FEBRUARY 2008 VOL16 NO2

NSC

NEW STEEL CONSTRUCTION

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Weathering steel for Kew Gardens
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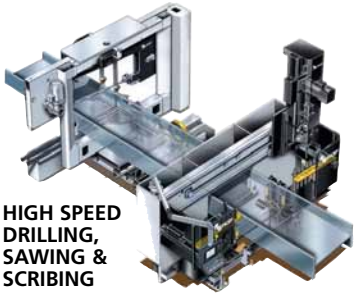

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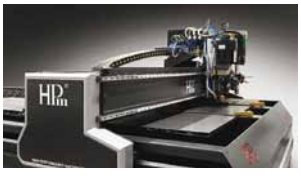

PLASMA & GAS CUTTING

steel projects
AUTOMATED CAM SOFTWARE

* Patent pending

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St Pancras Station
Client: Union Railways
Architect and engineer for redevelopment: Rail Link Engineering
Original ironwork contractor: Butterley Engineering
New steelwork contractor: Watson Steel Structures

CELLULAR BEAMS - MINIMISING RESOURCES, MAXIMISING BUILDING EFFICIENCY

* *A designer's guide to the benefits of selecting a circular ductwork system can be downloaded in a PDF format from Westok's website. Type* **Lindab** *into the Search facility , click on* **Go**, *then click on the first link,* **Lindab - Ductwork Turns Full Circle** *to download the file.*

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Steel sustainability the highlight of the show

All sectors of the construction industry will be presenting their sustainability cases at the Futurebuild event in London this month. Some of the highlights of the show will be provided by the steel construction sector (see News), with Corus providing a novel feature of a steel recycling counter, which will be switched on at the start of the three day show and will display in tonnes the amount of steel that will be recycled globally during that time. At over 15 tonnes every second, it will come as a surprisingly big number to some.

The counter is an imaginative way of getting some of the key sustainable steel construction messages across – among them that steel is the world's most recycled material, that it is derived from the planet's most abundant element, and there is no such thing as used steel without a present and future use and value.

Many people still don't have as full a grasp of the sustainability case for steel as they should, not yet appreciating for example that, unlike other materials, steel can be continually recycled without any degradation in its quality. Other materials can be crushed up and used as an inferior product to the one that it started out as, but not often. All steel has recycled content and it has been recycled for as long as it has been produced, long before the current sustainability impetus from the challenge of global warming.

So steel has always had a strong sustainability case, and the challenge now is to strengthen that case. Major investments have and are being made in improving steel construction all along the supply chain, from the extraction of iron ore and other raw materials through manufacture and fabrication to on-site erection.

All steel construction involves off-site construction, which is another key sustainability gain that will be highlighted at the show. A vision for sustainable steel framed housing will be shown on a Steel Ideal stand, incorporating a full scale ManuBuild prototype. Visitors will also see a gallery containing winning designs and entries from two Living Steel International Design competitions.

Other major sustainability related promotions will be taking place over the course of 2008 and we will keep readers informed about them through the year. For now however, the place to head for an update on some key steel sustainability efforts is Futurebuild at Earls Court from 26-28 February.

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corus BCSA The British Constructional Steelwork Association Ltd SCI

Interactive Blue Book reaches 5,000 milestone

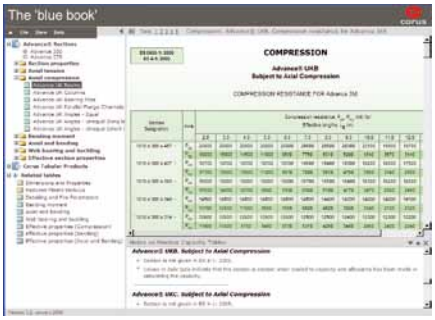
The Blue Book, published by the BCSA and SCI, is regarded as the essential tool for steel designers, providing section properties and member capacities in tabular form. A new web based version of the Blue Book has recently been produced by Corus and the SCI - the interactive Blue Book - and has achieved its 5,000th registered user. The interactive tool started life supporting the introduction of the Advance section range and was initially distributed in CD format only.

Since then the interactive Blue Book has been upgraded to include the full range of Corus structural sections and members, and has become an essential desk top tool for over 5,000 designers.

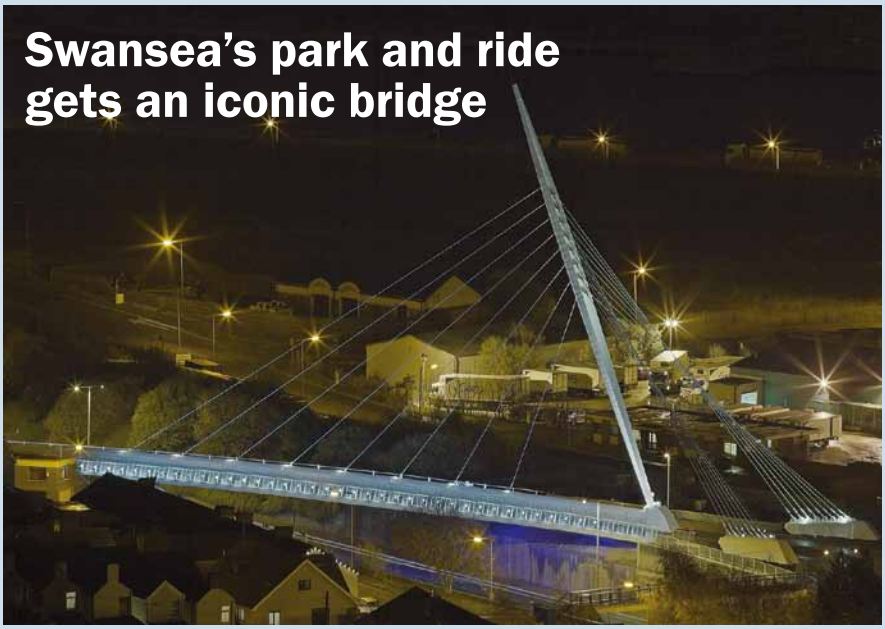
The software is now available for download via the Corus Construction website www.corusconstruction.com.

"As an integral part of a 'cradle to grave' quality management of software produced at the SCI, we track all software distribution," says John Moran, Senior Manager for ICT at SCI. "The interactive Blue Book has outstripped everything we've published before, we've never had anything used so widely, so quickly."

The interactive Blue Book is upgraded on a regular basis via an auto update facility and patches are available free of charge to registered users via the Corus Construction website. The latest upgraded edition, available since January, includes Hybox and Celsius hollow section from Corus Tubes as well as Advance sections.



Swansea's park and ride gets an iconic bridge



The city of Swansea has added an eye-catching bridge structure to its skyline. Known as the Sidings Bridge, it primarily carries an express bus route from an out-of-town park and ride facility over the busy A483 and into the city centre.

Officially opened late last year, the steel bridge has a 71m span at a skew angle of 65 degrees. Steel fabrication and erection was done by Rowecord Engineering and it extensively made use of off-site prefabrication of the bridge deck to minimise the number of required road closures.

The structure was installed in two possessions over successive weekends. The first possession was used to install the spine beams and four corner deck units over the abutments.

After the trimmer beams were welded to the spine beam, the second possession was used to install the remaining larger deck units. The spine beam was supported on a temporary trestle at mid-span until the stays were tensioned.

Major Scottish retail development

Steelwork contractor Severfield-Reeve has recently completed its work on a new 34,838m^2 retail development in Livingston town centre.

Known as The Elements, it is situated between the existing Almondvale Shopping Centre and Livingston Designer Outlet. When construction is complete, the new mall will be linked to Almondvale to create a combined retail destination of over 92,000m^2 under one roof.

The predominantly steel framed centre features four pedestrian malls, which all converge at a central plaza. The whole development has two trading levels, ground floor and a mezzanine level.

Steelwork also included The Elements' two 8,000m^2 anchor stores, a two-storey Debenhams and a three-level Marks & Spencer.

Main contractor is Miller Construction and the project is scheduled to open by October this year.

Demand for green homes grows

A nationally representative survey has found more people than ever before would appreciate a house built with sustainable materials, with just 15% of interviewed UK adults considering sustainability unimportant.

The survey, commissioned by the Steel Homes Group (SHG), also showed that older homebuyers were more concerned with sustainability.

More than 66% of people over the age of 45 felt the issue was important, compared to 51% among those aged 18 - 24, suggesting more experienced homebuyers have a greater awareness of green issues.

SHG is an industry body formed to promote the advantages steel framed houses can offer, with specific regard to the superior quality and sustainability benefits of off-site construction.

SCI Deputy Director and SHG Chair Dr Bassam Burgan, said: "There has been a lot of talk of how the UK can increase its housing supply and this survey shows that people want houses to be sustainable.

"Steel framed homes are the way to marry sustainable and affordable housing. By constructing homes off-site, for instance, costs are lower and production quicker."

The survey also found that the quality of construction is considered more important in a house than the method of construction. Only 5% would not consider the quality of construction when buying a home, but 57% do not consider the method of construction to be very important.

The Greenwich Millennium Village in London was constructed by Banro using steel frames.

"It is clear that homebuyers do not insist on traditional bricks and mortar houses - they want well-built, sustainable homes, and that is what steel-framed structures can provide," added Dr Burgan.

Allslade installs advanced fabrication line

One of the UK's most advanced Kaltenbach structural steel processing lines has been installed at Allslade's Portsmouth facility.

The new installation is housed in a completely refurbished site and is expected to improve production by 300%, while reducing material handling by around 70%.

The entire line comprises a Kaltenbach HDM1432 circular saw, a KBS1301 bandsaw, a KDX1215 three-axis five tool drilling system and the unique KC1201 robotic coper, which uses plasma and oxyacetylene.

All machinery is CNC controlled and inter-linked by Kaltenbach cross-conveyors, operated from each machine's touch-screen control desk,

or a centralised control console. The line can process the largest of structural steel columns, beams and tube.

A Gietart GW15/6 high performance six turbine shot blaster completes the last stage of the initial processes, before loading material directly onto one of several adjacent fabrication lines, with a new fast-flow transporting system.

From fabrication, structures enter a new state-of-the-art Gietart, multi-gun water-based automated paint system. A 25m-long drying tunnel outputs fully coated material ready for site erection. The system also reduces paint consumption by approximately 35%.

"Having started the business in 1984, we have had continued success in providing structures of generally up to 1,000t," said Roger Slade, Allslade Managing Director.

"The efficiency of the new system enables us to be even more competitive and handle projects beyond the 1,000t level."

Steel is just the ticket for new Dublin station

Construction of a new train station in Parkwest, Dublin is progressing rapidly with the entire project's steelwork lifted into place during one weekend possession in January.

The lift, involving two large steel segments with a total weight of 75t, required the use of the largest mobile crane available in Ireland.

The steel structural frame will form the floor for a concourse and ticket office, and once in position the two connected pieces measure 21m x 31m. It straddles two railway lines, supported by concrete cores at either side and a centrally located lift shaft.

Steelwork contractor Andrew Mannion Structural Engineers (AMSE) with McNally's Crane Hire first erected a 35t segment from the North side of the railway lines. The crane was then de-rigged, driven around the site and set up on the opposite side of the tracks to lift the second 40t piece into position.

To complete the operation, the steelwork was then balanced, trimmed and secured with bolted connections.

Prior to the lifting operation both segments were fully assembled on site with metal decking, shear studs, handrails and ducting all fitted.

"We also applied the high specification intumescent paint work, so there was no requirement to work over the live rail lines," said Denis McNelis, AMSE Engineering Director.

AROUND THE PRESS

Contract Journal
9 January 2008
'Ring of steel' proposal to safeguard Olympic Park
Olympic chiefs are considering building a "ring of steel" around the 2012 construction site which could be left in place to protect athletes once the Games begin. Final plans will be drawn-up later this year as Olympic Delivery Authority leaders consider the best way to secure the 2.5km² site.

Construction News
20 December 2007
Manchester's cool new winter wonderland
The frame of the building is made from the S355J0 grade of steel, which has been tested at low temperatures. It needs to be able to withstand huge variances as the steel passes through the ski chamber and beyond.

Building Magazine
18 January 2008
Specialist cost update
The results of the survey indicate that the structural steelwork market is likely to get busier. One third of the steelwork contractors who responded stated a 6-10% increase in the value of orders compared with their workloads six months ago. In addition, two thirds of the contractors stated that orders were already 50% to 60% of their capacity after the first quarter of 2007.

Construction News
24 January 2008
Asian steel producers look to UK for market lessons
Delegates from steel associations in China and South Korea are due to fly into London in the next month to meet up with executives at the BCSA. Derek Tordoff, BCSA Director General said: "These firms are not interested in exporting. What they're really interested in is developing their own markets. They're interested in why structural steel has a high market share in the UK and how they can get a bigger share in the markets they're in."

Sustainability takes centre stage at Futurebuild exhibition

Two of the highlights at Futurebuild 2008 will a giant steel recycling counter, ticking away on the Corus (F295) stand and the Steel Ideal stand, which will combine two innovative international programmes - Living Steel and ManuBuild.

The Corus steel recycling counter will be switched on at the beginning of the exhibition and will continue counting until the show's end. The amount of steel that will be recycled globally during Futurebuild will be displayed in tonnes, and Corus hopes this will raise awareness of the material's integral part in making construction more sustainable.

Roger Steeper, Corus Manager Construction Marketing, said: "There is no single answer to sustainable construction, instead the sustainability of a building is derived from a combination of factors during all phases of construction, from initial design through construction, occupation and end of life. This is driven by a desire to provide a better quality of life for people, while protecting the needs of future generations.

"Corus takes a whole life approach by looking at the material itself and the role it plays in the entire life cycle of a building. Only by looking at the construction process in this way can a truly accurate perspective be gained."

A vision for sustainable housing will be presented on the Steel Ideal stand. This will include a full-scale ManuBuild prototype, which is a steel-framed, pre-serviced module with demountable and moveable walls. The stand will also have a gallery of entries and winning designs from the two Living Steel International Design competitions.

Futurebuild takes place from 26-28 February at London's Earls Court.

