software, some designers may find the Eurocode approach more straightforward, though specifying the correct supports, restraints and loading is essential.

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i AD 311: T-sections in bending – stem in compression
Available from *http://www.steelbiz.org/*

New and revised codes & standards

From BSI Updates March 2016

BS EN PUBLICATIONS

BS ISO 17577:2016
Steel. Ultrasonic testing of steel flat products of thickness equal to or greater than 6mm
Supersedes BS ISO 17577:2006

BRITISH STANDARDS REVIEWED AND CONFIRMED

BS EN 10055:1996
Hot rolled steel equal flange tees with radisused root and toes. Dimensions and tolerances on shape and dimensions

BRITISH STANDARDS UNDER REVIEW

BS EN ISO 3497:2001
Metallic coatings. Measurement of coating thickness. X-ray spectrometric methods

BS EN ISO 4014:2011
Hexagon head bolts. Product grades A and B

BE EN ISO 4016:2011
Hexagon head bolts. Product grade C

BS EN ISO 4018:2011
Hexagon head screws. Product grade C

BS EN ISO 14372:2011
Welding consumables. Determination of moisture resistance of manual metal arc welding electrodes by measurement

BS ISO 5952:2011
Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion

BS ISO 9587:2007
Metallic and other inorganic coatings. Pretreatment of iron or steel to reduce the risk of hydrogen embrittlement

BS ISO 9588:2007
Metallic and other inorganic coatings. Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement

BS ISO 10587:2000
Metallic and other inorganic coatings. Test for residual embrittlement in both metallic-coated and uncoated externally-threaded articles and rods. Inclined wedge method

NEW WORK STARTED

ISO 15653:2010/A1
(Edition 3)
Metallic materials. Method of test for the determination of quasistatic fracture toughness of welds

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

16/30314754 DC
BS EN ISO 10027-1 Designation systems for steels. Part 1. Steel names
Comments for the above document are required by 30 April 2016

16/20323232 DC
BS EN ISO 3580 Welding consumables. Covered electrodes for manual metal arc welding of creep-resisting steels. Classification
Comments for the above document were required by 21 March 2016

16/30323238 DC
BS EN ISO 17633 Welding consumables. Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels. Classification
Comments for the above document were required by 21 March 2016

AD 395: Nominally pinned connections and axial forces

SCI is aware of a number of problems arising when the designers of structural frames have assumed "nominally pinned" connections in the frame design, but also require the connections to carry significant axial forces. This AD note offers advice with the aim of avoiding costly disagreements between the frame designer and the connection designer.

The difficulty arises when shear and axial forces (usually in combination) are to be resisted by the connection which has been assumed in the frame design to be "nominally pinned". It should be emphasised that the axial forces are not tying forces (which would not be considered in combination with the shear forces) - they are "real" axial forces. Such axial forces may arise when floors are not assumed to act as diaphragms, or when beams must carry forces around voids, or for other reasons.

The frame designer is likely to design the columns as "columns in simple construction", with nominal moments (only) due to the assumed eccentricity of the beam shear force. Special provisions are made in BS 5950-1:2000 (clause 4.7.7) and for BS EN 1993-1-1:2005 in NCCI (SN005 and SN048, www.steelbiz.org) for this common approach to column design.

If significant axial forces must be carried through the connection, it is highly likely that the relatively thin end plates (or fin plates) used in the standard nominally pinned connections will have to be increased in thickness. Plates may need extending, or other measures taken, but it is very likely that the principles governing the detailing of flexible connections cannot be maintained. A second, more easily addressed problem, is that the Green Books (SCI P212 and P358) do not cover the situation when connections are subject to shear and axial forces. The checks for tying resistance are (a) completed in isolation, without shear force and (b) assume irreversible deformation in the connection components, so cannot be used directly to consider "real" axial force in combination with shear force.

SCI has two recommendations in these circumstances, with the primary responsibility lying with the designer of the frame:

Firstly, the frame designer must recognise that if the connections must transfer shear and significant axial force, they may not be nominally pinned. This will have an impact on the design of the columns.

Secondly, if connection designers are asked to design nominally pinned connections subject to shear and significant axial force, they should advise the frame designer of the connection detail, pointing out that this may invalidate the assumptions made. This second recommendation is made to try and resolve potential problems before they become a significant issue.

