JANUARY 2006 VOL14 NO1

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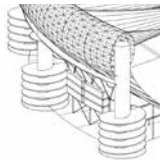


corus

The British Constructional Steelwork Association Ltd

The Steel Construction Institute

Clients line up in praise of sustainable steel

Nick Barrett - Editor

To judge by the comments we see in the press, few sectors of the construction industry would be able to field many clients happy to tell the story of hoiw they are being well served by their contractors. The constructional steelwork sector was able to do just that at the 2005 Steel Construction Conference, with one of the UK's biggest property companies taking the podium – Richard Elliott of British Land - alongside one of the UK's biggest private individual property investors – Julian Simmonds, the client behind the Manresa Road apartments project.

Both have had groundbreaking projects described in NSC during the year; British Land is a repeat customer of long standing for steelwork contractors and Julian Simmonds says he would like to be. The conference was a great success on many fronts as you can read elsewhere in this issue, not least for the launch of the steel sector's Sustainability Charter. The message was also clear from clients that they themselves have to think sustainability in their projects, and they expect their construction suppliers to be able to match their efforts. So sign up for the Charter or risk being left behind.

Steel stays positive

Client satisfaction and solid performance in improving sustainability credentials – these are strong and positive messages to be able to deliver in support of marketing and lobbying efforts that benefit the whole steelwork sector. This stands in sharp contrast to the marketing that we have seen recently from the concrete sector, in particular from an organisation calling itself the British Association of Reinforcement (BAR), which has placed several childish advertisements in the construction press. The person called the 'project director' of this organisation and who is quoted in BAR's press releases as an authority on fire safety engineering aspects of structural steel is also the press relations consultant for the Concrete Centre. Obviously an authority on this subject area.

With little positive to say in favour of concrete BAR is reduced to an anti steel knocking campaign. One of the advertisements likened steel to jelly. This not only insults the steel sector, but also the intelligence of the engineering design community and its clients who have overwhelmingly voted in the marketplace in favour of steel.

With puerile opposition like this it is not surprising that steel has outperformed concrete by such a huge margin over the past 20 years. Steel could, but need not, reply with adverts knocking the performance of concrete, such as the closure on safety grounds of the Castlepoint Shopping Centre in Bournemouth, the alkali silica scandal which we may not have heard the last of, or the scrutiny that very thin post tensioned floor slab designs are coming in for. Steel sector funds will continue to be invested in positive marketing and technical support for designers and users of constructional steelwork.

New Steel Construction welcomes hearing from steelwork contractors, structural engineers and architects about the projects you are involved in. You can send either initial ideas or detailed descriptions to the Editor at nick@new-steel-construction.com.

Contractors choose competitive steel

Steel construction is enjoying robust health with output up 7% this year, and is looking forward to a future brightened by the prospect of a demand for 250,000t of steelwork for the London Olympics alone, said BCSA President Donal McCormack in his opening address to the 2005 Steel Construction Conference & Exhibition (see report p16).

Mr McCormack made a plea for improved communications along the supply chain, as existing delays in the flow of information were a serious problem. He also promised that steel's sustainability credentials would be even further enhanced when the industry's 100% recyclability target was achieved.

In his keynote address to the conference, held in London in November, Richard Elliott, Head of Construction at British Land, a property company with a £12,500M portfolio, said achieving sustainability objectives were increasingly key to the success of developments and it was embedded into every British Land project. Steel had obvious advantages for developments, he said such as permitting off site fabrication which allows safer working environments and development of local skills. Productivity is increased and waste reduced.

Using steel can reduce transport needs and allows easy future modification of buildings: 'It reduces the need for wholesale redevelopment,' he said.

Television and radio presenter John Humphreys whose opening comments noted the continuing favourable outlook for steel chaired a lively debate on the future construction market. Panelists included BCSA Deputy President Richard Barrett who, answering a question from the floor, said that the growth of design and build was a factor in the recent success of steel. 'Inevitably contractors look for a competitive solution so choose steel frames,' he said.

John Humphrys talking to Corus Construction & Industrial's Neil Tilley at the exhibition.

Several new products were launched at the well attended exhibition that ran alongside the conference (report to follow in NSC February).

Goole swing bridge relieves congestion

Butterley has completed the installation of a new cable-stayed swing bridge at Goole in Yorkshire, which should help to relieve congestion on the A161. The bridge spans the Dutch River and replaces a narrow width swing bridge which used to lead to vehicle tail-backs.

The new bridge features a steel deck with a central swinging span of 45m that pivots at one end and can be opened to allow water vessels to pass. An 800t mobile crane lowered sections of the deck into place this summer.

The bridge has a main span of 45m, incorporates a 7.3m wide carriageway and 2.3m wide footway and includes 225t of steelwork. The design and build team included structural designer Cass Hayward and contractor Birse.

Butterley Sales Manager Stephen Ince said: "The design of this bridge helps to protect the main bearing so that it only takes the weight of the structure when it swivels. Consideration has been given to whole-life costing on this project as the bridge is envisaged to last a minimum of 120 years." The total project value of the bridge construction is £4.75M.

Wider use for safe system

Severfield-Rowen has made its innovative 'Off-Load Safe' patented handling system available to the wider market. 'The system has been used successfully within the Severfield-Rowen group for several months,' said Mike Ashton, Erection Director–Steelcraft Erection Services Limited.

'The constructional steelwork sector has a very good safety record already but we are continuously looking for ways to improve, so we decided to share the system across the industry. It can be used for unloading steelwork as well as other materials from trailers safely, minimising the risk of injury to operatives. Off-Load Safe is easy to assemble, time saving and favoured by operators.'

Severfield–Rowen Group companies are using the system extensively and it has attracted highly favourable reviews from clients, the HSE and other companies and industries engaged in material handling. The system has a safe working load of 260kgs, as verified by Lloyds British Testing.

Steelwork arriving at site ready to be safely off-loaded.

Cardington needed for concrete tests

The constructional steelwork sector is supporting calls to re-open the Cardington large building test facility to allow the UK's programme of fire testing to resume. Although the steel sector is confident that the behaviour of steel in fire is well known and understood, the need for keeping knowledge fully up to date through testing is recognised – and the behaviour of concrete in fire remains virtually unknown to modern tests.

Supporters of the campaign for the re-opening of the mothballed Cardington, which was started by New Civil Engineer magazine, say it is an asset of international importance and should reopen without delay.

"Only by doing tests at the kind of scale possible with Cardington can you get a full appreciation of how buildings really function under differing conditions," said BCSA's Director of Engineering David Moore. "In particular, accidental actions such as fire and explosion are difficult if not impossible to simulate by other means, such as computer modelling."

"We were greatly saddened when Cardington closed although there are currently very few unknowns about the behaviour of steel in fire," said Corus Construction & Industrial Market and Product Development Manager Roger Steeper.

The concrete sector had in the 1990s a series of six tests planned for concrete framed buildings to update decades-old knowledge about the behaviour of its products in fire, but only one limited test was carried out before Cardington closed in 2002.

Metals skills boost from merger

Efforts to recruit capable young people into the metals industry have been boosted by the merger of two key skills organisations. MetSkill, the metals industry skills and performance body, has merged with SEMTA, the Sector Skills Council (SSC) for the engineering and manufacturing technologies sector, to form one of the largest SSCs in the UK.

MetSkill Chairman Stephen Tilsley welcomed the merger. He said: "The merger will enhance both employer influence and the practical benefits for our companies. We will now be able to draw on SEMTA's wider access to policy makers and funds for employers, as well as extending MetSkill's business oriented services to a wider range of companies."

SEMTA Chairman Lord Trefgarne added: "We feel the merger will benefit both organisations but, most importantly, the employers whom we both serve."

MetSkill aims to achieve and sustain improvements in business performance by giving companies the ability to recruit higher calibre young people. It is currently working alongside the British Constructional Steelwork Association to carry out an audit of the training needs in the steel construction industry.

The merger will also allow MetSkill to continue to expand its development activities such as MICE – the Metals Industry Competitive Enterprise – and the Metals Academy, which is looking to attract 5,000 young people each year into careers in the metals industry. The Academy encourages strategic partnerships between companies and schools in key industry regions and promotes apprenticeship programmes that meet employer needs.

Elizabeth Bonfield joined MetSkill in July as its new Managing Director.

'Zero Defects' delivers savings for clothing firm George

Barrett Steel Buildings' 'zero defects' approach has delivered cost savings and a two week saving on programme on a project to design, supply and erect a steel frame for a large new distribution centre for Asda's clothing subsidiary George.

The 1150t steel frame building close to Washington, Tyne & Wear, which was erected in seven weeks, covers an area of 362,000ft^2 and has a clear height to the underside of the haunch of 16m.

The project benefitted from use of a new galvanised steel ground beam designed by Barrett Steel Buildings as an alternative to precast concrete. Commercial Manager Andrew Marston said: "The ground beam was developed as part of the ProShed 'Quality built in 50 days' project and eliminates the need for a return visit to fit cold rolled rails. Our galvanised steel ground beams are cheaper than using concrete beams and speed up the time taken to erect a steel frame building."

Construction of the distribution centre gave Barrett Steel Buildings a chance to employ and evaluate the success of its new zero defects approach to its work. 'Zero defects' involves identifying and rating potential hazards at the design and drawing stage and introducing control measures to make sure and problems do not reach site.

The main contractor is Simons Construction, the architect is Chetwood Associates, the engineer is Capita Symonds and the cladder FK Roofing.

AROUND THE PRESS

QS Week

9 November 2005

Steel is the construction material of choice or the Olympic venues because it meets the environmental benchmarks as well as providing innovative design and construction solutions

Construction News

1 December 2005

Despite claims that the steel market has been taking a battering due to rising global prices, Construction News' first annual league table of steel fabricators finds the industry in a happy, even friendly mood.

Construction News

8 December 2005

Keir has called in three specialist firms to work around the clock to prop up the car park on Bournemouth's £200M Castlepoint shopping centre after it was closed due to safety fears last week… Insufficient rebar in the concrete is the prime suspect behind the problems, which have plagued the car park since it opened in 2003.

Construction News

8 December 2005

Slab design under scrutiny

Tower Hamlets building control queries Aussie design for post tensioned concrete floor slabs

A landmark multi-storey concrete framed hotel in London is still undergoing structural design checks 18 months after it opened. The 33-storey One West India Quay development... was built using innovative techniques to construct very thin post-tensioned flat slab concrete floors.

Taking the lead with CE marking

Corus Construction & Industrial (CC&I) has become the world's first steel producer to gain approval for plates and sections against the Construction Products Directive. The approval means that CC&I is able to apply the CE mark to all of its conforming products manufactured against the structural steels standard EN 10025:2004 Parts 1 to 6.

In many European countries, but not yet the UK, CE marking is compulsory. "From 1 September 2006, all material used in the construction industry within Europe must be CE marked. So it was vital that we achieved this approval," said Alan Morris, Business Manager Quality Assurance and Standards of CC&I.

The audit for approval was conducted over a five day period during August and approval validated from 5 September 2005. Corus will now begin adding the CE mark to the inspection certificates of its conforming poducts.

The BCSA is currently in the process of producing guidance about the mark for steelwork contractors which will be available towards the end of 2006/start of 2007.

"Members have shown a lot of interest regarding the CE mark. The BCSA will be encouraging its members and manufacturers to follow in Corus' footsteps and use the CE marking system on their products" said British Constructional Steelwork Association Director of Engineering David Moore. "It is possible that the CE mark may be seen as a way of identifying a quality product and companies not using the mark may become less favoured."

Corus took the strain at Civils

Offering to 'take the strain' out of the industry, Corus' stand at Civils 2005 proved highly successful. The only two-level stand at the show offered free head, neck and back massages as well as the Corus Challenge involving a mini Olympics game and manual dexterity tests.

There was also a prize for the daily winners of the Corus Civils 2005 Olympic challenge. Simon Gerrard from NES International, Peter Chong from Peter Brett Associates and James McCulloch from Waterman Structures each won a bottle of wine.

"Corus manufactures a wide range of steel construction products which take the strain away from designers and contractors, so it was a very relevant theme for our stand." said Corus Technical Sales and Marketing Manager Roger Steeper.

"During the event the stand attracted a large amount of interest from a variety of business sectors and all the feedback received has been very positive."

Obituary – Rod Foster

Rod Foster, warmly acknowledged by colleagues as one of the quiet heroes of steel bridge engineering, has died peacefully at home, on his 65th birthday. Mr Foster spent over 40 years of his life in steel bridge engineering and he had a portfolio of project experience to rival many of the more publicly prominent engineers of his generation. Among those he worked for were Dorman Long, Fairfield Mabey, Cleveland Bridge and Cass Hayward & Partners.

Rod was born in Redcar, North Yorkshire. He joined Dorman Long at the age of 15 as a Trainee Structural Designer/ Draughtsman., achieving a Diploma in Civil and Structural Engineering via evening study in August 1963. His 'Theory of Structures' paper earned him the prize of a gold watch which was presented to him by the BCSA .

Dorman Long soon moved him south to work on the superstructure erection of the Severn Suspension Bridge in1964.. He became Senior Site Engineer on the Luangwa Bridge in Zambia. He returned to Dorman Long' in 1969 and in 1970 became a Chartered Civil Engineer.

The lure of large steel bridges brought Rod in 1970 to join Fairfield Mabey as their Chief Engineer for the Avonmouth Bridge. He stayed at Fairfield Mabey for 13 years, his more prominent projects including the erection of the steelwork for the new road deck on Britannia Bridge over Menai Straits.

Rod Foster as a young site engineer on the cable spinning platform for the Severn Suspension Bridge

Rod joined Cass Hayward & Partners in 1983 where he was responsible for many innovative approaches to bridge design and erection.

Towards the end of his career Cleveland Bridge called on Rod's experience to assist with the Tsing Ma Bridge in Hong Kong. He has left many legacies within the office and some of his design methods remain in use despite the much extended use of computers since his time.

Steel charts a sustainable future

The Steel Construction Sustainability Charter was formally launched at the 2005 Steel Construction Conference, and now has 28 companies signed up to its objectives. The aim of the Charter is: "to develop steel as a sustainable form of construction in terms of economic viability, social progress and environmental responsibility."