Apartments rise up in former hat making district

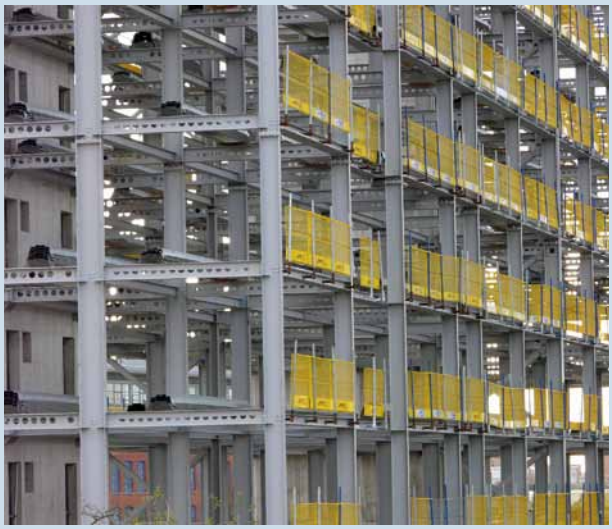
Steelwork has recently been completed on a new luxury eight-storey residential block at Milliners Wharf, Manchester.

The apartments represent the first phase of a City Lofts residential scheme, involving two more blocks, in the former hat making district of Ancoats.

Working on behalf of main contractor Ocon Construction, The AA Group (TAAG) erected all structural steel on the project.

To minimise the depth of the 7.8m span floors, Westok Ultra Shallow Floor Beams (USFB) were used. Typical sections used included USFB 314 x 165/305 x 71.5 and USFB 314 x 254/368 x 130.

At the basement car park level, heavier USFB transfer beams support columns to the above eight residential floors. Stability to the steel frame is provided by concrete cores which contain stairs.



Motherwell College starts Ravenscraig regeneration

Construction work has started on the new Motherwell College campus, the first major development on the former steelworks site at Ravenscraig, North Lanarkshire.

The new £70M college will include a five-storey teaching block, a residential building for up to 50 students and an engineering workshop block.

The campus will also feature conference facilities, a public learning centre, performing arts space, a job shop and a nursery.

The Bone Group has been awarded a multi-million pound contract, by Miller Construction, to supply and erect 1,500t of steel for the project's superstructure.

David Higgins, Group Chief Executive of the Bone Group, said: "This is a significant contract for a number of reasons and it's one that we're delighted to have secured."

Steel erection is currently underway and the college is due to open in August 2009.

Steel guidance completes two successful years

The Steel Industry Guidance Notes (SIGNS), distributed with issues of NSC since January 2006, have now completed two successful years.

The short, two page inserts give practical advice on technical, commercial, legal, marketing, and health and safety issues which then build into a comprehensive set of notes on key aspects of steel construction.

So far there have been 21 SIGNS:

SN01 Good acoustic performance
SN02 Tolerances in structural steelwork
SN03 Money: the most important thing
SN04 Health and safety on site
SN05 Steel in fire
SN06 Achieving airtightness with metal cladding systems
SN07 Floor vibrations
SN08 Welding is a key fabrication process, yet little understood outside the workshop
SN09 Sustainable steel construction
SN10 Galvanizing structural steelwork - Guidance for engineers on how to reduce the risk of liquid metal assisted cracking
SN11 Factors influencing steelwork prices
SN12 Steel specification
SN13 Composite construction
SN14 The prevention of corrosion on structural steelwork
SN15 Design information for constructional steelwork projects
SN16 The case for steel
SN17 CE marking of steel products
SN18 National Structural Steelwork Specification
SN19 Intumescent coatings
SN20 Modern standard forms of contract for modern, collaborative styles of procurement?
SN21 Stability of temporary bracing

All of the above are available for free download at the following websites:
www.new-steel-construction.com
www.steelbiz.org
www.steelconstruction.org
www.corusconstruction.com

Fabrication standard issued for formal vote

The European fabrication standard EN 1090-2 has been issued for formal vote and if accepted it will replace national standards this June.

"An announcement is expected by the end of March," Dr David Moore, BCSA Director of Engineering said. "And as most European member States will probably vote in favour of the standard, it will immediately take affect with no overlap period."

BS EN 1090-2: Execution of steel structures and aluminium structures - Part 2: Technical requirements for the execution of steel structures will replace current national standards BS 5950 Part 2 (buildings), BS 5400 Part 6 (bridges) and BS 8100 (towers and masts).

Big spans for new Corby warehouse

Barrett Steel Buildings is currently erecting 1,500t of structural steelwork for a new 46,000m² warehouse and office building for Greatline Developments in Corby.

The portal frame structure has four x 36m spans and also features a height of 15m to underside of haunch, which then increases to 20m at parapet.

External columns are set at 8m centres, with 40 bays in total giving the building an overall length of 320m. Three rows of internal columns are spaced at 16m centres.

Barrett Steel started on site in November 2007 and is currently erecting the second half of the development.

"Our programme has been adopted to suit the client's programme and this has meant we have been able to fabricate the steel early," said Tony Walker, Barrett's Design Director. "A gap in the programme allowed us to continue with production ready to send the steel to site when it was required for erection."

NEWS IN BRIEF

The European Industrial Fasteners Institute has made a complaint to the European Commission (EC) about the dumping of Chinese made iron and steel fasteners. An investigation has been launched and if the EC finds in favour of the complaint they will impose import duties on these products for five years. Dr David Moore, BCSA Director of Engineering, said: "This will increase the cost of structural bolts in the UK. At this stage it's difficult to say what the import duty will be, but figures of between 15% and 18% have been suggested."

The fastener industry is considering the need for a **quality management scheme** for the supply of mechanical fasteners. They argue such a scheme would be beneficial to stockist distributors who procure and supply mechanical fasteners, contractors who use them and clients who own the infrastructure in which these products are used.

David Cunningham, owner of corporate financiers and tax consultancy Glencairn, is the new majority shareholder of the **Allerton Group**. He now owns 84% of the Northallerton-based steelwork contractor.

FICEP and **HGG Profiling Equipment** have joined forces to supply a new pipe cutting machine to the structural steel industry. Known as the Pro Cutter, the unit can process tubular sections with diameters from 50mm to 610mm, and cut centric/eccentric slot, chamfers, saddles and multiple saddles. For more information on the product contact FICEP on Tel: 0113 265 3921.

Metsec has appointed Michael C. Fina, the world's first global employee reward and recognition company, to develop and run its employee long-service programme for 650 members of staff.

DGT Steel and Cladding's Project Engineer Ryan Thurston has been awarded the Denis Matthews prize in his qualifying exam for Incorporated Engineer status by the Institution of Structural Engineers.

Bridges will keep traffic flowing

Six junctions on the A1, between Peterborough and Blyth, are being upgraded with new steel bridges replacing busy and congested roundabouts.

According to the Highways Agency this 110km-long section, although of satisfactory standard, suffers from severe localised congestion and the bridges will alleviate this by allowing motorists a clear run.

The most northerly junction of the scheme is the Blyth A1/A614 interchange near Retford. Here, as with all the other five junctions, a new 30m-long bridge is being constructed over the existing A1 with new roundabouts either side.

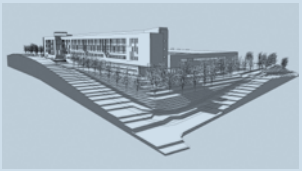
At this location an innovative and time-saving procedure has been used for bridge construction. While the bridge abutments were being readied, steelwork contractor Fairfield-Mabey, assembled the bridge steelwork on a temporary platform to the side of the new bridge position.

Once the 500t bridge deck was assembled, along with the concrete decking and edge protection, it was transported by self-propelled modular transporters over a distance of 200m and jacked into position.

Main contractor Interserve employed heavy lifting specialist Mammoet to carry out this procedure and said it reduced the construction programme at Blyth by approximately two months.

All six junctions are scheduled to be completed by October 2008.

New teaching blocks for Glasgow college



Atlas Ward, working on behalf of main contractor HBG Construction, is building two new teaching blocks at Anniesland College, Glasgow.

The project requires Atlas Ward to fabricate and erect more than 1,200t of structural steelwork, including approximately 200t of Fabsec plated floor beams.

Initially the work involves the construction of a four-storey teaching block with a total floor area of nearly 3,000m^2. This will be followed by the demolition and replacement of existing buildings with a new two-storey 5,000m^2 workshop.

The latter stages of the work will also include a new sports hall that will double up as an exhibition and performance hall, four dance studios and a fitness suite.

The entire project is scheduled for completion by 2010.

The new Aston Villa Football Club signage, atop the team's Trinity Road stand, was recently fixed into place using the Lindapter bolt-on CF high friction clamp. The system allowed the lettering - which is two metres high, 50m wide and mounted on to two channel sections - to be bolted onto the stadium's structural steelwork without any drilling or welding.

Diary

For all Corus events visit www.corusevents.com, email events@corusgroup.com telephone: 01724 405060
For all BCSA events email: david.moore@steelconstruction.org telephone: 020 7747 8122

5 February 2008
New Welding Coordination Requirements for Structural Fabrication
Joint seminar with The Welding Institute
National Motorcycle Museum
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Corus will be exhibiting at the show. Visit us on stand F295. Also at Futurebuild will be the Steel Ideal exhibit: a glimpse into the near-future of construction, combining learnings from two major on-going international collaborative initiatives, Living Steel and ManuBuild.

12 March 2008
Steel: The Show 2008
Thorpe Park, Leeds.
Free

9 April 2008
Sustainability Seminar
Hawthorden Lecture Theatre,
Edinburgh.
Free

22 April 2008
Corrosion Control of Steel Structures
Joint Seminar with Institute of Corrosion.
Oxford. £176.25 per delegate

23 April 2008
Sustainability Seminar
The Lowry, Manchester. Free

29 April 2008
CE Marking of Structural Steelwork
National Motorcycle Museum,
Birmingham, £100 for members, £150 non-members

7 May 2008
Sustainability Seminar
Thinktank, Birmingham.
Free

21 May 2008
Responsible Welding Coordinator Seminar
Boyne Valley Hotel &
Country Club
Drogheda, Republic of Ireland. £100 for members, £150 non-members

22 May 2008
Sustainability Seminar
Cavendish Conference Centre,
London.
Free

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Countdown to Eurocode Implementation

March 2007 | April 2007 | May 2007 | June 2007 | July 2007 | August 2007 | September 2007 | October 2007 | November 2007 | December 2007 | January 2008 | February 2008 | March 2008 | April 2008 | May 2008

Latest news on National Annexes

Significant progress has been made on the development of the National Annexes for Eurocodes 3 and 4. The National Annexes for the general part (Part 1.1), the fire part (Part 1.2) and the part on joint design (Part 1.8) are now complete and it is anticipated that they will be available in spring 2008. Similarly the general and fire parts of Eurocode 4 are also complete.

For UK designers, the Eurocode approach to brittle fracture was rather complicated, especially for building designers who are used to the simplicity of Tables 3 and 4 in BS 5950. This difficulty will be resolved with a Published Document (PD) from BSI, which will present simple look up tables that will be no more difficult than the current Standard. The draft of the PD has been prepared, and the limiting thicknesses are very similar to those in BS 5950.

The situation on the wind loading National Annex is rather different. A recent calibration exercise has highlighted significant differences between our national standard, BS 6399-2 and EC1 Part 1.4 for wind pressures on roof and wall cladding. A corrigenda top EC1 Part 1.4 will be issued later this year, which will allow the coefficients to be decided in the National Annex. A consequence of this is that the National Annex for EC1 Part 1.4 is likely to be still some time off.

Update on the design guides

SCI, Corus and the BCSA are developing a series of guides to help designers. In addition to the books of section properties and member resistances, there will be design guides on:

- Multi-storey braced frames
- Worked examples in open and hollow sections
- Fire design
- Concise Eurocodes for buildings
- Composite highway bridges
- Examples for students (without any National Annex values)

These guides should be available from spring 2008. Work has also started on simple connections to the Eurocodes, and it is expected that work will also start on a guide to composite construction, combined bending and torsion and an update of the Slimdek design guides.

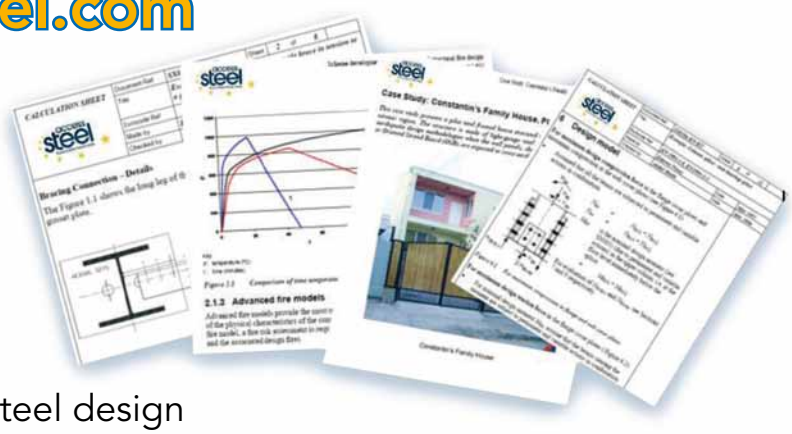
Non-conflicting complimentary information (NCCI)

Anything not covered in the Eurocodes, and yet useful for design, is classed as NCCI. This may range from technical articles in New Steel Construction, publications, PDs, information on websites etc. NCCI is referenced in the National Annex. In the steel world, the National Annexes will reference a single website, http://www.steel-ncci.co.uk where links to all NCCI can be found easily. This site should be fully operational by the end of February.

Writing software?

For designers keen to prepare their own spreadsheets or other software, nothing beats some definitive examples. Model examples, flow charts and guidance for application of the Eurocode rules (NCCI) are already freely available on the access-steel website.

www.access-steel.com



Already online:

- Worked examples
- Tedds Lite examples
- Case studies
- Harmonised guidance on steel design

Doing Manchester justice

In the first of a new series on completed steel framed buildings Nick Barrett looks at Manchester's celebrated Civil Justice Centre, the biggest court complex built in the UK since the Royal Courts of Justice in London during Queen Victoria's reign.

FACT FILE
Manchester Civil Justice Centre
Main client: *Allied London Properties*
Design and build contractor: *Bovis Lend Lease*
Architect: *Denton Corker Marshall*
Structural and services engineer: *Connell Mott MacDonald*
Steelwork contractor: *William Hare*
Steelwork tonnage: *3,000t*
Project value: *£165M*

When NSC first wrote about the Manchester Civil Justice Centre (MCJC) just after topping out in 2005 (NSC September 2005), we highlighted that its eye catching design represented a dramatic rethink of what a court building should look like. The completed structure is in fact a bit of a rethink of what any building should look like, as there is nothing quite like it in Manchester, or anywhere else, with its distinctive finger-like pods cantilevered from both ends, a striking atrium covering most of one elevation and an unusual high tech perforated metal cladding 'veil' on the other side.

The steel framed building has been lauded as a huge success, marking a step change from the traditional architectural approach in the City, which took inspiration from its red brick Victorian industrial heritage. The MCJC has been praised for managing to look modern and accessible at the same time as providing a link between surrounding Victorian structures, more distant post war commercial buildings and other developments currently underway.

