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NSC

NEW STEEL CONSTRUCTION

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Heathrow T4 extends
Olympic Gateway
Leisure centres on Tyne
Wrexham gets creative

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These and other steelwork articles can be downloaded from the New Steel Construction website at www.new-steel-construction.com

Cover Image
Heathrow Airport Terminal 4 redevelopment
Main Client: BAA
Architect: 3D Reid
Steelwork contractor: Watson Steel Structures
Steel tonnage: 700t

Project:
Brooktorkai, Hafencity,
Hamburg, Germany

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Steel stays safe as legislation is reviewed

Steel construction's reputation as an inherently safer way to build has been confirmed by the BCSA's news of a reduction in the Reportable Accident Frequency Rate of 60% over the past ten years (see News). One of the single biggest causes of serious injuries on construction sites is falls from height, which is repeatedly the target of Health and Safety Executive (HSE) and wider construction industry safety drives. It seems to defy efforts at eradication, but the steel construction sector managed it in 2009 when there were no such injuries reported.

That was a great performance but, as ever with safety, there is no room for complacency. There was a 30% reduction in construction industry-wide deaths in the six months to September 2009 to 18, plus three members of the public. Health and safety professionals took encouragement from the reduction – but any optimism that a corner had been turned was crushed when there were 13 deaths of construction workers in the months of October and November alone.

These fatalities underline the need to ensure that the efforts made across the sector that resulted in the achievement of the 60% reduction are at least maintained if steel construction is to stay safer. These efforts have included developing specific industrial good practice guides that promote use of netting and MEWPs for working at height. Others promote health and safety on site and in the workshop. There has been advice on risk assessments for work at height during loading and unloading, driver safety policy and tool box talks. A behavioural safety DVD has been produced and seminars and workshops held to promote good practices.

Close liaison is maintained with the HSE and other industry bodies, particularly on sharing information regarding accidents and injuries which has helped target efforts to reduce repeat injuries .

There is a growing focus on safety that is only going to increase over time. A raft of legislation in recent years has the aim of forcing the legal responsibility for safety lapses further up the corporate decision making ladder, and trade unions and others are calling for more.

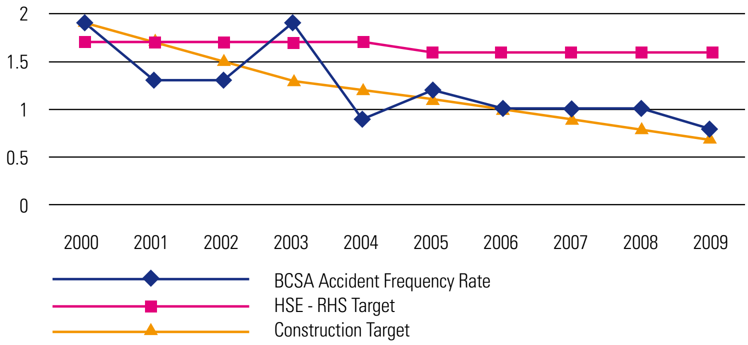
A substantial body of legislation already exists that should ensure safety is given the highest possible priority by directors and managers at all levels. The recent Donaghy Report into the underlying causes of fatal construction accidents called for, among other things, increasing the safety related duties of directors. This was not taken up by the government, but the prospects of increased responsibilities for senior managers and directors has not gone away.

An Independent Steering Group chaired by the HSE's Chief Scientist is currently reviewing safety legislation and the government was reported to be looking for ways to increase legal duties on directors when it was set up.

Safety conscious clients should find steel to be an even more attractive option in future as the legislative burden increases. The sector will be doing all it can to make sure that steel stays safe and is recognised as the safety first option.

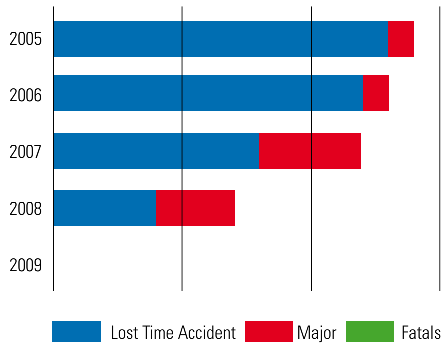
Nick Barrett - Editor

Steel construction accidents down by 60%



Left: Accident rates for BCSA members compared with the targets set by the HSE and the construction industry

Right: RIDDOR falls from height, 2005-2009



A dramatic reduction in reported accidents has been achieved by BCSA members over the last ten years, which is borne out by the latest published figures.

The Reportable Accident Frequency Rate for members has been reduced by 60% in the last ten years.

One of the key targets set by the Government and the Health & Safety Executive in 2000 was to reduce reportable accidents by 10% over a ten year period. The construction industry set a far more demanding target of 66% for the same period.

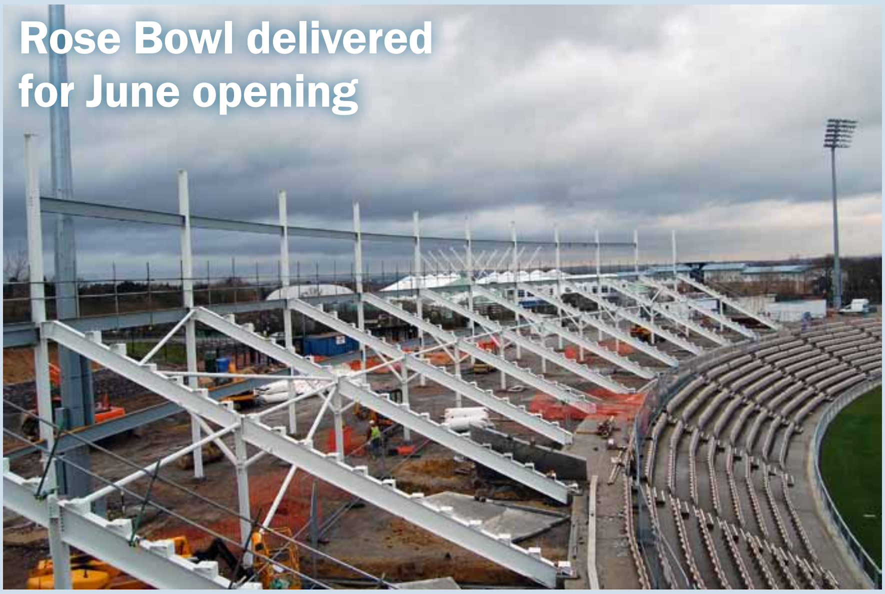
"BCSA members have achieved a 60% reduction in this period which is a very good result that demonstrates the industry is committed to improving working practices and procedures," said Pete Walker, BCSA Health, Safety & Training Manager.

"There has been a continuing reduction of injuries relating to falls from height, particularly in the last five years, and in 2009 no such injuries were recorded, which is a significant achievement for the constructional steelwork industry."

Prior to 2008 the injury category associated with falls from a height of below 2m did increase, however this trend has been reversed in the last two years.

Injuries from handling, lifting and moving had remained constantly high over a four year period. "However, in this category another significant improvement of 40% has been achieved," said Mr Walker.

Rose Bowl delivered for June opening



Steelwork has been completed on two new stands at Hampshire County Cricket Club's Rose Bowl stadium near Southampton.

Part of a £48M redevelopment, the scheme will transform the venue into a leading international cricket ground with an increased capacity of 25,000. The new stands will be officially opened for the floodlit England vs Australia One Day International on 22 June.

Constructed either side of the existing main pavilion, the stands will include catering facilities, a new club retail store, executive boxes and corporate lounges, as well as seating for debenture holders.

Main contractor for the project is Northern Ireland based McAteer & Rushe, and the steelwork programme was carried out by Rowecord Engineering.

Further plans are afoot at the venue, with work recently beginning on a 175-bed hotel.

Steel opens up historic London building

London's world famous Café Royal on Regent Street is being redeveloped into a five star luxury hotel, with structural steelwork playing an integral role in the work.

The project will require Billington Structures to install more than 1,200t of steelwork for building strengthening, as well as for replacing floors and tying new concrete cores back to the retained façades.

This will provide the building with a new interior to house 160 bedrooms, a spa, a restaurant and 1,486m^2 of retail space.

As the Café Royal is a Grade II listed building, much of the historic old structure is to be retained as part of the new build.

Mike Fewster, Chief Operations Officer at Billington Holdings said: "Billington remains focused on customer service and we are delighted to have won the contract for the redevelopment of the Café Royal. Our expertise in the sector is second to none, allowing us to be put forward for work, despite difficult market conditions."

Main contractor for the project is Mace, and the development is scheduled to be open in time for the 2012 London Olympics.

Innovation highlighted in SSDA shortlist

Corus and the BCSA have announced a 17 project shortlist for the 2010 Structural Steel Design Awards (SSDA), the 42nd year they have been held.

The projects shortlisted reflect the geographical spread of steel's appeal for jobs large and not-so-large, including single storey and multi storey buildings, bridges and other structures. The sectors of the construction market represented include transport, energy, education, leisure and industrial.

David Lazenby CBE, Chairman of the SSDA Judging Panel, said: "Structural steelwork demonstrates success yet again, as the material of choice. In these tough times the entries to the SSDA show great imagination, professionalism and service to the clients.

We are starting to see work related to the 2012 Olympics, but there are less of the "little gems" that we always hope to reward.

In challenging situations, the teams involved in these really exciting schemes have acted in concerted efforts to produce some outstanding results. 2010 has brought forward a great demonstration of the industry's strength and capabilities."

The winners of the awards will be announced at an evening reception at the Imperial War Museum, London, on 8 July.

The full shortlist is:

A40 Perryn Road Footbridge	Acton
Audi	Brentford
Cathedral Bridge	Derby
Courtyard Infill	London School of Hygiene & Tropical Medicine
Energy Recovery Plant	Corus Port Talbot
Forthside Pedestrian Bridge	Stirling
Helical Stair	500 Brook Drive, Green Park, Reading
Infinity Bridge	Stockton-on-Tees
Legacy Roof	London Aquatics Centre
M8 Harthill Footbridge Replacement	South Lanarkshire
Monkseaton Community High School	North Tyneside
North Liverpool Academy	Liverpool
Riverside Bridge	Cambridge
Riverside Museum	Glasgow
Terminal 2	Dublin Airport
The Rosebowl	Leeds Metropolitan University
Wind Turbine Enclosure, Strata	London SE1

Steel projects honoured at ACE awards

Steel related projects came out on top in a number of categories at the ACE Engineering Excellence Awards.

In the Building Structures (Large Firm) category the winner was Mott MacDonald for its work on Newcastle City Library, while Monkseaton Community High School was highly commended.

BAM Design was commended for its work on Clarion, 29 Wellington Street, Glasgow in the Building Structures (Small Firm) category.

In the Building Services (Large Firm) category, Waterman Group was highly commended for Watermark Place, London.

The awards recognise small, medium and large firms for excellence in building structures, infrastructure, and building services. There is also an award for the best, research, studies, and consulting project.

Clockwise from top left: Watermark Place, London; Clarion, Glasgow; Newcastle City Library; Monkseaton Community High School, North Tyneside.

Olympic Basketball Arena gets a lift

The 12,000 seat London 2012 Basketball Arena is taking shape with many of the 35m-high arched steel trusses lifted into place.

Once Watson Steel Structures has completed the 1,000t steel frame of the temporary 115m long Arena, it will be wrapped in 20,000m² of fabric to form a canvas for an innovative changing light design.

The temporary seating and accommodation around the venue will start to be installed this summer with the venue on track to be complete by mid-2011, ready for test events.

Olympic Delivery Authority (ODA) John Armitt said: "The Basketball Arena is taking shape in the new east London skyline alongside the Velodrome and Olympic Village. The innovative and efficient design and construction is testament to the excellence of the companies delivering the project."

Contractor Barr Construction will own the Arena structure, with the ODA renting it for the duration of the Games. Afterwards, the contractor will dismantle it to be reused elsewhere.

AROUND THE PRESS

Construction News
8 April 2010
Waste energy plant weathers big freeze
Bourne Steel has erected more than 2,000 tonnes of steel in the main structure, and a similar amount also being used to build internal supports and walkways.

Construction News
31 March 2010
Bristol BSF schools in a class of their own
With the site sloping from north to south down to the river a suspended steel bridge will bring pedestrians into the ground floor level of the new building which also features a lower ground, first and second floors.

The Structural Engineer
7 April 2010
Amendment to BS 5950-3.1
Composite beams are a very popular form of construction in buildings. The combination of the steel section and concrete slab provides an efficient section. In many cases the slab is also composite with a profiled metal deck providing permanent formwork and reinforcement.

New Civil Engineer
31 March 2010
Olympics Velodrome roof lifted into position
Measuring 5,000m^2 in size and using 16km of cabling, the roof is joined to the steel structure, which rises in height by 12m from the shallowest point to the highest part of the structure. This forms the distinctive double-curved shape that has been designed to reflect the geometry of the cycling track.

Building
1 April 2010
Paradise for petrol heads
Minimising the number of internal columns was essential to maximising flexibility but large spans mean deep roof trusses that weren't going to work in a height restricted building. The solution is a double arrangement of steel I beams for the columns and horizontal beams.

First Target Zero guidance now available

TARGET ZERO®

The first of five Target Zero guides, covering secondary schools, has been published and is now available at *www.targetzero.info*

The schools guidance provides invaluable information for designers, construction clients and their professional advisors on how to design and construct sustainable secondary schools.

The Target Zero school is based on a recently constructed building, Christ the King Centre for Learning secondary school in Knowsley, Merseyside. The building was 'stripped back' to basics so that all additional energy efficiency measures could be assessed for their benefit and cost above the 'base case' model.

Target Zero is a programme of work, funded by Corus and the BCSA, to provide guidance on the design and construction of sustainable, low and zero carbon buildings in the UK.

A further four non-domestic building types are being analysed, and these guides are due to be published later this year. Distribution warehouses will be published at the end of May, retail in July, medium-to-high-rise offices in September and finally mixed use buildings in November.

Technology park companies drive down electricity costs

Following a successful trial at the Corus Stocksbridge site, two companies based at the Advanced Manufacturing Park (AMP) in Rotherham are collaborating to provide industry with a system designed to cut costs and make lower carbon manufacturing processes a reality.

Sensdata and Drive Management Systems (DMS) are developing a monitoring system that enables the reduction of plant downtime, energy wastage and CO_2 emissions. The SensSlip System automatically monitors slippage in drive belts, which are widely used in manufacturing equipment.

