OCTOBER 2005 VOL 13 NO 9

NSC

NEW STEEL CONSTRUCTION

www.new-steel-construction.com

Flying history framed
Rebirth of St Pancras
Safety at height
World Trade Center – report

BCSA

Steel Construction CONFERENCE & EXHIBITION

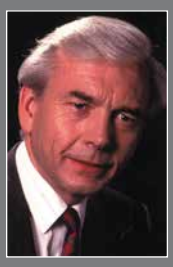
This image courtesy of Nick Guttridge

THE WAY AHEAD

Tuesday 15 November 2005

at The Brewery, Chiswell Street, London EC1Y 4SD

The aim of the "Steel Construction – The Way Ahead" Conference and Exhibition is to review the latest developments in the design and construction of steel structures.



The Conference is aimed at clients, designers, main contractors, steelwork contractors and suppliers.

John Humphrys, TV Presenter, will Introduce and Chair a Panel Discussion on "The Future Construction Market".

All delegates will receive a copy of a comprehensive new book "Steel Details", to be published by BCSA at the Conference. This new book will illustrate steelwork detailing as design decisions in context, not solely as calculation methodologies. It will include extensive case study material and reference data.

The Exhibition will open at 0930 hrs and will close at 1715hrs.

Exhibitors will include: steelwork contractors, suppliers of steel, software, purlins, cladding, decking, stud welding, bending, cellular beams, fabrication machinery, corrosion protection.

The Conference will commence at 1030hrs and conclude at 1615hrs.

The Conference fee is £160, plus VAT = £188. The fee includes attendance at the Conference and Exhibition, lunch, documentation and a copy of the new "Steel Details" book.

The event is being held at The Brewery, which is Samuel Whitbread's origional London brewery, built by John Smeaton and James Watt in 1750.

For Booking Forms contact: Gillian Mitchell MBE, Deputy Director General, BCSA 4 Whitehall Court, Westminster, London SW1A 2ES
Direct Tel: 020 7747 8121 **Fax:** 020 7839 4729 **email:** gillian.mitchell@steelconstruction.org **Web:** www.steelconstruction.org

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Developer: RAF Museum and Bridgnorth District Council
Steelwork Contractor: SH Structures
Architect: Fielden Clegg Bradley
Structural Engineer: Michael Barclay Partnership

NEW STEEL CONSTRUCTION NSC

www.new-steel-construction.com

EDITOR
Nick Barrett Tel: 01323 422483
nick@new-steel-construction.com
DEPUTY EDITOR
David Fowler Tel: 01892 538191
david@new-steel-construction.com
CONTRIBUTING EDITOR
Ty Byrd Tel: 01892 524455
ty@barrett-byrd.com
PRODUCTION EDITOR
Andrew Pilcher Tel: 01892 524481
andrew@new-steel-construction.com
ISDN: 01892 557302
ADVERTISING SALES MANAGER
Sally Devine Tel: 01474 833871
sally@new-steel-construction.com

PUBLISHED BY
The British Constructional Steelwork Association Ltd
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone 020 7839 8566 **Fax** 020 7976 1634
Website www.steelconstruction.org
Email postroom@steelconstruction.org

The Steel Construction Institute
Silwood Park, Ascot, Berkshire SL5 7QN
Telephone 01344 623 345 **Fax** 01344 622 944
Website www.steel-sci.org
Email reception@steel-sci.org

Corus Construction and Industrial
PO Box 1, Brigg Road, Scunthorpe, North Lincolnshire DN16 1BP
Telephone 01724 404040 **Fax** 01724 404224
Website www.corusconstruction.com
Email tsm@corusgroup.com

CONTRACT PUBLISHER & ADVERTISING SALES
Barrett, Byrd Associates
Linden House, Linden Close,
Tunbridge Wells, Kent TN4 8HH
Tel: 01892 524455
www.barrett-byrd.com

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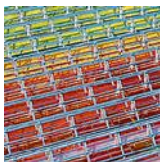

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The Steel Construction Institute

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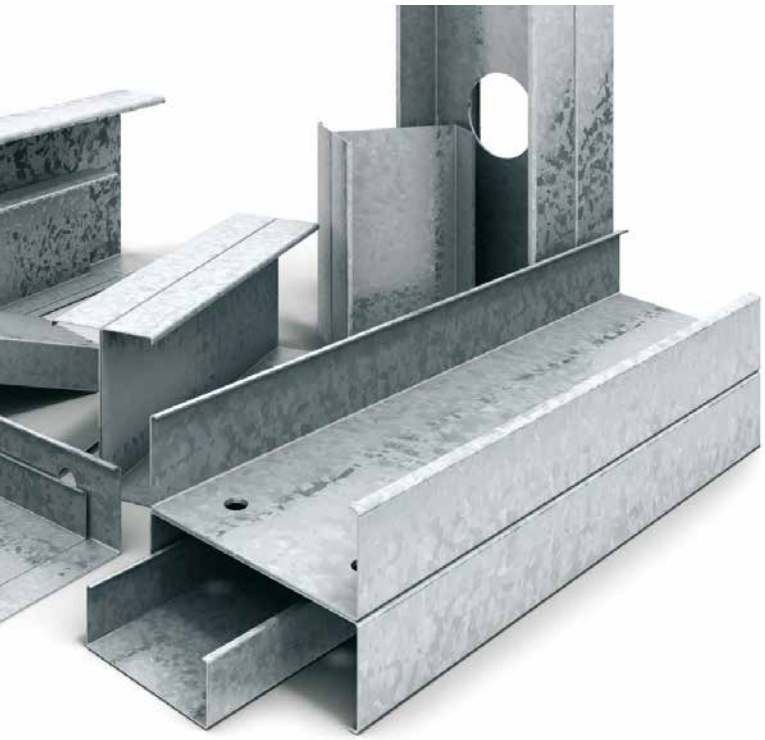
FOR NOT SO VERSATILE BUDGETS.



Multichannel4

The first 4mm cold rolled channel has arrived. We've invested £4 million in new production lines to manufacture the most versatile steel section around. This adds up to big savings in steelwork fabrication costs.

And 4mm sections open up a wide range of design possibilities for engineers. You can use Multichannel4 for windposts, secondary support members and other areas cold rolled channels couldn't previously go.

With increasingly pressurised site programmes you need to reduce your workload. Why bother cutting, punching, fabricating, welding, shot-blasting, painting and transporting when you can order Multichannel4. The significant saving will suit your not so versatile budget.

To obtain one of the new handbooks call 01944 712000 or visit www.kingspanmetlcon.com

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Tel: 01944 712000 Fax: 01944 710555 e-mail: sales@kingspanmetlcon.co.uk

Steel's competitive edge

Nick Barrett - Editor

Good news from Davis Langdon whose annual cost comparison between steel frames and concrete has once again proven that steel provides the most advantageous and economical framing solution (see News). That might come as some surprise to casual observes who have heard little about steel other than the news about raw material price rises over the past year or so. But the study confirms what the steel construction sector and savvy designers have been telling clients all along, that steel was outstandingly the cost effective framing material choice, and that other materials have been rising in price as well.

So what Corus last year dubbed the Competitive Gap between steel and concrete prices remains virtually unchanged. Using steel for frames is still cheaper than it was 20 years ago in real terms, an amazing productivity achievement that the steelwork industry – producers and fabricators as well as designers – has not received full credit for.

We will provide more detailed analysis of the cost comparison in the next edition of NSC, and there should be plenty there to cheer marketing departments. Since steel has maintained its competitive advantage and the other key messages about the benefits of steel have been getting through to more and more designers and end users, the annual market shares survey is also likely to bring good news in a few months time.

We are already hearing encouraging reports from the industry that healthy workloads are being seen in the key healthcare sector, where outdated impressions about the vibration issue have been successfully combated. Car parks are another area where inroads are being made into a sector that was not previously regarded as a traditional source of orders for steel – well it is now.

WTC debate will boost knowledge

Also in News you can read about the conference on the United States' National Institute of Standards and Technology report into the collapse of the World Trade Center towers that was held in September. Many of the world's leading experts on fire and structural behaviour met to discuss the implications of the results of no fewer than 43 different studies into the issues raised by the collapse.

Debates about the precise collapse mechanism and other key aspects of what actually happened after two fully fuelled and laden aircraft were deliberately crashed into occupied buildings will probably run for years yet. Which is as it should be; we want to learn as much as we can from these tragic lessons.

There will be many differences of emphasis emerging from the debates between the informed expertises that were gathered at Gaitersburgh, near where another aeroplane was flown by terrorists into the Pentagon, Washington. This sort of debate is one vital way in which knowledge grows. UK delegates at the conference report how refreshing it was to hear the issues being aired in an environment in which engineering debate flourishes. It made a welcome change from the sniping from the sidelines that they have to tolerate from sectors of UK construction who try to gain competitive advantage by shamefully suggesting that the use of steel was in some way to blame for the WTC disaster.

Steel's cost advantage maintained

Structural steel has maintained its cost advantage over alternative framing materials despite the raw material price increases of the past year, according to the latest update of a building cost comparison study carried out by Davis Langdon.

The study confirms industry evidence that for frame and floor costs in commercial buildings the competitive advantage of steel frames over concrete remained relatively unchanged in the 18 months to June 2005. 'The Competitive Gap between steel and concrete remains,' says Corus Construction & Industrial's Technical Sales and Marketing Manager Alan Todd.

'Both steel and concrete framing have increased in cost to a similar extent in the last 18 months, largely due to increased raw materials prices, including fuel.

The cost study data also suggests that steel's success in capturing market share in growth areas like healthcare and car parks will continue.

In 2004 steel continued to dominate the multi- storey office sector with a 71.7% share, measured by floor area. Steel's share of the market for all types of multi storey non- residential buildings was 69.2%.

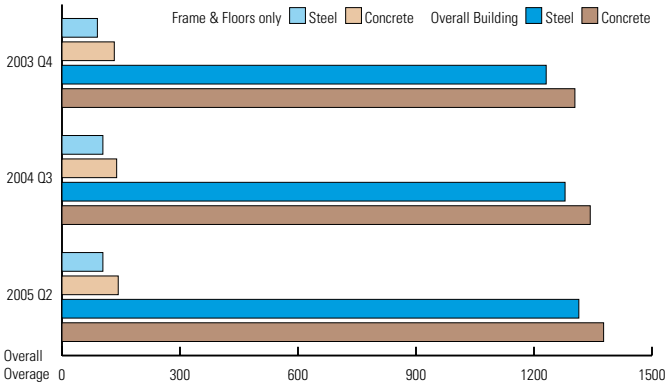


Figure 1 illustrates the updated competitive advantage graph – the gap shows that steel is still the cost effective option.

New forum to address practical fire safety issues

The Structural Fire Safety Forum, a new body set up in a joint initiative by the Steel Construction Institute and the Association for Specialist Fire Protection, held its inaugural meeting in September.

It aims to provide a liaison forum for all parties involved in the design, manufacture, specification, installation, inspection and maintenance of fire protection systems.

Groups with an interest in the subject including the Institution of Structural Engineers and the Institution of Fire Engineers, the BCSA and Corus Construction & Industrial plus insurers, fire officers, building control officers and contractors, were invited to attend.

Frank Sheehan, Chief Fire Officer of West Midlands Fire Brigade, was invited by ASFP and SCI to chair the group. Mr Sheehan was seen as independent of the construction industry, yet knowledgeable in the field of safety.

The forum will be free to define its own brief. However, areas it is expected to address include: methods of achieving appropriate and economic solutions for structural fire safety to meet Building Regulations and insurer requirements; best practice in the field of fire protection materials from initial testing to ensuring effectiveness throughout the life of the building; certification of fire protection applicators; and identifying where additional guidance is needed to make sure that those with responsibility for fire safety can make informed choices.

SCI Principal Engineer Dr Ian Simms said: "The forum will provide an opportunity to ensure that the steel construction industry has the information it requires to face the challenges posed by new construction techniques and materials and to maintain the good fire safety record that has been enjoyed to date."

Contact: i.simms@steel-sci

Daventry shed checks out for Tesco

Caunton Engineering has won the contract to design, supply and erect a new distribution warehouse at the DIRFT Logistics Park and rail freight terminal at Daventry, Northants, adjacent to Junction 18 of the M1. The five-span portal frame will encompass almost 70,000m^2 of warehouse space and 3,250m^2 of offices. Clear height is 19.5m and the structure uses 2,500t of steel. The warehouse has been pre-let to Tesco by a joint venture of British Land and Rosemound Developments which is developing 30ha of land at the site. The distribution centre is programmed to be operational by Christmas. Main contractor is John Sisk & Son and structural engineer is Sprigg Little Partnership.

Steel construction safety improvement beats target

No fatal injuries were reported by steel construction companies in the BCSA's latest accident survey covering 2004.