Previous court buildings, whether for civil or criminal justice, seemed designed to impress and perhaps intimidate miscreants, and probably also witnesses, with the majesty of the law. This design however is intended to make the law seem more accessible and user friendly.

It seems to have succeeded. The 15 storey building has been almost universally praised by locals as well as the international architectural community. The design, by Australian owned firm Denton Corker Marshall (DCM), has been hailed as a major success in extending Manchester's tradition of innovative architecture and urban design, bringing to life the City's new financial and legal district, Spinningfields.

Design and environmental award winner

The building has been sweeping up design awards, including the 2007 Green Major Project of the Year Award at the Green Construction Awards. Judges praised the MCJC's environmental solutions for integrating engineering and architecture. The main example of this is Mott MacDonald's natural ventilation system, with a mechanical back up. The client wanted the building to be as naturally ventilated as possible, which meant designing the structure to accommodate a complex web of ductwork allowing air to be taken in through vents at the sides of the atrium to be circulated throughout the building.

This design is intended to make the law seem more accessible and user friendly.

Mott MacDonald carried out a lot of modelling of how wind and air could be distributed through the building. An intelligent building management system brings in a back up forced ventilation mechanical system if wind speed drops.

Judges were also impressed by the perforated

Photography: Dave Nightingale

The universally acclaimed MCJC is a striking addition to Manchester's skyline.

Photo courtesy of Denton Corker Marshall. Photography: Morley von Sternberg

Structural challenges

The most complex engineering aspect of the project is the cantilevering fingers, which are designed as trusses. The high tensile forces produced at the top of each 'finger' and the high compression at the bottom are distributed through the composite steel deck floors to the main slipformed concrete core, via tension reinforcement where appropriate,

The component members of each finger are made of plated sections generally 450mm deep and 220mm wide. Flanges are typically of 30mm plate with 15mm webs.

The trusses are up to four storeys high, fabricated and welded at steelwork contractor William Hare's works with a built in precamber. Each truss was cut through the diagonals into sections and was bolted together on site. Pods were also assembled on site and craned into place.

A row of 700mm hollow equilateral triangular columns rise the full height of the atrium, restrained at irregular intervals by the beams which also support the pods. They are geneally designed to run for three storeys between restraints, which means nearly 18m because of the courtrooms. Sliding movement joints were placed between the atrium façade support structure and the main structure to accommodate differential thermal movement between the façade and the columns.

The columns are made from steel plate of either 15mm, 20mm or 35mm thickness, depending on the load on the column, welded at each triangle's vertex. One challenge for the steelwork fabrication was achieving a sharp edge detail desired by the architect at each corner of the columns. After mocking up a number of solutions a detail was selected in which rather than attempt to achieve a perfect point, the welded joint is squared off to 15mm wide.

Close cooperation between steelwork contractor and the rest of the design team from the earliest stage paid dividends. For example, after constructing a model in Strucad that included details such as the glazing system frame, areas of potential problems and missing information were identified and resolved before fabrication.

It is conceived of as a 'layered' building with different functions and degrees of transparency on particular levels.

veil, which helps reduce cooling load energy consumption by 20%.

Landmark design

The design brief called for a building that would provide a landmark on the way into the City when approaching along the historic main thoroughfare of Bridge Street. DCM scored points in the competition for the project design by proposing a main entrance on Bridge Street rather than the entrance on a side street that the client originally envisaged.

The building provides 34,000 m² of accommodation on 15 levels, housing 47 courtrooms, 75 consultation rooms and space for offices and support staff. It is conceived as a 'layered' building with different functions and degrees of transparency on particular levels. A striking atrium is one layer, providing the public areas and allowing for a 3.2m wide concourse at each level. Pods within the atrium provide meeting rooms for solicitors and their clients, designed to appear as if suspended in mid-air. The public pods connect to a light and airy concourse that is linked to the core.

The concrete core forms another layer,

Photo courtesy of Denton Corker Marshall. Photography: Morley von Sternberg

containing lifts and stairs and more meeting rooms, acting as a link to the next layer which contains courtooms, judges' chambers, administrative offices and a library. Although the cantilevered fingers are fully glazed they are not intended to be fully transparent as they contain courtrooms; there are however external views from the end of each courtoom and the sky is visible through high level glazing along each side.

The final layer is a distinctive 'environmental veil' set 600mm outside the line of the Bridge Street façade. This is a perforated metal cladding, with the degree of perforation varying to allow an appropriate amount of natural light through to the room behind, providing shading or natural light as required.

The grid is irregular, with floor to ceiling heights of 5.6m up to the court areas on level 11. Administrative offices are mainly on the four floors above, with more standard ceiling heights.

Left: The fingers are fully glazed but not fully transparent as they contain courtrooms.

Photo courtesy of Denton Corker Marshall. Photography: Morley von Sternberg

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In courtroom areas the maximum floor spans are 11.5m. Detailed vibration analysis was carried out for these long span areas and a response criteria twice as stringent as the normal standard for offices was adopted.

The architect says the working courts and offices are expressed as long rectilinear forms, articulated at each floor level and projecting at each end of the building as a varied composition of solid and void. In side elevation, these elements collectively establish a dynamic and distinctive building profile; in end elevation, they form a powerful sculptural interplay of light and shade, depth and complexity.

The architectural implication is that the courts are not forbidding or concealed, but open and accessible. This is achieved by maximising the use of glass, through which are visible coloured panels in the atrium and courtoom areas, reminiscent of a Mondrian painting.

Left: Plentiful natural daylight and ventilation are features of the MCJC

Photography: Dave Nightingale

Right: The structure's façade makes a bold and distinctive profile by night.

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FACT FILE
New Mental Health Unit, Edith Cavell Hospital, Peterborough
Main client: *Greater Peterborough Health Investment Plan*
Architect: *Nightingale Associates*
Structural engineer: *Robert Bird & Partners*
Main contractor: *Multiplex*
Steelwork contractor: *DGT Steel & Cladding*
Steel tonnage: *600t*

Flexible steel gets clean bill of health

Changing the structural design to steel, from timber and masonry, has resulted in a quicker construction time and more efficient buildings for a new healthcare facility in Peterborough.

Top: All plant will be housed within the building's roofs.

Above: All six structures are linked by curved walkways.

"What we've designed is an efficient and durable collection of structures, based around an original timber and masonry idea."

One of the latest PFI healthcare initiatives is a new Mental Health Unit (MHU) currently under construction at the Edith Cavell Hospital on the outskirts of Peterborough.

The project consists of six separate steel framed structures which are all linked by a series of covered walkways. Four of the buildings are single-storey, while two centrally located administration blocks have two floors.

The centre, which is due to open later this year, will offer 102 beds in state-of-the-art purpose built accommodation within single en-suite bedrooms. It will also include adult acute psychiatric wards, a psychiatric care unit, older people's mental health unit and a specialist service for people with learning disabilities.

DGT Steel & Cladding was awarded a £1.3M steel and cladding contract during 2007 to design, fabricate, deliver and then erect nearly 600t of structural steelwork for the project. In addition, it was also contracted to design, supply and install the roofing and cladding packages.

Matthew Byatt, who heads up DGT's in-house structural engineering design consultancy, says this overall involvement has proved invaluable in ensuring that the steel superstructure design and its inter-relationship with the building envelope, provided the most economic solution to meet the requirements for the building.

"By not just being the steelwork fabricator we've been able to deliver a more cost effective solution," adds Mr Byatt. "During the design stage we also suggested and then implemented some alterations which have saved the client time and money."

Originally the project was to be built with load bearing masonry supporting timber trussed rafters, however this plan was shelved by the client in favour of the faster and more cost effective steel option.

"The building's design however didn't change," explains Mr Byatt. "So we then had to design the steel frame around the original layout, and fit columns so as not to obstruct windows. Consequently we've ended up with a very irregular grid pattern."

Because each structure has a lot of large windows, there was very little room, once external columns were taken into consideration, for any bracing. So all bracing is limited to the buildings' gable ends.

"What we've designed is an efficient and durable collection of structures, based around an original timber and masonry idea," says Mr Byatt. "This highlights steel's inherent flexibility."

The two largest one-storey buildings needed internal column-free areas and there are spans up to 15m long within the structures. To support the roof DGT installed a truss arrangement to pick up beams as there are no columns.

"There are a couple of internal columns," adds Mr Byatt. "But these are only in corners where the curved sections of the roof intersect the straight roofs and the structure required the extra support."

The client wanted a collection of predominantly low-rise buildings and DGT says it met this requirement by designing the roof areas to support plant rooms in what is essentially a window-less floor level.

Summing up, Mr Byatt says the buildings will be efficient and durable, and as the walls are non loading bearing they can be moved in the future if the structure's layout is modified.

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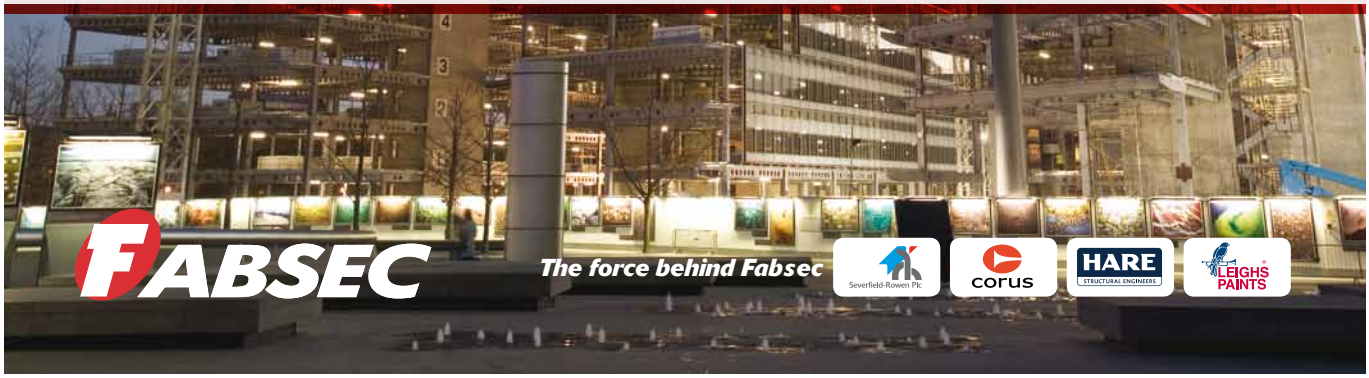

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The 18m-high walkway will consist of a 200m-long looped circuit.

A view from the top

An 18m-high walkway will give visitors to Kew Gardens a unique birds-eye view of the park and the tree canopy. Martin Cooper reports on how weathering steel is helping to create an exciting structure at this World Heritage site.

FACT FILE
Kew Gardens Treetop Walkway, London
Main client: *Royal Botanic Gardens Kew*
Architect: *Marks Barfield Architects*
Structural engineer: *Jane Wernick Associates*
Project manager: *Fanshawe*
Main contractor & steelwork contractor: *W.S. Britland*
Project value: *£3.5M*
Steel tonnage: *400t*

Due to open in May, the Xstrata Treetop Walkway will allow visitors to the Royal Botanic Gardens at Kew to embark on a 18m-high panoramic stroll through the canopy of some the park's oldest and tallest trees, and explore an otherwise inaccessible environment.

The walkway will consist of a 200m-long looped arrangement of modular trusses, connected by circular node platforms, which in turn are supported by triangular structural pylons, all of which will be fabricated from Corus' weathering steel. There will also be a large classroom-sized platform at the mid-point of the walkway to provide space for school groups of up to 35 children.

"Weathering steel was chosen for its strength, appearance and low maintenance."

The project is the most ambitious public installation at Kew for two decades and also includes an underground 'Rhizotron' exhibition space. At 1.6m below ground, this subterranean area will give visitors a chance to explore the tree root biology and its relationship with microorganisms.

Tree enthusiast and Kew's Head of the Arboretum Tony Kirkham, says the project will offer a unique visitor experience, both over and underground. "The tree canopy changes with the seasons and the walkway will allow people an intimate view of deciduous woodland and its wildlife from within the tranquility of the leaves."

The idea for the high-level installation came about after a temporary scaffold walkway was erected in the Gardens during 2003/04. This proved to be such a success that a permanent structure was decided on.

Chris Smiles, Associate at Marks Barfield and Project Architect, says the walkway will give an up-close experience of bio-diversity as well as blending into its arboreal surroundings.

"We looked at many materials," he says. "But weathering steel was chosen for its strength, appearance and low maintenance, which are all important criteria as we are working in an environmentally sensitive area.

"The attractive appearance and natural rust colour of the steel will blend into and compliment the surroundings."

Mr Kirkham goes on to say: "We needed a strong, safe, low maintenance material that would be durable and naturally blend into the trees of this World Heritage Site. Corus weathering steel satisfies

Above: Weathering steel is being used as it will help the structure to blend into the changing treetop environment.

Above left: A metal base grillage at Britland's fabrication yard.

all our requirements and unlike some materials, has no run-off that could over time do harm to our trees."

The natural environment also played a key role in the design of the walkway's 12 trusses. These steel-framed 12m-long units have been designed using the Fibonacci numerical sequence that lies at the heart of many plant structures.

"The simple design creates a seemingly random appearance of truss members, but has an integral strength based on a natural growth pattern," explains Mr Smiles.

This sequence is used for the spacing of the connection points for the diagonals of the walkway trusses. The 400t of Corus' weathering steel plate used for this structure was manufactured at Corus' Scunthorpe works and Dalzell steelworks in Motherwell. Steelwork contractor Britland has since been profiling the steel plate at a number of locations throughout the country.

"Since weathering steel can only be supplied in sheets we chose to fabricate triangular tapered sections that are strongest at the base and can branch out to support the walkway," explains Jane Wernick, Director of Jane Wernick Associates. "This wouldn't have been possible with tubular or other forms of steel."

Each Fibonacci inspired walkway truss will be entirely fabricated off-site and brought to Kew as a complete unit with all fittings such as timber handrails, expanded metal decking and balustrades attached. Each of the 12m-long trusses will weigh 4t.

Off-site construction is a key criteria for the job as this will ensure minimal impact on the project's surrounding trees. The platform nodes will also be fitted out off-site and brought to Kew in completed 1.5t units.

"Each truss is cut from steel plate and we are using 90% of the material," explains Britland's Special Projects Manager David Marriott. "There is a massive amount of cutting to do, but it's still the most economical way of producing the sections."

Fabricating the complete truss and node sections off-site means Britland just has to lift them individually into place during the erection process. This lessens on-site impact, while all sections are pin connected which minimises on-site welding.