Contact: **Abdul Malik**
Tel: **01344636525**
Email: **advisory@steel-sci.com**

BUILDINGWITHSTEEL

A restaurant in Hyde Park

A new modern restaurant has been built in Hyde Park on the banks of the Serpentine. It opened in July last year (1965) in The Dell, one of the prettiest parts of the park.

Built at a cost of £120,000, it is both striking and original in design. It is octagonal, a shape employed to avoid the need for curved surfaces, and the use of a regular segmental layout has produced a continuous window line. The result is a building with the advantages of a circular form, but achieved with the use of straight lines; it is 100 ft. across.

The structural design comprises two main elements, (1) an octagonal core supported on piles and (2) an umbrella of steel beams cantilevering from this core to the edge of the roof and carried at the window line by extremely slender tubular steel columns. Roof finish, insulation and the ceiling are carried on or suspended from the steelwork and the glass of the window fills the whole space between the columns. The inverse-arch form of each segment has made possible the use of a light structure: the curved shape is nearly that of the natural 'sag' of a roof slung between the main beam lines.

At the centre, the walls are taken up to carry and enclose an upper floor providing tank space and an office and terminating in a dome constructed of light timber trusses covered with copper roofing.

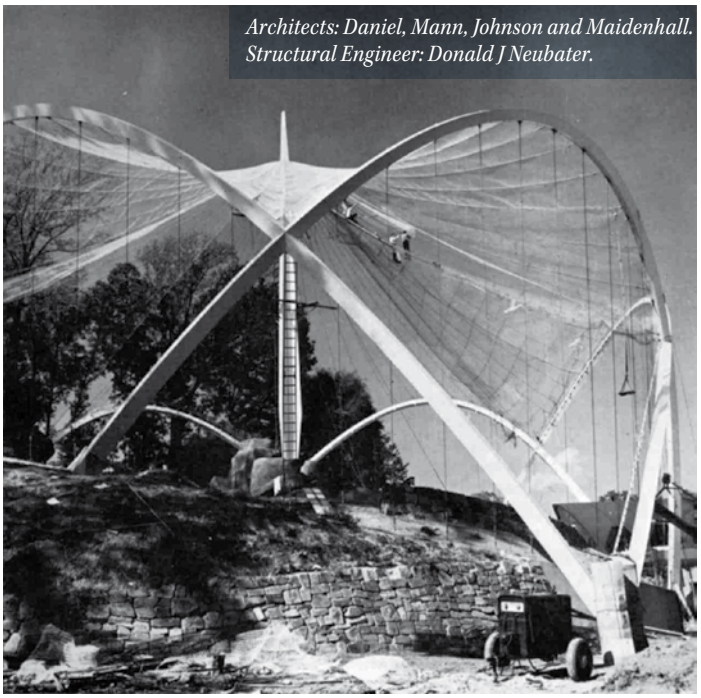
Both the enclosed and the outdoor terrace areas are covered by the large umbrella-like roof, the under-surface of which consists of shaped fibrous plaster panels separated from each other by a gap which creates a bold ceiling panel and provides a slot through which the curved window head glass is taken out of sight. This glass stretches from column to column on a staggered plan around the entire building.

The restaurant includes a cafeteria, an automat and a licensed buffet; it will seat 114 people inside and a further 136 outside on the terrace.

The architect was Patrick Gwynne and the Consulting Engineers were Jenkins and Potter.

From BUILDING WITH STEEL, Vol 4 No. 1, Winter 1966

Strictly for the birds



Architects: Daniel, Mann, Johnson and Maidenhall. Structural Engineer: Donald J Neubater.

An aviary in the United States has been created using structural steel members.

The Great Flight Cage at the National Zoo, Washington D.C. is 130 ft. diameter and 90 ft. high and dominated by six parabolic arches tilting outwards at 30°. It is built on the side of a hill and the need to keep the top of the arches on a level plane posed something of a problem for the designers. The arches are welded box sections tapering from 12 in. by 24 in. at the bottom to 12 in. by 16½ in. at top.