In addition the injury frequency rate for steel construction accidents has halved over the past four years, putting the industry's progress well ahead of that needed to meet Health & Safety Executive targets.

Injury frequency rate has reduced from 1.9 in 2000 to 0.9 in 2004. This measures the number of accidents to be expected in a working life of 100,000 hours, so that whereas the average worker could have expected nearly two reportable injuries in a working lifetime, now the expectation is for less than one. "To achieve a frequency rate of below one is a significant improvement," said BCSA Health and Safety Manager Pete Walker. "We want to continue to drive that figure lower, with the ultimate target of zero."

In its Revitalising Health and Safety initiative in 2000, the HSE set a target for reducing accidents by 10% annually by 2010, with progress to be monitored in 2004/5. The BCSA figures comfortably beat this target.

The survey also shows 92% compliance with the SKILL Card scheme exists in the steel construction industry.

Trojan horse lifts safety awareness

A second phase of the Trojan Horse safety messaging project is in progress after phase one showed the technique was successful in raising awareness of safety issues on site.

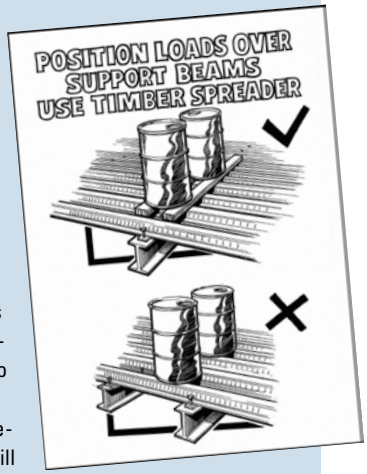
The idea of the project is to apply easily understood graphically represented safety messages direct to construction components. Phase one, which was carried out by the Steel Construction Institute and ran for a year to October 2004 drew wide support from industry bodies and trade associations. It tested messages related to steel sections, steel decking, precast components and trussed rafters. For the steel sections the message tested was 'Sling safely'.

Face to face interviews tested workers' awareness of the messages and whether they assimilated the information. The results were compared with control sites where no messages had been applied.

"The results were very positive," said Steel Construction Institute principal engineer Viken Chinien. "The level of awareness and uptake of information were similar to showing the message to operatives individually."

Phase one did not test the long-term effectiveness of the messages or whether the effect wears off over time.

"Phase two will address ways to reduce the long-term decay of the messages, for example by rotating messages or using different colours," said Dr Chinien. It will also use messages aimed at a wider audience. "Slingers are specialist operatives. Phase two will cover a more general population of site operatives."



A wider range of messages will cover more general issues such as exposure to noise.

The research will run till July 2006 and results will be reported in a high-profile seminar. It is being sponsored by the Health and Safety Executive, with participation by the Major Contractors Group, the Construction Products Association, and a number of specialist trade associations including the BCSA.

Steel bridge installed safely over live railway

Rowecord Engineering has pre-assembled and installed a 900 tonne railway viaduct over the London Underground Hammersmith and City line at White City. Engineers worked around the clock in a 99-hour rail possession to position the new structure with minimum impact on rail services. The structure doubles in size an existing railway bridge, allowing an extra line to be added.

The new bridge was built above live railway lines over a crash deck on specially-designed support trestles and the pre-assembled viaduct was moved into position using a hydraulic push-pull system provided by Mammoet. Main contractor was Costain.

AROUND THE PRESS

Construction News
8 September
Growth in the UK market for structural steel is set to easily outstrip that of concrete, independent market analysts at MBD claimed.

The UK steel market is forecast to experience 28 per cent real term growth until 2009, taking the overall market for structural steel products to well over the 2Mt mark.

Domestic output will account for 2.1Mt by 2009, while imports will only amount to 20,000 tonnes.

Building
16 September
On the £285M mixed use Bishops Square development, Spitalfields, London:
A steel frame was selected because of its speed of construction. The 18m wide office strips are supported on perimeter columns and clear-span beams to give flexible interiors.

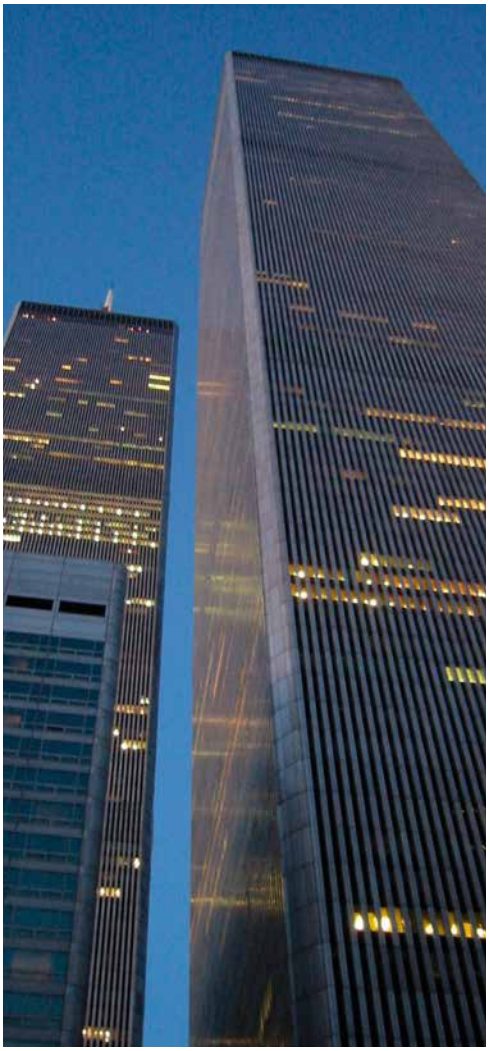
The beams all have a standard 650mm depth, with the thickness of steel varied to cope with differing loads and the web pierced by large circular holes to take service runs.

New Civil Engineer
22 September
A row over the causes of the World Trade Center twin tower collapses on 11 September 2001 broke out between British and American fire engineers last week.

British engineers strongly disputed official American claims that the towers became more vulnerable to collapse after the hijacked aircraft scraped vital fire protection from their steel frames.

Construction News
25 August
Mabey Support Systems used eight hydraulic jacks to lift the 700-tonne Bluther Burn Bridge in Rosyth clear of its bearings to enable highway operator BEAR Scotland to carry out maintenance work.

To minimise traffic disruption, the support specialist supplied a 117m long steel temporary bridge directly above the existing bridge.



Definitive World Trade Center report published

Four years after the terrorist attacks of 11 September 2001 led to the collapse of the World Trade Center towers, the US National Institute of Standards and Technology has released its definitive report.

Over 170 of the world's leading experts on fire and structural behaviour in extreme events gathered in Gaithersburg near Washington for the launch of the report, a vast document incorporating the results of 43 different studies into the questions raised by the collapse.

Over three days delegates heard detailed presentations by project leaders who prepared many of the reports. Though these were generally well-received the report was criticised on a number of counts.

One was that in the survey on evacuation of the buildings, too much emphasis had been placed on the events in the immediate aftermath of the attacks and not enough on the longer period between that and the final collapses.

Another came from Arup Fire, which has developed an alternative hypothesis for the collapse mechanism from that postulated by NIST.

Overall, NIST makes 30 recommendations grouped into eight categories of which two, Increased Structural Integrity and New Methods for the Fire Resistance Design of Structures, have potential implications for structural design.

(See feature page 26.
Full report of conference in next month's NSC.)

Kingspan introduces first 4mm channel

Kingspan has introduced a range of 4mm cold-rolled channel sections called Multichannel4. The new thicker sections will provide engineers and steelwork contractors with greater design flexibility and the potential to save cost. Multichannel4 will widen the applications for which the Multichannel range can be used including wind posts and secondary support members.

The new sections have an extensive range of hole and notching options providing a choice of connection details in both the flange and web. A selection of hole size and shapes is available from 7.9mm through to 150mm diameter. The range is available in section depths of 175mm to 450mm. All sections are pre-galvanised and can be supplied direct to site as single components or assemblies.

Sales and Marketing Manager Ian Hodgson said: "The 4mm cold rolled Multichannel4 sections are aimed at steelwork contractors for use in the construction of mostly single storey structures. We have developed Multichannel4 to provide designers and steelwork contractors with cost effective and speedy structural solutions."

Multichannel4 is the result of a £4m million investment in highly innovative and flexible production lines at the Sherburn site in North Yorkshire. A technical handbook on the new channel sections is available from the Kingspan marketing department on 01944 712000 or it can be downloaded from www.kingspanmetlcon.co.uk.

Part L final draft details released

The long-awaited changes to the Building Regulations covering conservation of fuel and power were published in September and will take effect from April next year.

Four Approved Documents which set out the requirements of the regulations in detail, covering new and existing domestic and non-domestic buildings, were published in final draft form. The Office of the Deputy Prime Minister said that the new regulations would save a million tonnes of carbon annually by 2010, equivalent to the emissions from more than a million semi-detached homes.

Initial reaction was that the only major surprise was the 'disappointing' target for improvement for domestic dwellings, said Graham Raven, Steel Construction Institute General Manager for Construction Technology. The target, compared with a building meeting the 2002 regulations, has been set at 20% for gas-heated dwellings, reduced from an expected 22% and the initially-proposed 25%.

For non-domestic buildings the target depends on a number of factors but in broad terms a 23% improvement for naturally-ventilated buildings and 28% for mechanically ventilated or air-conditioned buildings will be required.

The new regulations will introduce mandatory testing of airtightness for buildings above a certain floor area, while the use of 'low or zero carbon technologies' such as solar panels, heat pumps and wood pellet stoves will contribute towards the required improvement in energy efficiency.

A 'whole building' approach to calculating thermal performance will be introduced. Both methods for achieving this — SAP 2005 for domestic dwellings, and a beta version of the software-based Single Building Energy Model for non-domestic dwellings — were expected to be published by the end of September.

Feature, page 32

• The SCI has been appointed assessor for steel-framed house designs, following the recent publication of a chapter covering steel-framed dwellings as part of the National House Building Council's standards. This parallels the arrangements for timber-framed housing and by removing the need for third-party certification makes it easier for house builders to adopt steel frame. Once the supplier's system manual has been assessed by the SCI, site inspections only have to ensure the manual has been followed. Metek has become the first company to seek approval under the scheme.

Record entry expected for Design Awards

Entries are invited to the 2006 Structural Steel Design Awards. and following the interest generated by this year's awards, the organisers anticipate a record crop of entries for 2006.

The awards recognise excellence and success in design, in construction efficiency and in client satisfaction.

Of the entries to this year's awards, Chairman of the judging panel David Lazenby said: "The range is astonishing, from massive tonnages to detailed craftsmanship, from complex elegance to practical simplicity."

This was reflected in a list of winners diverse enough to include the Paddington rolling footbridge, the massive Midland Mainline Bridge, for the Channel Tunnel Rail Link project, and the Wellcome Trust's new London headquarters, the Gibbs building (pictured).

The judging panel assesses entries against a range of structural engineering and architectural criteria including: the benefits achieved by using steel; efficiency of design, fabrication and erection; architectural excellence; cost-effectiveness; and environmental impact.

The awards are open to steel-based structures in the UK or overseas built by UK steelwork contractors using steel predominantly sourced from Corus and completed during 2004 or 2005.

Closing date for submission of entries is 16 December.

The entry form with full details can be downloaded from the BCSA website: **www.steelconstruction.org/static/statics/awards/entry_form.pdf**

Charter to be launched at conference

The Steel Construction Sustainability Charter will be launched at next month's Steel Construction Conference and Exhibition by Professor Roger Plank of Sheffield University.

Richard Elliott, Head of Construction at British Land, will give the keynote address on "A Client's View of Sustainable Steel Construction'. Members of the British Constructional Steelwork Association and Register of Qualified Steelwork Contractors are now invited to sign up to the charter. Member firms which have made the formal declaration to adopt the charter will also be announced at the conference.

TV and radio presenter John Humphrys will be introducing and chairing an expert panel discussion session on future trends for the UK construction market at the conference, to be held at The Brewery in London.

NEWS IN BRIEF

Corus is to lead a consortium of construction industry clients from 10 countries in a four-year research programme on innovative construction methods for housing. ManuBuild aims to learn from the best in manufacturing processes to demonstrate how house-building could be much more efficient. The consortium has won a record €10M from the EU, which will be supplemented by €40M from the consortium.

