SEPTEMBER 2009 VOL 17 NO 8

NSC

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Blackburn goes continental
Flexible Liverpool school
Students shine in Awards

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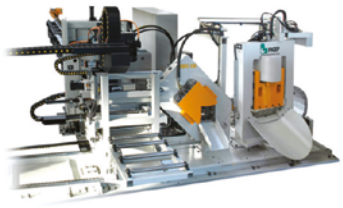

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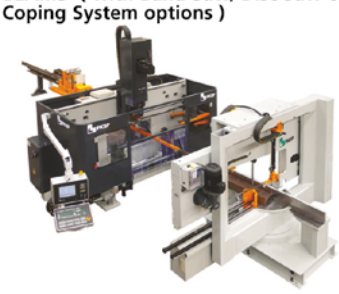

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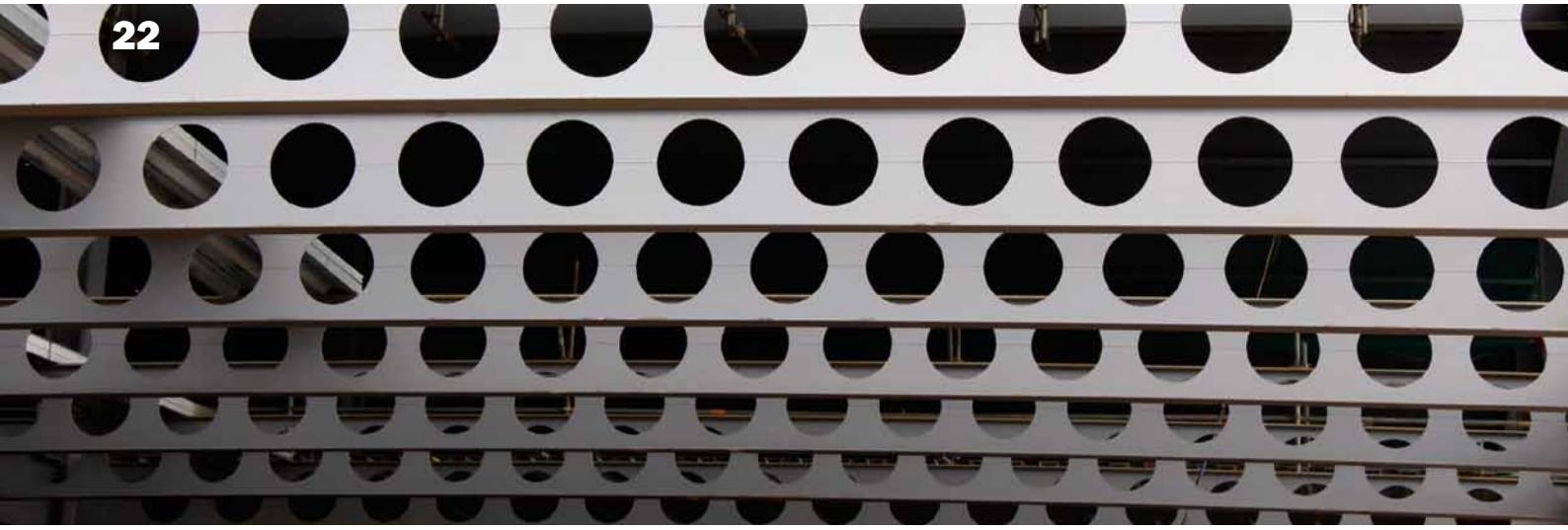
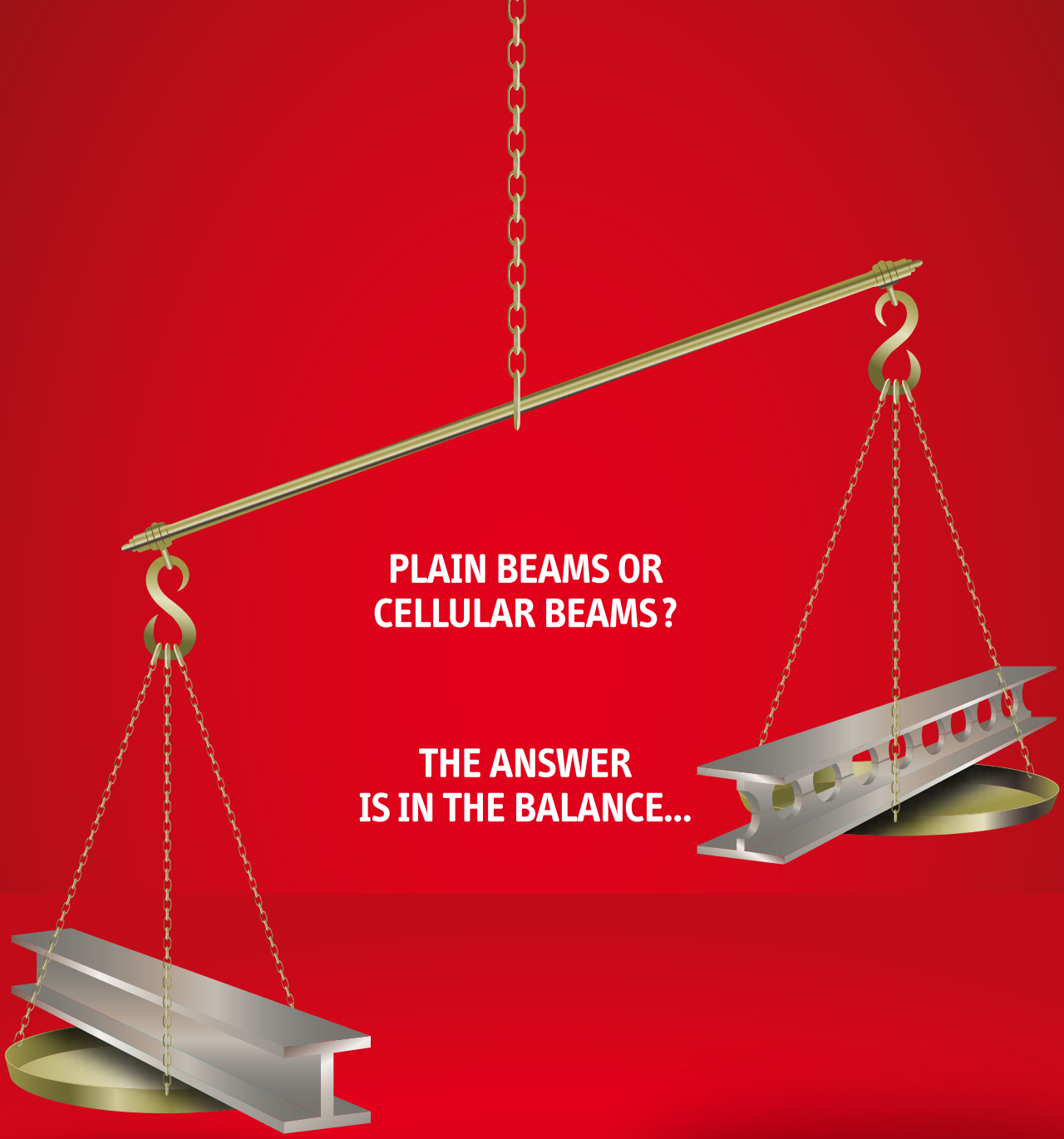


These and other steelwork articles can be downloaded from the New Steel Construction website at www.new-steel-construction.com

Cover Image
The Mall, Blackburn
Main Client: The Mall
Architect: Coleman Architects
Steelwork contractor: Robinson Construction
Steel tonnage: 2,500t



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NSC NEW STEEL CONSTRUCTION
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Sustainably essential steel

The steel construction sector has invested a great deal of time and money over the years in providing everything that a designer could need to make it easy to design in steel. Research and development has produced a wider range of detailed advice than is available to any other design community in the world. Finding out where it can all be accessed quickly is about to become even easier.

A new guide coming from Corus and the BCSA – The Steel Essentials Guide – reveals just how extensive this back up advice and help is and shows how to get at the crucial detail and who to ask for more advice. Steel Essentials is sure to deserve a place at the side of every busy designer, providing an at-the-fingertips guide to what is available and where to go to learn more about the key steel construction topics. All the information is also brought together on a new website – *www.steelessentials.info* – where key links will be found, as well as a downloadable pdf version of Steel Essentials.

Several other new initiatives have been under development during the summer months that will heighten the attractiveness of steel. Despite recession, sustainability remains high on the agenda for government, clients of the construction industry and for the entire steel supply chain. During the autumn we will learn more about the steel sector's Target Zero initiative, spreading the good news about the real facts concerning steel and carbon. The entire steel supply chain has recognised the crucial importance of lowering the carbon related impact of its activities.

The sector has devised a new Sustainability Strategy to be launched at a free seminar in October which spells out the already high sustainability performance of steel and details what further steps will be taken to support the government's drive towards sustainable construction (see News). The launch event will highlight steel's sustainability advantages, covering topics such as thermal mass and the carbon footprint of steel buildings.

Times remain tough in most markets and those now famous green shoots are having a hard time forcing their way through, but steel is still capturing the major share of business in key markets, and is proving to be the material of choice in most of the rare growth sectors like education and waste to energy plants. Thanks to initiatives like these, when the economic turn comes the steel sector will have an even greater depth and breadth of technical advice and back up than was available before, ensuring that designing and building in steel remains the easy as well as the economical option.

Nick Barrett - Editor

Guidance for Target Zero®

Target Zero, the joint BCSA and Corus initiative aimed at making zero carbon buildings a reality, will publish its first guidance document later this year.

The £1M three-year project will look at five major building types (schools, warehouses, offices, supermarkets and mixed-use) and will generate fully costed solutions demonstrating how to achieve the three highest BREEAM ratings and meet the anticipated changes to Part L of the Building Regulations.

Guidance will be produced for each building type, with the schools guidance document due to be available late 2009. The other four guidance documents will appear approximately every three months until all building types have been covered.

For more information and to register for newsletters and guidance documents, visit *www.targetzero.info*

Target Zero will provide designers with the guidance they need to meet emissions reduction targets towards the aspiration of zero carbon by 2019.

Building blocks in place for BSF school

Steelwork has been completed for the new educational block at Washington's Biddick School Sports College.

The project forms part of Sunderland City Council's BSF programme which has seen steelwork contractor Barrett Steel Buildings complete five schools on a design and build basis working for Balfour Beatty Construction.

Barrett Steel erected approximately 300t of structural steelwork for the job, as well as edge protection, precast stairs, metal decking and the concrete to the suspended floors.

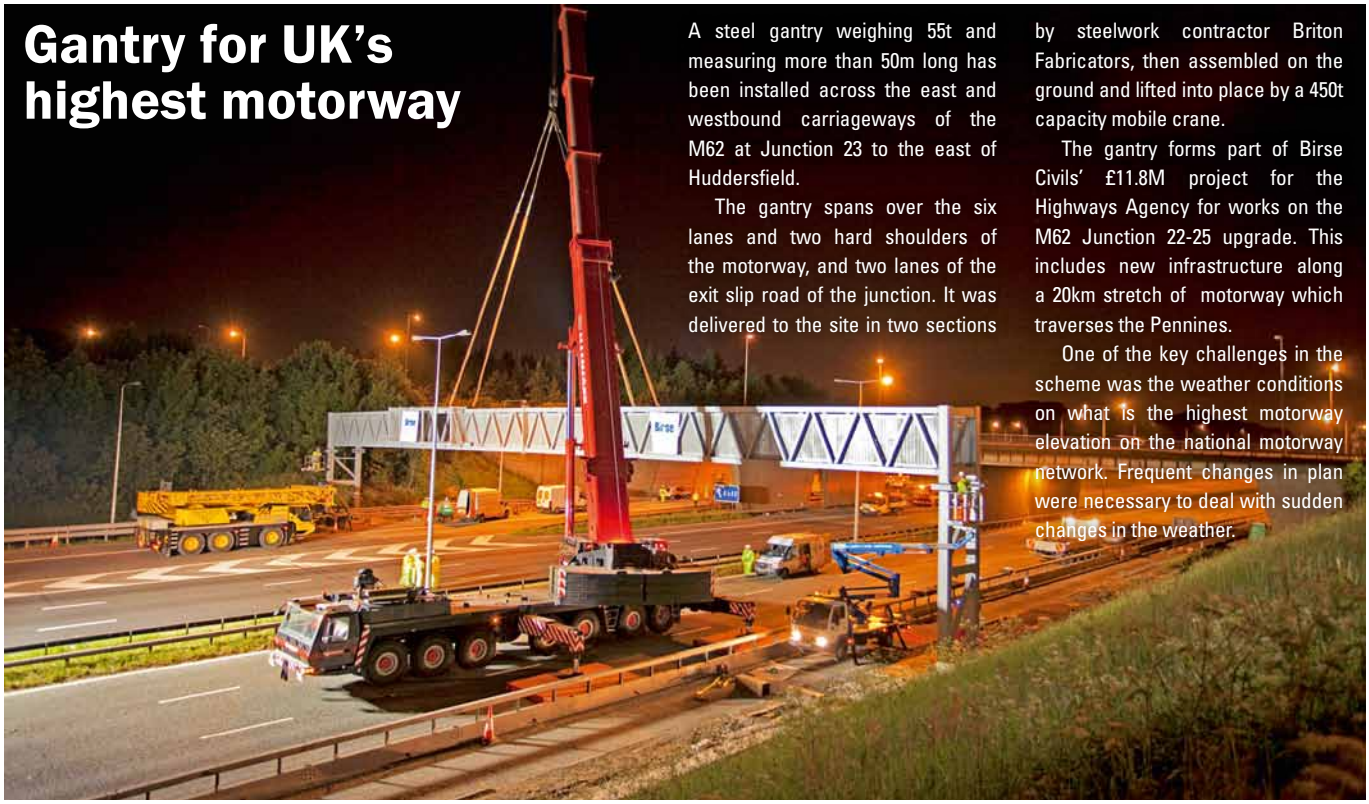
"The site was very confined as the new building is sandwiched between two existing blocks," said John Brennan, Joint Managing Director for Barrett Steel. "Consequently Balfour wanted a subcontractor that could undertake as many of the sub-trades as possible in order to keep subcontractors on site to a minimum."

