MAY 2009 VOL 17 NO 5

NSC

NEW STEEL CONSTRUCTION

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Olympic curving roof
Severn curtain rises
Steel performs at school
B&Q gets new HQ

Steel Construction Books

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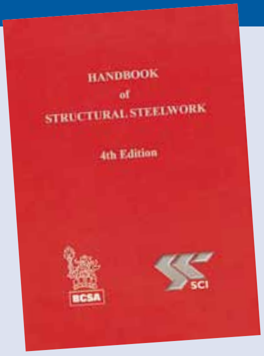
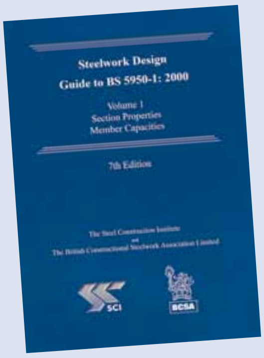


DESIGNING - The Red Book

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.



DESIGNING - The Blue Book

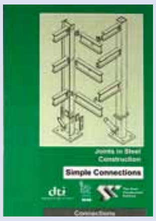
Steelwork Design Guide to BS 5950-1: 2000

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.

SPECIFYING - The Black Book

National Structural Steelwork Specification

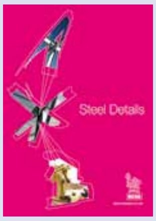
The 5th edition is a half-way house between the 4th edition and requirements of the forthcoming European standard EN 1090-2. Some of the changes include updating the specifications for steel sections, bolts and welding, the introduction of BS EN 3834 for the management of welding activities, a section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



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*

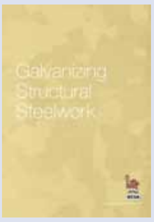
Steel Details

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

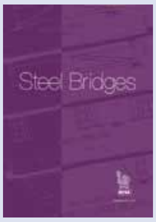
Galvanizing Structural Steelwork

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.

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.

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

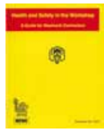
Cover all aspects in the planning and implementation of the safe erection of a steel bridge so that personnel in the whole team will benefit from a better understanding of the erection process. The guide is complementary to the publication Steel Bridges.

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.

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

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*Green Book, Blue Book and Magenta Book, in EU add £8, outside EU add £10

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Steelwork contractor: Bourne Steel
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Case proven for steel

We round up our Case for Steel series in this issue, with a four page section highlighting how and why steel construction so dominates the key markets in the UK. We have alternated the Case for Steel articles with a related series on the steel construction supply chain. Taken together they spell out why the UK leads the world in steel construction, technically and in terms of quality and market share.

We examined the Case for Steel under eight headings like health and safety, sustainability, economics and fire performance – we could have used others because there is such a wide range of benefits to be captured when steel is chosen.

A special supplement is included with this issue of NSC (some 140,000 copies of which will be circulated with construction magazines) called Value Benefits of Steel that spells out more about the benefits derived by architects, structural engineers and the users and owners of buildings from using steel. Again, a choice of benefits had to be chosen to focus on, but many others could have been selected.

Among the key benefits is health and safety, which seems to be suffering from a media backlash at the moment. A Panorama television programme in April identified health and safety as something of a nuisance, a killjoy weapon wielded by overzealous council officials to spoil our fun. Nobody involved in construction would identify with the naive message of that programme, and the steel construction sector, while not being complacent, is justifiably proud of its health and safety record and committed to continuously improving it.

The recession has brought a renewed focus on efficiency and value for money which are also areas that steel scores highest in. Being able to make an early start on site, with confidence in outturn cost and that the construction programme can be adhered to, is valued more than ever by project developers across the private and public sectors, and is increasingly important to nervous project funders who are anxious about when investments will start to pay back.

The steel construction sector routinely delivers challenging projects safely, sustainably, on time and within budget. Confidence will eventually return to the economy and when it does the benefits of steel will be more valued than ever.

Nick Barrett - Editor

Government offers six months top-up insurance

The Chancellor Alistair Darling announced in last month's Budget some strictly limited support in relation to credit insurance.

Marion Rich, BCSA Director of Legal and Contractual Affairs, said: "From this month (May) until the end of December 2009, suppliers will be able to purchase six months' top-up insurance from the Government if credit limits on their UK customers are reduced, backdated to 1 April 2009.

"This provides another alternative to the abrupt disruption of supply and cashflow, and gives time for the businesses affected to adjust to changing circumstances."

The top-up will be provided by private sector insurers and the amount available to each supplier, if a credit limit is reduced, will be that which either restores cover to the original amount, doubles the amount the company is able to obtain or £1M, whichever is the lower.

Expansion work drives the car industry forward

Caunton Engineering has completed three steelwork projects for Honda at its main UK manufacturing site in Swindon.

More than 190t structural steelwork was supplied to the car manufacturer for an extension to its press department. Here car body panels are shaped and Caunton's work comprised portal columns, crane beams and a lattice girder roof.

A further 270t of steel was supplied and erected for an extension to the site's paint plant where Caunton installed a lattice girder roof with infill, floor steel and floor plates. The third project involved 135t of steel for a beam and column expansion to the material logistics department. Here parts are delivered to the site and the expansion will add a further 18 docks to the department.

Simon Bingham, Caunton's Managing Director, said: "These projects have brought the number we've been involved with for Honda at Swindon over recent years to 12. We have supplied over 2,100t of steelwork in total and we appreciate being involved with this world leader in car production."

Steel contractor lands fourth Queen's Award

Dorset-based steelwork contractor John Reid & Sons (Strucsteel) has been named as one of the winners of the Queen's Awards for Enterprise 2009, the fourth time the company has landed this prestigious accolade.

John Reid won its first Queen's Award in 1985 and picked up further Awards in 2006 and 2008. It now holds three current Awards for international trade - a rare achievement - for the design and manufacture of such structures as aircraft hangars (left), industrial steel-framed buildings, bridges and communication towers.

Clients are offered a complete package including cladding, glazing, doors and other fittings which are engineered to fit easily together. Many of its projects have to factor in local conditions and climate, with many of its structures earthquake and hurricane proof.

Simon Boyd, Contract Director at John Reid & Sons, puts the company's success down to hard work and continual innovation.

"Manufacturing has been neglected in recent times, but we've always invested heavily in training."

In one year, since its 2008 Award, the company's export earnings have increased by 87% from its markets in 140 countries worldwide.

Bi-Steel barriers prove effective

As part of the Government's efforts to protect crowded places from terrorist attack by car or truck bomb, the Home Office organised a demonstration of how anti-attack vehicle barriers can be used.

The demonstration consisted of a 7t truck being driven at speed towards a Corus Bi-Steel barrier. The result, a completely wrecked vehicle and a barrier with only a dent and a few scratches.

The test dramatically showed how barriers like this can provide highly effective protection from this form of terrorist threat.

First link to Olympic Stadium in place

The first of five bridges which will link the Olympic Stadium to the rest of the London 2012 site has been erected by Fairfield Mabey.

A 1,000t capacity mobile crane was used to lift the 41m long 88t steel footbridge into place across the River Lea. With the steel beams in place, work is now under way to install the deck of the bridge and this is expected to be completed during the summer.

The 11m wide pedestrian link will serve the legacy use of the site once the Games are over. Another temporary bridge will also be added alongside this permanent bridge to accommodate increased spectator numbers during the Games.

Olympic Delivery Authority Chief Executive David Higgins, said: "The Olympic Stadium will be at the heart of all activity in the Olympic Park so it is essential we create new links into the site. Lifting the first permanent new bridge into place is an important milestone."

Ruling on Construction Products Regulations expected

The European Union (EU) is currently voting on the European Construction Products Regulations (CPR) and if accepted, it will come into force in July 2011.

It is proposed that the CPR should replace the European Construction Products Directive (CPD), with the main difference between the two being that the CPR is a regulation and as such is mandatory in all member states, similar to an Act of the European Parliament.

If the CPR does come into force CE Marking of constructional steelwork to BS EN 1090-1 will also become mandatory in all member states from January 2012. This means that after this date it will be illegal to continue fabricating steelwork without the CE Mark.

CE Marking is not currently mandatory in the UK and the Republic of Ireland, but BCSA members will have to comply with the UK Act of Parliament 'Construction Products Regulations' as CE Marked products are deemed to comply with the Act.

Scottish contractor expands with new sawing and drilling line

Ayrshire-based steelwork contractor Newton Group has installed a new FICEP Orient 11 drilling and sawing line along with a RB1500 shot blast machine, all housed within a new production facility near Prestwick International Airport.

The company's total investment in machinery exceeded £500,000 and gives it the option to significantly increase its service capability for customers throughout the country. The two new machines are laid out in line to afford an easy flow of material through both systems.

Andy Boylan, Works Manager of the Newton Group, said: "This investment and other measures we have taken have now increased our capacity to produce more than 200t per week with the existing and new plant working together in line."

Newton also continues to process and produce fittings with a FICEP A152 angle line that was purchased three years ago.

AROUND THE PRESS

Construction News
2 April 2009
Steel - The fundamental construction material
"Steel is also good when it's exposed and can be easily recycled, so it's sustainable. I like tried and tested materials," said Hemingway Design founder Wayne Hemingway.

Contract Journal
8 April 2009
Steelwork in safe hands
The dramatic improvement in accident frequency rates is a testament to the British Constructional Steelwork Association's (BCSA) efforts to foster a safe working environment.

Project Scotland
April 2009
High visibility
"Many projects of this type would have gone with concrete shear walls but we decided on steel cross braced walls which are easier to erect and much quicker, as they go up with the main steel frame," added Mohammad Ziauddin, project engineer at BAM Design.

The Structural Engineer
21 April 2009
Redevelopment of Thomond Park, Limerick
The use of concrete and steel for the main superstructure frame was examined during the design development. Early studies by the quantity surveyor in consultation with fabricators and pre-casters suggested that steel was cheaper and the tender design was progressed on this basis.

Transportation Professional
April 2009
Building up to a big bridge push
The concrete twin viaduct is being replaced with two new weathering steel composite structures. The steel deck was then completed in an 11 week programme.

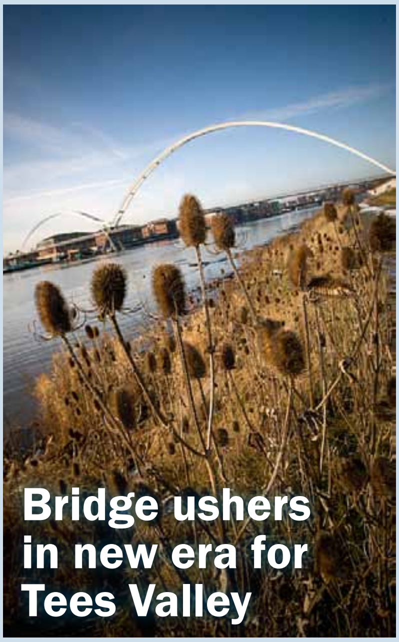
Mixed use development for historic city centre

More than 1,000t of structural steelwork has been erected for a prestigious multi-storey mixed use development in the heart of Chester.

The circular structure is steel framed from ground level upwards and comprises of an 85-bed hotel, 34 residential apartments as well as high quality office space. At ground level there will be a combination of retail units and restaurants centred around a piazza, with ample car parking situated below.

Known as the Head-Quarters building, as the site was formerly occupied by a police station, the structure rises to a maximum of six storeys and offers unimpeded views of the adjacent Chester Racecourse.

The main client for the project is Liberty Properties, while main contractor is Pochin Construction. All steelwork was designed, detailed, fabricated and erected by Robinson Construction.



Bridge ushers in new era for Tees Valley

A new landmark structure, known as the Infinity Bridge, which links the multi-million pound North Shore development with the thriving Teesdale area will officially open on 14 May.

The £15M footbridge is formed by two symmetrical flowing arches spanning a total 180m across the River Tees at Stockton. At its highest point it stands 40m above the river and was constructed with more than 300t of structural steel.

Innovative underfoot and handrail lighting ensure respect for the environment and create a pleasant effect for users. High quality stainless steel handrails together with bespoke designed feature lighting will illuminate the bridge at night.

The bridge will act as a major catalyst in the area's regeneration and created significant local employment during the construction phase with three local construction firms (including steelwork contractor Cleveland Bridge) involved throughout.

Tees Valley Regeneration Director, Neil Kenley, said: "Its function is not only practical but also economic and spiritual - it is a symbol of hope for the people of Stockton."

When fully developed, North Shore will create significant job opportunities, in total 1,000 houses and over one million square feet of commercial floor space are planned.

Chilled out warehouse

A new multi-temperature depot for foodservice distributor 3663 First for Foodservice is under construction in Paddock Wood, Kent.

Working on behalf of main contractor Buckingham, Atlas Ward is responsible for the fabrication and erection of approximately 600t of structural steelwork for the project.

The portal frame warehouse measures in excess of 12,000m^2 and is in the shape of a 'dog leg' because of adjacent railway lines.

The depot will include a three storey external office block and a 4,500m^2 chilled area that will help 3663 improve its delivery of fresh products across the UK.

A number of environmental features have been included at the site, including all electricity generated from renewable sources. Solar panels will provide energy and a solar thermal energy system will generate hot water on the site. A rainwater harvesting system will also be used for the washing of vehicles.

It is estimated the facility will cost approximately £13M and is due to open later this year.

British Standards to be withdrawn in favour of Eurocodes

In March 2010 the BSI will withdraw all those British Standards that conflict with the European design standards - the Eurocodes - and replace them with the relevant set of Eurocodes.

Dr David Moore, BCSA Director of Engineering, said: "For the design of steel buildings it's likely that the set of European Standards will include 16 Eurocodes, together with their associated National Annexes and supporting Published Documents (PDs)."

The Eurocodes for steel and composite buildings are:

BS EN 1993-1-1: 2005
BS EN 1993-1-2: 2005
BS EN 1993-1-3: 2006
BS EN 1993-1-4: 2006
BS EN 1993-1-5: 2006
BS EN 1993-1-6: 2007
BS EN 1993-1-8: 2005
BS EN 1993-1-9: 2005
BS EN 1993-1-10: 2005
BS EN 1993-1-11: 2006
BS EN 1993-1-12: 2007
BS EN 1993-5: 2007
BS EN 1993-6: 2007
BS EN 1994-1-1
BS EN 1994-1-2
PD 6695-1-9: 2008
PD 6695-1-10: 2009
BS 5950-9

All British Standards will be superseded by at least one Eurocode, the adjacent table shows the relationship between the two for steel structures.

Withdrawn British Standard	Superseded by
BS 5950-1	BS EN 1993-1-1 BS EN 1993-1-5 BS EN 1993-1-8 BS EN 1993-1-10 BS 5950-6
BS 5950-2	BS EN 1090-2
BS 5950-5	BS EN 1993-1-3
BS 5950-6	BS EN 1993-1-3
BS 5950-7	BS EN 1090-2
BS 5950-8	BS EN 1993-1-1 BS EN 1993-1-2
BS 5950-9	BS EN 1993-1-3(1)

Meanwhile, the relationship between the Eurocodes and withdrawn British Standards for composite buildings is:

Withdrawn British Standard	Superseded by
BS 5950-3-1	BS EN 1994-1-1
BS 5950-4	BS EN 1994-1-1
BS 5950-8	BS EN 1993-1-1 BS EN 1994-1-2

Centre court roof set for debut

This year's Wimbledon Tennis Championship will be the first to play undercover - if it rains - as a new retractable roof over the Centre Court has been completed.

The All England Club has confirmed that the roof is on schedule to be ready for the Centre Court Celebration matches to be played on 17 May. These games will form part of the final testing procedure before the main championship begins on 22 June.

The retractable roof is divided into two sections, with a total of nine bays of tensioned fabric - four bays in one section and five in the other. Each of the nine bays of tensioned fabric is clamped on either side to prismatic steel trusses.

There are 10 trusses spanning approximately 77m across the court. The ends of each steel truss are supported by a set of bogies that move along parallel tracks positioned at either side within a new fixed roof.

In preparation for closing the roof, one section is parked in its folded state at the north end of the court while the other is parked at the south end. A coordinated electro mechanical movement moves the trusses apart and, at the same time, unfolds and stretches out the fabric between the trusses over the court until the two sections meet in an overlapping seam above the middle of the court.

The entire retractable roof has been designed to close in a maximum of 10 minutes. Steelwork for the project was fabricated and erected by Watson Steel Structures.

Capital equipment for steel bending expansion

Barnshaws Steel Bending has invested more than £1M in new equipment at its site in Wolverhampton.

The new capital equipment includes what is thought to be the largest cold bending, three roll section bender ever produced. It has the capability to bend the largest sections that are produced by Corus and it can bend far tighter radii than previously achievable.