The central mast is a tapering Y-section fabrication tapering from its heaviest point about 18 ft. above ground. From a conical steel anchor ring near the top of the mast 72 half inch diameter wire rope cables radiate to the rims of the arches from where cables of similar dimensions extend downwards to anchorages around the periphery of the cage. In all, two miles of rope are used. Draped over the structure and clipped to the cables is a vinyl-coated steel mesh.

Although of such slender proportions the structure is extremely strong and stable, and capable of withstanding the worst weather conditions, particularly heavy wind loadings and ice build-up. The mesh, for instance, has been tested to a wind loading of 100 mph. The strength of the structure is due largely to the employment of 50,000 psi minimum yield corrosion resistant steel for the mast and arches, coupled with the design of the sections.

Corrosion has been eliminated by the corrosion resistant properties of the steel used in the main members, and the plastic coating on the steel mesh.

The size of the cage provides plenty of space for the birds to stretch their wings and the internal landscape has been planned to simulate natural conditions. To reduce the discomforts of wet and cold weather there are shelters and electrically heated perches are provided. Visitors can walk through and see the birds at close quarters.

Steelwork contractors for buildings

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

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

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

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

- **FPC** Factory Production Control certification to BS EN 1090-1
  - **1** – Execution Class 1
  - **2** – Execution Class 2
  - **3** – Execution Class 3
  - **4** – Execution Class 4
- **QM** Quality management certification to ISO 9001
- **SCM** Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)
A & J Stead Ltd	01653 693742			●	●					●	●			●	●		2		Up to £200,000
A C Bacon Engineering Ltd	01953 850611			●	●		●										2		Up to £3,000,000
A&J Fabtech Ltd	01924 439614	●			●		●				●		●			✔	3		Up to £400,000
Access Design & Engineering	01642 245151					●			●	●	●			●	●	✔	2		Up to £4,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●	✔	3	●	Up to £2,000,000
Adstone Construction Ltd	01905 794561			●	●	●	●									✔	2	●	Up to £3,000,000
Advanced Fabrications Poyle Ltd	01753 653617				●	●	●	●	●	●	●				●	✔	2		Up to £800,000
AJ Engineering & Construction Services Ltd	01309 671919			●	●					●	●			●	●	✔	4		Up to £1,400,000
AKD Contracts Ltd	01322 312203				●					●	●			●	●		2		Up to £100,000
Angle Ring Company Ltd	0121 557 7241												●			✔	4		Up to £1,400,000
Apex Steel Structures Ltd	01268 660828			●	●	●	●			●	●			●			2		Up to £1,400,000
Arminhall Engineering Ltd	01799 524510	●			●	●		●		●	●			●	●	✔	2		Up to £400,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●		●	●		2		Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●	✔	4		Up to £800,000
ASME Engineering Ltd	020 8966 7150				●	●				●	●			●	●	✔	3	●	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			●	●	●	●			●	●				●		2		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✔	4		Up to £4,000,000
Builders Beams Ltd	01227 863770			●	●	●	●	●		●				●	●	✔	2		Up to £1,400,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●				●	●	✔	4	●	Up to £3,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●		●	●	●		●	●	✔	4	●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●		✔	4	●	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●			●	●	✔	4		Up to £6,000,000
Cook Fabrications Ltd	01303 893011				●					●	●			●	●		2		Up to £1,400,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●	✔	2		Up to £800,000
D H Structures Ltd	01785 246269			●	●		●				●						2		Up to £100,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●	●		●	●			●	✔	4		Up to £4,000,000
ECS Engineering Services Ltd	01773 860001	●			●	●	●	●	●	●	●			●	●	✔	3		Up to £3,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✔	4	●	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✔	3	●	Up to £3,000,000
Four Bay Structures Ltd	01603 758141			●	●					●	●			●	●		2		Up to £1,400,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●				●		2		Up to £2,000,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●	●	✔	2		Up to £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
Had Fab Ltd	01875 611711				●				●	●	●				●	✔	4		Up to £3,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✔	4	●	Up to £2,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**FPC**	**SCM**	**Guide Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●			●	✔	2		Up to £1,400,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●	✔	2		Up to £3,000,000
Intersteels Ltd	01322 337766				●	●	●	●					●			✔	3		Up to £2,000,000
J & A Plant Ltd	01942 713511				●	●									●		2		Up to £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 £3,000,000
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 £800,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		3		Up to £1,400,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✔	4		Up to £800,000
Maldon Marine Ltd	01621 859000				●	●		●	●	●					●	✔	3		Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						2		Up to £3,000,000
Murphy International Ltd	00 353 45 431384	●			●		●				●				●	✔	4		Up to £1,400,000
Newbridge Engineering Ltd	01429 866722	●		●	●	●	●				●				●	✔	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
R S Engineering SW Ltd	01579 383131				●					●	●			●	●	✔	2		Up to £100,000
Rippin Ltd	01383 518610			●	●	●	●	●						●	●		2		Up to £1,400,000
S H Structures Ltd	01977 681931	●					●	●	●	●	●	●				✔	4	●	Up to £2,000,000
SDM Fabrication Ltd	01354 660895	●	●	●	●	●	●				●			●	●	✔	4		Up to £1,400,000
Sean Brady Construction Engineering Ltd	00 353 49 436 4144			●	●	●	●			●	●			●	●		2		Up to £800,000
Severfield plc	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
Shaun Hodgson Engineering Ltd	01553 766499	●		●	●					●	●			●	●	✔	3		Up to £800,000
Shipley Structures Ltd	01400 251480			●	●	●	●		●	●	●			●	●		2		Up to £1,400,000
Snashall Steel Fabrications 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			●	●	●	●	●	●		●			●	●	✔	2	●	Up to £2,000,000
TSI Structures Ltd	01603 720031			●	●	●	●	●			●			●			2		Up to £1,400,000
Tubecon	01226 345261						●	●	●	●				●	●	✔	4	●	Above £6,000,000*
Underhill Engineering & Building Services Ltd	01752 752483				●		●	●	●	●	●			●	●	✔	4		Up to £3,000,000
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		4		Up to £2,000,000
W I G Engineering Ltd	01869 320515				●					●					●	✔	2		Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✔	4		Up to £6,000,000
Westbury Park Engineering Ltd	01373 825500	●		●	●		●	●	●	●	●				●	✔	4		Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●			●		✔	4	●	Up to £4,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✔	4	●	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	FPC	SCM	Guide Contract Value (1)

