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NSC

South coast airport takes off

May 2011

Vol 19 No. 5

Studio completes crescent

Belfast factory takes wing

Nuclear facility for Sheffield

Touchdown for Salford Stadium

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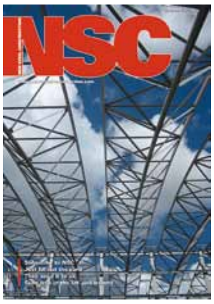

New Steel Construction keeps designers and contractors abreast of all major steel construction related developments and provides detailed technical information on key issues such as the introduction of the Eurocodes. NSC will be the first place most people hear about advances made by the extensive research and development efforts of the steel construction partners – Tata Steel, the British Constructional Steelwork Association, and the Steel Construction Institute, as well as other researchers.

Each issue of NSC is a blend of project reports and more in depth technical material. Taking up our free subscription offer is a guarantee that you will be alerted to significant developments in a sector that retains a commitment to continuous development in knowledge and techniques for timely delivery of cost effective, quality projects across all sectors of construction.

Each issue of NSC is typically 44 pages and contains five pages of news, developments related to Eurocodes, cutting edge project reports from site, and the latest technical updates from the Steel Construction Institute in its Advisory Desk Note series. Popular features are 50 Years Ago and 20 Years Ago, looking at key projects of the past by revisiting the pages of 'Building With Steel' and 'Steel Construction'.

A recent development has been the introduction of Steel Industry Guidance Notes, SIGNS, with each issue of NSC, a loose leaf insert series aimed at students and designers new to steel construction. SIGNS provide essential introductory explanations of basic steel related design topics and point the way towards where more detailed, free, support can be accessed in the steel sector.

NSC is available free of charge each month to subscribers living in the UK or Ireland by simply filling in the reply paid card bound into this issue, or by contacting us by email, post or fax as described on the card.

If the card has already been removed from this issue you can fill out this form and fax it to **020 7747 8199**, or scan and email it to **admin@new-steel-construction.com**

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Email






Cover Image
Bramall Music Building, University of Birmingham
Main Client: University of Birmingham
Architect: Glenn Howells Architects
Steelwork contractor: Robinson Steel Structures
Steel tonnage: 410t

May 2011 Vol 19 No 5

These and other steelwork articles can be downloaded from the New Steel Construction Website at *www.new-steel-construction.com*

Steel inherently more safe

Nick Barrett - Editor

Sad news from the Health and Safety Executive confirms that there will have been a rise in construction related fatalities for the year 2010-2011 which brings to an end a four year period when it seemed that the industry might have turned a corner on safety. The final fatality figures have yet to be revealed, but a significant rise is expected, the HSE has confirmed.

No one can be sure exactly why fatal accidents are on the rise again. The reasons why they occur are diverse and complex and no one has yet been able to generalise to any great extent about why they still happen despite all the time and effort of all levels of management and supervisory staff to instil a deeper safety culture into workforces.

It is not all bad news on the safety front. The HSE agrees that a sea change in the industry's safety culture has taken place in recent years, and the HSE are now going to target their inspections on organisations with the poorest records and unfortunately the construction industry is still seen as high risk. But HSE also warns that there could be troubles ahead; Chief Construction Inspector Philip White has been reported as warning that when the industry comes out of recession there may be a lot of younger and inexperienced workers entering it who are not risk aware. And when companies are expanding rapidly, processes and procedures like health and safety can suddenly find themselves swamped by the volume of new responsibility.

Against this background the steel construction sector can take some comfort that its efforts on health and safety over many years, including proper training and supervision of the workforce, are paying dividends, with the Reportable Accident Frequency Rate down by a further 25% in 2010 (see News). In 2010 there were no injuries relating to falls from height, for the second year. This compares to 2005 when there were 14 such accidents.

The steel construction sector has for long proudly boasted that steel is an inherently safer way to build, which its safety performance bears out year after year. This inherent safety is only fully captured by the full commitment to safety and to continuous improvement in safety that the sector demonstrates. Steel construction can justifiably hold itself up as a model for others to emulate.