In a trial at the Corus facility, the system revealed that thousands of pounds in energy costs could be saved.

Energy Services Engineer at Corus, Chris Spenceley said: "We have a number of heat treatment furnaces at the site with combustion air and fume extraction fans, which are powered by large motors. We therefore have lots of vee-belts.

"In critical areas we can't afford them to fail, and therefore we change the belts twice a year during planned shut downs."

In one sample period of monitoring a belt, over four days of continuous running, Sensdata confirmed the transmission drive was only running at times at 82% efficiency. This could equate to more than £9,000 of energy wastage. Accepted industry parameters are that vee-belts should provide peak efficiency of between 95-98% when first installed.

High performance machines debut at MACH 2010

FICEP UK will launch two new steel processing machines to the UK at the MACH 2010 show which is held at the NEC in Birmingham from 7-11 June.

With the launch of the Gemini 254 PG FICEP says it has created one of the world's most technologically advanced multi-function and flexible system for profile cutting, drilling, machining and scribing.

The compact machine can produce flat metal parts from plate, 5mm up 75mm thick in one set-up. FICEP says this process is more economical, combined with greater accuracy, than using separate cutting and labour intensive machining centres.

Also on show will be the 601 DE Excalibur 6 which FICEP says is the ideal machine for the smaller fabricator and those looking for a low cost solution to their productivity. The machine features a movable spindle that rapidly travels the entire length of the material and can drill a hole every five seconds.

Price rises to boost demand?

Construction materials prices are rising again, which could bring developers and other clients who have been waiting for prices to hit bottom from off the sidelines, says BCSA. Steel price rises are being driven by sharply rising raw materials costs worldwide and more rises look to be on the cards.

BCSA Director General Dr Derek Tordoff said: "The price rises are regrettable but inevitable given the background of rising iron ore and other raw material costs. But the trend could put an end to the policy of waiting for prices to fall further before committing to new developments.

"There appears to be a shortage of commercial property of the right type for the needs of many building users, and developers will be concluding that now is the time to move to catch low prices and to be ready for the next upturn."

Prices from steel makers will have increased by around £190 per tonne for the first half of 2010 once already announced rises take effect. A rise of £50 per tonne in March is being followed by a £60 per tonne rise from May. BCSA expects a further £80 per tonne rise in June.

Dr Tordoff added: "Iron ore costs have typically doubled and the cost of coking coal has risen by around 70%, largely due to the heavy demand for steel in the rapidly developing markets in China and India. Rival materials will also have to put their prices up and we expect the competitive position of steel construction to be maintained."

CE Marking objection resolved

A Finnish objection delaying the CE Marking of fabricated structural steelwork has been resolved at a meeting in Brussels between the European Commission and CEN.

It was agreed that the harmonised standard will be revised and EN 1090-1 will be included with the next batch of standards to be cited in the European Union's Official Journal. The responsible committee CEN/TC135, will initiate a revision that tackles the concern raised by Finland.

"This will probably happen in October this year," said Dr David Moore, BCSA Director of Engineering. "It is therefore anticipated that CE Marking of fabricated structural steelwork will come in to force towards the end of 2010 or early 2011."

CE Marking of fabricated steelwork was due to come into force this month (May), but has now been delayed as a result of the formal objection raised by Finland.

The Finnish objection relates to the serviceability characteristics of fabricated steelwork. While most European countries are happy for the client and the engineer to agree suitable serviceability limits, in Finland the serviceability limits are part of their Building Regulations.

As with all CE Marking standards there is a period of co-existence with the existing national standards. The object of this transition period is to allow steelwork contractors and Notified Bodies to gradually adopt the factory production control systems required for CE Marking.

After the transition period CE Marking of structural steelwork will become mandatory in most European countries. Although CE Marking is not mandatory in the UK the simplest way to comply with the UK's Construction Products Regulations 1991 is to ensure that all fabricated structural steelwork is CE Marked after 2011 or early 2012.

Bronze age returns to Cheshire

Steelwork contractor Hills of Shoeburyness has completed a complex steel and bronze project for a private customer in Cheshire.

Erected in the grounds of the customer's home, the project included a number of steel framed buildings all clad with bronze. These consisted of a pavilion, a gate house, a canopy and three water jetted solid bronze gates.

"We commenced this complex contract towards the end of last year, when our in-house drawing department, along with the client's own design team, started work on the detailing. This was the first time we'd fully utilised our new 3D drawing programme Solidworks," said Mark Elliott of Hills.

The company said without the use of 3D modelling this contract would have been difficult, as the 3D package allowed the exact dimensions for the faceted panels to be ascertained, particularly on the bronze gates.

"The project shows we are one of the few steelwork contractors that can also work with bronze," summed up Vaughan Chopping, Hills Managing Director. "Completing this complex project in April was also apt as we also celebrated our 50th anniversary."

NEWS IN BRIEF

SCI wants to test its on-line training facilities and needs volunteers. The idea is to present a one-day course on design to EC3, including worked examples, over three half-day sessions. Volunteer delegates will need a broadband connection and audio (speakers or headphones), and will need to be available for the three sessions, planned for the mornings of 14, 21, 28 May (all Fridays). The only obligation for delegates is to provide feedback on the experience. For more information contact: *j.burrell@steel-sci.com*

AceCad has launched StruPLANT evolution for the process, plant, oil and gas, and power generation industries. The company said the new software offers an opportunity to collaborate effectively across contracting strategies to gain more value when executing structural steel projects. For more information contact: *www.acecadsoftware.com*

The European Standards for Direct Tension Indicators (DTIs), BS EN 14399-9 and Tension Control Bolts (TCBs), BS EN 14399-10 were published by BSI in March 2009. CE Marking of both is in accordance with BS EN 14399-1 and the relevant clauses of BS EN 14399-9 and BS EN 14399-10. There is a two year period of co-existence with the existing national standards and products.

The British Standards Institute (BSI) has reorganised the technical committees responsible for the design and execution of steel structures. The existing committees B/525/31, B/525/32 and B/521 are to be merged into a single committee CB/203. The aim is to simplify the way that the UK responds to the development of Eurocode 3 and the associated standards EN 1090-1 and -2, dealing with conformity assessment and execution of steel structures. BSI has asked Dr Roger Pope to chair the new committee. Dr Pope said, "This is a great honour for me. Having been involved with the UK input to the development of the Eurocodes and EN 1090 through B/525/31 and B/521 for many years; the new challenge is learn from the experience that will now be gained as the standards are implemented in practice."

Galvanising protects gardeners

Gardeners in Scotland will be protected from the elements due to the work successfully completed by Wessex Galvanizers, part of the Wedge Galvanizing Group.

Wessex has galvanised structural steelwork for a new 960m^2 covered plant retail area at a garden centre at Bishopton, Renfrewshire. The centre is part of Erskine Hospital and Care Home for ex-servicemen and women.

The steelwork was galvanised for a Wessex customer that specialises in polytunnels, canopies and other steel framed buildings used in retail, agriculture and leisure industries.

The garden centre has a twin span canopy design with cantilevered arch sections, covered with flame retardant PVC.

"The permanent storage and display of many plants inside the new structure will create an environment with very high moisture levels. We were delighted to be asked to galvanise the steel for maximum protection in this highly corrosive atmosphere," said Richard Whiddet, Sales Manager at Wessex Galvanizers.

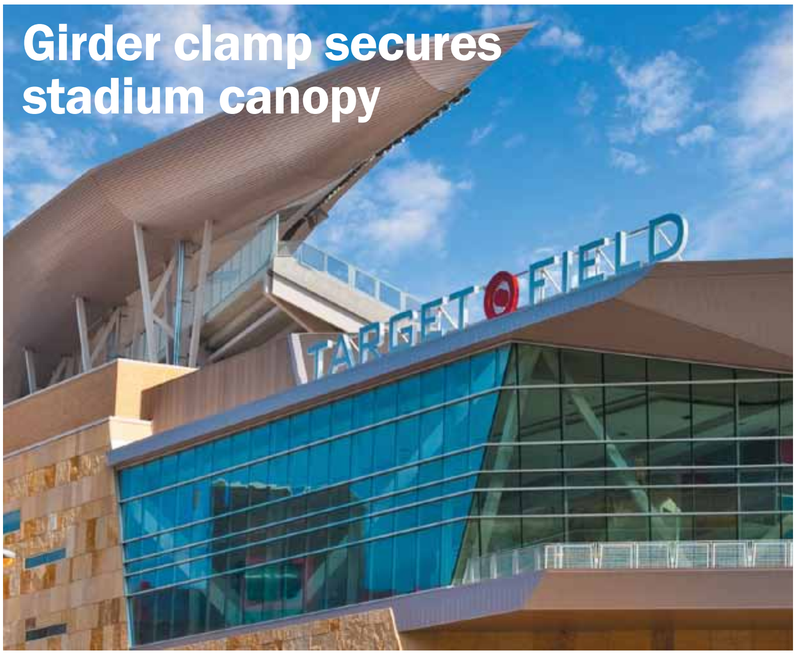
New processing equipment to make debut

Kaltenbach said the main thrust of its stand at the forthcoming Mach 2010 show (held at the NEC 7-11 June) will be production efficiency gains.

The company said it will unveil one of the world's fastest structural steel, mitre cutting bandsaw, the KBS 1051. This machine, it is claimed, will dramatically revolutionise the speed of processing structural steel.

The first KBS 1051 models arrive in the UK in mid 2010. Machine performance data and video presentations for these machines will be provided at Mach 2010 and visitors will be able to pre-register to attend special Kaltenbach in-house live machine demonstrations at their Bedford facilities. A limited number of Mach visitors with interest in the KBS 1051 will also be offered the opportunity to visit the Kaltenbach world headquarters technical centre in Lorrach, southern Germany, where the KBS 1051 will be demonstrated as an integral part of a complete, automated structural steel processing sawing/drilling line.

Girder clamp secures stadium canopy



The new Target Field ballpark in Minneapolis, USA, which features a 1,988t steel sunshade canopy that sweeps around the stadium, has been successfully suspended with Lindapter steelwork fixings.

The architecturally stunning curved canopy presented a challenge to the connection design due to the connecting beams varying in size and angle throughout. The engineers also had to meet a vital criterion of accommodating up to 22.3kN of wind load, while the contractor favoured a simple to install, universal connection that could be used on both primary and secondary steel sections.

Lindapter provided a single solution that exceeded these requirements with the Type LR Girder Clamp connection system, independently approved to a safe working load of 58.8kN at a 5:1 factor of safety. The self-adjustable assembly is compatible with flange thicknesses of 3mm to 20mm, while an over-sized slotted location plate enabled the simple adjustment to fit variations in beam width and connection angle.

The efficient connection allowed the canopy risers to be easily aligned into position, allowing a faster installation in comparison to more time consuming conventional methods such as drilling, or repeated tack welding and grinding, thereby reducing on-site costs.

Diary

For all joint Corus/BCSA events contact Ken Oliver tel 01709 825584 email: ken.oliver@corusgroup.com
For all SCI events contact Jane Burrell tel: 01344 636500 email: education@steel-sci.com

5 & 6 May 2010
Essential Steelwork Design
Bristol

12 May 2010
Preparation for Eurocodes
ISE, London

18 May 2010
Portal Frame Design
Edinburgh

27 May 2010
Stability of Steel Framed Buildings
Reading

8 June 2010
Steel Building Design to EC3
Nottingham

8 June 2010
Steel - the show
Manchester Conference Centre
Free half day seminar

17 June 2010
Stability of steel framed buildings
Glasgow

22 June 2010
Steel - the show
Hilton Hotel, Castle Donnington
Free half day seminar

24 June 2010
Steel connection design
Watford

New extension lands at Heathrow

FACT FILE
Heathrow Airport Terminal 4 redevelopment
Client: BAA
Architect: 3D Reid
Main contractor: Taylor Woodrow
Structural engineer: Buro Happold
Steelwork contractor: Watson Steel Structures
Steel tonnage: 700t
Project value: £70M

Heathrow Terminal 4 has been transformed into a light and airy airport building with the addition of a new extension featuring a 180m-long glazed façade.

Flying from Heathrow Terminal 4 was not always a particularly pleasant experience as the 1980s built structure had over the years become rather tired and past its sell by date in terms of passenger comfort. The building was congested, under lit and badly needed an overhaul, particularly as BAA had plans to move more airlines into the terminal as space was made available because of British Airways' transfer of operations to the new Terminal 5.

In order to create space for more check-in desks within the terminal an extension to the front of the original building has been constructed. The redevelopment means the terminal has now changed from a seven airline terminal to one housing 39 airlines, and the expansion also provides self service units, ticket desks, retail areas and mezzanine offices.

The design brief for the extension required a structure which was similar to the existing building, but also one that created a more light and airy space for passengers. But most importantly, the structure also had to be bomb blast resistant in order to withstand a terror attack. This criteria played a key role in the design of the 180m long, 13m tall predominantly glazed steel framed extension.

Structural engineer for the project Buro Happold initially designed the steelwork frame to take the dead, live and wind loads as normal and then analysed the frame to determine its stiffness. This figure was passed on to security consultants TPS which was responsible for dynamically modelling the effects that an explosive device would have on the extension's façade. Using this stiffness value, they were able to determine the blast loading on the structure and once this was known Buro Happold re-analysed the frame to calculate the deflection under loading.

"Some strengthening was needed to the frame, which was mostly localised and meant some steel sections had to be increased," says Alex Johnston, Buro Happold Project Engineer. "The extension's frame would absorb a potential blast and the connections have been designed so that these loads would also be absorbed back into the main (original) structure."

Once all of this information was collated the main façade as well as the extension's main frame was designed. This comprises of a total of 17 bays, each 10.8m wide and all with a depth of 25m. Each bay is formed by a steel portal frame, while the long column free interior is formed by a series of 2m deep braced trusses. The only internal columns are

located at either end of the extension, supporting the mezzanine offices.

Prior to the new extension being erected, the existing terminal's canopy was removed in preparation for the addition of the new steel frame. However, once the cantilever canopy was dismantled the critical load path in the existing steelwork was altered and so an eight week programme was necessary whereby the old terminal building's steel was stiffened up.

A steel solution for the new structure was always the preferred way to go, according to Mr Johnston. The existing terminal building has a steel frame, so marrying the two together seamlessly was easier with another steel frame for the new build.