Barnshaws have already been involved in making curved structural elements on prestigious projects such as Heathrow Terminal 5 and Arsenal's Emirates Stadium. The new machine will enable the company to increase the size of the sections and plate it can bend.

This large investment has been made possible, in part, due to a £230,000 Grant for Business Investment, administered by regional development agency Advantage West Midlands on behalf of the Government.

NEWS IN BRIEF

Tekla Structures has launched its Tekla Structures 15 software package for modelling and detailing. The company said the latest version of its BIM solution offers improved construction project collaboration, management and delivery through enhanced inter-operability and visualisation. There is also a 64-bit version available that allows the user to tackle even bigger projects. To help users benefit from the new features, Tekla provides online videos and tutorials.

In an effort to help steelwork fabricators reduce costs, **FICEP** in partnership with **Tekla** and **Steel Projects**, has organised two seminars. Entitled 1-2-3 Seminars, they will highlight how the three companies can help reduce costs and aid productivity increases. The seminars will be held at Wembley Stadium on 5 May and Old Trafford Stadium on 6 May. Book a place by phoning FICEP and quoting 'Seminars' on 0113 265 3921 or email info@ficep.co.uk

Composite Metal Flooring (CMF) has moved into its new production facility in Mamhilad, South Wales. The new premises for the company, which is part of the Studwelders Group, comprises a 2,787m^2 manufacturing area and a 789m^2 office space. Metal decking products are manufactured on three independent profiling machines which allow maximum flexibility to produce up to 3,200m^2 per eight hour working shift for each machine. When operating a two shift system a total of 19,200m^2 can be produced per day.

A scheme designed to fashion the business stars of the future by Bolton based coatings manufacturer, **Leighs Paints**, is proving to be a huge success. The commercial trainee programme has been devised by Leighs Paints ensuring that the skills and knowledge of current employees will be passed on to produce the future leaders of the company. Three trainees will be spending time in each department in the business, before choosing a preferred team to join upon completion of the course.

Slim floor solutions with enhanced version of SIDS

Corus has announced the launch of a new and enhanced version of the SIDS software which has been developed by SCI.

Offering a number of improvements over the previous SIDS 1.2, the latest SIDS 2.0 includes Design Expert, integrated deep deck design, RHS Slimflor design and roll forward and roll back functionality.

The new Design Expert simplifies the design process by allowing users to create optimised beam designs based purely on general arrangement and loading data. By utilising an expert knowledge database, the design may be optimised on minimum depth or minimum weight criteria.

The designer is presented with a set of design schemes which satisfy the chosen criteria. A single scheme can then be selected, reviewed and manually adjusted.

SIDS 2.0 also provides the complete Slimflor design package by incorporating deep deck analysis and design functionality. This feature allows the floor plate of beam and slab to be defined and checked in a single operation.

Since edge beams are frequently subject to torsional moments it is often desirable to use rectangular hollow sections (RHS Slimflor) in these situations. Design of these beams is now possible within SIDS, superseding and replacing the RHS Slimflor software which is now withdrawn.

Another important enhancement is the fact that the design of RHS Slimflor sections is now possible within SIDS 2.0, superseding and replacing the RHS Slimflor software which has now been withdrawn.

The new roll forward and roll back option allows the designer to move between the current and immediately previous designs, so the effect of design changes can be assessed without losing the previous input data.

Existing users with an internet link will receive automatic notification of the availability of SIDS 2.0 and will also be offered an immediate download.

SIDS 2.0 is also available from Corus Construction website at *http://www.corusconstruction.com/en/reference/design_software/software_sci_sids*

Epsom grandstand ready for Derby Festival

Ahead of this year's Derby on 6 June, Her Royal Highness, The Duchess of Cornwall has officially opened the new grandstand at Epsom Downs Racecourse.

Named 'The Duchess Stand' in her honour, the structurally imposing grandstand forms the key element of a three-year £38M development scheme at Epsom, which also includes an on-site hotel and a new Entrance Pavilion.

The 11,000 capacity stand was constructed in two phases, with the lower terracing completed in time for last year's Derby Festival and the upper levels finished during the last 10 months.

The stand can accommodate both racing and non-racing events and boasts a large 1,123m^2 Oaks Hall on the ground floor which doubles as an 800 seat conference venue. On the first floor there are three restaurants, while the second level contains 14 private boxes and the Downs View Suite, which can host over 100 people.

Nick Blofeld, Managing Director of Epsom Downs Racecourse, said: "We think it is very much in keeping with Epsom's style to have a Duchess Stand sit alongside the existing Queen's Stand and Prince's Stand."

Working on behalf of main contractor Willmott Dixon, Graham Wood Structural fabricated and erected more than 800t of steelwork for the project.

Diary

For all BCSA events contact Gillian Mitchell tel 020 7747 8121 email: gillian.mitchell@steelconstruction.org
For all SCI events contact Jane Burrell tel: 01344 636500 email: education@steel-sci.com

7 May 2009
Floor Vibrations
Croydon

12 May 2009
Preparation for Eurocodes
Joint with ISE, London

13 & 14 May 2009
Essential Steelwork Design (2 day)
Birmingham

21 May 2009
Steel Building Design to EC3
Cardiff

2 June 2009
Connection Design
Bristol

9 & 10 June 2009
Essential Steelwork Design (2 day)
Glasgow

11 June 2009
Steel Building Design to EC3
Joint with ISE, London

18 June 2009
Light Guage Steel Design
18 June 2009

23 June 2009
EC4 Composite Design
London

Lift-off for feature roof

The Aquatics Centre is one of the centrepieces of London's Olympic Park. Martin Cooper reports on the erection of its elegantly sweeping and curving roof structure.

Construction work at London's 2012 Olympic Park has now moved up a gear or two as some of the larger structures begin to take shape. The main stadium is progressing on schedule with steel sections of the roof already in place, while nearby the first structural elements of the Aquatics Centre have also begun to be erected.

Designed by Zaha Hadid, the Aquatics Centre will mark the gateway to the Olympic Park during the 2012 Games and in legacy it will provide elite and community facilities that east London does not currently have.

The entire roof will be supported on just three points.

The most eye-catching part of the venue is its complex steel roof. It sweeps upwards in a smooth curve from the south end and down again at the north, while the eastern and western tips curve upwards at the edges.

When complete, the 11,000m^2 roof structure will span a column-free area of 160m long and up to 90m wide. The roof will rest on two concrete cores 54m apart at the northern end, and a 28m long x 5m wide supporting wall at its southern end. The roof cantilevers 30m beyond its supports at the northern point while the two wings cantilever 27m on the sides. What this all means is, the entire roof will be supported on just three points.

There will be 2,500 seats inside a permanent building and a further 15,000 in two temporary structures on the sides. To enable spectators at the back of the temporary tiers to see the action, the roof has to be higher in the middle than at the edges.

Aside from the main steel roof, the temporary tiers, which will be removed after the Games, are also to be constructed with steel (rakers) while each of these side elements will have its own roof.

FACT FILE

Aquatics Centre, Olympic Park, London
Main client: *Olympic Delivery Authority*
Architect: *Zaha Hadid Architects*
Main contractor: *Balfour Beatty Construction*
Structural engineer: *Arup*
Steelwork contractor: *Rowecord Engineering*
Steel tonnage: *2,800t*

Steel trusses are supported on four rows of temporary trestles during construction.

Above: Steel sections are brought to site and assembled on the ground before being lifted into position.

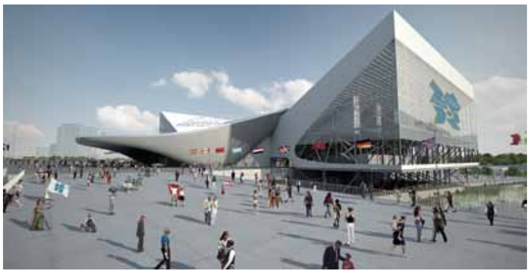
Independent of the main roof, the two temporary roofs will require the erection of one large 85m-long truss each.

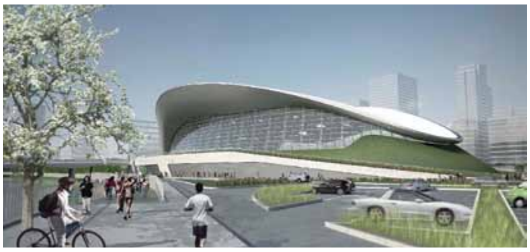
Structurally the system forming the main roof comprises a series of long span trusses over the main pool hall and these have a fan arrangement to create the plan geometry of the structure. The middle truss has a span of approximately 120m to a primary truss which in turn spans 54m in a transverse direction between the two concrete cores.

These centre fan trusses cantilever beyond the primary truss to form a 30m overhanging canopy at the northern end. The chords forming the trusses are facetted between truss node points with the purlins set at variable height off the trusses to produce the required roof curvature along the truss lines.

Top right: How the completed structure will look during the Games.

Bottom right: How the Aquatic Centre will appear after the Games minus the temporary seating.



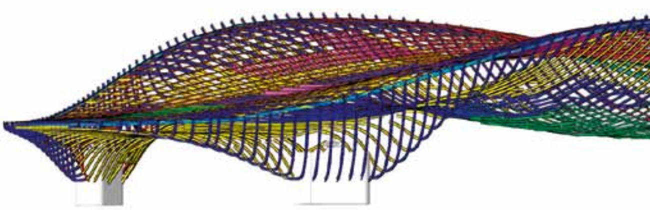


The trusses splay progressively outwards from the centre of the roof towards the edges like a fan. This supports the cantilevered wings at the sides as the trusses act like an inclined tied arch anchored by support points. The centre fan trusses carry the load over the central part of the roof in truss action. They are also supported by transverse transfer trusses taking the vertical load to discrete support points on the lower concrete superstructure.

Stability is provided by a system of horizontal and diagonal cross braces in the roof surface between the top chords of the fan trusses. The lower surface is braced up to the upper surface through lower surface horizontal braces and transverse diagonal bracing between the upper and lower surfaces.

Constructing the roof has not been helped by the site's numerous constraints. It has a railway line to the east, a canal to the west and the future water polo site to the north. Two large tunnels housing the high voltage cables that were originally carried by pylons pass beneath the site.

"We wanted to simplify the roof as much as possible for construction," says Mike King, Arup's Project Engineer. "It's a complex structure and the



Above: The initial primary truss being erected for the Aquatic Centre's roof.

"The roof reflects the fluidity of water and will provide an inspirational legacy for all Londoners well beyond the 2012 Games."

main structural challenge is the fact that it's only supported at three points."

To construct the roof while causing minimal impact on the overall programme the steel structure is being built in situ. The steel members are made from fabricated H-shaped sections by Rowecord Engineering. The initial steel section to be erected was a primary truss which sits on the south wall and supports the fan trusses that span the entire length of the roof.

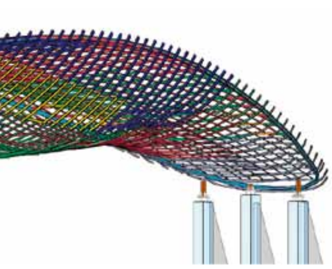
"Early in the design process we did consider building the roof with timber," adds Mr King. "However, it became apparent that the structure has too many high forces in its geometry, particularly where the fan trusses are thinnest."

The first parts of the fan trusses began to be erected in April and are being fabricated in sections. These are then brought to site by Rowecord and craned into position. They are then held up by temporary trestles arranged in four rows between the south and northern ends.

This methodology was chosen as the best solution, although building the entire structure on the ground and then jacking it into position was considered. However, the roof's curved shaped would have required just as many temporary supports.

The major benefits of the chosen erection sequence are that while the trusses are being erected the two northern cores are also being constructed. By the time the roof reaches the north end the cores will be complete. Also, by this time the southern or first line of support trestles will be dismantled once the roof gets to the middle point. This will allow main contractor Balfour Beatty to get started with the job of excavating the pool facilities.

Below: 3D image of the roof's east elevation.



Below: All steel sections have been fabricated and delivered to site by Rowecord Engineering.

When the steel roof structure is completed this Summer, the remaining support trestles will then be dismantled and to facilitate this the entire roof will be lifted up two metres at its southern end, turning on fixed spherical bearings at the northern supports.

Once all of the trestles are removed the 160m long roof frame will be lowered on to its permanent bearings at the southern end. Again, the entire roof will rotate about the northern spherical bearings when the southern end is lowered. Once this is complete, work will commence on the Kalzip standing seam roofing. Services will be fitted inside the roof void and timber cladding will be fixed to the underside of the structure next year.

Commenting on the structure, Architect Zaha Hadid says: "It is very exciting to see such progress on site. The roof reflects the fluidity of water and will provide an inspirational legacy for all Londoners well beyond the 2012 Games."

Retail efficiency

FACT FILE
B&Q Smartlab, Eastleigh, Hampshire
Main client: _B&Q_
Architect: _BDP_
Main contractor: _Sir Robert McAlpine_
Structural engineer: _BDP_
Steelwork contractor: _Barrett Steel Buildings_
Steel tonnage: _1,000t_

The redevelopment of B&Q's main headquarters has begun with the erection of a large office, laboratory and car park structure. For maximum efficiency and the need for large open areas, steel was chosen as the framing material.

The DIY specialist outlet B&Q is currently redeveloping its headquarters site in Eastleigh, Hampshire. The project involves the demolition of all existing buildings and the construction of new offices, a laboratory and a new car park.

Phase one of this scheme consists of a 4,645m^2 steel-framed building, measuring 72m x 96m, which will contain two floors of office space, a laboratory (known as a Smartlab by B&Q) with three levels of car parking on top.

Because of the constraints of the site, a number of very different functions are stacked in order to use the space as efficiently as possible. The interdisciplinary design team explored a multitude of options to reduce the complexity and proposed a steelwork solution to meet the challenges of span, structural depth and environmental performance.

The footprint of the sizeable building, which is under construction, will have two levels of office accommodation which wrap around in an L-shape along two elevations. This leaves the majority of the lower levels for the Smartlab which is a large double-height space.

Smartlab is B&Q terminology for an area where displays are readied and dressed prior to going out to the company's numerous stores. Products are delivered via a loading bay located at the rear of the building and stacked and arranged on shelves. To accommodate the Smartlab's superstore-sized shelving units this area of the building's ground floor has to have the same headroom as a B&Q store.

Interestingly, the three levels of car parking, which sit directly above the office space and Smartlab, have dictated the design of the overall building. The need to arrange columns in a typical car park 16m x 7.2m grid means the majority of the building's steel frame has been constructed around this same pattern.

"Transfer structures below the car park would have been the alternative," explains Richard Beesley, Technical Director for Barrett Steel Buildings. "But that would have been an expensive option so the decision was taken for long spans throughout." Cellular beams have been used for all of the 16m spans, as these sections were considered the most efficient and cost effective steel members.

Another important consideration, and one which also had a direct influence on the structure's design was the delivery of large and heavy goods to the Smartlab. Many similar type buildings have a car park on the lower levels and the offices above, however with regular truck deliveries to the site, the configuration with car park above offices was deemed the most suitable.

As the three levels of car parking are exposed and the lower levels (containing the lab and offices) needed to be kept warm, a solution was required as to how to insulate the dividing second floor slab.

"Encasing the steel beams would have been very time-consuming," explains Erik Dirdal, Structural Engineer for BDP. "We've actually put the insulation on top of the steelwork and precast planks which again was the most cost efficient way and ultimately

Above: Three levels of car parking sit above the Smartlab.

Left: Barrett Steel has installed both steelwork and concrete planks.

Top: The large open spans required for the car park.

Above: B&Q's vision of the future with the Smartlab building located top left.

gives the client what it wants."

The insulation for the second floor slab takes the form of a large sandwich with layer upon layer of materials. The make-up of the construction consists of steelwork beams, precast concrete planks, structural topping, a light screed, and finally an asphalt topping. This then forms a thermally insulated box for the lower levels of the building. The second floor slab is also the point where the main columns are spliced, with members capped below the slab and the thermal insulation with a base plate for the upper member on top.

The three levels of car parking, which sit above the office space and Smartlab, have dictated the design of the overall building.

Construction on site began last year when the main contractor cleared the plot ready for the Smartlab. An existing B&Q building was demolished and steelwork erection was able to start in January, with completion set for this May.

Steelwork contractor Barrett Steel Buildings has also installed the project's precast planks as this means one less trade on a rather confined site and better sequencing and coordination, especially with craneage.

"We started installing planks about 10 days after steel erection began," explains Stuart Bew, Barrett's Senior Site Manager. There are two mobile cranes on site and working with these two units we had to have one complete zone of the building up to full height before planks could start going in," he adds.