Awards shortlist shows diversity

The annual publication of the shortlist for the Structural Steel Design Awards has for 43 years highlighted the diverse type of projects that are successfully executed year in and year out by the use of structural steel. This year's shortlist is no exception (see News).

There is a geographical spread throughout the UK and Ireland, from a new football stadium in Brighton to a museum in Liverpool, a concert venue in London, a flyover on the East London Line, to a waste to energy plant in Kent. They are for sectors as diverse as commercial offices, sports, leisure, logistics and distribution, and transportation.

The strength of the 18 strong shortlist is made even more impressive by coming as it does at the tail end of possibly the worst recession that construction has ever seen. There are fewer projects around, but judging by the entries to the awards steel has been capturing market share in key traditional markets like single storey buildings,and multi storey commercial developments where it usually dominates, but also in new growth markets like waste to energy plants.

The winners will be announced at the awards ceremony in July, where details of all the shortlisted entries as well as the winners will be displayed. As a showcase for the best of what the construction industry can provide it will be unmissable.

NSC

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Accidents down by 25% in steel construction

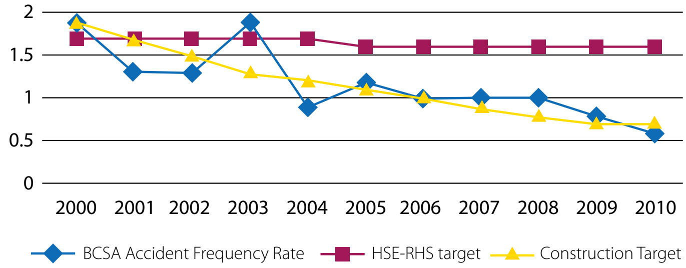
The latest published figures from the BCSA reveal that the Reportable Accident Frequency Rate (AFR) for member companies has been reduced by 25% over the last 12 months.

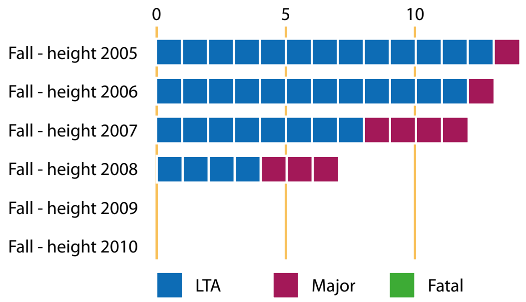
"The 25% reduction is a very good result that demonstrates the industry is committed to improving working practices and procedures, some of which are developed with the BCSA health and safety committee to address the current issues and best practice. This is based on shared experiences and intended to help reduce accidents and injuries further," said Pete Walker, BCSA Health, Safety & Training Manager.

More good news can be revealed as the number of 'falls from height above 2m' have also seen a dramatic reduction.

No such accidents were reported during 2009 and 2010 for the constructional steelwork industry.

"This is a significant acheivement," added Mr Walker. "Bearing in mind that in 2005 there were 14 such falls reported."





Above: Targets set by HSE and Construction Industry:

Left: RIDDOR Falls from height 2005 – 2010

Bridge relief for Kentish town

Mabey Bridge has completed the erection of the first of two bridges it will construct for the 1.4km long Sittingbourne Northern Relief Road in Kent.

Spanning the Sittingbourne and Kemsley Light Railway, the single span steel composite bridge consists of six 42m-long girders, which were brought to site as complete members and lifted into place individually by a 1,000t capacity crane.

The erection process was completed in two days and required the use of temporary props to be installed to stabilise the initial girders. All of the girders were spaced at 2.6m intervals, and all of the connecting cross members were installed during the two-day programme.

Bypassing Sittingbourne's town centre, the new road is expected to ease congestion and provide better access to a number of local business parks. Working on behalf of main contractor Jackson Civil Engineering, Mabey Bridge has begun work on the project's second steel bridge, a three span structure crossing Milton Creek.

Steel spans Welsh heritage railway

Steelwork has been completed on a bridge which will take traffic over the Welsh Highland Heritage Railway and the recently opened Caernarfon route.

