APRIL 2005 VOL 13 NO 4

NSC

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The Steel Construction Institute


SPAN
FURTHER

International effort will boost use of steel

Nick Barrett - Editor

News of a major International drive by steel manufacturers to enhance the attractiveness of their products to construction should come as welcome news to UK constructional steelwork designers and contractors (see News). A 10% rise in the use of steel in construction is the aim of the £10M, five-year programme being led by the International Iron and Steel Institute and supported by major producers including Corus.

A range of new initiatives is to enhance the competitive edge of the industry, including market research, technology benchmarking, knowledge management, an international architectural competition and demonstration building. This is all great news. It is in the interests of the UK constructional steelwork industry to have similar healthy industries elsewhere. Steel has been remarkably successful for the UK construction industry and if it were as widely used internationally then we would not so often feel that we are climbing learning curves alone; colleague industries would learn from the UK and pass back to us the benefit of their own lessons. International cooperation and technology exchange hold out great prospects for all constructional steelwork industries.

The UK industry of course has a vast reservoir of accumulated knowledge and experience to pass on already. As BCSA President Tom Goldberg pointed out in his speech at the National Dinner, one of the things that have been learned is that the use of steel is promoted mostly by solid technical knowledge and practice in key areas such as design codes, specifications, fire engineering (see below) and composite construction. All of this is coupled in the UK with an increasingly efficient steelwork contracting industry. Nobody ever has perfect knowledge, however, so the IISI-led initiative should enable any gaps to be at least identified and perhaps filled.

Intumescent success

The marked success of off-site applied intumescent fire protection is not quite hidden away among the other good news of the 2004 Market Shares Survey, but it deserves a bit more attention drawn to it. Few, if any, predicted how successful off-site application would become when a small group of fire engineering specialists, engineers and manufacturers first got together under the auspices of the Steel Construction Institute to produce P160, which has had to be updated after eight years to cope with an unexpectedly rapid pace of change and uptake of off-site application.

The off-site intumescent coating application industry is expected to fire-protect over 70,000 tonnes of structural steelwork this year, which represents about one third of the market for intumescents. There are many reasons for the success of off-site application. There are advantages to be gained in terms of cost, speed, improved safety, and quality control. Quality control will quite rightly be uppermost in the mind of anyone thinking about fire protection, and it is worth noting that the quality control procedures contained in the new model specification are regarded as even more stringent than those which apply on site, which themselves lack nothing in rigour.

Beijing tower for Siemens

Work has begun on a new Chinese HQ for electronics giant Siemens. The Siemens Centre Beijing is a 30-storey, $52,260m^2$ steel tower designed to house 3,500 staff, providing space to bring together existing staff from a number of subsidiaries in the capital as well as accommodating growth. The €100M (£69M) building will be one of Siemens's top 10 global investments. It will comprise a 123m tall tower linked to two five-storey base buildings with courtyards.

Project manager is SIBC, originally Siemens Industrial Building Consultants, a joint venture between the electronics firm and Turner & Townsend. T&T, which also managed the Siemens Centre in Singapore, has since taken full control of the venture. Architect is Taiwan's CY Lee, which was also responsible for Taipei 101, the world's tallest tower. Structural engineer is Beijing Paramount Design Institute.

Demolition of Siemens' existing offices on the site, in Beijing's Wangjing District, has just been finished and the building is scheduled for completion in 2007.

Drive to promote use of steel

Increasing the use of steel in construction by 10% is the aim of a five year €14M (£10M) programme launched by the International Iron and Steel Institute and 11 of its members, including Corus.

The leaders of seven of the steel companies formally signed the agreement in London in February and the first meeting of the group has since been held. Those who signed the agreement in London were Arcelor, BlueScope Steel, CELSA, Corus, Mittal Steel, POSCO, and Tata Steel. The Secretary General, Ian Christmas, signed the agreement on behalf of IISI. The four other companies participating in the programme are Erdemir, IMIDRO, Ispat Industries, and Ruukki.

The new initiative is an opt-in programme for companies active in the construction sector and IISI will continue to try and attract new programme members during 2005. The programme will enhance the competitive edge of steel companies in the construction through a range of new initiatives. These will include market research, technology benchmarking, knowledge management, an international architectural competition and demonstration building.

The programme grew out of the work done by IISI's Steel Solutions and Sustainable Urban Development (Scoping) Project Group, which presented a proposed work plan to IISI's Board of Directors in April 2004. The Project Group demonstrated that there are pockets of construction best practice amongst IISI members. However, no region had fully exploited the contribution steel can make to improved construction.

The first meeting of the participating companies was held from 21–25 February 2005 in Kolkata, India.

Singapore library chooses Corus steel

Corus has supplied structural steel for the prestigious new Singapore National Library, which is due to open in June.

The library, designed by architect TR Hamzah & Young, is claimed to be the most advanced ever built. It is 16 storeys high, boasts an observation pod on the roof, and includes three basement levels and walkway bridges connecting the upper levels.

Corus, as the sole supplier of structural steel, provided a package of structural sections and plates totalling more that 4,500t.

The material was supplied from Corus's plate mills in Dalzell and Scunthorpe, the beam mill at Teesside and the hollow section mill at Corby. Corus achieved an overall fabrication wastage of 8%, considerably better than the 12% that is typical for a building of such complexity.

Bernard Chung, Technical Manager of Corus International Asia, says: "Corus International's precise organisational structure and local support network allowed the project to run successfully through to completion. The local network of offices was able to source urgent requirements from stock within the region."

Buro Happold was consultant, including structural design, for client National Library Board. Maunsell Consultants (Singapore) was civil and structural consultant for the design and build project team, which was headed by main contractor Nishimatsu-Lum Chang.

Steel outlook stabilising

Demand for constructional steelwork is rising and the outlook for prices is stabilising, BCSA President Tom Goldberg told the National Dinner in London on 8 March.

"Steel construction is doing well, despite the 60% price rise in our raw material in 2004, and we are in an environment where our prices are now expected to be much more stable," he said. "Price rises for steelwork in 2005 should be of the order of 5%. Demand in the UK is nearly as high as in the last boom of 1988/89: it now totals 1.3M tonnes, and we are gaining market share in a number of key sectors such as residential, hospitals and education."

Mr Goldberg said prices are now sufficient to maintain a healthy level of investment by BCSA members in areas like machinery and in research and development of innovative products and methods. He added that a range of measures were in hand to make the industry even more competitive, and the industry was committed to finding better ways of delivering service to its customers.

BCSA was also striving for operational effectiveness and efficiency in-house and in the past year a review of the organisation and strategic planning had been undertaken. Sister organisations worldwide had been examined, and new strategies and work programmes instituted as a result.

Guest speaker Mr Philippe Varin, Chief Executive of Corus Group, said construction was the most important market sector for Corus and he aimed to be a value player in steel in construction. Conditions in the steel market were significantly better than they had been for some years. Corus had made a lot of progress recently and a turning point had now been reached. The worldwide demand/supply balance for steel would remain tight as China and other markets grew.

Corus aimed to replicate the success of the UK constructional steelwork industry in capturing dominant market shares in the commercial and industrial buildings markets in other European countries. In the UK residential construction had been identified as a priority for growth. To achieve these and other goals Corus recognised that it had to work alongside its customers.

Mr Varin said consolidation in the steel industry would continue and he expected to see the growth of truly global steel companies. The top five producers in Western Europe account for more than 60% of total steel production; in North America 50% and in Japan, about 80%. But the top five producers in the world account for under 20% of global steel production.

Tom Goldberg, President, BCSA

Philippe Varin, Chief Executive, Corus Group

New Forest, new hospital

Atlas Ward Structures has been awarded a contract to fabricate and erect structural steel for the new PFI Lymington New Forest Hospital in Hampshire.

Main contractor Sussex-based Rydon Construction will work in partnership with associate company and PFI specialist Ryhurst on the £29.8M deal recently signed with New Forest Primary Care Trust.

Atlas Ward Structures will fabricate and erect 500t of structural steelwork and install 8,000m^2 of metal floor decking.

Peter Blewett, Principal Engineer at structural engineer Upton McGougan, said the hospital was designed with a steel frame "because it is a clean, reliable and quality assured product, which can meet strict NHS standards for acoustic insulation and vibration levels."

The hospital, designed by architect Murphy Philipps, is made up of two buildings on a 3.72ha site. The main hospital building includes a three-storey ward building, a two-storey entrance and a two-storey diagnostic and treatment centre. The second building will provide the hospital's energy, waste and management centre. The project is due to be completed in November 2006.

Taking Cobalt to Newcastle

Cobalt 16 is the latest speculative development on Highbridge Business Parks' Cobalt Park development in Newcastle.

The four-storey development provides 9,400m^2 of floor space in two wings around the office core. Barrett Steel Buildings designed, fabricated and erected the 450 tonne structural steel frame for main contractor Bowmer & Kirkland.

The steel frame uses asymmetric beams to provide uninterrupted service zones under the precast concrete planks.

The front façade is constructed from full height curtain walling. This needed special attention at the design stage to eliminate all vertical bracing.

The rear elevation is clad in masonry built around full height windows, with 450x450 RHS sections providing floor and window support. Proprietary stainless steel angles supplied and fixed by Barrett support the masonry.

Architect was Ryder HKS and structural engineer was Cundall Johnson and Partners.

AROUND THE PRESS

Construction News
17 March 2005
The sixth and final section of Heathrow Terminal 5's 17,000-tonne steel roof, fabricated by Watson Steel, was slotted into place by Italian lifting specialist Fagioli earlier this month. The placement is a milestone in BAA's £4.2bn Heathrow project, which has now reached the half-way stage.

Building Canary Wharf (supplement to Building)
18 March 2005
"With structural steelwork, concrete and cladding, we together with our suppliers and contractors have achieved rates of erection not usually seen in the UK." Canary Wharf Contractors Executive Director Dan Frank.

The Structural Engineer
15 March 2005
'Steel construction is doing well... and we are in an environment where our prices are now expected to be much more stable,' announced BCSA President Tom Goldberg at the BCSA's National Dinner. Mr Goldberg said price levels were sufficient to maintain healthy investment in machinery, material handling equipment, computerised systems for design/control/operations, and training and maintenance of an ever-more-competent workforce, and in research and development of innovative products and methods.

Building
4 March 2005
'John Prescott set you a challenge four years ago. Today I set you an even greater one — it is to eliminate all deaths. Why? Because I believe every death in construction is avoidable." — Construction Minister Nigel Griffiths at the 2005 Health and Safety Summit.

Building
4 March 2005
"The UK industry went through a bit of a hiatus between the loss of traditional craftsmanship and the advent of computer technology. Now I think it is fantastic. Contractors that are using computers are doing incredibly good work. Thomas Vale, which worked with us on the Spiral Café at Birmingham, was great." — David Marks of Marks Barfield, designers of the London Eye.

New guide on intumescent coatings

Design and contractual guidance is being provided by an updated model specification for off site applied intumescent coatings, which will be launched this month by the Steel Construction Institute. The new guide — Structural Fire Design: Off-site Applied Thin Film Intumescent Coatings — is a new edition of SCI P160 which was introduced in 1996 and which is thought to have been overtaken by the rapid success of off-site applied intumescent coatings since then.

The off-site intumescent coating application industry is expected to fire-protect over 70,000 tonnes of structural steelwork this year, a success story which has taken many by surprise. The new guidance has been designed to more accurately reflect current standards, procedures and expectations of the structural steelwork industry. John Dowling, Chairman of the P160 Development Committee, said: "The first edition provided a new industry standard for the use of off-site applied intumescent coatings, and by presenting a model specification it was hoped that greater uniformity could be achieved in contract specifications.

"We said at the time that we would update the guidance in line with industry experiences and this revision relies heavily on the input of people from across the sector."

The guide is in two parts. The first part, Design Guidance, concerns handling, storing and transporting coated steelwork and has been fully updated to reflect the experience of the past nine years. The sections on fire protection of beams with web openings, concrete filled hollow sections, connections, composite beams and bracing, reflect the latest thinking. Information has now been included on the protection of partially exposed members.

The second part of the new guide provides Model Specification Clauses for use in the preparation of contract documentation relating to off-site applied thin film coatings. The standard clauses can be modified or omitted as required by the user but most should be capable of use without the need for modification.

The guide will be available to download as a Word document from www.steelbiz.org from 21 April 2005.

Tate's 100 tonne steps

Constructing a 100-tonne steel structure to form the centrepiece of a new exhibition by Sir Anthony Caro at the Tate Modern presented several unusual challenges for steelwork contractor William Hare.

'Millbank Steps', built from 40mm thick weathering steel plate, was made specially for a retrospective covering 50 years of the sculptor's work.