"Steel is more flexible, easier to model with and the material is better for achieving the long spans which were required," says Mr Johnston.

Another advantage in steel's favour was offsite fabrication as the trusses were brought to site, by steelwork contractor Watson Steel Structures, fully assembled. This meant less on-site work, as the 25m-long trusses were simply lifted into position and spliced to their supporting columns. These supporting members are large fabricated 650 x 250 box sections, which were specified because of the loads they are transferring, especially during a bomb blast scenario.

"The trusses were site welded to the columns to form an aesthetically pleasing and seamless connection," says Andy Luter, Watson Steel Structures' Project Manager. "This was a little time-consuming, but a bolted connection would have spoiled the glazed façade."

The area where the new extension is located was previously the Terminal 4 forecourt, which is essentially a bridge deck structure, and this threw up a challenge when it came to designing the steel frame. The new columns had to line up with the existing grid below and the original column heads needed to be strengthened to make sure loads of the extension were successfully transferred.

Working on the forecourt also meant the steel erection for the extension was done using one 80t-capacity mobile crane, the largest unit the area could support. "The erection of the structure on the upper deck necessitated that we had to carefully co-ordinate the delivery of steel with position of the crane together with the access platforms to ensure that the permissible deck loading was not exceeded. In addition large 6m x 4m spreader mats were utilised to spread load into the existing deck structure which also needed 10t forklift to set in position" adds Mr Luter.

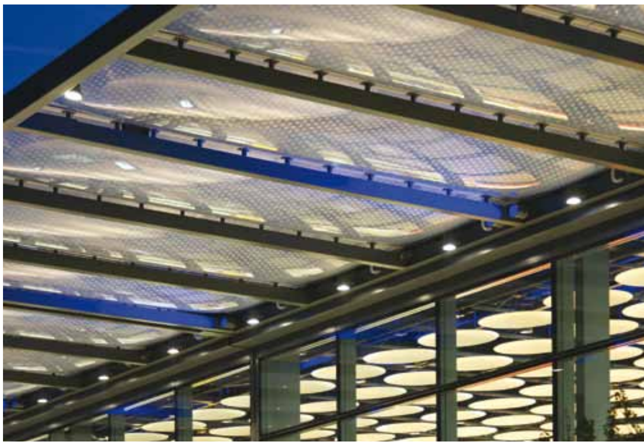
At the front of the extension above the large glazed façade a new 10m deep steel canopy has also been erected. The cantilever canopy is clad with ETFE which was chosen specifically because it would just disintegrate in a bomb blast, rather than becoming a projectile or a piece of shrapnel.

Above: The terminal building featuring its 180m long façade and 10m deep canopy

Far right: The canopy is clad with ETFE as this will disintegrate during an explosion

Right: The new Terminal 4 extension has more space and more check-in desks

Below: The extension has been built on the forecourt of the existing terminal building



The structure had to be bomb blast resistant in order to withstand a terror attack.

Westfield's Olympic

Located next to London's Olympic Park, Europe's largest urban shopping centre is rapidly taking shape. Martin Cooper reports from a project which will act as a gateway to the 2012 Games.

FACT FILE
Westfield Stratford City, London
Main Client: *Westfield*
Architect: *Westfield*
Main contractor: *Westfield*
Structural engineer: *Robert Bird & Partners*
Steelwork contractor: *Severfield-Reeve Structures*
Steel tonnage: *43,000t*
Project value: *£1.45bn*

Due to open next year Europe's largest urban shopping centre, and indeed London's largest retail destination is currently under construction in the east of the capital on previously disused land next to Stratford station. Over the last few years developer Westfield has completely transformed a site which was a mixture of railway sidings, small industrial units and an area used to deposit more than half a million cubic metres of overburden from the construction of the Channel Tunnel Rail Link (CTRL).

Westfield Stratford City, which sits adjacent to the Olympic Park, is huge and there are some big numbers associated with it. To start with there is an overall steel tonnage which is close to 43,000t and this total could even increase. Approximately 380,000m² of metal decking has been installed in a project which will offer more than 175,000m² of retail and leisure space including more than 300 shops.

Add to this the fact that Westfield estimates the development has a 4.1 million catchment population, equating to some £3.24bn weighted spend, what we have here is a massive project, both construction wise and economically. One which together with the Olympic Park covers more than 700 acres and is consequently one of the largest urban regeneration projects ever undertaken in the UK.

Although the development was on the drawing board prior to London's successful 2012 Olympic bid, it is intrinsically linked to the event. Stratford City will act as the gateway to the Olympic Park, as visitors arriving at either Stratford International Station or the Regional Station will have to walk through the shopping centre.

> ***"That's one of the advantages of designing with steel, it's flexible and you can add floors much quicker than with other materials."***

Preliminary works on site began in mid-2006 and were soon followed by a three-month earthmoving programme. The land had been raised in places by as much as 10m due to the rubble deposited from the CTRL, and apart from a few areas


Westfield's huge project takes shape in east London

gateway

that were contaminated, no material was taken off site. Instead Westfield created a number of plateaus before the entire site was piled using a combination of precast piles, continuous flight auger piles and sheet piles to create the basement walls.

Above ground the project is a steel-framed construction project, as the material lends itself to a "flexible and fast construction programme" according to Keith Whitmore, Westfield's Director of Design & Construction.

Speed of construction is vital to the majority of projects, but flexibility is equally important to Westfield. "With steel you can change things quickly and we have to be flexible around our clients demands," he says.

By using steel as the framing material much of the development has been 'future proofed' for further expansion. This decision was made early in the design process and includes all of the main buildings with the exception of the anchor blocks.

Westfield recently announced an extension to one which initially consisted of offices and retail over four levels, but will now be topped with an extra seven floors of commercial office space.

"The steelwork was designed to take extra loading from possible additional floors. That's another

Link bridge pushed over live railway lines

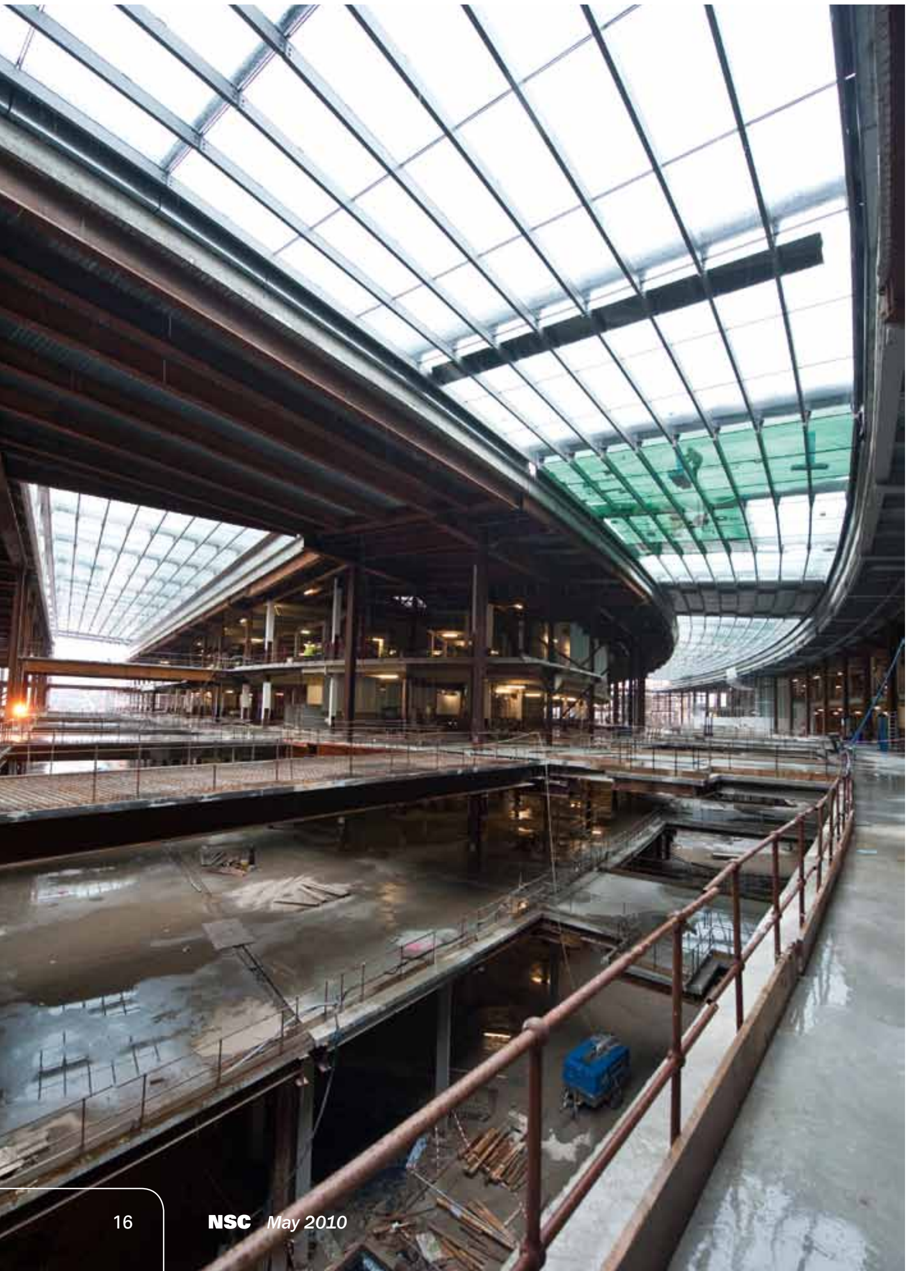
Westfield's development will be linked to the existing Stratford town centre via the 128m long x 14m wide Town Centre Link Bridge which spans 11 railway lines at Stratford Station. This steel composite structure weighing 1,600t, was assembled by Watson Steel Structures into three separate sections which were then progressively pushed out on three occasions.

The first two pushes involved night time possessions of the 'live' rails, and these were so successful that the final push was actually done during the day with no disruption to rail services or passengers.

"The town centre link bridge is crucial to getting millions of spectators from Stratford town centre to the other side, into the Olympic Park. It will play a key role during the Games and will play a key role in legacy, allowing residents and commuters to walk freely from one side to the other," says John Armitt, Chairman for the Olympic Delivery Authority.


Left: The link bridge to the Marks & Spencer anchor store

Above: Computer generated image of the Olympic Park and Westfield's shopping centre
Below: The main covered mall which links the two anchor stores



one of the advantages of designing with steel, it's flexible and you can add floors much quicker than with other materials," continues Mr Whitmore.

This philosophy has also been applied to the project's main car park. At present the plan is for 5,000 dedicated shopper car parking spaces across three separate locations, however the main car park has also been designed for possible future expansion. Here the main steel columns have been installed 6m below the basement slab, allowing room for a future excavation to create another subterranean level.

"We've put asphalt down on the lower level of this car park, instead of concrete as it's easier to dig up," explains Mr Whitmore.

Overall the development has eight main retail blocks and is anchored by a 22,296m^2 John Lewis store which sits above a 2,972m^2 Waitrose supermarket, and a 18,580m^2 Marks & Spencer. A state-of-the-art 12 screen Vue cinema is also under construction, while a 267-bed, 11-storey Premier Inn will be positioned conveniently close to the International Station. 'Future proofing' comes to the fore again, as there are plans to enlarge one of the retail blocks and add another hotel to sit on top.

There are plans to enlarge one of the retail blocks and add another hotel to sit on top.

The centrepiece of the project is a 400m long curved three level glazed mall which links the two anchor store buildings. Another route between the two major stores is uncovered and this passageway will provide direct access from Stratford Station to the Olympic Park.

Steelwork erection has been undertaken by Severfield-Reeve and its Contracts Manager Steve Pinkney says the most challenging aspect of the project has been the location. "The site is surrounded by railway lines on three sides, which has meant space is at a premium. As the project is erected we've used up the available storage space."

During the peak of the steel erection programme early in 2009, more than 800t was being erected a week, which required 40 to 50 weekly truck deliveries to keep the site fed. Severfield at this stage had seven erection gangs working on seven separate fronts.

"Although we are erecting a lot of steel, it is mostly repetitive as the retail zones are all based around a regular 7.5m grid and the car parks are 16m grids," says Mr Pinkney.

The exception to the regular grid pattern is the cinema where a series of 32m-long trusses form the required column free open plan area.

Westfield Stratford City is scheduled to open in 2011, a full year before the Olympics kick-off. This gives it plenty of time to get used to the thousands of expected shoppers who will visit the centre, although the numbers will significantly increase during the Games.

To this end, Westfield has plans in place to remove street furniture and outdoor planters from the main malls while the Olympics are on, to make the avenues wider and allow greater numbers of people unimpeded access through the site.

Creative university challenge

A key part of Glyndwr University's development programme, a new highly sustainable and environmentally friendly creative industries building is under construction. NSC reports from North Wales.

Work is underway on a new £2.4M facility at Glyndwr University in Wrexham which will be used to train the future workforce for the creative industries in north east Wales. The project will bring together the different disciplines associated with the sector, such as art and design, computing, theatre and performance and the humanities, all housed in a state-of-the-art sustainable steel-framed building.

The new Creative Industries Building will also contain television and radio production suites, furthering the success of the University's community radio station.

Sustainability (see box story) and the local environment have played key roles in the design and construction of the building. Andy Clarke, Senior Technologist for Lawray Architects, explains that the adjacent University building's clock tower is listed and the building has been designed to compliment and not distract or overshadow the older structure.

"The building relates to the existing structure, but also does not detract from the views towards the clock tower. We have been careful to ensure that the existing building retains its prominence. However the new Creative Industries Building completes the end of the site, and provides a focus to this frontage."

The structure has a large curved elevation to fit the site, while its sloping sedum roof will mean the building is virtually hidden from the adjacent main road.