The three span structure forms part of the £35M Porthmadog bypass and was erected by Cleveland Bridge, working on behalf of a joint venture partnership of Balfour Beatty and Jones Bros. Civil Engineering.

More than 150t of structural steelwork required 14 separate lifts, by a 200t capacity mobile crane, to complete the bridge deck.

Wyn Daniels, Partnership Project Manager, described the construction of the bridge as a major milestone in the bypass scheme.

He said: "We would like to thank everyone at the railway companies for the patience, understanding and cooperation while this essential work was carried out."

Excellence and innovation highlighted in SSDA shortlist

The shortlist for the 43rd Structural Steel Design Awards has been announced by the BCSA and Tata Steel.

The shortlisted projects for this year's SSDA awards, reflect the geographical spread of steel's appeal for jobs large and not-so-large, including single storey and multi storey buildings, bridges and other structures.

David Lazenby CBE, Chairman of the SSDA Judging Panel, said: "Structural steelwork demonstrates success yet again, as the material of choice. In these tough times the entries to the SSDA continue to show great imagination, professionalism and service to the clients.

"In challenging situations, the teams involved in these really exciting schemes have impressed the judges by the fine spirit of cooperation and 'can do' enthusiasm to produce some outstanding results. 2011 has brought forward a great demonstration of the industry's strength and capabilities."

The winners of the SSDA awards will be announced at an evening reception in London during July.

The shortlist is:
- Marks & Spencer, ProLogis Park, Bradford
- The Rose Bowl, Southampton
- Riverside Waste to Energy Plant, Belvedere, Kent
- Newport Station Regeneration
- The Hauser Forum, Cambridge
- The Point, Lancashire County Cricket Club, Old Trafford
- National Museum of Liverpool
- The St Botolph Building, 138 Houndsditch, London EC3
- Excel Phase 2, Royal Victoria Dock, London E16
- Cannon Place, Cannon Street Station, London
- River Suir Bridge, N25 Waterford Bypass, Ireland
- New Cross Gate Flyover, East London Line
- Bridge GE19, East London Line
- New South Bridge, A406 Hangar Lane
- Goodwood Festival of Speed Sculpture 2011
- Exposure, Lelystad, The Netherlands
- American Express Community Stadium, Brighton
- North Stand Redevelopment, Leicester Tigers, Leicester

Centrepiece atrium installed at Harlow school

Working on behalf of English Architectural Glazing (EAG), Adey Steel has supplied and erected steelwork for a feature centrepiece atrium at the Passmore School project in Harlow, Essex.

Construction work on the £23M two storey school began in January 2010. Designed by architect Jestico + Whiles, it will eventually accommodate 1,200 students in its naturally ventilated 'finger structures' which radiate outwards from the central atrium.

The steel framed elliptical atrium roof completed the main concrete structure, and erection progamme required the delivery of a myriad of small steel sections to form the complex shape.

Further to this part of the project, Adey has been subsequently awarded the package for the steel entrance canopy works which are due for installation during September.

Iconic steel framed building to transform prime London site

The largest development on London's Oxford Street for 40 years is progressing on schedule with the steel frame (as of mid April) approximately 70% complete.

Known as Park House, the structure will cover an entire city block, totalling almost half an hectare, on a prime West End location close to Marble Arch and Mayfair.

The mixed use development will include 15,000m² of offices and luxury residential apartments and a further 8,000m² of retail space on the lower ground and first floors. The steel framed structure will consist of eight floors, topped with a double height curved glass roof.

Working on behalf of Mace, steelwork contractor Severfield-Reeve Structures will erect approximately 3,300t of steel for the project, which is due for completion in 2012.

AROUND THE PRESS

The Structural Engineer
5 April 2011
Shard's steel composite design breaks records in speed and height
"Completing the initial and the largest part of the steelwork by November was a huge achievement to all those involved," says Gareth Lewis, Mace Chief Operating Office for Construction. "One of the main reasons for choosing steel was for its speed of construction."