The Charter was launched by Professor Roger Plank of Sheffield University who said that clients were behind improving the sustainability of construction, which helps make the industry's sustainability objectives achievable. He said there was great scope for improvement in construction generally, where 12% of the waste was due to overspecifying. Half of all energy used was used in buildings, so improved energy performance of buildings could have a great impact.

Global warming and changes in the ways buildings are used undermined the old saw that the thermal mass of concrete was an advantage, he said. The problem today was more one of how to cool a building down. 'We do not in fact need a lot of the mass of concrete in a modern building.'

Advances like structural fire engineering, which reduces the materials needed for a building and had been used on a steel framed projects in the City of London, were examples of steel being used in a lean and more sustainable way.

Members of the BCSA and the Register of Steelwork Contractors are eligible to sign up to the Charter. Companies listed below are signatories:

ACL Structures Ltd
Allerton Engineering Ltd
Atlas Ward Structures Ltd
Barrett Steel Buildings Ltd
Billington Structures Ltd
Bourne Steel Ltd
Butterley Ltd
Cairnhill Structures Ltd
Caunton Engineering Ltd
Conder Structures Ltd
Elland Steel Structures Ltd
EvadX Ltd
Fairfield-Mabey Ltd
Fisher Engineering Ltd
Frank H Dale Ltd
Graham Wood Structural Ltd
John Reid & Sons (Strucsteel) Ltd
Kingspan Metl-Con Ltd
Leigh's Paints
Rowecord Engineering Ltd
Rowen Structures Ltd
Severfield-Reeve Structures Ltd
Structural Sections Ltd
Traditional Structures Ltd
Warley Construction Company Ltd
Watson Steel Structures Ltd
Westok Ltd
William Hare Ltd

New steel guidance launched

A new feature called Steel Industry Guidance Notes (SIGNS) starts in this issue of NSC. SIGNS are short, two page inserts that will give practical advice on technical, commercial, legal, marketing and health and safety issues that will build in to a comprehensive set of notes on key aspects of steel construction. The audience for SIGNS includes clients, architects, M&E contractors, QS and engineers.

Each guidance note, which will also be carried on a number of web sites, will contain practical advice on the back page making the advice easy to locate, assimilate and apply. They will also contain either a contact point for further information or a list of up-to-date references where additional information can be found.

Each guidance note will be periodically reviewed and updated to ensure that only the most relevant and up-to-date information is available on the web site versions.

The first guidance note is issued with this edition of NSC, and explains the basics of acoustics and shows how steel framed buildings can meet the acoustic requirements for all building types. Future issues of New Steel Construction will include Steel Industry Guidance Notes on other topical issues such as:

- Tolerances
- Health and safety
- The economies of steel design
- Vibrations
- The most important items in a contract

SIGNS can be freely downloaded from the following web sites:
New Steel Construction – www.New-Steel-Construction.com
Steelbiz – www.steelbiz.org
BCSA – www.steelconstruction.org
Corus – www.corusconstruction.com/structuralsteel

Trusses span Wales conference centre

Erection of 356t of steelwork and an additional 49t of trusses forming part of a large extension and refurbishment of the North Wales Conference Centre & Theatre in Llandudno, has been completed by The A A Group.

Construction on phases one and two of the project began in October 2005 and involved extensions on the east and west sides of the existing building. The third phase of works will be to refurbish the original conference and theatre facility.

The east side will become a large arena constructed with 36m span steel trusses. The west side will house the building's amenities including cafeteria and new main entrance.

The A A Group will return to the project in May 2006 to install the interfaces between the new steelwork and the existing building which will involve erection of a further 8t of steel.

Phases one and two of the £8.6M project are due to be completed in April. The third phase is expected to be completed during October 2006.

NEWS IN BRIEF

Work to strengthen the Coalport Bridge in Shropshire has won a prestigious Historic Bridge & Infrastructure Award from the Institution of Civil Engineers. The bridge, which spans the River Severn, received bonded steel plates to reinforce cast iron arch ribs.

Construction traffic and pedestrians were carried during the works by a temporary steel girder bridge designed and built by **Mabey Support Systems**.

First Minister for Wales Rhodri Morgan opened a new manufacturing facility for **Rowecord Engineering** in Newport last month. The £2.5M investment includes new shot-blasting and spraying facilities, pipe-cutting and steel cutting machines and a precision plasma cutting machine.

REID Architecture has designed a new 46m high control tower for Newcastle International Airport. The proposed tower is of circular plan form, with a narrow stem that expands towards the top and splays out at the base.

The tower is to feature a steel frame at the base and to support some of the upper section and the structure will incorporate stainless steel cladding.

Structural and engineering work will be carried out by Arup and construction work is expected to commence in March 2006 and finish in September 2007.

Bourne Parking Ltd – a subsidiary of Bourne Steel – has been awarded a £2M contract from Lichfield District Council to design and build a 277 space semi basement car park and a 116 space temporary car park.

The company is also to design and build a 220 space, single deck car park to serve a new accident and emergency department at Coventry Hospital on behalf of Skanska in a £1.3M deal.

Corus website gets upgrade

Corus re-launched its construction website in November after a complete redesign.

"The website needed a revamp to give it a better structure and make navigation easier" said Corus Construction Development Manager Mike Webb. "The site is now divided up according to different types of construction components followed by an easy to use menu system."

To aid users looking for specific information, a new and improved search engine has also been added, which provides a much quicker and more accurate service.

"We have always been and remain proud of the content of all of our construction website, which continues to be aimed at providing information rather than selling products," added Mr Webb.

As well as revamping the site www.corusconstruction.com all of Corus' other websites have received improvements to aid the user and reinforce the corporate style.

Metsec purlins rise to challenge of complex roof

Construction of a new £2.6M Information & Communication Technology Learning Centre near Mansfield has found Metsec's zed purlins equal to the task of accommodating a complex roof design. The steel framed two-storey building has around 10 different roof shapes and set-outs of varying lengths, dimensions, tapers, pitches and hip ends, and required a single-span purlin layout. Adding to the complexity is an unusually high wind load due to the building's exposed location in Sherwood Forest and the requirement for the purlins to be set inside the rafter flanges to accommodate architect Patel Taylor's desire for a shallow perimeter parapet.

Purlin sections mainly 202mm deep of various sizes and gauges depending on span and totalling 15t were designed and detailed by steelwork fabricator Crown Structural.

"Crown Structural specified Metsec as the most structurally efficient and cost effective solution for the complex roof," said Sales Director of Metsec's Purlins Division, Kevin Jones. "StruCad drawings were electronically checked and the data used directly to programme our rolling mills. Sections were delivered to site with individual markings to make identification and erection quicker and more straightforward."

Credit insurance pays dividends

One of the largest payouts under the BCSA's Insolvency Protection Scheme has been awarded to a member following the insolvency of contractor RC Group Limited in Summer 2005.

The insurance payment for the six figure bad debt was made within four weeks of the claim submission to insurers, leaving the BCSA member Finance Director: 'Absolutely delighted. Over the moon.' Liability had also been admitted for all the retention payments that were payable, but not due, under contracts with RC Group.

The failure of RC Group came suddenly, surprising BCSA members and insurers alike. Cover was being provided on RC Group by credit insurance companies for amounts way in excess of the resultant bad debt mentioned above. RC Group's payment performance was prompt and the available financial accounting information on RC Group prior to the insolvency was satisfactory. BCSA Legal Director Marion Rich said:'This is, unfortunately, only one example of a bolt out of the blue as, according to insurer's statistics, over 50% of corporate failures are from businesses that had hitherto been good payers.

The failure of RC Group is an excellent example of how a failure can occur despite all the sophistication that surrounds credit management these days. The speed of the claims settlement is testament to the wisdom of the BCSA member to insure under the Scheme.'

Members of the BCSA have exclusive access to this credit insurance Scheme, organised by broker IRC.

Diary

8 - 11 February

North American Steel Construction Conference

An opportunity for professionals in the steel sector to learn about the latest design and construction trends and techniques.
Henry B Gonzalez Convention Center,
San Antonio, Texas. www.aisc.org

27 March

Designing for Fires in the UK – can we learn from the NIST report?

The NIST report will have an impact on fire engineering in the US. What effect will it have on the designing of tall buildings in the UK?
Institution of Civil Engineers, London
Visit www.iceconferences.com/fire

23 – 27 April

Interbuild 2006

An exhibition showcasing best practice, recent technological advances and new product development in the building industry.
NEC, Birmingham
Entry is £20 on the day, but free to visitors who register in advance. Visit www.interbuild.com

Young engineer high on performance and promise

Young Structural Engineer of the Year Sally Preston displays both confidence and competency – and an already well developed appreciation of the uses of constructional steelwork as Ty Byrd discovers.

Apart from being an extremely bright young structural engineer, Sally Preston, 27, is both pleasant and polite. She just about stifles a small sigh when asked, at the beginning of her interview for this profile, what her title is. "Ms," she replies. No, what is her professional title? "Oh, Senior Engineer with Buro Happold," she says, smiling at her mistake. You get an early sense she is expecting questions that are gender based and that she does not much approve of them. "That's right," she says. "I think construction (via its press) shoots itself in the foot every time it reaffirms 'the challenges faced by women in such a male dominated industry. Once a woman has proved herself, construction in general – and structural engineering in particular – is great. Emphasising this would encourage more females into engineering and result in much more talent becoming available to the industry."

That Sally Preston is talented herself was recognised last November when she was presented by the Institution of Structural Engineers with its 'Young Structural Engineer of the Year' award. This is made to a young engineer 'who has demonstrated outstanding performance and who shows exceptional promise for the future'. Sally got her award for the part she is playing in the Palestra project, the 12 storey office development in London's Waterloo (NSC April 2005).

"Getting the award was just fantastic," Sally says. "Quite apart from everything else, it looks good on my CV." She is not looking for her next career move just now, she says, as she continues to enjoy life with Buro Happold "and I still have much to learn from the firm". But the ambition shines out of her and it would be no surprise in a decade or so to see an innovative structural engineering practice bearing the name Buro Preston, or some such, headed up by herself. "That is what I would really like," she says. The intention to run her own business is possibly genetic: her father is civil engineer Ian Preston who is managing director of design and build steel bridge company CTS of Huddersfield, which he founded. She recalls: "Dad actually advised me against becoming an engineer because the pay is rubbish."

"Once a woman has proved herself, construction in general – and structural engineering in particular – is great"

Nevertheless, Sally took a four years masters degree in structural engineering and architecture at Sheffield University. She leaned at this stage towards architecture but on graduating decided first on a year in structural engineering – which has now stretched to five years. "Structural engineering, especially with a firm as creative as Buro Happold, is an intensely satisfying discipline. Problem solving comes into it, of course, but so does constructability and also aesthetics. I get the opportunity to make sure structures have a form that is easy to build, that stand up and continue standing, and look good."

She has spent most of the last four years on Palestra, a £68M development described as structurally very challenging. "I worked on the structural design, then on site, and my role has grown as I gained experience. I have managed the project for the last 18 months." She waxes lyrical about Palestra's structure, particularly its raking columns, composite cellular beam floors and the integration of structure and services. She displays a tremendous enthusiasm, in a vaguely sardonic manner. Most of all, she demonstrates ease with her ability. She is bound to go far.

Sustainable and flexible steel lifts Olympic gold

Above: The Olympic stadium in 'legacy' configuration with the upper tiers of seating removed to reduce capacity to 25,000

The London 2012 Aquatic Centre will be partitioned to allow competition and leisure use to take place alongside each other after the Olympics

London's successful bid to host the 2012 Olympic Games was anchored in a promise that many of the new sport venues would be flexibly designed to allow relocation or reconfigurement. David Fowler reports on the crucial role which steelwork will play in meeting these sustainable objectives.

Past Olympics have created a legacy of white-elephant stadia, inflexible facilities which see little use afterwards and tarnish the image of the Games themselves. The International Olympic Committee is keen to call a halt to this, and London 2012's candidate document — the official submission to the IOC — explained how the legacy costs of staging the Games could be cut, while still providing high quality facilities: "We are using existing venues wherever possible and temporary buildings where appropriate. We are only building new venues where clear legacy needs have been identified."

Four arenas are to be built to enable the Games to be held were identified as being capable of removal afterwards for rebuilding elsewhere in the UK. Many of the permanent venues, including the main 80,000 seat stadium itself, are being designed to be reconfigured with a reduced seating capacity to make them better suited to post-Games needs.

The origins of this approach can be seen at a number of locations around the world; in the UK it was first adopted for the Commonwealth Games in Manchester, where the organisers only built structures for which a later use had been identified. The City of Manchester athletics stadium was designed to be converted afterwards into a football ground, becoming the new home of Manchester City FC as well as helping to catalyse the regeneration of a former area of heavy industry.

Following on from this approach designers are looking at fully-demountable venues as a practical way of helping countries in the developing world cope with the expense of hosting an Olympic Games. The expense has given rise to anomalies such as the fact that although many Olympic medal winners have been of African origin, the Games have never been held in Africa. Using previously-used stadiums which could be dismantled from a western host nation and re-erected could bring the hope of staging the Games within the reach of many poorer countries.

Thinking like this is behind the decision to produce an alternative, relocatable design for the main 2012 stadium that has been proposed jointly by the project architect and structural engineer of the Manchester stadium. "Steel construction has a number of inherent advantages for this type of approach," says Mike King of Arup. "It has a good strength to weight ratio and it's easy to design connections that can be pulled apart and

Below: The Manchester City Stadium in its 'legacy' configuration as a football stadium

Courtesy of Arup

Olympic images courtesy London 2012

reassembled again, so a structure can be broken down into small parts for transportation."

Most of the new venues for London 2012 have only been designed in outline and contracts for detailed design will soon be awarded. However the Olympic delivery authorities clearly intend to make many of the venues adaptable or relocatable and designs were developed sufficiently for the purposes of the London 2012 bid to establish their feasibility.

All four of these arenas could be relocated anywhere in the UK and be used in a variety of roles

For example, the Aquatics Centre has been conceived as a steel-framed structure with lightweight geogrid roof, housing a 50m Olympic standard competition pool, a 50m warm-up pool, a 25m diving pool and two water polo pools with capacity to seat 20,000. After the games the water polo pools will be relocated. The building will be partitioned, leaving one Olympic pool to be used for international standard swimming competitions, with seating for 3,500, and the other pool being used as a leisure facility as part of a health and fitness centre.