To accommodate a sloping site the new building has a step in the ground floor slab. One end of the structure is two storeys high while the other end has three levels.

Prior to steelwork erection the ground floor slab was poured and readied by the groundworks team. This aided a speedy and easier steelwork programme said Mr Brennan. "We were working off a clean hard surface which allowed our team to finish ahead of schedule."

Biddick School is due to open by Spring 2010.

Gantry for UK's highest motorway



A steel gantry weighing 55t and measuring more than 50m long has been installed across the east and westbound carriageways of the M62 at Junction 23 to the east of Huddersfield.

The gantry spans over the six lanes and two hard shoulders of the motorway, and two lanes of the exit slip road of the junction. It was delivered to the site in two sections by steelwork contractor Briton Fabricators, then assembled on the ground and lifted into place by a 450t capacity mobile crane.

The gantry forms part of Birse Civils' £11.8M project for the Highways Agency for works on the M62 Junction 22-25 upgrade. This includes new infrastructure along a 20km stretch of motorway which traverses the Pennines.

One of the key challenges in the scheme was the weather conditions on what is the highest motorway elevation on the national motorway network. Frequent changes in plan were necessary to deal with sudden changes in the weather.

Roof starts to rise on Olympic Stadium

Steelwork for the London 2012 Olympic Stadium is nearing completion since the final section of the roof compression truss was lifted into place during August.

The roof has been constructed from 28 truss sections each 15m long x 13m wide and weighing 90t. Manufactured at Watson Steel Structure's Bolton facility, the trusses were brought to site and individually lifted into place by a 1,350t capacity crane.

"This is a ground-breaking project and the stadium will be extremely flexible," said Ian Crockford Project Sponsor for the Olympic Delivery Authority. "Over the coming months the cable net and then fabric roof will be lifted into place."

The stadium is highly sustainable, containing 10,000t of steel, making it the lightest Olympic Stadium to date.

"Because of the confined site and our wish to have a demountable stadium we have a compact and lightweight design," said Mr Crockford. "A stadium that will have a lasting legacy."

Steelwork contractor scoops supply chain accolade

Elland Steel Structures has won BAM Construction's National Quality Award for 2008 at BAM's Annual Supply Chain Awards ceremony.

The award was in recognition of Elland's overall performance in delivering quality throughout the year. This included the commercial and technical departments, right through to planning and production, and finally the handover of the completed structure.

Bob Thorpe, Elland Steel Chief Executive Director, said: "The Award is testament to the substantial financial investment put into our Halifax site, improving our quality, efficiency, and environmental impact. Our commitment to achieving continuous improved performance is widely recognised within our specialist industry.

Left to right: Mark Denham, Elland Steel Managing Director; James Wimpenny, BAM Construction North East Regional Director; and Bob Thorpe, Elland Steel Chief Executive Director

Innovation and sustainability reign at Galvanizing Awards

This year's winners of the seventeenth annual Galvanizing Awards were recently announced during a ceremony at the Royal Aeronautical Society in London.

This year the awards were divided into six categories with Gumuchdjian Architects winning the Galvanizing in Architecture award for St Marylebone School in London (below right). This project also won a commendation at last year's Structural Steel Design Awards.

Winner of the Sustainable Award was Bucholz McEvoy Architects for Elmpark Green Urban Quarter in Dublin (below left) , a project which took four years to complete and includes a hospital, hotel and apartments.

Other category winners were: Galvanizing in Engineering winner, Barr Technical Services for Colchester Community Stadium; Innovation Award, Roundhouse Building Solutions for The Roundhouse; and the Duplex Award winner was Tony Fretton Architects for Vassall Road Housing and Medical Centre in south London.

The Galvanizing in Detail Award was jointly awarded to Charles Barclay Architects for Kielder Observatory and Ian Moran for Springhill sculptures in Birmingham.

Speaking on behalf of the judging panel, Jan-Carlos Kucharek of the RIBA Journal, said: "The panel always look forward to judging the Galvanizing Awards. The generic and broad ranging nature of the categories and the applications means that sometimes the most incongruous projects can end up being directly compared."

AROUND THE PRESS

Construction News
13 August 2009
Show some steel to make up lost time
"In the end, we finished the steelwork erection ten weeks early, which was phenomenal," says Morgan Ashurst senior project co-ordinator Stuart Thompson. "That I guess, was the sheer focus and desire to achieve, despite the design issue that had occurred, maintaining its continuity into the production and the erection teams as well."

The Structural Engineer
21 July 2009
School design: blueprint for the future
At certain locations the structure consists of full height exposed vertical bracing, which is another aesthetic feature. A further unusual aspect of the building is that it does not have any ceilings; the intention is to impact semi-industrial character.

New Civil Engineer
6 August 2009
Flying high
Plans for an airport terminal to rival the elegance and ease of Heathrow airport's Terminal 5 were launched this week - Heathrow's Terminal 2A. In structural form the two are not very different. Both are steel framed, glass clad buildings and both are huge rectangular boxes.

Building
17 July 2009
Crazy angles, soaring steel
(Guangzhou Opera House) The structure looks like a flattish chunk of rock broken off a larger boulder, with its sharp edges softened by years of weathering. This freeform outer shell is made up of huge rectangular steel sections arranged as a triangulated structure.

The Structural Engineer
21 July 2009
Olympics 2012: the big build
The £244M Aquatics Centre is also under way on site. Its swooping whale-like roof, covered with aluminium and resting on three supports, will have a span of 160m, larger than Heathrow Terminal 5, and uses 2800t of steel.

CE Marking of structural steelwork published by BSI

The CE Marking standard for fabricated structural steelwork (BS EN 1090-1: 2009) has been published by BSI and has been available since 31 August 2009.

This harmonised standard allows CE Marking of fabricated structural steelwork and its scope covers buildings, bridges, towers and masts, tanks, silos including purlins, decking, sheeting, cladding, curved members, cellular beams and partially fabricated sections provided by stockholders and service centres.

The standard also has legal implications for stockholders, service centres, steelwork contractors and manufacturers of steel products. "This legal position is likely to change," said Dr David Moore, BCSA Director of Engineering.

"The Construction Products Directive (CPD) is currently being revised by the European Commission and is likely to change from a directive to a regulation."

This will mean CE Marking as a regulation will become mandatory in all member states including the UK and the Republic of Ireland. The revised CPD is about to enter its second reading and it is anticipated that it will be accepted by member states and come in to force in early 2012. CE Marking of fabricated steelwork will also then become mandatory in early 2012.

First bridge on new M74 lifted into place

The first of four major steel bridges along the M74 Completion project in Glasgow was lifted into place during August.

Known as the M8 Link Bridge, the 232m long steel composite structure will connect the existing M8's eastbound carriageways to those of the new M74. Steelwork for the bridge was delivered to site in 20 sections, ranging in size between 16m to 34m long, and weighing between 40t and 70t.

Once on site these fabricated girders were welded together to form eight large girders weighing up to 200t each and 70m long.

The girders were lifted into place, to form the bridge, two each night during four weekend partial and full carriageway closures of the M8. The lifting operation required the use of the UK's largest mobile crane, a 1,200t capacity Gottwald AK-680.

"We were delighted to reach this important milestone on the project," said Interlink M74 JV Project Director David Welsh. "The works are already visible and these beams, which will be seen by thousands of motorists each day, emphasise the significant progress being made on this job."

Over the next year three more steel bridges will be erected along the new five mile stretch of the M74 by steelwork contractor Cleveland Bridge. These consist of the 750m long Port Eglinton Viaduct, the 186m long Rutherglen Station Bridge and the Auchenshuggle Bridge across the River Clyde.

Main contractor for the project is Interlink M74 JV, a joint venture comprising Balfour Beatty, Morgan Est, Morrison Construction and Sir Robert McAlpine.

Steel secures Innovation Award from Network Rail

FLI Structures has won the Network Rail Partnership Award for Innovation at a prestigious event held at The Hilton Metropole, Birmingham.

The award was primarily for FLI's Light RDS steel grillage supported on steel piles which is made for sites with tight access. This product is 40% cheaper than the standard RDS system and is more compact and foldable.

The FLI team collect their award from comedian Jimmy Carr

The new grillages can be delivered to and installed on sites with restricted access and FLI estimates the product will result in Network Rail saving £1.65M on foundations.

Sustainability strategy launched by steel sector

Corus, the British Constructional Steelwork Association and SCI have worked together for many years to promote the effective use of structural steelwork. Sustainability is top of the construction agenda and steel is unrivalled in proving its value for meeting the challenges which lay ahead.

On Wednesday 28 October, a new Steel Sector Sustainability Strategy will be launched at a special event to be held at the Cavendish Conference Centre in London. The strategy sets out the steel construction industry's position on sustainability and the key related issues.

In addition to the launch of the new strategy, the event will include presentations and guidance from industry experts on a wide range of topics.

They include design of low carbon buildings, thermal mass, the carbon footprint of steel buildings and an introduction to developing technologies from the steel sector.

The event is 'free of charge' and will be supported by the new 'Steel Sector Sustainability Strategy' brochure.

Registration in advance is required to secure a place and will be on a first come, first served basis.

To register online visit *www.corusevents.com* or email your full details to *events@corusgroup.com*.

City's tallest tower takes shape

The steel frame for the Heron Tower is now more than halfway complete, with construction of the 46-storey building having surpassed level 24.

When complete in 2011 Heron Tower will be the tallest building in the City of London, standing at 202m high with a radio mast adding a further 30m to the overall height.

Working on behalf of main contractor Skanska, Severfield-Reeve will eventually erect approximately 11,000t of structural steel for the project, which will amount to some 8,500 pieces.

The development will provide 42,873m^2 of internal space providing office accommodation for more than 4,000 staff.

Overall the building will comprise three basement levels, three concourse levels incorporating entrance foyers and retail areas, 36 storeys of offices from levels 2 to 37, restaurants and bars from levels 38 to 40, and then six floors of plant.

Sustainability has played a key element in the building's design, with each elevation responding to its orientation. The southern elevation incorporates photovoltaic glass, cooled by recycled air to reduce energy consumption.

The steel structure is clad in stainless steel curtain walling incorporating natural ventilation to the east and west facades.

Heathrow takes off with new hotel

Main contractor John Sisk & Son has awarded the contract for the erection of structural steelwork on a new 350 bed Hilton Hotel at Heathrow Airport's Terminal 5 to Atlas Ward Structures.

The main part of the hotel consists of a five-storey structure containing a central atrium and three two-storey hotel wings - north, east and west - radiating off of the main building.

Atlas Ward will erect more than 1,600t of steelwork for the project, including a central 50t truss over the atrium. This large section measuring 28m will carry the loadings, derived from the rooftop plant, back down to the main structure.

Bill Armstrong, Atlas Ward Project Manager, said: "There are conference facilities incorporated into the east wing and consequently we've had to use some heavy plate girders to achieve the required clear spans."

The project is due for completion in December 2010.

NEWS IN BRIEF

CSC's structural design software Fastrak and Orion are now both fully compatible with the latest version of Autodesk's Revit Structure 2010. To share models between Fastrak/Orion and Revit a free download is available from *www.cscworld.com*

Lindapter has launched 'Assembly Selector' an innovative tool that allows a designer to select the type of steel sections they intend to connect, resulting in the software suggesting an appropriate Lindapter configuration. The assembly is presented in an integrated SolidWorks windows and can be rotated in 3D and manipulated to clearly illustrate the connection and individual components.

Leighs Paints supplied around 20,000 litres of its FIRETEX paint for Wimbledon's new iconic retractable roof. Selected by steelwork contractor Watson Steel Structures, FIRETEX coatings are designed to chemically react, in the event of a fire, to protect the steel and lengthen the time taken for it to reach its critical failure temperature.

The Steel Construction Certification Scheme has been accredited by UKAS for the National Highways Sector Scheme 19A – for Corrosion Protection of ferrous materials by industrial coatings. The SCCS is now carrying out certification assessments to the above scheme. This certification process will complement any existing BS EN ISO9001:2008 certified systems.

A new guide offering helpful advice and useful reference across a number of steel construction topics will be jointly published by the BCSA and Corus during September and available free with the October issue of NSC. The pocket-sized guide known as **Steel Essentials** is also complemented by a website - *www.steelessentials.info* - which includes links to reference works as well as sources of further information and a downloadable version of the guide.

Worcester's pavilion opens new innings

Worcestershire County Cricket Club opened the new £2M Graeme Hick Pavilion at its New Road ground at the start of the current cricket season.

Named after the world-famous county and England cricketer, the structure forms the first phase of the Club's redevelopment plans for the ground.

The new structure replaces an old stand which dates back to 1899. This wooden structure was completely dismantled and containerised for reconstruction as part of future phases of the development.

"Work was carried out from September to April, so as not to interfere with the cricket," explained Glyn Thomas, Project Manager of construction consultancy McBains Cooper.

"Once the old stand was gone the site was piled and the new structure's concrete podium was cast."

Above the podium level the new pavilion is a two-storey steel-framed structure housing changing rooms, umpires' room, cricket offices, players' dining room and physiotherapy/rehab area, as well as a new members' lounge and spectator seating.