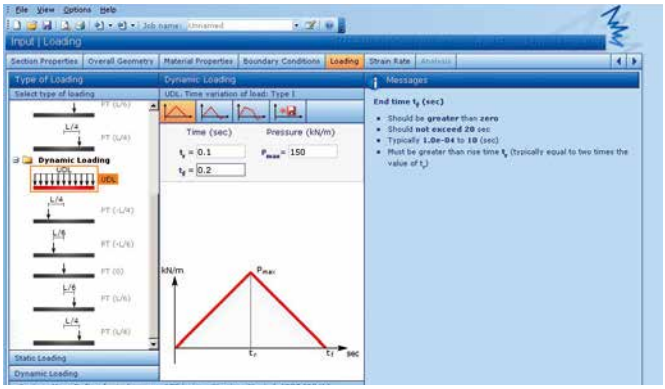
The UK's biggest building project, **Heathrow Terminal 5**, celebrated the completion of the main terminal building structure with a topping-out ceremony last month. The £4.2bn project will contain 80,000t of structural steel, over three times as much as Wembley Stadium, and is due for completion in March 2008.

The **Highways Agency** has become the latest organisation to indicate that it will insist that paiinting contractors working on its structures use ICATS qualified staff. The Industrial Coatings Applicator Training and Certification Scheme was launched earlier this year by the Institute of Corrosion to allow coating contractors and applicators to be trained to a universal standard recognised by clients.

Corus Distribution will not charge for CE-marked test certificates, contrary to earlier re-ports. It will be compulsory for steel in most European markets to carry the CE mark, which indicates it meets all relevant EU standards, from next year.

One in seven specialist firms have to wait an average of 60 days or even longer to be paid, according to a survey of 250 member firms by the **National Specialist Contractors Council.**

New explosion design software unlocks capacity of steel



Newly-released software for structural design for blast loading is said to make significant improvements over existing practice.

SATEL — Structural Analysis Tool for Explosion Loading — was developed by the SCI in a joint programme with the Health and Safety Executive, defence technology specialist Qinetiq, and blast wall manufacturer Mech-Tool.

The most widely used standard for explosion design is the US Department of the Army, the Navy and the Air Force Manual TM5-1300. It is based on the long-standing Biggs approach to design.

Both the Biggs method and SATEL apply to beams, columns and panels (such as blast walls) spanning between two supports. SCI Principal Engineer Viken Chinien said: "Because an explosion is an extreme event, you're allowed to use plasticity, yield and everything you can get from the structure."

SATEL is designed to achieve a very fast first pass analysis for blast analysis of steel elements. The analytical methods behind SATEL bring a number of significant improvements to take advantage of more of the load capacity of the steel under extreme events.

First, whereas Biggs only allows pinned or fixed supports, SATEL allows a moment capacity or rotational stiffness to be specified at each support.

Second, the new method takes into account the fact that explosion loading results in a high strain rate, which mobilises extra reserves of strength. "Yield strength increases with strain rate," says Dr Chinien. "Biggs doesn't allow for this."

Third, though Biggs takes into account plastic deformation, it ignores large deflections. The new method takes account of the 'catenary effect', associated with large displacements.

Results have shown good agreement between SATEL and finite element analysis.

The software will be available commercially from October.

Wembley Arena trusses placed

Three trusses, one of 65 tonnes and two of 55 tonnes were successfully lifted into place on consecutive days by Bourne Steel as part of a £35m refurbishment of Wembley Arena.

The building layout is being completely reversed, with the stage and entrance changing places together with a new square fronting the Arena.

Because the original ground level at the new stage end was higher, a new lorry ramp and 250m^2 service yard — big enough for 14 articulated lorries — had to be excavated to allow delivery of equipment for rock concerts to stage level. The three trusses, each 35m long, support the roof over the service yard. They were fabricated and transported to site as complete units, where they were erected by Bourne with a 500 tonne telescopic crane.

Bourne Steel is supplying and erecting over 800t of steel for main contractor John Sisk. In a separate contract with Sisk, Bourne is carrying out a succession of packages of internal refurbishment and strengthening inside the Grade II listed Wembley Arena building. These include installing terracing for seating, extending catwalks for access to lighting and other stage equipment, as well as strengthening the existing reinforced concrete floors by the addition of structural steelwork supports.

The building, originally the Empire Pool Wembley, was designed by Sir Owen Williams for the 1934 Empire Games. It was last used as a swimming pool in the 1948 Olympics. A temporary floor was subsequently placed over the pool and this was made permanent in 1976.

The refurbished building is due to re-open next April with a sell out show by Depeche Mode. With the construction of the new Wembley Stadium and planned redevelopment of the rest of the site, the Arena will be the last survivor of the complex of buildings on the Wembley site built for the Empire Games and 1924 Empire Exhibition.

Diary

6 October
National Association of Steel Stockholders Annual Steel Industry Dinner and Autumn Conference
Hilton Birmingham Metropole Hotel
CBI Director-General Sir Digby Jones is principal speaker at the dinner. Contact: margaret@nass.org.uk

10 November
SCI Annual Dinner
Landmark Hotel, London. Guest speaker, John Sergeant
Further details: l.chamberlain@steel-sci.com

15 November
Steel Construction Conference and Exhibition
The Brewery, Chiswell Street, London EC1.
Organised by BCSA. Contact:
Gillian.mitchell@steelconstruction.org

17 November
British Stainless Steel Association Conference and Dinner
"Stainless Steel – Converting Opportunities into Reality"
Stratford Manor Hotel, Stratford-upon-Avon.
Contact Alison Murphy/Rakhee Jaria 0114 2671 260 or enquiry@bssa.org.uk

22–24 November
Civils 2005 Exhibition
Olympia, London
Visit the innovative double-deck Corus stand for the latest information on the full range of Corus products. Corus's Chris Dolling gives a free technical seminar on Weathering Steel Bridges on the 22nd.
Details: www.civils.com

Charter brings sustainability to the fore

With clients increasingly looking to employ contractors that adopt sustainable practices, the newly launched charter for the steel construction industry is likely to get an enthusiastic reception

The charter has developed from the Sustainability Strategy for Steel Construction published in 2002

The Steel Construction Sustainability Charter will be launched at next month's Steel Construction Conference and Exhibition. It will mark the implementation of an important element of the sector sustainability strategy of three years ago, that of engaging the supply chain in adopting more sustainable behaviour.

Members of the British Constructional Steelwork Association and the Register of Qualified Steelwork Contractors can apply now to sign up to the charter.

The initiative will offer steelwork contractors a way of demonstrating that they are addressing sustainability, at a time when clients are becoming increasingly aware of the issues and seeking to employ firms which can show that they are monitoring their progress and making improvements in this area.

The client's view will be the subject of a keynote address to the conference by Richard Elliott of British Land.

In the words of the introduction to the charter, the aim of sustainability is "to improve the quality of life for everyone, now and for generations to come".

The charter stresses the need to regard environmental, economic and social issues equally, and companies signing up to the charter will be required to make a formal declaration that they will operate their business in accordance with the charter's objectives.

Charter companies will undertake to run their businesses on sustainable lines, demonstrate social responsibility, and share their knowledge of sustainability with others.

After signing the charter, companies will complete a sustainability application form and undergo an audit, carried out by RQSC auditors either as part of the company's routine registration audit or separately. The company must demonstrate that it has at least six of a list of 12 management systems in place (see box). Following a successful audit companies will be able to use the new Sustainable Steel Construction logo.

Companies with all 12 systems in place will qualify for a 'gold' rating and those with nine a 'silver' rating.

The company must also agree to provide annual returns for certain data to monitor progress towards targets for the future, so that being a charter company carries with it responsibility for continuous improvement.

BCSA technical consultant Roger Pope, a member of the Steel Construction Sector Sustainability Committee and one of the main architects of the charter, said: "The charter is intended to show that contractors are taking an interest in sustainability and have started moving in the right direction. The BCSA will then give them recognition."

He added that the general targets will be supplemented as key performance indicators are developed to aid future improvement: "As contractors are audited we will be able to pool best practice," he said. "We want to show that it's practical to assemble this sort of data and monitor progress."

Launch of the charter comes at an opportune moment. Dr Pope said: "Since the sector strategy was published, clients have become much more interested in sustainability. Two years ago steelwork contractors were asking, does it matter much? Now clients are coming to us and asking what we're doing."

During the sustainability audit a charter company must demonstrate it has at least half the following 12 management systems in place:

- **A published sustainability policy (mandatory)**
- **Monitoring of progress towards sustainability using specific management targets**
- **A programme of involvement with their local community on social issues**
- **An accredited Health & Safety management system to OHSAS 18001**
- **Investors in People accreditation**
- **A published equal opportunities policy**
- **A published ethical trading policy**
- **An accredited environmental management system to BS EN ISO 14001**
- **Use of environmental impact assessment for process improvement**
- **A policy to manage energy and vehicle fuel use in the business**
- **A policy to question whether suppliers have published sustainability policies**
- **An accredited quality management system to BS EN ISO 9001**

Judges sing praises of steel opera house

The Wales Millennium Centre, the new home of the Welsh National Opera, threw over some outdated views about the suitability of steel for auditoriums, and is now a winner of a major European steel design award.

FACT FILE
Wales Millennium Centre
Architect: *Capita Percy Thomas*
Structural Engineer: *Arup*
Main contractor: *Sir Robert McAlpine*
Steelwork contractor: *Watson Steel Structures*
Project value: *£106M*
Steelwork tonnage: *5034 tonnes.*

Clad in rough-hewn slate and timber and with a central stainless steel-clad auditorium, the Wales Millennium Centre has endured sniping about its appearance. But Cardiff's landmark theatre and opera house, constructed on time and to budget within 33 months, has been recognised for its innovative use of steel in the 2005 European Convention for Constructional Steelwork Design Awards.

The lottery-funded building contains an 1,800 seat theatre which is the home of the Welsh National Opera, but is designed to house a range of activities from opera and ballet to musicals.

The theatre's designers — architect Percy Thomas Partnership (now Capita Percy Thomas) with Arup as structural engineer — challenged conventional wisdom by choosing steel as a framing material.

Arup Director Chris Jofeh, writing in New Steel Construction in February 2004, said: "It was often thought that, because of the complicated geometry of balconies and the need for massive walls, theatres were best constructed from in-situ reinforced concrete." This was challenged by a number of Arup-engineered theatres in the US, which "showed that steel-framed construction was a credible alternative to concrete". Composite floors using normal and lightweight concrete on profiled metal decking "proved practical, even in regions of changing three-dimensional curvature such as the theatre balconies."

Advantages for the Cardiff project included the speed with which the primary frame could be erected and made watertight, allowing early commencement of the installation of services and theatrical equipment; and the ability to separate the design of the frame while the architectural and acoustic design continued to evolve.

A lighter steel structure could have been more susceptible to vibration than a concrete one, it was thought, but three-dimensional vibration analysis showed that even the main theatre balconies, which cantilever 10m, showed the concerns to be unfounded.

The superstructure is divided into a number of structurally separate buildings, to prevent unwanted noise being transmitted from the structure into the theatre.

One of the key components is the flytower, which houses the theatrical equipment needed for the stage. It has to be twice the height of the visible area of the stage to allow scenery to be lifted out of the audience's view. Unusually, the architect merged the tower and auditorium into a single curving unit, clad in chemically weathered stainless steel.

The flytower columns are about 35m tall with design axial loads of up to 11,000kN. Iain Hill, Design Director of steelwork contractor Watson Steel Structures said the tower was one of the most challenging parts of the structure to erect. "It was fairly complex in design and erection. It needed carefully-designed temporary works and careful sequencing to keep it stable during construction."

Storey-high trusses span over the building to support the roof. Their upper booms carry a concrete/metal decking roof slab while the lower booms support a ceiling formed of precast panels with an insitu topping. These two layers between them provide sufficient isolation to keep out aircraft noise.

Mr Hill and the leader of Arup's structural team, Lorraine Bradley, went to the ECCS Annual Meetings in Nice last month to collect the award.

The judges praised the project in glowing terms: "The Wales Millennium Centre demonstrates that steel has substantial benefits to design teams even when acoustic parameters are important. The design team effectively used a wide range of different structural elements to achieve a most exciting solution. The use of steel in an auditorium is novel. The use of different materials, because of the location of the structure, has been satisfied by the design team in a most striking manner."

Speaking before travelling to the awards ceremony, Mr Hill said: "We're very pleased to get recognition of a difficult job done well."

Arup's Jofeh added: "We're obviously delighted. It's a credit to a team who worked long and hard on the project."

The curved central mass of the building houses the auditorium and fly tower

Peter Alvey

Historic planes come in from the cold

A new aviation museum in Shropshire designed to evoke the Cold War is set to make its mark on the landscape, reports Margo Cole

FACT FILE
Aviation Museum, RAF Cosford
Developer: *RAF Museum and Bridgnorth District Council*
Value: *£12 million*
Architect: *Feilden Clegg Bradley*
Structural engineer: *Michael Barclay Partnership*
Main contractor: *Galliford Try*
Steelwork contractor: *SH Structures*
Steel tonnage *600t*

The vast hangar (above) will house 45 aircraft

The Royal Air Force Museum Cosford has a priceless collection of Cold War aircraft, including the only surviving examples of some significant aeroplanes. Some can currently be seen huddled together on patches of spare land next to the hangars of the aviation museum at the former RAF Cosford in Shropshire, but they desperately need to be under cover. The materials from which these aircraft, some well over 50 years old, are made include leather and timber, and they do not respond well to the elements, particularly damp.