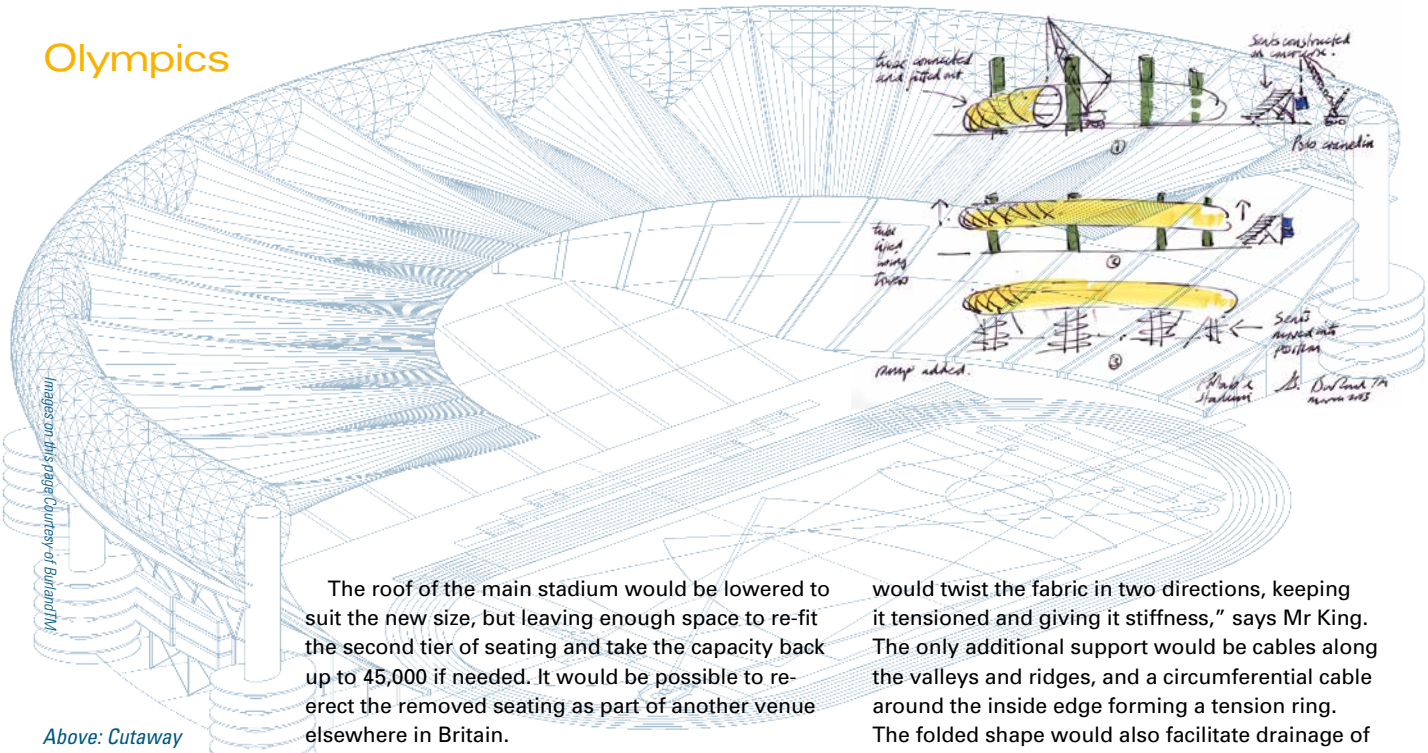
Four arenas will be built using a modular system designed by a team led by Laing O'Rourke and including structural engineer Robert Bird & Partners (formerly Bird, Marshall & Partners), Taiyo Membrane Corporation, services engineer Crown House Technologies and quantity surveyor Franklin Sports. Two of these will be 12,000 seat arenas, built in the Olympic Park for volleyball and basketball and for the fencing and shooting parts of the Modern Pentathlon. A temporary 6,000 seat arena on Greenwich Peninsula will house rhythmic gymnastics and badminton, and a temporary shooting hall will be built at the Royal Artillery Barracks, Woolwich.

All four of these arenas could be relocated anywhere in the UK and be used in a variety of roles. One of the larger arenas could provide a regional training and competition venue for a range of indoor sports; other possibilities include use as a local authority sports hall, or for large-scale events including pop concerts.

The modular system is based on bolted structural steelwork elements combined with pre-cast concrete plank floor units and seating. Lightweight cladding panels designed for fast assembly and disassembly will be used for external walls. The roofs will be of Teflon-coated glass fibre. Provision for lighting, scoreboards and multimedia would be included. Services, plant rooms and facilities such as toilets and changing areas would be prefabricated. It is estimated that the buildings could be re-erected for 30% less than the cost of building an equivalent venue from scratch in the new location.

The main £450M Olympic stadium designed by HOK Sport and Foreign Office Architects would hold 80,000. In their indicative design the main grandstand would be retained after the Games, but elsewhere the top two tiers of seating could be removed, leaving only the lowest tier and a seating capacity of 25,000.

Above: Four arenas will be capable of re-erection elsewhere after the Games, including one hosting Olympic volleyball



Images on this page courtesy of BurlandTM

Above: Cutaway axonometric view. The folded fabric roof would be supported by a cable tension ring at its inner edge. The seating units would be constructed in segments outside the stadium and slid into their final position.

The roof of the main stadium would be lowered to suit the new size, but leaving enough space to re-fit the second tier of seating and take the capacity back up to 45,000 if needed. It would be possible to re-erect the removed seating as part of another venue elsewhere in Britain.

Involving a steelwork contractor at an early stage delivered significant benefits for an even more radical design which has been proposed by James Burland and Mike King, who were respectively Project Design Director and Structural Engineer on the City of Manchester stadium, which could be completely dismantled and moved after the Games.

Mr Burland, formerly Head of Design at Arup Associates and now head of his own firm BurlandTM, and Mr King, an Associate at Arup, brought in Watson Steel Structures to advise on practical issues. Watson had erected the Manchester stadium roof and before that the Millennium Dome,

Their original idea was for a conventionally-shaped stadium with an oval playing area contained within a structure with a rectangular footprint. "Watson's advised us that we needed something really repetitive," says Mr Burland. This led to the idea of a circular structure which provides a constant radius for the seating terraces, giving the necessary repetition.

The seating terraces would be at a fairly steep rake of 42 deg to keep the structure as compact as possible and provide good sightlines. Inset seating for VIPs and media would be provided along the long side of the track in front of the main seating tiers.

A cable net roof would be used as at the Manchester stadium. The main structural element in the design is a huge compression ring around the exterior, supported on large diameter tubular-core structures which also form the basis of spiral entrance ramps. The ring, a diagrid structure made up of universal column sections, would be three storeys deep and could provide 29,000m^2 of floor space. With its supports, it could be built in advance to house offices for the Olympic organising committee before and during the Games as well as VIP facilities, a media centre and other facilities.

The ring could be pre fabricated — and fitted out — offsite or on the ground and winched or jacked up the columns. For transport to a new location it would be broken down into modular units.

The roof canopy would be a lightweight, translucent fabric folded into a zig-zag shape along the outer edge, but flat at the inner edge. "This would twist the fabric in two directions, keeping it tensioned and giving it stiffness," says Mr King. The only additional support would be cables along the valleys and ridges, and a circumferential cable around the inside edge forming a tension ring. The folded shape would also facilitate drainage of rainwater to the outer edge.

The seating terrace frame structures would be made from steel sections, each element being around 8m–12m long, assembled in segments independently of the roof, and slid into their final position. "The geometry would be repetitive and as simple as possible," says Mr King. "We would use steel because its strength to weight ratio is better than anything else commercially viable at present."

"We would use steel because its strength to weight ratio is better than anything else commercially viable at present."

For the seating itself, Burland and King propose using folded aluminium units spanning between the steel members. "Normally you'd use precast concrete, but with anything built in concrete it's difficult to argue it's transportable," says Mr King.

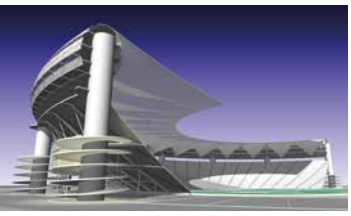
Prefabricated pods for toilets and washrooms would be added outside the stadium, and the whole structure would be 'dressed' by a simple additional square structure around it to provide an entrance foyer, ticket barriers and so on. This would not be an integral part of the scheme, though a similar idea with signage and banners to suit could be applied on subsequent uses. The cladding of the compression ring could also be changed as appropriate.

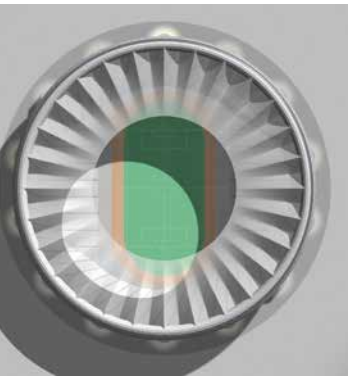
Burland and King's target cost had been £100M for an 80,000 seater stadium; the eventual design has been costed at £120M, which is still an economic price. Mr Burland pays tribute to the assistance of Watson Steel Structures in developing a practical design, and EC Harris in costing it.

After the Games the vacant site could be given over to mixed used development, using the drainage, roads and other infrastructure put in place for the stadium. "We will put in a bid for 2012 when the stadium goes to tender," says Mr Burland. "It would be terrific to have something to gift to Africa. The regeneration effect of staging the Olympics there would be incredible."

(This article is a shortened version of one that first appeared in Structural Engineer 1 November 2005)

Below: A cutaway rendering of the stadium Bottom: Plan of stadium shows the profile of the fabric roof. The circular form of the stadium allows the seating terraces to be structurally repetitive.





Steel shows a sustainable future

A strong and clear picture of a constructional steelwork industry in robust good health and confidently looking forward emerged from the 2005 Steel Construction Conference in London. Nick Barrett reports.

BCSA Deputy President Richard Barrett shares a joke from the podium

The conference theme was 'The Way Ahead', and the way was well signposted by a succession of case studies of successful projects ranging from steel's traditional core business areas such as commercial developments, to new growth areas like multi storey residential and healthcare. Satisfied clients took the rostrum to describe how using constructional steelwork is allowing them to meet their highly demanding business objectives.

The way ahead is obviously going to be a sustainable one as this was a constant theme from successive speakers. Appropriately enough the BCSA Sustainability Charter was formally launched at the conference by Professor Roger Plank of the University of Sheffield (see News). Good news was also heard on progress on preparing for the introduction of Eurocodes. A debate on the future construction market was introduced and chaired by John Humphrys of BBC Radio 4's Today programme. Fairly steady growth of around 3% for the coming year was the forecast, he said

The way ahead is obviously going to be a sustainable one as this was a constant theme from successive speakers

Sustainability featured in BCSA President Donal McCormack's address, as he reaffirmed the steel sector's commitment to achieving 100% recycling of steel, compared to the already creditable 90%. He looked forward to seeing the industry respond to the challenge of the London Olympics, with a total of 250,000t of steel predicted to be needed by Games related projects.

First up for the client side was Richard Elliott, Head of Construction with one of the UK's biggest property companies, British Land, who stressed the growing importance of sustainability to large property companies. Achieving sustainability objectives was now embedded into every British Land development, 'We have to prove the sustainability of our schemes,' he said. British Land's Sustainability Brief detailed steps that must be taken at every stage of a development to ensure that all sustainability issues are considered. For example, the construction team should consider setting a target for the percentage of the building that can be built from recycled materials. The reuse of materials has also to be considered, so bolting rather than welding of steel is preferred. Offsite fabrication is another area of preference.

'Steel has obvious advantages,' he said. Offsite fabrication meant a safer working environment, for example, as well as increasing productivity and reducing waste. Steel also allowed easy future modification of buildings to meet changing needs and reduces the need for wholesale redevelopment. It was no surprise then to hear Mr Elliott say: 'The majority of our schemes use steel.'

Chairman of the morning session, Steel Construction Institute Chairman Peter Head, said changes in the planning system underpinned the importance of sustainability. It was now absolutely necessary due to legislative changes to be able to measure deliverables against targets in Local Development Frameworks. Launching the Sustainability Charter, Professor Plank said clients are demanding that sustainability be placed on the agenda. Advances like structural fire engineering, which reduces the materials needed for a building and was now being used on City of London projects, were examples of steel being able to work in a lean and more sustainable way.

The debate on the future construction market, chaired by John Humphrys, who started with a review of the forecasts for the next two years,

The Swale Bridge was originally designed as a concrete box deck.

concluding that steady if unspectacular growth was on the cards. A lively debate involved questions from the floor fielded by a panel comprising Richard Elliott of British Land, Aaron Morby of Construction News, quantity surveyor Launce Morgan, and BCSA Deputy President Richard Barrett.

A delegate from the floor asked if there were any changes in the way construction projects were managed that would impact on the steel sector. Mr Elliott said Construction Management was still favoured by British Land, and under this procurement regime tenders would be sought from only one or two steelwork contractors. Selection would be based on their proposals, not just price. Richard Barrett said Partnering is still building momentum, and was preferable to the sealed bid tender approach.

Mr Humprhrys asked why clients did not involve the supply chain earlier in the project cycle. Mr Morgan said architects used to be relied on for specialist advice, but that advice was now elsewhere in the supply chain. Overall costs of using partnering approaches were no more than traditional ways of working, but administration and other costs could be higher with earlier involvement of the supply chain.

Mr Humphrys noted the large amount of smaller companies in construction; was consolidation coming? Mr Morby said it was common now to see major UK contractors owned by global companies. But overseas steelwork contractors who came into the UK market from time to time had not lasted the pace.

"The sector can deliver with the current set-up"

Richard Elliott saw little prospect of much consolidation, as the market for steelwork was often still a local market well served by local suppliers. Richard Barrett said the steelwork sector is fragmented all over the world. Economies of scale are not so pronounced as they are for other industries. Medium sized firms were both fleet of

Using steel allowed creation of large open plan spaces at Manresa Road.

foot and happy to take the long term view. 'The sector can deliver with the current set up,' he said.

In the afternoon parallel sessions were held. One hall had seminars updating the position on Eurocodes for Buildings by BCSA Technical Director David Moore and for bridges by David McKenzie of Flint & Neil Partnership. Good progress had been made on both.