"It's a contemporary design and the podium means it has been built 3m above the flood plain to ensure continuity of business," added Thomas.

Steelwork contractor for the project was Traditional Structures.

Albion building higher education

The £18.6M redevelopment project at St John's School & Community College in Marlborough, Wlitshire is nearing completion and the premises are scheduled to open this October.

Working on behalf of main contractor ISG Pearce, Albion Sections has supplied more than 77t of C-section steel, totalling 17,500m in length, to the project.

The overall works at the secondary school include the construction of five teaching blocks interlinked with walkways, a new entrance road and coach park, re-profiling the existing playing fields to a Sport England standard, and the supply of temporary classrooms for the duration of the project.

Corus Colors launches refurbishment website

Corus has launched a new digitally advanced website – *www.beatthewolf.com* – designed to provide customers with all the advice, support and information they need for a successful refurbishment project.

David Taylor, Business Development Manager for Corus Colors, said: "We are experts in refurbishment and it is important that the sector knows what benefits our Colorcoat products and services can offer.

"Our new refurbishment website features all the latest digital tools and widgets, such as our very own Refurb TV channel, an ask the expert function and a live twitter and blog feed, as well as plenty of refurbishment case studies."

In addition to the new website, Corus will also be using social media channels such as LinkedIn, twitter and YouTube which aim to provide help and guidance to the growing online refurbishment communities on a range of different issues and topics. These include resale and rental yield, asbestos, health and safety, reducing operational costs and the right type of refurbishment for different types of property.

Countdown to Eurocode Implementation

March 2009 | April 2009 | May 2009 | June 2009 | July 2009 | August 2009 | **September 2009** | October 2009 | November 2009 | December 2009 | January 2010 | February 2010 | March 2010 | April 2010 | May 2010

In March 2010 the suite of European loading and design standards for construction, the Eurocodes, will come in to force. The Eurocodes cover the design of buildings, bridges, towers and masts and most construction works in all the major construction materials including steel, concrete, composite (steel and concrete), timber, masonry and aluminium. Each Eurocode will be accompanied by a National Annex which will set the values of the partial safety factors and other nationally determined parameters (NDPs) for use with the Eurocodes. For those wishing to use the Eurocodes the BCSA, Corus and SCI have produced a series of helpful design guides. These include:

Steel building design: Introduction to the Eurocodes
This is a high level document that introduces the Eurocode system and sets out the format used. It also explains the relationships between the Eurocodes, the National Annexes and Non-conflicting complementary Information (NCCI).

Steel building design: Concise Eurocode
This publication provides a concise compilation of the design recommendations for common building design in the UK based on the Eurocodes and the UK National Annexes.

Steel building design: Design data (Blue book)
This publication presents design data in tabular format to assist engineers who are designing buildings in accordance with BS EN 1993-1-1: 2005, BS EN 1993-1-5: 2006 and BS EN 1993-1-8: 2005 and their respective National Annexes.

Steel building design: Worked Examples – Open sections
Includes worked examples for open sections and connections to the Eurocodes. These include restrained and un-restrained beams, columns in simple construction and simple connections (flexible end-plate).

Steel building design: Worked Examples – Hollow sections
Worked examples for hollow sections members including ties, beams, and columns in simple construction.

Steel building design: Worked examples for students
This publication presents a brief introduction to the Eurocode system and worked examples based on a multi-storey buildings. Members (beams and columns) are taken for a multi-storey building and designed to the Eurocodes.

Handbook of Structural Steelwork (Eurocode version) (Red book)
This is a practical guide to the design of structural steel elements for buildings. The guidance is in accordance with BS EN 1993-1-1: 2005 and where appropriate worked examples are presented.

Joints in Steel Construction – Simple Connections (Eurocode version)
This publication provides design guidance for structural steelwork connections for use in buildings design in accordance with the recommendations given in BS EN 1993-1-1 and BS EN 1993-1-8 and their National Annexes.

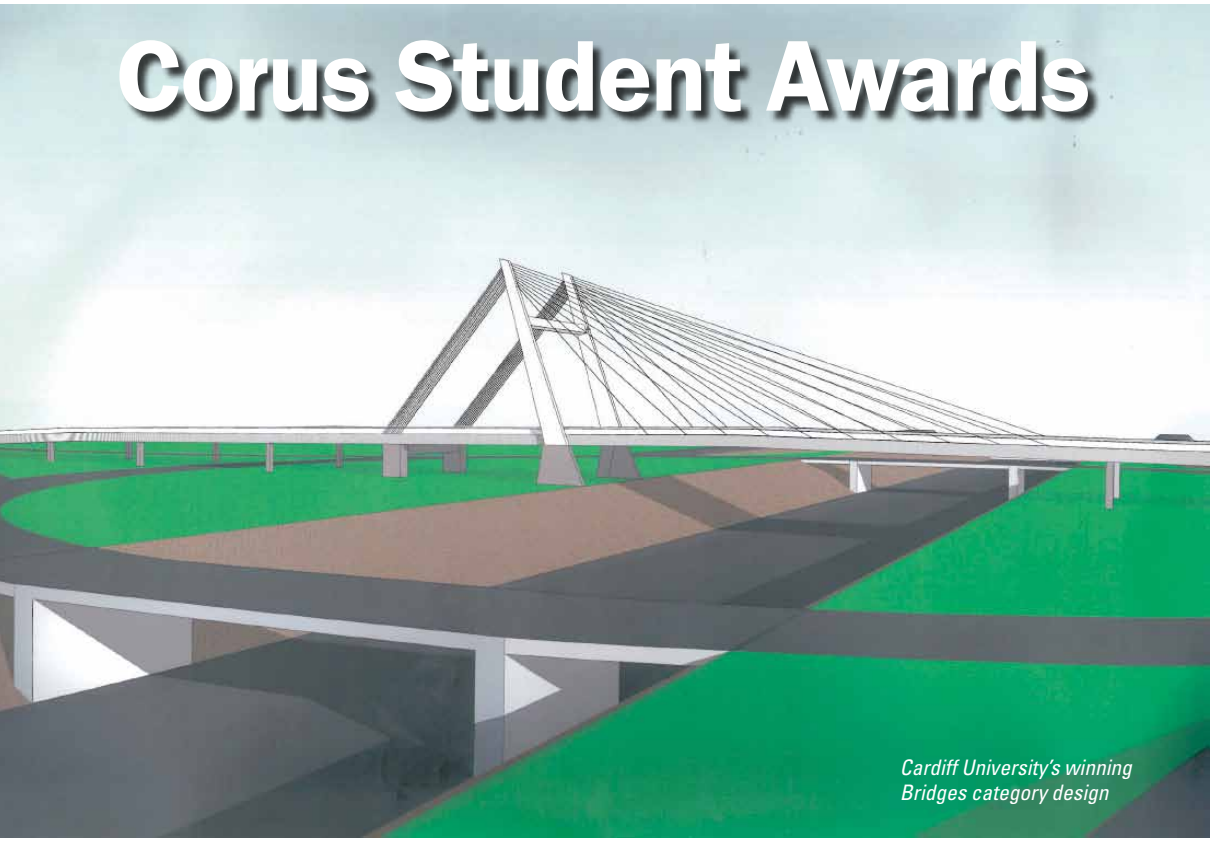
Design of medium-rise buildings
This is a Eurocode update of the existing publication on the design of medium rise buildings.

Combined Torsion and Bending
This is a Eurocode update of the existing publication on torsion and bending

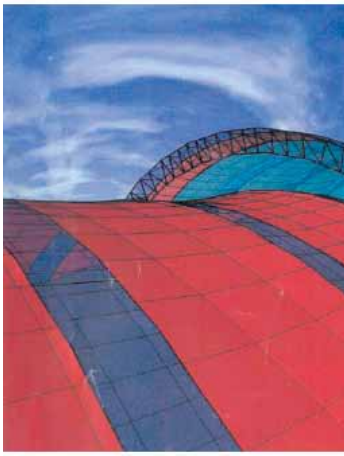
Eurocode Load Combinations for Steel Structures
This publication presents practical guidance on combinations of actions (load combinations) for two principal types of steel structure – multi-storey buildings and industrial buildings.

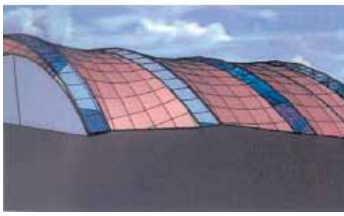
These design guides will be launched at a Eurocode seminar to be held in November 2009.

Corus Student Awards



Cardiff University's winning Bridges category design





Above: Four images of University of Southampton's winning Structures design

Right: Bridges category winner Jay Patel (left) of Cardiff University with Professor R Lark

A structure to enclose a winter sports facility or a bridge to carry a dual carriageway over a grade separated interchange were this year's competition requirements.

The 2009 Corus Student Design Awards - the 21st in its history - once again revealed the depth of architectural and engineering talent that is coming through UK universities and colleges, said Corus Chief Executive Officer Kirby Adams, who made this year's presentations at London's Science Museum in early July.

"The future of steel construction design looks secure, judging by the standard of this year's entries," said Mr Adams. "The winning teams showed a high level of innovation and design skill, with a developed appreciation of what steel can achieve. My congratulations go to them all."

The awards which were created 21 years ago to acknowledge excellence in steel design among undergraduates, were divided into two categories. The first - Structures - required and challenged students to produce an outline design for a structure to enclose a winter sports facility, including an artificial ski slope, an ice skating rink and a climbing wall.

Individuality and flair were among the qualities the judges were looking for. The Structures first prize went to the University of Southampton, whose entry comprised a series of trussed arches that the judges panel, chaired by Alan Jones of SKM anthony hunts, said has real architectural presence.

Second and third places in the Structures category went to the University of Sheffield and Swansea University respectively.

Cardiff University was awarded the Bridges prize, with the judges panel, chaired by Barry Mawson of Capita Symonds, commenting particularly on the good conceptual design of the approach spans, and good clear drawings.

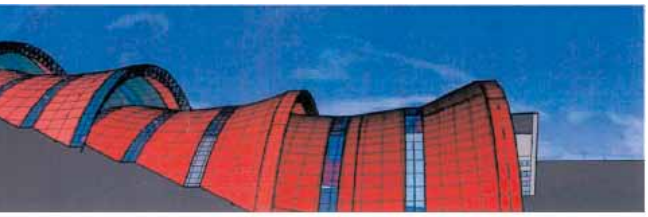
"The future of steel construction design looks secure, judging by the standard of this year's entries."

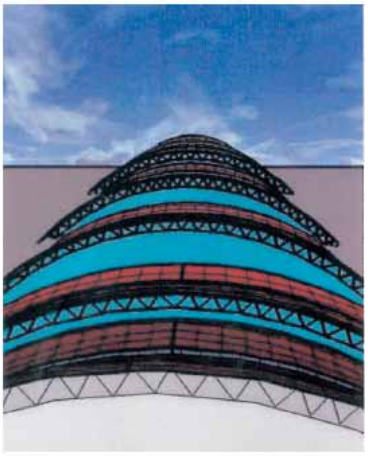
The brief for the Bridges category was to design a structure to carry a dual carriageway over a grade separated interchange with a motorway. An elegant structural solution had to be produced, demonstrating sound engineering and structural design skills.

Anglia Ruskin University London was awarded second place in the Bridges category, while Edinburgh University took third prize.

Mr Adams concluded: "Corus has for long fostered and helped develop the engineering and architectural talent of the future, and we are committed to maintaining that commitment even in todays' testing economic environment. Each category in this year's competition received a very high level of interest from the UK's student design community, which shows that they value the recognition these awards give to their hard work."

Right: The University of Southampton team, winners of the Structures category. L-R Rohan Mehpa, Laura Lee, Mark Eaden and Paolo Faccioli





Architectural Award announced

Also announced at the same ceremony at London's Science Museum were the Corus Student Awards - Architecture.

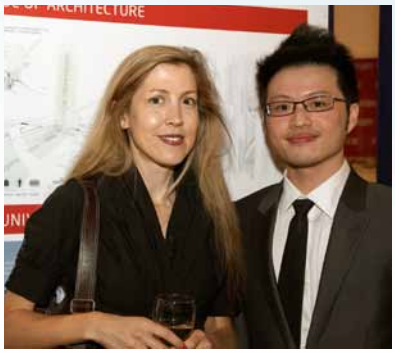
Manchester School of Architecture's winning entry was described by the judges panel, chaired by David Bonnett of David Bonnett Associates, as terrific and very elegant, and was an idea that had not been seen before.

The design brief for the Architecture award was to produce a design for Community One, a 'vertical community' where people would live, work and use leisure facilities under one roof instead of increasing pollution through travelling.

Second place went to Oxford Brookes University and third spot to Leicester School of Architecture.