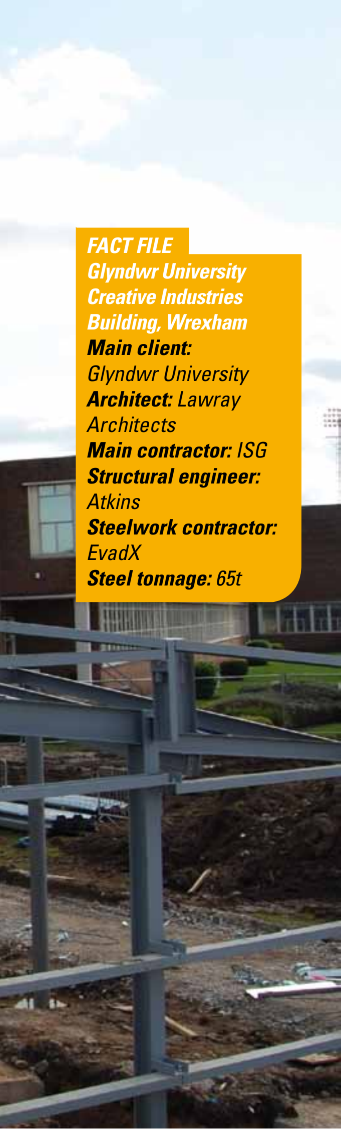
The direction of the roof's slope also means that while viewing the University from the road ones eye is automatically drawn upwards along the slope towards the taller clock tower building.

Overall the structure approximately measures 43m x 40m and consists of a two storey sector along one elevation (facing the existing buildings) connected to the recording suite, with a large open plan area which is topped by the sloping green roof.

The roof has three pitches and the slope changes from four to nine and then 11 degrees

The layout has been developed to create a large social area where students and others in the industry can work and relax, bringing together ideas from various fields of

Left: Computer generated image of the completed Creative Industries Building



FACT FILE
Glyndwr University Creative Industries Building, Wrexham
Main client: *Glyndwr University*
Architect: *Lawray Architects*
Main contractor: *ISG*
Structural engineer: *Atkins*
Steelwork contractor: *EvadX*
Steel tonnage: *65t*

Above: The new structure is designed to complement the adjacent listed building

Green building has abundant features

Environmentally friendly features incorporated into the new structure include air source heat pumps to provide the majority of space heating via low temperature under floor heating, a heat recovery VRV system for the areas that require cooling, a mini combined heat and power unit and an array of photovoltaic panels to generate electricity from the sun. The use of automated opening windows for natural ventilation will also combine with all of these technologies to provide a low carbon solution to the space heating, cooling and electrical requirements of the building.

Solar photovoltaics is a technology that is included within research programmes at the University. ISG has incorporated a bank of solar photovoltaics along the front south facing elevation, integrated within the building structure to act as a solar shading device. This enables the panels to be sited in the optimum location for solar collection and provides an additional function as a shading device. The panels would be rated at around 4kw peak power which would provide approx 3% of the building annual electrical requirement. The building also features a green sedum roof which helps to absorb CO_2, rainwater, provides insulation and creates a habitat for wildlife.

It should be appreciated that as the heating demand for the building is reduced by passive measures such as high performance fabric and glazing elements, the electrical consumption becomes an increasingly higher factor in the carbon emissions calculation. To offset this, the design will incorporate maximum daylight where practical, utilise energy efficient lighting such as high frequency fluorescent lamps, LED fittings and lighting controls.

Construction techniques and materials will allow the building thermal performance to be substantially better than the limiting values within Part L2 of the Building Regulations in order to achieve an economic solution to the energy strategy. The intention is to improve on these limiting values by at least 20%. The building has been designed to achieve a BREEAM 'Excellent' rating.

study. Near this specialist area classrooms are located where these ideas can be developed.

"Steel was chosen because of the height and shape of the building," adds Mr Clarke. "While a Kingspan cladding system was specified for the majority of the exterior for its thermal conductivity."

Although the steel tonnage for the project is only 65t, the steel programme has required some thorough design and planning because of the structure's irregular shape. The main part of the building's roof slopes with the purlins, consequently the purlins are always rising along the length of the structure. The roof also has three pitches and the slope changes from four degrees, to nine degrees and then 11 degrees for the main roof area.

"The majority of the two-storey element is based around a 4m x 4m grid and this is where we started our steel erection," explains Andrew Roberts, EvadX Project Designer. "The rest of the project is more bespoke, with a sloping roof and curved elevations which meant steelwork was mostly small pieces of varying sizes."

Adjoining the two-storey sector, the structure's recording suite is a 'box within a box'. The suite features a double height space and will be soundproofed from the remainder of the building.

A large high area was required for the recording suite's equipment and to insulate it from the rest of the building and to prevent traffic noise penetrating the steelwork has packs to isolate it from the main frame. A double skinned blockwork cladding and a concrete roof further insulates the suite.

Summing up, Mr Clarke says: "The new Creative Industries Building is a keynote development of the Plas Coch campus and of the University. It not only occupies an important site at the entrance to the University but also to Wrexham. The project announces the town and the University are moving forward."

Construction is scheduled for completion in December, with the facility opening in mid-2011.

Above: The shape of the structure dictated the use of steel

Below: The two-storey sector of the building will accommodate classrooms

Below: The roof has three separate pitches

Steel boost for Kent college

Above: The L-shaped teaching block overlooks the busy A2 and symbolises the regeneration of this part of Kent

Part of a phased redevelopment at North West Kent College, two new steel framed teaching blocks are currently under construction.

One of the most buoyant sectors for construction of late has been education, with a raft of new and refurbished schools and colleges going up across the country. An example of this is the work currently being undertaken by BAM Construction for North West Kent College in Dartford.

Two new buildings are being constructed at the college's Dartford campus, one a dedicated teaching block, and the other a mixed-use structure containing a sports hall and classrooms.

One, if not both, of the buildings are visible from the adjacent A2, and so highlight and symbolise the regeneration of this part of Kent. The modern teaching block replaces an old structure which was demolished last year, while the other building is set to provide the best facilities possible for the on-campus School of Sports and Public Services. This is apt because the nucleus of the Dartford campus was originally the pioneering PE College founded by Madam Osterberg where she invented the game of netball.

Malcolm Staunton, the Learning and Skills Council's Partnership Director says: "This project will enable more young people in the area to access high quality training in modern buildings with excellent facilities."

College Principal Malcolm Bell, agrees and adds, the college was delighted to receive the initial go-ahead for the project which forms an important element in this part of the Thames Gateway regeneration scheme.

Construction work began last November, when BAM began installing pad foundations in preparation for the steel frames to be erected. Two old buildings had previously been demolished as part of another contract so the ground had already been cleared.

> ***The nucleus of the Dartford campus was originally the pioneering PE College founded by Madam Osterberg where she invented the game of Netball.***

Specialist ground treatment works including microgravity surveys and Dutch Cone Penetration Testing were carried out to discover whether there are any subterranean anomalies present in the chalk strata, as historical chalk mine workings (Deneholes) has previously been identified in the vicinity. In addition pressure grouting was undertaken at targeted locations and at each pad foundation position.

"No deneholes were discovered, but some underground voids were located, and these had to be grouted before the foundation work could begin," explains Mick Kelly, BAM Project Manager.

Both new blocks are steel-framed structures, based around an economical design and regular grid pattern. The dedicated teaching block (known as Block B) is an L-shaped building with step - roughly halfway along - which takes the structure from two levels to its maximum height of three levels.

The other structure (known as Block S) is predominantly based around an 11m x 6.5m grid and has two levels which surround a central sports hall. The second level features a significant void, accommodating a large amount of suspended

FACT FILE
North West Kent College, Dartford
Main client: *NW Kent College*
Architect: *BAM Design/ KSS*
Main contractor: *BAM Construction*
Structural engineer: *BAM Design/AKT*
Steelwork contractor: *Robinson*
Steel tonnage: *630t*

Above: The feature cantilever façade of Block B

services. For stability, both steel frames feature cross bracing, situated in partition walls and along some elevations. In fact BAM Design designed out the originally proposed concrete cores resulting in significant savings.

According to BAM Design steel was chosen for a number of reasons: economics, speed of construction and the fact that Termodeck hollow core precast slabs were specified and these ordinarily require a steel frame construction method. Furthermore, the structural screed was omitted while maintaining diaphragm action at each floor level bringing further economies to the design.

The main steelwork feature of the project is the central multi-purpose sports hall in the middle of of Block S. This area is formed by a series of 32m long steel trusses which are delivered to site in two sections, one 19m long and the other 13m long. Steelwork contractor Robinson is welding the trusses together on site before lifting the completed sections into place.

A welded connection is considered to be more aesthetically pleasing than a bolted one, as the trusses will remain exposed internally as architectural features. The trusses are formed by CHS sections for the bottom boom and internal members, while the top boom is a SHS member. The trusses are curved and mirror the curvature of the block's roof, and this was considered easier to achieve with SHS members for the top boom.

Surrounding the sports hall Block S features an outdoor plant area along one first floor elevation. The rest of the first floor and the ground floor level consist entirely of classrooms.

Above: The steel trusses are brought to site in two pieces and welded to form the 32m lengths

Left: A two-storey structure surrounds the internal sports hall of Block S

Mohammad Ziauddin, BAM Design Structural Engineer, says: "The use of REVIT 3D modelling software greatly benefited the overall design and speeded up the detailed design phase bringing benefits to the whole team."

As part of BAM's contract another building, located between the two new build structures, is being renovated. This former indoor swimming pool is being converted into a new drama studio and teaching area.

The two new buildings are due to be completed during May/June 2011 and then fitted out by the college in readiness for the Autumn term.

Steel for joined up bridges

Why steel is usually the most suitable material for highway and railway bridges, footbridges and moveable bridges was highlighted at the Steel Bridges Conference in London in April. Nick Barrett reports.

Above: A comprehensive series of new publications was distributed at the conference

Footbridges make landmarks

Rowecord Engineering's Bridges Director Ian Hoppe highlighted the contribution that high profile footbridges were making to a range of communities, for example helping with regeneration in places like Newport where the River Usk footbridge is proving to be a stimulus for urban regeneration, and even providing a symbolic focus for mending barriers between communities as with the Peace Bridge over the River Foyle in Northern Ireland.

Other objectives being fulfilled by steel footbridges could be cultural, the desire for a prestigious landmark, to provide a focal point, to create cultural value. Mr Hoppe called the often iconic structures Architectural Footbridges. They differ from more run of the mill structures in several ways. For example, they are often technically more complex to fabricate, with challenging geometry. Welding challenges can be greater, erection can require a bit more thought which allows erectors to show what they can do. They involve more interfaces with other trades. Early involvement of all in the project's construction team was crucial for their success.

"A bridge has done its job if you cross it without even noticing it," said Mr Hoppe. "But Architectural Footbridges are different; they are there to be looked at."

Delegates at this packed event hosted by the BCSA and Corus heard successive speakers from the client side and designers describe how steel was excelling in performance and looks like continuing to be the material of choice for new road and railway structures of all sizes, including forthcoming major challenges such as the new Forth Replacement Crossing.

The conference also saw the launch of a wide range of new and updated design and other guidance for designers from the steel sector that takes account of the Eurocodes, including Composite Highway Bridge Design (SCI Publication P356) and a companion Worked Examples publication (SCI Publication P357). The Steel Construction Institute's David Iles introduced the Steel Bridge Group's Model Project Specification for the Execution of Steelwork in Bridge Structures (SCI P382) which is designed to facilitate the use of the new European standard BS EN 1090-2. He also announced the latest issue of Guidance Notes on Best Practice in Steel Bridge Construction (SCI P185) and explained the new Eurocodes design guidance.

BCSA launched its updated 'Purple Book', Steel Bridges: A Practical Approach to Design for Efficient Fabrication and Construction. This is a comprehensive revision of the previous Purple Book, the third edition of a guide originally published in 1985 and updated in 2002. A complementary BCSA Guide to the Erection of Steel Bridges was also given to conference attendees.

Carbon Calculator Design Tool

Corus presented a new range of bridges brochures, Steel bridges – Material matters, with separate publications on weathering steel, material selection and product specification, corrosion protection, and sustainability. Sustainability featured strongly throughout the conference, particularly in a presentation from David Smith, Regional Head of Bridge Engineering at Atkins, which is producing a Carbon Calculator Design Tool for steel bridges.

The tool, which will be available shortly, will be

Steelwork for the Sidings Bridge in Swansea was completed by Rowecord Engineering

used for quantifying the embodied and operational CO_2 of steel-concrete composite bridges. Mr Smith said it will be used to quantify and reduce the carbon footprint during construction and maintenance. It means the carbon footprint of steel bridges will be able to be accurately assessed and designers will have a tool to help identify ways to reduce CO_2. Mr Smith stressed that the tool produces realistic results, without necessarily being based on the most optimistic assumptions, using default values.

Mr Smith said used in conjunction with new Preliminary Steel Bridge Design Charts, which were also presented at the conference, the Carbon Calculator will give steel bridge designers new, powerful and quick feasibility tools. The new design charts were commissioned by Corus and the BCSA to update the existing steel composite design charts to the Eurocodes. The scope of the charts has been extended to cover both multi girder and ladder beam decks. They now align with guidance from the Steel Bridge Group.

Steel looks like continuing to be the material of choice for new road and railway structures of all sizes…

Mr Smith explained that the original charts were based on line beam analysis and the accuracy of the new ones is improved by using grillage models. The new charts cover a wider range of structure types, and should give greater accuracy and efficiency thanks to the more detailed analysis they make possible. They are available both as traditional charts or easy to use spreadsheets. Delegates were given free software derived from the charts to use as a quick calculating tool when preparing steel bridge designs.

Rising to the rail challenge

Steel bridges dominate the railway sector where cost effectiveness, longevity, ease of inspection for safety checks, offsite construction and ease of installation are all valued by a cost conscious industry where safety is of prime importance. Ian Bucknall of Network Rail chaired the second session of the conference which heard about new Standard Railway Bridge Designs, describing the exacting standards demanded by the UK's railway network operator. Introducing the following speakers he said: "We will hear how steel frequently rises to the challenge."

Network Rail's Jason Johnston described some recent railway bridge projects using the standard designs, the development of the standard designs and the drivers behind them. Network Rail has major delivery commitments in areas such as sustainability, safety, performance, capability, capacity and availability of track and stations, he explained. Efficiencies are needed to make 21% cost savings on top of the 27% made since 2003. "We have got to do things differently if we are going to meet our targets," Mr Johnston said.

Sustainable and whole life considerations would loom large in the HA's decisions regarding structures...

The standard designs are intended to reduce design costs by cutting repetitive design and checking of commonly used structural solutions. Productivity will be improved by reducing the time needed to implement structural solutions, and contractor and sub-contractor costs generated by uncertainties in detailing requirements will be minimised.

A key aim is to minimise maintenance requirements and reduce the volume and cost of remedial works by adopting good practice design and detailing. Other benefits will come from streamlining the Technical Approval process. Steel bridges allow many of the key functional requirements of new bridges to be easily achieved, such as having all main structural elements visible from at least one side and easily accessed, no debris traps, water managed, easily understood structural behaviour and warning signs visible should limit states be approached.