Case studies featured in another hall, starting with James Parson of Cass Hayward and Jeremy Sneddon of Fairfield Mabey who gave a joint presentation on Swale Bridge. The 92.5m main span structure is ahead of programme to finish in May 2006. Mr Parsons explained that the original design was a concrete box deck but this was rejected in favour of the more buildable steel design. Some 10,000t of permanent steel was used with 1,000t used for temporary works.

Alan Pottage of Severfield-Reeve Structures described the Blackburn Hospital, a design and build project in which 2,750t of steel was erected in 16 weeks to a framing plan from White Young Green. The National Health Service requirement for floor vibration response was easily achieved.

David Sands of Bourne Steel and Julian Simmonds, client for the 'Eight Star' Manresa Developments project to build up-market apartments in Chelsea, London, delivered a presentation on how they 'raised the barrier of excellence' to create what will be one of the most exclusive residential addresses in London (see NSC June 2005), with shell and core apartments costing up to £10M each.

Behind the 100m long retained façade are some of what have been called 'the swankiest pads the capital has ever seen', created using some 1,400t of structural steelwork. Mr Sands described how 22 pieces of steel were erected a day in a 100 day erection programme which finished one month early. Mr Simmonds, who put up his own capital to fund the project, described how he thought his personal presence on site enabled problems to be overcome quickly and promoted excellent on site relationships between all parties.

Mr Simmonds said using steel allowed the creation of large open plan spaces of 2,500 sq ft with no columns. 'Using steel saved having four columns in each unit,' he said. To the question would you do it again Mr Simmonds replied: "I would do it again. Undoubtedly, yes."

Nisa Today's' new UK headquarters near Scunthorpe includes new office space and goods distribution for 960 retail and wholesale members

Portals frame UK's biggest sheds

One of the largest sheds built in the UK has just been completed, fittingly enough a short distance away from the Corus steelworks at Scunthorpe. Jon Masters reports.

FACT FILE
Nisa Today's Headquarters
Main client: *Nisa Today's*
Architect: *Alan Johnson Associates*
Structural engineer: *WSP Group*
Main contractor: *Clugston Construction*
Steelwork contractor: *Atlas Ward Structures*
Steel tonnage: *1,750t*

Independent retailers and wholesalers in their hundreds jointly own and use the services of buyer and distributor Nisa Today's, gaining efficiency from their combined buying strength. So it seems appropriate that the organisation has made use of efficiencies that can be offered by steel construction, specifically a large portal frame structure, for its new headquarters.

At the heart of the new £30M development, at Foxhills Industrial Park near Scunthorpe, is a 56,000m² shed, designed, fabricated and erected by Atlas Ward Structures for Nisa Today's' Main Contractor Clugston Construction. Even though this is one of the largest sheds of its type in the UK, the period from design to completion of construction was a mere 12 months, including a 12 week steel erection programme.

"A few weeks after securing the order we are commencing fabricating, so we have to ensure each project is designed quickly."

Design of the steel frame and fabrication of the 1750t of steelwork was carried out at Atlas Ward's Sherburn offices and fabrication facility near Scarborough – one of 35 design and build shed projects completed by Atlas Ward this year. "It is fast track work," says Atlas Ward Design Engineer John Taylor. "A few weeks after securing the order, we are commencing fabricating, so we have to ensure each project is designed quickly. The calculations are submitted to the main contractor for building control check and then we are straight into fabrication."

Nisa Today's' new warehouse measures 351m in length, by 160m wide. Its portal frame consists of five 32m spans, with internal columns omitted on alternate frames, and 9m portal bay centres. Cellular valley beams were included to allow for services and sprinkler installation with galvanised PFC perimeter edge beams used instead of precast ground beams.

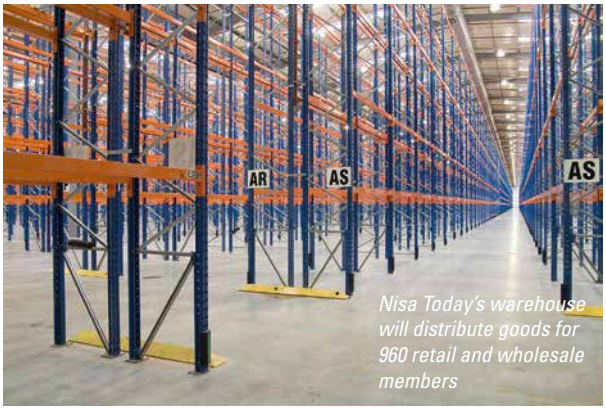
The shed also has three two-storey composite decked office buildings attached – one at a gable end and one along each side. This gives Nisa Today's over 60,000m² of new warehouse and office space, employing around 500 people and forming the new hub of the firm's UK operation.

This essentially involves buying and distributing goods to its shareholding membership – independent retailers and wholesalers supplying local shops. Retail members belong to the Nisa arm of the business and wholesalers to Today's. The organisation has 630 Nisa retail members operating some 5,000 shops, and around 330 Today's wholesale companies.

Business is on the up for Nisa Today's and the distribution sector in general, which is reflected in the continuing growth of steel shed construction. Atlas Ward Structures reports increased turnover and profits in the year that it became part of the Severfield-Rowen Group.

"We have had a very good year and current orders are strong, including various school and office design and build jobs as well as more shed work," says Atlas Ward Project Manager Ian Hunton. "The Nisa Today's project went very well. We have worked with Clugston Construction and their structural engineer WSP Group before, adopting a good professional approach that got the job finished on time."

Design to completion of construction took only 12 months including 12 weeks for erection of 1,750t of steelwork



Nisa Today's warehouse will distribute goods for 960 retail and wholesale members

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Right: The second lift goes up above the concreted level six

Steel delivers on post office site

A fashionable, modern apartment development has added a new lease of life to a stylish 1920s sorting office, as Margo Cole reports from Nottingham

FACT FILE
Marco Island, Nottingham
Main client: *Flambards*
Architect: *Franklin Ellis*
Structural engineer: *HSP Consulting*
Main contractor: *Ashford Construction*
Steelwork contractor: *DA Green & Sons*
Value: *£20 million*
Steel tonnage: *1,400t*

Like many British cities, Nottingham is undergoing a transformation. New fashionable bars, restaurants, shops and apartment buildings are springing up in previously run-down areas, regenerating former industrial buildings, gap sites and old offices.

One of the most ambitious of these developments is Marco Island, a newly completed project that has created 10 storeys of apartments on a prime city centre site. The views from the roof – and the two penthouses above it – are spectacular, but the view is not the only aspect of Marco Island that sets this £20 million development apart from other new apartment blocks in the city. The 10 storeys of new apartments have been built directly on top of an old Post Office sorting office, built in the 1920s and used up until 10 years ago, when a modern facility was built next door.

The original structure consisted of three storeys above ground and one basement floor, with a later, single storey of offices added on the roof. Although obviously functional, the sorting office was an elegant, curved building, clad in brick and glass, that filled one entire block of Nottingham's Huntingdon Street.

Post trucks loaded with mail were driven in at ground level through huge warehouse-style doors and their contents deposited ready for sorting on the floor above. To accommodate these activities, the ground floor had to be high and open enough to allow large vehicles to be driven in and out, while the first floor had to be strong enough for the heavy sorting machinery.

The structure was a steel frame consisting mainly of twin I-section beams, with additional steel plates up to 50mm thick riveted to the flanges to give extra strength. All the columns were encased in concrete for protection. The beams on the original grid were up to 25m in length, to facilitate the lorry movement and to span across the sorting equipment.

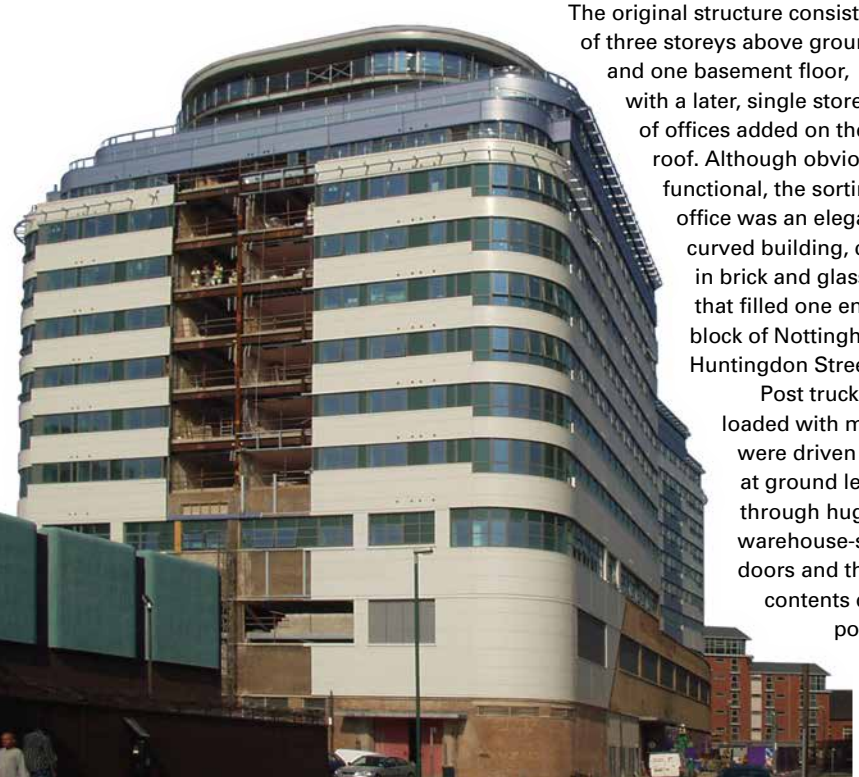
"It's really craftsmanship in steel"

Since the Post Office vacated the building several developers came up with different proposals to convert it, and eventually shied away – perhaps worried that the original building might not be able to cope with the extra load. But local property developer Flambards, together with architect Franklin Ellis, structural engineer HSP Consulting, contractor Ashford Construction and steelwork contractor DA Green & Sons, have proven that it could be done.

"This is actually an incredibly robust building," says Mike Baker, Project Engineer for HSP. "The beams in the sorting office were originally designed to take a live loading of about 10kN/m^2, and now the highest live load is 5kN/m^2 at the ground floor level."

Ian Burchnall, Contracts Manager for DA Green, is also impressed by the original construction. "It's really craftsmanship in steel," he says. "It's incredible when you compare the way this was built to the way we build now." The original heavy riveted steel frame has more in common with traditional shipbuilding techniques than modern steel construction.

In the new design, the basement of the old building will eventually be converted into leisure facilities - including a pool - while the ground floor will house restuarants and bars. the two floors have been converted into car parking, with the new apartment



Top: Preparing for construction of new mezzanine and stair core. Middle: An original column is exposed at the new mezzanine level Above: Both penthouses follow curved plans requiring major steelwork Below: The first lift is erected at the south end of the building as the original steelwork is exposed at the north end

block springing from what was the second floor.

The new building follows the curved shape of the original, although it steps back from the façade at third floor level for much of its area, and again near the top to give a hint of its main design reference – an elegant ship. Apartment space has been maximised by basing the design on a 9m x 12m grid. The apartments themselves measure 4.5m x 9m, with a 3m corridor between them.

Much of the new steel frame consists of 203 x 203 I-sections for the beams, and 305 I-sections for the columns, although they are reduced in size near the top of the building, where the loads decrease significantly.

To marry this new frame with the old steelwork, HSP designed new columns to be installed at basement, ground and first floor levels. At the locations of these new steel columns, steel web plates have been added to stiffen the existing beams to carry the loads through to the new columns. "Once we'd added the extra columns, the original frame was able to cater for the extra loading," says Mr Baker.

The only area where significant strengthening was needed was the second floor level. This was originally designed just to carry the roof and, even though it was later found to be strong enough to take the loads from the office that was built on top, superimposed loads were still very low. For the original steelwork at this level to be able to support the 10 floors of apartments above, it had to be beefed up, as Mr Baker explains: "The columns here were much smaller I-sections with no added flange plates. We strengthened them by converting them from an I-section to a box section by welding plates across the flanges. That made them stronger in every direction."

"It was an extremely complex job in challenging conditions."

Before welding could start, HSP commissioned tests of the existing metal to ensure it would be compatible with modern welding materials.

As well as looking at the original building' frame, HSP also investigated the foundations to make sure they could carry all the extra load. The sorting office was built on rock typical to the area - unweathered sandstone - which is traditionally assumed to have a bearing strength of 450kN/m^2. "Geotechnical reports suggest that it is probably at least 1000kN/m^2," says Mr Baker, "but the local authority told us that if we wanted to assume anything higher than 450kN/m^2 we would have to prove it." The consultant complied by commissioning boreholes, and discovered that the actual value was nearer 1200kN/m^2.

When HSP was brought onto the project, it was also asked if it would be possible to create a mezzanine between the first and second floors, to provide two levels of car parking beneath the apartments. Although the original first floor storey height was a generous 5.8m, splitting it in two creates two floors with very low headroom. The only way HSP could make it work was by specifying the Slimdek® composite floor system, supplied by Corus. This consists of a hot rolled asymmetric beam and a deep deck, which bears onto the wider bottom flange. Concrete is then poured to create a floor slab, which is thinner than that normally achieved in ordinary composite construction. As the beam is encased up to 60 minutes fire resistance can be achieved without the need for additional fire protection.

The mezzanine floor is just 380mm thick, which gives a headroom of 2.3m between the floor and the underside of the original beams, spanning 12m across the car park. During construction of the new floor the main support beams were pre-cambered up to 50mm to take out dead load deflection as the slab was cast.

The columns on the two car park levels have all been protected by concrete blockwork. Mr Baker explains: "We couldn't dry line them because of the problem of impact. And if they were painted you would be constantly repairing them all the time, so we went for blockwork, which provides impact protection as well as fire protection."

To give the entire building stability, the new 10-storey extension has been designed as a braced frame, with diagonal steel plate bracing fixed within the new lift and stair cores and additional bracing between apartments. HSP decided that, instead of trying to prove the existing structure as a sway frame, the new bracing would continue down through the existing structure to the ground floor.