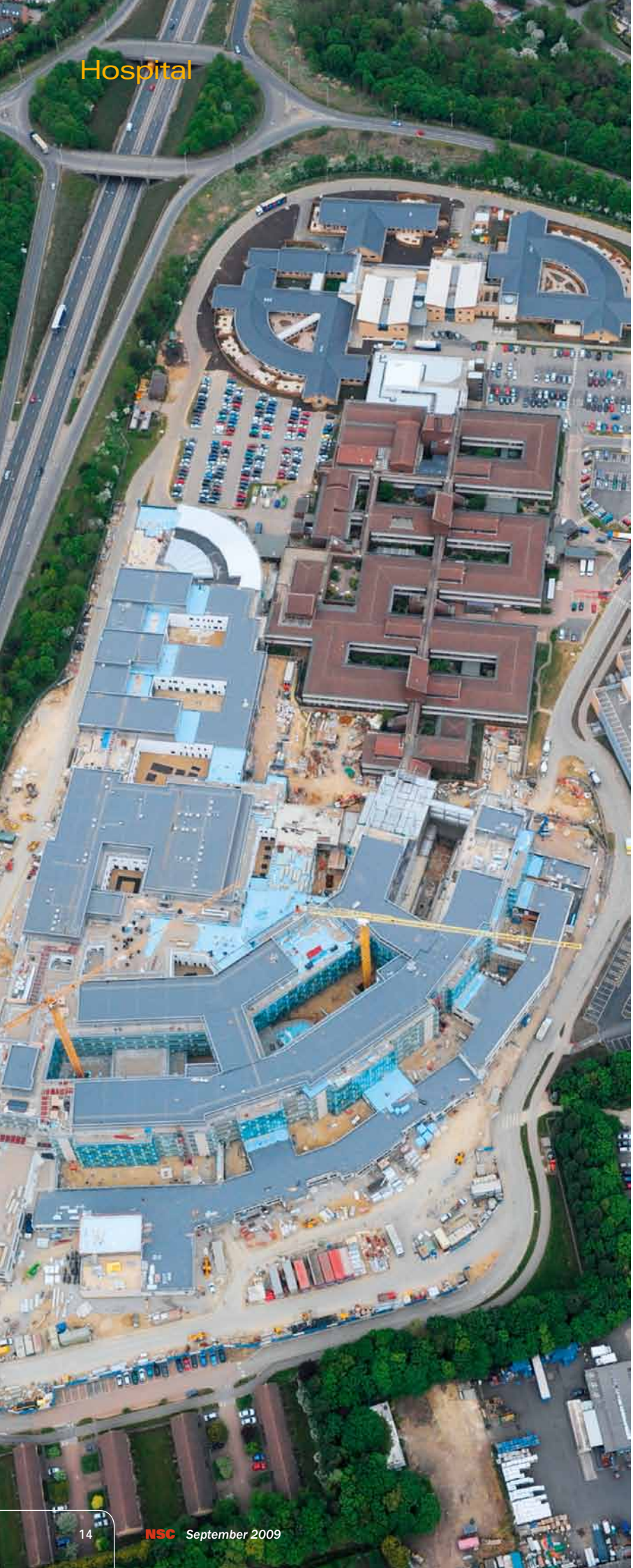
Summing up the awards, Corus Chief Executive Officer Kirby Adams said: "The judges were highly impressed by the quality of the entries in all three categories. All of the successful teams demonstrated their design skills in particularly innovation and effective ways, which convinces me that the future is very encouraging for steel design.

The Corus Student Awards - Architecture is supported by SCI, the BCSA and the Architect's Journal, with RIBA Education also supporting the competition.



Above: Manchester School of Architecture, winner of the Architecture category Romulus Sim and tutor, Siobhan Barry

Romulus Sim's intricately drawn concept.



Hospital gets steel treatment

Changing the cores to a steel braced design as well as incorporating a bespoke flooring system helped create an efficient steel programme at Peterborough's new City Hospital.

The city of Peterborough will have a new state-of-the-art acute hospital, when the £335M City Hospital project is handed over to the local NHS Trust in late 2010. Construction work on this huge project is currently progressing on schedule with the steel frame now complete and cladding also largely finished. A lengthy and time consuming fit out programme is now under way, although some minor building work is still to be undertaken.

The hospital is being built adjacent to the current Edith Cavell Hospital, which will decamp into the new buildings, along with Peterborough District Hospital, once the project is complete. The old hospital will then be demolished and the area landscaped and converted into new car parking as the final phase of the overall scheme.

Known as Peterborough City Hospital, the new facility will include 612 in-patient beds, an emergency care centre, a high-tech diagnostics unit, women and children's unit, cancer unit, specialist rehabilitation unit, renal dialysis and a multi-disciplinary training centre.

On the same site is the 102-bed Cavell Centre (see NSC February 2008) which fully opened earlier this year. This includes adult acute, psychiatric intensive care and older people's units and services for those with learning disabilities, dining areas, staff facilities and garden areas. When both projects are complete the overall site will become known as the Edith Cavell Healthcare Campus.

Construction for the City Hospital began on site in early 2007 with a major groundworks programme being undertaken on the former greenfield site. Steelwork contractor Rowecord Engineering began erecting the main frame in October 2007 and largely completed its work by August 2008.

Last July the project celebrated a momentous milestone when the structure was officially topped-out ahead of schedule. Nigel Hards, NHS Trust Chairman, said: "It has taken a great deal of hard

Above: The steel frame was completed ahead of schedule

Left: The new hospital buildings are adjacent to the existing hospital which will be demolished during 2011

work by the Trust, our PFI partners Progress Health and Brookfield Construction to reach this stage on what is probably Peterborough's largest building project since the construction of the cathedral some 800 years ago."

Commenting at the topping out ceremony, Ross Ballingall, Brookfield Construction UK Director responsible for the project, added: "Completion of the frame on such a large project ahead of schedule is a significant achievement. Our trade contractors Rowecord and Buildstone, who did the concrete floor slabs, have worked well with my team and all should be congratulated."

At its peak Rowecord had 30 trailers of steelwork on site, but as the site is quite confined, surrounded by roads and a functioning hospital, the majority of steelwork was delivered on a just-in-time basis.

"Although most of the steelwork was finished last year we've still had a presence on site over the past 12 months to finish small details and areas where access wasn't previously available due to other trades working there," says Colin Davies Contract Manager for Rowecord Engineering. "Some of the last areas to be erected included the main entrance which required a canopy supported on V-shaped tubular columns."

The build programme was divided into seven zones, which effectively split the one large structure into manageable sized areas. Movement joints have been placed along these zone boundaries with just one line of columns adjacent to the joint.

"Completion of the frame on such a large project ahead of schedule is a significant achievement."

The steelwork for the entire structure has been based around a constant 7.5m x 7.5m grid with steel braced cores supplying the necessary stability throughout the building.

"Initially the cores were designed in concrete," explains Mei Xiao Project Manager for Robert Bird & Partners, the structural engineer for the project. "However, the change was made for better sequencing as using steel reduced the amount of formwork on site and allowed the steelwork contractor to erect the cores along with the main frame."

As the six main braced cores are not centrally located extra stability bracing has also been placed in partition walls.

Changing the design of the cores certainly helped the steelwork erection process as Rowecord's Technical Director Paul Benwell explains: "Steel braced cores made the design and the erection process easier because there were less interfaces with other materials and consequently the detailing was less tricky."

Another interesting steel design issue revolved around a building height restriction which in turn impacted on the design of the floor beams. Consequently throughout the project the floor beams are asymmetric members fabricated from

FACT FILE

Peterborough City Hospital

Main client: *Peterborough and Stamford Hospitals NHS Foundation Trust*

Architect: *Nightingale Associates*

Main contractor: *Brookfield Construction UK*

Structural engineer: *Robert Bird Associates*

Steelwork contractor: *Rowecord Engineering*

Steel tonnage: *6,500t*

Top: The main hospital block features a number of structural voids which act as lightwells

Above: The ward block has a curved design to fit the available space

Right: Computer generated image of the new entrance

plate with unequal top and bottom flanges.

Deep CF225 metal decking was used with shear studs on the top flanges only. Because of this bespoke flooring design a lot of extensive connection design was needed to accommodate the plate girder beams.

"Time consuming detailing work was undertaken for the flooring system which was initially designed by Robert Bird and then checked by Rowecord's technical department," explains Ms Xiao.

Vibration can sometimes be an issue on hospital construction, but here again steel played a key role in mitigating any problems. All functional areas of the composite floors were assessed with the methods set out in the Steel Construction Institute (SCI) design guide.

Because of the required fit-out programme and to tie-in with the main contractor's groundworks scheme, Rowecord began its steelwork erection on the three-storey zone two part of the hospital. The steel erection then advanced onto the main curved ward block which has five levels plus a plant floor which is effectively a sixth floor.

The steelwork sequence required a large amount of temporary works as a two-week cycle was employed. These steel supports had to remain in place until the two floors above had been cast.

The entire hospital structure is broken up by numerous voids which act as atriums allowing natural daylight to penetrate into the central areas of the wards. Some of these atriums are open spaces down to ground floor level, while others will be covered with ETFE roofs.

The design of the ward block follows the rest of the structure's 7.5m grid pattern, but internally the wards, designed by architect Nightingale Associates, have been configured to provide a high level of privacy. The patient areas are divided into three separate zones per ward, one seven-bed unit

and two 11-bed units. This is said to allow patients with differing needs to be treated in the most appropriate environment.

The ward design also incorporates the new cruciform four-bed bay which the architects say provides better separation between patients and more space for staff to use hoists and other equipment. It also allows the creation of two quiet areas where patients can sit with relatives or have their meals.

Once Rowecord started erecting steel for the main ward building – a 200m-long curved structure with three internal voids – it was able to introduce four erection gangs to the job.

"This area of the job allowed us to work simultaneously in four separate directions," explains Mr Davies. "Each gang had the use of its own dedicated 55t mobile crane, which had sufficient capacity as none of the beams were heavier than 3t."

The main ward block is divided into two wings, north and south, with a service tunnel running beneath the later. "The construction of the tunnel meant we had to work in close sequence with the main contractor on this zone," says Mr Davies. "We obviously couldn't erect steel while the tunnel was being excavated."

The final part of the main steel erection, the energy centre, was completed last Spring. This two-storey structure consists of approximately 600t of steelwork and connected to the main part of the hospital at the western sector, although it is separated by a fire protection partition wall.

The first patients will be admitted to the new Peterborough City Hospital in November 2010 with the overall project scheduled for completion in September 2011.

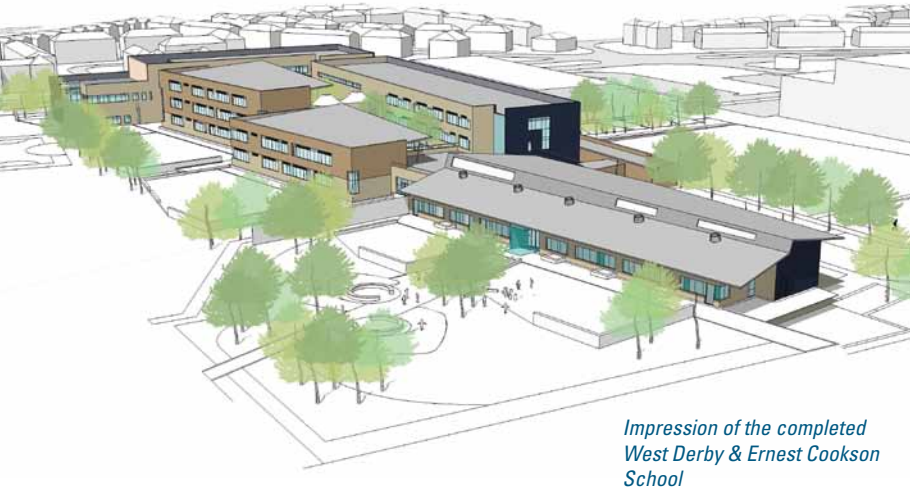
Right: Steelwork going up on the six-level high ward block

A school for future needs

In-built flexibility has played a major role in the design of a new school in Liverpool, where all teaching blocks can be enlarged and rearranged to accommodate changing future term needs.

Many towns and cities throughout the UK are benefitting from the Building Schools for the Future (BSF) programme. Ageing and unfit school buildings are being replaced with new and architecturally driven structures, set to inspire future students and staff alike.

Liverpool is no exception and a number of futuristic designs are being realised as part of a £485M transformation of the city's secondary schools. One example is the new West Derby School which is set to open in September 2010.



Impression of the completed West Derby & Ernest Cookson School

This £27M complex will replace the existing West Derby comprehensive, which is currently split across two sites at Bankfield Road and Quarry Road, as well as incorporating the Ernest Cookson school for boys with special education needs.

The school buildings are being built on playing fields near to the Bankfield site, and once construction is complete the old school will be demolished, making way for open space and a new staff car park. These playing fields are large however, and much is being retained to be converted into new sports pitches for the school.

As for the school buildings themselves, the steel framed structures are grouped about two central courtyard spaces, which run north-south down the site. A technology block and sports block are situated on one side of the courtyards with two teaching blocks opposite, again in a similar north-south orientation.

To the north, a community block containing a public library and a 200-seat lecture theatre is turned through 90 degrees to run east-west across the site, maximising the frontage to the main West Derby Road and so creating a 'solid protective urban edge to the street' as architect BDP describes it.

To the south of the site a dining hall and kitchen

Left: The use of steel saw the frame's contruction progress at a speedy rate

Right: The majority of steel has been erected around a constant 7.2m grid plan

building with an adjacent main entrance area closes the courtyard. Beyond this to the south there is a sixth block, containing the Ernest Cookson school, which protrudes south into a landscaped area.

The buildings are predominantly three storey in height but they step down to two storeys to the south east and south west ending with the single storey Ernest Cookson school. In total the buildings have a ground floor footprint of 6,896m² which equates to a total floorspace of 15,163m².

However important the school's floorspace is, at West Derby it will be able to be adapted and reconfigured in a number of different ways. Flexibility is one of the key designs of the school says Jonathan Richards, BDP Project Architect. Each of the two teaching blocks will feature movable internal walls which will ensure total flexibility and allow single classrooms to be joined up into larger teaching spaces.

"Teaching methods are moving away from classes with 30 kids and one teacher with a blackboard to smaller groups, which results in better teaching," explains Mr Richards. "With this in-built flexibility the classes can be reconfigured from traditional classrooms into these smaller clusters or even into larger spaces for vocational activities or exams."