"One of the main problems was how to get it into the gallery," said Richard Branford, William Hare Project Manager. "We had to size the components to go through doors and around corners, so it was fabricated in L-shaped components."

Welding was not allowed in the gallery, so the 35 pieces had to be bolted together. Because the sculptor wanted clean joints rather than visible bolts, the joints are made with 1500 countersunk bolts in drilled and tapped holes rather than the usual clearance holes. The components were sent to a machining shop to be drilled and tapped to the required accuracy.

The floor is too weak to carry the sculpture directly, so it rests on a transfer structure designed by structural engineer Campbell Reith Hill to direct its weight into load-bearing walls beneath. In addition some props have been used, making it necessary to close of part of the gallery's basement café for the duration of the exhibition.

There were no engineering drawings: William Hare worked from a set of drawings used to produce a plastic scale model provided by the sculptor from which it produced a walk-through X-Steel model for approval.

Due to height restrictions in the gallery and to ensure temporary stability of the sculpture, purpose-made equipment was designed. This included a gantry crane running on rails with movement of the frame being achieved by Tirfor winches, and a temporary support frame that allowed fine adjustments in level and plumb.

The programme for erection was three weeks. "We beat the programme by three or four days," said Mr Branford.

New machines boost T5 productivity

Use of "coupled" steel coping and drilling machines in a single production line significantly speeded up steel fabrication production on BAA's Heathrow T5 project.

Steelwork contractor Severfield-Reeve says new Kaltenbach KC1200 and KDX1215 equipment, installed in Severfield's Dalton facility in Yorkshire, enables the beams to be passed through the coper and drill in a continuous process — producing, in one run, beams with holes drilled and profiles cut.

Traditionally these are separate activities, which increases handling and machining time. As well as saving time, Severfield's Steve Snow says the new machines greatly increase flexibility as well.

The T5 fabrication also benefited from new software which uses design files to control cutting and drilling of members to almost any contour and combination of holes, with minimal operator input.

The KDX has three axes with five drill spindles and 11.5kW motors per axis, while the KC1200 coping systems have oxyacetylene and plasma cutting heads capable of profiling H, U and L sections.

The T5 structural elements are among the largest ever produced in Severfield's Dalton plant. Beam flanges are up to 125mm thick and weigh in excess of one tonne per metre.

The T5 structure, designed by architect Richard Rogers, contains approximately 60,000t of structural steelwork, of which 45,000t will be produced by Severfield-Reeve. The remaining 15,000t of complex roof support steelwork is being produced by sister company Watson Steel. The airport is on schedule to open in 2008.

Big in Bradford

Bradford's biggest single office investment for over a decade, No 1 The Interchange, has been completed. Elland Steel Structures supplied and erected 680 tonnes of steelwork and 8500m^2 of metal decking for the £12.5M scheme in the city centre, built on the site of an old bus depot. It will provide 5,600m^2 of prime office space, most of which has been taken by the Inland Revenue.

Tight planning provides key to Stroud Centre

Just in time delivery was a crucial factor in the erection of steelwork for a retail development in Stroud.

Conder Structures had a tough 12-week deadline to erect 800 tonnes of steel on a tight site for the £8.7M Merrywalks Centre. The centre will provide 10,000m^2 of retail and leisure facilities near the Gloucestershire town's historic commercial centre.

Conder Managing Director Gordon Ridley said: "We've done a number of town centre jobs and one of the difficulties is that it's always a confined site. You can't deliver the steelwork and leave it till it's needed. It required careful planning with delivery to site on a just in time basis."

Mr Ridley says that the ability to handle complex logistics "is a skill you have to develop". He added: "Not only did we have to fit in with Costain, the main contractor but right down the supply chain our suppliers had to work on the same basis. It was vital to the success of the project."

NEWS IN BRIEF

Radio and TV presenter John Humphrys has been confirmed to chair the panel discussion on the future construction market at the Steel Construction Conference and Exhibition, to be held at The Brewery, Chiswell Street, London in November.

The Respect for People code of practice, launched at the recent 2005 Construction Health and Safety Summit, has been developed to help the construction industry achieve the targets for injury and ill-health. The targets, set out in the Revitalising Health and Safety programme launched at the 2001 summit, are to be achieved in 2005 and 2010.

Metsec has released an updated version of its LatticeSPEC design software for its range of lightweight steel lattice joists and trusses. The program designs parallel, pitched and tapered trusses but now includes the company's curved beams and curved truss ranges as well. The software is available free on the new MetSPEC 2005 CD.
Lattice_joists@metsec.com

The British Stainless Steel Association has added two modules to its RIBA approved seminar programme. *The Structural Design of Stainless Steel* is aimed at structural engineers and architects and provides practical guidance on design principles, material properties and grade selection. Stainless Steel in Swimming Pools outlines the principles of good design and material selection, with advice on avoiding possible pitfalls.

Lloyd Instruments has demonstrated the ability to automate tensile strength testing of metals at high temperature and at the end of a temperature conditioning cycle, by linking its 100kN LR100K materials testing machine to two furnaces. Any number of heating and cooling cycles can be run automatically. At the end of the cycling process the system performs tensile tests on the sample without intervention from the operator.
Further details: 01489 486399

NSC welcomes letters from readers on steel construction related issues. Please keep your letters brief — the editor reserves the right to condense. Address your letters to: The Editor, NSC, BBA Linden House, Linden Close, Tunbridge Wells, Kent TN4 8HH. Fax: 01892 524456. e: info@new-steel-construction.com

Intumescent quality finish

Having had the opportunity to go around and photograph the Wellcome Trust building, I was particularly interested to read your article (NSC March 2005).

I can attest to the very high standard of the detailing and finish, which is only indirectly referred to in your article. It is sometimes said that the use of an intumescent paint is not conducive to a high standard of finish on the columns. I believe that this building disproves this assertion. The column finish was excellent. I am told that the fact that the circular column hollow sections were filled with unreinforced concrete, allowed the intumescent to be of minimal thickness and to go on in one coat, just like any other paint. That such thin coats can still give a one hour fire rating seems to me of great significance to architects, principally because of the superb finish that can be achieved but also because of the cost savings.

Andrew Calland
School of Engineering, Northumbria University, Newcastle upon Tyne

Lessons to learn from overseas

I read with interest Derek Tordoff's comments (NSC March 2005) on the worldwide market development activities in steel construction and the consequent decline in the use of concrete. In France we also have a comprehensive market development programme under way for steel construction which is resulting in increased market share against concrete in many sectors including multi-storey buildings and bridges. There is significant growth potential for steel in construction across the whole of Europe. As part of this programme, together with the European Convention for Constructional Steelwork (ECCS), from 20–21 September we will be holding an International Symposium on Architecture and Steel in Nice. Delegates from the UK would be most welcome to attend; the presentations will be given in English. Further details can be found from beginning of April at www.scmf.com.fr

Jean Louis Gauliard
Secrétaire Général du Syndicat de la Construction Métallique de France – SCMF

Concrete fire tests needed

Recent events at the Windsor Building in Madrid are a timely reminder that nothing can be taken for granted. The near collapse of the building in a fire which, although of long duration, did not appear to reach the temperatures under which materials are normally tested, indicates that the margins of error and levels of conservatism under which we often assume we operate may not always be valid. The fire has also shown the importance of getting all fire precautions installed correctly, and how a relatively small error such as the reported absence of fire stopping between the floors can have potentially catastrophic consequences. We have been concerned at this state of affairs in the UK, and it formed a part of the report from a Partners in Innovation project in 2003.

Of even greater importance, however, is the fact that the fire also raises questions about the behaviour of the building frame. This is understood to be reinforced concrete, a material which is believed to behave well in fire. However, I am aware that in recent years troubling questions have been raised as to whether this reputation is fully justified, and a number of fires such as that in Madrid, the Channel Tunnel and others which have led to concrete frame collapses have led to calls for a reappraisal of the situation. In particular, I am now finding widespread agreement that phenomena such as excessive spalling and thermal expansion of floors are causing particular concern and are not sufficiently well understood. For example, any reliance upon "membrane action" is something that requires more understanding.

I would like to add my voice to those who have expressed apprehension and call on the concrete industry to dispel these concerns through a commitment to large scale testing, similar to that carried out by the steel construction sector over the past decade.

David P Sugden
D P Sugden & Associates Ltd

No car park vibration issue

On reading your two articles regarding steel-framed car parks in NSC March 2005, I noticed that the question of vibration was not discussed. Please could you advise me if there are any reference documents regarding this ?

Matt Scolin
Bone Steel Ltd

The editor replies: The recently issued "Steel-Framed Car Parks" 3rd edition from Corus Construction & Industrial contains information on dynamic performance in steel-framed car parks. In it advice is given on response factors for car parks and results of a study of nine steel-framed car parks constructed over the last 15 years where no adverse comments about dynamic behaviour had been noted.

This section of the design guide concludes "The study shows that the traditional natural frequency value of 3.0Hz can be maintained for design, and used with confidence". A copy of this design guide is available from Corus literature hotline on 01724 404400 or via the website www.corusconstruction.com.

You may also be happy to hear that a revised and updated edition of the SCI design guide "Design guide on the vibration of floors" (P076) is planned for later this year. This complements the publication in 2004 of "Design Guide on the vibration of floors in hospital" (P331) also by the SCI.

Diary

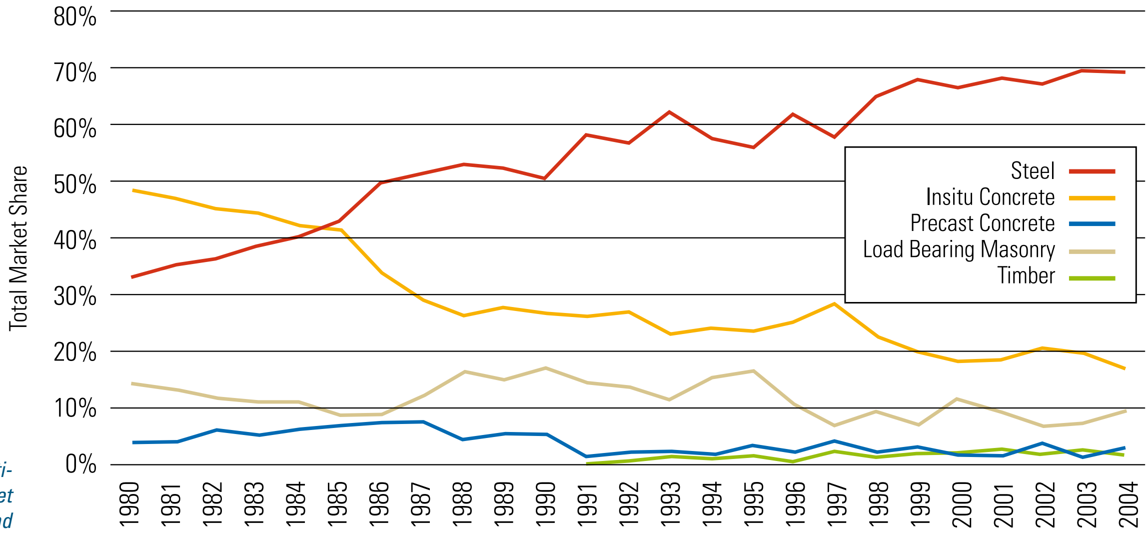
21 April **Launch of SCI P160, Model Specification for Off-site Applied Intumescent Coatings**
See page 8. National Liberal Club, Westminster, London,
Contact: Janice Radford, 01724 404863
email janice.radford@corusgroup.com

4-5 May **Steel bridges designed to BS5400** Inchyra Grange Hotel, Falkirk
Corus course covering common steel bridge forms, the code basis for loading, design of key elements, fatigue design and connection detailing.
Jane.parkins@corusgroup.com

23 June **Structural Steel Design Awards Luncheon** Savoy Hotel, London.
Winners of the 2005 awards, sponsored by Corus, the BCSA and the SCI, will be announced. Contact: Gillian.Mitchell@steelconstruction.org

20-21 September **Architecture and Steel International Symposium**, Palace de la Méditerranée, Nice (part of the ECCS 50th anniversary event). Presentations will be given in English. Further details available at www.scmf.com.fr

Concrete market crumbles



Steel's share of the multi-storey frames market remains on a rising trend

The 2004 Market Share Survey confirmed the dominance of steel as the constructional framing material of first choice in the key sectors of the market, as developers and designers continued to turn away from lower-tech alternatives like concrete. Nick Barrett highlights some of the strongest market trends.

One of the most encouraging features of the 2004 Market Share Survey was that in the major growth sector of high rise residential, steel was winning market share. In a market which had grown from 1% of the total accommodation starts in 1999 to 11%, steel has seen its market share increase from 39.4% to 43.5% in a single year.