From next autumn this unparalleled collection will be moved to a spectacular £12M purpose-designed building at the Cosford site. The structure, designed by architect Feilden Clegg Bradley, structural engineer Michael Barclay Partnership and building services engineer Max Fordham, is set to become a landmark in its own right — something co-sponsor Bridgnorth District Council was keen to achieve.

Exhibition designer Neal Potter's theme for the building's exhibition is "Divided World: Connected World", and it will tell the story of the Cold War period from the national, international, social/political and cultural perspectives. Internally the impact on visitors is likely to be dramatic. With only 6% of the building's envelope glazed and all structural elements visible, the interior is designed to evoke the atmosphere of the Cold War: dark, brooding, even intimidating. The heavily industrial feel will be emphasised even further by the sight of over 600 tonnes of exposed and unpainted structural steelwork.

The museum's design parameters were minimal: provide as much cover for as many aircraft as possible in the best environmental conditions within a pre-set budget. As Michael Barclay Partnership' Associate Malcolm Brady says: "This could mean anything from a fully climate-controlled building for a handful of aircraft to a tent that provides basic shelter for all of them." The team's solution lies somewhere in between. It is a solid building large enough to house all 45 aircraft in the collection, including the massive Short Belfast, with its 45m wingspan, and an example of all three V-bombers: Valiant, Victor and Vulcan. Although it will be unheated, humidity will be controlled.

The design is spectacular, as is the scale. The building measures 160m in length, has a maximum width of 60m and is 30m high for its entire length. It consists of two sections of a vertical spine wall and a roof formed by a series of steel trusses of different lengths. These fan out to create asymmetrical portal frames forming two hyperbolic paraboloids — surfaces that curve in

Steel trusses of up to 64m span at differing slopes form a hyperbolic paraboloid roof surface.

two directions. Although the finished structure will be characterised by these spectacular sweeping curves, clad in silver, every structural element is straight.

On plan the design provides 6,320m² of exhibition space in two triangular areas which will be divided by a central walkway, representing a world divided by ideology. Aircraft will be displayed both on the floor and suspended from the roof.

"After we had decided on the concept of an asymmetric double curved roof we had two problems: how to analyse it and how to build it," says Mr Brady.

For the first stage of the analysis the team turned to a consultant specialising in wind engineering. "As there was no precedent for this building we commissioned a scale model and wind tunnel test," explains Mr Brady. The results were fed into a 3D model built using the Robot program, which allowed the engineer to do a complete analysis of the entire frame. The analysis involved more than 450 different load cases including wind, snow and the weight of aircraft suspended from the roof. As Mr Brady says: "This building couldn't have been done without a 3D analysis package."

The analysis showed that the structure is very efficient, with most elements at between 85% and 90% of their capacity. The asymmetrical portal frames are stabilised by the spine walls at the gables, while the roof planes are braced by two large compound trusses. Fully welded joints at the top of the main roof trusses and pins at the bases ensure they are acting as portal frames, except at the ends where the trusses bear on the vertical spine walls.

With the design finalised, the team called in steelwork contractor SH Structures to help out with the buildability issues and to confirm that the structure could be built within the budget. One key issue still to be decided was the cladding — and how to fix it. The designers opted for a proprietary structural metal decking spanning between the trusses, with the aluminium standing seam system fixed on top, but had not worked out exactly how to fix the metal decking to the structural sections.

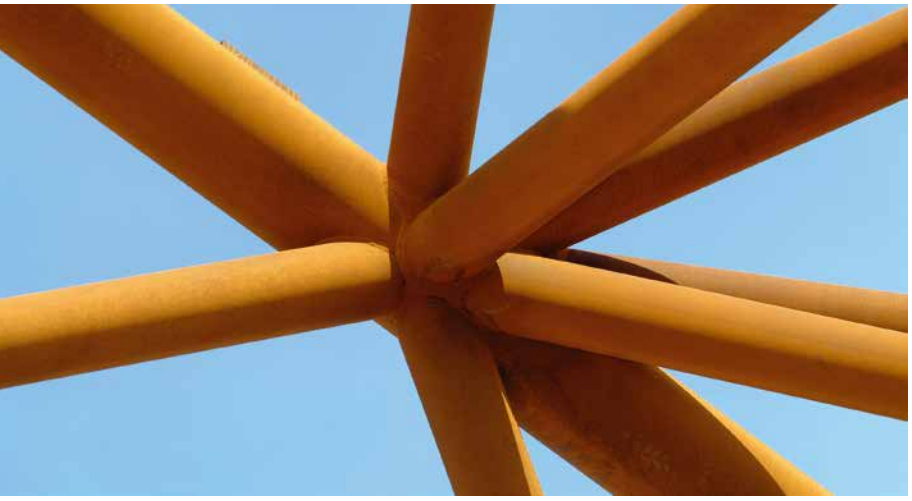
"We knew the main steelwork was going to be made from circular hollow sections, and that these would have a constant diameter but different wall thicknesses depending on the load they take," says Peter Redfern, Estimating Manager for SH Structures.

The challenge was to come up with a detail to fix the structural decking to the circular hollow sections. The varying pitch of the trusses means the decking meets each of the top chords at a

The structural frame was erected in just 10 weeks

SH Structures designed a special welded saddle detail to aid fixing of the roof decking

The steelwork is deliberately left unpainted to enhance the building's industrial feel



different angle and with a very limited bearing area, thanks to the circular section.

This led SH Structures to design a "saddle" that could be welded on to the circular sections and then fixed to an adjustable cleat that would create a larger bearing area. The 1,300 welded saddles can be seen in a spiral around the sections as you look along the length of the top chords. To check that the connection was feasible SH Structures built two full size bays 9m long with saddles on top.

Despite this early involvement in the project SH Structures still had to tender for the work when Galliford Try was appointed as main contractor. Having won the order the steelwork contractor then fed Michael Barclay Partnership's design details into its own modelling package, Tekla Xsteel. The company also carried out a value engineering exercise that resulted in some major savings, mainly through simplifying the connections.

Most of the roof trusses are too long to be delivered to site full length, so SH Structures planned to cut them down after fabrication and weld them back together on site before lifting them into place. One of the money saving initiatives was to replace the welded connections with bolted splices, while another was to assemble each of the compound trusses complete with internal bracing, rather than fixing this on site.

The longest of the roof trusses spans 64m and is displaced by 60mm under its own weight and a further 45mm under wind load. SH Structures has precambered the steelwork to take out the dead load displacement.

Fabrication took 15 weeks, while site erection took just 10 weeks and was completed in August. According to Malcolm Brady the structure was stable during construction because the elements are always braced. "Once the spine walls are erected it is very stable because of the braced element," he explains. "The compound box girder at the end is very stable, and as each truss is built from there it is tied back with A-frame trusses. It would have been different if the cladding was going on at the same time because it would have acted like a large sail."

In keeping with building's industrial feel the design team decided that the steelwork should not be painted, but allowed to rust. It was all shotblasted before delivery to site, and arrived as clean, bright metal. After just two or three days it had turned a vibrant orange. The only lacquering will be in areas where the public could touch the steel — such as around the entrance and the spine walls — but even here the colour will remain.

The industrial feel will be mirrored at the entrances, which will be made of weathering steel.

Although construction is due to finish at the end of this year, the new museum is not expected to be open to the public until autumn 2006, after a complex fit-out that includes a six month period to manoeuvre all the aircraft into place. Once open the building is set to become a visitor attraction in its own right, as well as a fitting home for some of the UK's most important aeroplanes.

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Rebirth of St Pancras

Extending St Pancras station to handle Eurostar trains called for an extension in harmony with the existing structure. A slender steel canopy is the result, discovers Jon Masters.

Impressive views of William Henry Barlow's great arched station canopy have greeted passengers arriving at St Pancras station for nearly 140 years. From 2007, though, the vista will be transformed. Passengers leaving trains at the far end of the platforms will see it to best advantage as they walk beneath a new 200m long steel canopy, which will then give way to a spectacular new view of the restored 1865 Barlow Shed.

How the new fits with the old is a major factor in the £400M Contract 105 of Section Two of the Channel Tunnel Rail Link. St Pancras Station is being restored and extended northwards to accommodate Eurostar trains, and a key design consideration for the new roof structure was that it had to be in harmony with Barlow's wrought iron arch.

"The design concept recognises the huge Barlow Shed, which is still reckoned to be the world's tallest single arch in a building," says Rail Link Engineering's technical director Mike Glover. "St Pancras is Grade I listed and so anything that is built on to it needs a sophisticated layering of environmental heritage approval. The roof extension came from a process of close consultation with English Heritage."

Urban Exposure/CTRL

(Left) Roof erection is following closely behind platform construction

Contract 105 is a project of nine years' duration so far for Glover, who heads the team that has developed the design concepts for the entire CTRL. This amounts to civil, structural and railway engineering worth around £6bn, including the transformation of St Pancras into an international and domestic transport hub.

Eurostar trains needing platforms about twice the length of Barlow's originals have to be catered for as well as domestic Midland Mainline, Kent commuter and Thameslink services. The result will be 13 platforms at the existing level with a new Thameslink station beneath. The middle six platforms for Eurostar trains will run the full 400m of the extended station to terminate in the Barlow Shed, while the remaining seven domestic platforms will terminate in the new structure.

"The options were either to extend the station roof matching the geometry of the Barlow arch, or to go for something that does not challenge the old structure. The extension needed to be considerably wider than the existing station, so the first option was out and we ended up with a flat roof subservient to the Barlow Shed," says Glover.

The new roof also had to be as thin as practical, with some geometric interest and a shape with a sense of flow and light, Glover says. The result is a structure with three spans across the tracks and seven 30m bays longitudinally. Four lines of 2.6m deep Warren trusses run longitudinally, supported by circular steel columns. Vierendeel girders span transversely between the same supports, with a saw-tooth roof profile curving from the top of each girder to the bottom of the next.

This main roof structure stops 22m short of

Urban Exposure/CTRL

Highly architectural canopy takes shape

A third of the roof was built in Phase I to accept diverted Midland Mainline trains while the Barlow shed was restored

Watson Steel Structures (WSS) is progressing the second and larger phase of the St Pancras extension steelwork, which amounts to around 3000t in total, from its Bolton yard. The first phase — the easterly half of the steel canopy structure — was completed to allow four new platforms to be opened for Midland Mainline services in April 2004.

This enabled Contract 105 principal contractor CORBER, a joint venture of Costain, O'Rourke, Bachy and Emcor (formerly Drake & Scull), to close St Pancras as it had been known for almost 140 years and begin a massive restoration programme in and around the Barlow Shed. Phase two of the extension — the remaining nine platforms and their roof structure — could then start.

"We have been on site for around two and a half years now. It's a huge slender canopy we are building with few supports," says WSS contracts director Alex Harper.

"We designed and built temporary steelwork to support the splice side of the first phase of the roof. Now we are back on site for phase two, the cross-trusses have been continued and the temporary works removed during night-time closures of the operational railway part of the extension."

"Highly architectural" is how Harper describes the entrance and side screen steelwork. Where possible, welded or hidden bolted connections have been used.

The main roof trusses are very slender being only 2.6m deep but up to 36m long. Prior to starting on site, lifting trials were carried out at Bolton to prove lift beams specially designed by WSS. Delivery to site is after 7pm to keep disruption to a minimum.

"It's a very challenging job," says Harper. "Logistics are complex and we have to coordinate closely with CORBER's concreting team, which we are currently chasing northwards down the job."

the gable end of the Barlow Shed. For the space between, Glover's team has designed a shallower transition roof structure to "telegraph" views between the old and new structures.

"The new roof meets the Barlow Shed where platforms for Midland Mainline and Kent commuter services will terminate and where passengers will come up from the new Thameslink station beneath. It will be a very busy and important concourse area," says Glover.

The transition roof will be a grillage of 1.1m deep plate girders supporting pyramids of glass and designed to create an atrium effect. It will hang from eight groups of four 30mm Macalloy bars which will drop from needle beams to be connected to the Barlow arch.

Erection of the main extension roof by Watson Steel Structures is progressing well (see box). Connection to the Barlow Shed, however, is a section that remains to be tackled.

"The Barlow Shed was built with indicative drawings, so little information exists in relation to the gable end of the arch," says WSS contracts director Alex Harper. "The gable has to be surveyed before we can model the structure and fabricate the end steelwork to connect with it."