The steelwork design of the teaching blocks is based around a regular 7.2m grid pattern with the majority of columns located in external walls and the few internal walls not featuring movable partitions. All classrooms within the school are 60m² and this larger size together with the shape of the rooms facilitates numerous ways of configuring the furniture to ensure flexibility.

The partition walls are hung from the floor beam above and slide along a track embedded in the floor slab. Although these classroom dividing walls look similar to any other internal wall, they can easily be moved by any able bodied person.

Toilets, stairs, structural cross bracing and risers have all been strategically positioned to allow two thirds of the teaching blocks to be reconfigured in the future.

"This approach has been extended to the technology block," says Mr Richards. "Here toilets, bracing and risers are all located at either end of the building to avoid the partitions."

The technology block will house the practical teaching areas of the school with engineering and construction activities accommodated in workshops on the ground floor, design on the first floor and science laboratories on the upper level.

A similar construction approach has also been adopted for the community block. Here the steelwork is being erected around a slightly larger 8.5m gird to allow more column free space. The top floor lecture theatre will be able to be opened up to the adjacent drama studio, allowing it to function as a professional theatre for performance, concerts and conferences. To allow this extra functionality in the second floor, internal columns end at the first floor ceiling, leaving the top floor with 20m clear spans.

"Future adaptability was one of the main reasons for choosing steel as the main framing material," says Farhad Afshari, Project Engineer for AECOM. "However, the most important factor in favour of steel, and one which Balfour Beatty was extremely keen on, is its speed of construction. The school needs to be finished in time for Autumn 2010 and by the middle of this Summer the building's frames were already up, way ahead of where we'd be with concrete frames."

FACT FILE
West Derby & Ernest Cookson School, Liverpool
Main client: *Liverpool BSF*
Architect: *BDP*
Structural engineer: *AECOM*
Main contractor: *Balfour Beatty Construction*
Steelwork contractor: *Elland Steel Structures*
Project value: *£27M*
Steel tonnage: *900t*

"By the middle of the summer the building's frames were already up, way ahead of where we'd be with concrete frames."

Right: The community block was the first phase of the project to be erected

Retail anchors regeneration

The cinema complex will dominate one end of the new pedestrianised street

A large redevelopment programme in Carmarthen aims to turn the historic market town into west Wales' main shopping destination.

Despite the ongoing credit crunch biting hard in many construction sectors, a number of new town centre retail developments are still progressing. In Carmarthen for instance, the £50M St Catherine's Walk project will provide the west Wales county town with 25,548m² of new retail and leisure space, including a Debenhams department store and a six screen Apollo cinema.

With a plan to turn Carmarthen into a prosperous and popular shopping destination the scheme also includes a new indoor market - which opened earlier this year, a new public square and a 900 space car park.

Joint venture partners, Carmarthenshire County Council and Simons Developments forecast the development, which will serve a catchment area with a population of 80,000, will create at least 300 new full and part-time jobs. This is on top of the hundreds of construction and fit-out jobs already created during the build programme.

The project is sited to the north of the existing town centre on ground formerly used as a cattle market. St Catherine's Road splits the site in two, with the majority of the development on the north side, including the main anchor store Debenhams, the cinema and car park. The smaller southern side consists of 12 retail units and the new indoor market. Effectively fitting the required structures into a tight site surrounded by existing buildings meant Simons Design had to use considerable ingenuity during the design stage.

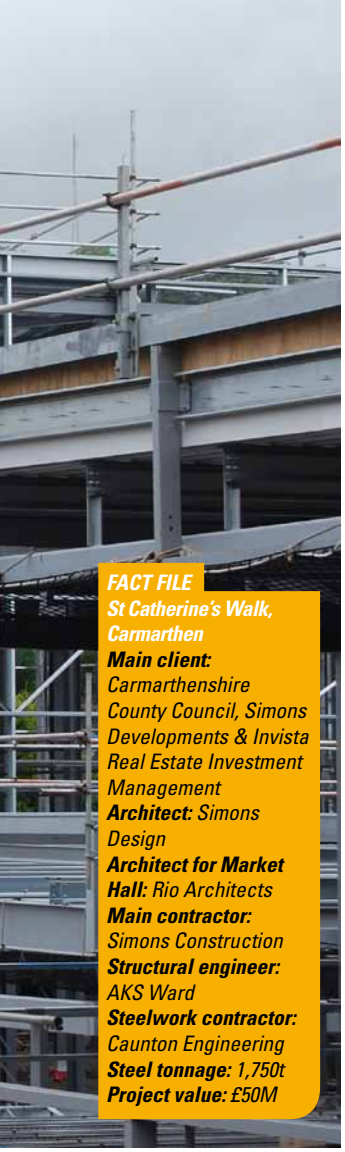
One of the main design criteria for the project was that the new development should not overwhelm the surrounding area, but fit in and compliment many of the older and residential properties. To this end the project is predominantly low-rise, with Debenhams and the car park the only structures which rise to three levels. In this way the new scheme will be a seamless extension to Carmarthen's town centre retail zone.

"Some days we were erecting as many as 80 individual steel members…"

As far as steelwork is concerned the first building to be erected was the new market hall. This building stands on ground previously given over to an outdoor market, which will return to the site once the development is complete. An adjacent listed clock tower has been retained and this played a central role in the market hall's design, as no new building could overshadow it or obscure its sightlines.

Work on the single storey market hall began in April 2008 with the demolition of an older structure. Approximately 200t of steel went into the main frame of the structure, while the roof is formed with long span glulam timber beams, which are

Above: The new indoor market hall and the retained clock tower



FACT FILE
St Catherine's Walk, Carmarthen
Main client: *Carmarthenshire County Council, Simons Developments & Invista Real Estate Investment Management*
Architect: *Simons Design*
Architect for Market Hall: *Rio Architects*
Main contractor: *Simons Construction*
Structural engineer: *AKS Ward*
Steelwork contractor: *Caunton Engineering*
Steel tonnage: *1,750t*
Project value: *£50M*

Below: The interior layout of the Debenhams anchor store

Above: The new development has been designed to complement the town's existing buildings

connected to the steel and were erected by main steelwork contractor Caunton Engineering, as part of its contract.

There has been a market in Carmarthen for over 800 years and with a sense of history and locality in mind, the new building was also built using Welsh Pennant stone and slate, in keeping with the retained clock tower.

A highly innovative design, featuring sloping walls and roof, certainly makes the new structure stand out. "There are no 90 degrees in the main frame, the walls consist of only vertical members," says AKS Ward Project Engineer Thanos Tserkezis. "This made the structure challenging to design, as well as the fact we couldn't put cross bracing on three elevations because of glazing."

The solution was for bracing to be located on one elevation while the overhead glulam beams were also incorporated into the overall stability equation. The Pennant stone facades also slope by seven degrees and this meant it had to be tied back into the main steel structure without undermining the waterproof insulation.

"It took four weeks to erect the market hall," says Tony Goodman, Contract Manager for Caunton Engineering. "Some days we were erecting as many as 80 individual steel members as the building consists of lots of small irregular steelwork."

During August Caunton had largely completed the steel erection for the northern sector of the project and revisited the southern site to begin erection of the retail units which will stand adjacent to the market hall.

The larger northern site will be dominated by the 8,268m^2 Debenhams anchor store which features two retail levels - ground and first floor - and a second floor which will be used for plant. Prior to steelwork beginning on this building in January, a ground improvement programme, involving vibro compaction, had been completed on the former cattle market land.

The Debenhams steelwork is founded on pad foundations and is based around an 11.4m x 10.8m grid pattern. This size was chosen as it offered the most natural and equal grid for the structure's dimensions.

Stability for the store is derived from the diaphragm action from the slabs along with cross bracing at various locations. Bracing couldn't be located in many areas as the store will be fully glazed along the majority of the lower level's elevations. The shop also steps in and out at numerous locations. Consequently the secondary steelwork needed a detailed exercise to get it to adapt to the architectural cavities in order to fix to the glazing.

"The large grid pattern was also ideal for the client as there are fewer columns in the retail area," explains Mr Tserkezis. "Also, the large ground floor slab could not incorporate any movement joints in order not to restrict Debenhams in their tiled floor layout."

Interestingly, the Debenhams' ground floor slab also incorporates a 10m wide undercroft which will house ancillary plant equipment.

Aside from the Debenhams anchor store the northern sector consists of a further three steel-framed structures: a large two-storey store with an attached restaurant, a retail block featuring seven units which is situated opposite Debenhams along a pedestrian street, and a six screen Apollo cinema complex.

Constructed under the guidance of Simons Construction's Project Manager Kevin Lake, the cinema's frame was designed and built with acoustic pads to improve acoustic control and isolate the seat supporting framework from the main frame.

St Catherine's Walk is scheduled to open in April 2010.

Steel aids retail expansion

A large shopping centre extension housing more than 20 shops and a continental style market hall is poised to boost retail options in Blackburn, reports Martin Cooper.

Top: Steelwork for the new mall extension dominates Blackburn's town centre

Above: Elliptical mezzanines overlook the project's central atrium

The former Lancashire mill town of Blackburn will shortly get a welcome retail boost as a new 23,225m^2 extension to the existing town centre shopping mall takes shape. Due to open in July 2010, the new build will include a continental style market hall, two levels of retail outlets and three upper levels of car parking.

As well as constructing the new extension main contractor Taylor Woodrow is also refurbishing the existing shopping centre which will further enhance the town centre's shopping options.

The project has been on the drawing board for a few years since The Mall Corporation purchased Blackburn's Shopping Centre in 2004. Under a separate contract part of the old centre was initially demolished before Taylor Woodrow came on board last year.

As the land had already been cleared, groundworks were easier and included the installation of 550 x 20m deep piles before the main steel frame was begun in February 2009. In little under seven days, 229 columns and beams, of various weights and sizes were erected.

The overall design of the structural frame is based on a long span grid which minimises the number of internal columns within the retail area. The choice of steel provided a lighter structure which was beneficial in the design of the foundations.

"Although the existing mall is a reinforced concrete structure," says Susanne McInnes, Project Engineer for Halcrow Yolles, "a steel structure was chosen for the new building as it provides the client with maximum flexibility for the future. Having worked with the client for nearly 20 years we know that flexibility is very important to its business."

Steel was also chosen for its speed of construction adds Rob McGann, Contracts Manager for Robinson Construction. "Halfway through the programme we maximised an opportunity and took advantage of our state-of-the-art production facilities to introduce an additional erection front which brought us four weeks ahead of the target programme."

The entire steelwork, decking and PC installation was handed over at the end of July to complete the structural frame in just 20 weeks, four weeks early. This allowed Taylor Woodrow to commence the following trades earlier.

The steelwork erection programme was divided into five phases and these were then sub-divided into lots with the exact number and types of columns, beams and braces allocated for each stage.

Taylor Woodrow's Construction Manager Matt Legg was ultimately responsible for ensuring the steelwork programme, comprising of 2,500t,

ran as smoothly as possible. "This was a fairly complex part of the build programme and required exceptional planning and organisation to ensure the correct pieces of steel were in the correct place at the right time. However, it was also one of the most rewarding, as the structure took shape over a matter of months."

As the entire structure has been erected around a standard 15m x 8.4m grid, partly dictated by the need for large spans for the car park, as well as a similar requirement in the retail zone, steel was erected swiftly. Four concrete cores had already been completed prior to the steelwork programme and these provide the main frame with its stability, as the core's walls are designed as shear cores.

Robinson Construction initially started erecting steelwork from the north western corner of the site and continued in a southward direction. Along the north and west boundary the extension abuts and links into the existing mall, while the other two elevations overlook busy town centre streets.

Steelwork to the elevations adjoining the existing shopping mall and the areas adjacent to the cores were subject to tight construction tolerances. "We developed a solution which offered a degree of flexibility in dealing with construction tolerances and this involved using temporary seating cleats during the construction stage," says Ms McInnes.

"A steel structure was chosen for the new building as it provides the client with maximum flexibility for the future."

The new development's centrepiece is a two storey glazed atrium which will provide the new malls with access to more than 20 shops as well as the refurbished shopping centre. The atrium will be the focal point of the mall and act as a crossroads between levels, including the upper car parking floors, as well as providing escalator access to the lower ground floor continental market.

Two elliptical mezzanines overlooking the atrium will provide accommodation for administration offices. These steel structures are approximately 10m wide and were formed with curved members. They cantilever from a central spine beam, restrained by a lift shaft, all of which reduces the number of internal columns allowing them to be spacious areas.

"They were very complex to design and erect as there are no fixed radii," explains Mr McGann.

The mezzanines are also an important architectural feature within the development. Halcrow consequently designed the supporting steel to be as slender as possible to enable it to be concealed within the architectural bulkheads.

The project's 6,317m^2 lower ground floor will be completely taken up by the continental market, which The Mall says is a UK first. This is a large open area with access from all the surrounding streets. Above this two levels of retail will be anchored by a 4,645m^2 Primark store spread over two levels.

On top of this there are three levels of car parking, which wrap around the atrium and slope to one level along the southern elevation. Robinson has installed all metal decking for the retail floors as well as the precast concrete planks which form the car parking floors.

Robinson had to install a large amount of temporary support steelwork to support the 15m long x 400mm deep PC Holocore slabs weighing 10t each. This was necessary to reduce the torsion in the main supporting steelwork in its temporary state.

The client requested that the soffit of the car park be kept clear as possible to create an open and spacious area. "We developed a solution using long span precast floor slabs to minimise the number of downstand beams," explains Ms McInnes. "This created a sustainable design solution as it maximised the free flow of air through the car park and eliminated the requirement for forced mechanical ventilation."