Britland started the erection process just before Christmas and expects to complete the job by early March. The process involves setting the pylons in place first - four supporting most of the node platforms and six for the larger classroom - and then lifting the walkway sections into place between the nodes.

The pylons are set into 6m-deep 273 CHS metal tubes in the concrete foundation. Each set of piles are linked at ground level by a heavy steel 356UC x 368 x 153 metal grillage which connects each of their bases and acts like a bridge. "The grillage spreads the load and minimises the depth of foundation, which prevents any tree root damage," says Mr Marriott.

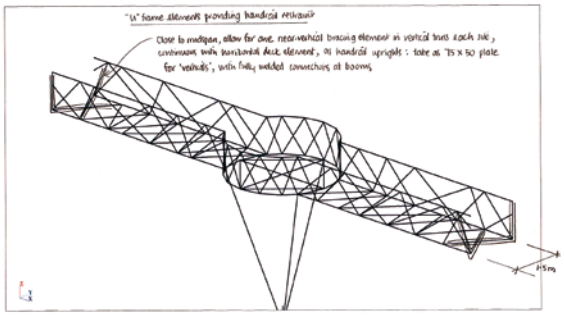
Each of the 18m-long pylons weigh about 11t and are being lifted into place by mobile crane. "Once the two sets of pylons are up, lifting the truss into place is just like erecting a bridge," explains Mr Marriott.

Two sections of the steelwork are, however, too big to be completely fabricated off-site. The classroom platform, and the walkway staircase will be brought to site in pieces and then welded.

Although the walkway will have a lift, primarily for the disabled or those with pushchairs, the staircase is the main visitor access to the 18m-high walkway.

"The staircase forms a fundamental experience of slowly going up into the tree canopy," explains Mr Kirkham. "I'd like to think that most of the 500,000 visitors we expect every year will use the stairs."

When the Xstrata Treetop Walkway and Rhizatron open they will encourage visitors to learn more about the crucial role of trees and the valuable ecosystems which live around, under and in them. The installation also forms the centrepiece of Kew's Festival of Trees which starts in May.



Specify steel – specify quality

Our series on the Case for Steel continues with Nick Barrett outlining why choosing steel construction is the quality option.

Steel as used for framing solutions in the majority of the UK's new buildings is one of the most quality assured products available anywhere. This assurance of quality runs from the sourcing of the raw materials used in steel production, through manufacture of steel at Corus owned UK steelworks, into factory controlled conditions of the steelwork contractors' fabrication workshops and onto erection on site. With steel, quality is built in, right along the supply chain.

Selection of steelwork contractor

The quality process for steelwork fabrication and erection starts with the selection of a steelwork contractor properly qualified to undertake the projects selected from the Register of Qualified Steelworkers.

The steelwork fabrication process also delivers quality certainty as it is typically driven by a seamless link between the 3-D model and numerically controlled fabrication machinery. The steelwork production process means that close cooperation between client, designers and steelwork contractors is easily achieved; when required, structural solutions can even be trialled before going to site using mock ups, as Severfield Rowen did for client BAA at Heathrow's soon to be opened Terminal 5. Production of steelwork to the tight tolerances made possible by these processes means steel is delivered to site with minimal defects, and hence there are fewer problems during the crucial on site phase of developments. Steelwork production in line with the National Structural Steelwork Specification helps ensure that steelwork will be accurately, economically and safely built.

The quality of steel construction is seen clearly when steelwork erection gets underway on site. The speed and trouble free nature of erection can surprise those unused to seeing the benefits of steel at first hand. Steelwork is erected by fully trained and highly competent operatives, following best practices that are published in comprehensive safety codes of practice by the BCSA.

Steelwork contractors have developed and shared many innovative safety related systems, such as edge protection systems, that help explain why the steelwork sector has a safety record that is the envy of the rest of the construction industry.

Below: Systems, such as the Easi-edge protection on this hospital project in Sunderland, are routinely put in place during steel erection.

Quality seen on site

Steelwork is not affected by the usual UK weather and special protection measures are only required when temperatures fall to unusual levels. There is a wide range of industry guides for the erection of different types of structures. Once erected, a steel frame is a durable product, not subject to creep or shrinking like other materials. Proven corrosion protection systems are available for use where harsh environments demand them. Most steelwork contractors have comprehensive certification of their operations through schemes such as the Steel Construction Certification Scheme.

The durability of steel has long been established.

In service, steel is strong and ductile and proves its quality characteristics by its resistance to accidental damage. Sections of steel can easily be replaced if required by either cutting, welding or bolting to restore full resistance with a solution that is predictable and assured. The quality of life of a steel frame can be extended as a steel framed building lends itself to easy extension and adaptability to changing uses.

The durability of steel has been long established; piles that have been extracted from the ground after being there for 100 years have been found to be in good enough condition to be re-used – all steel is of course fully recyclable as well. Piles extracted from the ground in Chelsea in 2006 were so

Advance a guarantee of quality

All structural steel sourced from Corus is CE marked, which gives an assurance that Corus steel is of guaranteed quality and of a provenance that can be confidently demonstrated

Corus has recently invested heavily in its plant and delivery systems to ensure the continuing delivery of quality products, including over £200M of improvements at its Scunthorpe long products site. The latest in steel rolling technology has been installed at the Medium Section Mill to create the world's first dual rail and structural sections rolling mill. Corus' Advance sections range benefits from this quality enhancement.

The new facility can produce structural sections to the most demanding specifications, well inside the minimum requirements set by national and international standards for dimensional tolerance and material performance. Corus' tight manufacturing controls also enable production of bespoke sections where depth and flange/web thickness of a section can be tailored to the particular needs of a project.

The investments also include the construction of a new world class Automated Distribution Centre (ADC) at Scunthorpe, which will receive Advance sections from the adjacent mill and stack and retrieve them as required while sheltered from the elements. The ADC improves customer service by ensuring that all products are despatched on time and reach customers in first class condition.

Corus was the first steelmaker in the world to gain approval to CE mark its structural sections and plates to meet the EU Construction Products Directive (CPD). Advance sections were the first in the world to be accredited under the onerous Lloyds Register marine quality scheme, and Corus is one of a very small number of manufacturers outside Japan to carry approvals from the Japanese Institute for Standardisation.

In 2006, to make it even easier to specify Corus CE marked sections compliant with the CPD, Corus introduced Advance as the new name for its entire range.

The name Advance was chosen to reflect the many technological improvements and the well-established world-class processes involved in producing Corus structural sections. Manufacturing excellence is assured for steel with the Advance sections mark.

Designers need to be sure that sections they specify comply with the CPD, and choosing a CE marked product is the simplest way to achieve this. The Advance range includes all section types (channels, angles and bearing piles as well as beams and columns), all with the Advance mark rolled into the web for ease of identification and traceability.

At the same time 21 new beams and columns were added to the 'traditional' UK section range to increase the flexibility that steel offers designers to achieve the most effective structural solution.

well preserved that the rolling marks and the name Frodingham could still be seen, confirming that they were produced in Scunthorpe in 1907.

More is known about the performance of steel in the harshest of conditions – fire – than any other material. The quality of the material and the designs that it allows is such that fire regulation requirements are easily achieved. Advances in structural frame analysis are still advancing, increasing our knowledge of the performance of structural steel frames in real fires, allowing improvements in economic design for fire conditions.

Below: Tubes can be structurally integral to a project as well as lending some aesthetic quality.

Aesthetic quality

For many people the quality of a building or other structure is most clearly seen in its finished appearance, and it is here that steel allows major benefits to be shown. Steel is increasingly seen as the aesthetic choice for structures as it allows architects free rein to express their vision. Steel can be curved in three dimensions, bent to almost any shape architects can envisage. Tubular steel has become almost the default choice for large external trusses in sports stadiums as a result. Tubes are also increasingly used as the main structural columns for prestige office buildings such as the Wellcome Trust's corporate headquarters in London.

A comprehensive range of structural plate grades is available to the UK market, including weathering steels as well as a complementary range of sections. The bridge market is a key user of these products and steel has recently made inroads to parts of the bridges market traditionally left to concrete, such as shorter span road bridges.

Weathering steels have been used recently on some high profile road bridge projects and are being specified by architects and engineers as well as being requested by clients for their aesthetic properties. They are a quality solution for a wide range of outdoor applications for structures in exposed locations. Durable painted protection systems have been specially developed for locations where such a finish is required.

FACT FILE
St Pancras Station
Client: *Union Railways*
Engineer & Architect: *Rail Link Engineering*
Main contractor: *Costain, O'Rourke, Bachy & Emcor joint venture (CORBER)*
Original ironwork contractor: *Butterley Engineering*
New steelwork contractor: *Watson Steel Structures*

All change at St Pancras

The £800M redevelopment of St Pancras Station not only involved the construction of a new extension, but also the restoration of the famous Barlow shed's wrought ironwork, which has been in place since the structure opened in 1868.

Above: The majority of the Barlow shed's ironwork was in good condition and just needed repainting.

The completed construction work at London's St Pancras Station has seen an architectural restoration and expansion of a unique London landmark. As of last year, Eurostar trains, bound for Paris and Brussels, as well as Midland domestic services, now arrive and depart from the fully reglazed, repainted and extended Barlow train shed.

Located behind the impressive Gothic station frontage, which formerly housed the Midland Hotel, the Barlow train shed is a spectacular feat of Victorian engineering and even held the world record for the largest enclosed space for many years during the nineteenth century.

The engineer behind this architectural masterpiece was the Midland Railway Company's Engineer in Chief William Barlow. He oversaw the construction of the train shed which features a 210m-long and 30.4m high roof with a span of more than 74m. The arch was fabricated and erected in 1868 by Butterley Engineering. Another interesting Victorian record is the fact that the clear span wasn't surpassed for another 30 years, making it the world's widest for most of the era.

Structurally the shed is a tied arch, with a row of 46 huge iron girders (ribs) running the width of the station. The arch is not a smooth curve as it rises to a point. Aesthetically pleasing to look at, this feature does reduce the outward thrust of the arch.

All of this adds up to a tough structure, which was hit several times by bombs during both World Wars. The story goes that the railway authorities simply patched the shed up each time and services carried on pretty much as normal.

Any old iron

The massive restoration of the shed entailed cleaning and repairing the arch's wrought ironwork above a huge arched scaffold and platform. As well as reglazing the structure, the paint work has been taken back to its intended pale sky blue. In keeping with modern sustainable and environmental procedures, the building has been restored by recycling the brick work from the original structure or getting clay from the nineteenth century source in the Midlands to make new replica bricks.

The roof has been totally restored to its pre-World War II condition with ridge and furrow glazing (14,080 glass panels in total) over the crown and 300,000 handcrafted Welsh slates over the remainder. The glazing was an enormous undertaking and covers an area of 10,000m^2, which is almost equal to two full-size football pitches.

"The columns are pristine, but nobody knows how they were made…"

Ben Ruse, Head of Media for St Pancras International, says there were two areas of the arch, in particular, which needed a lot of repair work. This involved new steel being welded into areas were the wrought-ironwork had corroded badly.

"The north gable, as it is exposed, had suffered from quite a lot of corrosion, but as the arch was repainted no-one can now see the welds between new steel and old iron."

The other area which required some time-consuming repair work was below ground on the 'iron boots' which support the 46 ribs, which form the

The new extension was designed to be subservient and complementary to the original structure.

arch. These large chunks of iron had been repaired many times over the years and even had concrete inserted in places where corrosion had set in.

"All concrete was scraped out and we again repaired the ironwork with new steel, before painting," adds Mr Ruse.

Under the giant shed, the platform structure has been substantially altered. The Victorian platforms and track were originally supported by 800 wrought-iron columns and a grillage of wrought-iron beams. Eurostar trains now enter at the same level, but on a new heavily reinforced concrete trackbed.

Numerous escalator and light wells have been cut out of the wrought-iron structure to connect the two new levels and whereas the grillage of beams has become redundant, most of the original columns were in good condition and remain to support the new trackbed, albeit with bearings added to their tops to take into account movement from above and the extra weight of modern day rolling stock.

Below the tracks, in what was originally an undercroft for beer storage and more recently a network of small businesses, is now the arrivals hall with ticket and passport control.

Mr Ruse says the wrought ironwork below ground was in a remarkably good condition after nearly 150 years. "The columns are pristine, but nobody knows how they were made, though it is known that rope, tree trunks and horse urine were involved. We don't know what the urine did, but the theory was it made them harder and long-lasting."

Although the theory lacks any scientific proof, the fact that the columns are still in use certainly gives some credence to this, archaic and equine, Victorian procedure.

Victorian heritage

One thought as to why there was such a huge outlay on the vast train shed was that it would allow internal flexibility, although, in fact, the position of the tracks and platforms remained unchanged until it closed in the 1990s. But now Barlow's concept has been fully justified, as the single span has allowed the internal space to be rearranged and the iron-columned basement – designed on a module of Burton beer barrels – partly hollowed out for Eurostar facilities, while a new flat-roofed shed extension has been tactfully added on.

Watson Steel Structures erected the new extension and the options for this were either to extend the station roof matching the geometry of the Barlow arch, or to go for something that does not challenge the old structure.

As no original detailed plans remain of the Barlow shed, it was decided to build an extension that was considerably wider that the existing station, but subservient to the older structure.

The reason for the extension was that Eurostar trains are about twice the length of trains originally catered for in the Barlow shed. As a result of the extension works there are now 13 platforms with the middle six exclusively for Eurostar trains and running the full 400m of the extended station to terminate in the Barlow Shed, while the remaining seven domestic platforms terminate in the extension.

Top: The St Pancras redevelopment is one of the initial phases of a much larger regeneration programme.

Above: Eurostar trains now arrive in the refurbished Barlow shed.

Building for the future

The Europe wide ManuBuild project could revolutionise the continent's housebuilding sector by delivering faster and more sustainable houses by using modular off-site construction with standardised components.

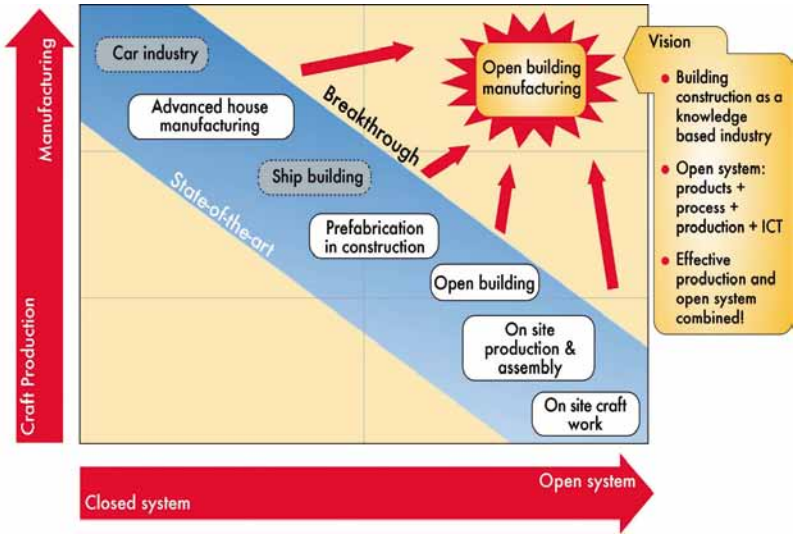
For the first time inspirational unconstrained building design will be combined with highly efficient industrialised and standard-ised production.