Corporate Members

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

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

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

Industry Members

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

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

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
AJN Steelstock Ltd	01638 555500								●		M	
Albion Sections Ltd	0121 553 1877	●									M	
Arcelor Mittal Distribution - Scunthorpe	01724 810810								●		D/I	
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	
BW Industries Ltd	01262 400088	●									M	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
Cellbeam Ltd	01937 840600	●									M	
Cellshield Ltd	01937 840600							●			N/A	
Cleveland Steel & Tubes Ltd	01845 577789								●		M	
CMC (UK) Ltd	029 2089 5260								●		D/I	
Composite Profiles UK Ltd	01202 659237	●									D/I	
Cooper & Turner Ltd	0114 256 0057									●	M	
Cutmaster Machines (UK) Ltd	01226 707865					●					N/A	
Daver Steels Ltd	0114 261 1999	●									M	
Dent Steel Services (Yorkshire) Ltd	01274 607070								●		M	

Steelwork contractors for bridgeworks

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

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

FG Footbridge and sign gantries
PG Bridges made principally from plate girders
TW Bridges made principally from trusswork
BA Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
CM Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
MB Moving bridges
RF Bridge refurbishment

AS Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
QM Quality management certification to ISO 9001
FPC Factory Production Control certification to BS EN 1090-1
1 – Execution Class 1 2 – Execution Class 2
3 – Execution Class 3 4 – Execution Class 4
SCM Steel Construction Sustainability Charter
(● = Gold, ● = Silver, ● = Member)