Summing up, Ken Ford, Chief Executive of The Mall, says: "Since we purchased The Mall Blackburn in 2004 we have been working hard alongside Blackburn and Darwen Council to create the best possible development for the town. The confidence of key retailers in coming to Blackburn for the first time or expanding their representation is hugely positive for the town and will provide a dramatic boost to the local shopping experience."

Above: The upper levels of car parking are formed with precast planks installed by Robinson along with the main frame steelwork

FACT FILE
The Mall, Blackburn
Main client: *The Mall*
Architect: *Coleman Architects*
Main contractor: *Taylor Woodrow*
Structural engineer: *Halcrow Yolles*
Steelwork contractor: *Robinson Construction*
Steel tonnage: *2,500t*
Project value: *£66M*

This way to CE Marking

The BCSA outlines the measures which must be undertaken to fulfill the requirements of BS EN 1090-1, that allows companies to CE Mark its structural steelwork.

The new European standard for the CE Marking of structural steelwork, BS EN 1090-1, is expected to come into force in May next year. Once in place steelwork contractors in all European Union member states will be able to CE Mark their fabricated steelwork.

While CE Marking will not be enforced immediately in the UK and the Republic of Ireland (ROI), it is likely to become a legal mandatory requirement in 2012. To support steelwork contractors and ensure that they are fully prepared, BCSA has produced a series of guidance notes and a comprehensive publication outlining the requirements for CE Marking.

All of the BCSA's guidance is aimed at providing steelwork contractors with practical advice on the routes to achieving a certified Factory Production Control system by which they can declare conformity with the requirements of BS EN 1090-1, and, as a consequence, CE Mark structural steelwork produced in their factories.

Factory Production Control system

BS EN 1090-1 defines the manufacturing controls required to ensure that structural steel components meet a range of clearly set-out technical requirements relevant to the manufacture of steel components. In particular, it requires a steelwork contractor to implement and maintain a 'certified' Factory Production Control (FPC) system.

An FPC system for structural steelwork is similar to a BS EN ISO 9001 Quality Management System (QMS), with the exception that incorporated within it the steelwork contractor is required to have a documented Welding Quality Management System (WQMS). A nominated a person responsible for all welding activities - a Responsible Welding Coordinator (RWC) - is also required.

Welding Quality Management System

To satisfy the manufacturing controls of BS EN 1090-1, a steelwork contractor is also required to demonstrate that its steelwork meets the technical requirements of BS EN 1090-2, the fabrication standard for CE Marking.

This requires the steelwork contractor to implement and maintain a documented Welding Quality Management System (WQMS) in accordance with the relevant part of BS EN ISO 3834. The relevant part, and consequently the stringency of requirements, is determined by the Execution Class (EXC) declared by the steelwork contractor for its fabricated steelwork.

Execution Class

Specification of an Execution Class (EXC) for steel structures is a new concept within the steel construction industry. In BS EN 1090-2 these range from EXC1 to EXC4, and the strictness of requirements increases correspondingly from 1 to 4.

The choice of EXC is a design issue where each class is based on the criticality of a structure in terms of its service conditions and the consequence of its failure. However, while the designer is responsible for determining the required EXC, to enable CE Marking of its fabricated steelwork, a steelwork contractor must declare and demonstrate its capability to produce a structure that will conform to a specified EXC.

The importance of a steelwork contractor declaring the correct EXC for its range of fabricated steelwork cannot be overstated since this not only impacts on the systems and competency of personnel used to implement and control its manufacturing operations but also the work to be tendered for in the future. A steelwork contractor declaring conformance to a particular EXC can undertake work in a lower class but not to a higher class.

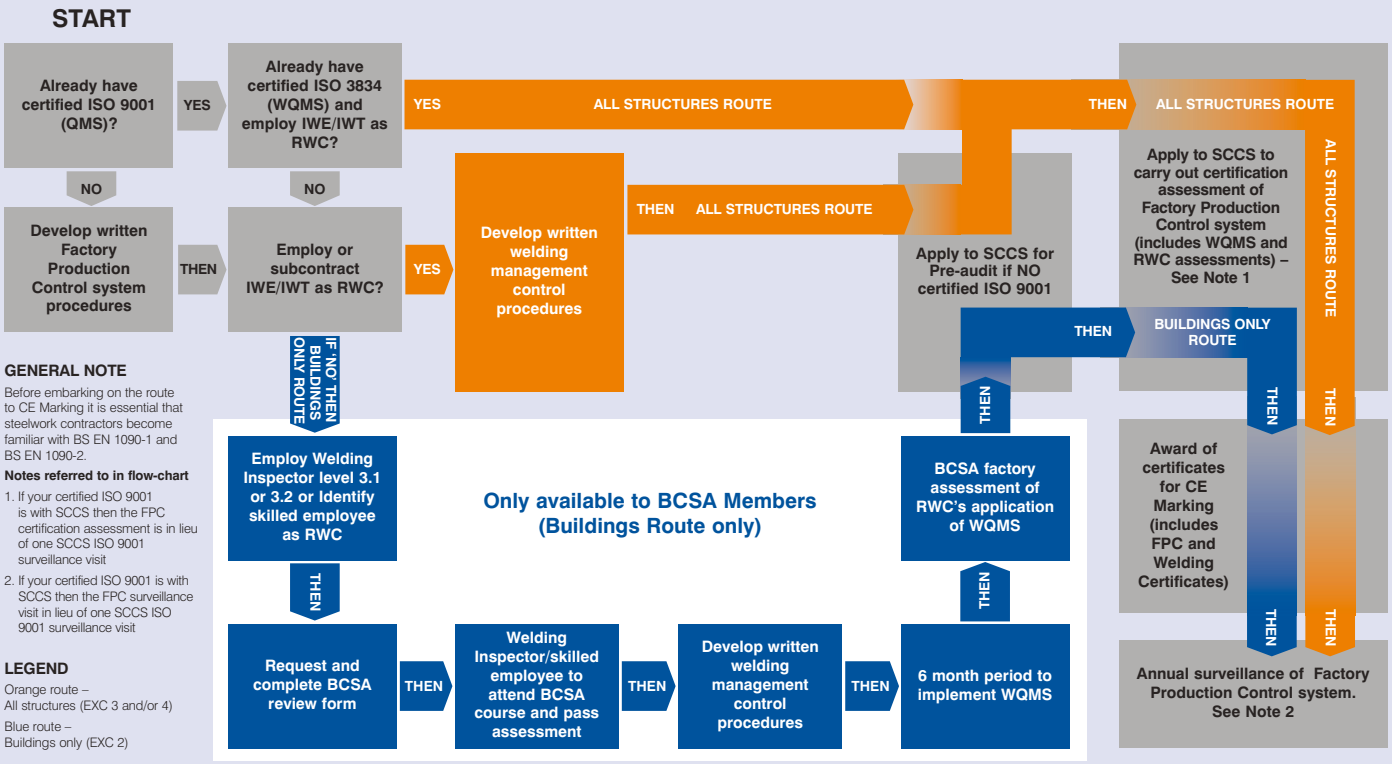
Responsible Welding Coordinator

The term Responsible Welding Coordinator (RWC) is used to identify the person who is competent to control and supervise a steelwork contractor's welding activities. A steelwork contractor should nominate at least one RWC with the technical knowledge and experience appropriate for the range of fabricated steelwork being manufactured.

BS EN 1090-2 sets out the technical knowledge requirements for the RWC based on the steelwork contractor's declared EXC, the welding processes and materials used. It makes reference to the International Standard for Welding Cordination (BS EN ISO 14731) which specifies three categories of technical knowledge ie: Comprehensive, Specific and Basic, and links these respectively to International Welding Engineer (IWE), International Welding Technologist (IWT) and International Welding Specialist (IWS).

BCSA has recognised the difficulty in finding formally qualified IWS, IWT or IWE personnel, particularly for those steelwork contractors working solely on buildings. The BCSA is offering its members an alternative RWC training and assessment route for their direct employees. Using a direct employee as the RWC is the preferred option, however, this may not always be possible

Routes to CE Marking Certification for Steelwork Contractors



Further information on CE Marking can be found in BCSA's 'Guide to the CE Marking of Structural Steelwork', Pub No. 46/08

and BCSA recommends that where subcontractor personnel are engaged they should hold the appropriate IWE, IWT or IWS qualification.

BCSA Members' Training and Assessment Route

The BCSA training and assessment route is aimed at providing skilled and experienced personnel with the technical knowledge required to undertake the role of the RWC. This route is limited to BCSA members and their direct employees only; it is aimed at those steelwork contractors working primarily in the Buildings sector wishing to declare CE Marking conformance to Execution Class 2.

The route requires the steelwork contractor to propose an employee who it considers suitable to fulfil the RWC role. The candidate is then required to complete and submit an authenticated CV to the BCSA for review, attend and successfully complete the BCSA RWC training course which last two days.

"The candidate then returns to the workplace to develop and implement an appropriate WQMS and following a six month implementation period we would then carry out a factory assessment of both the RWC and WQMS to demonstrate RWC competency and readiness for a FPC pre-assessment by the Steel Construction Certification Scheme (SCCS)," says Dr David Moore BCSA Director of Engineering. "This tests the candidate's knowledge gleaned from the course and competency at work."

The Steel Construction Certification Scheme

The Steel Construction Certification Scheme (SCCS) is the certification body specifically for companies engaged in design, manufacture and erection of structural steelwork and its associated products and services. The scheme's objective is to secure high standards of excellence and quality of processes and associated construction procedures and practices through independent certification.

SCCS is a UKAS accredited notified body for the assessment of factory production control systems, ie: those required for CE Marking of structural steelwork.

For those BCSA members who currently have their BS EN ISO 9001 QMS certification with SCCS, SCCS is proposing to substitute a QMS surveillance visit with an FPC visit. SCCS is also exploring how best to alternate surveillance visits to minimise costs, while maintaining the effectiveness and accreditation of both systems.

Part L consultation

The public consultation on changes to Part L of the Building Regulations closes this month. It is proposed that the 2010 revision leads to a 25% reduction, from 2006 levels, in operational CO_2 emissions from new buildings and it is a major step towards zero carbon buildings. It is likely to have a major impact on how we design and construct buildings, writes SCI's Roly Chuter.

With the UK Government committed to an 80% reduction in national carbon dioxide (CO_2) emissions by 2050, the time has come to take our first steps down this ambitious path. Buildings contribute a significant proportion of the country's CO_2 emissions (see Figure 1) and have been identified by the Government as a key area for improvement. Following the last revision to Part L in 2006, to reflect the requirements of the European Energy Performance of Buildings Directive (EPBD), the buildings and construction industry is unique within the UK in having both the Regulatory Framework and the necessary tools to deliver progressive improvements in the energy performance of buildings.

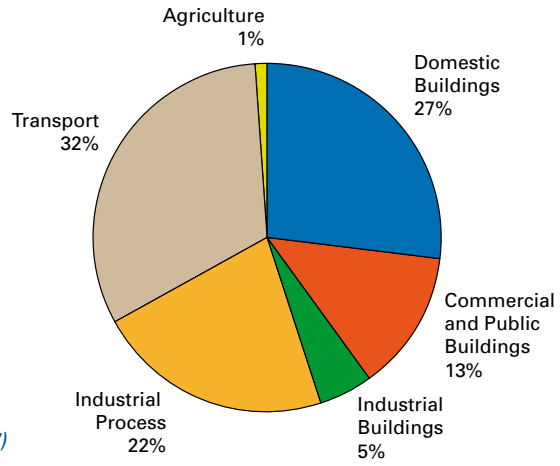


Figure 1: In 2005 the UK emitted 550m tones CO_2 (Energy White Paper, 2007)

In the 2007 consultation *Building a Greener Future* the domestic agenda was set out with a 25% CO_2 reduction (from 2006 levels) mooted for 2010, a 44% reduction for 2013 and for all new homes to be zero carbon by 2016. Although the non-domestic roadmap is less clear, commitments in the 2008 budget set a deadline for zero carbon schools in 2016 and other buildings in 2019 with the recognition that there would need to be milestones along the way implemented via Building Regulations. The definition of zero carbon is contentious and has not yet been fully agreed, indeed, it has been subject to a consultation already and will likely undergo further refinement. Nevertheless, the time has come to take the first step on the journey towards zero carbon buildings: revision of Part L of the Building Regulations due for enactment in 2010.

The Consultation

The good news is that the current five compliance criteria have not changed. These are still:

1. Achieving an acceptable building CO_2 emissions rate (BER)
   - This requires that the BER be less that the target CO_2 emissions rate (TER) as defined by the Building Regulations
2. Limits on design flexibility
   - These are a set of fabric and services 'backstop' values
3. Limiting effects of solar gains in summer
   - Required to show that solar gains are below a certain level or that overheating will not occur within occupied spaces
4. Quality of construction and commissioning
   - To ensure that buildings are constructed as designed and achieve the predicted performance, for example requiring air-tightness testing of buildings
   - Correct commissioning of the building services
5. Providing information
   - For example, providing a building log book.

The proposed changes are in how these Criteria are defined and applied.

The main change proposed is that the methodology for calculating the TER be altered such that new buildings deliver an average 25% reduction, from 2006 levels, in operational CO_2 emissions. Use of the word 'average' gives flexibility in allowing certain building types to target a lesser reduction provided this is offset by other types achieving larger reductions to give an average 25% reduction. This is because for some building types a 25% reduction will be more costly than for others and the Government are keen for the changes to be implemented in the most cost-effective manner.