Recent plans unveiled by Gordon Brown's government to build three million new homes by 2020, coupled with a decline in the number of skilled tradesmen in the UK, means there is a need to deploy fewer workers on site by employing new and innovative housebuilding methodologies.

ManuBuild, a four-year project and the largest ever part EU funded European construction scheme, has been initiated to address this issue. The project value is €45.8M, including contributions from industry, the highest European Union funding ever awarded to a research and development project in the construction industry.

The project aims to allow customers in the future to purchase high quality, manufactured buildings with a high degree of design flexibility and at a lower cost than today. For the first time, inspirational unconstrained building design will be combined with highly efficient industrialised and standardised production.

Currently construction processes are seen as being very fragmented across Europe and are a long way behind the automotive and aerospace industries. ManuBuild wants to change current construction methods towards more unconstrained design combined with ultra-efficient manufacturing leading to industrial style construction. By utilising more modular type off-site construction methods the industry will reap the benefits of injury-free sites, zero-defect buildings, dramatically reduced build times and carbon neutrality.



Open building

The project wants to open up the supply chain, allowing any number of modular off-site suppliers to offer standardised products and components combined with design flexibility. Potential impacts of the strategy include a significant reduction in waste, cost and the time it takes to construct buildings. This will ultimately improve Europe's building stock, while also releasing resources that can be allocated to other important industrial sectors. ManuBuild calls this approach the "Open Building Manufacture system".

Architect Steve Thompson of Corus Construction Services & Development, says this open system will allow greater flexibility and choice for customers seeking modular construction.

"The system combines value driven, innovative, efficient and safe manufacturing and assembly in factories and construction sites, and an open system for products and components offering diversity of supply and building component configuration.

"ManuBuild is taking a new approach to overcoming some of the associated challenges by combining four key elements - building concepts, business processes, production technologies and ICT support," he explains.

At the project's inception more than 100 stakeholders were interviewed, to get their opinions about the specific features of ManuBuild and align the project according to the different geographical areas. Project partners include Sweden, the UK, Germany, The Netherlands, Poland, Spain and Finland. All these nations have different building trends and needs and stakeholders were able to map out a strategic roadmap acceptable to all.

Since the implementation of ManuBuild, the stakeholders expect major advantages such as higher quality, real time control of the construction process, more cost efficiency and controlled structure manufacturing.

Steel involvement

ManuBuild has 23 European partners, led by Corus, the only steel manufacturer to be involved with the project, along with architects, contractors, developers, materials producers and public authorities.

Although the project is non-material specific, steel inherently lends itself to this flexible modular and off-site construction. As part of the ManuBuild →

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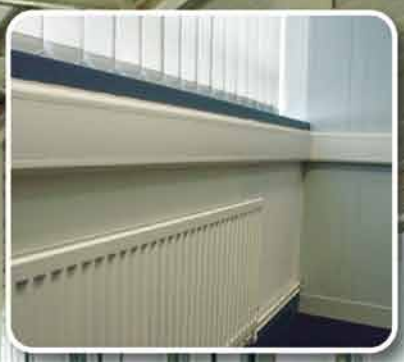

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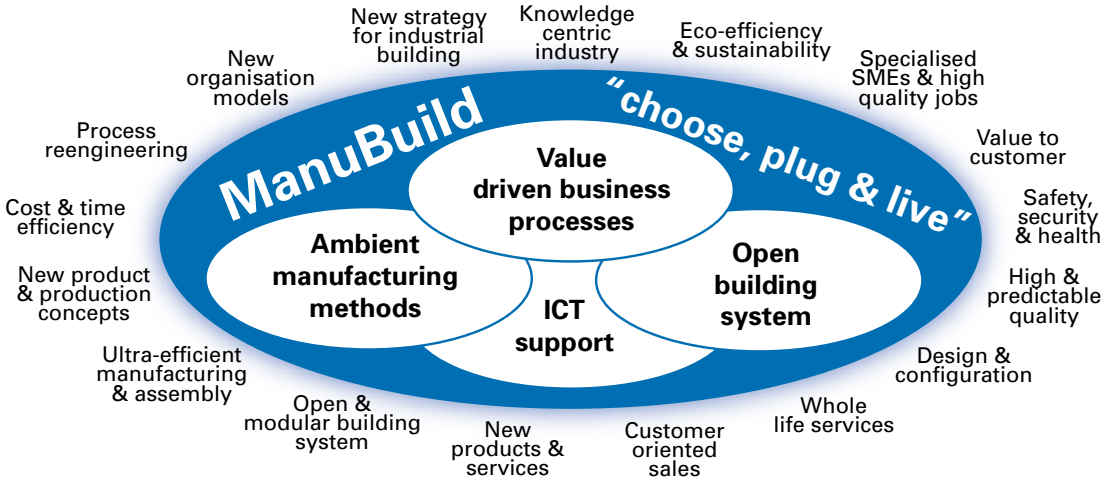


project Corus has developed the Corus Building System - initially for two to seven-storey residential blocks - this system makes use of rectangular hollow sections to produce corner supported building modules.

The frame and infill of these modules will always be produced off-site allowing for a more sustainable approach. The module design uses standard components and allows complete freedom in module sizes up to their maximum spans. This means total flexibility and also allows for future re-configuration. A number of modules may initially be bolted together to form a two-bedroom flat with a large living room/kitchen area. This same apartment could in the future – simply by the occupant moving a couple of walls – be re-configured into a three bedroom flat. The same concept would even work on a larger scale, whereby all apartments on one floor could be re-configured. For example four three-bedroom flats could become five two-bedroom apartments.

"It isn't usually possible or suitable to guess the needs of occupants in the future," says Mr Thompson. "This meant adopting a flexible approach whereby internal walls are easily movable and modules can be taken out of a structure and moved or even replaced."

These steel-framed modules can be equipped with various cladding materials and because of their standardised construction, could be available from a number of sources.

Below: Steel modules can be easily reconfigured as they have movable walls and partitions.

However, one of the key design elements of the Corus module is the integration of services within floors. "By integrating the services there will be less on-site work and this allows for much quicker installation of the modules and frees up valuable plan space," says Mr Thompson.

The Corus system has also developed long span floor beams for easy re-configuration of space. These high performance spans are up to 8m long and will be of a composite design.

Demonstrations

A detailed study was carried out to develop three main medium rise apartment typologies – Nordic, Central European and Mediterranean, and to assess what the residential markets are looking for in each region, and what is seen as architectural quality. The Central European typology includes assessments of the Code for Sustainable Homes and how the Corus system can support this and similar market needs in the future.

A central European demonstration building is being built by ManuBuild partner Taylor Wimpey on a site in Telford. Here low-rise two-storey housing units are to be constructed using the Corus Building System of corner supported modules made from rectangular hollow sections. The whole off-site modular construction features steel frame and in-fill, and perfectly demonstrates steel's flexibility and cost efficiency.

Concurrently a Mediterranean demonstration project is under way in Madrid and also features Corus system concepts. This scheme consists of two apartment blocks - one four-storeys high and the other with seven-floors - and both featuring a top floor of penthouses.

The higher structure is being entirely constructed as a steel framed building, while the four-storey apartment block is concrete framed except for the top floor of penthouses. The architects for the Spanish demonstration project expect to make an up to 60% saving in energy consumption by using the ManuBuild modular system.

"These projects will fully demonstrate the advantages the off-site modular approach has for the housing market across Europe," sums up Mr Thompson. "Speed of construction, flexibility and standardised components will mean a more sustainable housing market."

Retail boost for coastal resort

A shopping centre extension, spanning bus lanes and a main arterial road, has required a phased steel erection programme in order to keep the highway partially open to traffic throughout construction.

Above: The site is hemmed in by roads, the existing shopping mall and a car park.

FACT FILE
Market Gate Shopping Centre, Great Yarmouth
Main client: *Miller Developments*
Architect: *Broadway Malyan*
Structural engineer: *Halcrow Yolles*
Main contractor: *ISG Jackson*
Steelwork contractor: *D.A. Green & Sons*
Steel tonnage: *700t*
Project value: *£7.8M*

The East Anglian seaside resort of Great Yarmouth is popular with holiday-makers, but as yet it isn't renowned as a Norfolk shopping destination. This is about to change as a result of the £7.8M Market Gate project, which will be completed later this year.

The scheme got underway in early 2007 and consists of a major redevelopment of the town's existing shopping centre which will add an additional 6,000m² of retail space, with high profile tenants such as Debenhams, New Look and Iceland already signed up.

The new structure will straddle three traffic lanes.

The first phase of the project consists of a four-storey extension erected adjacent to the old shopping mall. This part of the new structure will link directly into the existing mall and is the only part of the new build with a ground floor.

Ian Burchnall, Contracts Manager for D.A. Green & Sons, explains: "The rest of the extension has two-storeys and will be built over three traffic lanes used as a bus station terminus and an arterial road.

"The rest of the extension will be built over a bus station terminus and an arterial road"

"This part of the job is extremely challenging and involves a number of phases for steel erection, with some work needing day and night closures to the roads."

D. A. Green completed the first phase of the steelwork package in November and this comprised the entire four-storey retail block and the steel structure over one traffic lane.

The ground floor of this part of the project has been pre-let to Iceland and speed of construction was critical as the client moves in this month (February) to start its own fit-out. Iceland will then vacate its site within the existing mall, allowing main contractor ISG Jackson to begin a refurbishment of the old shop.

Above: Feature CHS columns will be filled with concrete for extra impact resistance.

The site for the initial phase of construction was previously occupied by an old emporium which was demolished early in 2007. An extensive piling programme was then under taken before steelwork erection could commence.

The majority of the four-storey structure was erected with a 7m x 7m grid pattern, using primary 533 UKBs and secondary 406 UKBs. "The pattern was dictated client requirements," says Mr Burchnall. "While the ground floor does require some longer spans as Iceland wanted a more column free area."

The front (north) elevation of the new structure will house a new entrance to the enlarged shopping mall and will have one row of perimeter 406mm diameter 12m-high CHS columns. These feature members will extend from ground level to the second floor. Behind this facade the first floor level is effectively a mezzanine floor and set back by 6m from the perimeter. As a safety precaution, and because these CHS's are within metres of a busy road, they will be filled with concrete for added impact resistance.

The proximity of the existing building means the initial new build sector has a complex arrangement of cantilevers to take into account foundations and pile cap positions.

"We've had to pull in the column lines to avoid what's already in the ground. The resulting structure has around 180 cantilever members," explains Gary Farquhar, Project Engineer for Halcrow Yolles. "We were able to adopt a rationalised grid above first floor, but at ground level our footprint was restricted by the arrangement of the existing highways."

While erecting the initial phase of the project D.A. Green did have the relative luxury of having a set-down area for steel deliveries. After this section of the project was completed, areas suitable for material storage will come and go as the road layout changes to allow the extension to be built overhead.

"As we got closer to completing the main block we had virtually no spare room left on site," explains Mr Burchnall. "From now on we have a very tight programme, and we have to fine tune deliveries to fit in exactly with erection, especially the final phases."

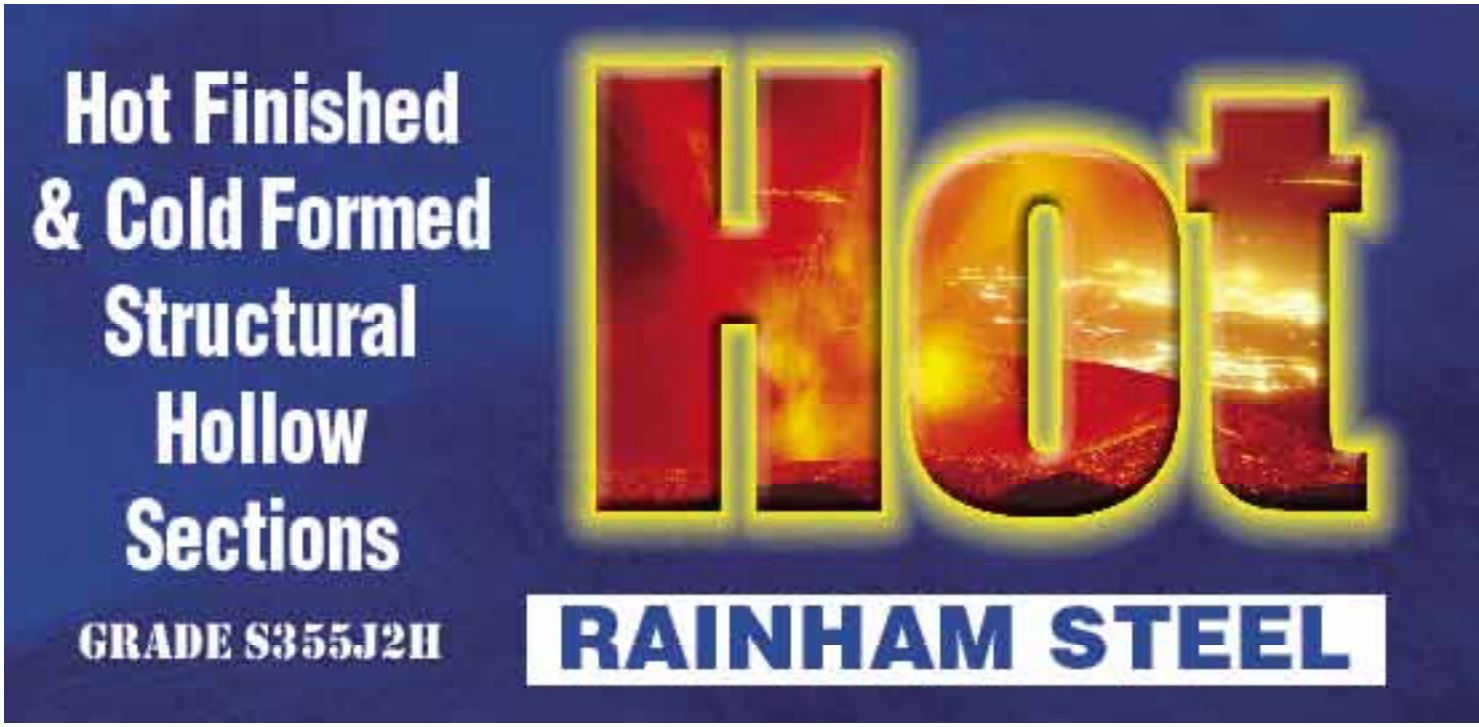
This will primarily be achieved by downsizing truck deliveries, from 24t to 10t loads per day. "This will ensure all steel delivered to site is erected that day and allows for minimal storage of materials on the confined site," explains Andy Crunkhorn, D.A. Green's Site Supervisor.