When alterations to the old structure are nearer completion, WSS will be given access to the full height scaffold for the structural survey. The final steelwork will then be erected to produce what should be an awesome mix of modern and Victorian engineering.

All change at Barlow shed

Restoration of WH Barlow's St Pancras train shed entails cleaning and repairing the arch's wrought ironwork above a massive arched scaffold and platform. But conversion of the old station is also necessary.

The roof is being restored to its pre-World War II condition with ridge and furrow glazing over the crown and Welsh slate over the remainder, but the platform structure is being substantially altered.

The Victorian platforms and track were supported by 800 wrought-iron columns and a grillage of wrought-iron beams. Eurostar trains will enter at the same level, but on a new heavily reinforced concrete trackbed. Below, what was originally an undercroft for beer storage and more recently a network of small businesses, will become the arrivals hall with ticket and passport control.

Numerous escalator and light wells are being cut out of the wrought-iron structure to connect the two levels and whereas the grillage of beams will become redundant, most of the columns will remain to support the new trackbed.

FACT FILE
St Pancras Station Extension — part of Channel Tunnel Rail Link Section 2 Contract 105
Client: *Union Railways*
Engineer and Architect: *Rail Link Engineering*
Main contractor: *Costain, O'Rourke, Bachy and Emcor joint venture (CORBER)*
Steelwork contractor: *Watson Steel Structures*
Steelwork tonnage: *5200 tonnes*
Project value: *£400M (overall)*

Eurostar trains will arrive in 2007

CJW Photographic Services/CTRL

Team-working to boost safety

Proposed changes to the CDM Regulations are designed to cut paperwork and encourage team-working. But will they work? Margo Cole reports

Consultation has now closed on the Health & Safety Executive's proposals to change the Construction (Design and Management) Regulations – otherwise known as CDM. Although the Executive describes the changes as "evolution not revolution", there are some fairly substantial differences that could significantly affect steel designers and fabricators.

Aims of the revision include cutting down on the bureaucracy associated with the regulations and clarifying the CDM requirements for the different duty holders. But Peter Walker, Safety Manager of the British Constructional Steelwork Association (BCSA), says: "The HSE is at pains to point out that it wants less bureaucracy, but we feel that the more responsibility you put onto clients and designers, the more bureaucracy there is for main contractors and subcontractors."

Mr Walker fears that clients may try to offset their more onerous requirements by putting more demands on those further down the chain, in the form of questionnaires, checklists and forms to be filled in.

The current CDM legislation has been in force since 1994. Three years ago the HSE undertook a major consultation exercise on a wide range of safety issues and found that, while the principles of CDM were generally welcomed, changes were needed if all the anticipated benefits were to be achieved. These included looking closely at the role of clients.

In its consultation the HSE found that clients' attitudes and approach — particularly the emphasis on cheapest and/or quickest solution — was the second biggest hindrance to progress on safety.

The HSE wants to encourage more co-ordination between designers and contractors

The linked issue of "industry culture" was the first.

In its proposed revisions to the regulations the HSE tries to address this by promoting a "team-based" approach and putting more onus on clients to take responsibility for safety — for example by demonstrating that they have appointed a "competent" designer and main contractor. The HSE acknowledges that "law cannot itself directly change the industry culture", but hopes that "the actual process of changing the law does provide opportunities to positively influence the culture".

One way it hopes to achieve this is through strengthened requirements regarding coordination and cooperation, particularly between designers and contractors. There is also a specific requirement on the client to appoint a principal contractor at the earliest stage.

Mr Walker is supportive of the team-based approach, but believes it is all too rare in today's construction industry. And, even if the main contractor is appointed early, key subcontractors are still, more often than not, left out of the discussions. "Team-working has been tried and it works," he says. "When you have partnerships or alliance working safety is usually taken very seriously. And if safety is put at the top of the agenda you usually find that efficiency and profitability come with it.

"But," he adds, "most projects don't work this way. I'm very concerned that, come the construction stage and the appointment of a steelwork contractor to the project, the designer is no longer there, it's a long time after the designer designed it and, if the steelwork contractor needs more information, they can't get hold of it."

The result, more often than not, is that the steelwork contractor ends up "filling in the gaps", working out for itself the correct loading or other important details.

So, while the CDM regulations might be aiming for a 'partnership' approach, in reality they will do little to address the reality of the way contracts are run, says Mr Walker.

"Too often the steelwork contractor is involved in decision-making after the event. Steeelwork contractors make practical changes — for example to connections — to improve buildablity. But changes may have wider implications for how the structure is built, for example because more work has to be done at height or in difficult positions, so that the safety implications need to be re-examined. It's problem-fixing at the time of construction."

While most steel specialists have been putting up with this situation for years, under the proposed

new CDM regulations they could now carry extra liability. Anyone supplying design information for the project can be deemed to be the "designer" under the terms of the legislation, with all the legal responsibilities that carries. Though this has always been the situation in the underlying legislation, the new regulations spell out the designer's responsibilies more explicitly, in an attempt to make the legislation more easily enforceable.

"In the legislation it does point out that designers should provide as much information as they can, but it's not strong enough," Mr Walter says. "We strongly recommend that designers involve a steelwork contractor in their designs, and it's a shame the regulations don't head towards this. The earlier the involvement the better. Even if the steelwork contractor is not involved for months afterwards, it will have made a significant difference."

If this approach were taken, he says, all parties would be more comfortable assuming their responsibilities as "designer" in the eyes of the law. And clients could still have all the reassurances they need about the capabilities of the steel specialist to carry out design work.

A final point is that, as proposed, the revised version of the CDM regulations puts the onus on the client to appoint "competent" designers – as did the original version. But the HSE's consultation suggested that, in practice, this is too vague. The research found that, while the principle is generally accepted, "the arrangements adopted by most clients do not ensure competence".

The HSE acknowledges this in its consultation document for the revised regulations, stating: "We must address the need to ensure competence both of individuals working on a project and of businesses engaged to carry out the work." But, it adds, "we recognise that assessing competence is not always easy, particularly for less experienced clients".

The organisation has, therefore, commissioned more research on the subject of competencies, which includes identifying existing schemes that encompass best practice in their particular sectors or disciplines. The BCSA's Register of Qualified Steelwork Contractors (RQSC) is one such scheme. "If the HSE is looking at a model for competencies this fits very well with CDM," says Mr Walker. "Why send out lots of questionnaires when all you have to do is look at the list of RQSC-listed contractors? They are all audited and categorised, so it is clear where their competencies are and, if that is followed, there will be a significant improvement in reducing bureaucracy."


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Safe working at height in the steelwork industry

New regulations for working at height outline principles for choosing a "reasonably practicable" solution and set out a hierarchy of fall prevention measures, reports BCSA Health and Safety Manager Peter Walker

Peter Walker

Working at height is a known and necessary part of steel erection work. Great strides have been made in recent years in improving safety systems. Compared with the situation 10 years ago, simple to erect and effective edge protection systems have been introduced, mobile working platforms have almost superseded ladders and work restraint systems have been improved.

New regulations on work at height came into force on 6 April 2005. They place duties on employers, the self-employed, and anyone who controls the work of others (for example facilities managers or building owners who may contract others to work at height).

The effect of the new regs is mainly to consolidate existing regulations, but their scope has been widened to embrace industry in general, rather than being primarily aimed at the construction industry.

The regulations apply to all work at height where there is a risk of a fall liable to cause personal injury. They do not apply to the provision of instruction or leadership in caving or climbing by way of sport, recreation, team-building or similar activities.

Under the regulations, duty holders are required to ensure that:

- all work at height is properly planned and organised;
- those involved are competent;
- the risks from the work are assessed and appropriate work equipment is selected and used;
- the risks from fragile surfaces are properly controlled; and
- equipment is properly inspected and maintained.

Table 1

Description	Collective	Personal
Existing work place	Gantry with guards	N/A
Work equipment that prevents falls	Guard rails, mobile towers & MEWPs	Work restraint systems
Work equipment that minimises height and consequences of fall	Nets at high level or soft landing systems >2m below the surface	Fall arrest ststem - must include provision for rescue.
Work equipment that minimises consequences of fall	Soft landing systems or nets at low level <6m below the surface	Injury reduction system (nets. airbags)
Work equipment that does neither	Ladders, step ladders, trestles without guards	Training and supervision

The regulations include schedules giving requirements for existing places of work and means of access for work at height, collective fall prevention (such as guardrails and working platforms), collective fall arrest (such as nets, airbags and so on), personal fall protection (work restraints, fall arrest and rope access) and ladders.

Hierarchy of Fall Prevention/Protection Measures

Table 1 can be used as a guide to selecting the appropriate protection for working at height. It represents a hierarchy, starting at the top left corner with the most desirable option and working down to the bottom right corner as the least desirable option. You may use whatever system represents a "reasonably practicable" solution to your working needs, but if you select one of the systems lower down the hierarchy, you must be able to demonstrate why you could not use the more desirable solutions. Collective protection is preferred over personal protection.

Risk Assessment

All workplace activities need to have a risk assessment carried out prior to the work commencing. Although in most cases well-established safe systems of work can be employed, unusual or exceptional circumstances may always arise that mean that risk assessments have to be developed to minimise the distance and a consequence of a fall.

Assessment of Residual Risks

You should avoid putting more people at personal risk while installing and dismantling fall protection

measures, especially if the actual work is expected to be of short duration and can be carried out with less risk than the work required to install the protective measures. For example installing scaffolding around a trailer to unload it could put two people at considerable risk for a longer period than it would to put a person on a restraint system to complete the loading/unloading work. Similarly installing a net under a cantilever to install decking panels could put the net installers at greater risk, when the decking panels could be installed using a work restraint system. The message is really to look at the bigger picture of all the associated activities before deciding what action to take, rather than putting more and more trades at risk.

Remember there is no one solution that satisfies all activities: that is why there should be a risk assessment of each activity and duty holders should be "reasonably practicable" in their approach to managing the identified risks.

The Work at Height Regulations 2005 consolidate previous legislation on working at height and will implement European Council Directive 2001/45/EC concerning minimum safety and health requirements for the use of equipment for work at height (the Temporary Work at Height Directive or TWAHD).

Work platforms have almost completely replaced ladders on steel construction sites

Edge protection contributed to greatly improved safety over the last decade

United States can learn from worldwide fire engineering expertise

The US National Institute of Standards and Technology makes 30 recommendations to improve the safety of tall buildings in its report on the collapse of the World Trade Center. But, in the second of a series, John Dowling reports that NIST appears reluctant to accept experience from outside the US regarding performance-based fire design.

After nearly three years of research, the draft of the National Institute of Standards and Technology (NIST) report into the collapse of the World Trade Center towers was released in June of this year. Readers were invited to submit comments by early August and the final report was issued to coincide with a seminar at NIST headquarters in Maryland in mid-September. The report deals specifically with the collapse of the twin towers and the recommendations are explicitly aimed at tall buildings, defined as taller than 20 storeys, and buildings of special risk.

NIST has used the launch of the report to call on the organisations that develop building and fire safety codes, standards and practices — and the state and local agencies that adopt them — to make specific changes to improve the safety of tall buildings, their occupants and emergency services. The report, which incorporates the results of 43 detailed technical investigations, makes 30 recommendations divided into eight groups (see box).

From the point of view of the steel construction sector, the report makes a number of positive statements, including: "The WTC towers likely would not have collapsed under the combined effects of aircraft impact damage and extensive multifloor fires if the thermal insulation had not been widely dislodged by impact." This supports previous statements from the research team which had pointed to the excellent performance of the structure after the impacts.

The report states that at the time of impact, the towers contained 17,400 occupants, spread almost evenly between the two. Some 87% of occupants, including over 99% of those below the impact points, were able to escape. The reports concludes that "...for those seeking and able to reach and use undamaged exits and stairways, the egress capacity was sufficient to accommodate survivors."

The Freedom Tower (left) is the centre-piece of the proposals for redeveloping the World Trade Center site.

The Report's Recommendations

Increased Structural Integrity
The standards for estimating the load effects of potential hazards (such as progressive collapse, wind) and the design of structural systems to mitigate the effects of those hazards should be improved to enhance structural integrity.

Enhanced Fire Resistance of Structures
The procedures and practices used to ensure the fire resistance of structures should be enhanced by improving the technical basis for construction classifications and fire resistance ratings; improving the technical basis for standard fire resistance testing methods; using the "structural frame" approach to fire resistance ratings; and developing in-service performance requirements and conformance criteria for spray-applied fire resistive materials (the WTC Towers were fire protected using this type of material).

New Methods for Fire Resistance Design of Structures
The procedures and practices used in the design of structures for fire resistance should be enhanced by requiring an objective that uncontrolled fires result in burnout without local or global collapse. Performance-based methods are an alternative to prescriptive design methods.