Resistance to catastrophic failure in the event of a bridge strike is another requirement that steel delivers, as is robustness which means damage will not be disproportionate to the cause. Minimisation of disruption to rail users during installation, maintenance and other operations is also crucial for Network Rail.

Roads to the future

Steel bridges will figure prominently in plans for the future of the national roads network, as was apparent from a presentation by Geoff Bowden, Principal Structures Adviser at the Highways Agency, on National Highway Sector Schemes which are bespoke quality management schemes. They focus on quality, providing an industry benchmark. A properly trained and competent workforce is another key focus. The aim is to reduce costs and enhance quality.

Several of the sector schemes affect steelwork. For example, under Sector Scheme 19A which was revised in July last year, registration to the scheme is required for firms to be engaged in painting of steelwork on HA projects. Those wanting to be involved in steelwork for Highways Agency bridges have to prove their competence and register to Sector Scheme 20 by December 2011. Mr Bowden said clients and their agents should speak to their supply chains to ensure they are meeting the requirements of the schemes.

Neil Loudon, Highways Agency Group Manager Structures Policy/Pavement Teams, chaired the first session of the conference, outlined structures issues from the HA perspective. No longer primarily a road builder, the HA was transforming itself to be a world leading road operator. Sustainable and whole life considerations would loom large in the HA's decisions regarding structures, which had to be cost effective, safe, efficient, durable, buildable, accessible and inspectable, maintainable, aesthetically pleasing, flexible and adaptable.

Above: The Port Eglinton Viaduct is an integral part of Glasgow's M74 Completion Project

Completing the picture

Steel is featuring on the biggest road project under way in the UK, the M74 extension in Glasgow, and is strongly favoured to be used on the £2,000 million Forth Replacement Crossing, both projects that the conference heard presentations on.

David Kite of Arup described what is to be a cable stayed, triple mono-tower structure over the Forth which will stand alongside the existing steel Forth railbridge and road bridges. The project is now at tender and is due to open to traffic in 2016. There will be two 650m main spans with approach spans up to 90m. The decks will be of closed box design to give safe inspection and maintenance, long term durability and large flat areas for repainting.

Major features of the design are fixed but tenderers have the final say in materials which could mean a steel orthotropic box, a steel-concrete composite box, a push launched composite twin box or a balanced cantilever prestressed twin box. Whatever the detail of the tenders which are due to be submitted at the end of this year Mr Kite said:" There will be a lot of steel in all of them."

Cleveland Bridge's Jim O'Neil described the progress of the M74 Completion which is transforming transport in and around Glasgow. There is some 21,180t of steel in the project's four major bridges which are either assembled or are being assembled on site. The biggest structure is the 12 span, 750m long Port Eglinton Viaduct in the south side of the City using 16,039t of steel.

Design development undertaken by the project team resulted in a number of beneficial changes including a reduction in weld sizes, revised internal frame corner joints, curved flanges in plan by pressing, reorganised internal bracing, repositioning of transverse seams and optimisation of work between fabricating facility and site.

Mr O'Neil described the production effort at Cleveland Bridge's fabrication workshop, where eight lines were producing seven boxes a week.

Image courtesy of P+HS Architects

FACT FILE
Blaydon Leisure & Primary Care Centre, Gateshead
Main client: *Gateshead Council and Gateshead Primary Care Trust*
Architect: *S&P Architects / P+HS Architects*
Main contractor: *Willmott Dixon Construction*
Structural engineer: *Cundall*
Steelwork contractor: *Hambleton Steel*
Steel tonnage: *340t*

Above left: Impression of the completed Blaydon centre

Below: Speed of construction meant steel was chosen for the main frame at Blaydon

More leisure and primary care opportunities for North East

Forming part of a programme to construct new leisure and primary care facilities in Gateshead, NSC reports on two steel framed centres currently under construction in the borough.

Leisure facilities in Gateshead are undergoing an extensive upgrade with a number of buildings being replaced by brand new structures. Two of these jobs, at Blaydon where a leisure and primary care centre is being built, and Heworth where a leisure centre is under construction, both involve steel frames, metal decking and feature glulam rafters and form part of Gateshead Council's £29M 'Building an Active Future' programme.

Gateshead Council Cabinet Member for Culture Councillor Linda Green said: This is an important moment in Gateshead's history, construction projects of this magnitude are a once in a lifetime opportunity to transform the leisure and health services on offer.

"We believe Gateshead can become a shining example of an active and healthy society but we recognise that the only way to do that is by creating facilities and opportunities that people want to use."

At Blaydon the combined leisure and primary care centre consists of one large structure divided by a glazed atrium. Either side of this common entrance area the two disparate facilities have been designed as structurally independent frames, although forming one large building.

"The client's brief required the design to take into account the possible future removal of one of the buildings sections," explains Duncan Cox, Associate at Cundall. "The entire structure is braced and either side could remain structurally integral without the other side."

A steel frame, combined with glulam beams over the pool hall, was chosen for a number of reasons; economics, speed of programme and aesthetics.

The leisure centre part of the building features a 25m, six lane swimming pool and learner pool, changing facilities and an area for plant equipment.

Above the pool's changing rooms there is a first floor area containing a large gym and a multi-purpose room with views over an adjacent nature reserve.

The structural divide between the two parts of the centre is 60/40 in favour of the primary care centre. The primary care sector of the building will include a GP-led health centre and walk-in and minor injuries unit, as well as other services such as dentistry and a therapy pool.

"Either side could remain structurally integral without the other side."

The ground floor of the primary care centre is roughly figure of eight in shape and contains two internal courtyards. Above this, the first floor area is C-shaped and covers approximately 50% of the structure's footprint.

The new centre is being constructed on land previously occupied by the now demolished Blaydon Comprehensive School. A thorough groundworks programme was completed prior to the steel frame being erected by steelwork contractor Hambleton Steel. The steel frame is founded on pad foundations.

The Blaydon Leisure and Primary Care Centre is scheduled to be completed this summer.

FACT FILE
Heworth Leisure Centre, Gateshead
Main client: Gateshead Council
Architect: S&P Architects
Main contractor: Willmott Dixon Construction
Structural engineer: Cundall
Steelwork contractor: Hambleton Steel
Steel tonnage: 110t

Above: Heworth's pool hall is formed with glulam rafters

Above: A gym overlooks the pool hall at the Blaydon Leisure Centre

Left: The Blaydon project nears completion

Heworth Leisure Centre

A similar project is on-going at Heworth where a new leisure centre is under construction. The centre will include a four lane, 25m swimming pool, a learner, an infants pool and the north of England's first 'flow rider' for indoor surfing. The ground floor of the building will also contain the reception, changing rooms, offices and a plant area. Part of the structure has a first floor and here a gym, a multi-purpose studio and further plant areas will be located.

The structure for the Heworth centre is a steel frame incorporating feature 19m long glulam beams over the pool hall. For stability the entire structure is braced, with the majority of bracing secreted into walls.

However, some bracing has to remain on view as the two main elevations feature large expanses of glazing. "On these frontages we've inserted an architectural visual bracing system which consists of a central tension ring with four diagonal wires connecting back to the main frame," says Michael Tungate, Cundall's Project Engineer.

A 19m long transfer beam supports the first floor area as it cantilevers over a portion of the pool hall

The centre's roof is curved, with three barrel vaults, two over the pool and the third over the two storey sector. "The main rafters are double curved and are connected to curved steel members which continue the roof over the changing rooms and gym area," adds Willmott Dixon's Project Manager Richard Saville.

There are some heavy-duty connections between the rafters and the steel members, mostly hidden behind bulkheads, although the eaves connections are on view. Similar to the Blaydon project, a steel frame incorporating precast planks and feature long span glulam beams was chosen as the most efficient solution for the job.

It is not only the timber element which incorporates long spans, as a 19m long transfer

Image courtesy of S&P Architects

Above: Impression of the completed Heworth Leisure Centre

beam supports the first floor area as it cantilevers over a portion of the pool hall. This beam is a large 914 column and was needed because it is not only supporting a cantilever balcony - affording views over the pools - but also five bays of precast planks.

The site was previously greenfield and prior to the steel frame being erected preliminary works included the installation of mass-filled pad foundations, as well as a cast in-situ concrete basement. Once the steel frame was fully erected, the pools were excavated and blockwork installed along with the feature glazing.

Heworth Leisure Centre is scheduled for completion in July.

Below: Large glazed areas are a feature of the two main elevations

Bending and Compression to BS 5950 and BS EN 1993-1-1

Armed with a copy of the new "Blue Book" David Brown looks at the tables of member resistances – this time combined bending and compression.

Several articles have indicated that combined bending and compression according to BS EN 1993-1-1 is not amenable for manual design. No doubt software will provide an easy solution for the few occasions when we do need to deal with members subject to force and moment. There are ways to make life simpler, always at the cost of some conservatism. These simpler approaches, and the help provided by the new "Blue Book" are covered in this article.

Combined bending and compression – in BS 5950

In truth, combined bending and compression isn't a joy in BS 5950 either! For engineers undertaking manual design, clause 4.8.3.3.1 offers a "simplified approach". However, even the "simplified approach" demands satisfying two inequality expressions:

$$\frac{F_c}{P_c} + \frac{m_x M_x}{p_y Z_x} + \frac{m_y M_y}{p_y Z_y} \leq 1$$

$$\frac{F_c}{P_{cy}} + \frac{m_{LT} M_{LT}}{M_b} + \frac{m_y M_y}{p_y Z_y} \leq 1$$

The expressions require the flexural buckling resistance about both axis (P_{cx}, P_{cy} and the minimum P_c), the lateral-torsional buckling resistance, M_b, and factors m_x, m_y, and m_{LT}, accounting for non-uniform bending moments.

For the brave, there is the "More exact method for I and H sections with equal flanges" in clause 4.8.3.3.2. A typical expression from this clause is:

$$\frac{F_c}{P_{cx}} + \frac{m_x M_x}{M_{cx}}\left(1 + 0.5\frac{F_c}{P_{cx}}\right) \leq 1$$

The point of interest is the introduction of an amplifier $\left(1 + 0.5\frac{F_c}{P_{cx}}\right)$ which involves the applied axial load, F_c and (in this expression) the resistance in the major axis, P_{cx}.

The concepts seen in BS 5950's "more exact approach" go a long way to illuminating the *k* factors in BS EN 1993-1-1.

Combined bending and compression – in BS EN 1993-1-1

There has been plenty written about the subject in New Steel Construction in previous articles. Suffice to say that the calculation of the *k* factors will cause the most angst, where even the "Blue Book" cannot help directly. The interaction expressions are:

$$\frac{N_{Ed}}{N_{b,Rd,y}} + k_{yy}\frac{M_{y,Ed}}{M_{b,Rd,y}} + k_{yz}\frac{M_{z,Ed}}{M_{z,Rk}} \leq 1 \quad (6.61) \text{ and}$$

$$\frac{N_{Ed}}{N_{b,Rd,z}} + k_{zy}\frac{M_{y,Ed}}{M_{b,Rd,y}} + k_{zz}\frac{M_{z,Ed}}{M_{z,Rk}} \leq 1 \quad (6.62)$$

Within 6.61 and 6.62, the *k* factors are of the form:

$$k_{yy} = C_{my}\left(1 + 0.8\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}}\right)$$

which more plainly is

$$k_{yy} = C_{my}\left(1 + 0.8\frac{\text{Applied axial load}}{\text{Major axis axial resistance}}\right)$$

C_{my} is analogous to the *m* factors of BS 5950, and accounts for a non-uniform bending moment diagram.

Options, Options

The following sections illustrate by example the various ways that a problem might be tackled, using the available resources. The problem is shown in Figure 1 (overleaf).

Option 1 – use the software

Probably the best option! Commercial software is available. There are a number of design aids to assist in the calculation of the *k* factors, including tools for SCI members on *Steelbiz*.

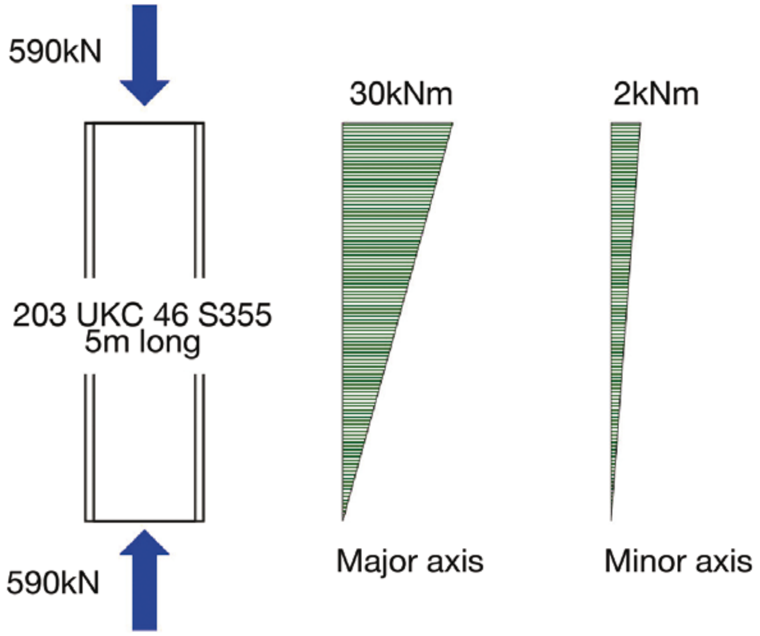


Figure 1 Typical axial and bending problem

Using Annex B from BS EN 1993-1-1, the "benchmark" resistances, *C* factors and *k* factors are:

Major axis flexural resistance, $\chi_y N_{Rk}$	$(N_{b,Rd,y})$	1583 kN
Minor axis flexural resistance, $\chi_z N_{Rk}$	$(N_{b,Rd,z})$	832 kNm
LTB resistance, $\chi_{LT} M_{y,Rk}$	$(M_{b,Rd,y})$	74 kNm
Minor axis moment capacity, $M_{z,Rk}$		82 kNm
C_{my}, C_{mLT} and C_{mz}		0.6
k_{yy}		0.72
k_{yz}		0.72
K_{zy}		0.80
K_{zz}		1.19

Expressions 6.61 and 6.62 from BS EN 1993-1-1 become:

$$\frac{590}{1583}+0.72\frac{30}{174}+0.72\frac{2}{82}=0.51\text{, OK}$$

$$\frac{590}{832}+0.80\frac{30}{174}+1.20\frac{2}{82}=0.88\text{ , OK}$$

From the "Blue Book"

The "Blue Book" provides the major terms for use in expressions 6.61 and 6.62, but some care must be exercised, and some conservatism in the tables will be seen. An extract from the "Blue Book", page D-167, is shown in Figure 2.