There has also been a selection of mobile cranes used on site, varying from 35t capacity units up to 100t, utilised for both steel and precast plank installation.

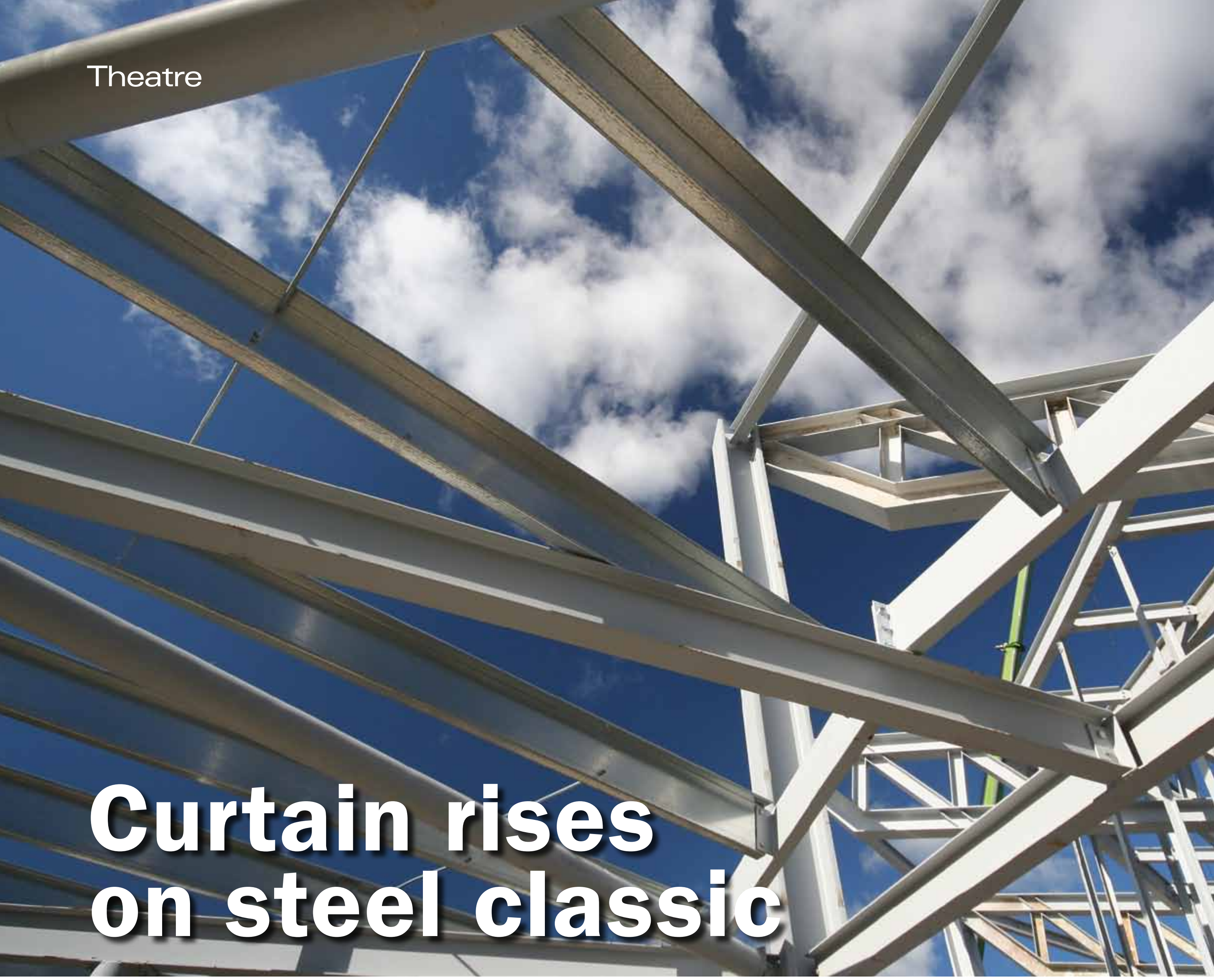
Steel deliveries have generally been made in 20t loads and in a just-in-time schedule. As the building progressed the available space for materials storage got smaller so the delivery sequence became more important.

"It was all about keeping both the steel and the planks going up in an economical fashion," says Mr Bew. "We were doing 60 planks a day at the peak."

Aside from the long cellular beams, the main structure is an efficient column and beam construction, although there is a feature cantilever containing the conference facilities at first floor level. One elevation also features a two-way steel-framed ramp for the car park.

As the overall structure is steel framed, stability is derived from five steel framed cores containing lifts and staircases. Steel bracing, positioned in walls and within the floor void provide additional stability.

Once the Smartlab is operational an adjacent office block will be demolished, making way for a new headquarters to be built. Due to be fully operational by spring 2011, the project will bring all of B&Q's 1,400 head office employees together under one roof.



Curtain rises on steel classic

Changing the design of Shrewsbury's Theatre Severn from a concrete frame to steel frame resulted in a number of benefits, such as speed of construction and cost effectiveness, which all helped produce a structure the town is rightly proud of. Martin Cooper reports.

Above: A steel frame meant faster cons

Below: The fly tower under constructio

Below right: The completed Theatre Se

Shropshire's county town of Shrewsbury is now home to a new eye-catching waterside theatre that since officially opening in March has been regularly packing in audiences. Located on the banks of the River Severn at Frankwell Quay, one of the main gateways into the town, the theatre has quickly enhanced Shrewsbury's reputation as a regional centre for cultural and leisure opportunities.

It has been a while coming, as the idea for a new theatre was first mooted more than 40 years ago. The project came very close to being approved on a number of occasions, various sites and building designs were put forward over the years, and the final approved design was even altered at the last moment.

Initially the approved design was a concrete framed structure, however main contractor Willmott Dixon tendered an alternative bid with its own design team. Working alongside architects Austin Smith Lord and engineers Curtins Consulting, a steel framed solution was tendered and accepted, which generated significant cost savings to both the superstructure and substructure. Acoustic and dynamic performance were analysed carefully to ensure the steel frame was acceptable.

"Speed of construction and cost effectiveness were the main advantages associated with the steel design," explains Harry Dhanjal, Operations Manager for Willmott Dixon.

Ashley Davies, Director at architects Austin Smith Lord agrees and says: "There were a number of reasons why a steel frame was more viable for the project. The spans for the main performance areas suited the use of steel trusses, while a lighter frame in general sits better on the slab and meant less piling."

Once the design was finalised work got under way on site in late 2006. As the project is located in the centre of an old historic town, the discovery of archaeological finds below the surface was not a surprise. Remnants of a 13th Century bridge's abutments were unearthed during preliminary works. The findings were thoroughly surveyed by a team of archaeologists before being covered over for future

FACT FILE
Theatre Severn, Shrewsbury
Main client:
Shrewsbury & Atcham Borough Council
Architect:
Austin Smith Lord
Main contractor:
Willmott Dixon
Structural engineer:
Curtins Consulting
Steelwork contractor:
Midland Steel Structures
Steel tonnage: *800t*
Project value: *£20M*

truction and less piling.

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generations.

The bridge remnants now lie beneath the main stage area and so there was a requirement for extensive foundation structures to transfer the loads from the fly tower columns over and away from the archaeological remains.

The majority of the brownfield site had already been cleared of its post-war industrial units before Willmott Dixon started work. A small scale site clearance was needed before 25m deep CFA piles and reinforced concrete ground beams were installed.

"The spans for the main performance areas suited the use of steel trusses, while a lighter frame in general sits better on the slab and meant less piling."

Above this a suspended slab was cast with the main steel frame founded on the ground level pile caps.

Because of the theatre's riverside location there is a danger of localised flooding and so the plans had to take this into account. Planning conditions restricted any public areas below the level of the river's flood wall, so the theatre's ground floor only accommodates storage areas, some offices and the box office.

"The building is one floor higher than it would have been because of these restrictions," explains Mr Davies. "The three levels above ground floor house all of the public facilities such as foyers, bars and performance areas."

The main core of the structure houses a 638-seat main auditorium with three levels of seating, the smaller 250-seat Walker Theatre, a dance studio, a small exhibition space, green rooms and dressing rooms, a restaurant and a bar.

Most of the pubic amenities begin on the first floor, which provides access to the main auditorium stalls, as well as the Walker Theatre and Chapel Bar. Above this, two more floor levels provide access to the circle and the upper circle of the auditorium. Wide landings on the upper floors curve around the main auditorium, while also giving a sense of the scale of the building.

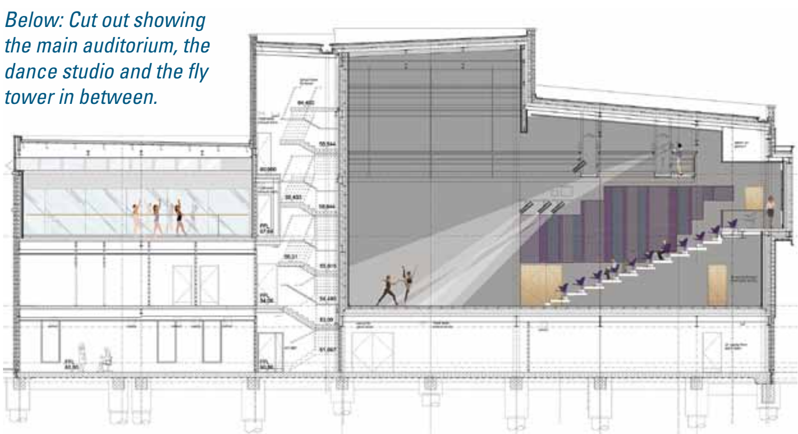
The main element of the project is the auditorium which is housed in a horseshoe-shaped drum and fronted by the three levels of seating. A series of 20m long x 1m deep trusses span this large open column free space with services running through the trusses' depth. "There are a number of services in the main auditorium and the trusses also have to support lighting gantries and other technical equipment," says Mr Dhanjal.

Above: The main auditorium has three levels of seating.

The auditorium's perimeter has been constructed with a series of raking columns which support the roof trusses above. Cantilevering beams are hung from these columns to support the upper circles of seating as well as lighting gantries. Both circles have been formed with steel beams, cranked for the seating arrangement, and then infilled with timber. Another 18m long truss, tied into the roof truss steelwork, forms the stage's proscenium arch.

Off-site construction played an important role in the construction of the auditorium's fly tower. This steel framed core-like tower was erected by steelwork contractor Midland Steel Structures along with the rest of the frame. However the upper section of the tower houses the technical area where lighting and equipment are stored. This section consists of a large grid which was prefabricated at Midland's yard and brought to site in three pieces. These were then bolted together on the ground before being lifted into place as one. The grid comprises a host of small steel sections and would have presented the erectors with a very time consuming task to assemble it on site.

Below: Cut out showing the main auditorium, the dance studio and the fly tower in between.



Located in one corner of the fly tower's footprint was an old substation which served the flood defence system for the surrounding area and relocation was not possible until the flooding season had ended. Unfortunately, construction was already underway so a phased works programme resulted in the 25m high tower being erected in two stages. Once the first phase was completed it had to be temporarily propped while the substation was moved allowing space for the rest of the tower to be erected.

As Theatre Severn houses a number of performance areas, acoustics as well as noise breakout was an important consideration in the design. The area around the theatre is a noise conservation area and to prevent sound escaping into the environs a pre cast concrete roof has been installed while heavy partitions divide the internal performance spaces.

Separating the main auditorium from the theatre's foyer is a curved sloping zinc clad wall formed with cold rolled Metsec 200M12 studs in a twin frame configuration with three layers of 15mm plasterboard on each side for acoustic performance.

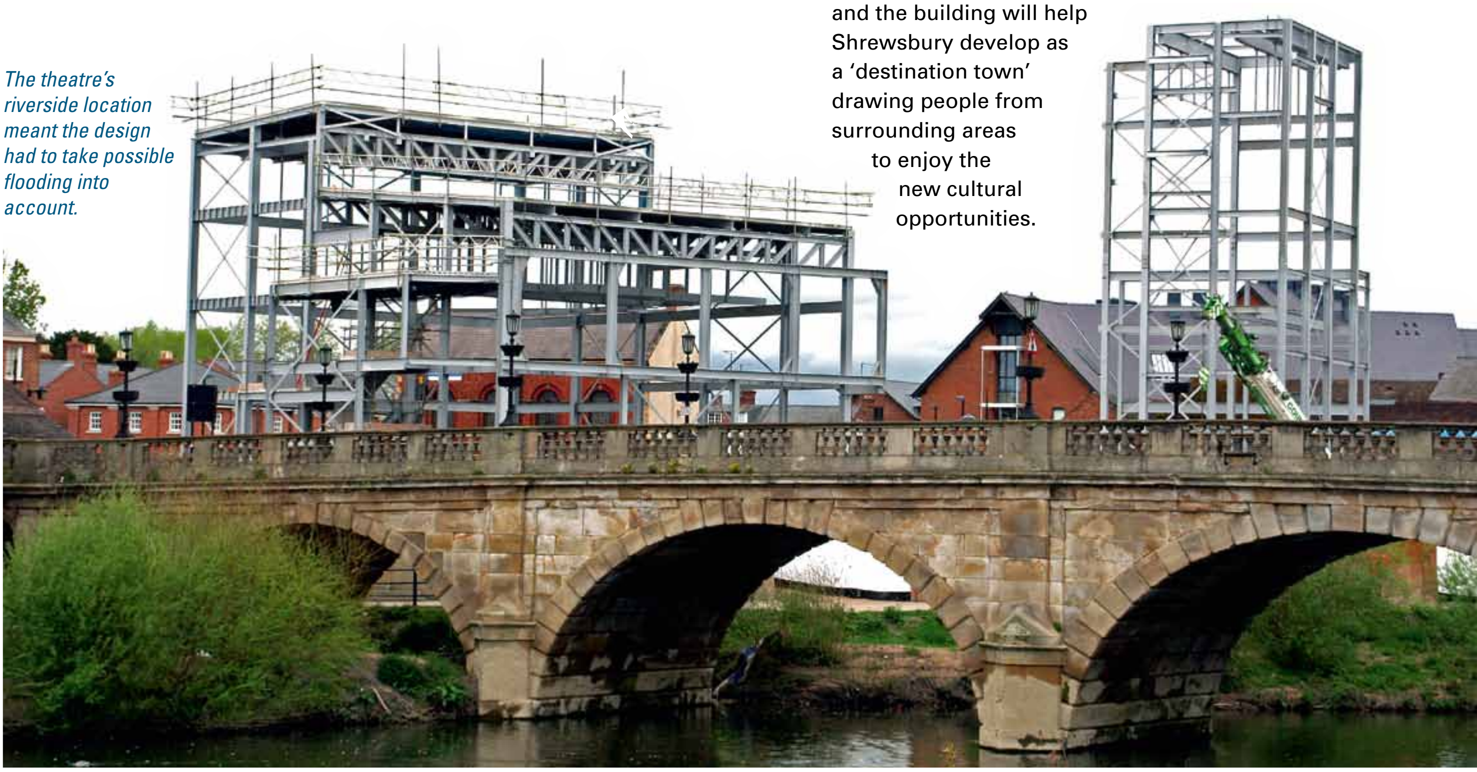
The lighting grid was prefabricated at Midland Steel Structures' yard and brought to site in three pieces. These were then bolted together on the ground before being lifted into place as one.

"The two wall configuration is a cinema style partition," explains Mr Dhanjal. The zinc rises above the glazed circulating areas to link with the auditorium side walls and is visible both internally and externally.

Meanwhile, the Walker Theatre has been noise insulated within a concrete box formed by two concrete slabs and a double row of columns with a 150mm cavity in between. This then isolates this performance space from the level below and the rest of the first floor. What makes this smaller theatre interesting is just how it was squeezed into the overall plan. "Because of height restrictions there wasn't anywhere for the control room," explains Curtins Project Engineer Paul Menzies. "The solution was to put a cantilever over one external elevation formed with a 15m long storey-high truss which houses the control room."

Not all elements of historic interest were underground on this site. There is an old 19th Century Methodist Chapel which was recently used for a car tyre business. This building has been renovated and incorporated into the theatre. It now houses offices on the ground floor and fittingly the chapel bar on the first floor. A large 3D truss supports the curtain walling spanning over the chapel's existing roof and connects into the theatre's roof truss arrangement.

Now that the theatre is open, Shrewsbury and Atcham Borough Council has had time to reflect on the construction teams' well designed project. A council spokesperson comments that the town has waited a long time for a new theatre and the building will help Shrewsbury develop as a 'destination town' drawing people from surrounding areas to enjoy the new cultural opportunities.



The theatre's riverside location meant the design had to take possible flooding into account.