The number of steel-framed apartments has doubled since 2003, with steel frames used for over 10,000 high rise apartment units in 2004, compared with less than 5,000 units in 2003. These tend to be prestige developments, often waterfront, and the good news is that despite all the worries about the broader housing market, apartment building still looks like being on the increase — and a large proportion of new building will be multi-storey. With the competitive position regarding steel versus concrete frames unchanged by rising steel and cement prices, steel can expect to continue the recent trend of capturing market share as developers latch on to other benefits of steel — not the least important of which for the housebuilders is construction speed and being able to catch windows of market opportunity.

A number of factors have come together to create this rising demand for high rise accommodation. The house buyers' view of high rise living seems to have undergone a sea change in the past few years. There has been a marked increase in the popularity of city centre living and as people return to towns they are demanding apartments rather than the terraced houses or tenements of the past. An increasing amount of this is being provided in multi-storey structures.

According to a survey by property consulant Savills, there are over 87 high rise blocks of over 20 storeys either under construction or planned across the UK. As well as providing around 19,000 housing units, they will give great views across cities or rivers, and they are being built with car parks, gyms and other features. These signature buildings are a far cry from the public sector high rise failures of the past, and are the most visually arresting part of the urban renaissance of the UK's major cities.

Government policy of encouraging brownfield developments rather than building new homes in the countryside has been a factor in encouraging these inner city, high rise residential developments. Although London will be the focus of the action, hardly a major city does not have a major development or two in the pipeline.

The growing popularity of multi-storey residential blocks is a trend which favours steel

Of those identified by Savills, 49 were in London, but almost 25% were in the North East and North West. Towers are expensive to build; according to data from cost consultants construction costs rise markedly between 20 and 40 floors. As the building's height rises so does the need for foundation strength, and the relatively low self weight of steel helps swing the cost argument further away from concrete.

This is a market which is usually thought to depend to a crucial extent on cost. As Savills' survey pointed out, for the tallest residential buildings of over 50 storeys a developer needs to achieve sales values in excess of £425 per sq ft, which may explain why relatively few tall residential towers have been developed in the past. Savills says that in spite of this, many developers turn a blind eye to the finances as there is an acceptance that a signature building can offer help in promoting a large regeneration scheme. "It may not make the developer his fortune, but the marketing and awareness that it generates for the scheme as a whole, far outweighs any loss in the overall profit margin," Savills argues. Still, we can be sure that price is still in the equation somewhere, which suits steel.

There have been misleading press reports that post-tensioned concrete slabs have doubled their volume in terms of floor area over the past two years and taken share from steel frames. But as the Construction Markets survey shows, the volume of high rise apartments has risen substantially, from 3% of the residential market in 2002 to 11% in 2004. Post-tensioned concrete volumes may well have increased in absolute numbers, but this simply masks the fact that steel frames have also gained, not only in volume but also in market share at the expense of concrete alternatives.

Trends are also running steel's way elsewhere. What was marked in the 'all multi storey non-residential buildings' category was the continued lack of market interest in concrete for frames there. Steel's market share increased to 69.2%, with in-situ concrete down to 16.8%, its lowest level since the survey began in 1980.

The concrete collapse was also marked in multi-storey offices where steel extended its dominance with a share of the market, defined by floor area, of 71.7%, while insitu concrete saw its share of offices fall to 20.9%, from 23.3% in 2003.

In the 'other multi-storey buildings' category, which includes retail, leisure, education and health buildings steel enjoyed a 68.2% market share with insitu concrete being used on just 15%, down from 17.5% in 2003. Load bearing masonry saw its share of these sectors rise to 11.2% from 8.4% in 2003.

Of particular note in steel framed multi-storey non-residential buildings is the continuing rise in the use of intumescent coatings for fire protection. In 1995, around 10% of steelwork in multi-storey buildings used intumescent coatings; in 2004 that figure has risen to 65%. The steel industry's commitment to research and development into steel's fire performance has led to an engineered approach incorporating intumescent coatings becoming the industry standard, with significantly reduced costs and improved safety. Fire performance was once regarded as steel's Achilles Heel, but the improved understanding that has been developed through focused research is now turning it into something of an advantage, particularly when compared with in situ concrete — where designers are increasingly recognising that it is a mistake to consider concrete as inherently fire resistant.

Curved steel boosts creative design

Steel bending specialists have invested in research and development for new equipment that is giving designers greater freedom to express their creativity using curved steel. Nick Barrett visits market leader Barnshaws Steel Bending.

Reverse bends in the same section can be created to reduce the welded joints. A straight section in between the curves is usually needed.

Not only is Barnshaws the biggest steel bending company in the world, it can now do the biggest bends thanks to investment in developing new equipment. Architects and engineers can now routinely use curved steel in ways which were not possible 10 years ago, thanks to advances in bending technology.

Investment by companies like Barnshaws means that bends are more economical than ever before — a bend for a rafter might cost only £65. The same investments mean that the highest quality is now routine, with bend tolerances to ± 2mm. Joints and welds are increasingly disappearing as curves become more common. "Curving is often less expensive than cut and weld," says Managing Director Craig Barnshaw.

"We take on the difficult jobs, for example putting six or seven bends in a single sheet. A lot of fabricators can do the simpler jobs themselves, but none have the capability that we have with our machines. We start where most fabricators have to finish, because we have the tooling. We can bend anything that Corus makes." For the tightest bends Barnshaws insists on using Corus steel for quality reasons. "Not everything that people source is suitable for bending," says Barnshaw. "Some imported steel for example is presented as High Grade, but what they do to make it high grade sometimes makes it harder to bend."

Barnshaws today employs about 200 at its six UK sites and turns over some £12M for a surprisingly large number of customers — 4,000 live accounts at the moment — ranging from Corus through to fabricators of all sizes to manufacturers of mirror frames and napkin rings. "It is amazing who needs steel to be bent to precise tolerances, but the structural steelwork industry offers us our biggest challenges," says Barnshaw.

The turnover from bending has remained relatively static in recent years but the demand from construction has risen as other customers, such as manufacturers of gear casings, have moved production from the UK to Eastern Europe.

Barnshaws undertakes section and tube and hollow section bending as well as universal beam cambering, tee splitting and straightening, press braking and shearing, and plate rolling. Aluminium extrusions can also be curved and Barnshaws Specialist Profiles Division cuts shapes for architectural supports, stiffeners or features.

Sections and shapes can be designed on AutoCAD and the drawing e-mailed to Barnshaws for manufacture. Multiple radii can be used as shown in the picture.

The growth in tubes and box section curving for buildings and bridges has been marked: "Ten years ago we saw very little of that, but in recent years this has changed," says Barnshaw. "Now we can bend tubes in three dimensions or bend on different axes. We can bend sections to a tighter radius than before as well. Before we may have needed a 10mm thick section but now we can bend 5mm thick sections to the same radius, which cuts material costs."

With price pressures on fabricators, there is an increasing need to reduce the weight of structures. Barnshaws is constantly reducing the radius of sections which can be curved. As a result designers can use lighter sections and reduce the total weight and associated costs like foundations.

Growth is also being seen in the cold rolled market as lighter weight sections are increasingly used in growing markets like off-site. Curved steel usually has high visibility and is seen commonly on new stadiums, a market which continues to expand. Growth is also coming from wherever clients are demanding clear column-free spaces.

Though it is most obvious in high profile structures such as stadiums, the trend to larger spans is apparent in buildings as well. Many designers prefer hollow sections for aesthetic reasons, and as architects become more adventurous in their designs the demand for bending heavier sections increases. This is where Barnshaws' new bending machine comes into its own. It can bend sections with an elastic modulus of up to 84,000cm^3, three times the previous maximum section depth.

"Larger parts of buildings are now being curved, not just the feature parts," says Barnshaw. "At one time, not many architects designed using curved steel, but the spread of computer aided design and associated software means that being able to do the calculations for curves is now common."

The pace of change has been rapid recently. Barnshaw says that the Gateshead Millennium Bridge, which has a lot of steel curved by induction bending, might not be done that way now. "Our new method of cold bending sections offers greater flexibility to fabricators."

The new machine is believed to be the world's biggest bending machine, costing some £750,000 to develop, and is finding ready applications in growing markets. Installed only in November, by March is was already fully booked until summer. The machine underwent testing during last year and has already completed two contracts. It is capable of bending tubes up to 60" or 1524mm diameter x 60mm thick. Typical applications will include stadium roof structures and bridges.

Cold bending has the advantage that the section can be pre-painted, and doesn't have to be heat treated afterwards. "Anyone can bend a section using brute force, but maintaining the section at the same time is much more difficult. We've spent a lot of money on achieving that," says Barnshaws Commercial Manager Greg North.

Previously, the other options for bending large sections were hot bending or induction bending. Hot bending entails heating the section to 1000°C, at which point its strength falls to 5% of its normal yield strength allowing it to be bent easily. But when it cools the yield strength is reduced and heat treatment is needed to get back to the original strength.

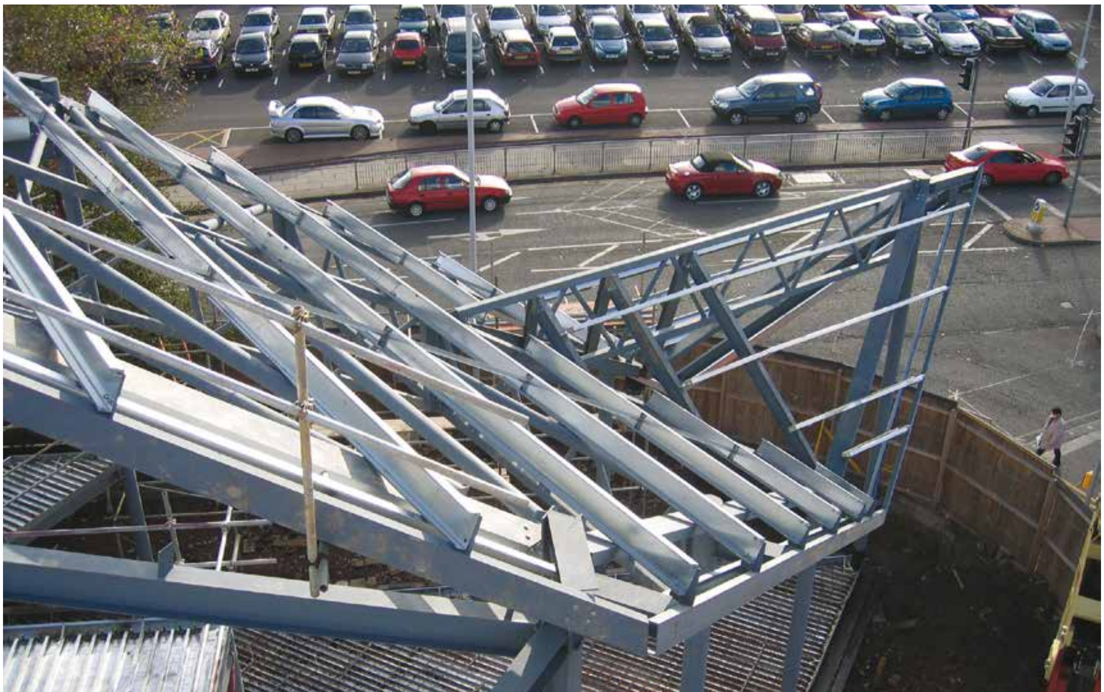
The new machine undertook its first job last September when it was used to bend a 457 x 152 x 82kg universal beam to an inside radius of 5534mm, considerably tighter than possible with cold bending previously. It is currently being used on 1000mm diameter, 45mm thick circular hollow sections for Newport Street rail bridge in Bolton, believed to be the world's biggest cold bend tube to date. This is a parabolic arch designed by Cass Hayward and fabricated by Watson Steel. The tightest part of the bend is 8.4m radius. There is no limit on the length of section that can be accommodated.

Barnshaw concludes: "This capacity cannot be achieved anywhere else. We lead the world in this area of bending.

"But it's important for clients to know the limitations of what we can bend and the impact it might have on the geometry of what they're proposing, so they should involve us at an early stage. We're trying to get it into people's minds that much more can be done than ever before, and that they shouldn't design on the basis of what the limitations used to be."

(Guidelines for architects and engineers as to what is technically possible can be found on the Barnshaws website: www.barnshaws.com)

Savings can be made in the fabrication process with the bending and folding of steel plate to eliminate welding. Plate up to 12,000mm long and 100mm thick can be folded. Common applications include flanges for fabricated beams.