Active Fire Protection
Active fire protection systems (sprinklers, standpipes/hoses, fire alarms and smoke management systems) should be enhanced through improvements to design, performance, reliability and redundancy of such systems.

Improved Building Evacuation
The process of evacuating a building should be improved to include system designs that facilitate safe and rapid egress; methods for ensuring clear and timely emergency communications to occupants; better occupant preparedness for evacuation during emergencies and incorporation of appropriate egress technologies.

Improved Emergency Response
Technologies and procedures for emergency response should be improved to enable better access to buildings and more effective response operations, emergency communications, and command and control in large-scale emergencies.

Improved Procedures and Practices
The procedures and practices used in the design, construction, maintenance, and operation of buildings should be improved to include encouraging code compliance by non-governmental and quasi-governmental entities; adoption and application of egress and sprinkler requirements in codes for existing buildings; and retention and availability of building documents over the life of a building.

Education and Training
The professional skills of building and fire safety professionals should be upgraded through a national education and training effort for fire protection engineers, structural engineers and architects.

The big message, however, is that "a full capacity evacuation of each tower with 25000 people... would have required about four hours. Had the buildings been full, it is possible that as many as 14,000 people could have lost their lives... the egress capacity required by current building codes and practice is based on phased evacuation strategy, not full evacuation." Survivors moved much more slowly than in previous non-emergency evacuations and fire brigade personnel had difficulty getting up the stairs due to the counterflow. This has led to recommendations for full building evacuation in tall buildings and the use of protected/hardened elevators.

It is this issue which is likely to have the most immediate impact on tall building design and the effect is already being seen in proposed changes to Building Regulations Approved Document B (the most widely used source of information on fire safety requirements in England and Wales). The proposal, which the Office of the Deputy Prime Minister acknowledges has been inspired by research into the World Trade Center collapse, and which it is intended will apply to buildings over 30m in height, will result in wider stairs. The increases would vary from 70 to 1400mm but would typically be about 300 to 400mm.

NIST encourages owners, designers and regulators to consider the recommendations and "take steps to mitigate unwarranted risks without waiting for changes to occur in standards and practice". However, until more detailed guidance is available, it is likely that these recommendations will be used mainly as guidance in risk-based approaches on specific buildings.

Only two of the eight sets of recommendations have implications for structural design. Those under the heading of increased structural

integrity call for the prevention of structural collapse. In a recent article, Faith Wainwright of Arup (*The Structural Engineer*, 19 July) writes, "Clearly in the UK we are somewhat ahead in having a basic requirement to design against progressive collapse. However, with a new call for guidance, there should be increased impetus to consider how collapsing structures cater for the large deformations which result — this is not covered in the UK. Imperial College is currently researching the development of simple guidance for steel structures... once this is understood, the interaction with fire needs to be taken into account. The NIST call for development is therefore welcome."

Under the heading of new methods for fire resistant design of structures, the report carries four specific recommendations. The most interesting of these occurs where NIST recommends the development of "performance-based standards and code provisions, as an alternative to current prescriptive design methods, to enable the design and retrofit of structures to resist real building fire conditions, including the ability to achieve the performance objective of burnout without structural or local floor collapse and the development of tools, guidelines and test methods necessary to evaluate the fire performance of the structure as a whole system." The report goes into considerable detail as to the amount of research and development which is required before the tools and methods are available to enable this type of analysis to be carried out. This was picked up in an article in *New Civil Engineer* shortly after the publication of the report which said that there was to be "no further use of performance-based fire design until more research is completed". The report contained no such quote in its text or recommendations.

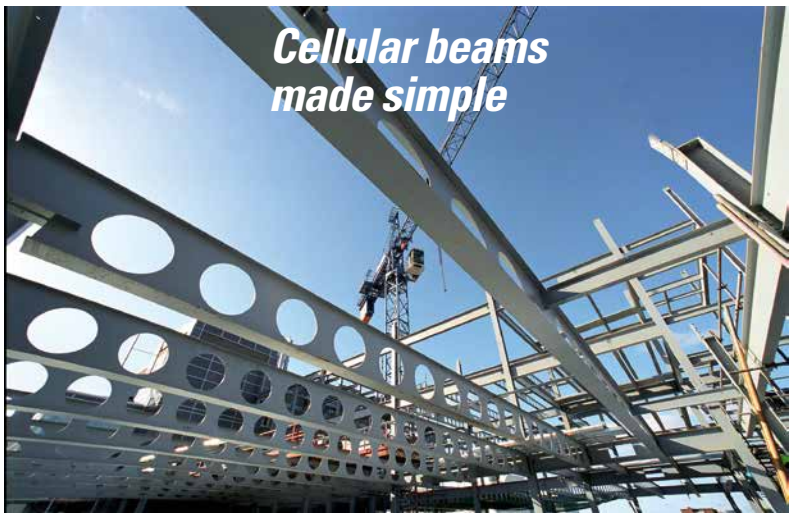
Although the tenor of the recommendations is strongly supportive of performance-based approaches to fire engineering design — and very logically, since such approaches provide a much better understanding of how real structures behave in fire and therefore give a much clearer indication of real safety levels than traditional prescriptive methods — the nature of the recommendation is disappointing. It points to a significant weakness of the work which has been carried out by NIST: the apparent refusal to accept that anything could be learned from the experience and knowledge of researchers and practitioners outside the US. In the UK, performance-based methods have been in widespread use for some years and leading consultancies such as Arup Fire and Buro Happold Fedra as well as the Universities of Sheffield and Edinburgh, among others, have considerable expertise in this area. It is hoped that NIST does not reinvent the wheel.

The third and last in this series of articles, a report on the NIST Conference in September, will appear in the November issue of New Steel Construction.

The draft NIST report is available at http://wtc.nist.gov/pubs/reports_june05.htm.

Design without drudgery

In the second part of a software round-up, New Steel Construction looks at some of the latest releases for designing cellular beams and for 3D modelling.



FBEAM automatically finds the most economical cellular beam design

Designers of cellular beams will welcome the ability to optimise their designs in the latest version of cellular beam manufacturer Fabsec's free software.

Beam Wizard, launched a year ago in version 3.1 of Fabsec's free FBEAM software, "takes the donkey work out of designing a cellular beam," says Head of Software Development Guy Rutter.

"Most packages will do design and analysis and confirm whether the section has spare capacity or is under capacity in shear, bending and so on. Then you tweak the sizes and analyse again." Someone very familiar with the process may do this in a few minutes but for an engineer in a general structural engineering practice who might only design a cellular beam intermittently the process is much slower.

"With the optimisation function you simply enter the load and span, and the program goes through the process and gives you the most economical solution in a matter of seconds," says Mr Rutter. Conversely, an under-designed beam can be optimised with mass added automatically until the beam passes. In addition, FBEAM has a simple but sophisticated cell generate /edit toolbar for circular, rectangular or elongated openings. The software has been independently accredited by FEDRA of Buro Happold.

The software has an automated updating system. FBeam 3.1 will in addition optimise for fire protection. "If the beam is fire protected, the coating may be of a similar order of cost to the steel itself," says Mr Rutter. "The software will optimise the section mass and coating thickness to provide the most economical solution first time. Prices are updated automatically based on information supplied by Corus and Leigh's Paints.

Fabsec is aiming to integrate its software with CAD modelling packages in its next release, so that an engineer designing a frame in a 3D CAD package will be able to choose an element from a layout and design it as a cellular beam without coming out of the CAD package.

FBEAM 3.1 is available free from Fabsec at www.fabsec.co.uk

Three-dimensional challenge

Some engineers struggle at first to see the benefit of 3D CAD models. Creating a 3D model first in order to generate 2D drawings is a new way of working for many. And it may not be worth the effort of creating a model for a small project involving just a few beams. But, says CSC, for most projects involving a steel frame (and any other material) there can be signficant time savings. Marketing Manager John Carey says that CSC clients have reported savings of 40% or more in drafting time.

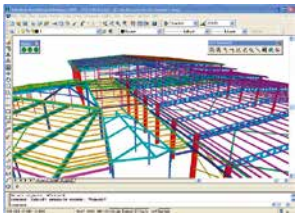
CSC's 3D+ CAD system for structural engineers runs under AutoCAD and is used by many companies as their standard method of generating general arrangmement drawings. According to CSC, it is proven to help engineers produce general arrangment drawings more easily, faster and more accurately. It also helps track and manage changes, automatically revising the drawings when required.

Waterman Group CAD Manager Lee Barnard says: "Our CAD technicians prefer to use 3D+ to create structural models, as it is then quicker and easier to generate the required 2D and 3D views."

CSC is challenging structural engineers to let it prove 3D+ could help them produce their drawings more quickly. "We invite them to give us some sample drawings from a past project for us to reproduce in 3D+. Often we can recreate drawings that would normally take weeks within a few days."

To take up the challenge contact sales@cscworld.com or 0113 239 3000.

CSC 3D+ can cut drafting times from weeks to days



Capita Symonds

White Young Green

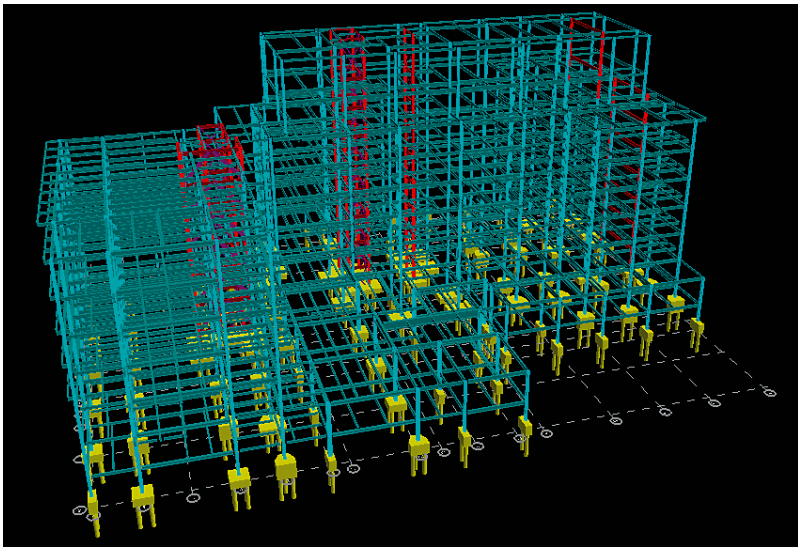
RAM packs in more power

Version 10 of the RAM structural system is due to land on structural engineers' desks — as a free upgrade — at the beginning of October.

New features include enhanced wall modelling and an FEA engine, allowing for openings to be easily placed anywhere on a wall and the resultant forces to be graphically displayed, while gravity wall load takedown automatically tracks wall loads to the foundations. Line loads can be placed anywhere on floor slabs and the software will accurately distribute the loads to supporting members. These features will benefit steel designers since in most buildings the steel frame interacts with other materials.

Integration with RAM CADstudio has been improved, as has the two way link with Bentley Structural - Drawing Generation and building information model software.

One company which will be benefiting from the upgrade is Robert West Consulting. The screen shot shows a multi-storey building modelled by associate Jon Bird in the first week of use.



This multi-storey building model was created in eight hours.

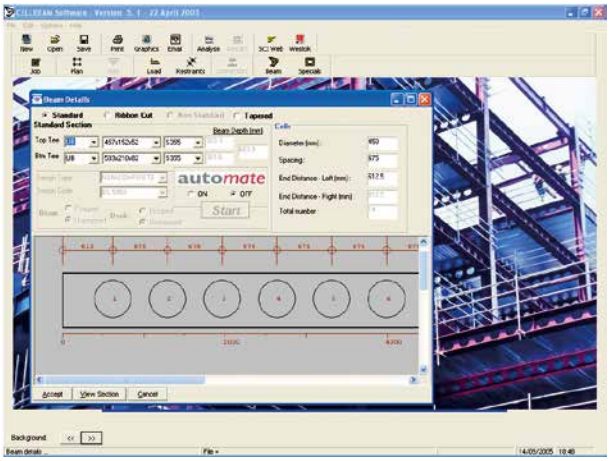
Mr Bird used the system to create a full model of the structure in eight hours. From the model, the design of the beams, columns and lateral frames were automatically generated, producing calculations, material take-offs and drawings. Previously it would have taken four weeks each for the load take-down, beam design, column design and lateral stability assessment, analysis and design – with RAM it took under a week.

Contact RAM International at sales@ramint.co.uk

Cellbeam offers optimisation

The latest version of Westok's popular Cellbeam v5.1 software is christened 'Automate' and is said to bring a new dimension to cellular beam design. Composite cellular floor beams typically span up to 25m, whereas a roof beam the span can exceed 40m. For optimised use of material the beam sections are usually heavily asymmetrical, made from a light top section and heavy bottom flange, and their design presents numerous choices, the first being which standard sections to fabricate them from.