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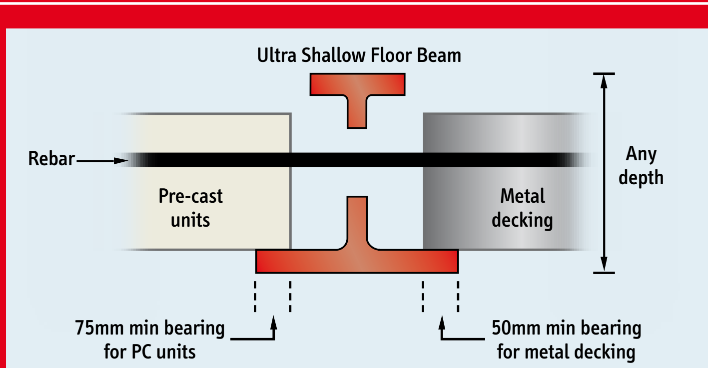

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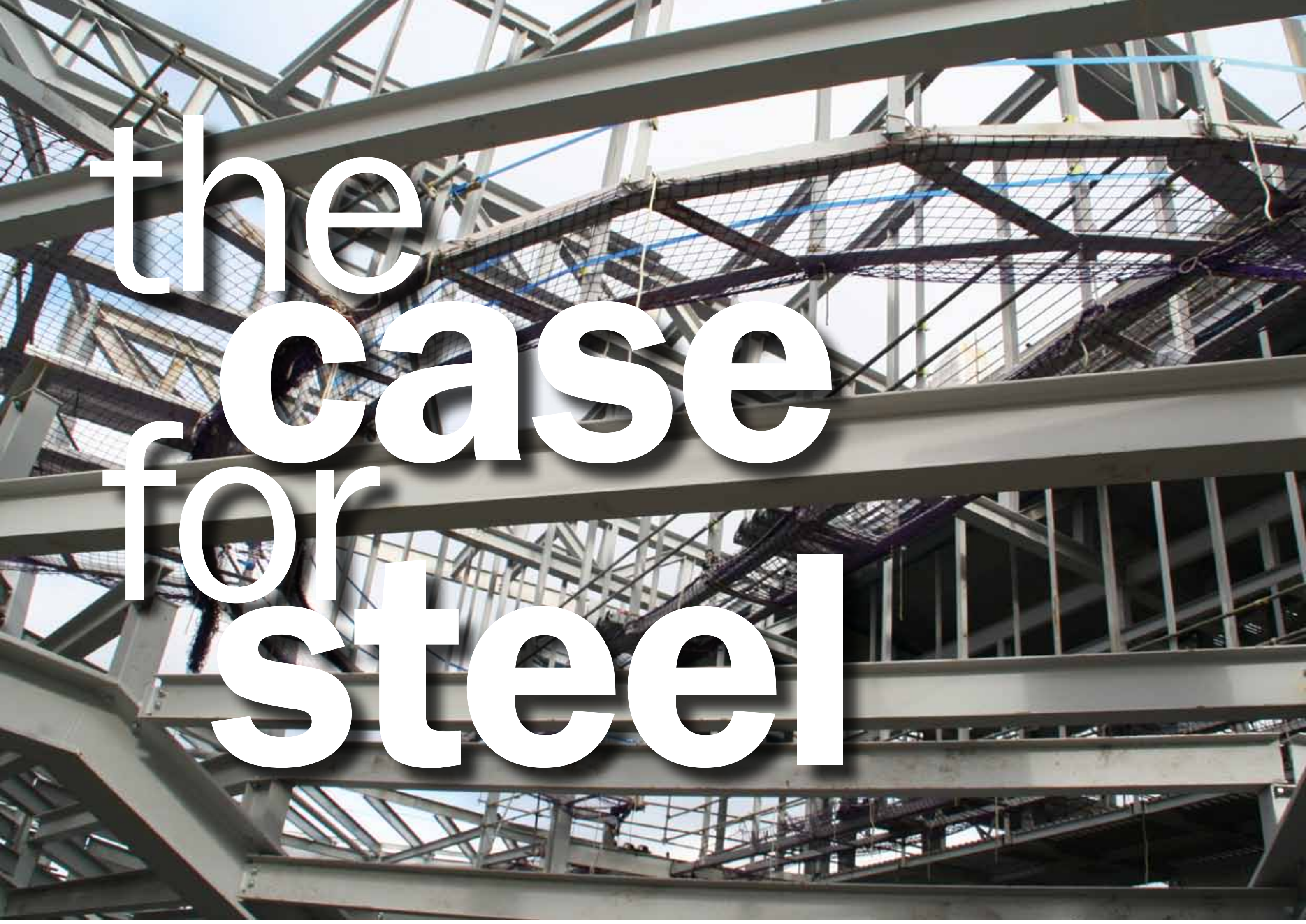
the case for steel



Over the past year NSC has carried articles detailing the main benefits for designing and building in steel in the Case for Steel series. Over the next few pages we summarise the main messages of the Case for Steel, the reasons why steel enjoys the confidence and support of the UK design community to such an extent that 97% of single storey industrial buildings and over 70% of multi storey buildings are steel framed.

The cost and sustainability advantages of steel are perhaps the most widely recognised, including cheaper up front cost as well as lower life cycle costs. But there are many more benefits, some delivered immediately the decision is made to frame a building or build any other structure in steel, and others that arise throughout the life of a building.

From the earliest stages of project planning technical support is provided free of charge by the steel sector, helping to inform design decisions. Construction programmes are faster and project pay back periods are earlier because of the speed with which steel buildings are safely and accurately erected, allowing the earliest possible start on site.

Steel construction is inherently safer than alternatives as most of the work is carried out offsite in factory-controlled conditions. On site work is by small, well-trained specialist erection teams, rather than the multiple trades needed for concrete construction.

Advanced steel fabrication technology allows architects fuller freedom of expression, as is evidenced by the dramatic and iconic structures being built in steel today. Curving and shaping means that innovative designs that were once thought impossible are now routinely realised. Structural engineers value the inherent strength of steel, taking full advantage of its high strength to weight ratio in their cost effective designs, providing light and airy, column free spaces.

Steel-framed buildings retain their attractive and modern appearance for longer than those built from other materials, which makes steel a popular choice for corporate headquarters and other prestigious buildings. They easily retain their up to date look and feel, making them more attractive places in which to work.

Steel-framed buildings are easily adapted for changing uses, which is crucial in sectors such as healthcare, education and commercial, and can be easily extended horizontally and vertically, avoiding costly and environmentally harmful demolition and redevelopment.

Even when a steel-framed building has reached the end of its useful life – which will have been prolonged by using steel – it delivers value through being recycled. Steel is the most recycled material in the world; it is multicycled and old steel becomes new steel without any loss of properties or performance.

The Case for Steel rests on its ability to provide satisfaction to building and other structure owners, developers, designers and builders. As readers of our series will agree, the case for steel is proven.

the case for steel

The case for using steel as a construction material in the UK is overwhelmingly strong. Steel dominates the market as a building framing solution and for longer span bridges, and increasingly for shorter spans as well.

Over the past year or so NSC has run a series of articles aimed at providing a comprehensive outline of why the choice of constructional steelwork represents the value for money option with an overview of the case for steel. The Case for Steel was described under the following headings:

Health and safety
Quality construction
Vibration and acoustics
Fire performance
Sustainability
Economics
Supply chain
Sector support
Structural solutions

The features identified as making the case for steel are summarised here. The full articles can be read and downloaded from NSC's website:

www.new-steel-construction.com

Health and safety

- Steel is inherently safer than other methods of construction
- Steel's use reduces the numbers of people working on site, reducing the risk of accidents
- Accurate offsite fabrication reduces the amount and handling of waste
- On site pre-assembly can further reduce the number of lifting operations, with less need to work at height
- Temporary works are minimised
- Steelwork can be easily modified, even if changes are needed while erection is underway

Sector support

- Extensive specialist advice is provided by the steel construction sector free of charge, a level of technical and other support that is unmatched by any other construction material
- Steel sector support is committed to helping designers develop innovative solutions
- This is underpinned by experts at Corus, the BCSA and SCI in all technical matters across engineering, building physics, design and fire safety
- No other construction material has such a sustained track record of major investment in technical research and development
- Since the 1980's Corus has operated a network of regional based technical managers who are on hand to offer guidance and support to designers in steel
- An extensive range of support material is available and a comprehensive range of design guides covering all aspects of steel construction is provided
- Significant resources have been committed to preparing design guidance, training aids and web-based learning packages in connection with Eurocodes and will be available for practising engineers when they need it

Economics

- In inflation-adjusted terms steel has fallen in price since 1980 and is cheaper than it was 15 years ago
- Steel's many cost advantages give pay-back during the course of construction and throughout the building's working life
- The most recent Market Shares survey, for 2008, shows steel now commands over 70% of the market for multi storey buildings
- Lighter foundation loads made possible by steel frames can have a big impact on costs
- Steel structures can be erected speedily, delivering time savings in the build programme compared to a concrete frame
- Steel's adaptability and flexibility mean that future changes or extensions can be carried out with minimal disruption and cost
- The large column-free spaces created by long-span steel sections mean that buildings can be constantly adapted to cope with changing requirements
- Building interiors can be easily and economically adapted, avoiding the high costs of redevelopment or demolition.

Sustainability

- Steel is the most recycled material in the world
- 99% of structural steel used in the UK is re-used or recycled
- Steel is multicycled, and never loses its original quality
- Waste is either minimal or non-existent
- Offsite production is inherently safer than on site construction
- Steel buildings are adaptable and flexible
- BCSA members signing up to BCSA's Sustainability Charter agree to assessment of their sustainability credentials

Fire performance

- More is known about how steel-framed buildings behave in fires than about the fire performance of any other construction material
- The performance of other materials in fire is under researched – concrete for example has never been subject to large scale fire tests
- Major concerns exist about spalling of concrete in fires
- Offsite application of intumescent coatings has been a breakthrough for the steel construction sector
- Thanks to full scale testing at the BRE's Cardington facility, performance based design approaches have been developed that reduce the extent of fire protection needed in composite construction
- It is sometimes possible to design structural steelwork to achieve 30 minutes fire resistance without additional fire protection, by increasing the weight of steel sections or substituting a higher grade of steel

Structural solutions

- Steel allows minimum floor construction depths and large column free floor areas are routinely achieved
- Steel provides large column free areas on many iconic buildings
- A wide range of benefits flows from using composite floor slabs that are the most common solution on multi storey buildings in the UK
- The established composite floor systems represent familiar site practice, without the need for careful on site control
- Services and ceilings can be quickly installed thanks to the simple fixing arrangements provided with a steel frame
- Services can easily be integrated with supporting steelwork
- The advantages of a long span, lightweight steel solution can outweigh the desire for a shallow construction depth
- Steel frames are readily adaptable, and can be extended horizontally and vertically with relative ease
- Steel framed buildings can be easily dismantled and all of the steel can either be re-used or be returned to the steel making process

Vibration and acoustics

- Floors of steel framed buildings have always performed in line with requirements of the varying and demanding uses to which they are put.
- Physical tests on finished steel framed buildings show that no special measures need be adopted for vibration on most steel framed buildings
- The same design of floor that is typical of multi storey commercial buildings satisfies the most exacting National Health Service requirements
- Health service professionals value the 'future proofing' that the easy adaptability of a steel framed building provides
- The long span solutions that only steel can provide can be even more appropriate for vibration sensitive areas as the greater mass that participates in the vibration motion tends to reduce the dynamic response, so there is less vibration
- The acoustic performance requirements of Part E of the Building regulations are easily satisfied by steel framed buildings without any special measures
- Compliance with Part E must be demonstrated by post-completion testing, or by the use of approved details known as Robust Details
- Robust details of proven reliability are available for floors, walls and flanking connections. Details are continuously being developed

Quality construction

- Steel provides the surest guarantee of a high quality finished building or bridge
- Steel is fully tested and certified before it arrives on site
- All Corus structural steel is CE marked
- Steelwork is produced in factory conditions to high tolerances
- Steel production and fabrication processes are fully quality assured
- Fabrication is driven by 3D modelling and numerically controlled fabrication machinery
- All BCSA steelwork contractors are regularly checked for their technical capabilities and financial standing

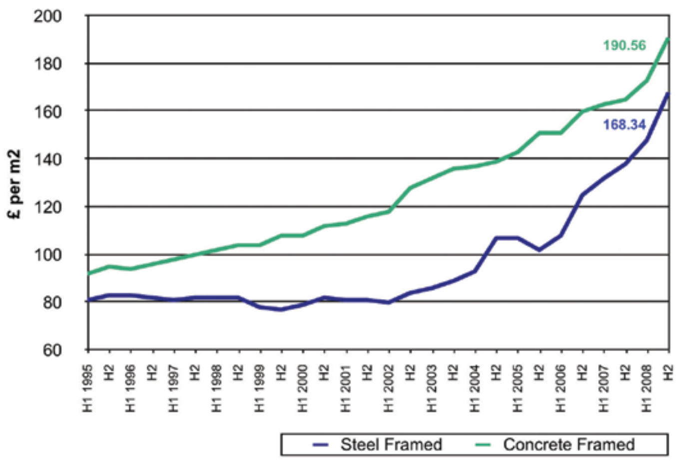
Supply chain

- The strength of the steel supply chain is one of the most striking characteristics of the UK construction market
- There is a wide range of highly skilled and experienced steelwork contractors able to tackle the most complex and technically challenging projects
- Steelwork contractors ensure a competitive tendering environment, compared to projects using other materials that might at best attract only two bids
- Corus introduced 21 new beams and columns to its standard section range to create the Advance range. Advance covers the full range of hot-rolled sections manufactured by Corus for the UK market, fully CE marked and compliant with the Construction Products Directive.
- Developments in fabricating machinery are a large part of the reason for the advances in quality and productivity in steel construction
- Paint and protective coatings manufacturers continuously improve products for the steel sector

The market votes for steel

The competitive gap between steel and concrete frames is widening, according to the latest independently produced Cost Comparison study. Steel retains its dominant share of the key single storey industrial buildings and multi storey buildings frames market in the latest report from independent market researchers Construction Markets. Taken together the two independent reports provide compelling confirmation that designers are making the right choice when they opt for steel.

Steel frames are consistently shown to be the fastest and most cost effective choice for frames for commercial multi storey buildings in the annual Cost Comparison studies. The latest study, for the fourth quarter of 2008, shows how steel has gained in competitive advantage since 1995. The average building options in 1995 showed a £12.10/m² cost advantage for steel – this had grown to £22.22 in 2008. The study showed concrete frame and floor options costing an average of £190.56/m² against only £168.34/m² for steel.



Comparison of Steel and Concrete frame and floor costs for Buildings A and B – Average of all schemes.

The Department for Business, Enterprise and Regulatory Reform (BERR), formerly the DTi, produces monthly statistics tracking material costs against GDP inflation to provide a comparison in real terms. These figures show that since 1995 the cost of steel has increased by 43%, the cost of concrete has increased by 25% and reinforcement bar has increased by 87%.

Constructed component costs over the same period show that the relative costs of fire protection and metal decking have fallen below or remain very close to 1995 levels, which has helped maintain steel's competitive advantage over concrete.

Although the cost of a frame and floor is a relatively small part of the total cost of a building, a steel frame reduces timescales and has a beneficial effect on other costs such as foundations, cladding and services, leading to significant overall cost savings.

Two buildings are analysed for the Cost Comparison study:

Building A

This tracks the cost per m² for various frame and floor options for Building A: a regional office block located in Manchester.

Composite beam and slab is the most competitive option costing £131/m² whilst the Reinforced concrete flat slab is the most expensive at £176/m².

There is little difference in price between the other three options of Slimdek, cellular beam, and insitu frame with precast floors.

Building B

This tracks the cost per square metre for various frame and floor options for Building B: a prestige company headquarters located in London.

Again Composite beam and slab is the most cost effective framing option at £161/m². This compares with £210 for Reinforced concrete flat slab and £227 for Post tensioned ribbed concrete flat slab.

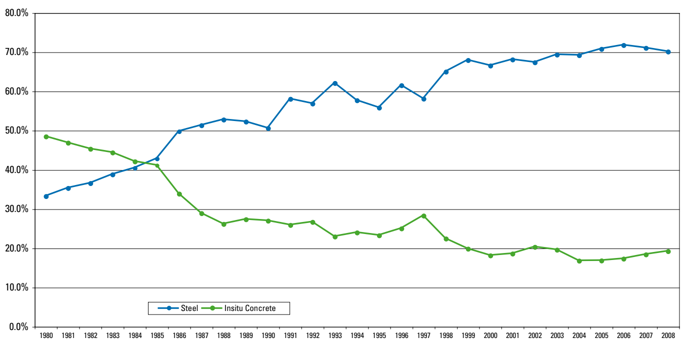
The steel options of Slimdek and cellular beam also have significant cost savings for this building. In comparison with the cheapest concrete option, both systems offer savings of £14/m².