Atrium poses 3D puzzle

The striking kite shaped atrium had to be modelled in 3D to define connection points to the main building

Virtual walkthrough software proved to be an essential tool in the detailing and fabrication of steelwork for the striking atrium at Birkenhead's new community based Lauries Centre. Paul Wheeler reports

North Wales based EvadX erected and fabricated all the structural steelwork on the new £3M Lauries Centre, which is taking shape in Birkenhead.

Visualising and detailing the Wirral community centre's atrium provided a few headaches for the design team — or would have done had 3D software not been available.

The Wirral Council funded centre will provide office space for up to eleven community-based organisations, a conference and function hall and a community café. EvadX's £350,000 structural steelwork order includes just under 250t of hot rolled steel and a further 10t of cold rolled secondary steels.

The striking building, structurally designed by consultant Williams Jones & Partners and built by main contractor Lockwood, features an inclined three-dimensional diamond or kite shaped atrium that connects the structure's two and three storey side wings.

The centre is designed to be environmentally efficient and sustainable, in that it includes self-cleaning windows, solar power and boasts high energy efficiency.

The atrium's frame measures 27m from tip to tip and 14.5m across, and at its highest point is 18.5m from the ground. The pitch of the atrium's roof varies from 33° for the main section to 58° for the smaller frame which intersects the main roof of the atrium.

Structurally the atrium works like a cross, says EvadX's Drawing Office Manager Andrew Roberts, and the challenge is all in the shape. It is made up from three trusses, fabricated and assembled at EvadX's Kinmel Bay facility in Rhyl, transported to site and then bolted together.

As EvadX Managing Director Simon Adams says: "If you were to take out the atrium, the building would be a standard, basic frame. But the atrium was both difficult to detail and make."

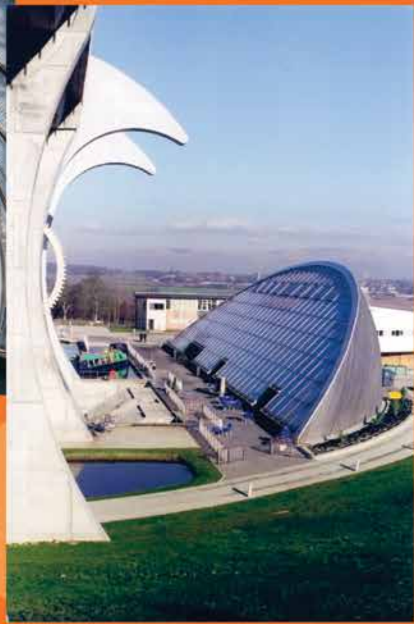
The company was unquestionably assisted in this task through the use of the latest version of AceCAD's StruCAD design software, which in version 10 includes a walkthrough graphics facility.

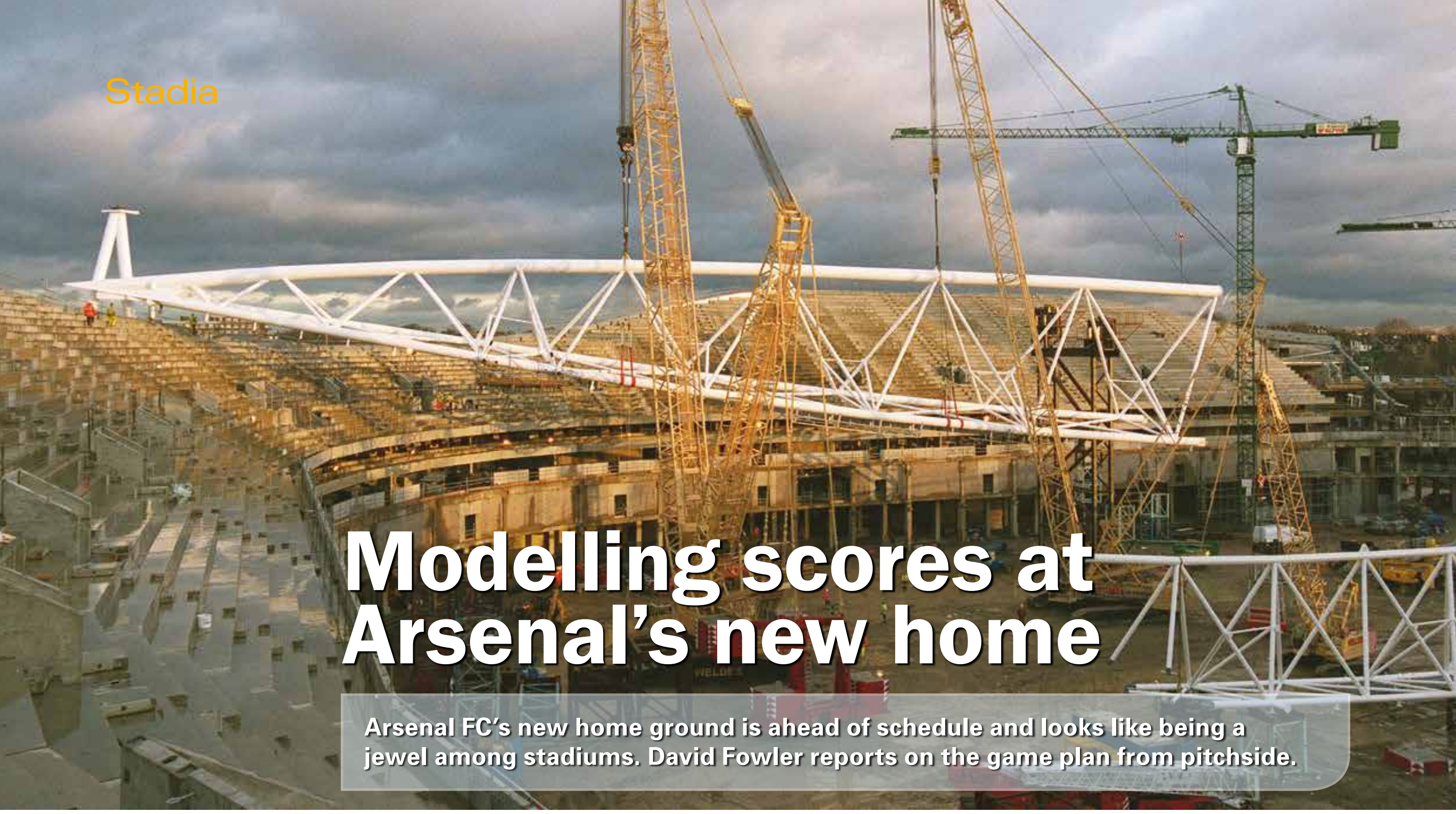
"The atrium is so unusual that is was initially difficulty to translate the architect's ideas into workable structural designs," says Roberts. "But through StruWalker, we were able to create a walk through the atrium, showing the connection points and developing the design. Without the software, this would have been very difficult."

Andy Dickinson, Project Engineer with structural engineer Williams Jones & Partners goes further: "Because you've got orthogonal converging angles it was very useful to see it in three dimensions. It meant we could talk through and modify the designs on screen and in one case this identified that the two-dimensional plans did not quite fit in. Without StruCAD it would have been a nightmare to visualise and we would have spent a long time agonising over the detailing."

The proof of the pudding is in the eating, so it was a great relief that once on site the atrium was erected without drama. As Adams points out: "With tolerances of just millimetres, there was nothing to play with."

In fact the design and fabrication of the Lauries Centre atrium proved so unusual that EvadX has submitted its model to StruCAD developer AceCAD's annual international design competition.





Modelling scores at Arsenal's new home

Arsenal FC's new home ground is ahead of schedule and looks like being a jewel among stadiums. David Fowler reports on the game plan from pitchside.

Each section of a primary truss weighs 350 tonnes

Elliptical bowl was the most efficient fit for the awkwardly shaped site.

Self-effacement is not a quality normally associated with a stadium — nor with professional football in general. But for Arsenal's new home ground it was essential. The Emirates stadium is only 0.5km from Highbury, the club's revered home of 92 years, in an area of dense Victorian housing, and gaining planning approval was not a straightforward task.

"It's quite unlike Wembley: it's all about being discreet — for a 60,000-seat stadium," says architect Christopher Lee of HOK Sports Architecture. The Emirates stadium's 46m height would fit three times under the new Wembley arch.

Even a 46m high structure is going to be noticeable. It's likely, though, that Emirates will come to be thought of as a jewel among stadiums, very much in the tradition of Highbury, whose Art Deco east and west stands are listed structures.

Finding a site in the inner city so close to the club's existing home is a minor miracle in itself but it presented a number of construction challenges. The triangular plot is bounded on one side by the East Coast Main Line railway and on the other by the Network Rail line from Moorgate. The PIccadilly and Victoria tube lines run under the railways and a main Thames Water sewer crosses the site from east to west.

The site was most recently used for light industry. Watson Steel Structures is currently welding together the second halves of two primary roof trusses on what will next year be the pitch but last year was a working waste recycling station attracting 200 lorries daily. This waste transfer station continued, fully operational, from the start of construction last February until a new centre, built as part of the project, was ready in August.

Nonetheless, just over a year into the contract and with around 15 months to go, progress is impressive. The north stand superstructure (which is steel for the top tier and reinforced concrete at lower levels) and the north half of the steel roof are well on the way to completion, though at the other end things are less advanced, because of the lack of access. And two steel bridges to carry pedestrians from the nearby stations across the rail lines to the stadium, the bigger one weighing 380t and measuring 22m wide, were lifted into place last autumn.

Construction of the roof is ahead of schedule. Sir Robert McAlpine Project Director Rolv Kristiansen, a veteran of high-profile projects such as the Millennium Dome, says: "We set ourselves a tough programme for 2004 deliberately, and lifted the roof trusses in December, rather than January as planned."

For the form of the stadium, the architect adopted an elliptical bowl with seats all round as the most efficient way to fit the stadium into the site. The roof, the stadium's most impressive feature and with a plan area of 26,000m^2, has a "billowing" or saddle-shaped inner edge, which derived from the elliptical plan. The main roof structure consists of two primary trusses spanning north-south between 11m high tripod supports at each end, two secondary trusses spanning between the primaries, and tertiary trusses spanning between the primaries or secondaries and a perimeter truss.

The roof slopes down towards the pitch so that the 15.5m deep truss at the front will be more or less hidden from the outside. The view will be uninterrupted by columns, and a great deal of work has gone into optimising sightlines from all seats. Because of the slope of the roof, rainwater has to be pumped back up the slope from the front.

The primary trusses are being erected in two halves, each 102m long and weighing 350t, with the first halves already in place, spanning between a tripod and a temporary trestle at mid-span. Each 100m secondary truss weighs 100t, while the longest tertiaries are 52m and 37t. The top boom of each primary is formed from 1.2m diameter cold formed circular hollow section.

Buro Happold Project Leader Geoff Werran says: "We worked closely with Watson Steel to make sure temporary stability was OK at every stage."

Use of circular hollow sections makes individual members inherently resistant to lateral buckling. All the trusses are three-dimensional with a triangular cross-section, which gives them built-in stability against lateral-torsional buckling.

"When built, the roof members stabilise each other," Werran continues. "The secondaries stabilise the primaries, and even the tertiaries contribute to stability."

Werran adds that "huge investment" in producing a 3D X-Steel fabrication model of the entire structure has paid off: "Producing the model can be quite a painful process — you can't do it in a piecemeal way, you have to have everything detailed for it to work, but it paid off in fit-up."

Watson Steel Structures director Peter Miller says: "We do a 3D X-Steel model for every project now. All the cutting, drilling and burning is done electronically. But on this particular job it would have been very difficult if not impossible to resolve the geometry in any other way."

This is partly because the roof structure is curved in two directions, but also because of progressive deflection as it is built.

"As we build the roof it changes shape. We have to predict the change of shape as we build it so each element will fit." This consequently means that the model has to be set up knowing the sequence of construction. "We spent a long time working with the architect and engineer to get information up-front before starting the manufacturing process."

Mr Miller says this will pay dividends again later because all the necessary brackets for loudspeakers and ancillary components are already detailed and fitted, avoiding possible delays and the additional cost of having to go back and retrofit brackets 40m above ground after the structure has been erected.

Mr Miller adds that collaboration was facilitated by a two-stage tender process by which Sir Robert McAlpine was appointed but did not have to confirm a final price until the design was almost complete. The same applied to subcontractors.

"We were involved in discussions on design, manufacture and programme for two years. By the time we had to submit a final price we'd already solved most of the problems," he says. The contract was then signed as a fixed lump sum.

To illustrate the benefit Mr Miller cites the main trusses. "Working with McAlpine we identified 16 possible erection methods. We weren't sure which was the optimum. We developed a programme and cost details and a list of pros and cons for each, then agreed which would be best for the project as a whole.