A key undertaking within the Part L consultation has been a Regulatory Impact Assessment (RIA) of the proposed changes. This has included energy modelling of typical buildings using the relevant compliance tools (SAP for domestic and iSBEM for non-domestic buildings) to understand the specifications required for achieving the 25% cut. These solutions have been costed so that the appropriate specifications can be identified using the lowest cost of CO_2 abatement.

Domestic buildings

The Government's preferred option for domestic buildings is that their TER should be calculated as a 25% reduction from that required by Part L 2006. This has the benefits of being a well understood (since it is based on the current Building

Regulations) and has also been estimated, via the RIA, to save money over a 60 year period. This is called the "flat 25%" option.

A series of models have been run for the Consultation to show example specifications of how this 25% reduction could be achieved for different house types (Table 1).

Element	Detached	Semi-detached	Mid-terrace	Gas flat	Electric flat
Roof U-value ($Wm^{-2}K^{-1}$)	0.20	0.25	0.25	0.25	0.15
Wall U-value ($Wm^{-2}K^{-1}$)	0.25	0.30	0.35	0.28	0.20
Floor U-value ($Wm^{-2}K^{-1}$)	0.20	0.25	0.25	0.25	0.15
Window & door U-value ($Wm^{-2}K^{-1}$)	1.7	2.0	2.1	1.8	1.4
Air permeability ($m^3h^{-1}m^{-2}$)	7	7	7	7	7
Thermal bridging	0.04	0.04	0.04	0.04	0.04

Table 1: Example domestic specifications to meet proposed 2010 Part L standards

Non-domestic buildings

To reflect the differing costs of achieving CO_2 reductions in different building types and with the desire to make the 25% reduction as cost-effective as possible, an alternative method is proposed for non-domestic buildings. Instead of requiring a fixed reduction across the board, a specific target is to be set depending on the building use and form.

Two separate 2010 Notional building specifications are proposed, one for top-lit buildings and one for side-lit buildings and those without glazing (see Table 2). These have been modelled and costed to provide the most cost-effective path to achieving an overall 25% reduction, and will define the exact target for each building. Table 3 shows the resultant CO_2 reduction targets for the buildings modelled for the RIA. This is called the "aggregate 25%" option.

Table 2: "Aggregate 25%" Notional 2010 building specifications

Element	Side-lit/no glazing	Top-lit	2006 backstops
Roof U-value ($Wm^{-2}K^{-1}$)	0.15	0.24	0.25
Wall U-value ($Wm^{-2}K^{-1}$)	0.18	0.30	0.35
Floor U-value ($Wm^{-2}K^{-1}$)	0.21	0.22	0.25
Window & door U-value ($Wm^{-2}K^{-1}$)	1.6	1.8	2.2
Air permeability			
($m^3h^{-1}m^{-2}$)	5.0	5.0	10.0
Lighting (lumens.W^{-1})	65	75	N/A

Building Type	CO_2 Reduction Target
Shallow plan office (nat vent)	27%
Shallow plan office (air con)	33%
Deep plan office (air con)	19%
Warehouse (no rooflights)	22%
Warehouse (with rooflights)	36%
Hotel	25%
School	23%
Retail	33%
Supermarket	11%

Table 3: Resultant targets for modelled buildings used in the RIA

Impacts to the steel construction industry

The most obvious impacts to the steel construction industry are likely to be increased fabric performance levels i.e. U-values, air-tightness and thermal bridging. Although the proposed "back-stop" values for these parameters have not changed from 2006, it is likely that significantly improved performance levels will be required to meet 2010 CO_2 targets. This is unlikely to impact hot-rolled structural steelwork significantly unless unforeseen consequences of the revisions lead to a sea change in the method of building, for example north-light solutions for large warehouses. However,

companies providing envelope solutions, both as bolt-ons to a structural frame as well as light-gauge steel elements will be affected by having to provide more air-tight, better insulated products with low thermal bridging as discussed below.

There is a possibility that architects and specifiers will demand the exact "aggregate 25%" specifications (Table 2) as a de-facto "elemental method" solution to meet Part L 2010, and assume that a CO_2 calculation is not required. Although this simple method may produce a compliant design it must be remembered that a SAP or SBEM calculation will still be required to comply with the Building Regulations.

Air-Permeability

- An airtightness of $5m^3h^{-1}m^{-2}$ is likely to be routinely specified since this is quoted in the "aggregate 25%" specifications.
- This will require not only good detailing but also training and supervision of erectors and installers to ensure good workmanship
- If whole-building testing shows that the building does not meet the design value, it will be required to show Part L compliance by improving some other aspect of the building's performance.

U-values

- Although the U-values specified for the "aggregate 25%" approach are not requirements, merely in place to enable the TER to be calculated, there is a possibility that specifiers will demand these levels of insulation as a "quick-fix" solution to meet Part L 2010.
- It will be up to the industry to respond by either offering products which meet these performance levels or to educate specifiers about the flexibility available to them with regard to the specification of the fabric and services. For example to suggest that the designed U-values could be relaxed and compensated for by increased air-tightness or better detailing leading to reduced thermal bridging.

Thermal bridging

Heat losses due to thermal bridging are already included in both the domestic and non-domestic CO_2 calculation methods and this will continue to be the case. Additionally, the Government is consulting on ideas for an Accredited Construction Details (ACDs) scheme which reliably accounts for the thermal performance of building details as well as their buildability, ensures a realistic level of thermal bridging is included in the CO_2 calculations and allows the benefits of innovative detailing to be recognised.

Although much of the focus for the Part L 2010 consultation has been on reducing CO_2 emissions there are a number of other changes hidden away in the 700+ pages of consultation documents, the consequences of which may not be immediately clear but could be significant. For example there is a proposal to limit solar gains that may place practical limits on the percentage of glazing that can be used in office buildings.

The steel construction industry should not forget that where there is change, there is opportunity. Although the exact future of Part L is not clear, what is clear is that the proposed changes to Part L are a priority for Government and they are only the first step in a progressive regulatory shift towards meeting their zero carbon building targets. Any innovative and practical ways to incorporate energy efficiency measures or low and zero carbon energy generation into steel construction will be of benefit to the industry and the country.

First British Rail bridge in weathering steel

Above: Erection of bridge after erection steelwork

The first stage of the British Rail Freightliner network was virtually completed in mid-summer 1967 and plans were then prepared for the next stage of the development. Market research had shown that a second terminal would be required in Manchester and that it would need to be a major terminal using Goliath cranes spanning six railway tracks.

The only railway site available with suitable connections in the area was at Trafford Park adjacent to a motive power depot which was to be closed. Existing road access to the site, however, was very poor and it could not be improved because of the position of Manchester United F.C. Ground and adjoining premises. The solution was to construct a completely new access to the site from Westinghouse Road on the other side of the Bridewater Canal. This scheme entailed the building of a bridge over the canal and the demolition of some premises of the Springfield Warehouse Company through which the northern approach to the bridge would pass.

The design of the bridge presented no great difficulties; the span, 61ft between bearings, is moderate and the skew, 17°30', not large. A simply-supported welded steel plate girder bridge on piled concrete abutments was therefore decided upon. The question of maintenance naturally had to be considered and, in view of the limited headroom of little more than 12ft above water level, it was felt by the Chief Civil Engineer, London Midland Region, British Railways Board, that here was an excellent opportunity to gain experience of using a corrosion resistant, or weathering, steel. Such steels had been successfully welded for a number of bridgeworks in North America but there was no knowledge of their behaviour in this country and, although it was intended to use Cor-ten B steel produced under licence in Great Britain to the specification of the United States Steel Corporation it was considered desirable to call for welding tests before making a firm decision to order it. Consequently, the BCSA arrange for comprehensive tests to be carried out by the Welding Institute (formerly the BWRA). The results of these tests having proved satisfactory, British Rail decided to have the bridge at Trafford Park fabricated in Cor-ten B steel and the necessary materials were ordered.

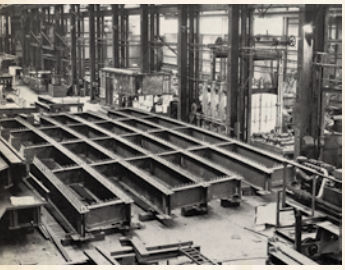
The bridge consists of seven welded plate girders, 63ft long at 5ft centres, with 24in × 9in welded I-section diaphragms of ½in plate flush with the top flanges. Each girder, 2ft 8in deep, is fabricated from a web plate 29¾in deep and ½ in thick, a top flange plate 12in × ¾in and a bottom flange comprising a plate 11in × ¾in welded under another 12in × ¾in plate. The total weight of Cor-ten B steel is 33 tons.

Stud shear connectors welded to the top flanges of both girders and diaphragms ensure composite action with the 8in thick concrete deck slab which is surmounted by a bituminous waterproofing membrane protected by a layer of quarry tiles and an asphalt wearing surface laid with a camber of 3in to both sides of the 24ft wide carriageway. An initial camber built into the plate girders provides for longitudinal falls from the centre of the bridge. The girders were welded up complete with diaphragm brackets, stiffeners and shear connectors in the shops, where a complete trial assembly of the steelwork was made before delivering the components to the site. All welds are ¼in fillets and all site connections are made with ⅞in diameter high tensile bolts in 15/16in diameter holes. The bolts and washers are zinc plated and the nuts are cadmium plated. Site erection was carried out with the aid of a mobile crane.

The bridge and the associated roadworks are due for completion in May 1969 and the Freightliner terminal is expected to commence operating in August 1969.

The design of the bridge was carried out by the Chief Civil Engineer, London Midland Region, British Railways Board, whose permission to publish this article is gratefully acknowledged.

Below: Trial assembly in shops



1989 - European Year of Steel Construction

The ECCS has proclaimed 1989 as the "European Year of Steel Construction". This year has been chosen to celebrate the centennial of the construction of the Eiffel Tower and, moreover, to celebrate the resurrection of steel construction for buildings in Great Britain, for bridges in France and for the industry in the whole of Europe.

The Eiffel Tower was the result of a huge challenge, between both sides of the Atlantic, to erect a tower 1,000 feet tall. Several projects were proposed such as a factory chimney, in bricks, in guyed plate sheet, in timber. The project of Mr Koelin, Chief of the research department of Mr Gustave Eiffel, was chosen to become the tallest building of the Universal Exhibition of Paris in 1889.

The City of Paris gave a 10 years concession to Gustave Eiffel, which was only once renewed. This means that by 1909 the steel tower should have been dismantled and that the site should have become again as it was before.

The whole of Paris, i.e. intellectuals, painters, sculptors and especially writers were against this "hideous and useless" monument. Guy de Maupassant wrote that the best location in Paris was the last floor of the Eiffel Tower, because from this spot only it could not be seen any more!

In 1909, a Communications Officer, Captain Ferie, settled on the 3rd Floor to install a radio transmitter-receiver. Due to this, the date of dismantling was postponed. It is said that this radio station accounted for the first victory of the Marne, for in 1914, all the German Invasion Army's broadcastings were received. And, when victory came in 1918, everybody forgot the 1887 protocol.

Now, a century later, the tower made of iron is still there. This proves that steel construction can be guaranteed for a century given the necessary maintenance for which a precise estimation of cost can be calculated. Of course, the tower was strengthened in 1902 and audited and restored in 1968.

What other material, except perhaps granite, could last as long?

Jean Roret
Chairman, Promotion and Economic Committee of ECCS;
1st Vice-Chairman, Syndicat de la Construction Metallique de France;
Chairman, Engineer and Scientifics of France.

Princess Royal Opens BCSA/ECSS Conference

Mr Joe Locke, BCSA President presenting a cheque to Her Royal Highness from BCSA and ECCS for "The Save The Children Fund" after the opening address given by Her Royal Highness to the delegates attending the Congress.

On Monday 18 September 1989 Her Royal Highness The Princess Royal opened the week-long Congress of the European Convention for Constructional Steelwork at Stratford-upon-Avon. During the week, 500 delegates from 25 countries took part in the International Symposium, Committee Meetings and ECCS Annual Meetings.

In her opening address, Her Royal Highness stated:

"This year sees the centenary of the construction of the Eiffel Tower and 1989 has been appropriately designated the 'European Year of Steel Construction'.

The past century has seen many exciting steel structures built throughout the world both for the convenience of mankind, in the form of hospitals, schools, power stations, factories, offices, bridges etc, and the enjoyment of mankind in the form of shops, theatres and leisure centres.

Such imaginative structures could not have been constructed without the technical developments in design, fabrication and erection which have been fostered by the European Convention for Constructional Steelwork and its constituent national associations, which in the United Kingdom is the British Constructional Steelwork Association.

The quality, speed, flexibility and reliability of steel framed structures has put steel in the position of the leading construction medium in the United Kingdom; this congress and the future research of the ECCS Technical Committee will be a step towards establishing steel in that position world-wide."

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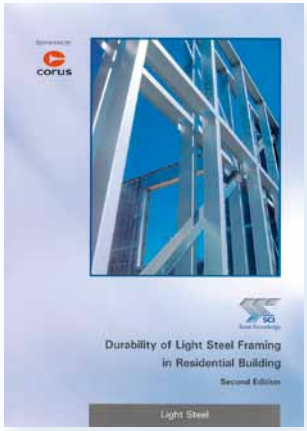

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Authors; A G J Way, S O Popo Ola, A R Biddle and R M Lawson
ISBN 978-1-85942-193-2;
52 pp, A4, paperback;
July 2009

Durability of light steel framing in residential buildings. Second Edition

Confident prediction of design life is based on data recorded for more than 10 years

The Second Edition of this publication updates and extends the durability data and design life predictions for galvanized light steel framing presented in the First Edition. Recently recorded durability data is included for several buildings using light steel framing. This data has been recorded for more than 10 years and permits a confident prediction of design life.