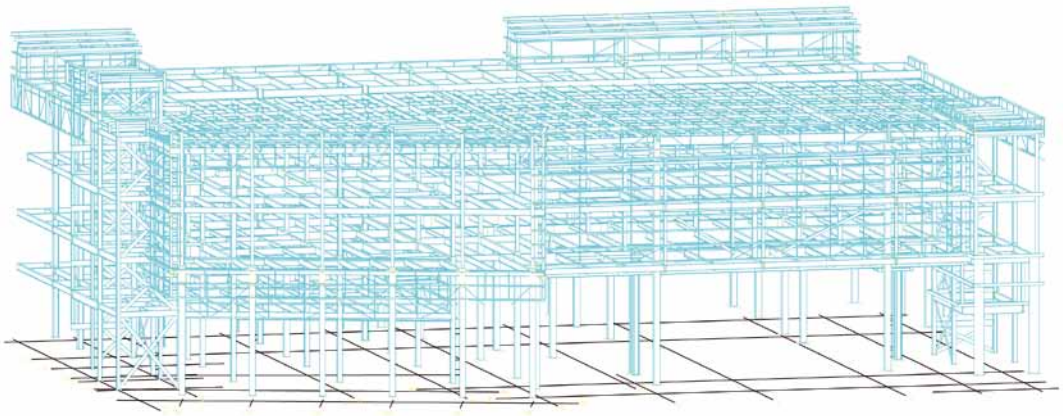
During January, main contractor ISG Jackson has been reinstating the one traffic lane which has been built-over. This is now open as a joint bus and traffic lane, while the other two lanes have been ripped up and piling work has begun, with the final steelwork erection phase beginning in April.

"To keep traffic disruption to a minimum we will erect the majority of the steelwork over the roads during the night," says Mr Burchnall. "During the day two lanes will remain open, reducing to a single lane while we are working at night."

The final stage of steel erection will also involve some of the largest sections being lifted into place. The majority of the bus terminus and road lanes are separated by two islands where structural 356 x 406 x 393 supporting columns will be placed. However, at the front elevation the road lanes splay outwards and there is a clear span of some 18m.

To support the new structure over this long span a pair of 1,200mm deep, 325mm wide fabricated plate girders will be erected. Each of these two





Left: More than 700t of structural steelwork will be erected during a phased construction programme.

Below: The first phase of steel erection involved a four-storey extension built on land previously occupied by small shops.

sections will have 90mm deep flanges and weigh approximately 18t each.

"The fabricated sections bridging the roads act as transfer beams supporting columns above," says Mr Farquhar.

The spans over the traffic islands are between 7m and 12m, and here 900mm x 325mm plate girders support the new overhead two-storey structure. These members were designed as continuous sections across multiple spans to keep depth and weight to a minimum.

Summing the project up, Chris Harrall, Director of ISG Jackson's Commercial Division, says: "The challenging site conditions that we are encountering at Market Gate demand a robust and highly detailed programme of works. Allied to a restricted and busy site location, we are working above a key arterial route into the town centre and need to deliver a phased project to meet specific requirements of retailers. We are confident that once completed, the enlarged centre will attract increasing footfall within Great Yarmouth ensuring it becomes a true regional shopping destination."

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Frame design to the Eurocode

SCI Deputy Director David Brown examines the important issues of frame imperfections, and frame stability. As the opportunity to design to the Eurocodes draws nearer, subsequent articles will look at other aspects of design.

What's new?

Despite the immanent arrival of the Eurocodes (National Annex for BS EN 1993-1-1 is expected around March) the underlying physics has not changed, and BS 5950 is a mature Standard. We would not expect much to change, although it might be presented in a different way. That is certainly the case with issues of frame imperfections and frame stability. The same principles are being applied, and both Standards are trying to ensure that designers allow for the inevitable imperfections in real frames, and to make sure that second order effects are accounted for, if they are significant.

Frame imperfections.

In BS 5950, we have Notional Horizontal Forces (NHF) that the Standard says are "to allow for the effects of practical imperfections such as lack of verticality". They are 0.5% of the factored vertical load, and applied horizontally at floor and roof levels. Strangely, BS 5950 says that they need only to be considered in what is commonly known as the "gravity loadcase", i.e. with dead and imposed loads. BS 5950 says they should not to be combined with applied horizontal loads. The philosophy is interesting, as it could be seen to imply that frames that are imperfect under vertical load only, but somehow become perfect when the wind blows on the structure.

According to BS EN 1993-1-1 the frame may be modelled as out of plumb as shown in Figure 1. It could be modelled like this, but thankfully the Standard also allows the lack of verticality to be modelled by "Equivalent horizontal forces" (EHF), in exactly the same way as BS 5950. The basic EHF are presented as $^1/_{200}$ of the factored vertical load (exactly the 0.5% in BS 5950), and there are reduction factors available, depending on:

- The height of the columns (it can't be that bad for the full height of a tall column)
- The numbers of columns (they can't all be so far out of plumb)

The change in EC3 is that the EHF are applied in ALL load combinations. This will be quite new to UK designers, but appears to have a reasonable logic. Frame imperfections no longer depend on the wind blowing, or not.

One important implication is that the bracing system will experience higher loads than UK designers are used to. Not only is the maximum combination factor for wind 1.5, but the bracing will carry the EHF in addition to the wind. In both Standards, the EHF are related to the factored vertical loading, which obviously changes depending on the combination being considered. Under the Eurocode loading system, if wind is the "leading" variable action, then the other variable actions have a reduced combination factor. Reduced vertical loads will result in smaller EHF.

Experience will quickly determine if the critical load combination for bracing design is:

- Maximum wind load, and reduced EHF, or
- Reduced wind load and maximum EHF.

.

Additional design cases for bracing systems

In addition to the design cases including the EHF as described above, the bracing must be checked for two further design situations which are local to the floor level:

- Horizontal forces to floor diaphragms
- Forces due to imperfections at splices

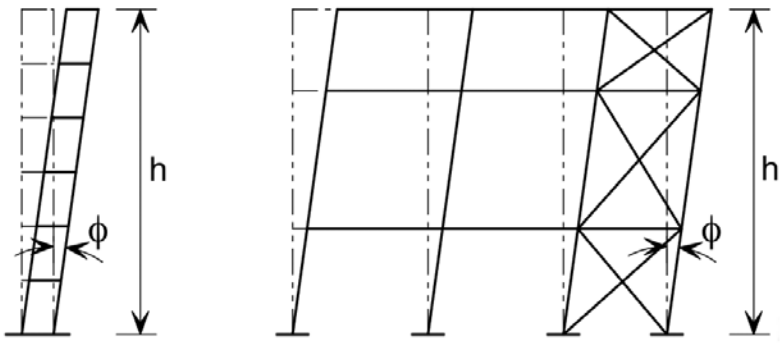

Figure 1. Frame imperfections.

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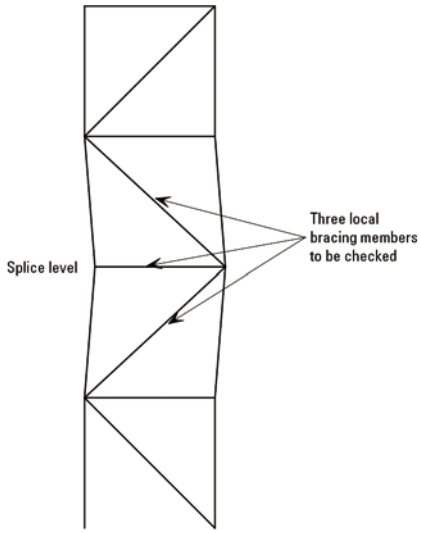

Figure 2. Assumed kink at splice level and bracing to be checked.

In both these design situations, the bracing system is checked locally (the storeys above and below, as shown in Figure 2) for the combination of the force due to external loads together with the forces due to either of the above imperfections. The EHF are not included in either of these combinations and only one imperfection needs to be considered at a time.

The horizontal forces to be considered are the accumulation of all the forces at the level being considered, divided amongst the bracing systems.

The importance of restraints to compression members (in this case columns) is covered in both BS 5950 and EC3, and this force needs to be taken to the bracing system. The second check, which assumes a kink in the column at a splice position, will be new to UK designers. In many orthodox structures, the bracing will not need to be increased as (a) the EHF are not included when carrying out either check and (b) the additional force in the bracing members is generally small.

Frame Stability

UK Designers will be of familiar ground here, except with the presentation of the check for frame stability. In the UK, we are used to checking frame stability by calculating $\lambda_{cr} = \frac{h}{200\delta}$, where h is the storey height, and δ is the horizontal storey deflection, under the notional horizontal forces alone. A small value of λ_{cr} indicates a sensitive frame, where second-order effects must be allowed for, usually by a simple amplifier.

Under EC3, the equivalent check becomes $\alpha_{cr} = \left(\frac{H_{Ed}}{V_{Ed}}\right)\left(\frac{h}{\delta_{H,Ed}}\right)$, where

H_{Ed} is the design value of the horizontal reaction at the bottom of the storey

V_{Ed} is the total design vertical force on the structure on the bottom of the storey

$\delta_{H,Ed}$ is the horizontal storey deflection

h is the storey height

The significant change in the Eurocode approach is that the system of horizontal loads used to check frame stability is not the EHF alone, but the actual loads on the bracing in that combination. Typically, the loads used when checking frame stability will be the wind loads plus the EHF. (Remember that there is no direct equivalent load combination to the BS 5950 "gravity loads only", as the wind is always applied, even if it has a reduced combination factor.)

It would be easy to assume that the EC3 approach would give quite different results to BS 5950, but this is not the case. For a vertical bracing system the storey deflection is obviously liked to the level of lateral load, and thus as a proportion $\left(\frac{H_{Ed}}{\delta_{H,Ed}}\right)$ is remaining about the same. Looking at the EC3 equation, it could be expressed as $\alpha_{cr} = \left(\frac{EHF}{V_{Ed}} + \frac{Wind}{V_{Ed}}\right)\left(\frac{h}{\delta_{H,Ed}}\right)$, which, without using any of the reduction factors available for tall or multiple columns, becomes

$$\alpha_{cr} = \left(\frac{1}{200} + \frac{Wind}{V_{Ed}}\right)\left(\frac{h}{\delta_{H,Ed}}\right)$$

As expected, the outcome is close to the BS 5950 value.

How to allow for second order effects

If $\alpha_{cr} > 10$, then second order effects can be ignored, so familiar territory to UK designers. If $\alpha_{cr} < 10$, then a simple amplifier can be used as long as α_{cr} is larger than 3.

The amplifier is $\left(\frac{1}{1-1/\alpha_{cr}}\right)$, which with some simple rearrangement, becomes $\left(\frac{\alpha_{cr}}{\alpha_{cr}-1}\right)$, again a familiar friend.

Conclusions

There should be no difficulty in understanding the general principles of frame imperfections, since these were covered in BS 5950. The logic of having the EHF appearing in every combination will perhaps appeal.

As far as second order effects are concerned, the update to BS 5950 in 2000 has done us all a good turn, by introducing us to frame stability. Having become used to checking this to the UK standard, it will be straightforward to apply our experience to Eurocode design. The direction in the Eurocode to use the actual loading conditions to check frame stability, rather than a separate loading system (the NHF alone, in BS 5950) is probably an advantage, reducing the different analyses to be completed.

In truth, the more significant challenge in both frame imperfections and frame stability will be to maintain a good grasp on the loading combinations, and apply the correct loads (including the appropriate EHF for that combination) to the stability systems.

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Steel trusses eliminate the Death Watch Beetle

Rebuilding the roof of Eton College Chapel

(From a report by Lord Holford, FRIBA, MTPI)

King Henry VI was the founder of Eton College Chapel, which was built, as we now know it, from 1449-1460. After a lapse of over ten years it was roofed in 1475, the ante chapel being completed seven years later. The piers, the internal proportions, the external buttresses are all splendid, but the original wooden roof must have been the simplest and cheapest possible. None of it now survives except for fragments laid on the wall plates or on brackets from the heavy oak timbers of the roof of 1699, and these are now preserved in Eton's museum.

The 1699 roof was of oak, the main beams of the half-trusses that sprang from the top of the piers being over 20 feet long and with a section roughly 14 in. by 14 in. Almost from the start they housed the death-watch beetle, who found food and drink in the moisture of the low-lying river valley and in the oak protein of the wood. Beetle were heard and observed in the seventeenth and early eighteenth centuries and attempts were made to eradicate them, entirely without success. One difficulty was that without internal scaffolding specially erected, the ceiling of the chapel, some 70 feet above the ground, could not be reached. Above the rafters it was boarded and covered with lead. On the underside great cobwebs grew undisturbed: and later, when the Victorian stained glass of the windows was shattered during the second World War, bats and birds nested in the dark corners.

After the war major repairs were put in hand. The lead covering the roof and its enormous gutters was found to be defective, and tell tale pellets of the death-watch beetle began to appear on the floor of the Chapel in increasing quantities.

By the summer of 1956 it had become necessary for the College to face the expense and inconvenience of erecting a section of scaffolding to reach the roof, in such a way as to permit daily services to continue. But when the roof was reached it was found that some of the timbers were only paper thin. It was clearly unsafe to hold services at all, and the chapel was closed, not to open again till 1959.

The Provost and fellows asked their architects for an immediate report on the Chapel roof and a scheme for its repair or reconstruction in timber. This was done but subsequently rejected on the score of high cost and slowness of execution. There was also the difficulty of insuring against continued beetle infestation.

Eventually one of the Fellows asked the inevitable question: 'Why should we set out to provide fodder for these insects? Why not build a new roof without any timber at all?' This was a completely revolutionary suggestion, and caused immediate argument and discussion.

The architects finally decided to examine other roofs of the period, and after much study, concluded that roofing at the time was highly experimental and empirical, and that designs for vaulting, although planned with great care and executed with immense skill, might sometimes have been quite different in result or in compromise from what had been generally in mind when the foundations of the building were laid.