"The one chosen was one of the most expensive from the steelwork aspect but saved many months on the overall programme. We wouldn't have offered that on a normal lump sum tender because we may not have won the job."

Highbury is renowned for having the best pitch in the Premiership and much thought has gone into emulating this in the new stadium, with comparative studies being undertaken between the existing and new pitch microclimates. The low overall roof height, allowing plenty of light through, will be the biggest contributor to the pitch quality. The expert view is that the natural microclimate of the new pitch will not quite match that of the old, because the existing stadium has open corners, but that it will be as close as possible.

Meanwhile work continues towards the target of opening in time for the start of the 2006 season. Even after the structure is finished, commissioning the complex IT and ticketing systems and training Arsenal staff in using them will be considerable tasks.

So the collaborative spirit on the project, and the fact that Mr Miller expects the second half of the main trusses will be ready to lift by Easter, with a probable mid-April lift date, can only be good news. He says: "We set out to try and beat the target on the north end and put ourselves in the position that if the civils work was ahead we could take advantage of it. We're hoping to do the same with the south end."

The roof slopes down towards the pitch to maximise light.

FACT FILE
Client:
Arsenal Football Club
Architect:
HOK Sports Architecture
Structural Engineer:
Buro Happold
Main Contractor:
Sir Robert McAlpine Ltd
Steelwork Contractor:
Watson Steel Structures Ltd
Steel Tonnage:
3000t in roof
Project Cost:
£357M
Due for Completion:
July 2006

Tripods 11m high support the main trusses

Palestra's dramatic overhangs reflect the reality of commercial office rents

Dancing columns at Waterloo

A new London office development in Southwark challenges some of the preconceptions of what a building should look like and presented a few challenges to the structural design team, as David Fowler discovered

A framed letter from a worried member of the public hangs in the site office of the new Palestra development near Waterloo in London.

The writer, probably one of the thousands of commuters who pass the Southwark site every day travelling into or out of Charing Cross, wanted to alert the contractor to a serious problem of workmanship which appeared to be afflicting the structure. The ground floor columns, the writer pointed out, were drastically out of plumb, to an extent easily visible to the most casual observer.

However disconcerting this may at first appear, though, the raked columns at the first and seventh storeys of this new speculative office development are intentional. And what architect Will Alsop describes as 'dancing' columns are by no means the building's most dramatic feature.

There is also the external treatment, which divides the 12-storey building into two masses, one box on top of another. The upper box, consisting of the top three stories, cantilevers 1.5m beyond the lower one on three sides — and by a huge 9m, overhanging Blackfriars Road, on the fourth.

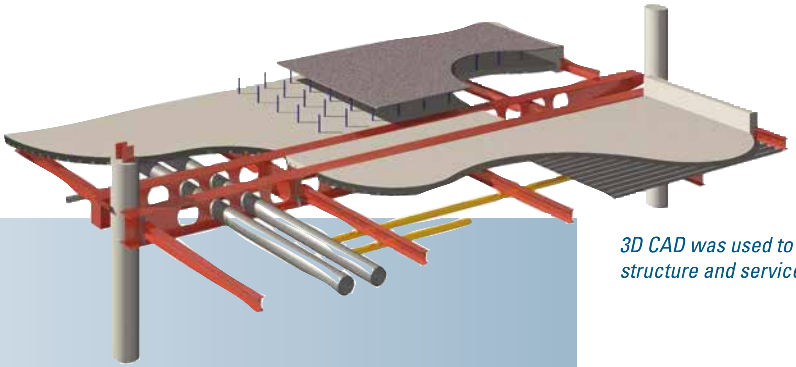
Then there is the curtain walling, the bottom edge of which is on a slant so that it rises from ground level at one end of the building to a height of two storeys at the other.

The £68M, 37,098m^2 gross project, which began on site in January last year, is being developed by Blackfriars Investments and Royal London Asset Management, with Skanska as main contractor. Steelwork contractor is William Hare.

Its unusual features are not simply whims of the architect. The 9m cantilever arises from moving the entire top three storeys over by one grid square for planning reasons, to avoid overshadowing nearby residential properties. The extra 1.5m all round the top storeys recognises the fact that space on upper floors is more desirable and commands a premium rent. The edge of the curtain walling rises to provide public space and an area for a coffee bar at the corner of the building facing the pedestrian route from Southwark tube station to the Tate Modern.

All this provided a number of challenges for the structural design team, Buro Happold. The dancing columns lean over at varying angles and in two directions, inducing horizontal forces at the top and bottom of each. "We paired them so one leaning one way is balanced by one leaning the opposite way somewhere else," says Buro Happold Partner Stephen Brown. The balancing columns are not placed adjacent to each other so that this is not obvious, he adds. But even though this balances

Enlarged holes in the web made service installation easier.



3D CAD was used to model structure and services.

Composite cell beams speed services

One of the factors contributing to Palestra's structural efficiency is the use of cellular beams for the floors, acting compositely with the insitu concrete floor slabs. Rather than the floors resting on the top flange of the beam, as is usual, the flange is cast into the slab. This results in more effective use of the steel, gives greater load carrying capacity in the same structural depth, and removes the need for shear studs.

In a fire, it reduces the ratio of the heated perimeter of the beam to its section area. This means that a single coat of intumescent paint applied off site, rather than two, can be used. This costs roughly the same as boarding, which is more easily damaged and less attractive aesthetically.

Also, because the depth of the cell beam is greater, the holes in the web through which services pass can be made bigger. In this case, this meant an increase from about 350mm to 430mm in the openings, allowing more room for the ducts and associated fire protection and also the operative's hands, making for a quicker, more efficient service installation. "That's very important — it's real money in a speculative building," says Mr Brown.

the horizontal forces, a twist is still imparted into the floor slab.

"Understanding the twist put into the building was an important part of the design," says Mr Brown. "Both the ground and first floors have to work quite hard to hold the columns."

Between the first to the seventh floors everything remains vertical. Then there is another tier of two-storey dancing columns, compounded by the fact that at the ninth floor the grid changes from a 10m x 7.5m module to 12m x 7.5m because of the 1.5m cantilever all round. "None of the columns meet the columns above at all," says Mr Brown. Moreover, the whole ninth floor is offset by 7.5m to the west. "It causes an interesting twist at the seventh level, plus the overturning effect of the cantilever."

The overturning force induced by the 9m cantilever is considerable: 20 times the average wind load, to be transferred into the stair and lift cores, which use conventional steel K-braced frames.

Buro Happold Associate Andrew Lacey adds: "The 9m cantilever is more or less plugged on to the side of the building. The architect wouldn't allow any visible diagonal bracing, and planning restrictions on the height prevented any structure to suspend it from above roof level."

A solution which would work within the existing floor depths had to be devised, and the result is a fully fixed Vierendeel girder from the ninth to the 12th floors, tied

Lifting in the 9m cantilevers required a partial road closure.

FACT FILE
Palestra
Project Value:
£68M
Net Office Space:
26,400m^2
Client:
Blackfriars Investments and Royal London Asset Management joint venture
Architect:
Alsop Architects
Main contractor:
Skanska
Steelwork contractor:
William Hare Ltd
Structural and M&E Engineer:
Buro Happold

back to the primary core. It is made up of very substantial plate girders with flanges typically made from 70–80mm plate.

"There's as much steel in the ninth floor as in the third to sixth put together," says Mr Lacey. This tends to obscure the fact that the basic steel frame is otherwise very efficient. Even with the cantilever, the weight of steel is a respectable 75kg/m^2

Buildability has been a primary concern on the project, given that the site is bounded by roads, the main railway line from Charing Cross and the Jubilee Line underground. "Because of the railway, roads and tube, the building is designed around understanding the contractor's problems," says Mr Brown. Any crane lift of more than 8.5 tonnes is deemed a 'controlled lift' requiring special supervision by Network Rail personnel, so the building is designed to be constructed without exceeding this limit.

The composite steel columns are designed to be structurally efficient, light to lift, and easy to erect (see box). Column splices need just four bolts. The 508mm hot finished circular hollow sections are grouted with concrete after construction, providing two hours fire resistance. The steel section alone is enough to cope with dead loads, however, so erection of the steel frame can continue leaving the grouting to be done later and taking it off the critical path.

Unless high winds intervene to prevent the cantilever steel being lifted into place, steelwork erection was on target for completion on schedule in March, with overall completion scheduled for summer 2006. The finished building will be ideally placed to whet the appetite of fans of modern design on their way to the Tate Modern — provided they aren't too nonplussed by the dancing columns.

The efficient design includes composite cell beams and CHS columns

The column layout of the top three storeys bears no relation to the floors below

Deep cellular beams have large holes for ease of fitting services

Installing the steelwork for the cantilever over Blackfriars Road

Clean, circular and composite

A great deal of innovative thought has gone into the composite columns and their connections with the floor beams. Composite construction, using circular hollow section columns filled with concrete, is efficient both structurally and from a fire resistance point of view. The concrete acts as a heat sink to conduct heat away from the fire. Because the concrete is confined within the steel tube, it cannot fail by bursting (which is why this approach is used in design to resist earthquakes). The overall column size is kept compact and no external fire protection is needed.

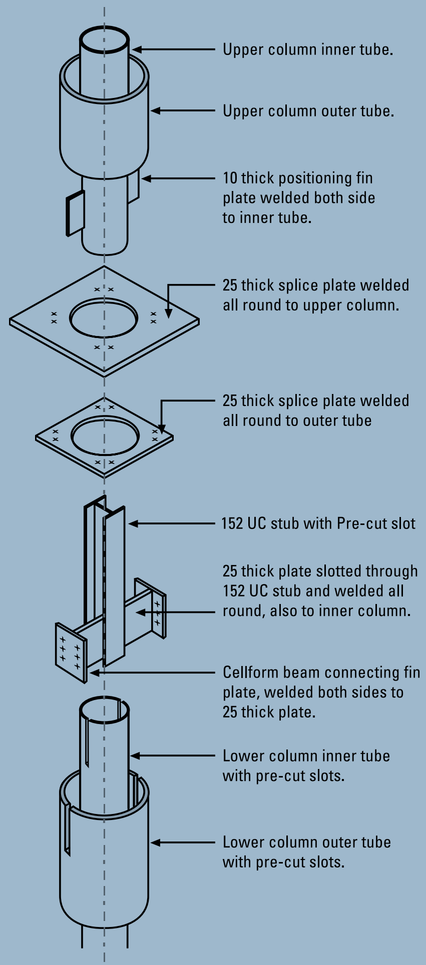
To achieve a two-hour fire rating, Eurocode 4 calls for the concrete to be reinforced. Instead, Buro Happold provided the same area of steel using another CHS (273mm diameter in this case) within the outer one. "This makes life easier for the steelwork contractor, as there's no reinforcement to worry about," says Buro Happold partner Stephen Brown.

Steelwork contractor William Hare supplied the columns to site in three storey lengths, as one unit welded to a common base plate.

At each floor level a 1.5m length of universal column is slotted into the column. A welded plate connecting piece at right angles bolts to dual floor beams running either side of the column. A plate welded to the top of the column provides a bearing for the steel decking for the floor units, and the base plate of the column above is attached by four bolts.

The whole cruciform beam/column connection is then cast into the concrete floor. But because it transfers no moment into the column, the floor beams can be designed as continuous, making them more efficient and allowing them to be spliced away from the columns at the point of minimum bending moment.

The columns are grouted later in lifts of three storeys by filling with self-compacting grout, which requires around 2m^3 for each column.



Steel design can be simple using EC3

Many steel designers still hanker for the simpler days of BS 499. But could a simple BS 449-like approach emerge from the apparent complexity of Eurocode 3, asks Charles King

The arrival of Eurocode 3 calls us to reconsider our approach to design. Design can be complex, for those pursuing economy of material, but it can be simplified for those pursuing speed and clarity. Many designers feel depressed when new codes are introduced. There are new formulae and new complications to master, even though there seems to be no benefit to the designer for the majority of his regular workload.

If we study the reasons for the increasing complexity of codes, we can see how it might be possible to simplify design. The increasing complexity generally arises because:

1. earlier design practice over-estimated strength in a few particular circumstances, causing safety issues
2. earlier design practice under-estimated strength in various circumstances affecting economy
3. new forms of structure evolve and codes are expanded to included them.

However, simple design remains a possibility if:

1. a scope of application is defined to avoid the circumstances and the forms of construction in which strength is over-estimated by simple procedures.
2. the designer is not too greedy in the pursuit of the least weight of steel from the strength calculations.
3. the code requirements are presented in an easy-to-use format, such as the tables of buckling stresses in existing BS codes.