The major and minor axis flexural buckling resistances are extracted directly for 5m length, as 1580 kN and 832 kN respectively. However the lateral torsional buckling resistance is given as 129 kNm, compared to the value given above as 174 kNm. The explanation is that in Figure 2, the LTB resistances assume a uniform bending moment diagram, when in fact the bending moment diagram varies from 30 kNm to zero – a less onerous situation.

A more precise answer can be obtained from the resistance tables dedicated to LTB resistance, as shown in Figure 3, which is an extract from page D-78 of the "Blue Book"

At 5m, the figure of 129 kNm can be seen for a C_1 factor of 1.0. But the actual bending moment diagram leads to a C_1 factor of 1.77, and by interpolation, a LTB resistance of around 170 kNm – rather closer to the precise value of 174 kNm.

As with all resistances, the calculated value depends on the classification of the section, and designers should treat this with care.

Member buckling check

Section Designation and Resistances (kN, kNm)	n Limit	Compression Resistance $N_{b,y,Rd}$, $N_{b,z,Rd}$ (kN) and Buckling Resistance Moment $M_{b,Rd}$ (kNm) for Varying buckling lengths L (m) within the limiting value of $n = N_{Ed} / N_{pl,Rd}$													
		L (m)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
203x203x46	1.00	$N_{b,y,Rd}$	2080	2070	2010	1950	1890	1820	1750	1580	1390	1190	1010	855	726
$N_{pl,Rd}$ = 2080		$N_{b,z,Rd}$	2030	1890	1740	1590	1430	1260	1100	832	635	495	395	321	266
$f_y W_{el,y}$ = 160	**1.00**	$M_{b,Rd}$	177	177	173	166	158	151	144	129	115	104	93.5	85.1	77.9
$f_y W_{el,z}$ = 54.0															

Figure 2 Extract from the "Blue Book", member buckling check

Designation / Cross section resistance (kNm) / Classification	C_1 (1)	Buckling Resistance Moment $M_{b,Rd}$ (kNm) for Length between lateral restraints, L (m)												Second Moment of Area y-y axis I_y cm^4
		1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	
203x203x46	1.00	177	177	173	166	158	151	144	129	115	104	93.5	85.1	77.9	4570
	1.50	177	177	177	177	177	177	172	161	150	139	128	118	109	
$M_{c,y,Rd}$ = 177	2.00	177	177	177	177	177	177	177	177	173	164	155	146	137	
$M_{c,z,Rd}$ = 81.9	2.50	177	177	177	177	177	177	177	177	177	177	175	167	160	
Class = 2	2.75	177	177	177	177	177	177	177	177	177	177	177	176	169	

Figure 3 Extract from the "Blue Book", member bending

USFBs or CONCRETE ?

ULTRA FAST CONSTRUCTION

From ex-stock steel, so accelerates any site programme. Supplied through any steelwork contractor.

Engineer: PWP Consulting Engineers

Milliners Wharf, Manchester
Luxury 8-storey residential development using 7.8m span USFBs with 225mm deep metal deck supported on bottom flange, and with concrete flush to top flange.

ULTRA COMPETITIVE PRICES

Compares favourably with the cost of flat-slab concrete.

Engineer: Whitby Bird

Phoenix Medical Centre, Newbury
9.2m span USFBs, carrying PC units and cambered 27mm.

ULTRA SHALLOW FLOORS

As shallow or shallower than flat-slab concrete.

Engineer: SKM Anthony Hunt

George IV Bridge, Edinburgh
Eight floors of hotel and retail space with floor depths as shallow as 160mm.

Ultra Shallow Floor Beams - faster, cheaper & shallower construction. For FREE & immediate designs contact

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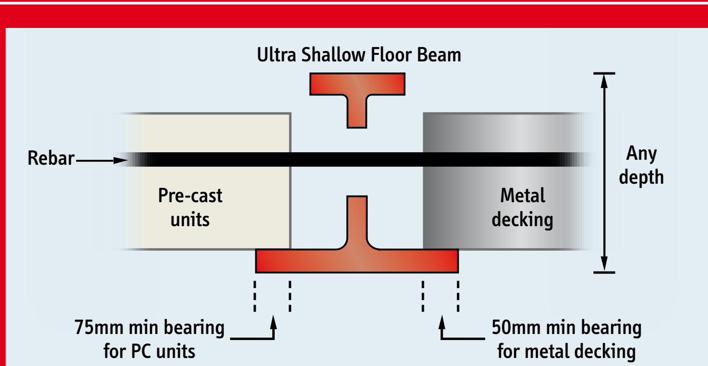

ASD Westok Limited, Charles Roberts Office Park, Charles Street
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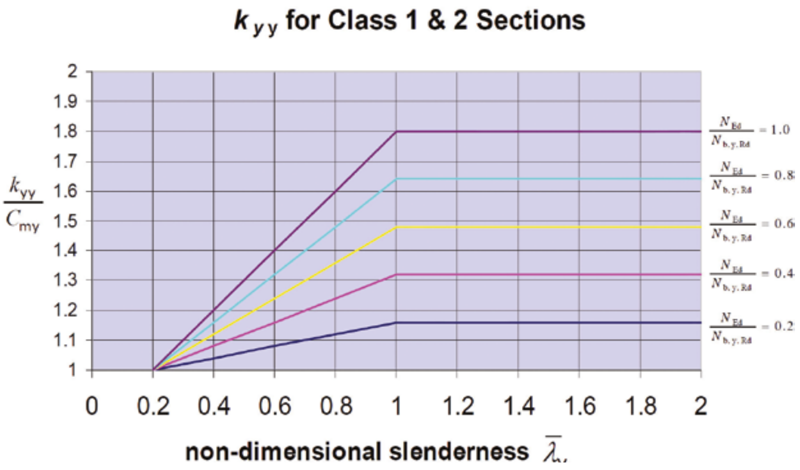


Figure 4 *k_{yy} factor from the* Concise Guide

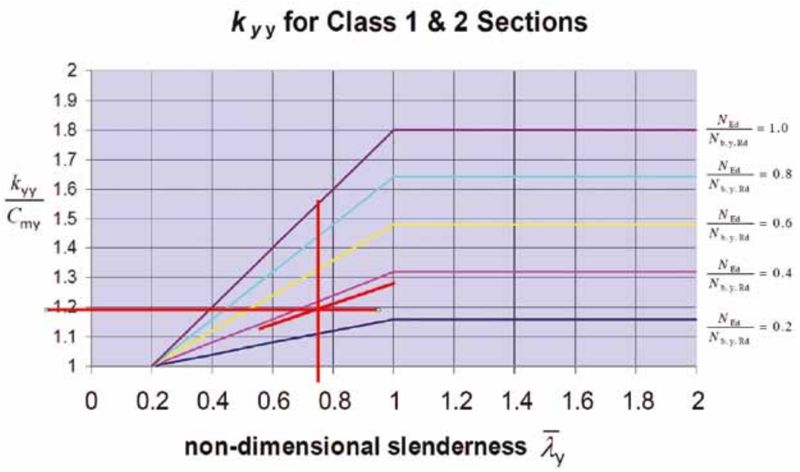


Figure 5 *k_{yy} factor from the* Concise Guide

The minor axis bending resistance is also required, which is another example of a resistance that depends on classification. On page D-167, the elastic resistance, $f_y W_{el,z}$ is quoted as 54 kNm. But the section is Class 2 under this combination of loading, and the plastic resistance, described as $M_{N,z,Rd,}$ is given as 81.9 kNm on page D-166.

So far, so good, but what about the *k* factors?

Use of software is again the answer – some is available on *Steelbiz*. Alternatively, the factors can be calculated manually, which is laborious. As a further alternative, the factors can be obtained using graphs in the *Concise guide*. Figure 4 shows the figure for the k_{yy} factor.

If resistances have been taken directly from the "Blue Book", the non dimensional slenderness has not been calculated. But

$$\bar{\lambda}_y = \frac{\text{major axis resistance}}{\text{cross-sectional resistance}}$$

The cross-sectional resistance is quoted as 2080 kN on page D-166, so $\bar{\lambda}_y = \frac{1580}{2080} = 0.76$

The ratio of applied/resistance = 590/1580 = 0.37

The intersection of these two values is shown in Figure 5.

This leads to a k_{yy}/C_{my} ratio of approximately 1.19. Because C_{my} is 0.6, then k_{yy} is approximately 1.19 × 0.6 = 0.71, which compares with the precise value of 0.72. Similar diagrams are available for the other *k* factors.

Simplified interaction expressions

If designers are prepared to sacrifice increasing degrees of resistance, simplified expressions are available. In The Structural Engineer of 4 November 2008, Mike Banfi presented simplified expressions. For Class 1 and Class 2 sections the expressions are:

$$\frac{N_{Ed}}{N_{b,Rd,y}} + C_{my}\frac{M_{y,Ed}}{M_{b,Rd,y}} + C_{mz}\frac{M_{z,Ed}}{M_{z,Rk}} \leq 0.85 \quad \text{(6.61 simplified)}$$

and

$$\frac{N_{Ed}}{N_{b,Rd,z}} + 0.78\frac{M_{y,Ed}}{M_{b,Rd,y}} + C_{mz}\frac{M_{z,Ed}}{M_{z,Rk}} \leq 0.78 \quad \text{(6.62 simplified)}$$

The above expressions are significantly simpler – the *k* factors are replaced with *C* factors alone, or in the second expression, a value of 0.78.

In the second expression, both 0.78 factors are a minimum value. Less conservative factors depend on the ratio of axial load to buckling resistance, as shown in Figure 6.

In the example problem, the ratio of axial load / resistance is 590/832 = 0.71. From Figure 6, the required value is 0.86. The simplified interaction expressions become:

$$\frac{590}{1583} + 0.6\frac{30}{174} + 0.6\frac{2}{82} = 0.49 < 0.85\text{, OK and}$$

$$\frac{590}{832} + 0.86\frac{30}{174} + 0.6\frac{2}{82} = 0.87 > 0.86\text{, unsatisfactory}$$

Even more simplification

For even simpler verification checks, the most conservative terms from the simplified expressions above may be taken and combined as a single expression. This conservative expression will appear in the Institution of Structural Engineers' Manual:

$$\frac{N_{Ed}}{N_{b,Rd,minimum}} + \frac{M_{y,Ed}}{M_{b,Rd,y}} + C_{mz}\frac{M_{z,Ed}}{M_{z,Rk}} \leq 0.78$$

The interaction limit may be increased to 0.86 using Figure 6, in which case the expression becomes:

$$\frac{590}{832} + \frac{30}{174} + 0.6\frac{2}{82} = 0.90 > 0.86\text{, unsatisfactory.}$$

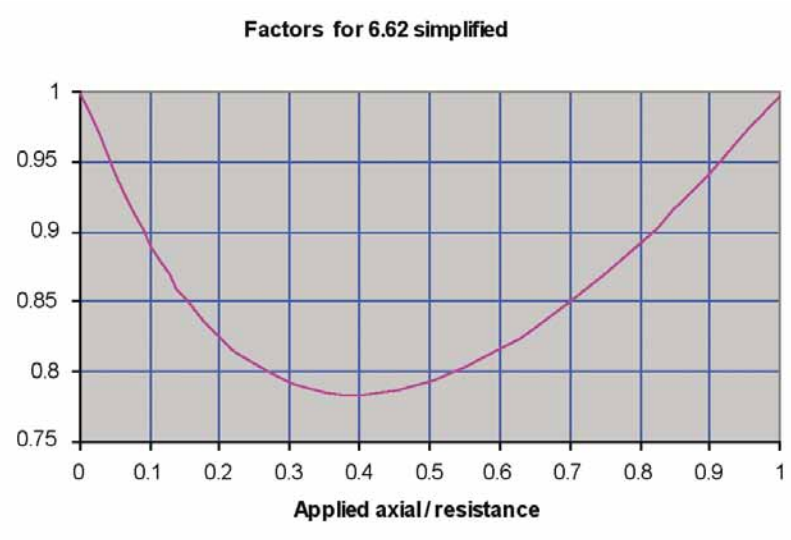


Figure 6 Variation of 6.62 factors with axial load / resistance

> p37

The Dartford Bridge

The Dartford Bridge, now well into construction, is the most significant steel bridge to be built in Great Britain since the completion of Humber and Kessock in 1981 and 1982. The total length of 2,872m will make it the second longest bridge in Britain and third longest in Europe. It includes a crossing of the Thames in a 450m cable stayed span, the longest of its type in Europe and second equal longest in the world.

The arrangements for promotion and construction of the bridge, which will double the capacity of the existing tunnel crossing at Dartford, are novel, the project being entirely privately funded. A company, Dartford River Crossing Ltd (DRC) was formed by Trafalgar House and three financial organisations to take over the tunnels, construct the bridge and operate the combined toll crossing for a concession period of 20 years. DRC then placed a contract for design and construction of the bridge with a consortium of Cementation Construction Ltd, responsible for the subs structures and other concrete works, and Cleveland Bridge, responsible for the steel superstructures. Cleveland Bridge designed the superstructure of the approach viaducts in their own design office. For the cable stayed bridge superstructure they employed Dr Ing H Homberg and Partner of Hagen, West Germany, who had collaborated with them for the Kessock and other bridges. The sub-structures were designed for Cementation Construction by TH Technology Ltd.

The traffic arrangement is unusual. The bridge will have four lanes undivided and will normally carry all southbound traffic. The two 2-lane tunnels will take all northbound traffic. Diversion of traffic between the tunnels and bridge will be provided for, in the event of breakdowns or other emergencies, exceptional weather or to deal with the transport of special or dangerous goods. The bridge has been designed to take live loading to

Department of Transport BD 23/84, subsequently the heaviest in the world, including the case of any cable removed for repair or replacement.

The new crossing comprises approach viaducts of 21 spans, generally 50.67m on the north side and similar spans on the south side, leading to a cable stayed bridge with a main span on 450m and three back spans or anchor spans on either side, totalling 812m. The deck rises to give clearance of 57.5m over the navigation channel, thus requiring a gradient on the south, downhill, approach of 4%.