Market share stays high

In the 2008 Market Shares Survey – the 28th in this series of annual surveys - steel's share of the key multi storey market remains at around 70% since 2003.

Steel dominates the single storey industrial building market with a 97% market share, as developers and tenants of sheds, often large retailers and others with complex distribution and logistical needs, become increasingly concerned with sustainability.

Steel enjoyed a 70.1% share of the overall market of 15.3M square metres for multi storey building frames in 2008. Dominant market share was also retained in the key growth sectors of education and healthcare.



The market for structures - non residential multi-storey buildings. Steel versus insitu concrete.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FACT FILE
Farnborough town centre redevelopment
Main client: *Key Properties*
Architect: *Lyons + Sleeman + Hoare*
Main contractor: *ROK*
Structural engineer: *Michael Bradbrook Consultants*
Steelwork contractor: *Conder Structures*
Steel tonnage: *1,400t*
Project value: *£80M*

Town centre revamp

Above: Long trusses form the bingo hall's roof.

The centre of Farnborough is undergoing a much needed make-over with the construction of new shops, a hotel and leisure facilities. NSC reports on how steel is playing a dominant role in the transformation of this Hampshire town.

A whole raft of town centre redevelopments around the M25 were mooted a few years ago, and while some have been put on the back burner due to the current financial climate, one scheme in the Hampshire town of Farnborough is definitely on stream.

An £80m regeneration project covering a 14 acre site will transform a large swathe of the town centre, replacing some tired and unloved 1960s retail outlets. Under construction are 57,000m^2 of new shops including two large anchor stores, leisure facilities and a 77-bedroom Travelodge hotel.

Alongside the commercial aspects of the scheme, there will be one, two and three bedroom apartments and some affordable housing units in partnership with Thames Valley Housing Association.

Councillor Peter Moyle, Leader of Rushmoor Borough Council, said: "I am absolutely thrilled to see construction work beginning on the town centre; it's great news for the economy of the town and local residents. We watched the town centre being transformed by the demolition work and now we can look forward to the new centre rising from the rubble."

Following the demolition of the site's existing

Below: A Travelodge hotel fronts the development.

Above: Phase 1 of The Meads project under construction on a site previously occupied by an old shopping centre.

buildings and some essential infrastructure work, which included the installation of new underground pipes and cables, the initial phases of the project are now on schedule for completion before the end of the year.

Developer for the project Key Property Investments, a joint venture between St Modwen Properties and Kuwaiti-based Salhia Real Estate Company, is confident that locals will be using the first phase of the scheme to do their Christmas shopping.

The new development, known as The Meads, is adjacent to the existing Kingsmead Shopping Centre and parts of the new scheme's block 3 will wrap around and connect into the retained shopping complex.

The project has been divided into four main blocks and a multi-screen cinema complex.

Block 1 of the scheme contains the Travelodge hotel and a large ground level Sainsbury supermarket with a Gala Bingo Hall above. The hotel has three levels and sits above some ground floor retail units.

"I am absolutely thrilled to see construction work beginning on the town centre; it's great news for the economy of the town and the local residents."

Steelwork contractor Conder Structures erected the frame of the hotel at the beginning of its programme in January, and has since been erecting steel in an eastwards direction away from the hotel with completion of block 1 set for this month (May).

The height of the hotel is 13.5m to eaves and is constructed with hot rolled structural steelwork up to first floor level with Metsec cold rolled steelwork above for the hotel's frame and internal partitions.

Directly behind the hotel, and part of the overall block 1 structure, the ground floor level Sainsbury's supermarket covers a footprint 15,000m^2.

The construction of the supermarket is based around a large 8m x 16m grid with four long internal spans keeping columns to a minimum. Above this, the Gala Bingo hall's roof is formed with a series of 20m long 2t lattice trusses which provide the facility with its requited column free area. Ten trusses make up the roof with one end cantilevered from the column and designed with a moment connection. The trusses are formed from 152 x 152 x 30 column sections and linked to a transverse beam from a 914 x 419 x 388 beam located on the level below.

"The Sainsbury's store has been the driver for phase 1 of the scheme," comments Ian MacIver, Project Engineer for Michael Bradbrook Consultants. "They required a large open floorplan and this was then carried on throughout most of the structure."

Above the Sainsbury's supermarket on two elevations are three levels of apartments meaning the side elevations of block 1 rise a further three floors to level 5. The project's apartments are being constructed in a similar fashion to the hotel, with Metsec lightweight steel.

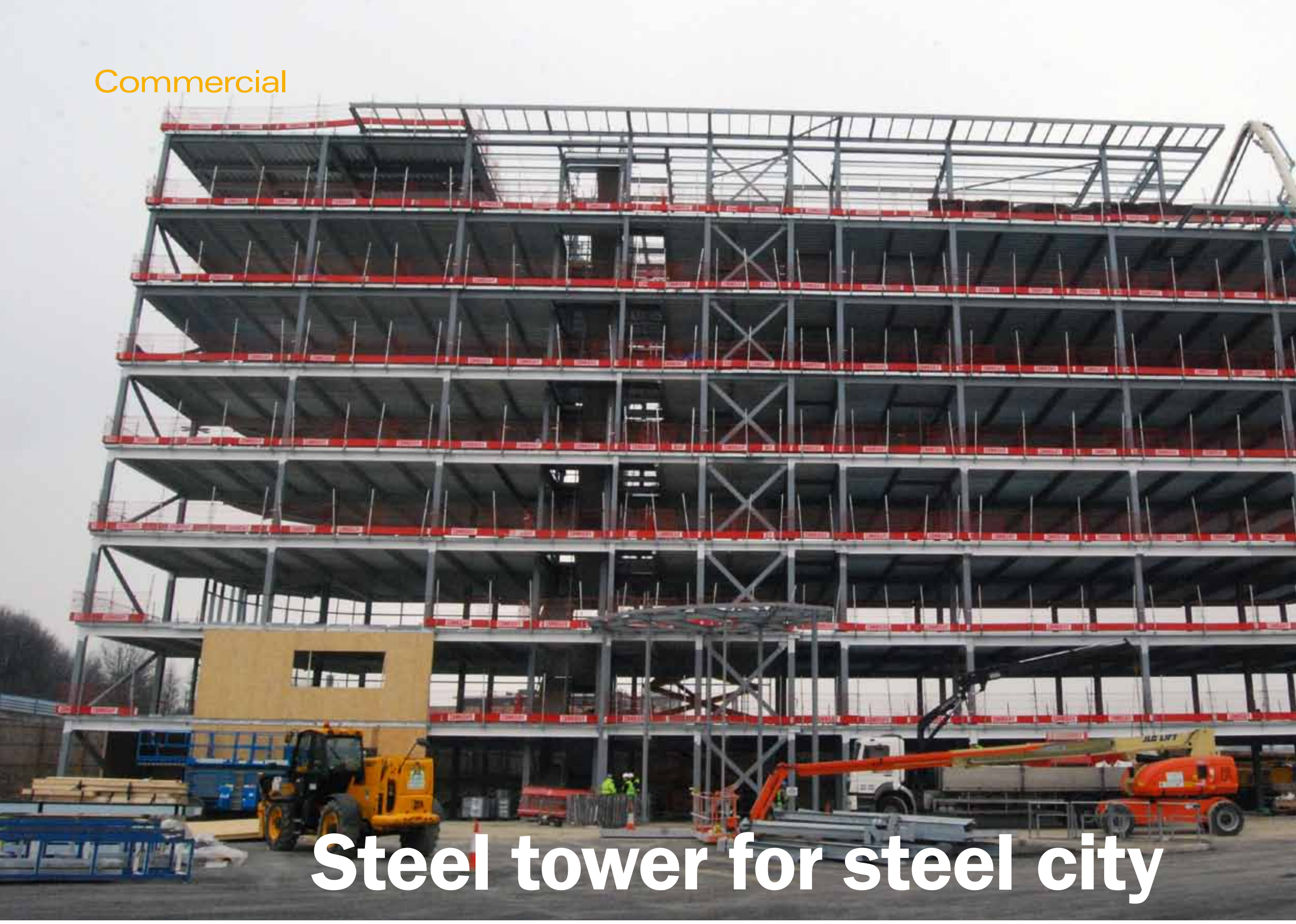
"Using lightweight cold rolled steel for the apartments keeps the weight down and negates the need for heavy transfer decks below," explains Mr MacIver.

Abutting block 1, a further retail zone known as block 2 is also currently under construction. This steel framed structure will house more than 30 shops on two levels with a 69-space roof top car park above to serve the three levels of residential apartments wrapped around two elevations on block 1.

A further two blocks, numbers 3 and 4, are planned and are due to start later this year. Both of these phases will contain more retail units with upper levels of residential apartments. Block 3 will incorporate a rooftop car park and will be linked to block 2 via a steel footbridge.

A stand-alone steel framed multi-screen cinema complex is also planned to the south of blocks 2 and 3. Containing a ground level car park, with the main cinema and restaurant facilities above, this structure is also expected to begin later this year.

Below: The entire development is scheduled for completion in 2010.



Steel tower for steel city

Above: Parkway Edge will be an iconic tower overlooking Sheffield's gateway.

An iconic steel framed commercial development is under construction on a plot overlooking Sheffield's main arterial gateway.

The city of Sheffield seems to be bucking the current trend and experiencing a mini construction boom as a number of commercial, civic and educational buildings are under construction, or recently completed. One of the most prominent is Parkway Edge, a new eight-storey pre-let commercial development positioned on the city's recognised gateway.

Given the location on the edge of the Victoria Quays mixed use area the site probably demands a high quality and distinctive design. This is exactly what the design team have come up with for Parkway Edge as some impressive architectural elements have been incorporated into the project, while inspiration has also been taken from designs adopted in locations such as Dubai.

Offering approximately 7,800m^2 of floorspace, the steel-framed building is based around an economical design with 140mm thick trapezoidal deck and a 7.2m x 8m grid pattern. There are no concrete cores and stability is derived from braced bays secreted in partition walls and the structure's lift shaft.

However, it is externally that the main architectural features are most noticeable. As the building is positioned adjacent to one of Sheffield's main thoroughfares, tubular bracing, which will remain in full view behind a glazed facade, has been used along the elevation closest to the road.

Another large glazed area is just above the main entrance area. The reception, located adjacent to a large car park, which has a steel canopy supported on two-storey high feature CHS columns.

Jonathan Palmer, Project Engineer for Capita Symonds Structures, says the design has taken advantage of the project's location and the fact that many commuters entering Sheffield will see the building. "We've added a number of impressive architectural features such as a CHS braced rear elevation and horizontally plained A-frames at two intermediate levels."

On the rear elevation, above level 3, the building steps out 500mm which required an intricate bolted connection to allow the 254 column to cantilever off the 305 perimeter beam.

Another notable and highly visible element of the project is an overhanging eliptical shaped canopy which will form a roof top level tied flag pole. Positioned on one corner of the building's roof, the canopy is partially supported by a 38m-high inclined column. Founded at ground level, just outside of the building's footprint, the 450mm diameter column has been erected in three sections.

At roof level the building also features an external courtyard which will be ideal for office functions, while the western elevation incorporates a stylish cantilever that wraps around two corners.

"This is another architectural feature which will make the building stand-out," explains Mr Palmer.

FACT FILE

Parkway Edge, Sheffield

Main client: *Towers Investment*

Architect: *Cordonier Escafeld*

Main contractor: *Capita Construction Management*

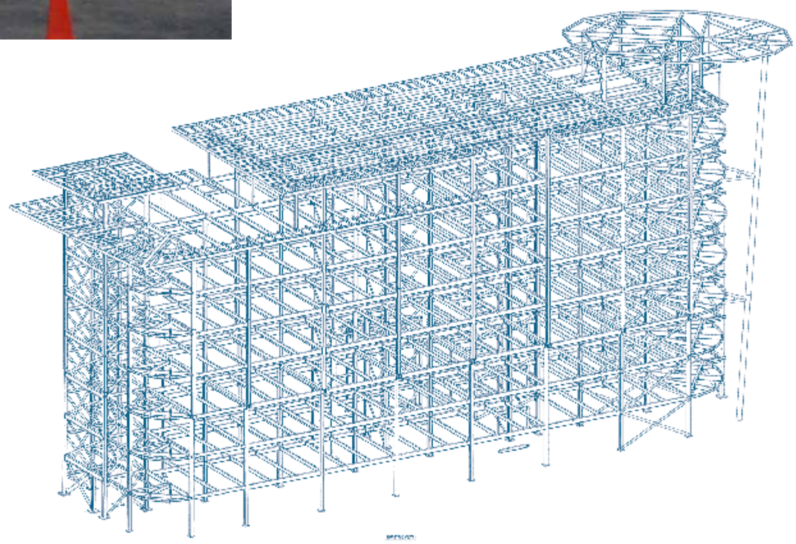
Structural engineer: *Capita Symonds Structures*

Steelwork contractor: *Hambleton Steel*

Steel tonnage: *450t*

Above: Bracing has been positioned in lift shafts and partition walls.

Below: Steel detail showing rooftop cantilever and canopy.



Computer generated image showing Sheffield's latest commercial development.

The cantilever fans-out to a maximum of 6m at one corner and has been formed with 305 sections - used for there appearance - and cold rolled infill.

Cost and efficiency have been the main drivers for this project and Capita Symonds says that is why steel was chosen for the main frame. "We wanted a lightweight frame as we have a raft foundation which was chosen as piling was out of the question because old underground coal shafts were discovered below the site," says Mr Palmer. "Steel was consequently the best solution."

There are no concrete cores and stability is derived from braced bays secreted in partition walls and the structure's lift shaft.

Steelwork contractor Hambleton Steel completed its package in 13 weeks and its work included installing 6,000m^2 of metal decking, placing the concrete flooring as well as steel erection.

Prior to the steelwork beginning a cut and fill operation was carried out during the initial construction programme. The majority of this material was compacted on top of the concrete raft, which minimised material leaving the site.

But efficiency and sustainability do not end there, the building has been designed to reduce its energy demand by upgrading the thermal fabric to reduce heat loss by 20% over the minimum required by the current Building Regulations.

Similarly heat loss by leakage will be reduced to achieve an air permeability of 20% better than the minimum standards required by current regulations.

Parkway Edge is conveniently located above the district heating network, and feasibility studies proved that connection to the network would afford both operational cost savings and significant carbon reductions, as well as lower installation costs than those for traditional gas fired boilers.

Capita Symonds says enhancements to the building were modelled extensively through dynamic thermal simulation software. Then through coordination with themselves and the architect, each element was enhanced beyond Building Regulations requirements, thereby improving the energy performance and further reducing carbon emissions.

Some thought has also gone into the fit-out of the building and lighting installations comprising high frequency light sources with daylighting control which will enable the operational savings associated with the reduced artificial lighting, and will also emit less heat in the summer months, reducing the need for mechanical cooling installations.

As much care and attention has been applied to developing a building which acts as a focal point on a major city thoroughfare. "It's a local development on a prime location which has been designed and built with as much local expertise and trades people as possible," sums up Mr Palmer.

Parkway Edge is due for completion in early 2010.

15m high feature columns in the entrance hall have been fabricated from CHS sections with a T-plate welded to the back.

New school is lesson in design

Large internal spans and plenty of exposed steelwork were central to the design of new buildings for a school in south London renowned for its performance and drama facilities.

One of the largest schools in the capital and the biggest in the London Borough of Lewisham is nearing completion after being completely rebuilt. Students at Sedgehill School in Catford moved into some of their new school premises this January, with the remainder of the buildings scheduled for completion this summer.

As with most new school projects, construction at Sedgehill has been undertaken while most of the adjacent old buildings were still in use. Once the new school is entirely up and running the original school will be demolished making way for new sports pitches and landscaped gardens.

The school is one of only a few London schools with a Performing Arts Specialist School tag and this is reflected in its new drama and dance facilities, with four studios and an 'agora-style' central external performance space which is intended for local community and school outdoor activities.

The outdoor performance area is central to the school's design with the new buildings arranged around it. The buildings consist of one large steel-framed crescent shaped structure which houses the main entrance, offices, drama and dance studios, sports hall and some classrooms, with four smaller dedicated classroom blocks opposite.

"The long internal spans needed for the drama theatre and sports hall all lent themselves to steel construction."

Most of the school buildings are three storeys high, including the large main building, although this structure does contain a number of building-high open spaces, such as the drama theatre, sports hall and entrance area.