Not pursuing least weight might seem disloyal to the client, but generally it is not. It is well known that least weight of steel usually does not result in the cheapest structure, because lighter members often need more stiffening or strengthening at connections. In addition, many structures are governed by deflection and vibration criteria, so that the strength is not the critical issue for many members.

Observing these points, it is possible to derive design procedures that could be called "Eurocode 3 kept simple". To demonstrate the simplicity of such a procedure, it is compared with BS codes in Table 1 for the design of an unrestrained beam. The comparison includes both BS 449, long regarded as the best code for simplicity, and the simplest BS 59501 procedure. The number of steps is similar in each case.

Table 1: Comparison of Eurocode 3 (EN 1993-1-1) with BS 449 and BS 5950-1:2000 for simplified design

Design an unrestrained UB in S275 steel — the steps commonly used in practice

Eurocode 3 kept simple	BS 449	BS 5950 kept simple
Choose UB size Look up h/t_w, i_z and f_y in tables Calculate slenderness $\frac{l}{i_y}$ Look up $\chi_{LT} f_y / \gamma_{M1}$, the allowable buckling stress in a table such as Table 2 on p26 (values need to be tabulated). Calculate buckling resistance moment $M_{b,Rd} = (\chi_{LT} f_y / \gamma_{M1}) W_{pl}$ Compare applied moment with $M_{b,Rd}$	Choose UB size Look up D/T and r_y in tables Calculate slenderness $\frac{l}{r_y}$ Look up allowable buckling stress p_{bc} in a Table 3a and check thickness in table 2. Calculate applied stress $f_{bc} = \frac{M}{Z}$ Compare f_{bc} with p_{bc}	Choose UB size Look up D/T, r_y and f_y in tables Calculate slenderness $\frac{L_E}{r_y}$ Look up allowable buckling stress p_b from Table 20 assuming $\beta_W = 1$. Calculate buckling resistance moment $M_b = p_b S_x$ Compare applied moment with M_b
Check shear Look up h and t_w in tables Calculate the shear resistance $V_{c,Rd} = (f_y / \gamma_{M0} / \sqrt{3}) h t_w$ (Note that γ_{M0} is expected to be 1.0) Check applied shear $\leq 0.5 V_{c,Rd}$	**Check shear** Look up D and t in tables Calculate the shear stress $f_q = Q / (Dt)$ Compare f_q with p_q from Table 11	**Check shear** Look up D and t in tables Calculate the shear resistance $P_v = 0.6 p_y tD$ Check applied shear $\leq 0.6 P_v$

Table 2

Lateral torsional buckling resistance: Part table of stress $\chi_{LT} f_y / \gamma_{M1}$

UBs, S275 steel, thickness not exceeding 16mm

Slenderness		*h/t_f*									
l/i_y	$\bar{\lambda}$	5	10	15	20	25	30	35	40	45	50
30	0.35	275	275	275	275	275	275	275	275	275	275
35	0.40	275	275	275	275	275	275	275	275	275	275
40	0.46	275	275	275	275	275	274	274	274	274	274
45	0.52	275	275	272	271	270	269	269	269	268	268
50	0.58	275	273	268	266	265	264	263	263	263	263
210	2.42	238	193	159	135	118	107	98	92	87	83
220	2.53	236	189	154	130	113	102	93	87	82	78
230	2.65	233	185	150	125	109	97	89	83	78	74
240	2.76	223	175	140	117	101	90	82	76	71	68
250	2.88	229	178	141	117	101	89	81	75	70	67

Those who have read EN 1993-1-1 in detail may be surprised by the simplifications in the procedure entitled "Eurocode 3 kept simple". Several procedures in the Eurocode document are omitted because other steps in Table 1 ensure that the calculations comply with the Eurocode even though the procedures do not appear. The explanations are as follows:

1. The classification of the cross-section can be omitted because the use of a UB for bending alone in S275 ensures that the beam is at least Class 2, allowing the use of the plastic modulus, W_{pl}. (This approach has long been used in the application of BS 449 which also has slenderness limits for flanges and webs. They are rarely calculated when using UBs and UCs because designers expect these sections satisfy the limits for S275.)

2. Shear buckling of the web has not been checked because S275 UBs do not have web slenderness sufficient for this type of buckling.

3. The moment gradient has not been considered. The tabulated stresses assume uniform moment even though this may under-estimate the buckling resistance of the beam.

4. The cross-section check for bending has been omitted, because it can never be critical in a uniform beam if the buckling check assumes a uniform moment and the coincident shear is not more than 50% of the shear resistance.

5. Reduction of moment resistance by high coincident shear force has been avoided by checking that the shear force is not more than 50% of the shear resistance.

6. The shear area used above is simple whereas the formula in EN 1993-1-1 is complicated. However, for UBs, the simple area above is always slightly conservative and therefore safe.

7. The formulae in Eurocode 3 do not explicitly show l/i_y, but re-arrangement of the formulae in the EN 1993-1-1 allows this tabulation to be performed, because the fundamental approach of the Eurocode is also used by BS 5950 and BS 449.

(The steps 1 to 5 above have also been omitted from the BS 5950 procedure in Table 1 for the same reasons.)

Table 1 only shows the procedure for an unrestrained beam, but simplifications are possible for several other aspects of design, such as columns in simple braced frames. It is hoped that SCI will produce simplified guidance of this type suitable for rapid design both in industry and for universities.

Table 3: EN 1993-1-1 symbols	
i_z	Radius of gyration about minor axis, r_y in BS codes
f_y	Yield stress dependent on the flange thickness
$\overline{\lambda}_{LT}$	Relative slenderness for lateral torsional buckling
χ_{LT}	Strength reduction factor for lateral torsional buckling
W_{pl}	Plastic modulus about the major axis
γ_{M1}	Partial safety factor for buckling resistance
$M_{b,Rd}$	Buckling resistance moment
h	Overall height (or depth) of the section, *D* in BS codes
t_w	Web thickness
$V_{c,Rd}$	Cross-sectional resistance to shear
γ_{M0}	Partial safety factor for cross-sectional resistance

The Eurocode 3 symbols are new to engineers using BS codes, so the symbols used in Table 1 are explained in Table 3.

High grade steel: the new standard for cost effectiveness

High grade steel is becoming much more popular. Richard Barrett, Chairman of BCSA's Process and Technical Committee, explains why modern designers increasingly prefer high grade over standard grade

Distribution warehouse Peterborough

Twenty years ago the vast majority of structural steelwork was designed in "standard" grade 275 (or grade 43 as it was then known). It was quite unusual on everyday structures to come across "high" grade 355 steel (old grade 50). Today high grade steel is widely used; for example, last year in the author's own business the majority of steel used was 355 grade. What has changed over this period? Why is high grade steel becoming the grade of choice for many designers?

Steel grades

S355 grade steel is not new, and it's not particularly high grade either! It is colloquially referred to as high grade, to differentiate it from standard grade 275. In reality there are many much higher grades available, but these are not seen on day-to-day structures. So for simplicity I will continue with the "high" grade colloquialism throughout this article, although the purist would refer to S355 grade each time.

The grade refers to the yield strength of the steel – the higher the grade, the higher the yield strength. The various grades are set down in BS EN 10025:2004. Steelmakers can increase the yield strength of their steel through various means — adjusting the chemical composition, using heat treatment and through manufacturing processes such as cold working. The chemical composition of high grade steel will normally differ from standard grade through the addition of either carbon or other elements. Adding carbon increases strength but also reduces the steel's toughness, so it is common to also "alloy" the content by adding trace metals such as manganese, chromium, molybdenum, nickel or copper.

There are various subgrades or so-called "qualities" available with each grade category. In particular, special subgrades will be required for low temperature applications such as external steelwork or exposed cold store steel, where the normal subgrade would not be suitable due to the reduced toughness of steel at lower temperatures.

The steel producer provides a Test Certificate or Inspection Document for the steel which shows the grade, subgrade, and the chemical analysis of the batch, together with results of mechanical tests. These should show that the yield strength is above the minimum required in the product standard for the particular grade.

Fabrication aspects

Whereas with true high grade steel (460 and upwards), welding needs to be carried out with special care, using techniques such as pre-heating this is rarely the case with Grade 355

Residential development Solihull

steel. Fittings material is normally standard grade, being easier to source for items such as flats and angles. There is a danger however, that the use of high grade steel will result in more complex connections, particularly if inappropriately small beams size are selected. The experienced designer will avoid this problem by carefully considering the practicality of the joint when selecting the steel size, to ensure it is possible to form a connection without the need for excessive welding or stiffening.

Commercial factors

One of the major changes over recent years has been the increasing availability of high grade steels. Medium and large sizes of universal beams and columns are now widely available through steel stockholders, as are the Corus Hybox range of hollow sections. As these sizes have become more popular, stocks have increased, creating a virtuous circle of usage and availability. Additionally, the premium charged by steelmakers for high grade over standard grade has been progressively reduced, for some sizes disappearing altogether. High grade now offers a very attractive cost-to-strength ratio when compared with standard grade.

Availability is still an issue for small sections, and is likely to stay that way. This is because there is little or nothing to be gained by using high grade steel for beam sizes below 406mm, and therefore usage is small. Specifying high grade in these small sizes is wholly uneconomical and should be avoided if possible. The same applies with flats, angles and channels.

Design issues

In modern designs, high grade steel is essential to optimise the economy of the steel frame. Many types of buildings will benefit from the use of high grade steel — in single storey structures for large span portal frames, in multi-storey structures for the columns, and in composite construction for the beams as well. The photographs show examples of the use of high grade steel by the author's company, Barrett Steel Buildings. These building types are the mainstream of the industry and represent the areas where most steel is used — hence the rapidly rising use of high grade steel. Designs for this type of structure incorporating high grade steel will give very economical solutions.

Owing to classification of sections for design purposes, certain sizes are not suitable for plastic action. In standard grade there are just five such sizes (all are UCs). With high grade there are more, seven beams and nine columns. This only affects a few serial sizes, normally the lightest section in the size (such as 356x171x45UB or 406x178x54UB). Consequently these sections are somewhat restricted in suitability for high grade use. Additionally high grade will probably not benefit designs where fatigue loading is present, or when buckling action is the critical case.

It is normal to use standard grade material for connections. Therefore connection design, including weld strength, will be governed by the strength of the connection material rather than the strength of the high grade main members.

Future trends and conclusions

Increasing availability of high grade steel, coupled with diminishing premium costs, means that it offers a very attractive cost-to-strength ratio. Consequently use is increasing rapidly, and this is improving the overall competitiveness of steel framed solutions. In the long term I believe it is likely that Grade 355 will become the standard grade for most beam, column and hollow section sizes, with Grade 275 only being retained for small beams and fittings materials.

AD 285
Floor Systems for Simple Construction using Discontinuous Columns and Continuous Beams

This AD provides advice on the floor-plate systems to be used with discontinuous (storey-high) columns and continuous beams in simple construction. AD 281 provides general advice on this form of construction and AD 283 covers the design of the column. As previously noted, this form of construction need not be restricted to the residential sector alone.

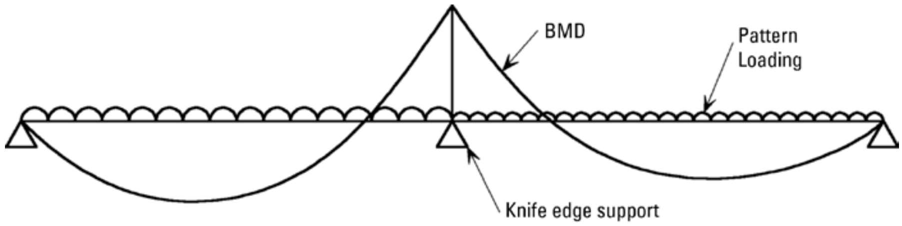


Figure 1 Continuous beam model

Floor-plate

The column design procedure outlined in AD 283 implicitly relies on rotational restraint both out-of-plane and in-plane to the column ends for the permanent condition, although the column's effective length factor is taken as unity. This allows the use of a simple design model with nominal moments even though the actual behaviour is complex. In BS 5950-1, the term 'rotational restraint' is described as directional restraint. AD 281 and AD 283 assume that the floor-plate is Slimdek but an alternative would be to use precast concrete units in the depth of the floor beam with topping, and with any voids between the precast units and the beams filled with grout. Both solutions are suitable for residential and commercial developments.

The above systems, with the floor-plate within the depth of the beam, have the advantage that the column ends are rotationally restrained out-of-plane by the slab. The use of box ties and structural tees, as shown in AD 281 and AD 283, offers positional restraint during construction but offers no rotational restraint out-of-plane to the column ends.