DA Green, which has a long, successful working relationship with main contractor Ashford, advised on sequencing at the start of the project, and integrated its work with the contractor to develop the most efficient method for erecting the new frame. "We built it up three floors at a time, splitting the building into two halves," explains Ian Burchnall. "We used lightweight cherry pickers, which could reach three floors at a time, and worked out that, while we built half of the frame for three floors, they could net, deck and concrete the other three floors."

He commends the commitment of his site erectors and welders saying: "It was an extremely complex job in challenging conditions."

Many of the 350 apartments have already been sold and occupied, and Flambards intends operating the remainder as an "apart-hotel" of serviced apartments. The client also plans to convert the ground and basement levels into conference facilities, swimming pool, bars and restaurant, adding to the buzz of this fast-growing quarter of Nottingham.

The north façade with most of the primary steelwork in place

Intumescent fire protection of tall buildings

Tests on intumescent coatings have demonstrated that they will provide protection against explosion and hydrocarbon fire as well as severe natural cellulosic fires. Dr Bill Allen of Leigh's Paints reports.

KEY POINTS

- **Should the Building Regulations' Fire Safety requirements be reviewed to improve fire safety in tall buildings?**
- **Leigh's Paints have subjected a number of Firetex intumescent coatings to explosion and hydrocarbon fire**
- **Can the construction industry learn from the Piper alpha disaster by adapting building codes to meet more demanding test requirements?**
- **Advantica Technology conducted an experiment to evaluate the resistance of Firetex thin film intumescent coatings to a gas explosion**
- **There was no sign of damage to any of the specimens due to the over-pressure generated by the gas explosion and the coatings remained intact**
- **The series of tests using more reliable and robust intumescent coatings has demonstrated that they will provide protection against explosion and hydrocarbon fire in addition to severe natural cellulosic fires.**

The Building Regulations for England and Wales, Approved Document B, entitled Fire Safety states "The building shall be designed and constructed such that, in the event of a fire, it will maintain its stability for a reasonable period". What is a reasonable period?

The same document gives fire resistance periods in terms of building height and use. These vary from 30 to 120 minutes and also can depend on whether sprinklers (active fire protection) are installed in the building. The fire resistance periods are achieved by applying insulating products (passive fire protection) to the structural steel members in the building. These materials have to satisfy the requirements of BS 476: Part 21 Fire Testing Standard for the period designated by Approved Document B. Essentially this involves testing loaded and unloaded steel columns and beams at a UKAS approved laboratory. The fire test regime is based on a standard cellulosic fire in a furnace where the rate of temperature rise is controlled to meet the standard heating curve. The fire test results are then assessed and the thickness of passive fire protection required for each steel section is determined. One important class of fire protection materials frequently favoured by architects and designers are Intumescent Coatings.

Should these requirements be reviewed to improve fire safety in tall buildings?

There is currently no legislative requirement within the UK for structural steel assemblies (where gas, oil and chemicals are not a hazard) to carry out any further testing beyond the requirements of the Building Regulations. Specifically there is no requirement for any testing or approval against the effects of explosion and/or hydrocarbon fire. A similar situation prevails in the rest of Europe and the USA, where only cellulosic fire testing is required to the appropriate National Standard.

Since the events at the World Trade Center in New York on September 11th 2001 many questions have been asked about the fire protection of tall buildings around the world. In order to provide an additional level of confidence and to address some of these questions in advance of any specific requirements, Leigh's Paints have subjected a number of Firetex intumescent coatings to explosion and hydrocarbon fire.

In September this year the opportunity arose to comment on the fire protection of tall buildings at the NIST Technical Conference on the Federal Building & Fire Safety Investigation of the World Trade Center Disaster.

Piper Alpha Disaster

On July 6th 1988 the UK had it's own catastrophic fire event, the world's worst ever off-shore oil disaster. A gas leak followed by explosion and fire left 167 dead. The fire was uncontrollable and evacuation was difficult. This event radically changed the oil and gas industry and it's treatment of fire safety.

Today epoxy intumescent fire protection is widely used provided it has been shown to survive the rigours of explosion and hydrocarbon fire testing and in many cases jet-fire testing.

Can the on-shore construction industry learn some valuable lessons from these tragic events by adapting building codes to meet more demanding test requirements.

In the event that an explosion precedes a fire, to fulfil its role in protecting the underlying structure from a fire, the intumescent coating must remain intact and well adhered both during and after the explosion. Leigh's Paints contracted Advantica Technology (formerly British Gas Technology) to

conduct a gas explosion experiment to evaluate the resistance of Firetex thin film intumescent coatings to the explosion.

In addition to the above experiments Leigh's were invited to place a steel column section coated with Firetex intumescent inside a fire compartment in a multi-storey test building at the Building Research Establishment in Cardington. This section of the building was then subjected to a severe natural fire exposure. The performance of this intumescent-coated steel section is also reported in this paper.

Gas Explosion experiment

The explosion experiment was carried out on a number of I-section columns coated with Firetex intumescent materials in a 182m^2 explosion chamber. The average peak over-pressure of 1697mbar was generated with an average duration of 104msec.

There was no sign of damage to any of the specimens due to the over-pressure generated by the gas explosion.

The experiment was conducted using an explosion chamber at the Advantica, Spadeadam Test Facility. The explosion chamber shown in Figure 1, measures 4.5m x 4.5m in cross section and 9.0m in length. The chamber has a vent opening on one of the 4.5m square faces, with all other faces being confined.

Four universal columns 254 x 254 x 132kg each 1.6m in length were positioned horizontally in the vent opening frame shown in Figure 2. The four beams were coated with a 90 minute intumescent thickness.

The test was ignited by a single low energy spark positioned at the back of the chamber opposite the vent opening and behind the banks of pipes. See Figure 2, a still photograph captured from the video at the height of the blast.

Pressure transducers were used to measure the over-pressure in the test rig, and video cameras were used to provide visual records of the test.

The average over-pressure measured by the pressure transducers was 1697mbar, with an average duration of 104msec.

When inspected visually post-test there was no sign of damage to any of the specimens due to the over-pressure generated by the explosion and the coatings were intact. (See Figure 3). These tests are

Figure 1: An explosion chamber at the Advantica, Spadeadam test facility

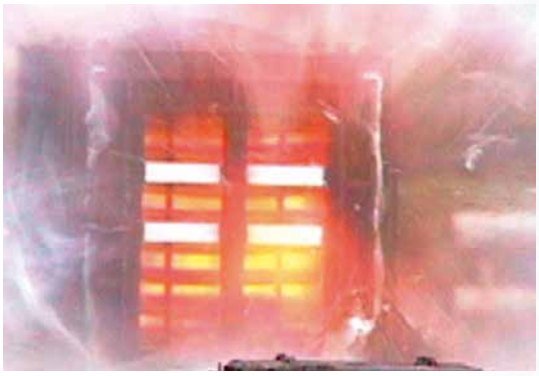


Figure 2: The test blast at its height

Figure 3: On inspection none of the test specimens showed any sign of damage

reported fully in Advantica Report No. 5539.

This poses the question; how would other fire protection materials perform in similar explosion conditions, and would the material retention be sufficient to offer adequate fire protection?

Following this experiment the test specimens were to further undergo hydrocarbon fire testing.

Hydrocarbon Fire Testing

The blast tested and control specimens were then subjected to a fire test which simulated the heating conditions specified in Appendix D of BS 476: Part 20: 1987. This appendix relates to a temperature relationship, which simulates fires burning hydrocarbon fuels.

Hydrocarbon fires are generally much greater in severity than cellulosic fires, as can be seen when comparing the standard BS 476: Part 20. (See Diagram 1)

It should be noted that the performance of these materials, which were designed for use in cellulosic fires, was excellent. On the whole in the hydrocarbon fire tests the materials achieved in the region of 60% of their expected performance in a cellulosic fire. See Figure 4 showing Firetex M78 intumescent on a steel column during a fire test.

These fire tests were witnessed by an officer of Warrington Fire Research and are reported fully in Warres Report No. C128566.

Performance of Firetex M78 in a large-scale natural fire

This report is concerned with the performance of an intumescent coating to a steel column section during a severe natural fire exposure. The performance in the natural fire is assessed against test data provided from a BS 476 Part 21 test on a similar section with a similar thickness of intumescent coating.

A 203 x 203 x 52kg universal column section 1m in length was protected was with 90 minute intumescent coating thickness.

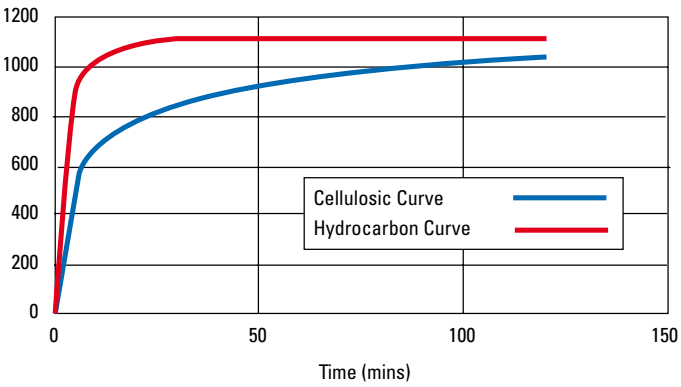


Diagram 1: Hydrocarbon fires are generally much gretaer in severity than cellulosic fires.

The location of the fire compartment on the third floor of the steel building at Cardington is shown in Figure 5

The figure also illustrates the severity of the fire during the post-flashover stage. The compartment floor area was 11m by 7m and the height of the compartment was approximately 4m. The time equivalence for this fire was calculated as 72 minutes. It was therefore considered appropriate to coat the steel column with a 90-minute fire protection thickness.

The results indicated that a steel member protected in a similar manner to the indicative test specimen with Firetex M78 would have maintained load-bearing capacity for the entire duration of the natural fire and for a period corresponding to an equivalent fire severity of approximately 100 minutes - see BRE Report No. 211576

Concluding Remarks

In conclusion the above series of tests using more reliable and robust intumescent coatings has demonstrated that they will provide protection against explosion and hydrocarbon fire in addition to severe natural cellulosic fires.

The author hopes that this paper will go some way to provide additional confidence in expertly formulated intumescent coatings when they have been subjected to far more than statutory requirements.

Figure 4: Firetex M78 intumescent on a steel column during a fire test

Figure 5: The fire compartment at Cardington in flames

New guide shows way to economies in fire safe design

A new edition of a guide based on major fire tests allows further economies to be made in the fire safe design of buildings. Gerald Newman, Manager – Fire Engineering at the Steel Construction Institute, explains.

In 2000, the first edition of a design guide based on major fire tests carried out between 1995 and 1996 on a composite metal deck steel frame at the Building Research facility at Cardington was published. It offered guidance on the design of composite steel framed buildings in fire based on lessons learned from these full-scale tests. The Cardington experience and other large-scale natural fire tests have shown consistently that the fire performance of steel framed buildings is much better than the performance of individual structural elements in a standard fire resistance test – the normal method of assessing performance in fire – might suggest. It was clear that even though most composite steel framed buildings are designed assuming that members are not continuous, in fire a real structure has appreciable continuity which creates a large reserve of strength, and that the amount of protection being applied to steel elements may be excessive and, in some cases, unnecessary.

The guide contains simple design rules that were based on the observed behaviour in the Cardington tests and on additional research carried out by BRE. By following the recommendations, it can be shown that many beams may be left without applied fire protection, thus allowing economies to be made in the fire protection requirements of some composite steel-framed buildings whilst still maintaining the required levels of safety. In this second edition of the guide - *Fire Safe Design: A New Approach to Multi-Storey Steel-Framed Buildings; SCI Publication P288 (Second edition)* - improvements have been made to the recommended design method which will allow some further economies to be made.

The Building Regulations in England and Wales are based on functional requirements; these outline what needs to be done but not necessarily how to do it. One of these statutory functional requirement states: "The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period". Approved Document B[1] gives practical guidance with respect to the statutory requirements and states that: "A fire safety engineering approach that takes into account the total fire safety package can provide an alternative approach to fire safety".

The Regulations in Scotland[2] and the Regulations in Northern Ireland[3] have recently changed and are now, like Approved Document B, based on the test of "reasonableness" and allow a fire safety engineering approach to be used.

The recommendations presented in the guide can be seen as extending the fire engineering approach in the area of structural performance and developing the concept of fire safe design. It is intended that designs carried out in accordance with these recommendations will achieve at least the level of safety required by regulations while allowing some economies in construction costs.

Recommendations are given on the following topics: compartmentation, column fire, protection, site control and connections. The main recommendations, to justify the use of unprotected secondary beams, are based on a structural model[4,5,6] developed by Professor Colin Bailey, formerly with BRE and now of the University of Manchester, that combines the residual bending resistance of the composite beams with the contribution of the composite slab, calculated using a combined yield-line and membrane action. A photo of a recent test on a floor slab carried out by Professor Bailey is shown in Figure 1. In the figure it can be seen that the slab has failed by fracture of the reinforcement in the longspan direction – exactly as predicted by the mathematical model.

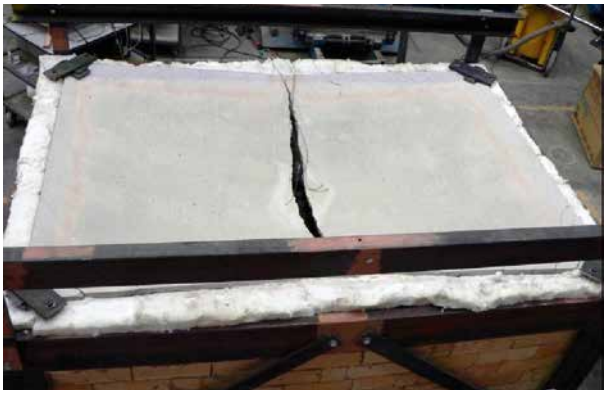


Figure 1: Failure of a slab in a fire test at Manchester University

The main design information is presented in a tabular format. These cover trapezoidal and re-entrant steel decks for 30, 60, 90 and 120 minutes. In the original guide, the fire resistance period for which the design method was considered to work was very conservatively limited to 60 minutes. This has now been extended to 120 minutes following experience of using the method and further research. The design tables are presented to enable an initial estimate to take place. It is recommended that all designs should be checked using downloadable software TSLAB, which may be downloaded from http://www.corusconstruction.com/en/reference/software, and is designed to assist engineers with final designs and with selecting the most appropriate mesh and slab depth.