"That's why steel was chosen for the main school building," explains Nick Calvert, Project Engineer for SKM. "The long internal spans needed for the drama theatre and sports hall all lent themselves to steel construction."

Working on behalf of main contractor Costain, Bourne Steel has erected 475t of structural steelwork for the project. The majority of the steelwork was completed by the end of 2008, however one section, around the new sports hall, could not be finished until earlier this year as a small building had still to be demolished.

Architectural features are high on the agenda for the main school building. There are no cores for stability within this structure so bracing has been placed in a number of locations, much of which is on view. The drama studio needed to be a large open column free space and the roof has been formed with a series of 23.8m long cellular beams.

"These beams are on show in the completed building and that's why we chose to go with cellular rather than regular beams," adds Mr Calvert.

The cellular beams were all brought to site in two pieces and spliced together before being erected. The beams also have a crank in them to accommodate the building's roof ridge.

Another interesting and visual element within

Above: The school's performance studios are housed in one crescent shaped building.

Above: Large column-free areas were integral to the design.

FACT FILE
Sedgehill High School, Lewisham, London
Main client: Lewisham Schools PFI
Architect: Architects Co-Partnership
Main contractor: Costain
Structural engineer: Sinclair Knight Merz
Steelwork contractor: Bourne Steel
Steel tonnage: 450t

the drama studio is the bracing along one wall. Again this is in full view and has been installed as a feature rather than secreting it within a partition wall. The vertical bracing was installed as a 21m wide storey high truss which was delivered to site in two fully welded pieces. They were then welded together on the ground before being lifted and placed on to spigoted columns.

The drama studio is a large space and bracing was required along one complete elevation as there was no diaphragm continuity. Horizontal loads had to be transferred through to the 300mm deep braced truss which allowed services to pass through the void.

Adjacent to the drama theatre, the school's main entrance is another large open structure-high area. There are no internal columns, except for perimeter members arranged along the front and back external elevations.

These 15m high steel columns are again architectural features and have been fabricated from 273mm diameter CHS members with a T-section plate welded to the back as a stiffener. These columns support curtain walling and there are eight of them at the front and four at the back.

"If we'd have used just CHS columns they would have been much larger sections (457mm diameter) and the clear spacing between the members would have been less," says Mr Calvert. "By using specially fabricated sections we have more open space around the entrance hall perimeter."

The rest of the main school building consists of offices, a dining hall and some classrooms arranged over three levels. On the eastern end of the structure there is the portal framed sports hall with spans of 15m.

The sports hall was, as previously mentioned, one of the final sectors of steelwork to be completed by Bourne.

"We also had to finish off the feature canopy at the front of the entrance hall," adds Dave Jackson, Bourne's Site Manager. "We erected the majority of the canopy, but because an existing boiler house had still to be demolished we had to temporarily prop one final section."

The canopy is supported on six 16m long CHS columns, and the last two of these members were only erected once the old building was gone. The boiler house had a chimney which was the main obstruction to completing the canopy, and its foundations have been reused for the new columns.

Commenting on the new school, Karen Bastick-Styles, Head Teacher of Sedgehill School, said: "The opportunity to design a new school for the students and staff has been an incredibly exciting experience. It's allowed us as a community to think creatively and innovatively about the type of teaching and learning we want to develop.

"The building really is quite beautiful. The colours, the bright light spaces and the campus design with and centre circle as a focus point, combine to make Sedgehill feel like a special place."

Below: The drama theatre has internal spans of 23m formed by feature cellular beams.

Getting the best out of LTBeam

*Alastair Hughes of the SCI explains how to take advantage of software freely downloadable from **cticm.com** for design to the Eurocode.*

Introduction

The European curves for lateral-torsional buckling (LTB), which were reviewed in NSC17/1 (January 2009), have a non-dimensional format different from familiar buckling curves (or tables). Instead of plotting strength reduction against slenderness of the traditional L_{cr}/i_z type, in which L_{cr} is the effective buckling length and i_z is the weak-direction radius of gyration, they have as their abscissa the so-called 'non-dimensional slenderness' ('relative slenderness' in Eurocode 4). Non-dimensional slenderness is defined as $\sqrt{(W_y f_y / M_{cr})}$, in which $W_y f_y$ is $M_{y,Rd}$, the moment the cross-section could resist if restrained against LTB, and M_{cr} is the elastic critical moment for LTB. It is easy to calculate the former, but what about the latter? The Eurocode makes the rather flattering presumption that its users know how. Providers of NCCI (non-conflicting complementary information) have stepped in to fill the breach. A variety of methods to calculate M_{cr} (or non-dimensional slenderness directly) is on offer. The most precise and productive of them is a freely available piece of software written for just this purpose.

The concept of elastic critical moment

It is important to understand from the outset that this concept is a theoretical one. M_{cr} is the peak M_y (strong-direction moment) developed in a perfect, and perfectly linear elastic, beam on the point of failure by LTB. The beam is made of a material whose E-value is the same as steel, 210GPa, but whose strength is limitless. Truly the stuff of science fiction.

The compression flange (let us assume it is the top one) fails by buckling sideways when the load is scaled up until the P-Δ effect overcomes available lateral stiffness. The flexural rigidity of the flange is supplemented by the torsional rigidity of the section as a whole, since the tension flange naturally tends to remain straight and the top flange cannot buckle without twisting the beam. Torsional properties therefore influence M_{cr}.

M_{cr} depends on more than just the span and the section properties. Lateral deflection of the top flange is influenced by curvature all along the length, not just at the critical point. So the shape of the bending moment diagram is important. (This is the effect allowed for in BS5950's Table 18.)

The level at which the load is applied makes a difference. If the load is sitting on the top flange, and it deflects laterally, it will deflect some more because of the induced torque the beam must counter. On the other hand, if the point of attachment is below the shear centre, the same effect in reverse adds stiffness and increases M_{cr}. (BS5950's Table 13 makes very crude allowance for this effect, when the load is 'destabilizing'.)

The top flange could also be stiffened up by clamping its ends against rotation in its own plane. In theory, this could make a significant difference. In practice, it is virtually impossible to guarantee that any top flange, still less a bottom one, is effectively clamped. A rotational spring may be the best that surrounding structure can offer, but this too presents challenging problems of reliability and quantification. Connections such as fin plates certainly cannot be expected to keep the flanges in line. Even if the beam is continuous over more than one span, available restraint stiffness evaporates if both spans could buckle simultaneously in opposite directions. (This is tantamount to suggesting that it will rarely be prudent to adopt an effective buckling length ratio less than 1 in BS5950's Table 13.)

Has the concept of effective length gone away?

Effective length is the traditional way to deal with the influence of end restraint on strut buckling, and it has also been applied to LTB. In this context it ought to be borne in mind that typical beam-to-column connections, especially those favoured in simple construction, are distinctly more effective in the restraint the beams offer against column buckling than vice versa. In practice, whether we like to admit it or not, part of the appeal of the effective length concept is that designers can skate over some murky water by exercising judgement in declaring what that length should be. Not all Europeans are equally comfortable with this approach. The reader of EN1993-1-1 Section 6.3 (on buckling generally) might conclude that the concept has been eradicated. In fact, it survives, in pockets: clause 6.4.2 (on laced compression members) introduces L_{ch}, the buckling length of a chord, and Annex BB (on lattice structures) introduces L_{cr}, the buckling length. However, both these are for strut buckling, so the initial impression that Eurocode 3 wants nothing to do with the concept of effective length may not be far from the truth, for LTB at any rate.

Enter LTBeam

With serious application of the Eurocode looming, CTICM (SCI's counterpart in France) was commissioned to develop software to compute M_{cr} directly so as to provide the missing link in the design process for LTB. The project was Community funded and the product is freely downloadable on *cticm.com*, without any need to register. The program simulates buckling by an iterative process capable of taking full account of all the influences discussed above, and of intermediate restraint, such as might be provided by secondary beams or a system of bracing. It caters for cantilevers as well as beams. It has been thoroughly tested and compared with results from other methods. It represents an authoritative solution to the problem as defined, and is probably as 'official' as any piece of software can ever be.

LTBeam is a polished product, bilingual in English and French. However it is not as user-friendly as some, at least on first acquaintance. This article aims to provide guidance to first-time users.

Downloading LTBeam

LTBeam can be downloaded from CTICM's website. A Google search for CTICM or LTBeam will locate the source. The web pages generally have an option of changing the language to English. *http://www.steelbizfrance.com/telechargement/desclog.aspx?idrub=1&lng=2* is a direct link to the English download page. A series of zipped files are downloaded, and clicking the setup.exe file will begin the installation. Then follow a series of mainly obvious instructions in French, but beware that 'anuller' means cancel. 'OK' to 'L'installation de LTBeam a réussi' completes the setup process.

Launching the application brings up the first of four tabbed pages, as shown in Figure 1.

First page: Beam / Section / Steel

This first page is to input the section and the span. The second is to input the restraints. The third is to input the load(s). The fourth is to perform the computation. If these pages come up in French, switch to English via 'outils' (tools) / 'options' / 'langue' / 'UK English' / 'OK'.

Sections may be defined in three ways. Standard rolled doubly symmetric I- and H-sections are selected from LTBeam's catalogue, via 'open catalogue' / 'series' (scrolling down to reveal UB and UC) / 'number'.

ASB are ex-catalogue, as are recent additions to the Corus Advance UKB and UKC range, for the time being. For these the second option, direct entry of section dimensions, may be used. Overwrite the default values in the table which pops up when 'by dimensions' is selected in preference to 'in catalogue'. The scale drawing at bottom right should give some confidence that dimensions have been correctly entered. Four key section properties are on display; click on 'more' for the shear centre location, among others.

The third option, which could be used for SFB (and any RHS slender enough to be LTB susceptible) is to select 'by properties' and enter values for I_z, I_t, I_w and β_z. The three I-values for SFB are in the Corus handbook (though not all in the cm units demanded by LTBeam) but β_z is not. This monosymmetry parameter (zero for a doubly symmetric section) will not be dwelt on here. Refer to ECCS Publication 119 Annex B for evaluation of β_z, under its alias $-z_j$. Note that LTBeam does not handle sections such as PFC which are not symmetrical about the z-axis.

Before leaving the first page remember to overwrite the default 10m in the 'total length' box, unless the span happens to be 10m. There is generally no need to alter the default number of elements. Everything in the 'Steel' frame should be left as it first appears.

Second page: Restraints

For a typical simply supported beam, without intermediate lateral restraint, nothing needs to be entered on this page. Leave it as it first appears (Figure 2) and proceed to the third page.

If intermediate lateral restraint is present, tick

LTBeam is a polished product, bilingual in English and French.

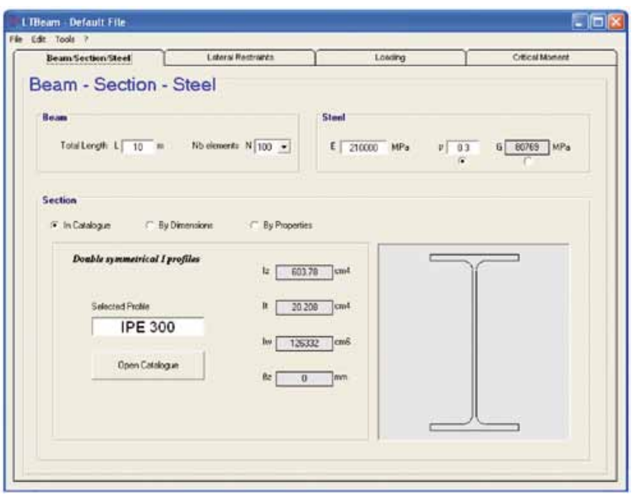


Figure 1.

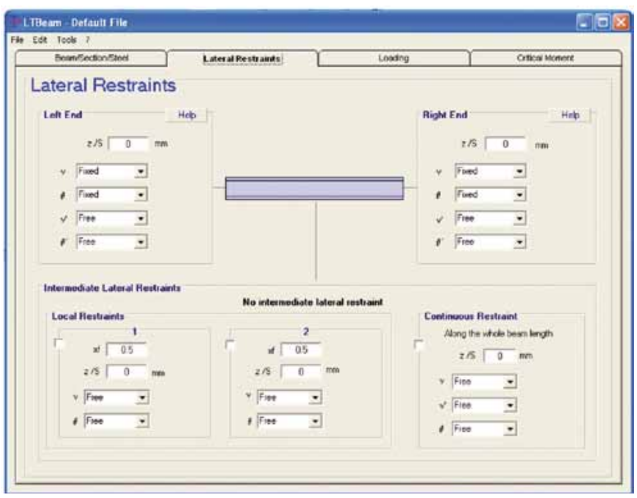


Figure 2.

one or more of the empty boxes just below the top left corners of the three frames at the bottom of the page. LTBeam can handle single or two point restraint, and/or continuous restraint. Each of these restraints can be lateral and/or rotational, and there is the option of assigning a spring value to every restraint. So if, for example, two parallel primary beams are connected by an intermediate secondary beam, the restraint provided to the primary beam can be represented by a spring of rotational stiffness equal to twice the secondary beam's bending stiffness *EI* divided by its length.

For lateral restraints, effectiveness is level-dependent and the height of the restraint above the shear centre must be specified. Default is zero, implying restraint at mid-height of a doubly symmetric section.

The two frames at the top of the page are for end restraints. Clicking on 'help' will bring up diagrams which help to explain what the symbols mean. v represents lateral restraint, and θ represents torsional restraint. Normal beam end connections provide fixity in both senses; different settings might be called for at the free (RH) end of a cantilever. There is provision for the restraint to be applied at a set height, though obviously torsional fixity makes this immaterial.

v' represents rotational restraint (of the whole section) about the z-axis, and θ' represents warping restraint, which means holding the top flange parallel to the bottom flange. Normal beam end connections, even those designed to resist moment, provide little or no reliable restraint in either of these senses; special measures at the root of a cantilever, such as those progressively illustrated in BS5950's Table 14, could justify different settings. Quantifying the stiffness of available restraint of these types is easier said than done, which is part of the argument for not relying upon it. If it does have to be done, LTBeam makes it very easy to test the sensitivity of M_{cr} to different stiffness assumptions.

The safe assumption for typical beam end connections is lateral and torsional fixity only, LTBeam's default setting. Presuming any further restraint could be problematic, for reasons discussed above.

Third page: Loading

As well as loading, this page (Figure 3) allows the beam to be set as simply supported, fixed ended, LH end fixed / RH end pinned or as a cantilever (from LH end). Rotational y-axis springs at member ends are not on offer.

LTBeam can handle up to three point loads and/ or up to two distributed loads, each of whose intensity may vary linearly from end to end. Every one of these loads can be applied at a different (but constant) height relative to the shear centre. This allows, for instance, the beam's own weight to be applied as a UDL at centroid level, separately from its payload which might be a UDL at top-of-steel level. LTBeam, ignorant of load factor and orientation relative to gravity, cannot automatically apply the beam's own weight. Observe the sign convention: downwards loads have a minus sign in front.

There is also provision to apply one intermediate point moment and/or moment at one or both ends. For some reason 100kNm end moments are set as default loading; remember to cancel them (unticking the box will suffice) if not wanted. Conversely, make sure that all the boxes are ticked for the loads intended to apply. Clicking on 'refresh' to generate a loading sketch, BMD and SFD can help confirm that loads **are** entered correctly. LTBeam calculates $M_{y,Ed}$ ('M_{max}') for display alongside the BMD.

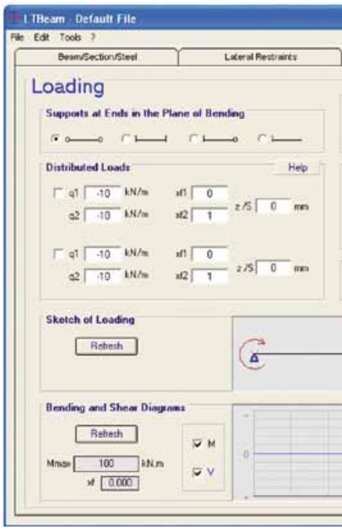


Figure 3.