The viaducts consist of five lines of continuous plate girders 2.6m deep with composite reinforced concrete deck slab supported on single stem piers with concrete cross heads. Four lines of inspection walkways are provided throughout their length.

The cable stayed bridge is a development of the Kessock design, the deck structure being of open plate girder construction only two metres deep with steel and composite concrete roadway. This allows normal and easily replaceable hot rolled asphalt surfacing to be used. The main span deck is supported along each edge by two systems of 28 individual cables, in a modified harp pattern, from steel box pylons rising to a height of 137m above water level, with corresponding cables to anchorages along the back spans. To cater for uplift in normal loading conditions, the back spans deck is connected to its piers by steel pendel links. The cables are round wire spiral strands and include the largest size of these yet made for bridge work with a guaranteed minimum breaking strength of 2,280t. The main and pendel piers below deck level consist of individual slip-formed concrete legs. The transition piers at the junctions with the approach viaducts are massive slabs, to provide a visual break between the different types of construction.

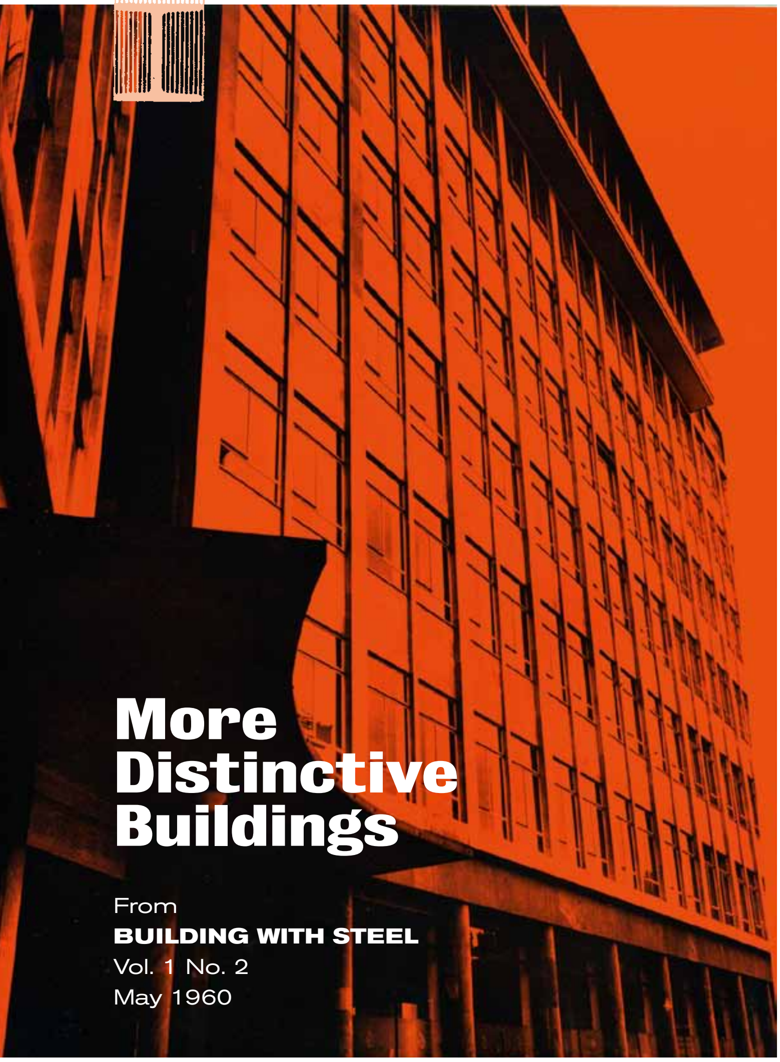
The total weight of structural steel and cable in the crossing is over 20,000t. With the object of assured rapid construction and minimum weather interference, all site connections are by high strength friction grip bolts, of which there are over three quarters of a million.

An extensive series of wind tunnel tests was carried out on a full aero-elastic model of the cable stayed bridge to prove aerodynamic stability in the final and erection conditions in wind regimes representative of the actual site.

Erection of the viaduct steelwork is by heavy crawler cranes, lifting pre-assembled groups and girders and cross bracing, working progressively from each abutment to the transition piers. This is complicated by crossings of a main line railway and main road and by the proximity of two overhead electric transmission lines. Ground conditions have been found to be very poor and much local reinforcement is necessary for operation of the cranes. deck slab concreting follows progressively in a predetermined sequence behind the steel erection.

The design of the cable stayed bridge has been based on using the largest in-shore floating cranes to erect the main girders of the back spans in span length pieces and the steel pylons in only three pieces to each leg. The remaining back span deck steelwork is erected by special derricks travelling on the deck. these derricks then erect the entire main span in 15m bays, the cables being installed and tensioned on each bay before proceeding to the next. As the contract programme requires the cable-stayed bridge superstructure to be erected before the approach viaducts are completed, all material has to be lifted up 50m at each transition pier by two large capacity tower cranes. by these means the main span is erected with no interference to the shipping channel.

The entire steelwork for the crossing is to be erected and the bridge completed for traffic in under two years, a world record for the size and type of structure, and the total construction period including for the substructure will be less than three years. At the time of writing, the substructure is virtually complete, about half the steelwork is erected on each viaduct with deck concrete following and steel erection is proceeding on the back spans on both sides of the cable stayed bridge. The new crossing is due to be completed in mid 1991.



More Distinctive Buildings

From
BUILDING WITH STEEL
Vol. 1 No. 2
May 1960

SALFORD CITY POLICE HEADQUARTERS

Salford

This building was specially designed for the administrative functions of a civil authority.

ARCHITECTS AND SURVEYORS: *Bradshaw Glass & Hope, Bolton*

BRITISH ENGINE, BOILER AND ELECTRICAL INSURANCE CO. LTD.

Manchester

Another example of the imaginative design of a modern commercial building.

ARCHITECTS: *H. S. Fairhurst and Son, Manchester*

GLASGOW UNIVERSITY ENGINEERING BLOCK

Glasgow

It is fair to say that in the design of schools and colleges, steel is an admirable medium in which to work.

ARCHITECTS: *Keppie, Henderson & Partners*

CONSULTING ENGINEERS: *Geo. Davie, Crawford & Partners*

C. & A. MODES LTD

Princes St, Edinburgh

The flexibility of structural steel is of particular value in contemporary store design: the example illustrated is one of a number of stores being built by this famous company.

ARCHITECTS: *North & Partners, Maidenhead*

ROYAL INSURANCE CO. LTD.

Manchester

An attractive commercial building of modern design, one of many such structures using steel being erected up and down the country.

ARCHITECTS: *H. S. Fairhurst and Son, Manchester*

AD 345
Load factors in BS 5950-1:2000 for crane loading

The purpose of this Advisory Desk Note is to update the advice in AD111 on the factors to be used in various load combinations for buildings with overhead travelling cranes. AD111 was based on the 1990 version of BS 5950-1 and guidance was needed because use of the values in Table 2 was not very clear. When the Standard was revised in 2000, Table 2 was made clearer; in particular the factors for combinations with crane loads with imposed loads. The Amendment in 2007 gave additional clarification by adding a Note to the Table. Nevertheless, the Advisory Desk still receives questions about combinations of loads when there are crane loads. This Advisory Desk Note provides further advice and supersedes AD111, which is now withdrawn. Any loadings which have been determined on the basis of AD111 will either be conservative or the same as the current Table 2 and this AD.

Generally, in the design of buildings, all possible combinations of loads should be considered. Load factors are applied to nominal loads according to the probable coexistence of the various loads. Where dead loads and vertical crane loads have a favourable effect (such as in resisting overturning) a load factor of unity is applied to those loads. The range of possible combinations of dead, imposed and wind loads, without crane loads, is not considered here. This AD Note only considers combinations when there are crane loads.

There are eight possible combinations that might occur. They may be expressed as follows:

LC1: 1.4D + 1.6V
LC2: 1.4D + 1.6H
LC3: 1.4D + 1.4V + 1.4H
LC4: 1.2D + 1.4I + 1.4V
LC5: 1.2D + 1.2I + 1.2H
LC6: 1.2D + 1.2I + 1.4V + 1.2H
LC7: 1.2D + 1.2W + 1.2V + 1.2H
LC8: 1.2D + 1.2I + 1.2W + 1.2V + 1.2H

Where
D is the dead load
I is the imposed load
W is the wind load
V is the vertical crane load (i.e. dynamic vertical wheel loads: which is self-weight of the crane plus the lifted load and the allowance for dynamic effects)
H is the horizontal crane load

All the above load factors have been taken from Table 2 of BS 5950-1:2000 (amended 2007). The relevant 'type of load' and associated load factor for each of these combinations is as follows:

Explanation for LC1 and LC2:
"Dead load except as follows" = 1.4
"Vertical crane loads" = 1.6
"Horizontal crane loads" = 1.6

Explanation for LC3:
"Dead load except as follows" = 1.4
"Vertical crane loads acting together with horizontal crane loads" = 1.4
"Horizontal crane loads acting together with vertical crane loads" = 1.4

Explanation for LC4:
"Dead load acting together with crane loads and imposed load combined" = 1.2
"Imposed load acting together with vertical crane loads" = 1.4
"Vertical crane loads acting together with imposed load" = 1.4

Explanation for LC5 and LC6:
"Dead load acting together with crane loads and imposed load combined" = 1.2
"Imposed load acting together with horizontal crane loads" = 1.2
"Horizontal crane loads acting together with imposed load" = 1.2
"Vertical crane loads acting together with imposed load" = 1.4

Explanation for LC7 and LC8:
"Dead load acting together with crane loads and wind load combined" = 1.2
"Wind load acting together with crane loads" = 1.2
"Crane loads acting together with wind load" = 1.2
"Imposed load acting together with horizontal crane loads" = 1.2
"Imposed load acting together with vertical crane loads" = 1.2

Contact: Abdul Malik
Tel: 01344 636525
Email: advisory@steel-sci.com

Technical

Bending and Compression to BS 5950 and BS EN 1993-1-1

Continued from p33

Observations

The "Blue book" will help with the major terms required when checking combined axial load and bending, but there is no escaping the fact that the determination of the *k* factors can be laborious by hand. The real answer for most structural economy is to use software, or at least a spreadsheet – help is available on *Steelbiz*. If a little conservatism can be tolerated, the simplified expressions found in Mike Banfi's paper are significantly less effort.

Columns in "simple construction" are a special case. A simplified interaction expression for this form of construction can be found on *Access-steel*.

New and Revised Codes & Standards

(from BSI Updates April 2010)

BS EN PUBLICATIONS

BS EN ISO 3506-2:2009
Mechanical properties of corrosion-resistant stainless steel fasteners. Nuts
Supersedes BS EN ISO 3506-2:1998

BS EN ISO 14713-1:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. General principles of design and corrosion resistance
Supersedes BS EN ISO 14713:1999

BS EN ISO 14713-2:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. Hot dip galvanizing
Supersedes BS EN ISO 14713:1999

BS EN ISO 14713-3:2009
Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. Sheradizing
Supersedes BS EN ISO 14713:1999

CORRIGENDA TO BRITISH STANDARDS

BS EN 1991-1-1:2002
Eurocode 1. Actions on structures. General actions. Densities, self-weight, imposed loads for buildings
CORRIGENDUM 2. *Also incorporates Corrigenda 1*

BS EN 1991-1-5:2003
Eurocode 1. Actions on structures. General actions. Thermal actions
CORRIGENDUM 2. *Also incorporates Corrigenda 1*

BS EN 1991-1-6:2005
Eurocode 1. Actions on structures. General actions. Actions during execution
CORRIGENDUM 1

BS EN 1993-1-1:2005
Eurocode 3. Design of steel structures. General rules and rules for buildings
CORRIGENDUM 2. *Also incorporates Corrigenda 1*

BS EN 1993-1-2:2005
Eurocode 3. Design of steel structures. General rules. Structural fire design
CORRIGENDUM 3. *Also incorporates Corrigenda 1 & 2*

BS EN 1993-1-5:2006
Eurocode 3. Design of steel structures. Plated structural elements
CORRIGENDUM 1

BS EN 1993-1-6:2007
Eurocode 3. Design of steel structures. Strength and stability of shell structures
CORRIGENDUM 1

BS EN 1993-1-7:2007
Eurocode 3. Design of steel structures. Plated structures subject to out of plane loading
CORRIGENDUM 1

BS EN 1993-1-8:2005
Eurocode 3. Design of steel structures. Design of joints
CORRIGENDUM 3 *Also incorporates Corrigenda 1 & 2*

BS EN 1993-1-9: 2005
Eurocode 3. Design of steel structures. Fatigue
CORRIGENDUM 3 *Also incorporates Corrigenda 1 & 2*

BS EN 1993-4-1:2007
Eurocode 3. Design of steel structures. Silos
CORRIGENDUM 1

BS EN 1993-4-2:2007
Eurocode 3. Design of steel structures. Tanks
CORRIGENDUM 1

BS EN 1994-1-2:2005
Eurocode 4. Design of composite steel and concrete structures. General rules. Structural fire design
CORRIGENDUM 1

BS EN 1994-2:2005
Eurocode 4. Design of composite steel and concrete structures. General rules and rules for bridges
CORRIGENDUM 1

BS EN 1998-1:2004
Eurocode 8. Design of structures for earthquake resistance. General rules, seismic actions and rules for buildings
CORRIGENDUM 1

UPDATED BRITISH STANDARDS

BS 5950-3.1:1990+A1:2010
Structural use of steelwork in building. Design in composite construction. Code of practice for design of simple and continuous composite beams
AMENDMENT 1

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – ADOPTIONS

10/30196793 DC
BS ISO 630-1 Structural steels. Part 1. General technical delivery conditions for hot rolled products

10/30196796 DC
BS ISO 630-2 Structural steels. Part 2. Technical delivery conditions for structural steels for general purposes

10/30207371 DC
BS ISO 4998 Continuous hot-dip zinc-coated carbon steel sheet of structural quality

10/30207386 DC
BS ISO 16160 Continuously hot-rolled steel sheet products. Dimensional and shape tolerances

10/30207389 DC
BS ISO 16162 Continuously cold-rolled steel sheet products. Dimensional and shape tolerances