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

BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	FPC	NHSS 19A	NHSS 20	SCM	Guide Contract Value (1)
A&J Fabtech Ltd	01924 439614	●	●		●				●	✓	3				Up to £400,000
Bourne Construction Engineering Ltd	01202 746666	●	●	●				●	●	✓	4			●	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	4		✓		Up to £4,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	4		✓	●	Up to £3,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	✓	4	✓	✓	●	Above £6,000,000*
Donyal Engineering Ltd	01207 270909	●						●	●	✓	3		✓	●	Up to £1,400,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	3		✓	●	Up to £2,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●		●				●	●	✓	4		✓	●	Up to £3,000,000
Millar Callaghan Engineering Services Ltd	01294 217711	●						●	●	✓	4				Up to £800,000
Murphy International Ltd	00 353 45 431384	●	●	●					●	✓	4				Up to £1,400,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	4	✓	✓		Up to £4,000,000
S H Structures Ltd	01977 681931	●		●	●	●	●		●	✓	4		✓	●	Up to £2,000,000
Severfield (UK) Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	4		✓	●	Above £6,000,000
Taziker Industrial Ltd	01204 468080	●						●	●	✓	3	✓	✓		Above £6,000,000
Underhill Building & Engineering Services Ltd	01752 752483	●	●	●	●			●	●	✓	4				Up to £3,000,000
Non-BCSA member															
AIC Steel Ltd	01633 528400	●	●	●					●	✓	4	✓	✓		Up to £800,000*
Allerton Steel Ltd	01609 774471	●	●	●	●				●	✓	4		✓		Up to £4,000,000
Centregreat Engineering Ltd	029 2046 5683	●	●	●	●		●	●	●	✓	4				Up to £800,000
Cimolai SpA	01223 836299	●	●	●	●	●	●	●	●	✓	4				Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●	●	●	●		●	✓	4			●	Up to £800,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	2		✓	●	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	3				Up to £2,000,000
HS Carlsteel Engineering Ltd	020 8312 1879	●	●					●	●	✓	3		✓		Up to £400,000
IHC Engineering (UK) Ltd	01773 861734	●							●	✓	3		✓		Up to £400,000
Interserve Construction Ltd	020 8311 5500							●	●	✓	N/A				Above £6,000,000*
Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	4	✓		●	Up to £2,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	N/A				Up to £3,000,000
Total Steelwork & Fabrication Ltd	01925 234320	●						●	●	✓	3		✓		Up to £3,000,000
Victor Buyck Steel Construction	00 32 9 376 2211	●	●	●	●	●	●	●	●	✓	4				Above £6,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
Duggan Profiles & Steel Service Centre Ltd	00 353 56 7722485	●							●		M	
easi-edge Ltd	01777 870901							●			N/A	●
Fabsec Ltd	01937 840641	●									N/A	
Ficep (UK) Ltd	01942 223530					●					N/A	
FLI Structures	01452 722200	●									M	●
Forward Protective Coatings Ltd	01623 748323						●				N/A	
Goodwin Steel Castings Ltd	01782 220000	●									N/A	
Graitec UK Ltd	0844 543 8888		●								N/A	
Hadley Group Ltd	0121 555 1342	●									M	○
Hempel UK Ltd	01633 874024						●				N/A	
Highland Metals Ltd	01343 548855						●				N/A	
Hilti (GB) Ltd	0800 886100								●		M	
Hi-Span Ltd	01953 603081	●									M	○
International Paint Ltd	0191 469 6111						●				N/A	●
Jack Tighe Ltd	01302 880360						●				N/A	
Jamestown Cladding & Profiling Ltd	00 353 45 434288	●									M	
John Parker & Sons Ltd	01227 783200								●	●	D/I	
Joseph Ash Galvanizing	01246 854650						●				N/A	
Jotun Paints (Europe) Ltd	01724 400000						●				N/A	
Kaltenbach Ltd	01234 213201					●					N/A	
Kingspan Structural Products	01944 712000	●									M	●
Kloeckner Metals UK	0113 254 0711								●		D/I	
Lindapter International	01274 521444									●	M	

Company name	Tel	1	2	3	4	5	6	7	8	9	CE	SCM
Longs Steel UK Ltd	01724 404040				●						M	
MSW UK Ltd	0115 946 2316	●									D/I	
Murray Plate Group Ltd	0161 866 0266								●		D/I	
National Tube Stockholders Ltd	01845 577440								●		D/I	
Peddinghaus Corporation UK Ltd	01952 200377					●					N/A	
PPG Performance Coatings UK Ltd	01773 814520						●				N/A	
Prodeck-Fixing Ltd	01278 780586	●									D/I	
Rainham Steel Co Ltd	01708 522311								●		D/I	
Sherwin-Williams Protective & Marine Coatings	01204 521771						●				M	○
Sika Ltd	01707 384444						●				M	
Simpson Strong-Tie	01827 255600									●	M	
Structural Metal Decks Ltd	01202 718898	●									M	●
StruMIS Ltd	01332 545800		●								N/A	
Tata Steel Distribution UK & Ireland	01902 484000								●		D/I	
Tata Steel Ireland Service Centre	028 9266 0747								●		D/I	
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		D/I	
Tata Steel Tubes	01536 402121				●						M	
Tata Steel UK Panels & Profiles	0845 3088330	●									M	
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	