The Automate function chooses the optimum combination of sections for fabricating the cellular beam.



Automate will choose the most efficient combination of UB or UC sections, as well as varying the steel grade if needed, to suit the load and span within the constraints that might be a fixed, a particular cell layout or, perhaps, a target maximum depth which the designer can set. The software logs each design combination, checking the critical failure modes at each section, adjusting section selection automatically to achieve the most efficient pass. The software also permits the designer to fix the position and size of cell holes to accommodate service runs while designs are re-optimised.

The software was developed under the SCI's strict QA regime. During calibration testing over 150 'expert' designs provided by Westok's specialist designers were compared with Automate performance. The software managed to beat the experts on several occasions. As part of the through-life quality management of the software it will automatically check itself using internet communications to see if a new revision is available, and warn the engineer accordingly, offering an automated update.

An ambitious programme of development work is now under way for the next Cellbeam software releases.

Cellbeam v5.1 automate is available from Westok at www.westok.co.uk

Part L and airtightness of the building envelope

Airtightness is likely to become a critical consideration in meeting the new Building Regulations on thermal performance. Graham Raven reports on tests by the SCI and Oxford Brookes University which will help designers and subcontractors devise practical details which perform well.

Extensive changes to the Approved Documents for Part L of the Building Regulations, *The Conservation of Fuel & Power* were expected to be published in July 2005 for implementation on 4 January 2006 (NSC last month). Following a delay in publication the Apoproved Documents were released last month with headline requirements broadly as expected: a 20% reduction in carbon emissions for domestic buildings and 23–28% for non-domestic buildings when compared with equivalent buildings that would have complied with the 2002 Regulations (see news). Apart from the need to reduce carbon dioxide emissions a further major change is the requirement to use a national whole building calculation model in determining compliance. Methods based on considering each element of the building individually will no longer be permissible.

The new regulations will be used to implement the EU Energy Performance of Buildings Directive (EPBD) which will enforce energy passports for buildings. The effects of this are already being seen in much greater interest from building owners in obtaining better performance.

For domestic buildings the calculation tool is to be SAP (Standard Assessment Procedure) 2005 which is an updated version of the existing SAP procedures. For non domestic buildings the Simplified Building Energy Model (SBEM) is being developed at BRE. A test version was expected in late September or October 2005.

Methods of Compliance

Although alternative methods have been permitted, much of the industry is accustomed to achieving compliance through elemental methods with maximum U-values being set for various construction elements, a pass/fail limit for airtightness in non domestic buildings and maximum permitted areas of items such as rooflights, windows and doors. In the new regulations, apart from back-stop maximum U-values (probably the 2002 compliance values) for the various components in the envelope, compliance will only be assessed taking the whole building performance, including services performance, into account. Pre-completion airtightness testing is likely to be required on a sample basis for domestic buildings and all non-domestic buildings above a certain size. This is likely to be set at the existing limit of 1,000 m^2. There will be a maximum permitted back stop value set at the 2002 compliance level of 10 m3/m2/hr at a pressure of 50 pascals. However as improvements in U-values are reaching the point of dramatically diminishing returns it is very likely that designers will turn to improvements in airtightness as the most economic way of improving the efficiency of the envelope.

For example, in a typical shed building a reduction in tested airtightness from 10 to 5 $m^3/m^2/hr$ gives an 18% reduction in carbon dioxide emissions while dropping U-values by 0.05 W/m^2K from the current compliance levels of 0.35 for walls and 0.25 for roofs gives only around 2% saving. Even this improvement in U-values is achieved by a disproportionate increase in the thickness of insulation in a roof from 160 to 240 mm.

From this it can be seen that there is likely to be a concentration on improving airtightness. There is considerable work to do because although a few companies are achieving good results, demonstrating that it can de done, the general level of enforcement and compliance is currently low. It has been estimated that only one-third of buildings are being tested and of these one-third are failing. Good details with good construction generally give good results, bad details can be rescued by excellent construction and good details ruined by bad construction.

An important feature of the SBEM is that a design value for airtightness is chosen as part of the input; but this value then becomes the pass criterion and has to be achieved in pre-completion testing. This means that there will be a focus on low values for airtightness that are reliably attainable in practice with different types of cladding and in different sizes of building. The smaller the building the more difficult it is to achieve low values.

There will also be a strong focus on whose responsibility it is to choose the design value and whose responsibility it is to achieve it. Pre-completion testing is by its nature at a critical point in the build programme should there be a failure. There may be a tendency to base the design on a low value and then put all the responsibility on the envelope subcontractor to achieve this. A significant problem will be determining where responsibility lies for the interfaces between all the elements: wall, roof, windows, rooflights, doors, smoke vents and any other penetrations which may be formed

Test facility at Oxford Brookes

after the envelope subcontract has been otherwise completed. Developing and understanding the performance of sound details will be of paramount importance. While clearly site performance is critical it will also be sensible to develop data for differing details and how they are affected by sealant positions, flashing configurations, the number and type of fasteners and so on. This will enable designers and contractors to understand achievable levels, good detailing practices and the critical priorities for good quality construction. Clearly there are too many variables on site to develop this knowledge and a practical answer lies in laboratory facilities.

SCI and Oxford Brookes University

In order to offer services to the envelope suppliers and specialist subcontractors the SCI and The Oxford Institute for Sustainable Development (OISD) at Oxford Brookes University are collaborating. A test box (see photograph), has been constructed and is currently being used to assess air leakage rates through the joints of a variety of commercial cladding products, for both built up systems and composite panel.

The objective of this testing is to be able to show for a specific building design that the sum of expected leakage from all the cladding joints does not compromise the ability of the finished building to meet ADL2 requirements. To do this, linear leakage figures (m^3 per metre length of joint per hour) need to be measured for all types of joint. The test cell has been designed to enable sections of cladding system such as wall panels, corners, roof ridges, gables, and eaves to be mounted on top of a perfectly sealed open top box. Air is then pumped into the box to achieve a predetermined pressure, commonly 50 pascals as this is the prescribed test pressure for buildings, and the resulting airflow rate measured to indicate leakage. Leakage rates can be assessed for a range of pressures to give a leakage characteristic for the cladding details under test. Typical results are shown in the graph.

The main output of interest to cladding manufacturers and building designers is the leakage rate of a particular joint per linear metre at the stated pressure differential. Knowing this parameter for all types of cladding joint used in a particular building enables the overall theoretical leakage rate due to joints to be calculated. This is a useful tool to determine the leakage contribution of cladding jointing in a full size building in relation to Part L standards. Clearly the details have to be dependably replicated on site.

Initial test work for Corus Colors has proved the performance and usefulness of the equipment in assessing the effect of different fixing details. The service is now available through SCI to other suppliers and specifiers of envelope systems.

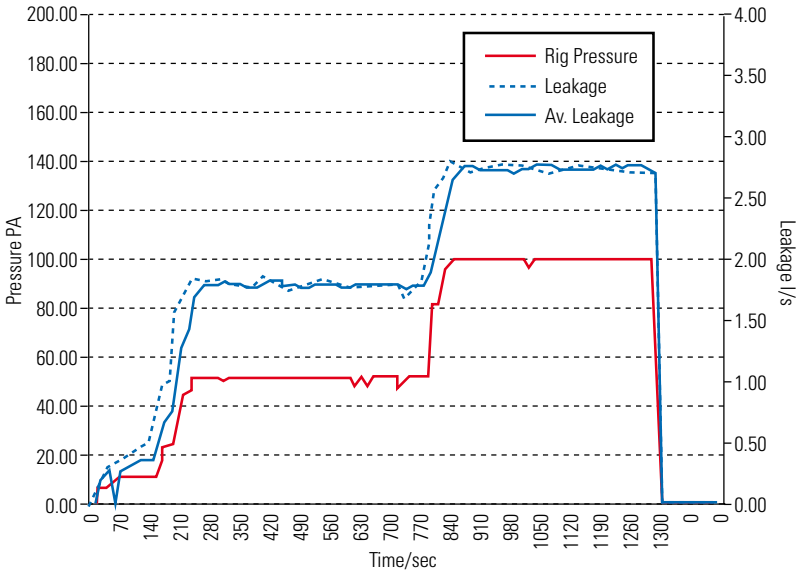
Final Thoughts

Apart from developing a better and quantified understanding of the key issues in cladding detailing for cladding suppliers, knowledge of how details should perform will help in the determination of responsibilities in achieving the required performance of the finished buildings.

A detail that performs well under test, assuming buildability has been taken into account, is capable of performing well when constructed; if it does not it is likely to be because of a workmanship problems rather than design. The facility will also help in developing new details which should be less reliant on site performance.

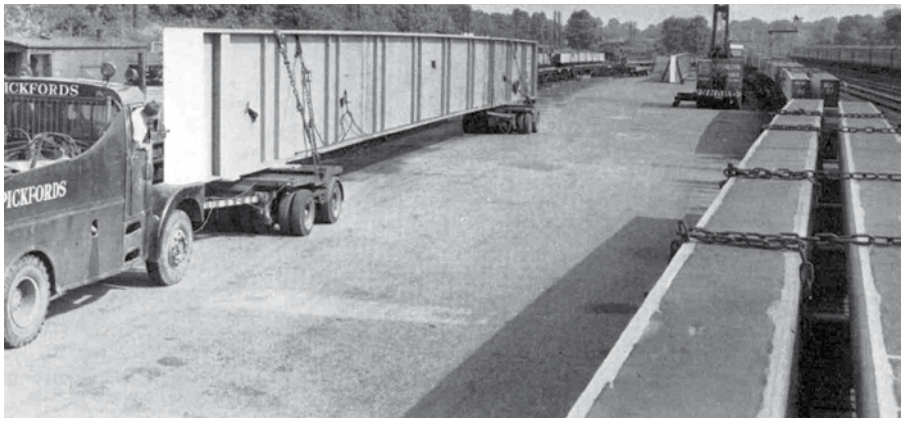
Graham Raven is the Senior Manager for Construction Technology at the Steel Construction Institute
g.raven@steel-sci.com

Sample graph of rig pressure and leakage against time



BUILDINGWITHSTEEL

Bridge travels from Glasgow to London



Motorists eagerly await the completion of the M1 Southern Extension which will give much greater significance to the Motorway so far as the Capital is concerned.

The Hertfordshire Council is responsible for 3 miles of this extension, acting as Agents for the Ministry of Transport. This work is under the direction of the County Surveyor of Hertfordshire, John V. Leigh, M.B.E., B.Sc., M.I.C.E., M.I.Mun.E.

A total of 18 bridges is to be built on the extension and of these No. 16 is of particular interest not only for the steel girders used – the longest being 135 ft. – but also because it has been possible, by a well co-ordinated programme of expert transportation, to convey the girders the whole way from fabricating shop to site in one piece and place them in position with military precision and timing.

The M1 extension is being carried across the A411 by bridge No. 16 which is 121 ft. wide, skewed at 42° (clear skew span 121 ft. 7 in.). Construction is of hollow box steel girders with welded stud shear connectors at 9-foot centres with a concrete 9-inch deep slab acting compositely. The girders are placed square to the abutments and are trimmed by welded steel plate girders 8 ft. 3 in. deep, which also serve as parapets. Indeed, a principal feature of the bridge is the trimming girders: they are not found in any of the remaining bridges. Total weight of steelwork is 288 tons, of which 236 tons are to B.S.968:1962.

All steelwork was fabricated in Glasgow. The actual transportation of the steelwork to the site entailed the moving of 27 girders. 25 of them ranging from 19 to 96 ft. presented no difficulty at all, but the remaining two parapet girders, 135 ft. long, 8 ft. 4 in. deep and weighing 40 tons a piece, raised several problems.

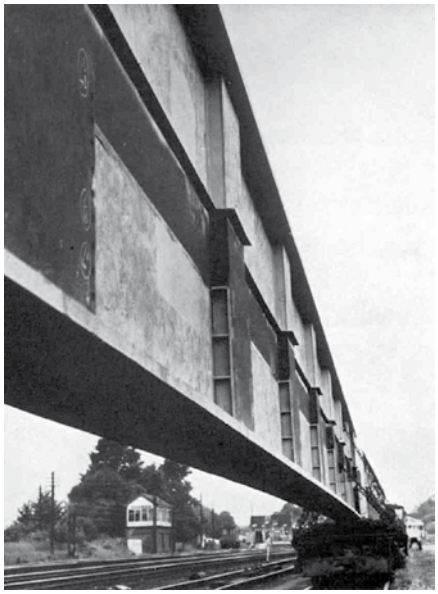
Consultations between the main contractors, the steel fabricators and British Rail produced a detailed plan of action, sending the girders by train from Glasgow to Harpenden Central station, and then by road to the site.