The significance for fan vaulting of the ratio between the width and depth of the bays (at Eton 2:1) was observed and the space between the vault and the roof. At Kings college one can walk upright over the vault, whereas at Eton there would be no space at all *if the fans were fully developed*, ie if the largest of the concentric ribs met at the apex of the vault. But if a rather flat cross section were adopted the central part of the ceiling could be sustained by a pattern of ribs which are effectively *liernes*. The geometry of a fan vault could then be used. Even so there would be very little room between the top of the vault and the outer roof. If the truss could not be of wood it must be steel: and this would not only be lighter in weight but so designed as to provide the right pitch for the outer metal covered roof, and to allow a cat walk in the intervening space.

The roofing of the chapel by a vault depended on the solution of a teasing structural problem, that of building the ribs of the vault without centering. A temporary hood, covered with waterproof sheeting, could be erected over the whole interior volume of the Chapel; under this the wooden trusses could be dismantled and the steel trusses assembled. But the light steel scaffolding in the interior would not be adequate to carry centering for stone ribs. It was therefore thought preferable to construct any vault decided upon from above rather than below.

At this point it was decided to use the steel truss - the modern equivalent of timber - for centering. The fabricators were asked if they could produce a bottom member of the truss to follow the precise curve of the transverse ribs, and in the form of an inverted 'T'. This made it possible to hang the sections of the masonry arches onto the steel angles by means of bolted steel clips and the masonry ribs by the use of bolts and lead tamps. In the end they did this with great skill and precision, almost as if they had been dealing with hand wrought iron rather than steel, handling the sections with immense care and protecting the metal from corrosion at all stages and into the foreseeable future. The first courses of each fan were sprung in solid stone, and as the stones began to overhang they were clipped and bolted to the supporting steelwork until the whole arched rib settled into its final position, with dry joints between voussoirs.

The other roof, whose ridge is now about two feet higher than it was formerly, is merely a weatherproof and thickly insulated covering for the vaulting and roof space beneath it, but needs to be as light as possible. The lead was replaced by thick, very pure aluminium used in a combination of hard flat sheet and softer metal for rolls, flashing and gutters. It had to be protected against electrolytic action. Over the years the metal has oxidized and now resembles the lead it has replaced. It will also be much less costly to repair than lead, and is proving to be as durable.

Architects: William Holford and Partners.

Partner in charge: Edward Duley FRIBA.

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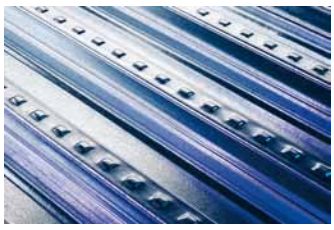

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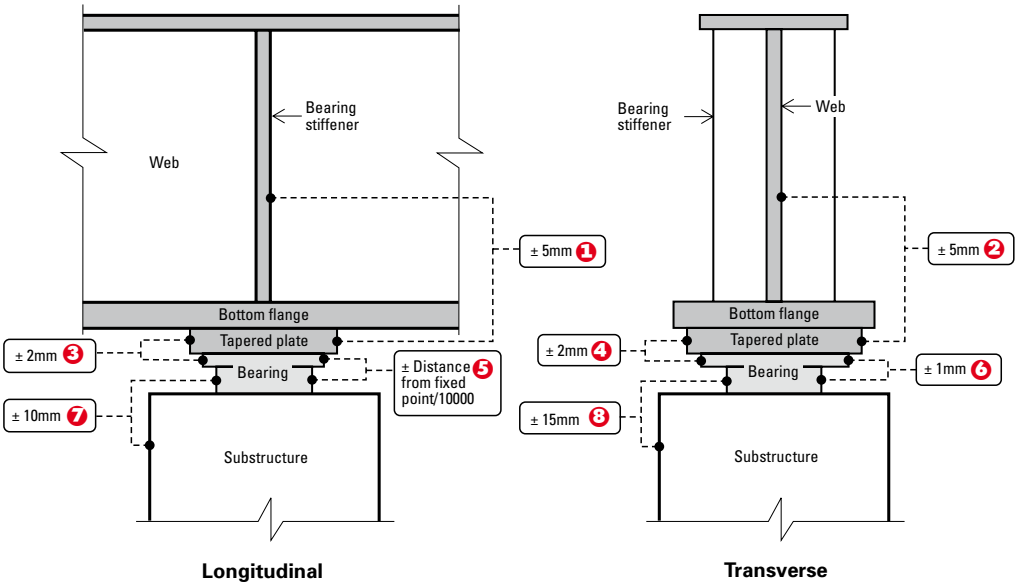
AD 318
Tolerances on plan position of steelwork in bridges

There has been some debate about the build-up of tolerances in bridge steelwork and the accuracy with which the steelwork can be positioned on the substructure. The tolerance of ±5 mm given in clause 6.302 iii) of the Model Appendix 18/1 (publication P170) is now generally accepted as being unrealistic and an over-simplification of what is a complex issue. The following diagrams and table show typical longitudinal and transverse deviations in plan position (at datum temperature) between the various components, together with a brief commentary. The Model Appendix 18/1 needs to be modified to reflect these comments.



Interface		Commentary
Ref	Deviation	
1	Offset of bearing stiffener relative to tapered plate	Stiffeners and tapered plate are set out by hand, or installed to machine-generated powder-marks on theoretical bearing centreline.
2	Offset of web relative to tapered plate	The web is located manually or by T&I machine, and the centre of the tapered plate is set manually; both are set to the measured centreline of the flange.
3&4	Offset of web relative to tapered plate	Both sets of holes are drilled using CNC machines.
5	Overall length, causing offset of top plate of bearing relative to bottom plate	This is caused by cumulative small systematic variations in girder lengths and splice gaps – see Guidance Note 5.03. It should be allowed for in the design translations for the bearings.
6	Slack in bearing	Top and bottom plates are held in position by transit cleats until the steelwork is erected, or by the guides.
7	Position of bearing on substructure	This is accommodated by clearance in the dowel pockets.
8	Position of bearing on substructure	This is due to offset of overall location and variations in width between girders arising from variations in positions of holes in bracing members and stiffeners, widths of stiffeners, gaps in welded joints, clearance in bolt holes, and offsets of webs and tapered plates.

It is not intended to print a modified version of P170 but the electronic version that is available on Steelbiz (currently the Third Edition) will be updated as follows:

In clause 6.302 ("The tolerance on steelwork dimensions and levels at completion is as follows:"), the wording of (iii) will be modified and item (v) will be added.

iii) on plan position of steelwork at bearings (structure at datum temperature):

Transverse position of bearing top and bottom plates relative to substructure: ±15 mm

Longitudinal position of bearing top plate relative to bottom plate: ±(10 mm+L_s/10000)

Longitudinal position of bearing bottom plate relative to substructure: ±10 mm

Where L_s is distance from the fixed point.

v) on spacing of top flanges where permanent formwork is to be used: ±10mm.

It is also not intended to modify any of the Guidance Notes (publication P185) at present, because they will be updated in about a year's time, to align with recommendations in the Eurocodes and in the execution standard, EN 1090-2. However, the following additional comments should be noted, in relation to GN 1.04 and GN 5.03:

In GN 1.04, under the heading of "Basic principles for good articulation", add the following advice:

"Allow for fabrication tolerances in calculating design translations for the bearings

Include an allowance for systematic growth/shrinkage of the steelwork due to fabrication tolerances, as quantified in GN 5.03/3 Tolerances on Length."

In GN 5.03, the above change to the Model Appendix 18/1 clause 6.302 iii) makes some of the text in GN 5.03 redundant. Under the heading "Tolerances on length", disregard the comments in paragraphs 2 & 3 (i.e. from "Model Appendix 18/1 clause …" to "… *unnecessary tolerances upon each other.*").

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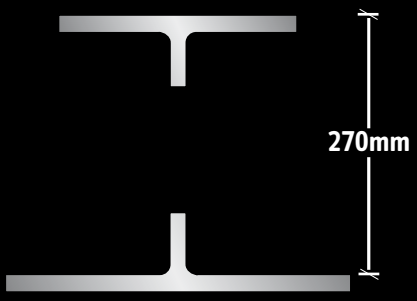

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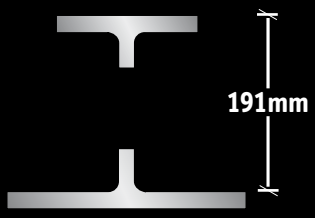

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New and Revised Codes & Standards

(from BSI Updates December and January 2007)

BS EN PUBLICATIONS

The following are British Standard implementations of the English language versions of European Standards (ENs). BSI has an obligation to publish all ENs and to withdraw any conflicting British Standards or parts of British Standard. This has led to a series of standards, BS ENs using the EN number.

Note: The date referenced in the identifier is the date of the European standard.

BS EN 10340:2007
Steel castings for structural uses
No current standard is superseded

BS EN ISO 12944:-
Paints and varnishes. Corrosion protection of steel structures by protective paint systems

BS EN ISO 12944-5:2007
Protective paint systems
Supersedes BS EN ISO 12944-5:1998

NA to BS EN 1997:-
UK National Annex to Eurocode 7. Geotechnical design

NA to BS EN 1997-1:2004
General rules
No current standard is superseded

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT

07/03161131 DC
BS EN ISO 2560 Welding consumables. Covered electrodes for manual metal arc welding of non-alloy and fine grain steels. Classification

BRITISH STANDARDS DECLARED OBSOLESCENT

BS 5950:-
Structural use of steelwork in building

BS 5950-7:1992
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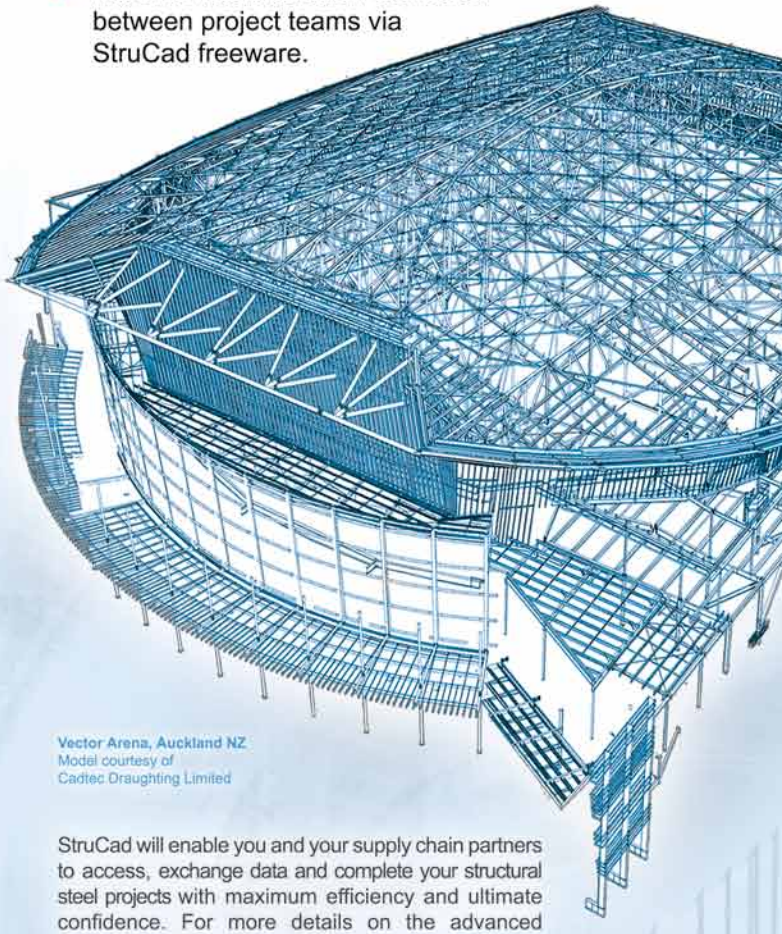

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KEY

Categories

- **A** All forms of building steelwork
- **B*** Bridgework
- **C** Heavy industrial plant structures
- **D** High rise buildings
- **E** Large span portals
- **F** Medium/small span portals and medium rise buildings
- **H** Large span trusswork
- **J** Major tubular steelwork
- **K** Towers
- **L** Architectural metalwork
- **M** Frames for machinery, supports for conveyors, ladders and catwalks
- **N** Grandstands and stadia
- **S** Small fabrications

Quality Assurance Certification

- **Q1** Steel Construction Certification Scheme Ltd
- **Q2** BSI
- **Q3** Lloyd's
- **Q4** Other

Classification Contract Value

- **10** Up to £40,000
- **9** Up to £100,000
- **8** Up to £200,000
- **7** Up to £400,000
- **6** Up to £800,000
- **5** Up to £1,400,000
- **4** Up to £2,000,000
- **3** Up to £3,000,000
- **2** Up to £4,000,000
- **1** Up to £6,000,000
- **0** Above £6,000,000

Notes

1. Applicants may be registered in one or more categories to undertake the fabrication and the responsibility for any design and erection of the above.
2. Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification are those of the parent company.
- * For details of bridgework subcategories contact Gillian Mitchell at the BCSA.