Construction News
31 March 2011
Specialists Awards
(Referring to SH Structures) The judges said: "In declining market conditions they have further developed their technical and quality management systems. They have retained all of their staff. They are a preferred choice by clients."

Construction News
24 March 2011
Regeneration takes shape
(Bilston Leisure Centre) Delivering such a design typically requires the use of very large steel beams, which can put very high loadings on the foundations. As a result, Shepherd has elected to use cellular beams, which it says reduces the load on the raft slab foundations.

Building Magazine
25 March 2011
Carnegie Pavilion
The new home of the Yorkshire County Cricket Club and the Tourism, Hospitality and Events faculty of Leeds Metropolitan University at the iconic Headingley cricket ground has been transformed into an abstract, futuristic shell that is intended to project a new dynamic image... green, perforated triangular steel panels clad three sides of the pavilion.

New Civil Engineer
24 March 2011
Tale of the river bank
(Taunton bridge) "Steel fabrication tolerances are tight, but they are tight for a reason," says Somerset County Council major schemes manager Richard Needs. "We didn't want any unjustified features that gave maintenance issues in the future."

Landmark Olympic Stadium completed on time

The London 2012 Olympic Stadium has been completed on time and under budget. Marking the end of the construction programme, the final piece of turf for the stadium's field of play has been laid, bringing to an end three years of high profile building activity.

Olympic Delivery Authority (ODA) Chairman John Armitt said: "To complete a complicated project such as this in less than three years is testament to the skill and professionalism of the UK construction industry."

Only 10,000t of structural steelwork has been used on the project, making it the lightest Olympic Stadium to date. All of the steel was fabricated, supplied and erected by Watson Steel Structures.

The steelwork total includes 112 steel rakers to support the stadium's terracing units, while the roof compression truss is made up of 28 steel sections, each one 15m high by 30m long and weighing 85t.

The 80,000 capacity stadium has been designed to be flexible enough to accommodate a number of different requirements. West Ham United Football Club will take over the site once the Games are over, this will require the configuration and the capacity to be altered.

In next month's *New Steel Construction* (June issue) there will be a full round-up of all the Olympic structures.

Sustainable future demonstrated at Tata Steel site

A unique centre which will develop and demonstrate ultimate low-carbon, low-energy sustainable construction technologies, has been opened by the First Minister of Wales, Carwyn Jones at Tata Steel's Shotton site.

Known as the Sustainable Building Envelope Centre (SBEC), the Centre is a result of a collaboration between the Welsh Assembly Government, the Low Carbon Research Institute (LCRI) and Tata Steel.

The building will be a showcase for sustainable products and used to test and monitor new integrated heating, energy and ventilation systems on the fabric of the building. At SBEC, a team of researchers and technologists will create building façades – the walls and roofs – capable of transforming buildings from being energy consumers into energy generators.

Launching the facility, the First Minister said: "This Centre will showcase practical solutions for a sustainable future. It shows how we can optimise Wales's strengths in research and development in engineering and technology, and also in the manufacture of steel products for the vital construction sector. It is good to see this development in North Wales turning sustainable ambition into reality."

Seminar series set to boost industry awareness

A new series of Steel Essentials seminars is due to start at Southampton on Wednesday 8 June.

The series of morning events are free of charge and aimed at keeping construction professionals aware of the latest developments in steel construction, covering a number of topics including:

Target Zero Project: This research has investigated three key areas of sustainable construction - how to achieve higher BREEAM ratings at lower cost; which energy efficiency measures can be employed to gain higher operational performance and how to treat embodied energy. The study produced a series of fully costed guidance reports outlining the most cost-effective solutions for reaching lower carbon buildings.

Design for Fire: The presentation will examine the legislation behind fire regulations in England and Wales. It will look at different forms of structural fire protection and describe the advantages and disadvantages of each. Fire testing and its implications and limitations will be explained.

Eurocodes – Introduction to EC3: The steel sector has played a leading role in assisting designers during the changeover to the Eurocodes. There is an extensive range of support available that is helping ensure that our world renowned ability to produce efficient steel designs extends seamlessly into this new era.