It reviews reports and publications from research projects carried out by Corus, BRE, ECSC, SCI and the former DETR on zinc coated cold formed steel sections. New data have also been collected from measurements on houses and similar buildings that use galvanized steel components.

The performance of galvanized (zinc coated) steel components within protected environments (e.g. 'warm frame' applications) is very good. This research shows that the predicted design life of the standard Z275 coating, based on the measured loss of zinc from the strip steel, is over 200 years, provided that the building envelope is properly maintained. The evidence for this conclusion is based on measurement of zinc loss on light steel frames in various applications and locations. A formula for the loss of zinc over time in areas subject to low condensation risk is presented.

Recommendations are given on the detailing of light steel framing in 'warm frame' applications in order to minimise the presence of moisture during the life of the building's frame.

PRICES:
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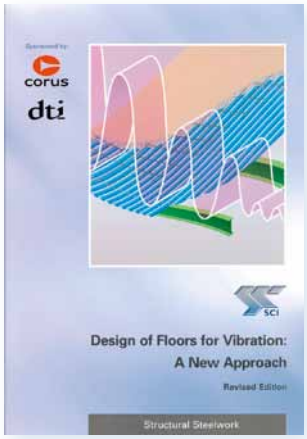

Catalogue Reference: P354
Authors: A L Smith, S J Hicks and P J Devine
ISBN 978-1-85942-176-5,
128 pp, A4, paperback,
June 2007; July 2009

Design of Floors for Vibration: A New Approach (Revised Edition)

This new design guide will enable designers to determine the vibration response of sensitive floors with improved accuracy

This publication presents guidance for assessing the vibration behaviour of floors in steel framed buildings caused by pedestrian traffic. It has particular relevance to composite floors. It describes the phenomenon in both general and technical terms, contains a background commentary and specific design recommendations. A set of worked examples illustrate the design procedures.

The **revised edition** includes the latest advice on health buildings. Opportunity was taken to include the amendments in corrigendum 1 and correct some typographical errors. The values in the worked examples have been adjusted in line with the corrigendum. Customers who purchased the first edition can access the updated information in Section 8.2 and Appendix D by visiting www.steelbiz.org and searching for P354.

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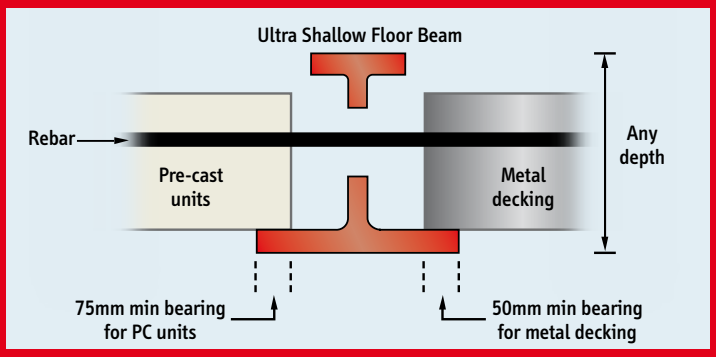

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(from BSI Updates May 2009)

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NA to BS EN 1998:-
UK National Annex to Eurocode 8. Design of structures for earthquake resistance.

NA to BS EN 1998-2:2005
Bridges
No current standard is superseded

DRAFTS FOR DEVELOPMENT

DD CEN/TS 1992:-
Design of fastenings for use in concrete

DD CEN/TS 1992-4-1:2009
General
No current standard is superseded

DD CEN/TS 1992-4-2:2009
Headed fasteners
No current standard is superseded

DD CEN/TS 1992-4-3:2009
Anchor channels
No current standard is superseded

DD CEN/TS 1992-4-4:2009
Post-installed fasteners. Mechanical systems
No current standard is superseded

DD CEN/TS 1992-4-5:2009
Post-installed fasteners. Chemical systems
No current standard is superseded

CORRIGENDA TO BRITISH STANDARDS

BS EN 1990:2002+A1:2005
Eurocode. Basis of structural design
CORRIGENDUM 1 *Also incorporates Amendment 1*

UPDATED BRITISH STANDARDS

NA TO BS EN 1990:2002+A1:2005
UK National Annex for Eurocode. Basis of structural design
AMENDMENT 1

BRITISH STANDARDS WITHDRAWN

BS 5531:1988
Code of practice for safety in erecting structural frames
This standard has been withdrawn as it is no longer relevant

NEW WORK STARTED

BS ISO 12930
Seismic design examples based on ISO 23469

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – NATIONAL BRITISH STANDARDS

09/30128355 DC
NA to BS EN 1991-4 UK National Annex to Eurocode 1. Actions on structures. Part 4. Silos and tanks

09/30203421 DC
BS 5950-3-1 AMD1 Structural use of steelwork in building. Part 3. Design in composite construction. Code of practice for design of simple and continuous composite beams

CEN EUROPEAN STANDARDS

EN 1090:-
Execution of steel structures and aluminium structures

EN 1090-1:2009
Requirements for conformity assessment of structural components

EN 1993:-
Eurocode 3. Design of steel structures

EN 1993-3-1:-
Towers, masts and chimneys. Towers and masts
CORRIGENDUM 1: July 2009 to EN 1993-3-1:2006

EN 1993-4-3:-
Pipelines
CORRIGENDUM 1: July 2009 to EN 1993-4-3:2007

EN 1993-6:-
Crane supporting structures
CORRIGENDUM 1: July 2009 to EN 1993-6:2007

EN 1998:-
Eurocode 8. Design of structures for earthquake resistance

EN 1998-1:-
General rules, seismic actions and rules for buildings
CORRIGENDUM 1: July 2009 to EN 1998-1:2004

AD 337
Wind pressures for buildings with dominant openings

This AD offers clarification on the determination of wind loads on buildings with dominant openings in the event of a severe storm. Dominant openings (defined in BS 6399-2 and BS EN 1991-1-4 as openings in one face of an area at least twice the total area of openings in the other faces) are often assumed to be shut during a storm but both BS 6399-2 and BS EN 1991-1-4 require that the accidental situation of them being open must be considered. The rules in BS 6399-2 and BS EN 1991-1-4 are discussed.

BS 6399-2

For the situation where the dominant opening is assumed shut, the normal internal pressure coefficients are used, in conjunction with external pressure coefficients, to determine wind loads at ULS. In BS 6399-2, internal pressure coefficients are selected with reference to Clause 2.6 and Table 16. A common assumption is that the four walls are equally permeable and the roof impermeable – which results in a C_{pi} of –0.3. BRE Digest 436 Part 1, Question 43, notes that the "the internal pressure coefficient for completely clad enclosed warehouse-type buildings without opening windows, may be taken as C_{pi} = –0.3".

Where the dominant opening is open, the internal pressure coefficients are determined using Table 17. However, where a dominant opening is assumed shut for the ULS design situation, the condition where it is actually open during a severe storm should be considered; this is explicitly covered in Clause 2.6.1.3, which states that "the condition with the door open should be considered as a serviceability limit state".

Further advice was given in SCI publication P286, Section 6.2, which clarifies this situation (assumed shut for ULS but actually open) as an *accidental* limit state (effectively another ULS not a SLS) and recommends that a revised S_p factor of 0.8 should be used. This leads to a much reduced dynamic pressure, and thus reduced values of both internal and external pressure, in conjunction with the load factors being set to 1.0.

BS EN 1991-1-4

In the Eurocode, internal pressure coefficients are given by Clause 7.2.9. For situations where there is no dominant opening (an "opening at the dominant face" in Eurocode terminology), the coefficient is given by Figure 7.13; the internal pressure coefficient varies with opening ratio μ. Note 2 to Figure 7.13 advises that where it is not possible, or not considered justified, to estimate the opening ratio for a particular case then the coefficient should be taken as the more onerous of +0.2 and -0.3. For completely clad industrial buildings, with equal areas of opening on each face, the opening ratio is 0.75 and the resulting internal pressure coefficient is between approximately –0.13 and –0.23, depending on the *h/d* ratio of the building.

Where there is a dominant opening, the internal pressure coefficients are determined by paragraph 7.2.9(5), which relates internal pressure to external pressure in the same way as Table 17 of BS 6399-2. However, where a dominant opening is assumed normally to be closed during severe storms, the situation where it is unintentionally left open during a storm must also be considered: paragraph 7.2.9(3) states that the condition with the door or window open should be considered as an accidental design situation. The determination of effects for an accidental design situation is covered by expression (6.11a) in BS EN 1990, which effectively sets the partial factor on wind actions at 1.0.

Comment

The Eurocode approach (treating the situation with a door or window left open as an accidental design situation) gives credence to the advice given in P286. The internal pressure coefficients are generally similar in the two standards and the reduction in the magnitude of the wind loading when treated as an accidental design situation is also similar.

Contact: D G Brown
Tel: 01344 636525
Email: advisory@steel-sci.com

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 £6,000,000
Angle Ring Company Ltd	0121 557 7241												●				Up to £800,000
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 8954 0028				●					●	●			●	●	✓	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 £100,000
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
Bone Steel Ltd	01698 375000	●	●	●	●	●	●			●	●	●		●		✓	Up to £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
BSB Structural Ltd	01506 840937			●	●	●									●		Up to £800,000
Cairnhill Structures Ltd	01236 449393				●	●	●	●		●	●			●	●	✓	Up to £1,400,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●			●	●		●		✓	Up to £6,000,000
Chieftain Contracts Ltd	01324 812911			●	●										●		Up to £400,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●		Up to £6,000,000
Compass Engineering Ltd	01226 298388			●	●		●		●								Up to £2,000,000
Conder Structures Ltd	01283 545377		●	●	●	●	●				●	●		●	●	✓	Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓	Up to £3,000,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●		Up to £1,400,000
Cronin Buckley Fabrication & Construction Ltd	00 353 21 487 0017			●	●	●	●				●						Up to £6,000,000
Crown Structural Engineering Ltd	01623 490555			●	●	●	●		●		●			●	●	✓	Up to £1,400,000
D A Green & Sons Ltd	01406 370585		●	●	●	●	●	●	●	●	●	●		●	●	✓	Up to £6,000,000
D H Structures Ltd	01785 246269				●						●						Up to £200,000
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
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●		✓	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)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	Above £6,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●						Up to £3,000,000
Frank H Dale Ltd	01568 612212		●	●	●	●										✓	Up to £6,000,000
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
Harry Peers Steelwork Ltd	01204 558500			●	●	●	●	●	●	●	●			●		✓	Up to £4,000,000
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*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						Up to £1,400,000
Leonard Cooper Ltd	0113 270 5441				●		●		●		●			●			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 £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓	Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		Up to £1,400,000
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 £4,000,000
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
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●		Up to £400,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		Up to £800,000
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
Remnant Engineering Ltd	01564 841160				●		●	●		●					●	✓	Up to £400,000*
Rippin Ltd	01383 518610			●	●	●	●	●									Up to £2,000,000
Roberts Engineering	01482 838240				●					●				●	●		Up to £100,000
Robinson Construction	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
Selwyn Construction Engineering Ltd	0151 678 0236									●	●				●	✓	Up to £200,000
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
The Steel People Ltd	01622 715900				●					●					●		Up to £100,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●	●		●		✓	Up to £3,000,000*
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
W S Britland & Company Ltd	01304 831583				●		●	●	●		●				●	✓	*Accounts outstanding*
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
2 Computer software
3 Design services
4 Steel producers
5 Manufacturing equipment
6 Protective systems
7 Safety systems
8 Steel stockholders
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	●								
Alternative Steel Co Ltd	01942 610601								●	
Andrews Fasteners Ltd	0113 246 9992									●
Arcelor Mittal Distribution Solutions UK – Bristol	01454 311442								●	
Arcelor Mittal Distribution Solutions UK – Wales	01443 812181								●	
Arcelor Mittal Distribution Solutions UK – Warrington	01925 817000								●	
Arcelor Mittal Distribution Solutions UK – 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							●		
Combisafe International Ltd	01604 660600							●		
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 Bristol	01454 315314								●	
Corus Dartford	01322 227272								●	
Corus Ireland Service Centre	028 9266 0747								●	
Corus Newcastle	0191 414 2121								●	
Corus Panels & Profiles	01684 856600	●								
Corus Service Centre Dublin	00 353 1 405 0300								●	
Corus Tubes	01536 402121				●					
Corus Wednesfield	01902 484100								●	

Company name	Tel	1	2	3	4	5	6	7	8	9
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 722260	●								
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	●								
Industrial Shotblast & Spraying Ltd	0845 130 6715						●			
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 (UK) Ltd	01355 232266	●								
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						●			
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	●								
Struthers & Carter Ltd	01482 795171								●	
Studwelders Ltd	01291 626048	●								
Tekla (UK) Ltd	0113 307 1200		●							
Tension Control Bolts Ltd	01948 667700									●
Trailerpal Ltd	01743 446666							●		
Voortman UK Ltd	01827 63300					●				
Wedge Group Galvanizing Ltd	01909 486384						●			
Wells Protective Coatings Ltd	01302 733611						●			

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 Ltd	01733 558989	●	●	●	●		●	●	✓	Up to £800,000 *Operating under CVA*
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
Fairfield-Mabey Ltd*	01291 623801	●	●	●	●	●	●	●	✓	Above £6,000,000
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*
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
TEMA Engineering Ltd	029 2034 4556	●	●	●	●	●	●	●	✓	Up to £1,400,000*
W S Britland & Co Ltd*	01304 831583	●							✓	*Accounts outstanding*
Watson Steel Structures Ltd*	01204 699999	●	●	●	●	●	●	●	✓	Above £6,000,000

* Denotes membership of the BCSA

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