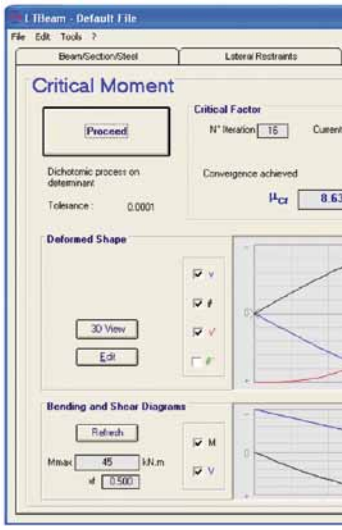
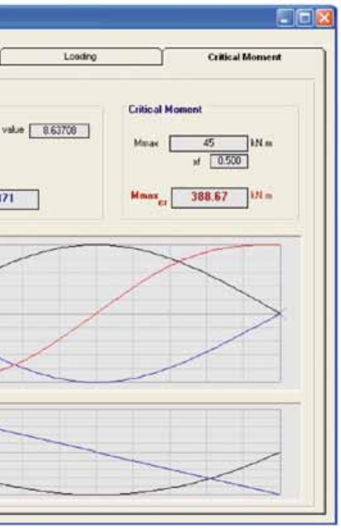


Figure 4.



As an aside, it may be noted that all the loading in LTBeam is uniaxial. Loading other than that which subjects the beam to strong-direction bending is ignored. For instance, a touch of lateral load, or compression, would surely help precipitate LTB, and in principle LTBeam's solution process could make due allowance. But these interactions are for a later stage in the design process, when EN1993-1-1 exp (6.61) / (6.62) and the like will be applied. For the time being, the fiction is maintained.

Fourth page: Critical Moment

There is nothing to enter on this page. Just click on the 'proceed' button and enjoy a sensation akin to standing in front of a fruit machine for a second or so until a drumbeat heralds a result, as shown in Figure 4. The views of the buckled shape are a feast to the eye, but what is of predominant interest to the designer is the figure in red in the box labelled 'Critical Moment'.

To capture the result in print, click on 'edit' / 'results' (from the menu bar). A new window contains a printable summary of the whole exercise, under the Franglais heading 'Edition of results', shown in Figure 5. It can be printed by clicking on 'file' / 'print' in the usual way (before clicking on 'OK', which means 'close').

Footnote: Having established M_{cr}, why doesn't LTBeam complete the task by computing what the user really needs, the non-dimensional slenderness? There is a simple answer: non-dimensional slenderness is $\sqrt{(M_{y,Rd}/M_{cr})}$, and $M_{y,Rd}$ depends on yield strength which might, for sections of a certain thickness range, be 265MPa in Dover and 275 in Calais.

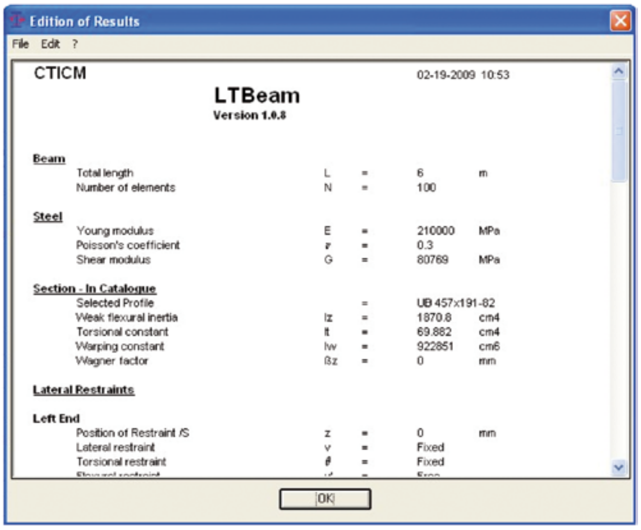
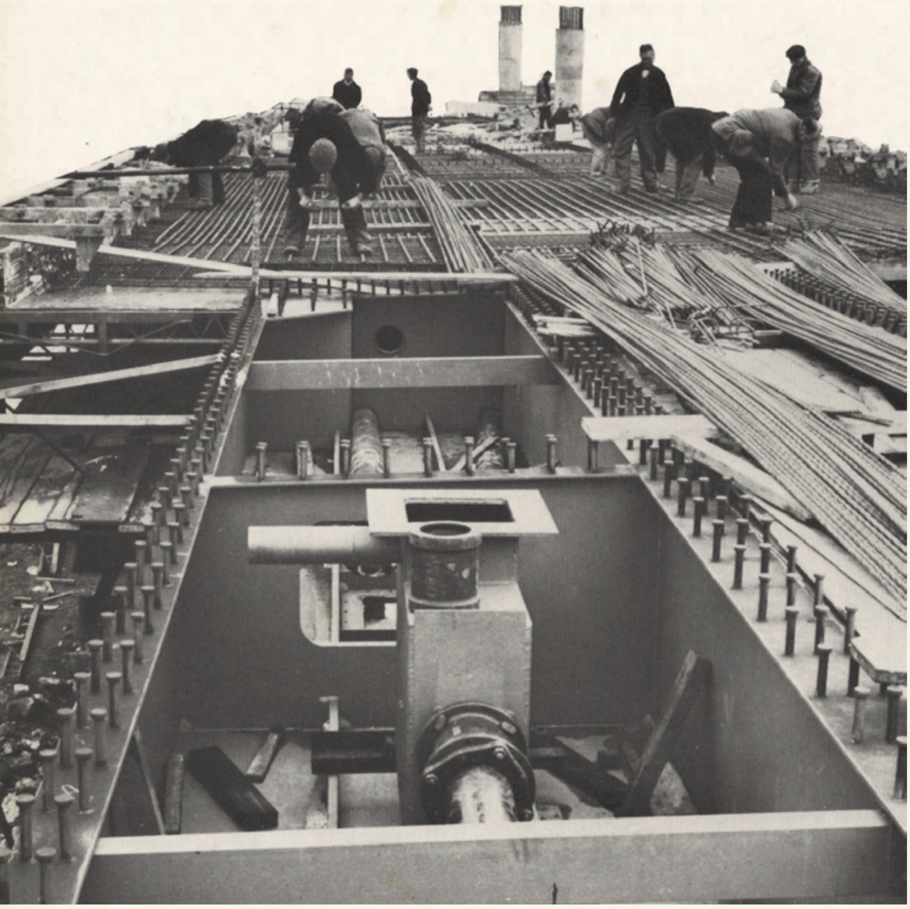


Figure 5.

Separating the Mersey Tunnel



Above: Work in progress on the viaduct.

In 1935, when the Birkenhead to Liverpool Tunnel under the River Mersey (the Queensway Tunnel) was opened, the total number of vehicles on British roads was 2.6 million. By 1966 the figure had increased to 13.3 million. The amount of traffic wishing to use the Mersey Tunnel had increased in an even greater proportion and the vehicular traffic flow through the Tunnel during peak flow periods is restricted by the capacity of the Tunnel itself. This in turn results in the overloading and congestion of the approach roads which have to act as queueing reservoirs for Tunnel traffic. The main commercial shopping centre of Birkenhead is about a quarter of a mile away from the Birkenhead main entrance to the Tunnel, and town traffic is brought to a standstill as queues backing up from the tunnel encroach on this area. This occurs during morning and evening peak hours and summer weekends with the evening peak hours and summer weekends with the result that this vital town centre is obstructed with traffic for long periods.

In 1965, Mr H. C. Oxburgh, BSc, C.Eng, AMICE, MIMimE, DipTP, MTPI (Borough Engineer and Surveyor to the County Borough of Birkenhead), drew up the scheme shown in the photo-montage of the project on this page, and now being implemented to ensure the free flow of traffic in the centre of Birkenhead. This proposal provides grade-separated relief roads to segregate 'Tunnel only' traffic from town traffic and incorporates two large marshalling areas or queueing reservoirs for the Tunnel bound traffic. Not shown in the photograph is the large number of underground obstructions complicating the implementation of the project. These include the local MANWEB electricity distribution system and 132 kV CEGB grid cables, high and low pressure gas mains from the adjacent gas woks, water mains, telephone cables (including the GPO's London-Liverpool-Glasgow trunk services) and Rediffusion cables. Many of these services have had to be extensively re-routed. In addition there are four railway tunnels running under the site.

In September 1965 Consulting Engineers were appointed for the detailed design of the project and for the supervision of its construction. The design which they have developed for the elevated viaduct structures has been based on the use of composite steel-concrete box girder sections spanning over steel columns. This arrangement was chosen for several reasons. The single column configuration has certain obvious advantages in providing clearances to existing and future traffic lanes and railway tracks and other less obvious ones, such as reducing the intrusion of foundations into the underground services networks. Furthermore, the clean lines so achieved, have aesthetic advantages not only in their contribution to the general appearance of the structure but also in avoiding the forest of columns that would ensue at bifurcation points if a twin post format were adopted. The span dimensions are mainly dictated by site requirements and range from 67 ft to 110 ft. The composite steel-concrete box girder arrangement adopted is of advantage where long spans to tight horizontal radii are necessarily involved and resulting in comparative ease of erection, aesthetically pleasing outlines and low depth span ratios.

In order to limit the effects of temperature and stress movements the design was based on the cantilever – suspended span principle in which longitudinal portals, each with one fixed leg and one free leg, alternate with spans suspended with cantilever extensions to the portals. All longitudinal forces are taken by the fixed columns. The lateral stability of the structure is ensured by both the fixed and the free columns, the latter widening out at their bases to form cross beams, which sit on sliding 'Rotaflon' bearings. Other designs, using prestressed or reinforced concrete, were investigated at an early stage but it was found that although some of these alternatives would have resulted in comparable costs per square foot of deck area, other advantages weighed in favour of the adopted design.

A solution was required for the junction between the columns and the beams of the portal spans, which would not encroach on certain critical clearances and in which the clean flowing lines of the structure were not interrupted. These requirements ruled out any form of external crosshead to the column and in the adopted design, the reinforced concrete column is cast integrally into the steel box as shown. The viaducts consist in principle of two or three cell box girders 12 ft or 18 ft wide respectively. The box girder acts compositely with the concrete deck slab (or with the reinforcement in the deck slab in areas of hogging moment), but at the crosshead the central webs are terminated at transverse diaphragms 5ft on either side of the column centre line. As this crosshead has to transmit longitudinal moments from the span to the column, the column reinforcing bars are continued up into the crosshead section to lap with bent down elements of the longitudinal deck reinforcement, the whole of the crosshead section being filled with concrete.

A similar reinforcement arrangement caters for the transverse and torsional moments which arise for the horizontal curvature and eccentric loading. The vertical loading normally carried by the steel box girder webs is transferred from the span sections into the concrete crosshead block by shear studs on the diaphragms and on the outer webs.

In order to verify the soundness of the design of the crosshead area of the structure, tests were carried out at the Imperial College of Science and technology on a quarter-full-size model illustrated on this page. These tests were made primarily to determine the manner in which loads from the steel elements of the structure find their way through the crosshead section and down into the reinforced concrete column. One hundred and twenty strain gauges, which were 'read' electronically, were used to record the distribution of stresses within the crosshead area under the various loading conditions imposed. Investigations were also made into the stiffness of the intermediate diaphragms and on the effect of introducing access manholes in the bottom flanges of the spans.

After the full series of tests to simulated working load values under a variety of loading conditions had been carried out, the loads on the model were increased to determine the ultimate factors of safety of the constituent elements of the structure. The basic interpretation of the results shows that the steel box girder section outside the crosshead was the weakest link but that even so a factor of safety of 2.65 existed at this position in the model.

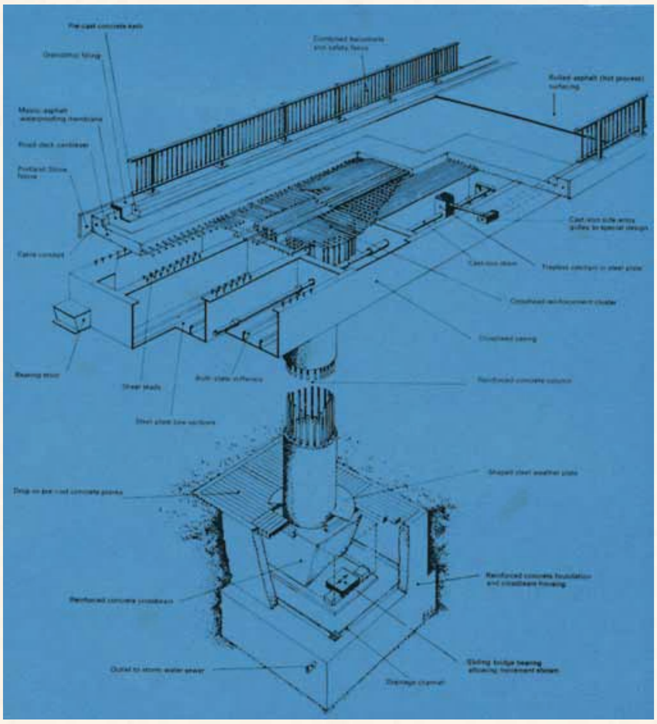
The tunnel traffic sections of the viaduct system have been designed in accordance with BS 153: Steel Girder Bridges, to carry HA loading and checked for 37½ units of HB loading. The town traffic viaduct has been designed to carry HA loading and checked for 45 units of HB loading. The various drafts of CP 117: Part 2, Beams for Bridges, were used for guidance in the design of the composite elements of the structures.

In general, because of the length of the spans (from 67ft to 110ft) and the width of the steel box girders (12ft or 18ft) the portal sections are each fabricated in a maximum of six sub-assemblies. The entire structure will be erected on trestles prior to making the site connections. The longitudinal joints in the span sections will be site welded and the transverse joints site bolted using high strength friction grip bolts. At the crosshead, the bottom flange splice and the lower part of the web splice utilize the rim plate type of joint while the 'top flange' splice is made by the steel reinforcement running over the joint.

Shop fabrication of the steel superstructure commenced in September 1967 and the first sections were erected in mid-December 1967. In all, some 1,700 tons of structural steelwork will be erected by December of this year.

Consulting Engineers - Brian Colquhon and Partners.

Above: Photo montage of the project.



Above: The composite steel box girder arrangement adopted.

Below: The quarter size model at the Imperial College of Science and Technology.

AD 334
Tension capacity of bolts in tapped holes or when nuts are not fully engaged

The Advisory Desk is often asked for guidance on the calculation of tension capacity of bolts in tapped holes or when the end of the bolt is not protruding beyond the nut. Design rules in BS 5950 and Eurocode 3 do not cover these situations. It is not possible to give simple rules for determining tension capacity but this AD Note does discuss the various modes of failure and the factors that need to be considered in such situations and it gives references to more detailed information.

The discussion in this Note relates only to the design of non-preloaded bolts. Preloaded bolts should only be used with the appropriate grade of nut and tightened in accordance with the appropriate standard.

Modes of failure:

There are four possible modes of failure of a bolt loaded in tension:

- Tensile fracture of the bolt
- Stripping of threads on the bolt
- Stripping of threads in the nut or the tapped material
- Stripping of both threads simultaneously.

Clearly, failure occurs at the lowest failure load of these four modes.

For a bolt to one of the commonly used British Standards, fully engaged with the appropriate strength grade of nut, failure will normally be by tensile fracture of the bolt; the thread and nut dimensions are such that stripping will not occur prematurely.

If the bolt is not fully engaged in the nut or the tapped material is of a strength different from that of a normal nut, thread stripping might occur.

Factors affecting thread stripping

The following factors all have an important effect on the bolt load at which a thread will strip

The variation in the dimensions of the thread, (such as major, pitch and minor diameters) has a significant effect on both internal and external threads stripping strength.

Tensile and shear strength variations in the material for both the internal and external threads.

The effect of radial displacement of the nut or tapped component (generally known as nut dilation) in reducing the shear strength of the threads. The tensile force in the fastener acts on the threads and a wedging action generates a radial displacement which reduces thread strength.

The effect of bending of the threads, caused by the action of the fastener's tensile force acting on the threads, resulting in a wedging action that decreases the shear area of the threads.

The effect of slight hole taper or bellmouthing in tapped holes.

Bellmouthing is the slight taper on the hole that is usually encountered to some degree on most drilled and tapped holes. This taper extends normally for about half the diameter from the start of the hole. The cause of this tapering is torsional and transverse flexibility of the drill together with instability of the drill point during entry into the material. Bellmouthing can be minimised by the use of close fitting, well aligned and rigid drill bushes together with accurate drill sharpening.

Guidance on the evaluation of tension capacity, taking into account these factors, is given in the references below.