The design method developed by Professor Bailey is based on calculating the slab strength at a particular value of maximum displacement. The displacement can be predicted from knowledge of the thermal curvature and elongation of the mesh. The loss of mesh strength due to heating is

also considered. The program TSLAB combines a thermal analysis of the slab with the Bailey strength calculations. The strength calculations are carried out at one-minute intervals and the lowest value is assumed to be the design value.

The fire safety requirements of many modern buildings are assessed using advanced fire engineering as an alternative approach to the more common Approved Document method. One of the techniques used is to adopt a natural fire model as an alternative to the standard fire. One commonly used model is a parametric fire model, described in EN1991-1,2[7]. Natural fire models take into account the size of the fire compartment, the number of openings and the amount of combustibles. Such an approach takes the designer away from dependence on the standard fire test and its limitations.

In a natural fire, after an initial development phase, the gas temperature rises very quickly but, after a time, when the bulk of the combustibles have been consumed, the temperature begins to fall. The temperature rise in a typical parametric fire and the temperature rise in the standard fire are shown in Figure 2.

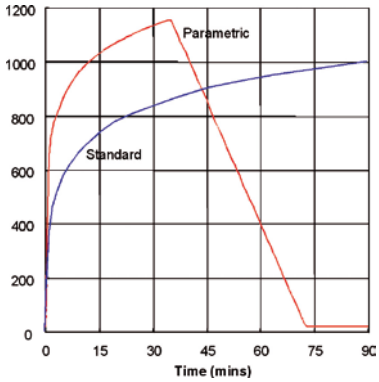


Figure 2: Parametric and standard (BS476 Part 20) temperature curves

The use of the parametric fire is discussed in the new guide but, because of the large number of different combinations of compartment geometry and fire load, the design tables are confined to the standard fire. The associated software can analyse floor slabs subject to a parametric fire, although the SCI recommend that this option should only be used by experienced fire safety engineers. For the parametric fire, in which the fire temperature rises and then falls, the slab capacity will reduce to a minimum value before increasing.

In this second edition, the model has been extended to use orthotropic mesh, i.e., meshes with different areas in each direction. Therefore, as well as the standard A series meshes, B series meshes are included. For rectangular floor areas, the lightest mesh will often be one with the ratio of area of main wires to area of transverse wires larger than that offered by a standard B series mesh. TSLAB will assist engineers in selecting the best mesh. In all cases, the mesh must meet the requirements of the appropriate design standard for the composite floor slab.

BS5950-8 gives three possible values for the imposed load partial factor. Tables are presented for a value of 0.5, i.e. it is assumed that the building in question is an office. It is also assumed that the fire is a standard fire. For other situations, the software can be used and the complete range of values may be entered into the software.

Type of load	Location/type	Partial load factor χf
Imposed	Office	0.5
	Escape stairs and lobbies	1.0
	Other	0.8
	Storage	1.0
Permanent	All	1.0

Example

The method of design developed by Professor Bailey and described here has been used on a number of buildings including the T Mobile headquarters building at Hatfield, Hertfordshire. The method was used to justify the removal of fire protection on a number of long span beams. A general view of the building is shown in Figure 3 and an internal view, showing the unprotected long span beams, is shown in Figure 4.

There were six buildings in the development, each of three floors. The mesh size was increased from A142 to A252 but this cost was outweighed by the saving on fire protection costs. The total saving was at least £60,000.

The consultant engineer was Baynham Meikle and the fabricator was William Hare Ltd.

Figure 3. General view of the building

Figure 4. Internal view showing unprotected beams

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1 ODPM, The Building Regulations 2000, Approved Document B, Fire Safety. TSO, 2000
2 Technical standards for compliance with the building standards, The (Scotland) Building Regulations,1990 (as amended 2001). TSO, 2001
3 Department of Finance and Personnel (DFP, Northern Ireland). The Building Regulations (NI) 2000. Technical Booklet E - Fire Safety TSO, 2005
4 BAILEY, C.G. and MOORE, D.B., The structural behaviour of steel frames with composite floor slabs subject to fire, Part 1: Theory. The Structural Engineer, June 2000
5 BAILEY, C.G. and MOORE, D.B., The structural behaviour of steel frames with composite floor slabs subject to fire, Part 2: Design. The Structural Engineer, June 2000
6 BAILEY, C.G., The influence of thermal expansion of beams on the structural behaviour of columns in steel-framed buildings during a fire. Engineering Structures Vol. 22, July 2000, pp 755-768
7 CEN. EN 1991: Eurocode 1: Basis of design and actions on structures. EN 1991-1-2, General actions - actions on structures exposed to fire 2002

Oral contracts need to be covered by the Construction Act

A frequent basis for challenging an adjudicator's jurisdiction is on the grounds that no written contract exists. BCSA Legal and Contractual Affairs Director Marion Rich calls for a change in the law to bring part-oral and part-written contracts within its scope.

It is a few years now since the Court of Appeal transformed our understanding of s.107 of the Construction Act (Part II of the Housing Grants, Construction and Regeneration Act 1996) in the case of ***RJT Consulting Engineers Ltd v DM Engineering (Northern Ireland) Ltd [2002] BLR ('RJT')***. This whole issue has been discussed before in New Steel Construction (May/June 2002 and Nov/Dec 2004) but no apology is needed for revisiting it: it is a vital issue for the whole of the construction industry.

To remind you, 107 is the clause that requires a construction contract to be evidenced in writing before the Construction Act applies to it. The plain wording of s.107 is so comprehensive that the widely-held view before RJT was that only wholly oral construction contracts would be outside the scope of the Act and that by far the majority of construction contracts would be covered.

What happens if a party simply ignores the request to agree for whatever reason?

In RJT, however, the Court of Appeal held that it was not merely the existence of a contract that had to be evidenced in writing but all of the terms of the contract (or possibly, all of the relevant terms). Difficulties arise because, as we are all aware, many, many contracts in the construction industry – perhaps most - are not fully reduced to writing.

So far, the answer of the courts to this problem remains that given by Her Honour Judge Frances Kirkham in *Debeck Ductwork Installation Ltd v T&E Engineering Ltd TCC 14 October 2002*:

> *'[Counsel] asks rhetorically what a claimant is to do in these circumstances if it wishes to obtain the benefit of the protection of the Act. It seems to me that the answers are quite straight forward. A contractor can require a contract to be reduced to writing. A contractor can at some later stage clarify the terms which he believes have been orally agreed and invite the other contracting party to agree that those are indeed the agreed terms of the agreement'*

So Kirkham J's answer is two-fold:

- A contractor can require a contract to be reduced to writing (presumably at the time the agreement is made), or
- A contractor can at some later stage clarify the terms he believes to have been agreed and invite the other contracting party to agree.

The second part of the answer is particularly interesting: what happens if a party simply ignores the request to agree for whatever reason? It appears that the first party will be left at the will of the other. It will have a contract other than in writing, unable to avail itself of the benefits of the Construction Act – unless the other party judges it worth its while to change its mind later.

It is clear that most challenges of this type can be easily dealt with by a robust adjudicator

But even the first part of Kirkham J's advice is a counsel of perfection and takes no account of the relative commercial strengths of the contracting parties. Yes, we should be encouraging proper documentation to be made and kept; but in the meantime, organisations should not be denied recourse to adjudication.

Policy

In *Grovedeck Ltd v Capital Demolition Ltd [2000] BLR*, His Honour Judge Bowsher QC gave a policy reason behind the approach of the courts (this was quoted with approval by in RJT):

> *'...disputes as to the terms, express and implied, of oral construction agreements are surprisingly common and are not readily susceptible of resolution by a summary procedure such as adjudication. It is not surprising that Parliament should have intended that such disputes should not be determined by adjudicators under the Act...'*

What are the problems?

Anecdotally, adjudicators report that their jurisdiction is now invariably challenged on the basis that the contract does not display a sufficient degree of writing.

It is clear that most challenges of this type can be easily dealt with by a robust adjudicator and indeed this was the wish of Lord Justice Ward in RJT. Adjudication, he said, would be 'emasculated' if a party were able to deprive the adjudicator of his power simply by putting up an argument that some term was or was not incorporated into an

agreement otherwise accepted to be in writing.

This is all very well but referring parties and adjudicators are left in the position whereby yet another argument has to be understood, refuted and tested before ever the substantive dispute can begin to be dealt with. One of the recurring themes of the Specialist Engineering Contractors' Group's research with its member companies has been that the cost of adjudication is increasing. One powerful way to reduce the cost of adjudication is to limit the number of arguments extraneous to the substantive dispute. These arguments cost money to investigate, argue and decide but they add nothing to the process.

One of the recurring themes of the Specialist Engineering Contractors' Group research has been that the cost of adjudication is increasing

And, of course, where adjudicators do act robustly, judges do not always agree – one example of this is *Lloyd Projects Ltd v John Malnick (TCC 22 July 2005)* where the judge agreed with the respondent that extra terms had been agreed orally, outside an ostensibly wholly written contract.

Construction Act Review

For the purposes of the review, working groups were set up to prepare reports for Sir Michael Latham's Review Group. Some of the discussions between the various different interest groups represented became very animated. There was one issue however on which everyone involved in the industry was agreed, without exception: that the decision in RJT was harmful and had to be changed, by legislation if necessary.

The consultation document prepared by DTI, however, was extremely disappointing in its response to this very strong recommendation – it merely noted:

> *'...we do not intend to consult on amending Section 107 of the Construction Act...'*

and, later in the document,

> *'We accept the Court of Appeal's interpretation as appropriate in the context of adjudication. It is essential that the adjudicator can identify easily the terms agreed between the parties. Time spent arguing over such terms would wholly undermine the intention of this statutory adjudication process.'*

This would not be an unreasonable line to take if in fact it meant that arguments had been reduced by the decision. This is not the case, as pointed out above. Much more realistic was the comment made by the adjudicator in Lloyd v Malnick, John Riches of Henry Cooper Consultants Ltd, that 'it would be a darn sight easier to deal with oral contracts than to wrestle with some of the jurisdictional issues that arise.'

Despite the policy behind the courts' and DTI's approach, there is no inherent reason why wholly oral contracts should not fall within the scope of the Construction Act: the New Zealand legislation (the Construction Contracts Act 2003) applies to both written and oral contracts and has not seemingly given rise to any particular difficulties.

It is also worth remembering that s.107 is in the same terms mutatis mutandis as s.5 of the Arbitration Act, which was drafted to encourage wide use of arbitration; it seems to have been successful in doing so. Perhaps it is unfortunate that such similar words are interpreted differently when they appear in the Construction Act.

Conclusion

Whether RJT Consulting was correctly decided or not – and it strains the meaning of parts of s.107 to breaking point – there can be no doubt that it has caused and continues to cause great difficulty, inconvenience and cost to the construction industry.

The construction industry frequently works in an informal manner, the more so the smaller the party. The smallest parties are those least able either to have the specialist knowledge to realise that all the terms (or all the relevant terms) must be in writing or to be able to impose such a requirement in their dealings with other, more powerful, contractors. It is thus these small contractors that are most likely to require the protections that the legislation provides and simultaneously the least able to ensure that they obtain them.

Small contractors are most likely to require the protections that the legislation provides and simultaneously the least able to ensure that they obtain them.

The answer is to change the legislation to make it clear that part-written, part-oral contracts come within its scope. Most in the industry are surprised that there is even any argument about this.

New and Revised Codes and Standards

(from BSI Updates October & November 2005)

BRITISH STANDARDS

BS 4:-
Structural steel sections
BS4-1:2005
Specification for hot-rolled sections
Supersedes BS4-1:1993

BS 4449:2005
Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification
Supersedes BS 4449:1997 which remains current

BS 4482:2005
Steel wire for the reinforcement of concrete products. Specification.
Supersedes BS 4482:1985 which remains current

BS 4483:2005
Steel fabric for the reinforcement of concrete. Specification
Supersedes BS 4483:1998 which remains current

BS 8666:2005
Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification
Supersedes BS 8666:2000 which remains current

BRITISH STANDARDS PROPOSED FOR CONFIRMATION

BS 499:-
Welding terms and symbols
BS499-2C:1999
European arc welding symbols in chart form

BS6779:-
Highway parapets for bridges and other structures
BS6779-1:1998
Specification for vehicle containment parapets of metal construction

NEW WORK STARTED

BS5950:-
Structural use of steelwork in building
BS5950-1:2000/Amendment 1
Code of practice for design. Rolled and welded sections.

DOCUMENTS NOT ISSUED AS DPCs

BS EN 1994:-
Eurocode 4. Design of composite steel and concrete structures
BS EN 1994-1:-
General rules
BS EN 1994-1-2
Structural fire design
This standard will shortly be prepared for publication.
Please submit any comments to the committee secretary (B/525/4).
Contact: Frank Thomas.
Email: frank.thomas@bsi-global.com

CEN EUROPEAN STANDARDS

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

EN 10027:-
Designation system for steels
EN 10027-1:2005
Steel names

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Disproportionate Collapse and the Building Regulations	17 January 06	Manchester
BS 5950-1: 2000 – Understanding the Essential Principles	18-19 January 06	Birmingham
Disproportionate Collapse and the Building Regulations	1 February 06	Southampton
Preparation for Eurocode 3	21 February 06	London
Frame Stability for BS 5950-1 and BS 449	28 February 06	Leeds
Composite Design	22 March 06	Bristol

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BCSA

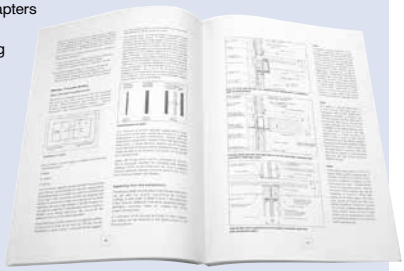
Health & Safety • Specification • Contracting • Assessment • Erection • Design

STEEL DETAILING - The Magenta Book*

Steel Details

This book provides practical advice on the issues that affect the efficient detailing of steelwork connections. There is always pressure in the design office to produce details which convert the client's aspirations in to nuts and bolts. The chapters on connection detailing, cost, simple design and basic fabrication give advice on how to create practical structures. Other chapters provide the reader with an insight into connection behaviour and the on-going developments in the 'green books'.