Sustainability: This is a significant issue for designers to consider. This part of the seminar demonstrates the case for steel in sustainable construction through the building's life-cycle. It also reviews the issue of thermal mass and gives guidance on embodied carbon content.

Value Engineering: The steelwork contractor turns the engineer's vision into a working structural frame. However, a design that optimises structural efficiency may not always provide the best value and/or the quickest construction. The steelwork contractor can work in partnership with the structural designer to provide best value solutions and this presentation demonstrates how this can be achieved.

Commercial aspects of Steel Construction: This presentation will give an overview of how to develop a budget price for a structural frame in steel, identifying key drivers that influence that price. It will also consider steel's competitiveness against other materials.

Case Study: Each seminar will feature an interesting project that exemplifies the beneficial use of steel.

The forthcoming Steel Essentials seminars are:

Wednesday 8 June
Novotel
1 West Quay Road
Southampton SO15 1RA

Thursday 9 June
Novotel
Bristol Centre
Victoria Street
Bristol BS1 6HY

Wednesday 22 June
Menzies Strathallan Hotel
225 Hagley Road
Edgbaston
Birmingham B16 9RY

Thursday 23 June
Radisson Blu Hotel
107 Old Hall Street
Liverpool L3 9BD

To reserve your place please e-mail your contact details to *events@steelconstruction.org* quoting your preferred venue e.g. 'Birmingham'.

Any queries, please contact the event team on 0207 747 8131.

Steel serves the food industry

More than 400t of structural steelwork has been supplied by Caunton Engineering for a new manufacturing facility in the Staffordshire town of Leek for Adam Food Ingredients (AFI).

The overall structural design of the triple span portal frame premises has been undertaken by Acies Group. The steelwork also includes mezzanine levels and an adjoining two storey office block.

AFI is investing millions of pounds in the new 5,500m² factory which will help the company increase its range of products and services.

Owned by the Irish Dairy Board, AFI produces a range of dairy ingredients such as cheese flavours, whey protein and lactose, and technical ingredients, such as texturisers, emulsifiers and stabilisers, for various food and drink categories.

International recognition for BCSA Director General

On a recent visit to New Zealand, Dr Derek Tordoff, Director General of BCSA, received an award from the International Steelwork Contractors Group (ISCG). The award was for his work, over many years, in developing the market for steel construction in the UK. Presenting the award are Hennie de Clercq, Chief Executive of the South African Institute of Steel Construction (left) and Don MacDonald, Chief Executive of the Australian Steel Institute (right).

The ISCG is made up of BCSA's sister organisations in the USA, Canada, South Africa, Australia and New Zealand. Dr Tordoff was a prime instigator of the group, which exists to share knowledge and experiences of steel construction development activities across the world.

NEWS IN BRIEF

The **BCSA** and **Tata Steel** will co-sponsor a major sustainability conference in London on 7 July. The event, run by Building Magazine, will provide construction professionals with practical guidance on topics such as: operational energy, embodied energy, BREEAM, life cycle assessment and sustainable design. Leading practitioners will deliver a mixture of presentations, panel discussions and case studies. A website *www.deliveringsustainablebuildings.co.uk* , giving more in-depth information on the conference will go 'live' this month (May).

Tata Steel and **Dyesol** have decided to expand their joint photovoltaics development project based at the PV Accelerator Centre at the Tata Steel site at Shotton in North Wales. The number of personnel working on the project will be increased from 30 to 50. The £11M project, whose initial development phase is due to be completed in June 2011, set out to develop the world's first continuously manufactured dye sensitised photovoltaic product on steel for building applications.

AceCad Software has released Service Pack 2 for StruCad evolution. This electronic release contains more than 40 fixes and enhancements that will benefit clients that have already purchased the original software. All users should have received a complementary email with full content descriptions.