Floor beams

The floor beam in this form of construction may be designed as simply supported or continuous but it is assumed that no moment is redistributed from the beam to the column. Therefore, pins (no stiffness) or knife edge supports must be used in the frame or beam analysis. The column is designed in accordance with the procedure in AD 283, which shows how to determine its nominal moments. Figure 1 shows a continuous beam model with knife edge supports. To provide the necessary in-plane rotational restraint to the columns, the peak moment in the mid-span region of a beam should not exceed 90% of its reduced plastic moment capacity M_r in the presence of axial force (if any).

Composite section properties may be taken advantage of in sagging regions. In addition, if the beam is continuous, pattern loading must be considered in its analysis and design. Moreover, designers should be aware that the practice of designing beams as simply supported and installing them as two-span continuous will result in an underestimation of the column loads. Beams need to be analysed as they will be constructed in order to determine the correct column loads.

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Frame Stability	12 May 05	Torquay
Excel for Engineers	24 May 05	Ascot

Progress Report on the Severn Bridge

A bridge across the Severn has been thought about and talked about for do long that now, when it is approaching actual completion, one can hardly believe in its reality. Yet there it is in its sheer beauty of line and grace straddling the river, gathering up from the river itself the 88 steel deck units which combine to make the complete deck or roadway. Each of these units, which are in high stress steel, weighs 130 tons and the total weight of steelwork thus represented by the completed deck is approximately 12,000 tons.

Nearly everything about the Severn Bridge is unusual and original. Although a similar type of bridge to the Forth Road Bridge opened by the Queen last September (1964), the Severn has the advantage of development work carried out after the Forth Road Bridge design was completed: this work included additional aerodynamic testing which paved the way for an entirely new design to be created for the Severn Crossing.

Whereas the Forth Road Bridge has latticed stiffening girders and separate roadway decking, the Severn bridge is having a single all-welded steel box girder with the road running on the upper surface and the footways and cycle tracks cantilevered out at each side: this box girder is suitably shaped to minimise the effect of wind forces and to ensure aerodynamic stability.

Saving in both weight and cost is achieved by these new methods.

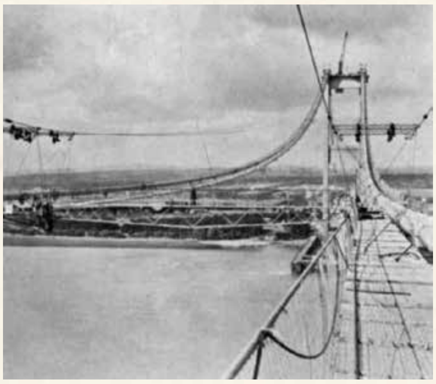
The sequence of fabrication and erection operations is unusual – fabrication of elements, metal spraying and other anti-corrosion processes are being carried out in three separate works in the country then dispatched to a works in Chepstow where they are welded together, launched and finally floated down the river Wye into the Severn and so under the new bridge: each unit is then hoisted from the river to its position on the bridge.

There is here a considerable triumph for welding which contributes greatly to the slender beauty of the bridge.

The Severn Bridge design has created much interest in America where the Verrazano Bridge was opened last November. The British design, with its greater economy in the weight of steel used and consequent saving in cost, has produced lively comment and comparison, much of it favourable to the British design.

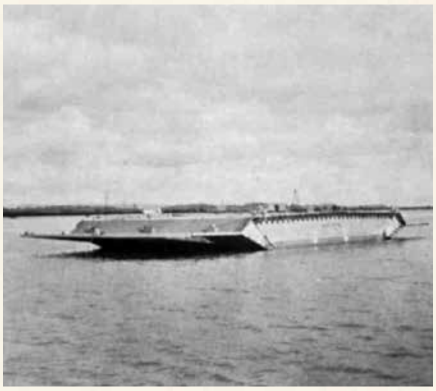
The Severn Bridge is part of the grand project which will save 50 miles on the journey from Southern England to South Wales: the project includes the Beachley Viaduct and Wye Bridge with eight miles of approach road and will be finished next year (1966).

1. Cable bands being transported into position.

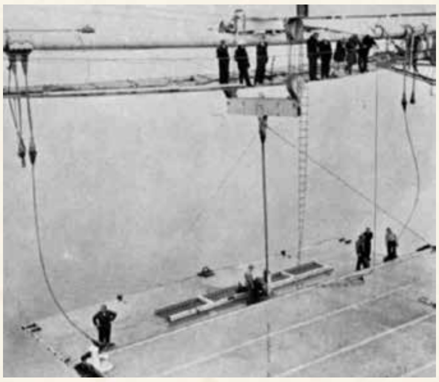


2. View at mid-span showing cable bands in position.

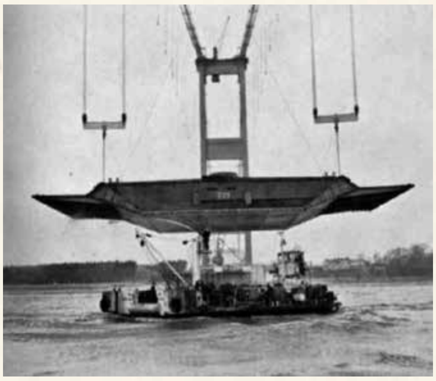
3. Feeding a suspender into position.



4. Deck section moored in the River Severn.



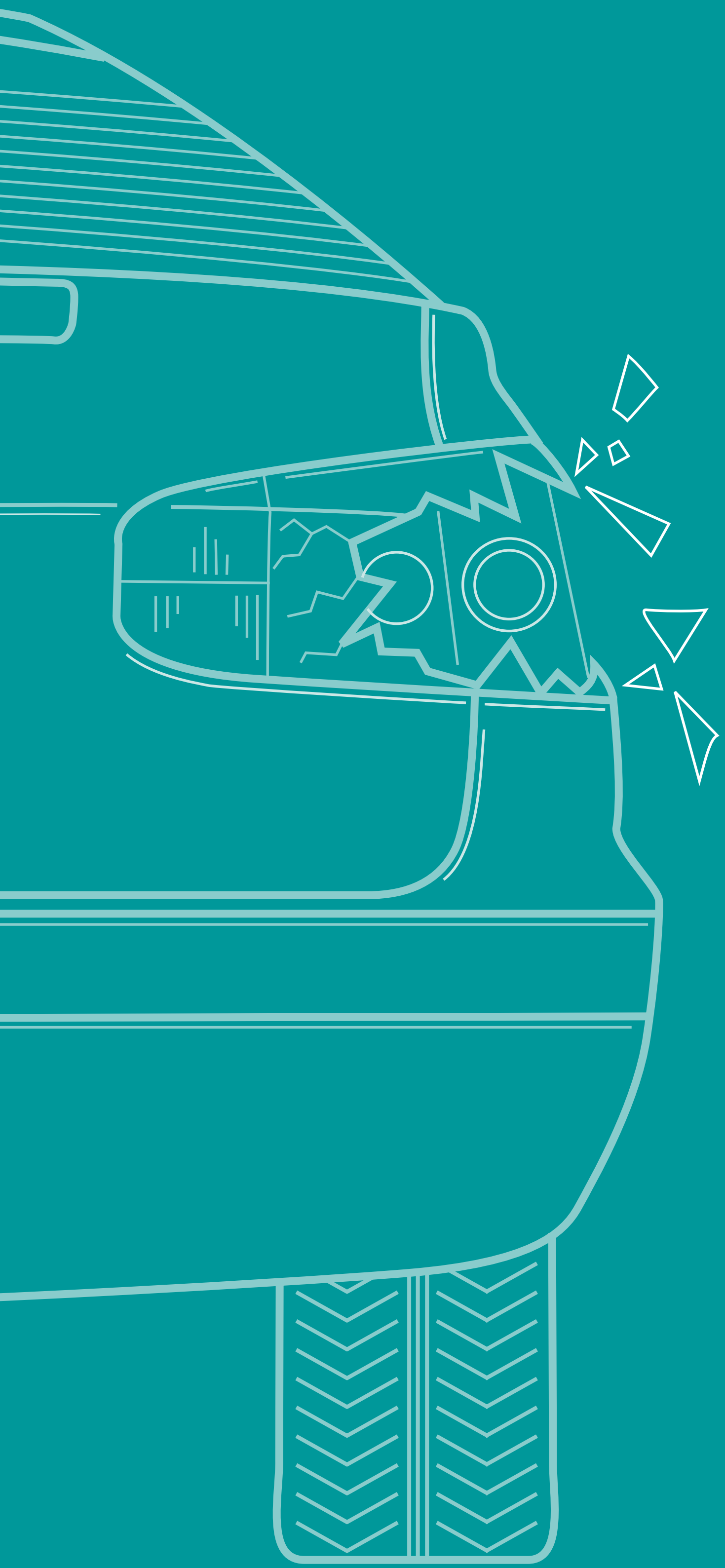
5. Deck section clear of water and ready for lifting.



6. Washing down a deck section with fresh water.

7. Deck section being lifted with handrails and ballast tank in position.

8. View along the partially completed deck.



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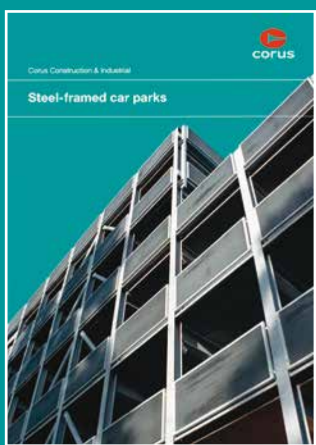

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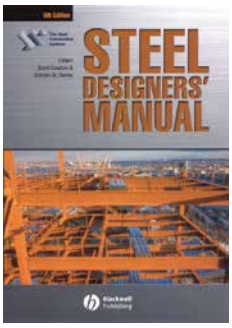

Steel Designers' Manual – 6th Edition
Editors: B Davison & G W Owens
ISBN 1405134127,
1,368 pp,
246×171 paperback,
April 2005

PAPERBACK REISSUE

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"It is hard to imagine that there is any steel topic that doesn't receive at least a mention in this book. Even if you can't find the complete answer, each section is riddled with references to places where it might be" — Mike Fewster, (Director, Billington Structures) in New Steel Construction May/June 2003.

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- New chapter on simple and moment connections, summarising industry best practice in these important areas.
- New chapter on Sustainability and Steel Construction reflecting the rapidly growing importance of the topic.
- New chapter on Eurocodes, summarising the principal differences with current national standards.
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Structural Fire Design: Off-site Applied Thin Film Intumescent Coatings (Second Edition)
Editors: L C Newman, J J Dowling, and W I Simms
ISBN 1 85942 162 8,
48 pp,
A4 paperback,
Feb 2004

NEW BOOK

Structural Fire Design: Off-site Applied Thin Film Intumescent Coatings

This publication is presented in two parts. Part 1 covers the background to the use of off site applied intumescent coatings for structural steelwork and acts as a reference text for Part 2, which presents a Model Specification. By presenting a Model Specification it is hoped that greater uniformity will be achieved in contract specifications relating to off site applied intumescent coatings.

This second edition of SCI P160 has been extensively updated. In Part 1, the guidance on handling, storing and transporting coated steelwork has been updated to reflect the experience that has been gained in these areas. The guidance provided on the fire protection of beams with web openings, concrete filled hollow sections, connections, composite beams and bracing, reflects the latest guidance available. Information has now been included on the protection of partially exposed members.

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ANNOUNCEMENT

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This essential Directory for Specifiers and Buyers in the steel construction industry is now available.

The directory lists details of every BCSA member for 2005; from British steelwork contractors to their suppliers. RQSC (Registered Qualified Steelwork Contractors) listings are also given as are Quality Assurance Certification details.

Images of members' work are shown throughout the directory, which also contains details about steel as a material, the benefits of using it (from fire protection benefits to design possibilities) and essential tables.

To receive your free copy email emma.willoughby@steelconstruction.org or phone 020 7839 8566.

New and Revised Codes and Standards

(from BSI Update February 2005)

BS EN PUBLICATIONS

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

BS EN 1990:2002 (Package)
Eurocode. Basis of structural design. Package containing BS EN 1990:2002 and the National Annex to BS EN 1990
No current standard is superseded.