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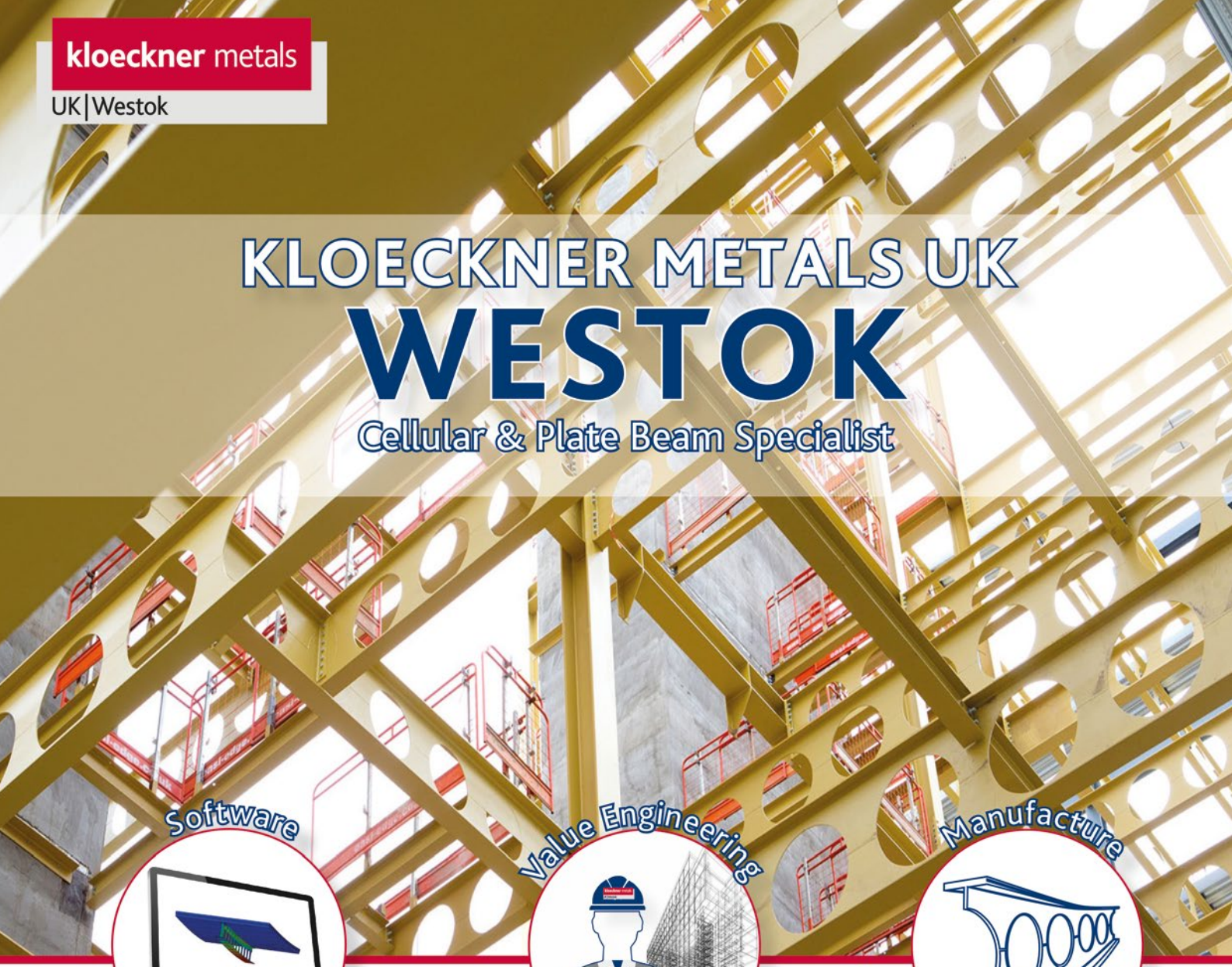

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