The *2011 Steel Construction Industry Directory for Specifiers and Buyers* is now available, free of charge, from the **BCSA**. The directory is the best source of information for those looking to find reputable steelwork contractors and suppliers to the steel construction industry. Please contact Gillian Mitchell MBE, Deputy Director General, BCSA, Premier House, Carolina Court, Wisconsin Drive, Doncaster DN4 5RA. Tel: 020 7747 8121 (direct line), Fax: 020 7747 8199 or Email: *gillian.mitchell@steelconstruction.org*

Steel Day Scotland, a joint BCSA and IStructE event will take place on 5 May at Crush Hall, Path Buildings, University of Stirling. The day commences with a number of optional factory tours to Scottish BCSA members, this is followed by a series of lectures and finally a hot buffet. For more information contact Gillian Mitchell at the BCSA.

Foundations laid for low carbon economy

A new £2.6M resources centre in Cambridge will help speed up growth of the low carbon economy in the east of England.

Currently under construction, the steel frame for the building was erected by H Young Structures working on behalf of main contractor Kier Marriott.

Known as SmartLIFE Low Carbon, the project is a joint venture between Cambridgeshire County Council and Cambridge Regional College. It forms part of a much larger scheme called The Hive, which will eventually include an enterprise park and eco-homes.

Pick Everard project architect Eelin Loo said: "SmartLIFE Low Carbon has been designed to be a low impact and highly energy efficient building. Solar thermal water heating, highly efficient heat recovery systems, rainwater harvesting, solar shading, photovoltaic arrays for electricity generation and automated lighting are being installed to achieve a BREEAM 'Excellent' rating."

Fast track college revamp relies on steel

Huntingdonshire Regional College in Cambridgeshire will soon be the recipient of a new glazed entrance hall as well as an enhanced main facade.

The £1.9M fast track scheme, awarded to main contractor ISG Jackson, will also extend and refurbish the College with the addition of new classrooms and seminar areas.

Work has begun on the steel framed entrance extension, which will incorporate a mezzanine level, new lift installation and a link walkway into the refectory.

The double height entrance will house a new reception and break out seating area, with extensive glazing to maximise natural light entering the building.

Steelwork contractor for the project is B&B Group.

Diary

For all SCI events contact Jane Burrell, tel: 01344 636500 email: *education@steel-sci.com*
For Steel Day: Scotland contact Gillian Mitchell, tel: 0207 747 8121 email: *gillian.michell@steelconstruction.org*
For Steel Essentials: To reserve your place e-mail your contact details to *events@steelconstruction.org* quoting your preferred venue e.g. 'Birmingham'. For queries, please contact the event team on 0207 747 8131.

SCI Steel Knowledge

5 May 2011
Portal Frame Design
Bristol

SCI Steel Knowledge

10, 17, 24 May 2011
On-line Steel Building Design to EC3 Part 1
On-line course

BCSA

5 May 2011
Steel Day: Scotland
Joint BCSA / IStructE Scottish Branch CPD event
Aimed at members of both organisations, this event looks to promote closer links through better understanding of the design and fabrication process. A combination of factory tours facilitated by BCSA Members, followed by a series of short lectures at Stirling University.

BCSA TATA STEEL

8 June 2011
Steel Essentials
Half day seminar - Free
Southampton
Novotel, 1 West Quay Road, Southampton SO15 1RA

BCSA TATA STEEL

9 June 2011
Steel Essentials
Half day seminar - Free
Bristol
Novotel, Bristol Centre, Victoria Street, Bristol BS1 6HY

BCSA TATA STEEL

22 June 2011
Steel Essentials
Half day seminar - Free
Birmingham
Menzies Strathallan Hotel, 225 Hagley Road, Edgbaston, Birmingham B16 9RY

BCSA TATA STEEL

23 June 2011
Liverpool
Steel Essentials
Half day seminar - Free
Radisson Blu Hotel, 107 Old Hall Street, Liverpool L3 9BD

Strength from Advisory Service

Designing and building in steel has never been as straightforward as it is today, and steel still remains the material of choice for construction in the UK. The steel sector provides comprehensive and in-depth technical back up to ensure that those using steel have all the guidance and support they could need at their finger tips.