The two main girders left Glasgow by train early in the week preceding the agreed installation date: the journey took three days as the girders could not be moved in high winds. The remaining girders followed a day behind.

Delivery to the site began according the schedule at midday on Friday; the girders were loaded in correct sequence, the smaller ones between the larger sizes. Thanks to the special arrangements made with the police and careful route reconnaissance and timing, the numerous journeys were all completed without any major hitch and the entire operation was completed during the Saturday and Sunday.

The site erection period had been determined as being 59 hours *in toto* and continuous working was required under both natural and artificial lighting. Feeding of girders for erection had been planned and regulated in association with the rest of the operation. A 100-ton mobile crane was used to lift the parapet girders and certain of the deck beams. For the lighter sub-girders a 25-ton mobile crane was used.

The ability to fabricate and transport complete units of such magnitude, combined with the use of high yield stress steel, ensuring minimum weight and maximum strength provides yet another illustration of the extraordinary flexibility and strength of steel as a structural medium.



Left: The girders travelling by rail,
Top: Off loading at Harpenden station onto a heavy duty road tractor.
Above: Negotiating a difficult part of the road journey – one is left in no doubt about the incredible length of the girders.

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AD 292
The Use of Discontinuous Columns and Shallow Deck Composite Slabs on Floor Beams

Since the publication of the AD series on discontinuous columns and continuous beams in simple construction (AD281, AD283, AD285 and AD288) with Slimflor or Slimdek construction, our attention has been drawn to their possible use with a shallow composite floor slab on the top flange of the beams.
We considered this possibility when writing the above series and rejected it at that time because of the difficulties associated with designing the connection zone which is illustrated in Figure 1. Our advice in AD 285 explicitly limits the use of the system to where the floor plate is contained within the depth of an ASB beam and this advice remains current. The following comments explain some of the problems and the reasons for our advice.

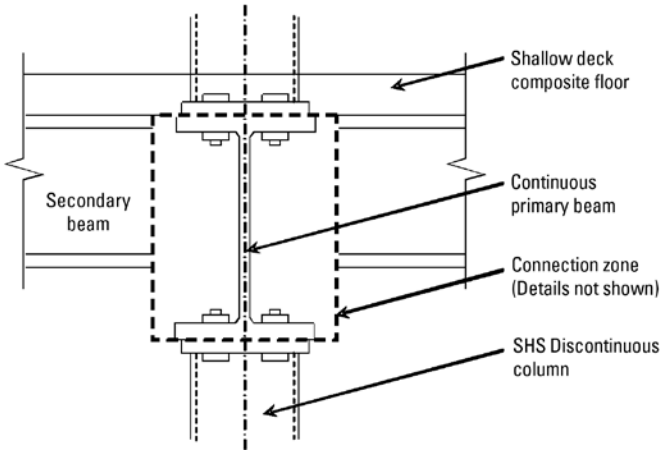

Figure 1. Shallow deck composite floor slab on top flange of floor beam with discontinuous columns

With shallow composite floor construction, modern steelwork practice often uses large openings in the webs of composite beams to achieve service integration and make the overall depth of floor construction shallower. Making the primary beam continuous over (or through) the column would reduce the overall depth of construction further (because shallower beams can be used) and also allows the use of SHS discontinuous columns with simple end plate details. This would make the overall structural package very attractive for larger residential and commercial developments. However, as the discontinuous column form of construction is a recent development it was not considered in the design of whole buildings by the BS 5950 code committee. BS 5950-1 only makes reference to the design of cap plates (where the cap plate on the column supports a beam end). There is insufficient material in BS 5950-1: 2000 to cover all of the complexities that arise with this type of design concept when a shallow deck composite slab is placed on the top flange of the continuous beams, particularly on deep beam sections.

Beam-column Connection

A major concern when discontinuous columns are used with downstand beams is that the beam-column connection to the bottom flange of the primary beam (which is in compression in the hogging moment region) is not restrained laterally (unlike with Slimfor and Slimdek construction) and will buckle, as shown in Figure 2. The compression in the flange is a de-stabilizing effect **in addition** to that arising from the discontinuity of the column.
BS 5950-1: 2000 has provision for the column effects alone; clause 4.5.3.3 requires that 'If the load or reaction is applied to the flange by a compression member, then unless effective lateral restraint is provided at that point, the stiffener(s) should be designed as part of the compression member applying the load, and the connection should be checked for the effects of strut action, see C.3.' In addition, clause 6.1.8.2 requires that the 'intended' member stiffness about each axis be maintained at the connection. However, the Code does not contain provisions for dealing with the combined effects due to the column discontinuity and the compression in the beam flange. Furthermore, the column will be required to sustain biaxial bending.

Distortional Buckling of Primary Beam

Placing the floor slab on the top flanges of the floor beams requires that the continuous primary beam be checked for distortional buckling in the hogging moment region. Therefore the stiffeners in the connection at the beam-column junction would also have to provide torsional restraint to the primary beam. This requires continuous secondary beams, with sufficient flexural stiffness to provide torsional restraint to the primary beam connected to it at the beam-column junction by moment connections. The required stiffness of the moment connection between the beams to provide the torsional restraint would also have to be determined.

Conclusion

It is the SCI's advice at this time that shallow deck composite floor slabs placed on the top flange of the beams should not be combined with discontinuous columns and continuous beams, unless there is a detailed calculation of the instability problems arising.

When the floor plate is placed within the depth of an ASB beam, it prevents out of plane buckling of the discontinuous column ends and avoids the need for a distortional buckling check of the primary beam in the hogging moment region. Moreover, the thick flanges of the ASB beams make the beam-column connection design, including the structural integrity checks on the column, easier to achieve.

Contact: Thomas Cosgrove
Email: t.cosgrove@steel-sci.com
Telephone: 01344 623345

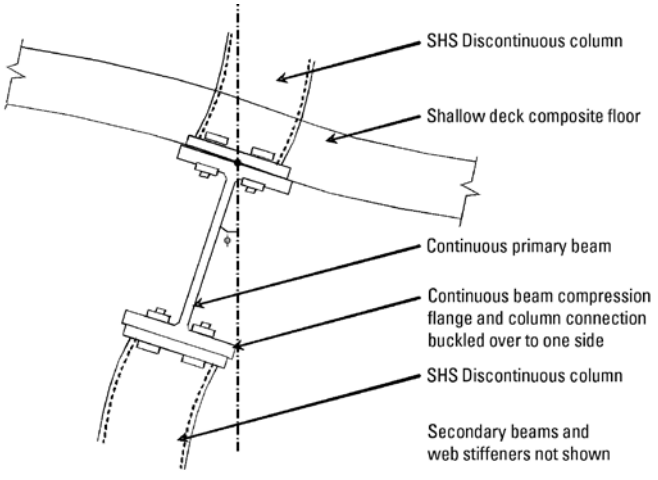

Figure 2. Buckling deformation at connection zone

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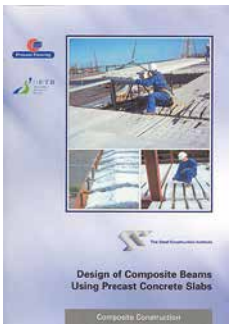

Design of composite beams using precast concrete slabs
Catalogue Ref: P287
Authors: S J Hicks and R M Lawson
ISBN 1 85942 139 3, 102 pp, A4 paperback, June 2003

SPECIAL OFFER ON THIS POPULAR PUBLICATION

Design of composite beams using precast concrete slabs

Precast concrete floors are widely used in building construction, but there is little detailed design guidance on their application in steel framed buildings. It is estimated that close to 50% of floors used in steel framed buildings in the UK use hollow core or solid plank slabs. Most of these applications are in regular steel construction in which the precast slabs sit on the top flange of the beams, but there is an increasing number of composite frames and slim floor constructions where the precast slabs are designed to interact structurally with the steel frame. The use of hollow core or solid plank precast units offer benefits in terms of cost (the long spanning capabilities of the precast slabs lead to fewer secondary beams) as well as the advantages offered by composite construction.

This publication provides guidance on the design of steel beams acting compositely with precast concrete slabs in multi-storey buildings. The design basis is generally in accordance with BS 5950-3, supplemented by recommendations from Eurocode 4 and data from tests; it applies to hollow core units of 150 to 260 mm depth, and to solid precast planks.

The guidance also emphasises the importance of the design of the steel beam in the non composite construction stage, where out-of-balance loads can occur during installation of the precast concrete units.

A step-by-step design procedure is given for composite beams using various forms of precast concrete units, with or without a concrete topping. This is supplemented by a fully worked design example for a composite beam in a 15.8 m x 7.2 m grid, and a series of design tables for concept design.

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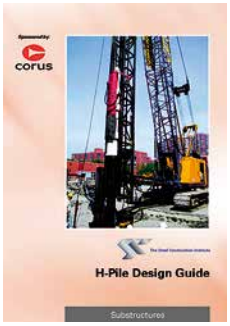

H-pile design guide
Authors: A R Biddle
ISBN 1 85942 164 4,
124 pp, A4 paperback,
September 2005

NEW BOOK

H-pile design guide

"This design guide will provide the confidence for practising engineers to use steel H-piling more extensively"

This publication gives guidance on the selection, design and installation of steel H-piles and UC section plunge columns for foundations to all types of structure. Current practice and experience in this field are presented, discussed and recommendations given.

The characteristics and advantages of steel bearing piles in construction are described in order to assist in the primary process of selection of the correct pile type for any given site and soil conditions. Load transfer mechanisms are described and limit state design methods applied in line with the new Eurocodes. The sections on design include axial and lateral load resistance prediction methods, combined loading effects on retaining walls and pile group analysis. Up to date pile driving analysis is presented as a basis for planning efficient installation and as an aid to design. Practical aspects of test loading, installation tolerances and connection details are covered.

It is noted that excessive conservatism has been found in current practice and this results in unnecessary overdesign. This publication adopts limit state design using the new Eurocodes and suggests more reliance be placed on static and dynamic load test methods to establish ultimate capacity to permit more economic steel pile design.

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

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

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

KEY

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

Quality Assurance Certification
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- **Q2** BSI
- **Q3** Lloyd's
- **Q4** Other

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- **10** Up to £40,000
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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.

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T J O'Connor & Associates*
Walsh Draughting Services Ltd

Italy
FICEP S.p.A.
Politecnico Di Milano
Universita Degli Studi Di Trento

Kenya
David Engineering Ltd
H P Gauff Consulting Engineers
Steel Structures Ltd

Korea
INI Steel Company
Korea University

Lithuania
Vilnius 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 Associates

Norway
Tee Consult Holding AS

Portugal
Universidade de Aveiro
Universidade de Coimbra

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
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 July/August 2005 issue*

With RAM International software...

The Sky is the limit!

Manchester Hilton, Deansgate - tallest residential building in the UK

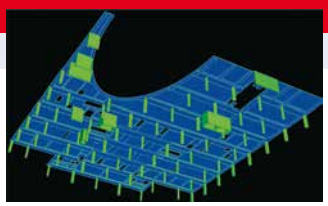
"RAM software was an integral part of this project as it is on nearly all of our projects."

Kamran Moazami, Director, WSP Cantor Seinuk, London

RAM International announces the release of three new INTEGRATED products and a major upgrade to the RAM Structural System!

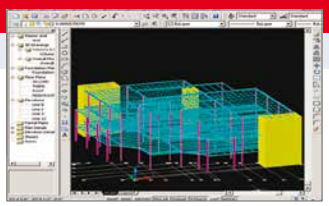
RAM Structural System™

Version 8.2 —Now including the automated design of web openings and links to RAM Concept, RAM CADstudio and RAM Advanse.



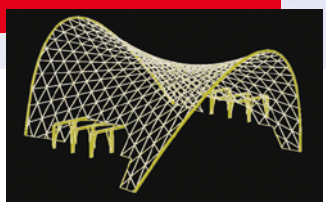
RAM Concept™ New!

Special purpose finite element based analysis and design of reinforced or post-tensioned concrete slabs and foundations to BS8110.



RAM CADstudio™ New!

Drawing management system for AutoCAD. RAM CADstudio is the answer to automatic change control management and generation of drawings.



RAM Advanse™ New!

Full featured 2D or 3D finite element analysis and design for general structures or building components such as continuous beams, trusses, towers and more, all to BS5950.

From Steel to Reinforced Concrete and Post-Tensioned Concrete... RAM will take you higher.

Only RAM makes you this productive!

RAM International (Europe) Limited
4 Woodside Place
Glasgow G3 7QF
United Kingdom
Tel: +44 (0) 141 353 5168
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www.ramint.co.uk

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