BS EN 1997:-
Eurocode 7. Geotechnical design.
- **BS EN 1997 - 1: 2004**
  General rules
  Supersedes DD ENV 1997-1:1995

BS EN 10163:-
Specification for delivery requirements for surface conditions of hot rolled steel plates, wide flats and sections.
- **BS EN 10163 - 1:2004**
  General requirements
  Supersedes BS EN 10163-1:1991
- **BS EN 10163 - 2:2004**
  Plate and wide flats
  Supersedes BS EN 10163-2:1991
- **BS EN 10163 - 3:2004**
  Sections
  Supersedes BS EN 10163-3:1991

NA to BS EN 1990:2002
UK national annex for Eurocode 0. Basis of structural design
No current standard is superseded

AMENDMENTS TO BRITISH STANDARDS

BS EN 1011:-
Welding. Recommendations for welding of metallic materials.
- **BS EN 1011- 8:2004**
  Welding of cast irons
  CORRIGENDUM 1 AMD 15497

BS EN 1991:-
Eurocode 1. Actions on structures
- **BS EN 1991-1:-**
  General actions
- **BS EN 1991-1-1:2002**
  Densities, self-weight, imposed loads for buildings
  CORRIGENDUM 1 AMD 15507
- **BS EN 1991-1- 3:2003**
  Snow loads
  CORRIGENDUM 1 AMD 15509
- **BS EN 1991-1- 5:2003**
  Thermal actions
  CORRIGENDUM 1 AMD 15510
- **BS EN 1991- 2:2003**
  Traffic loads on bridges
  CORRIGENDUM 1 AMD 15508

NEW WORK STARTED

BS EN 1993:
Eurocode 3. Design of steel structures
- **BS EN 1993 - 1:-**
  General rules
- **BS EN 1993 - 1- 3**
  Supplementary rules for cold-formed thin gauge members and sheeting

CEN EUROPEAN STANDARDS

EN 1998:-
Eurocode 8. Design of structures for earthquake resistance
- **EN 1998 - 1:2004**
  General rules
- **BS EN 1993 - 1- 3**
  General rules, seismic actions and rules for buildings

The British Constructional Steelwork Association Ltd

You can find out email and website addresses for all these companies at www.steelconstruction.org

BCSA is the national organisation for the construction industry; its member companies undertake the design, fabrication and erection for all forms of construction in building and civil engineering. Associate Members are those principal companies involved in the purchase, design or supply of components, materials, services etc, related to the industry. Corporate Members are clients, professional offices, educational establishments etc, which support the development of national specifications, health and safety, quality, fabrication and erection techniques, overall industry efficiency and good practice. The principal objectives of the association are to promote the use of structural steelwork; to assist specifiers and clients; to ensure that the capabilities and activities of the industry are widely understood; and to provide members with professional services in technical, commercial and quality assurance matters.

Details of BCSA Membership and services are available from: Gillian Mitchell MBE, Deputy Director General, British Constructural Steelwork Association Ltd, 4 Whitehall Court, Westminster, London SW1A 2ES. **Tel** 020 7839 8566 **Fax** 020 7976 1634

KEY

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

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

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

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

* For details of bridgework sub-categories contact Gillian Mitchell at the BCSA.

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ASD METAL SERVICES – DAVENTRY
Royal Oak Ind. Est., Daventry, Northants NN11 5QQ
Tel 01327 876021 **Fax** 01327 87612

ASD METAL SERVICES – TIVIDALE
Tipton Road, Tividale, Oldbury, West Midlands B69 3HU
Tel 0121 520 1231 **Fax** 0121 520 5664

AUSTIN TRUMANNS STEEL LTD
Moss Lane, Walkden, Manchester M28 5NH
Tel 0161 790 4821 **Fax** 0161 799 0411

BARRETT STEEL SERVICES LTD
Barrett House, Cutler Heights Lane, Dudley Hill, Bradford BD4 9HU
Tel 01274 682281 **Fax** 01274 651052

BROWN MCFARLANE LTD
Ladywell Works, New Century Street, Hanley, Stoke-on-Trent ST1 5QH
Tel 01782 289909 **Fax** 01782 289804

CORUS SERVICE CENTRE
Farnigham Road Station, South Darenth, nr Dartford DA4 9LD
Tel 01322 227272 **Fax** 01322 864893

CORUS SERVICE CENTRE
Badminton Rd Trading Est., Yate, Bristol BS37 5JU
Tel 01454 315314 **Fax** 01454 325181

CORUS SERVICE CENTRE
Spittlegate Industrial Estate, Grantham, Lincolnshire NG31 7UP
Tel 01476 565522 **Fax** 01476 562459

CORUS SERVICE CENTRE
Blackamore Road, Walker Industrial Estate, Guide, Blackburn BB1 2LJ
Tel 01254 55161 **Fax** 01254 670836

CORUS SERVICE CENTRE
South Street, Glasgow G14 0BX
Tel 0141 959 1212 **Fax** 0141 959 0111

CORUS SERVICE CENTRE
Moira Rd, Lisburn, Co. Antrim BT28 2SN
Tel 01846 660747 **Fax** 01846 660748

CORUS SERVICE CENTRE
Wakefield Rd, Stourton, Leeds LS10 1AY
Tel 0113 276 0660 **Fax** 0113 272 4418

CORUS SERVICE CENTRE
The Steelpark, Steelpark Way, Wednesfield, Wolverhampton WV11 3BR
Tel 01902 484000 **Fax** 01902 484041

DUDLEY IRON & STEEL CO LTD
Unit 8, Autobase Industrial Estate, Tipton Road, Tividale, West Midlands B69 3HU
Tel 0121 601 5000 Fax: 0121 601 5001

NEWTON STEEL STOCK LTD
Landshire Lane, Gibbs Marsh Trading Estate, Henstridge, Somerset BA8 0TN
Tel 01963 365028 **Fax** 01963 365034

STEELSTOCK (BURTON ON TRENT) LTD
Ryder Close, Cadley Hill Road, Swadlincote, Derbyshire DE11 9EU
Tel 01283 226161 **Fax** 01283 550406

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

STRUCTURAL FASTENERS

THOMAS WILLIAM LENCH LTD
P O Box 31, Excelsior Works, Carnegie Road, Rowley Regis, West Mids B65 8BZ
Tel 0121 559 1530 **Fax** 0121 559 3920

CORPORATE MEMBERS

BALFOUR BEATTY POWER NETWORKS LTD
Tel 01332 661491

GRIFFITHS & ARMOUR
Tel 0151 236 5656

HIGHWAYS AGENCY
Tel 08457 504030

ROGER POPE ASSOCIATES
Tel 01752 263636

The Register of Qualified Steelwork Contractors

BUILDINGS SCHEME

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

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

Company Name	Telephone	A	C	D	E	F	H	J	K	L	M	N	S	QA	Contract Value (1)
ACL Structures Ltd	01258 456051				●	●	●				●				Up to £2,000,000
Adstone Construction Ltd	01905 794561														In process of audit
Atlas Ward Structures Ltd	01944 710421	●	●	●	●	●	●	●	●	●	●			●	Up to £3,000,000*
B D Structures Ltd	01942 817770			●	●	●	●								Up to £1,400,000*
B & K Steelwork Fabrications Ltd	01773 853400		●		●	●	●	●	●		●			●	Up to £4,000,000*
A C Bacon Engineering Ltd	01953 850611				●	●	●								Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560				●	●	●	●				●		●	Up to £2,000,000
Barrett Steel Buildings Ltd	01274 682281				●	●	●							●	Up to £6,000,000
Betgate Structures Ltd	01608 677551				●	●	●								Up to £100,000
Billington Structures Ltd	01226 340666	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
Bison Structures Ltd	01666 502792			●	●	●	●							●	Up to £2,000,000
Border Steelwork Structures Ltd	01228 548744		●		●	●	●	●				●			Up to £800,000
Bourne Steel Ltd	01202 746666	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
Briton Fabricators Ltd	0115 963 2901		●			●	●	●	●	●	●			●	Up to £800,000
CTS Ltd	01484 606416						●	●							Up to £800,000
Carnaby Structures Ltd	01262 401325		●	●	●	●	●								Up to £4,000,000*
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Compass Engineering Ltd	01226 298388		●		●	●	●		●						Up to £2,000,000
Leonard Cooper Ltd	0113 270 5441		●			●	●		●		●			●	Up to £800,000
Curtis Engineering Ltd	01373 462126					●									Up to £400,000
Frank H Dale Ltd	01568 612212				●	●								●	Up to £4,000,000
Dew Construction Ltd (Fabrication Division)	0161 624 5631				●	●	●		●					●	Up to £800,000
EAGLE Structural Ltd	01507 450081				●	●	●	●		●					Up to £400,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●		●			●		●	Up to £4,000,000
Emmett Fabrications Ltd	01274 597484				●	●	●								Up to £800,000
EvadX Ltd	01745 336413				●	●	●	●		●	●	●		●	Up to £1,400,000
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Fisher Engineering Ltd	028 6638 8521	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
Glentworth Fabrications Ltd	0118 977 2088					●	●	●	●	●	●	●		●	Up to £2,000,000
Graham Wood Structural Ltd	01903 755991	●	●	●	●	●	●	●	●	●	●	●			Up to £2,000,000
D A Green & Sons Ltd	01406 370585				●	●	●	●						●	Up to £3,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456		●		●	●	●	●	●	●	●			●	Up to £6,000,000
James Bros (Hamworthy) Ltd	01202 673815				●	●	●	●				●		●	Up to £2,000,000
James Killelea & Co Ltd	01706 229411		●		●	●	●					●			Up to £6,000,000*
Meldan Fabrications Ltd	01652 632075		●		●	●	●	●	●		●			●	Up to £2,000,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●				Up to £2,000,000
Harold Newsome Ltd	0113 257 0156				●	●	●								Up to £1,400,000
Normanby Wefco Ltd	01724 875555		●						●		●			●	Up to £800,000
Oswestry Industrial Buildings Ltd	01691 661596				●	●	●		●		●				Up to £400,000
Quantrill Steel Ltd	01953 881853				●	●	●	●		●	●			●	Up to £40,000
RSL (South West) Ltd	01460 67373				●	●	●				●				Up to £800,000
John Reid & Sons (Strucsteel) Ltd	01202 483333	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
J Robertson & Co Ltd	01255 672855									●	●		●		Up to £100,000
Robinson Construction	01332 574711		●	●	●	●	●							●	Up to £6,000,000
Roll Formed Fabrications Ltd	028 7963 1631				●	●	●	●		●	●	●		●	Up to £800,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Rowen Structures Ltd	01623 558558	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
SIAC Butlers Steel Ltd	00 353 502 23305		●	●	●	●	●	●				●		●	Up to £6,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Henry Smith (Constructional Engineers) Ltd	01606 592121		●	●	●	●	●	●							Up to £2,000,000
Traditional Structures Ltd	01922 414172				●	●	●	●	●		●	●		●	Up to £800,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Webcox Engineering Ltd	01249 813225				●	●	●				●				Up to £400,000
H Young Structures Ltd	01953 601881		●		●	●	●	●				●			Up to £800,000

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

RQSC
The Register of Qualified Steelwork Contractors Scheme

BRIDGEWORKS SCHEME

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

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

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

Company Name	Telephone	FG	PT	BA	CM	MB	RF	X	Contract Value (1)
Allerton Engineering Ltd	01609 774471	●	●	●	●	●	●		Up to £1,400,000*
Briton Fabricators Ltd	0115 963 2901	●	●	●			●		Up to £800,000
Butterley Ltd	01773 573573	●	●	●	●	●	●		Up to £3,000,000*
CTS Ltd	01484 606416	●							Up to £800,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●		Above £6,000,000*
Coastground Ltd	01493 650455								in process of audit
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●		Above £6,000,000*
William Hare Ltd	0161 609 0000							●	Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●		●	●	Up to £6,000,000
Interserve Project Services Ltd	0121 344 4888						●		Above £6,000,000
Interserve Project Services Ltd	020 8311 5500		●	●		●	●		Up to £400,000*
Mandall Engineering Ltd	0114 243 0001	●	●	●	●	●	●		Up to £800,000*
Meldan Fabrications Ltd	01652 632075	●	●	●	●	●	●		Up to £2,000,000
'N' Class Fabrication Ltd	01733 558989	●	●	●		●	●		Up to £1,400,000
Normanby Wefco Ltd	01724 875555	●	●	●			●		Up to £800,000
Nusteel Structures Ltd	01303 268112	●	●	●	●				Up to £2,000,000*
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●		Above £6,000,000
Taylor & Sons Ltd	029 2034 4556	●	●	●	●	●	●		Up to £800,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●		Above £6,000,000*

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

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- Composite Construction
- Connections
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- Fabrication
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- Information Technology
- Fire Engineering
- Light Steel and Modular Construction
- Offshore Hazard Engineering
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Details of SCI Membership and services are available from:
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Telephone: +44 (0)1344 623345 Fax: +44 (0)1344 622944
Email: pat.ripley@steel-sci.com Website: www.steel-sci.com

The Steel Construction Institute Institute would like to welcome the following new Corporate Members:

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