References

(1) *Structural steelwork connections by Graham W Owens & Brian D Cheal (pages 58/61).*

(2) *An introduction to the design and behavior of bolted joints by John H Bickford (pages 270/275).*

(3) *BS 3580:1964, Guide to design considerations on the strength of screw threads.*

(4) *BS 4439:1969, Specification for screwed studs for general purposes.*

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Codes & Standards

New and Revised Codes & Standards

(from BSI Updates February 2009)

BRITISH STANDARDS

NA to BS EN 1993:-

UK National Annex (informative) to Eurocode 3. Design of steel structures

NA to BS EN 1993-1-3: 2006

General rules. Supplementary rules for cold-formed members and sheeting

No current standard is superseded

NA to BS EN 1993-1-4: 2006

General rules. Supplementary rules for stainless steels

No current standard is superseded

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT – NATIONAL BRITISH STANDARDS

09/30129886 DC

NA to BS EN 1993-3-1 UK National Annex to Eurocode 3. Design of steel structures. Part 3 -1. Towers, masts and chimneys. Towers and masts

Steelwork contractors for buildings

BCSA is the national organisation for the steel construction industry.
Membership of BCSA is open to any Steelwork Contractor who has a fabrication facility within the United Kingdom or Republic of Ireland.
Details of BCSA membership and services can be obtained from
Gillian Mitchell MBE, Deputy Directory General, BCSA, 4 Whitehall Court, London SW1A 2ES
Tel: 020 7839 8566 Email: gillian.mitchell@steelconstruction.org

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

- **C** Heavy industrial platework for plant structures, bunkers, hoppers, silos etc
- **D** High rise buildings (offices etc over 15 storeys)
- **E** Large span portals (over 30m)
- **F** Medium/small span portals (up to 30m) and low rise buildings (up to 4 storeys)
- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
- **K** Towers and masts
- **L** Architectural steelwork for staircases, balconies, canopies etc
- **M** Frames for machinery, supports for plant and conveyors
- **N** Large grandstands and stadia (over 5000 persons)
- **Q** Specialist fabrication services (eg bending, cellular/castellated beams, plate girders)
- **R** Refurbishment
- **S** Lighter fabrications including fire escapes, ladders and catwalks
- **QM** Quality management certification to ISO 9001

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●										Up to £1,400,000
ACL Structures Ltd	01258 456051			●	●		●				●						Up to £3,000,000
Adey Steel Ltd	01509 794561				●	●	●	●		●	●			●	●		Up to £3,000,000
Adstone Construction Ltd	01905 794561			●	●	●											Up to £4,000,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●	✓	Up to £800,000
Andrew Mannion Structural Engineers Ltd	00 353 90 644 8300		●	●	●	●	●	●			●	●		●		✓	Up to £6,000,000
Angle Ring Company Ltd	0121 557 7241												●				Up to £800,000
Apex Steel Structures Ltd	01268 660828				●		●			●	●						Up to £800,000
Arromax Structures Ltd	01623 747466			●	●	●	●	●	●		●	●					Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●		●			●	●			●	●		Up to £800,000*
ASD Westok Ltd	01924 264121												●				Up to £6,000,000
ASME Engineering Ltd	020 8954 0028				●					●	●			●	●	✓	Up to £1,400,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	Above £6,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●		●							●			Up to £2,000,000
AWF Steel Ltd	01236 457960				●					●				●	●		Up to £100,000
B D Structures Ltd	01942 817770			●	●	●	●				●			●			Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✓	Up to £2,000,000
Barnshaw Section Benders Ltd	01902 880848												●			✓	Up to £800,000
Barrett Steel Buildings Ltd	01274 266800			●	●	●	●									✓	Up to £6,000,000
Barretts of Aspley Ltd	01525 280136				●					●	●						Up to £3,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●							●			Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Bone Steel Ltd	01698 375000	●	●	●	●	●	●			●	●	●		●			Up to £6,000,000*
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Browne Structures Ltd	01283 212720				●			●							●		Up to £400,000
BSB Structural Ltd	01506 840937			●	●												Up to £800,000
Cairnhill Structures Ltd	01236 449393				●	●	●	●		●	●			●	●	✓	Up to £1,400,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●			●	●		●		✓	Up to £6,000,000
Chieftain Contracts Ltd	01324 812911			●	●										●		Up to £400,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000*
CMF Ltd	020 8844 0940				●		●	●		●	●				●		Up to £6,000,000
Compass Engineering Ltd	01226 298388			●	●		●		●								Up to £2,000,000
Conder Structures Ltd	01283 545377		●	●	●	●	●				●	●		●	●	✓	Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓	Up to £3,000,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●		Up to £1,400,000
Cronin Buckley Fabrication & Construction Ltd	00 353 21 487 0017			●	●	●	●				●						Up to £6,000,000
Crown Structural Engineering Ltd	01623 490555			●	●	●	●		●		●			●	●	✓	Up to £1,400,000
D A Green & Sons Ltd	01406 370585		●	●	●	●	●	●	●	●	●	●		●		✓	Up to £6,000,000
D H Structures Ltd	01785 246269				●						●						Up to £200,000
Discain Project Services Ltd	01604 787276				●					●	●				●	✓	Up to £1,400,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●						Up to £6,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	Up to £6,000,000
Emmett Fabrications Ltd	01274 597484			●	●	●	●							●			Up to £1,400,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	Up to £3,000,000
F J Booth & Partners Ltd	01642 241581			●	●		●				●				●	✓	Up to £4,000,000
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Fisher Engineering Ltd	028 6638 8521			●	●	●	●	●	●	●	●	●				✓	Above £6,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**Contract Value (1)**

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●						Up to £3,000,000
Frank H Dale Ltd	01568 612212		●	●	●	●										✓	Up to £6,000,000
Gibbs Engineering Ltd	01278 455253				●		●	●		●	●				●	✓	Up to £800,000
Glentworth Fabrications Ltd	0118 977 2088				●	●		●	●	●	●	●		●	●		Up to £800,000
GME Structures Ltd	01939 233023			●	●		●	●		●	●			●	●		Up to £800,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●			Up to £1,400,000
Graham Wood Structural Ltd	01903 755991		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000
Grays Engineering (Contracts) Ltd	01375 372411				●			●		●	●				●		Up to £200,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●				✓	Up to £4,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●						Up to £2,000,000
Had Fab Ltd	01875 611711								●		●				●	✓	Up to £1,400,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●					Up to £2,000,000
Harry Peers Steelwork Ltd	01204 558500			●	●	●	●	●	●	●	●			●		✓	Up to £4,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121			●	●	●	●	●									Up to £4,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●		Up to £3,000,000
Hills of Shoeburyness Ltd	01702 296321									●	●				●		Up to £800,000
J Robertson & Co Ltd	01255 672855									●	●				●		Up to £200,000
James Bros (Hamworthy) Ltd	01202 673815			●	●		●			●	●	●			●	✓	Up to £2,000,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●		●			Up to £6,000,000*
John Reid & Sons (Strucsteel) Ltd	01202 483333		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						Up to £1,400,000
Leonard Cooper Ltd	0113 270 5441				●		●		●		●			●			Up to £800,000
Leonard Engineering (Ballybay) Ltd	00 353 42 974 1099			●	●	●	●				●						Up to £3,000,000
Lowe Engineering (Midland) Ltd	01889 563244									●					●	✓	Up to £800,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓	Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		Up to £1,400,000
Maldon Marine Ltd	01621 859000				●			●	●	●					●		Up to £1,400,000
Midland Steel Structures Ltd	024 7644 5584			●	●	●	●										Up to £800,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●						Up to £3,000,000
Milltown Engineering Ltd	00 353 59 972 7119			●	●	●	●	●									Up to £6,000,000
Newbridge Engineering Ltd	01429 866722			●	●	●	●									✓	Up to £1,400,000
Newton Fabrications Ltd	01292 269135			●	●	●				●	●	●			●	✓	Up to £4,000,000
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●		Up to £400,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		Up to £800,000
Paddy Wall & Sons	00 353 51 420 515			●	●	●	●	●	●	●	●					✓	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●		●	●			●					✓	Up to £2,000,000
Peter Marshall (Fire Escapes) Ltd	0113 307 6730									●	●				●		Up to £800,000
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		Up to £1,400,000
Remnant Engineering Ltd	01564 841160				●		●	●		●					●	✓	Up to £400,000*
Rippin Ltd	01383 518610			●	●	●	●	●									Up to £2,000,000
Roberts Engineering	01482 838240				●					●				●	●		Up to £100,000
Robinson Construction	01332 574711		●	●	●	●	●		●	●	●	●		●	●	✓	Above £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Rowen Structures Ltd	01773 860086		●	●	●	●	●	●	●	●	●	●		●			Above £6,000,000*
RSL (South West) Ltd	01460 67373			●	●		●				●						Up to £1,400,000
S H Structures Ltd	01977 681931						●	●	●	●							Up to £3,000,000
Selwyn Construction Engineering Ltd	0151 678 0236									●	●				●	✓	Up to £200,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Shipley Fabrications Ltd	01400 231115			●	●	●	●		●	●	●				●		Up to £200,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●			●	●				✓	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●				●	●				✓	Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●		Up to £2,000,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		Up to £800,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●	●			●		Up to £400,000
Terence McCormack Ltd	028 3026 2261			●	●		●	●								✓	Up to £800,000
The AA Group Ltd	01695 50123			●	●	●	●			●	●				●		Up to £4,000,000
The Steel People Ltd	01622 715900				●					●					●		Up to £100,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●	●		●		✓	Up to £3,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		Up to £4,000,000
W I G Engineering Ltd	01869 320515				●					●					●		Up to £400,000
W S Britland & Company Ltd	01304 831583				●		●	●	●		●				●	✓	*Accounts outstanding*
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✓	Up to £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●			●			●	●	●	●				●	✓	Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●					✓	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Company name	**Tel**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**	**L**	**M**	**N**	**Q**	**R**	**S**	**QM**	**Contract Value (1)**

Associate Members

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9
AceCad Software Ltd	01332 545800		●							
Advanced Steel Services Ltd	01772 259822								●	
Albion Sections Ltd	0121 553 1877	●								
Alternative Steel Co Ltd	01942 610601								●	
Andrews Fasteners Ltd	0113 246 9992									●
Arro-Cad Ltd	01283 558206			●						
ASD metal services - Biddulph	01782 515152								●	
ASD metal services – Bodmin	01208 77066								●	
ASD metal services - Cardiff	029 2046 0622								●	
ASD metal services - Carlisle	01228 674766								●	
ASD metal services - Daventry	01327 876021								●	
ASD metal services - Durham	0191 492 2322								●	
ASD metal services - Edinburgh	0131 459 3200								●	
ASD metal services - Exeter	01395 233366								●	
ASD metal services - Grimsby	01472 353851								●	
ASD metal services - Hull	01482 633360								●	
ASD metal services – London	020 7476 0444								●	
ASD metal services - Norfolk	01553 761431								●	
ASD metal services - Stalbridge	01963 362646								●	
ASD metal services - Tividale	0121 520 1231								●	
Austin Trumanns Steel Ltd	0161 866 0266								●	
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●								
BAPP Group Ltd	01226 383824									●
Barnshaw Plate Bending Centre Ltd	0161 320 9696	●								
Barrett Steel Services Ltd	01274 682281								●	
Bentley Systems (UK) Ltd	0141 353 5168		●							
Cellbeam Ltd	01937 840600	●								
Cellshield Ltd	01937 840600							●		
Celtic Steel services	01443 812181								●	
Combisafe International Ltd	01604 660600							●		
Composite Metal Flooring Ltd	01495 761080	●								
Composite Profiles UK Ltd	01202 659237	●								
Computer Services Consultants (UK) Ltd	0113 239 3000		●							
Cooper & Turner Ltd	0114 256 0057									●
Corus	01724 404040				●					
Corus Bellshill	01698 748424								●	
Corus Blackburn	01254 55161								●	
Corus Bristol	01454 315314								●	
Corus Dartford	01322 227272								●	
Corus Ireland Service Centre	028 9266 0747								●	
Corus Newcastle	0191 414 2121								●	
Corus Panels & Profiles	01684 856600	●								
Corus Service Centre Dublin	00 353 1 405 0300								●	
Corus Stourton	0113 276 0660								●	
Corus Tubes	01536 402121				●					
Corus Wednesfield	01902 484100								●	
Daver Steels Ltd	0114 261 1999	●								
Development Design Detailing Services Ltd	01204 396606			●						
Easi-edge Ltd	01777 870901							●		
Fabsec Ltd	0845 094 2530	●								
Ficep (UK) Ltd	0113 265 3921					●				
FLI Structures	01452 722260	●								
Forward Protective Coatings Ltd	01623 748323						●			
GWS Engineering & Industrial Supplies Ltd	00 353 21 4875 878									●
Hempel UK Ltd	01633 874024						●			
Hi-Span Ltd	01953 603081	●								
Industrial Shotblast & Spraying Ltd	0845 130 6715						●			
International Paint Ltd	0191 469 6111						●			
Interpipe UK Ltd	0845 226 7007								●	
Jack Tighe Ltd	01302 880360						●			
Kaltenbach Ltd	01234 213201					●				
Kingspan Structural Products	01944 712000	●								
LaserTUBE Cutting	0121 601 5000								●	
Leighs Paints	01204 521771						●			
Lindapter International	01274 521444									●
Metsec plc	0121 601 6000	●								
MSW (UK) Ltd	01355 232266	●								
MSW Structural Floor Systems	0115 946 2316	●								
National Tube Stockholders Ltd	01845 577440								●	
Northern Steel Decking Ltd	01909 550054	●								
Northern Steel Decking Scotland Ltd	01505 328830	●								
John Parker & Sons Ltd	01227 783200								●	●
Peddinghaus Corporation UK Ltd	01952 200377					●				
Peddinghaus Corporation UK Ltd	00 353 87 2577 884					●				
Portway Steel Services	01454 311442								●	
PP Protube Ltd	01744 818992	●								
PPG Performance Coatings UK Ltd	01773 837300						●			
Profast (Group) Ltd	00 353 1 456 6666									●
Rainham Steel Co Ltd	01708 522311								●	
Richard Lees Steel Decking Ltd	01335 300999	●								
Rösler UK	0151 482 0444					●				
Schöck Ltd	0845 241 3390	●								
Site Coat Services Ltd	01476 577473						●			
South Park Steel Services	01925 817000								●	
South Park Steel Services	01724 810810								●	
Steel Projects UK Ltd	0113 253 2171		●							
Steelstock (Burton-on-Trent) Ltd	01283 226161								●	
Structural Metal Decks Ltd	01202 718898	●								
Structural Sections Ltd	0121 555 1342	●								
Struthers & Carter Ltd	01482 795171								●	
Studwelders Ltd	01291 626048	●								
Tekla (UK) Ltd	0113 307 1200		●							
Tension Control Bolts Ltd	01948 667700									●
Trailerpal Ltd	01743 446666							●		
Voortman UK Ltd	01827 63300					●				
Wedge Group Galvanizing Ltd	01909 486384						●			
Wells Protective Coatings Ltd	01302 733611						●			

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

Corporate Members

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

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

Steelwork contractors for bridgework

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

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

- **FG** Footbridge and sign gantries
- **PG** Bridges made principally from plate girders
- **TW** Bridges made principally from trusswork
- **BA** Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
- **CM** Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
- **MB** Moving bridges
- **RF** Bridge refurbishment
- **QM** Quality management certification to ISO 9001

Notes

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

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

Company name	Tel	FG	PG	TW	BA	CM	MB	RF	QM	Contract Value (1)
'N' Class Fabrication Ltd	01733 558989	●	●	●	●		●	●	✓	Up to £800,000 *Operating under CVA*
Allerton Engineering Ltd*	01609 774471	●	●	●	●	●	●	●	✓	Up to £1,400,000 *In administration*
Briton Fabricators Ltd*	0115 963 2901	●	●	●	●	●		●	✓	Up to £2,000,000
Cimolai Spa	01223 350876	●	●	●	●	●	●		✓	Up to £6,000,000
Cleveland Bridge UK Ltd*	01325 502277	●	●	●	●	●	●	●	✓	Above £6,000,000*
Concrete & Timber Services Ltd	01484 606416	●	●	●		●	●		✓	Up to £800,000
Fairfield-Mabey Ltd*	01291 623801	●	●	●	●	●	●	●	✓	Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	✓	Up to £6,000,000
Interserve Project Services Ltd	0121 344 4888							●	✓	Above £6,000,000
Interserve Project Services Ltd	020 8311 5500	●	●	●	●		●	●	✓	Up to £400,000*
Nusteel Structures Ltd*	01303 268112	●	●	●	●	●		●	✓	Up to £4,000,000*
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	✓	Up to £3,000,000*
Remnant Engineering Ltd*	01564 841160	●							✓	Up to £400,000*
Rowecord Engineering Ltd*	01633 250511	●	●	●	●	●	●	●	✓	Above £6,000,000
Taylor & Sons Ltd	029 2034 4556	●	●	●	●	●	●	●	✓	Up to £1,400,000 *In administration*
W S Britland & Co Ltd*	01304 831583	●							✓	*Accounts outstanding*
Watson Steel Structures Ltd*	01204 699999	●	●	●	●	●	●	●	✓	Above £6,000,000

* Denotes membership of the BCSA