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Ryder Close, Cadley Hill Road, Swadlincote, Derbyshire DE11 9EU
Tel 01283 226161 Fax 01283 550406

STRUTHERS & CARTER LTD
Erimus Works, Valletta Street, Hedon Road, Hull HU9 5NU
Tel 01482 795171 Fax 01482 786186

STRUCTURAL FASTENERS

ANDREWS FASTENERS LTD
Latchmore Park, Latchmore Road, Leeds LS12 6DN
Tel 0113 246 9992 Fax 0113 243 6463

BAPP GROUP LTD
Unit 15, Darton Business Park, Darton,
Barnsley, South Yorkshire S75 5NQ
Tel 01226 383824 Fax 01226 390004

COOPER & TURNER LTD
Sheffield Road, Sheffield S9 1RS
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GWS ENGINEERING & INDUSTRIAL SUPPLIES LTD
Link Road, Poulavone, Ballincollig, Co Cork, Republic of Ireland
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LINDAPTER INTERNATIONAL
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Tel 01274 521444 Fax 01274 521130

TENSION CONTROL BOLTS LTD
Whitchurch Business Park, Shakespeare Way,
Whitchurch, Shropshire SY13 1LJ
Tel 01948 667700 Fax 01948 667744

CORPORATE MEMBERS

BALFOUR BEATTY
POWER NETWORKS LTD
Tel 01332 661491

GRIFFITHS & ARMOUR
Tel 0151 236 5656

HIGHWAYS AGENCY
Tel 08457 504030

ROGER POPE ASSOCIATES
Tel 01752 263636

The Register of Qualified Steelwork Contractors

BUILDINGS SCHEME

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

A All forms of steelwork (C-N inclusive)
C Heavy industrial plant structures
D High rise buildings
E Large span portals
F Medium/small span portals and medium rise buildings
H Large span trusswork
J Major tubular steelwork
K Towers
L Architectural metalwork
M Frames for machinery, supports for conveyors, ladders and catwalks
N Grandstands and stadia
S Small fabrications

Company Name	Telephone	A	C	D	E	F	H	J	K	L	M	N	S	QA	Contract Value (1)
ACL Structures Ltd	01258 456051				●	●	●				●				Up to £2,000,000
A&J Fabtech Ltd	01924 402151		●			●								●	Up to £400,000
Advanced Fabrications Poyle Ltd	01753 531116					●	●	●	●	●	●			●	Up to £400,000
Allslade PLC	023 9266 7531				●	●	●			●					Up to £4,000,000
Atlas Ward Structures Ltd	01944 710421	●	●	●	●	●	●	●	●	●	●			●	Above £6,000,000*
B D Structures Ltd	01942 817770			●	●	●	●								Up to £2,000,000*
B & K Steelwork Fabrications Ltd	01773 853400		●		●	●	●	●	●		●			●	Up to £4,000,000*
A C Bacon Engineering Ltd	01953 850611				●	●	●								Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560				●	●	●	●				●		●	Up to £2,000,000
Barrett Steel Buildings Ltd	01274 266800				●	●	●							●	Up to £6,000,000
Billington Structures Ltd	01226 340666	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744		●		●	●	●					●			Up to £2,000,000
Bourne Steel Ltd	01202 746666	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Brooksby Engineering	01707 872655					●		●	●	●	●				Up to £200,000
Cairnhill Structures Ltd	01236 449393		●			●	●	●		●	●			●	Up to £1,400,000*
Caunton Engineering Ltd	01773 531111		●		●	●	●	●			●			●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Compass Engineering Ltd	01226 298388		●		●	●	●		●						Up to £2,000,000
Conder Stuctures Ltd	01283 545377			●	●	●	●							●	Up to £6,000,000
Leonard Cooper Ltd	0113 270 5441		●			●	●		●		●			●	Up to £800,000
Costruzioni Cimolai Armando SpA	01223 350876	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
Curtis Engineering Ltd	01373 462126					●									Up to £800,000
Frank H Dale Ltd	01568 612212			●	●	●								●	Up to £6,000,000
EAGLE Structural Ltd	01507 450081				●	●	●	●	●	●					Up to £400,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●		●					●	Up to £4,000,000
Emmett Fabrications Ltd	01274 597484				●	●	●								Up to £800,000
EvadX Ltd	01745 336413	●	●	●	●	●	●	●	●	●	●	●		●	Up to £3,000,000
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Fisher Engineering Ltd	028 6638 8521	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
Gibbs Engineering Ltd	01278 455253					●	●	●		●	●				Up to £800,000
Glentworth Fabrications Ltd	0118 977 2088					●	●	●	●	●	●	●			Up to £2,000,000
Graham Wood Structural Ltd	01903 755991	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
D A Green & Sons Ltd	01406 370585	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
William Haley Engineering Ltd	01278 760591				●	●		●			●			●	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456		●		●	●	●	●	●	●	●			●	Up to £6,000,000
Hills of Shoeburyness Ltd	01702 296321									●	●		●		Up to £800,000
James Bros (Hamworthy) Ltd	01202 673815				●	●	●	●					●	●	Up to £1,400,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●			Up to £6,000,000*
Meldan Fabrications Ltd	01652 632075		●		●	●	●	●	●		●			●	Up to £4,000,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●				Up to £2,000,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●	Up to £2,000,000*
Oswestry Industrial Buildings Ltd	01691 661596				●	●	●		●		●				Up to £400,000
Pencro Structural Engineers Ltd	028 9335 2886				●	●	●	●			●			●	Up to £2,000,000
RSL (South West) Ltd	01460 67373				●	●	●				●				Up to £800,000
John Reid & Sons (Strucsteel) Ltd	01202 483333	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
J Robertson & Co Ltd	01255 672855									●	●		●		Up to £100,000
Robinson Construction	01332 574711		●	●	●	●	●							●	Above £6,000,000
Roll Formed Fabrications Ltd	028 7963 1631				●	●	●	●		●	●	●		●	Up to £800,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Rowen Structures Ltd	01623 558558	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
SIAC Butlers Steel Ltd	00 353 502 23305		●	●	●	●	●	●				●		●	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●							●	Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121		●	●	●	●	●	●							Up to £4,000,000
The AA Group Ltd	01695 50123		●	●	●	●	●				●				Up to £1,400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●	●		●	Up to £2,000,000*
Warley Construction Company Ltd	01268 726020				●					●					Up to £400,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Webcox Engineering Ltd	01249 813225				●	●	●				●				Up to £400,000
H Young Structures Ltd	01953 601881		●		●	●	●	●				●			Up to £800,000

Notes (*) Contracts which are primarily steel but which may include associated works. The steelwork contract for which a company is pre-qualified for 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.

RQSC
The Register of Qualified Steelwork Contractors Scheme

BRIDGEWORKS SCHEME

Based on evidence from the company's resources and portfolio of experience, the Subcategories that can be awarded are as follows:

FG Footbridges and sign gantries
PT Plate girders [>900mm deep], trusswork [>20m long]
BA Stiffened complex platework in decks, box girders, arch boxes.
CM Cable stayed bridges, suspension bridges, other major structures [>100m]
MB Moving bridges
RF Bridge refurbishment
X Unclassified

Applicants may be registered in more than one sub-category.

Company Name	Telephone	FG	PT	BA	CM	MB	RF	X	Contract Value (1)
A&J Fabtech Ltd	01924 402151	●	●	●			●		Up to £400,000
Allerton Engineering Ltd	01609 774471	●	●	●	●	●	●		Up to £1,400,000*
Briton Fabricators Ltd	0115 963 2901	●	●	●	●		●		Up to £1,400,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●		Above £6,000,000*
Concrete & Timber Services Ltd	01484 606416	●	●		●	●			Up to £800,000
Costruzioni Cimolai Armando SpA	01223 350876	●	●	●	●	●			Up to £6,000,000
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*
Meldan Fabrications Ltd	01652 632075	●	●	●	●	●	●		Up to £4,000,000
'N' Class Fabrication Ltd	01733 558989	●	●	●		●	●		Up to £1,400,000 (CVA)
Nusteel Structures Ltd	01303 268112	●	●	●	●				Up to £2,000,000*
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●					●		Up to £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●		Above £6,000,000
Taylor & Sons Ltd	029 2034 4556	●	●	●	●	●	●		Up to £800,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●		Above £6,000,000

Notes (') Contracts which are primarily steel but which may include associated works. The steelwork contract for which a company is pre-qualified for 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.

SCI Members

SCI (The Steel Construction Institute) develops and promotes the effective use of steel in construction. It is an independent, membership-based organisation. Membership is drawn from all sectors of the construction industry; this provides beneficial contacts both within the UK and internationally. Its corporate members enjoy access to unique expertise and free practical advice which contributes to their own efficiency and profitability. They also recieve an initial free copy of most SCI publications, and discounts on subsequent copies and on courses. Its multi-disciplinary staff of 45 skilled engineers and architects is available to provide technical advice to members on steel construction in the following areas:

- Technical Support for Architects
- Bridge Engineering
- Building Interfaces
- Civil Engineering
- Codes and Standards
- Composite Construction
- Connections
- Construction Practice
- Corrosion Protection
- Fabrication
- Health & Safety — best practice
- Information Technology
- Fire Engineering
- Light Steel and Modular Construction
- Offshore Hazard Engineering
- Offshore Structural Design
- Piling and Foundations
- Specialist Analysis
- Stainless Steel
- Steelwork Design
- Sustainability
- Vibration

Details of SCI Membership and services are available from:
Sandi Gentle, Membership Manager, SCI (The Steel Construction Institute), Silwood Park, Ascot, Berks.
Telephone: +44 (0) 1344 636544 Fax: +44 (0) 1344 636510
Email: s.gentle@steel-sci.com Website: www.steel-sci.com

SCI would like to welcome the following new Corporate Members:

UK
Blind Bolt Company Ltd
TRP Consulting Ltd

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Mabati Rollings Mills Ltd

All full members of the BCSA are automatically members of SCI. Their contact details are listed on the BCSA Members pages.

Steel Construction Books

Health & Safety • Specification • Assessment • Erection • Design

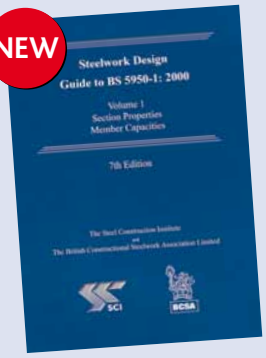
NEW

DESIGNING - The Red Book

The Handbook of Structural Steelwork

This handbook gives practical design advice, worked examples, section properties and member capacities. This edition includes the additional 21 new Advance sections produced by Corus and the section property and member capacity tables have been dual titled to reflect the relationship between BS 4 sections and the Advance range of sections. The tables for hot formed tubes have also been dual titled. The handbook is in accordance with the recommendations given in BS 5950-1: 2000.

NEW



DESIGNING - The Blue Book

Steelwork Design Guide to BS 5950-1: 2000

This edition of the Blue book gives a comprehensive range of member property and capacity tables in accordance with BS 5950-1: 2000. It includes the 21 new Advance sections produced by Corus and the section property and member capacity tables have been dual titled to reflect the relationship between BS 4 sections and the Advance range of sections. This edition also includes a wider range of hollow sections. The tables for hot finished hollow sections have also been dual titled to show the relationship between BS EN 10210-2 sections and the Celsius range of sections.

NEW

SPECIFYING - The Black Book

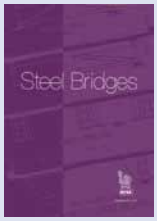
National Structural Steelwork Specification

The 5th edition is a half-way house between the 4th edition and requirements of the forthcoming European standard EN 1090-2. Some of the changes include updating the specifications for steel sections, bolts and welding, the introduction of BS EN 3834 for the management of welding activities, a section on LMAC, an updated table on hold times and a new annex giving guidance on visual inspection of welds.

SPECIFYING - The Grey Book

Commentary on the 4th edition of the National Structural Steelwork Specification

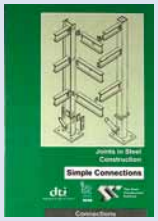
This publication provides useful guidance to both specifiers and contractors and can be used as an informative reference.



BRIDGES - The Purple Book

Steel Bridges

A practical approach to the design of steel bridges for efficient fabrication and construction.



CONNECTING - The Green Book*

Joints in Steel Construction: Simple Connections

Design guidance and worked examples based on BS 5950 - 1:2000 for connections in buildings designed as braced frames where connections carry mainly shear and axial loads only.

STEEL DETAILING - The Magenta Book*

Steel Details

This book provides practical advice on the issues that affect the efficient detailing of steelwork connections. The publication contains a rich array of details from actual structures and allows both engineers and architects to interrogate them.

STEEL BUILDINGS - The Silver Book

Steel Buildings

This book covers everything from steel design; section property tables; industrial and multi-storey buildings; cladding and decking; through to fire; transport and erection; software; contracts and case studies.

GALVANIZING - The Beige Book

Galvanizing Structural Steelwork

An approach to the management of Liquid Metal Assisted Cracking. Practical guidance to clients, specifiers and engineers identifying circumstances where any increased risk of LMAC can be ameliorated.

ASSESSING - The Brown Book

Historical Structural Steelwork Handbook

Developments from the mid-19th Century in iron and steel and the changes in design, loading and stresses; tables of section properties rolled since 1887; guidance on assessment of existing structures.

Code of Practice for Erection of Multi-Storey Buildings

The document provides guidance to clients, planning supervisors, principal contractors, designers and steelwork contractors on management procedures and methods, erection method state-ments, site preparation, delivery, storage, stability, lifting etc and aids compliance with the Health and Safety at Work Act.

Code of Practice for Erection of Low Rise Buildings

Invaluable guidance on the safety aspects of: site management & preparation; delivery, stacking & storage of materials; structural stability; holding down & locating arrangements for columns; lifting & handling; interconnection of components.

Code of Practice for Metal Decking & Stud Welding

Clear, unambiguous and practical information for Clients, Planning Supervisors, Principal Contractors, Designers and Steelwork Contractors about the systems of work to be employed on site together with the required site safety attendances.

Guide to the Erection of Steel Bridges

Cover all aspects in the planning and implementation of the safe erection of a steel bridge so that personnel in the whole team will benefit from a better understanding of the erection process. The guide is complementary to the publication Steel Bridges.

Guide to Steel Erection in Windy Conditions

Covers issues as the maximum wind speed in which steelwork should safely be erected, the role of management and supervision of controlling work etc. Advice is also provided for designers concerning aspects raised by the effect of wind on steelwork during erection.

NEW

Guide to Work at Height during the Loading and Unloading of Steelwork

The aim of this guide is to improve health and safety during loading and unloading of steelwork from lorries and trailers that takes place either at the steelwork factory or on sites. It describes the management procedures and methods to be adopted for access and working at height and is intended to serve as a standard reference when drafting site-and project-specific method statements.

Health and Safety in the Office

The booklet covers all hazards found in offices and the precautions that must be taken to avoid injury and ill health. It provides basic Health & Safety information for employees.

Health and Safety in the Workshop – A Guide for Steelwork Contractors

It is intended that it should be given to each employee in the workshop, thereby assisting the company to discharge part of its legal responsibilities under Health & Safety Regulations.

Health and Safety On Site

The booklet covers a range of Health and Safety topics that site-based personnel need to understand in order to carry out work safely.

Health and Safety: a Pocket Guide for Managers & Supervisors

This booklet covers topics such as risk assessment, method statements, policies, setting up the workplace, inspections, training, statutory test etc and provides a useful, easy to understand, reference on Health & Safety Law.

For help and advice on steel construction and information about companies and suppliers visit www.SteelConstruction.org

PLEASE SUPPLY:

- ☐ copies of The Red Book @ £40 each inc. P&P
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- ☐ copies of The Grey Book @ £10 each inc. P&P
- ☐ copies of The Purple Book @ £25 each inc. P&P
- ☐ copies of The Green Book* @ £70 each inc. P&P
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- ☐ copies of The Beige Book @ £15 each inc. P&P
- ☐ copies of The Brown Book @ £27 each inc. P&P
- ☐ copies of Erection of Multi-Storey Buildings @ £20 each inc. P&P
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