The publication also contains a rich array of architectural details from actual structures and allows both engineers and architects to interrogate them.



CONTRACTING - The Orange Book

The Contractual Handbook

A publication specifically for those not in the legal profession who are involved in aspects of construction contracting. Written in clear and under-standable language using non-legal terms.

CONNECTING - The Green Book*

Joints in Steel Construction: Simple Connections

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

STEEL BUILDINGS - The Silver Book

Steel Buildings

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

ASSESSING - The Brown Book

Historical Structural Steelwork Handbook

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

SPECIFYING - The Black Book

National Structural Steelwork Specification

Now in its 4th edition, the industry standard specification used in the majority of all forms of building steel framed construction; contains information on materials, welding, bolting, tolerances, etc.

GALVANIZING - The Beige Book

Galvanizing Structural Steelwork

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

DESIGNING - The Red Book

The Handbook of Structural Steelwork

This vital handbook gives practical design advice, worked examples, section properties and member capacities. This edition has been completely revised in accordance with BS 5950 - 1:2000.

SPECIFYING - The Grey Book

Commentary on the National Structural Steelwork Specification

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

BRIDGES - The Purple Book

Steel Bridges

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

Code of Practice for Erection of Low Rise Buildings

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

Code of Practice for Metal Decking & Stud Welding

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

Guide to the Erection of Steel Bridges

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

Guide to Steel Erection in Windy Conditions

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

Health and Safety in the Office

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

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

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

Health and Safety On Site

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

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BUILDINGWITHSTEEL

Special steel dock for aircraft tail

Constructed to simplify the servicing of the huge VC10 jets of the British United Airways' fleet at Gatwick Airport, this interesting dock is in halves which move inwards so that the catwalks completely encircle the tail unit.

The huge steel framed hangar built to house VC10 jets of the British United Airways' fleet was one of the major buildings completed at Gatwick this year. It was described in Vol 3, No 5 of *Building with Steel* (and in this section of *NSC* Vol 13, No 1 forty years later). The hangar incorporates a number of interesting features including 191 ft. cantilever roof truss girders which allow for an exceptionally large unobstructed area of floor space.

A tail dock of original design has now been constructed against the rear wall of this hangar to facilitate servicing of the tail plane, elevators, fin, rudder and port and starboard engines of an aircraft, all of which are a considerable height above floor level. The design of the dock is such that all of these vital parts can be inspected and serviced at the same time.

Composition of the dock

The dock comprises three structures, a central fixed unit and retractable port and starboard units. Integral with each retractable unit are two cantilevered catwalks which encircle half the rear end of the aircraft and completely encircle it when both units are brought together.

The fixed unit is mostly constructed from 6 in. by 6 in. stanchions and 7 in. by 4 in. beams, braced with rectangular hollow sections (RHS) of various sizes: these were fabricated throughout as single items for site bolted connections. The framework of retractable units is of similar dimensions: the catwalks are fabricated from RHS sections delivered as a fully-welded unit complete with guard rails and ready for bolting to the main frame. A feature of the cantilevers is the provision of hinged flaps in the floor at each level which allow the rudder operation to be checked while the whole tail plane is fully enclosed by the dock. Each of the three units is designed to carry loads of up to 80 lb./sq. ft.

Immense size

Some idea of the size of the dock may be gained from the fact that the fixed unit weighs 14 tons and has a base area of 50 ft. long by 15 ft. wide and is 35 ft. high: it has four flights of steps. The first two flights terminate at a landing at the 18 ft. catwalk level: the third flight is from the 18 ft. level to the 25 ft. catwalk level. The function of these two platforms is to provide direct access to the two cantilever catwalks on the retractable units. The fourth flight of stairs leads to the 35ft. level giving access to the top platform of the reatractable units.

Each retractable unit weighs 8 tons and on the base frame there is a series of rigid castors allowing movement of the units along metal tracks laid flush with the floor. Each unit is capable of up to 11 ft. sideways movement by hand-operated 2 in. diameter lead-screws, accurate alignment parallel to the front of the fixed unit being ensured.

For servicing purposes the aircraft enters the hangar tail first and is brought up to the fixed unit. Then, in a matter of minutes, the retaractable units are moved in from the sidesuntil the two sets of catwalks completely encircle the rear of the machine.

This tail dock was prodced as the result of a combined effort by British United Airways' engineers and the design staff of the steelwork fabricators.

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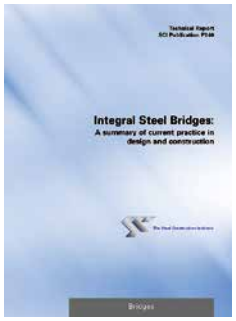

Integral Steel Bridges: A summary of current practice in design and construction
Catalogue Ref: P340
Author: DC Isles
ISBN 1 85942 166 0,
30 pp, A4 paperback,
December 2005

NEW BOOK

Integral Steel Bridges: A summary of current practice in design and construction

Since 1996, the extent of integral bridge construction has grown significantly and preferred forms of construction and construction details have developed. This Technical Report presents an overview of the forms that have been most commonly chosen for bridges with composite decks and discusses the details and the reasons for their adoption.

It presents a brief summary of current practice, based on the experience of designers and constructors actively involved in the construction of integral steel bridges. The report identifies the three principal configurations that are most commonly chosen and presents data about the numbers and types of steel highway bridge that have been built in the period since 2000. For each of the three configurations, the form of construction of the end supports are described and illustrated, and the particular design and construction issues are discussed.

The effect of skew on the design of the end supports is also discussed, the junction with the road pavement is mentioned and the choices for intermediate supports are presented.

PRICES: Non-member £20
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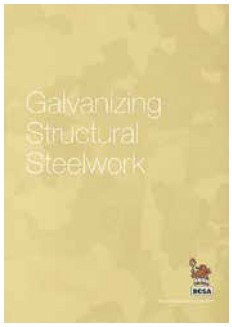

Steel Details
ISBN 0 85073 048 1
20 pp, A4 paperback,
September 2005

NEW BOOK

Galvanising Structural Steelwork

Liquid Metal Assisted Cracking (LMAC) can occur when steel components come in to contact with molten zinc. This form of cracking is uncommon but if it is not detected and repaired it can have extremely serious consequences on the performance of the structure. It is generally agreed that there are three main prerequisites for LMAC to occur. These are:

- Stress level
- Material Susceptibility
- Liquid Metal

Although the relative importance and the inter-relationship between these issues in increasing the risk of LMAC are largely unknown there is strong evidence to suggest that careful consideration of these issues with respect to the following activities can reduce the risk of LMAC:

- Design and detailing
- Type and quality of steel
- Quality of fabrication
- The Galvanizing process

This publication provides practical guidance to clients, specifiers and engineers on each of these topics to identify circumstances where any increased risk of LMAC can be ameliorated.

A post galvanized inspection regime is also suggested as a pragmatic approach to reducing the potential consequences of LMAC. It is recommended that the Engineer should specify 100% visual inspection after galvanizing for all structural steelwork that is to be utilised in building construction. In the event some LMAC cracks are found non-destructive testing (NDT) using Magnetic Particle Inspection (MPI) is recommended to determine the extent of cracking. Finally a welding repair procedure is described for repairing most cracks in a galvanized component. This involves removing the zinc from around the area to be welded, repairing the crack and restoring the protective coating with a zinc rich paint or similar system.

By following the guidance given in this publication and by committing a modest amount of attention to detail at each stage of the construction process the chances of LMAC occurring can be substantially reduced.

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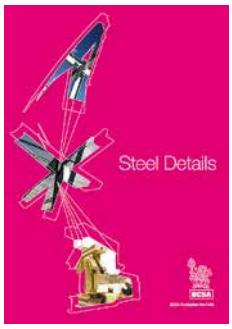

Steel Details
Edited by Roger Pope
ISBN 0 85073 049 X
186 pp, A4
November 2005

NEW BOOK

Steel Details

This book provides practical advice on the issues that affect the efficient detailing of steelwork connections. There is always pressure in the design office to produce details which convert the client's aspirations in to nuts and bolts. The chapters on connection detailing, cost, simple design and basic fabrication give advice on how to create practical structures. Other chapters provide the reader with an insight into connection behaviour and the on-going developments in the 'greenbooks'.

The reader is are brought up to date on developments in specialist areas of steelwork design and details. These include articles on bridgework, hollow section joints, tension connections, towers and masts and the recent developments with structural fasteners.

The publication also contains a rich array of architectural details from actual structures and allows both engineers and architects to interrogate them.

UK Price: £55.00, EU/Overseas: £63.00, Outside EU: £65.00
(BCSA members discount 25% - i.e. £41.25)
Available from: British Constructional Steelwork Association Ltd (Publications Department), 4 Whitehall Court, Westminster, London, SW1A 2ES.
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AD 294
Web panel Zones in Vierendeel Girders (Part 2) – hot-rolled sections

This is the second AD in a series on web panel zones in Vierendeel girders.

This AD provides advice on the design of the panel zone, or joint between the members, using hot-rolled sections. AD 293 provided advice on the distinction between F_{vp} and F_v (as described in clause 6.1.9 of BS 5950-1: 2000) and their method of calculation.

Resistance Checks

The joints in Vierendel girders must resist bending moments combined with shear and axial forces.

It is recommended that the joints be checked using BS 5950-1:2000 as follows:

1. Check that the web depth-to–thickness ratio is not more than 70ε, to avoid shear buckling.
2. The shear force F_v in the web panel zone (see AD 293) is checked against the provisions of clause 6.1.9 using the shear capacity P_v of the chord given by clause 4.2.3.
3. In the compression chord, the coexistent moment, shear and axial are checked against the provisions of clause 4.8.3.2, remembering to use M_{cx} for high shear from clause 4.2.5.3 where F_v in the web panel zone > $0.6P_v$. Clause 4.8.3.2(a) is used for sections of Class 1, 2 or 3. Clause 4.8.3.2(c) is used for sections of Class 4.
4. In the tension chord, the coexistent moment, shear and axial are checked against the provisions of clause 4.8.2.2, remembering to use M_{cx} for high shear from clause 4.2.5.3 where F_v in the web panel zone > $0.6P_v$.
5. The transverse web stiffeners in the chord, in-line with the flanges of the vertical members, are checked to ensure that they can transfer forces from the vertical member into the chord, in accordance with the requirements of Clause 4.5.

It is understood that some designers have checked the joints in Vierendeel girders using Clause 6.1.9 alone, without reference to Clause 4.8. In many girders, the Clause 6.1.9 check will be the critical check, but the designer should remember that it does not explicitly check the effects of coexistent axial load and bending.

The alternative of using Clause 4.8.2.3 for either tension or compression chords should not be used in cases with high shear ($F_v > 0.6P_v$) because it does not allow for the interaction of shear stress.

Strengthening the joints

If the chord sections fail the checks at the joints, the designer may prefer to strengthen the joints rather than choose different sections. Two common ways to strengthen the joints are by supplementary web plates, shown in Figure 1, and diagonal stiffeners, shown in Figure 2.

Advice on the design of these strengthening systems will be given in a subsequent AD.

It should be noted that *'Design of Welded Structures'* by Omer W. Blodgett published by The James F. Lincoln Arc Welding Foundation and several editions of the Steel Designers' Manual have been consulted and drawn upon for the preparation of this AD series. Designers are advised to consult these publications when dealing with more difficult cases than the simple cases covered in this series of ADs.

Contact: Thomas Cosgrove
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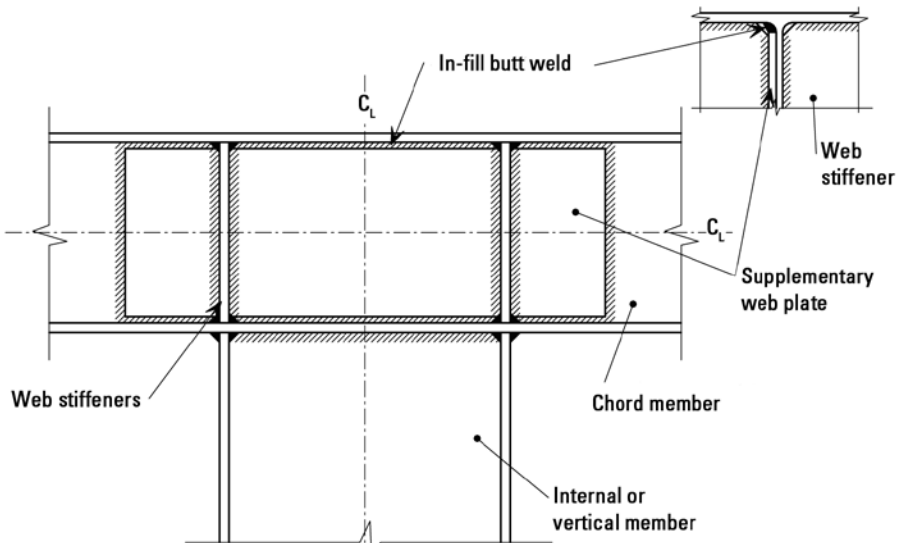

Figure 1. Supplementary Web Plate in Vierendeel Joint

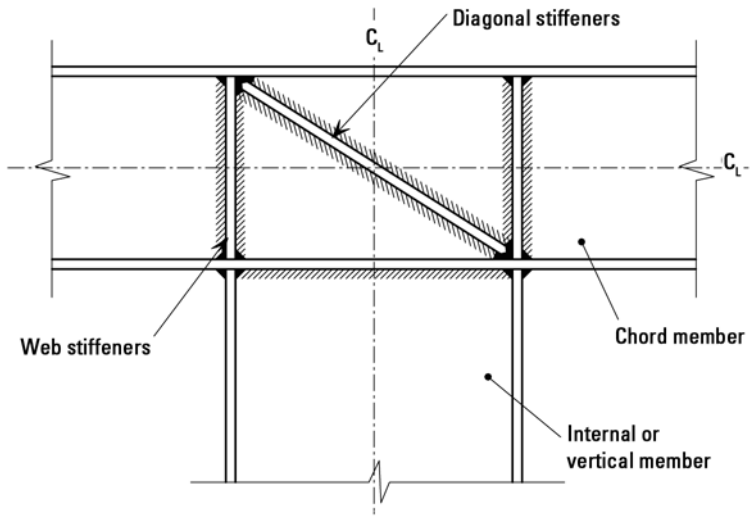

Figure 2. Vierendeel Joint incorporating Diagonal Stiffeners

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 steel 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