10/30207392 DC
BS ISO 16163 Continuously hot-dipped coated steel sheet products. Dimensional and shape tolerances

CEN EUROPEAN STANDARDS

EN 1991-1-7:-
Eurocode 1. Actions on structures. General actions. Accidental actions
CORRIGENDUM 1: February 2010 to EN 1991-1 -7:2006

EN 1991-2:-
Eurocode 1. Actions on structures. Traffic loads on bridges
CORRIGENDUM 1 February 2010 to EN 1991-2:2003

EN 10283:2010
Corrosion resistant steel castings

ISO PUBLICATIONS

ISO 17635:2010
(Edition 2)
Non-destructive testing of welds. General rules for metallic materials
Will be implemented as an identical British Standard

ISO 23279:2010
(Edition 2)
Non-destructive testing of welds. Ultrasonic testing. Characterization of indications in welds
Will be implemented as an identical British Standard

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Steelwork contractors for buildings

BCSA is the national organisation for the steel construction industry.
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 Directory General, BCSA, 4 Whitehall Court, London SW1A 2ES
Tel: 020 7839 8566 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
- **QM** Quality management certification to ISO 9001

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	Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●										Up to £1,400,000
ACL Structures Ltd	01258 456051			●	●	●	●				●				●		Up to £3,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●		Up to £3,000,000
Adstone Construction Ltd	01905 794561			●	●	●											Up to £4,000,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●	✓	Up to £800,000
Andrew Mannion Structural Engineers Ltd	00 353 90 644 8300		●	●	●	●	●	●			●	●		●		✓	Up to £3,000,000
Angle Ring Company Ltd	0121 557 7241												●				Up to £1,400,000
Apex Steel Structures Ltd	01268 660828				●		●			●	●						Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●		●	●					Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●		Up to £800,000*
ASD Westok Ltd	01924 264121												●				Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●					●	●			●	●	✓	Up to £1,400,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	Above £6,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●		●							●			Up to £2,000,000
AWF Steel Ltd	01236 457960				●				●	●	●			●	●		Up to £400,000
B D Structures Ltd	01942 817770			●	●	●	●				●			●			Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✓	Up to £2,000,000
Barnshaw Section Benders Ltd	01902 880848												●			✓	Up to £800,000
Barrett Steel Buildings Ltd	01274 266800			●	●	●	●									✓	Up to £6,000,000
Barretts of Aspley Ltd	01525 280136			●	●	●				●	●			●	●		Up to £3,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●							●			Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Browne Structures Ltd	01283 212720				●			●							●		Up to £400,000
Cairnhill Structures Ltd	01236 449393				●	●	●	●		●	●			●	●	✓	Up to £1,400,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●			●	●		●		✓	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●		Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓	Up to £3,000,000
Cougar Steel Stairs Ltd	01274 266800									●					●	✓	Up to £6,000,000*
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●		Up to £1,400,000
Crown Structural Engineering Ltd	01623 490555			●	●	●	●		●		●			●		✓	Up to £800,000
D A Green & Sons Ltd	01406 370585		●	●	●	●	●	●	●	●	●	●		●	●	✓	Up to £6,000,000
D H Structures Ltd	01785 246269				●						●						Up to £40,000
Deconsys Technology Ltd	01274 521700				●					●				●	●		Up to £200,000
Discain Project Services Ltd	01604 787276				●					●	●				●	✓	Up to £1,400,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●					✓	Up to £6,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	Up to £6,000,000
Emmett Fabrications Ltd	01274 597484			●	●	●	●							●			Up to £1,400,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	Up to £3,000,000
F J Booth & Partners Ltd	01642 241581			●	●		●				●				●	✓	Up to £4,000,000
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	Above £6,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●						Up to £3,000,000

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
Gibbs Engineering Ltd	01278 455253				●		●	●		●	●				●	✓	Up to £200,000
GME Structures Ltd	01939 233023			●	●		●	●		●	●			●	●		Up to £800,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●			Up to £1,400,000
Graham Wood Structural Ltd	01903 755991		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000
Grays Engineering (Contracts) Ltd	01375 372411				●			●		●	●				●		Up to £100,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●				✓	Up to £4,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●						Up to £2,000,000
Had Fab Ltd	01875 611711								●		●				●	✓	Up to £1,400,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●					Up to £2,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121			●	●	●	●	●									Up to £6,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●		Up to £4,000,000
Hills of Shoeburyness Ltd	01702 296321									●	●				●		Up to £800,000
J Robertson & Co Ltd	01255 672855									●	●				●		Up to £200,000
James Bros (Hamworthy) Ltd	01202 673815			●	●		●			●	●	●			●	✓	Up to £2,000,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●		●			Up to £6,000,000*
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						Up to £1,400,000
Leonard Engineering (Ballybay) Ltd	00 353 42 974 1099			●	●	●	●				●						Up to £3,000,000
Lowe Engineering (Midland) Ltd	01889 563244									●	●			●	●	✓	Up to £400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓	Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		Up to £1,400,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Maldon Marine Ltd	01621 859000				●			●	●	●					●		Up to £1,400,000
Midland Steel Structures Ltd	024 7644 5584			●	●	●	●			●	●	●		●	●		Up to £2,000,000
Mifflin Construction Ltd	01568 613311		●	●	●	●	●				●						Up to £3,000,000
Milltown Engineering Ltd	00 353 59 972 7119			●	●	●	●	●									Up to £6,000,000
Newbridge Engineering Ltd	01429 866722			●	●	●	●								●	✓	Up to £1,400,000
Newton Fabrications Ltd	01292 269135			●	●	●				●	●	●			●	✓	Up to £4,000,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✓	Up to £4,000,000
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●		Up to £400,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		Up to £1,400,000
Paddy Wall & Sons	00 353 51 420 515			●	●	●	●	●	●	●	●					✓	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●		●	●			●				●	✓	Up to £2,000,000
Peter Marshall (Fire Escapes) Ltd	0113 307 6730									●					●		Up to £1,400,000
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		Up to £1,400,000
REIDsteel	01202 483333		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000*
Remnant Engineering Ltd	01564 841160				●		●	●		●					●	✓	Up to £400,000*
Rippin Ltd	01383 518610			●	●	●	●	●									Up to £1,400,000
Robinson	01332 574711		●	●	●	●	●		●	●	●	●		●	●	✓	Above £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Rowen Structures Ltd	01773 860086		●	●	●	●	●	●	●	●	●	●		●			Above £6,000,000*
RSL (South West) Ltd	01460 67373			●	●		●				●						Up to £1,400,000
S H Structures Ltd	01977 681931						●	●	●	●							Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Shipley Fabrications Ltd	01400 231115			●	●	●	●		●	●	●				●		Up to £200,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●	●		●	●				✓	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●				●	●				✓	Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●		Up to £2,000,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		Up to £800,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●	●			●		Up to £400,000
Terence McCormack Ltd	028 3026 2261			●	●		●	●									Up to £800,000
The AA Group Ltd	01695 50123			●	●	●	●			●	●				●		Up to £4,000,000
Traditional Structures Ltd	01922 414172		●	●	●	●	●	●	●		●	●		●		✓	Up to £4,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		Up to £4,000,000
W I G Engineering Ltd	01869 320515				●					●					●		Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✓	Up to £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●			●			●	●	●	●				●	✓	Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●					✓	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)

Associate Members

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9
AceCad Software Ltd	01332 545800		●							
Advanced Steel Services Ltd	01772 259822								●	
Albion Sections Ltd	0121 553 1877	●								
Andrews Fasteners Ltd	0113 246 9992									●
ArcelorMittal Distribution – Bristol	01454 311442								●	
ArcelorMittal Distribution – Mid Glamorgan	01443 812181								●	
ArcelorMittal Distribution – Birkenhead	0151 647 4221								●	
ArcelorMittal Distribution – Scunthorpe	01724 810810								●	
Arro-Cad Ltd	01283 558206			●						
ASD metal services - Biddulph	01782 515152								●	
ASD metal services – Bodmin	01208 77066								●	
ASD metal services - Cardiff	029 2046 0622								●	
ASD metal services - Carlisle	01228 674766								●	
ASD metal services - Daventry	01327 876021								●	
ASD metal services - Durham	0191 492 2322								●	
ASD metal services - Edinburgh	0131 459 3200								●	
ASD metal services - Exeter	01395 233366								●	
ASD metal services - Grimsby	01472 353851								●	
ASD metal services - Hull	01482 633360								●	
ASD metal services – London	020 7476 0444								●	
ASD metal services - Norfolk	01553 761431								●	
ASD metal services - Stalbridge	01963 362646								●	
ASD metal services - Tividale	0121 520 1231								●	
Austin Trumanns Steel Ltd	0161 866 0266								●	
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●								
BAPP Group Ltd	01226 383824									●
Barnshaw Plate Bending Centre Ltd	0161 320 9696	●								
Barrett Steel Services Ltd	01274 682281								●	
Bentley Systems (UK) Ltd	0141 353 5168		●							
Cellbeam Ltd	01937 840600	●								
Cellshield Ltd	01937 840600							●		
CMC (UK) Ltd	029 2089 5260							●		
Composite Metal Flooring Ltd	01495 761080	●								
Composite Profiles UK Ltd	01202 659237	●								
Computer Services Consultants (UK) Ltd	0113 239 3000		●							
Cooper & Turner Ltd	0114 256 0057									●
Corus	01724 404040				●					
Corus Ireland Service Centre	028 9266 0747								●	
Corus Panels & Profiles	01684 856600	●								
Corus Service Centre Dublin	00 353 1 405 0300								●	
Corus Tubes	01536 402121				●					
Corus Wednesfield	01902 484100								●	
Daver Steels Ltd	0114 261 1999	●								
Development Design Detailing Services Ltd	01204 396606			●						
Easi-edge Ltd	01777 870901							●		
Fabsec Ltd	0845 094 2530	●								
Ficep (UK) Ltd	01924 223530					●				
FLI Structures	01452 722200	●								
Forward Protective Coatings Ltd	01623 748323						●			
GWS Engineering & Industrial Supplies Ltd	00 353 21 4875 878									●
Hempel UK Ltd	01633 874024						●			
Hi-Span Ltd	01953 603081	●								
Hilti (GB) Ltd	0800 886100									●
International Paint Ltd	0191 469 6111						●			
Interpipe UK Ltd	0845 226 7007								●	
Jack Tighe Ltd	01302 880360						●			
Kaltenbach Ltd	01234 213201					●				
Kingspan Structural Products	01944 712000	●								
LaserTUBE Cutting	0121 601 5000								●	
Leighs Paints	01204 521771						●			
Lindapter International	01274 521444									●
Metsec plc	0121 601 6000	●								
MSW Structural Floor Systems	0115 946 2316	●								
National Tube Stockholders Ltd	01845 577440								●	
Northern Steel Decking Ltd	01909 550054	●								
Northern Steel Decking Scotland Ltd	01505 328830	●								
John Parker & Sons Ltd	01227 783200								●	●
Peddinghaus Corporation UK Ltd	01952 200377					●				
Peddinghaus Corporation UK Ltd	00 353 87 2577 884					●				
PMR Fixers	01335 347629	●								
PP Protube Ltd	01744 818992	●								
PPG Performance Coatings UK Ltd	01773 837300						●			
Prodeck-Fixing Ltd	01278 780586	●								
Profast (Group) Ltd	00 353 1 456 6666									●
Rainham Steel Co Ltd	01708 522311								●	
Richard Lees Steel Decking Ltd	01335 300999	●								
Rösler UK	0151 482 0444					●				
Schöck Ltd	0845 241 3390	●								
Site Coat Services Ltd	01476 577473						●			
Steel Projects UK Ltd	0113 253 2171		●							
Steelstock (Burton-on-Trent) Ltd	01283 226161								●	
Structural Metal Decks Ltd	01202 718898	●								
Structural Sections Ltd	0121 555 1342	●								
Studwelders Ltd	01291 626048	●								
Tekla (UK) Ltd	0113 307 1200		●							
Tension Control Bolts Ltd	01948 667700									●
Voortman UK Ltd	01827 63300					●				
Wedge Group Galvanizing Ltd	01909 486384						●			

Company name Tel 1 2 3 4 5 6 7 8 9
Company name Tel 1 2 3 4 5 6 7 8 9

Corporate Members

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

Company name	Tel
Balfour Beatty Utility Solutions Ltd	01332 661491
Griffiths & Armour	0151 236 5656
Roger Pope Associates	01752 263636
Highways Agency	08457 504030

Steelwork contractors for bridgework

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
- **QM** Quality management certification to ISO 9001

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	FG	PG	TW	BA	CM	MB	RF	QM	Contract Value (1)
'N' Class Fabrication & Installation	01733 558989	●	●	●	●			●	✓	Up to £800,000
Andrew Mannion Structural Engineers Ltd*	00 353 90 644 8300	●	●	●	●				✓	Up to £3,000,000
Briton Fabricators Ltd*	0115 963 2901	●	●	●	●	●	●	●	✓	Up to £3,000,000
Cimolai Spa	01223 350876	●	●	●	●	●	●		✓	Above £6,000,000
Cleveland Bridge UK Ltd*	01325 502277	●	●	●	●	●	●	●	✓	Above £6,000,000*
Concrete & Timber Services Ltd	01484 606416	●	●	●		●	●		✓	Up to £800,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	✓	Up to £6,000,000
Interserve Project Services Ltd	0121 344 4888							●	✓	Above £6,000,000
Interserve Project Services Ltd	020 8311 5500	●	●	●	●		●	●	✓	Up to £400,000*
Mabey Bridge Ltd*	01291 623801	●	●	●	●	●	●	●	✓	Above £6,000,000
Nusteel Structures Ltd*	01303 268112	●	●	●	●	●		●	✓	Up to £4,000,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	✓	Up to £3,000,000*
Remnant Engineering Ltd*	01564 841160	●							✓	Up to £400,000*
Rowecord Engineering Ltd*	01633 250511	●	●	●	●	●	●	●	✓	Above £6,000,000
SIAC Butlers Steel Ltd*	00 353 57 862 3305	●	●	●	●	●		●	✓	Above £6,000,000
TEMA Engineering Ltd	029 2034 4556	●	●	●	●	●	●	●	✓	Up to £1,400,000*
Varley & Gulliver Ltd*	0121 773 2441	●						●	✓	Up to £4,000,000
Watson Steel Structures Ltd*	01204 699999	●	●	●	●	●	●	●	✓	Above £6,000,000

* Denotes membership of the BCSA