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- **Q4** Other

Classification Contract Value

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- **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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Bourne Steel Ltd
The Brazier Holt Partnership Ltd
Bridgetown Developments Ltd
The British Constructional Steelwork Association Ltd
British Energy Plc
British Nuclear Group
British Stainless Steel Association
Briton Fabricators Ltd
Browne Structures Ltd
Brunner Mond UK Limited
Building Design Partnership
Bunyan Meyer & Partners Ltd
Bureau Veritas Weeks Consulting
Burks Green Architects and Engineers
Buro Happold
Burroughs Stewart Associates
Bury Metropolitan Borough Council
Butterley Ltd
BWB Consulting Ltd

C.S.C. Engineers Ltd
CADS (Computer & Design Services Ltd)
Cairnhill Structures Ltd
Caledonian Building Systems
Cameron Taylor
CampbellReith
Capita Gwent Consultancy Ltd
Capita Symonds
Cardiff County Council
Cardiff University
Carl Bro
Carter Design Group
Cass Hayward LLP
Caunton Engineering Ltd
CB&I John Brown Ltd
CEL International Ltd
Cheshire County Council
Chieftain Contracts Ltd
CIRIA
City University
Civil & Structural Computer Services Ltd
Clarke Bond Group Limited
Clarke Nicholls & Marcel
Clarkslegal LLP
Clegg Associates
Cleveland Bridge UK Limited
Collis Engineering Ltd
Compass Engineering Ltd
Complete Design Partnership Ltd
Conder Structures Ltd
Conwy County Borough Council
Cordell Group Ltd
Cornwall County Council
Corus Group plc
Corus Panels & Profiles - Tewkesbury
Coventry Construction Ltd
Coventry University
Cowan & Linn
Crown Structural Engineering Ltd
CSC (UK) Ltd
Curtins Consulting Engineers
Custom Metal Fabrications Ltd
Custom Steel Fabrications Ltd
CWT Partnership

D A Green & Sons Ltd
D H Structures Ltd
D J Barrington (Construction) Ltd
D J Hartigan & Associates Ltd
Dalton Consultants
Deakin Walton Limited
Defence Estates
Devon County Council
Devonport Management Ltd
Dew Construction Ltd
Dewhurst Macfarlane and Partners
DGK Structures
DGT Steel & Cladding Ltd
Dibsa Structures Ltd
Dorman Long Technology Ltd
Dougall Baillie Associates
Doyle Partnership
Dundee City Council

E T Design
Eastwood & Partners
Edmund Nuttall Ltd
Elland Steel Structures Ltd
Elliott Wood Partnership LLP
Emmett Fabrications Ltd
Engineering Solutions Partnership
Evadx Ltd
Evans & Langford LLP
Expedition Engineering Limited

F J Samuely & Partners Ltd
F W Consulting
Faber Maunsell
Fabsec Limited
Fairfield-Mabey Ltd
Fisher Engineering Ltd
Flint & Neill Partnership
Fluid Structural Engineers
Fluor Ltd
Foggo Associates Ltd
Frank H Dale Ltd

Galvanizers Association
Gardenwood Ltd
Gary Gabriel Associates
George Mathieson Associates
Gibbs Engineering Ltd
Gifford & Partners Ltd
Glasgow Caledonian University
Glentworth Fabrications Ltd
GME Structures Ltd*
Goodwin Steel Castings Ltd
Gorge Fabrications Ltd
Graham Wood Structural Ltd
Grays Engineering (Contracts) Ltd
Gregg & Patterson (Engineers) Ltd

H Young Structures Ltd
Had-Fab Ltd
Halcrow Group Ltd
Halcrow Yolles
Hallmason Design Ltd
Hambleton Steel Ltd
Hanson Building Products Ltd
Harley Haddow Partnership
Harold Newsome Ltd
Harry Marsh (Engineers) Ltd
Harry Peers Steelwork Ltd
Haskoning UK Limited
Hawkes Construction Co
HBG Design Ltd
Henry Smith (CE) Ltd
Hescott Engineering Company Ltd
High-Point Rendel
Highcliffe Court Design Ltd
Hillcrest Structural Ltd
Hills of Shoeburyness Ltd*
HOP Consulting Ltd
Horwich Steelworks Ltd
HOSDB
HSP Consulting
Hurst Peirce & Malcolm LLP
Hyder Consulting (UK) Ltd

Imperial College London
Integer Software Limited
Inverclyde Council
ISS Limited

J Robertson & Co Ltd
Jacobs Babtie
Jacobs Engineering
James Bros (Hamworthy) Ltd
James Killelea & Co Ltd
James Lupton Consultants
Jenkins & Potter
Jex Engineering Co Ltd
John Reid & Sons (Strucsteel) Ltd
John Wicks & Son Ltd
Jordan Pritchard Gorman
Joy Steel Structures (London) Ltd

Kellogg Brown & Root Ltd (KBR)
Kenneth Brown & Partners
Kier Limited
Kingspan Metl-Con Limited
Kingston University
Knapp Hicks & Partners Ltd

Laing O'Rourke - Group Technical Services
Leach Structural Steelwork Ltd
Leigh's Paints
Leonard Cooper Ltd
Les Gooding Design Associates
Lindab Butler Building Systems
Lindapter International

Liverpool John Moores University
London Borough of Hillingdon
Lowe Engineering (Midland) Ltd

M D Fabrications Ltd*
M & S Engineering Ltd*
M Hasson & Sons Ltd
Mace Ltd
Maldon Marine Ltd
Maltech (UK) Ltd
Manchester City Council
Marconi APT
Mario Minchella Architects
Martin Healer Development Services Ltd*
Martin Stockley Associates
Marton Engineering Services Ltd
Maslen Brennan Henshaw
Mason Navarro Partnership
Mech Tool Engineering Ltd
Melliss LLP
Metals Industry Skills & Performance
Metek Building Systems Ltd
Metronet Rail SSL Ltd
Metsec Plc
Michael Barclay Partnership
Midland Steel Structures Ltd
Midland Structural Services
Mifflin Construction Ltd
Mike Curnow
Mitchell McFarlane & Partners
MJM Consulting Engineers Ltd
MLM Maddocks Lusher & Matthews
Molabolt Ltd
Morgan Est
Mott MacDonald Group Ltd
MSL Engineering Ltd
MSW (UK) Ltd

Napier University
Newbridge Engineering Ltd
Newton Fabrications Ltd
NNC Ltd
Norder Design Associates Limited
Nottingham Trent University
NPS North East Limited
NRM Bobrowski
Nusteel Structures Ltd
NW Structural Consultants Ltd

On Site Services (Gravesend) Ltd
Outokumpu Stainless Ltd
Overdale Construction Services Ltd
Owen Williams Consultants
Oxford Brookes University

Parsons Brinckerhoff Ltd
Paul Reading & Partners
Pell Frischmann Consultants Ltd
Pencro Structural Engineering Ltd
PEP Civil & Structures Ltd
Peter Brett Associates
Peter Taylor & Partners Ltd
Pick Everard
Pinnacle Consulting Engineers Ltd
Plandescil Ltd
Portakabin Ltd
Portal Ltd
Powerwall Systems Limited
Price & Myers Consulting Engineers Llp
Pyper McLarnon Partnership

QMEC Ltd
Queen's University Belfast

R G Parkins & Partners Ltd
RAM International (Europe) Ltd
Ramage Young Partnership
Remnant Engineering Ltd
Renfrewshire Council
Research Engineers (Europe) Limited
Richard Jackson plc
Richard Lees Steel Decking Ltd
Richard Wood Engineering Ltd
Rigby & Partners
Rippin Ltd
RMJM Scotland Ltd
Robert Bird & Partners*
Robert Tucker Associates
Roberts Engineering
Robinson Construction
Robinson Consulting Limited
Roger Bullivant Ltd
Rowecord Engineering Ltd
Rowen Structures Ltd
Royal School of Military Engineering
RPS Consulting Engineers
RSL (South West) Ltd

S H Structures Ltd
Scott White & Hookins
Scott Wilson Kirkpatrick & Co Ltd
Scottish Borders Council
Selwyn Construction Engineering Ltd
Severfield-Reeve Structures Ltd
Sheffield City Council
Shell UK Exploration & Production
Shipley Fabrications Ltd
Skanska Technology
Skidmore Owings & Merrill Inc.
SKM anthony hunts
Snashall Steel Fabrications
South Durham Structures Ltd
South Lincs Consulting Ltd
SSI Group of Companies
The Steel People Ltd*
Stewart & Harris
Stirling Maynard & Partners
Structural Design Associates
Structural Design Partnership
Structural Metal Decks Ltd
Structural Sections Ltd
Surrey County Council
Survey Design Associates Ltd

T A Kirkpatrick & Co Ltd
Taylor & Russell Ltd
Teague & Sally Limited
Techniker Ltd
Tekla (UK) Ltd
Tension Control Bolts Ltd
Terence McCormack Ltd
Terrapin Ltd
Terrell International
Thomas Morgan & Associates
Thomasons LLP
Tony Gee & Partners
TPS Consult Ltd
Traditional Structures Ltd

University of Aberdeen
University of Birmingham
University of Bolton
University of Bristol
University of Dundee
University of East London
University of Edinburgh
University of Greenwich
University of Leeds
The University of Manchester
University of Nottingham
University of Paisley
University of Plymouth
University of Portsmouth
University of Salford
University of Sheffield
University of Southampton
University of Surrey
University of the West of England
University of Wales Swansea
University of Warwick
URS Corporation Ltd

W A Fairhurst & Partners
W F Brown Associates Ltd
W S Britland & Co Ltd
Wakefield MDC Building Control*
Waldrons Limited
Walsh Associates
Walter Watson Ltd
Warley Construction Co Ltd
Waterman Structures Ltd
Watson Steel Structures Ltd
WCJ Engineers
Wessex Structural Services Ltd
Westbury Park Engineering Ltd
Westok Ltd
Whitbybird
White Young Green Consulting Ltd
W I G Engineering Ltd
William Haley Engineering Ltd
William Hare Ltd
William J Marshall & Partners
The Willocks Practice
The Wood Boyle Partnership
Wright Associates
WSP Group

ORGANISATIONS WITH MEMBER SERVICE AGREEMENTS WITH THE SCI

Construction Industry Directorate
Health & Safety Executive (HSE)
Highways Agency
The Institution of Structural Engineers

INTERNATIONAL CORPORATE MEMBERS

Australia
Australian Steel Institute
BlueScope Steel Research

Belgium
Bocad Service International S A
International Iron & Steel Institute (IISI)
Staalinfocentrum - Centre Information Acier

Brazil
Brazilian Centre of Steel Construction (CBCA)
CODEME Engenharia S.A.
Gerdau Acominas S.A.
USIMINAS

Canada
Canadian Institute of Steel Construction

Chile
Construcciones Y Montajes S.A (COYMSA)

Croatia
Institut Gradevinarstva Hrvatske d.d.

Finland
Finnish Constructional Steelwork Association
Rautaruukki Oyj
Seinajoki Polytechnic
VTT Building and Transport

France
CTICM
Terrell International

Germany
Bauen mit Stahl e.V.
Stahl + Verbundbau gmbh

Greece
Computer Control Systems SA
Democritus University of Thrace
K.Liaromatis SA
Maraveas & Associates SA
Metallostegastiki SA
Technical Chamber of Greece (TEE)

Hong Kong
Arup Group
Corus Asia Ltd
The Hong Kong Polytechnic University
WSP Asia

India
Bechtel Overseas Corporation
Institute for Steel Development & Growth

Ireland
Barrett Mahony Consulting Engineers
Barry Kelleher & Associates
C S Pringle Consulting Engineers
Corus Ireland
Coyle Kennedy Ltd
Downes Associates
Dryform Limited
ESB International Ltd
Frank Fox & Associates
Fusion Building Solutions
Hanley Pepper Consulting Engineers
Hayes Higgins Partnership
J B Barry & Partners Limited
Joda Engineering Consultants
Kigallen & Partners Consulting Engineers Ltd
McCabe Delaney
The McKenna Pearce Practice
Michael Punch & Partners
National University of Ireland, Galway
Nestor Kelly
Nordman Profile Ltd
O'Connor Sutton Cronin
Oliver Russell & Associates Ltd
Pat O'Gorman & Associates
Project Management Ltd
RPS Consulting Engineers Ltd
SIAC Butlers Steel Ltd
Stanta Limited
T J O'Connor & Associates
Walsh Draughting Services Ltd

Italy
Politecnico Di Milano
Universita Degli Studi Di Trento

Kenya
David Engineering Ltd
H P Gauff KG
Steel Structures Ltd

Korea
INI Steel Company
Korea University

Lithuania
Vilnius Gediminas Technical University

Malaysia
Corus Asia Ltd
Malaysian Structural Steel Association
Universiti Teknologi Malaysia

The Netherlands
Bouwen met Staal
Delft University of Technology

New Zealand
Heavy Engineering Research Association

Norway
Tee Consult Holding AS

Portugal
Universidade de Aveiro
Universidade de Coimbra – Polo II

Principality of Liechtenstein
HILTI AG

Qatar
Metalex Trading & Contracting Co. W.L.L

Romania
S.C. Altiscad SRL

Republic of Singapore
Corus South East Asia Pte Ltd
Jurong Engineering Ltd
LSW Consulting Engineers
Ngee Ann Polytechnic
Singapore Structural Steel Society

South Africa
Southern African Institute of Steel Construction

Spain
In Hoc Signo Vinces, S.L.
ITEA
University of Navarra

Sweden
Luleå University of Technology
Outokumpu AB
Swedish Institute of Steel Construction

Turkey
CIMTAS Celik Imalat Montaj Ve Tesisat A.S.
UMO Architecture Engineering and Consulting Ltd Co

United Arab Emirates
Corus Middle East
GINCO Steel L.L.C.
The PHB Group
Techno Steel Construction Co

USA
American Institute of Steel Construction Inc
American Iron & Steel Institute (AISI)
Corus America Inc
Epic Metals Corporation
Steel Recycling Institute

**New corporate members since last long list in October 2005 issue*