The co-ordinated and comprehensive support provided by the BCSA's Structural Advisory Serivce is free of charge to specifiers, clients and designers. Technical experts are on hand to provide an extensive range of services, including design assistance on structural form, performance of steel buildings, seminars and in-house CPD presentations, etc.

Richard Dixon, Manager, Structural Advisory Services, who heads up the network of Regional Technical Managers throughout the UK and Ireland said: "We have a team of experienced regional engineers who are on hand to offer design support and advice to designers, and to point them to the wide range of technical guidance and resources available to them and inform them in a practical way on key topics like EC3 and the sustainability of steel construction through in-house CPDs."

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Acoustics drive design

FACT FILE
Bramall Music Building, University of Birmingham
Main client:
University of Birmingham
Architect:
Glenn Howells Architects
Main contractor:
BAM Construction
Structural engineer:
URS Scott Wilson
Steelwork contractor:
Robinson Steel Structures
Steel tonnage: 410t
Project value: £13M

The new domed structure sits comfortably within its historic setting

The University of Birmingham is building a new concert hall, one which will provide state of the art performance and rehearsal space as well as enhancing the surrounding historic buildings. Martin Cooper reports.

Constructing a university auditorium may not be such an unusual project in itself, but building a brand new concert hall that links into historic buildings and, importantly, compliments and enhances its surroundings is far from being run-of-the mill.

This is a concise description of what is happening at the University of Birmingham, where a new auditorium, known as the Bramall Building, is being constructed within the historic redbrick semi-circle of buildings which have been the heart of the University since 1909.

The historic crescent was never fully completed; a missing segment was left out and a number of structures have stood in the plot over the years. None of these fully complemented the surroundings or the adjoining buildings, while the Bramall Building on the other hand will join up the two portions of the crescent. Facing the University's famous clock tower, the crescent features three main T-shaped finger blocks, with the protruding sections sticking outwards from the back elevation of the block.

"The Bramall Building represents the missing fourth finger of the historic crescent," explains BAM Construction Project Manager Scott Marsh. "Although the new structure is not supposed to completely replicate the original Edwardian architecture, a lot of time and effort has gone into ensuring it does fit and match the environment."

Redbrick heritage

The main campus of the university occupies a site some three miles south-west of Birmingham city centre. It is arranged around the Joseph Chamberlain Memorial Clock Tower (affectionately known as 'Old Joe'), which commemorates the university's first chancellor, Joseph Chamberlain. The university's Great Hall is located in the domed Aston Webb Building, which is named after one of the architects.

The initial 100,000 m^2 site was given to the university in 1900 by Lord Calthorpe. The grand buildings were an outcome of the £50,000 given by steel magnate and philanthropist Andrew Carnegie to establish a "first class modern scientific college" on the model of the Ivy League Cornell University in the USA.

The original domed buildings, built in Accrington red brick and forming a semi-circle to form Chancellor's Court sit on a 9.1m drop, so the architects placed their buildings on two tiers with a 4.9m step between them. The clock tower stands in the centre of the Court.

To this end red bricks sourced from the Netherlands match the hue of the original bricks, stone for the exterior cladding has been purchased from the quarry that supplied the construction project in the 1900s, while architecturally the Bramall Building features identical elements to its adjoining structures, such as arched windows and doorways, and at rooftop level a dome - to be clad in lead - and four turrets. Internally, little or no expense has been spared, as oak paneling is the preferred covering for walls and flooring.

"Predominantly the design of the entire project has been acoustics driven," adds Mr Marsh. "From the shape of the auditorium right down to the fact that the seating will have little or no padding, which again aids better acoustics within a concert venue."

A point of interest is the shape of the auditorium, as previously mentioned the original crescent consists of T-shaped finger blocks, but this shape was not suitable for an acoustically driven music facility and so the new building is more coffin-shaped in plan, with two arms protruding from the uppermost elevations to link into the existing buildings.

Structurally the new building is steel framed, to create the open plan area for the auditorium and the domed roof which adorns the music rehearsal room at the front of the building.

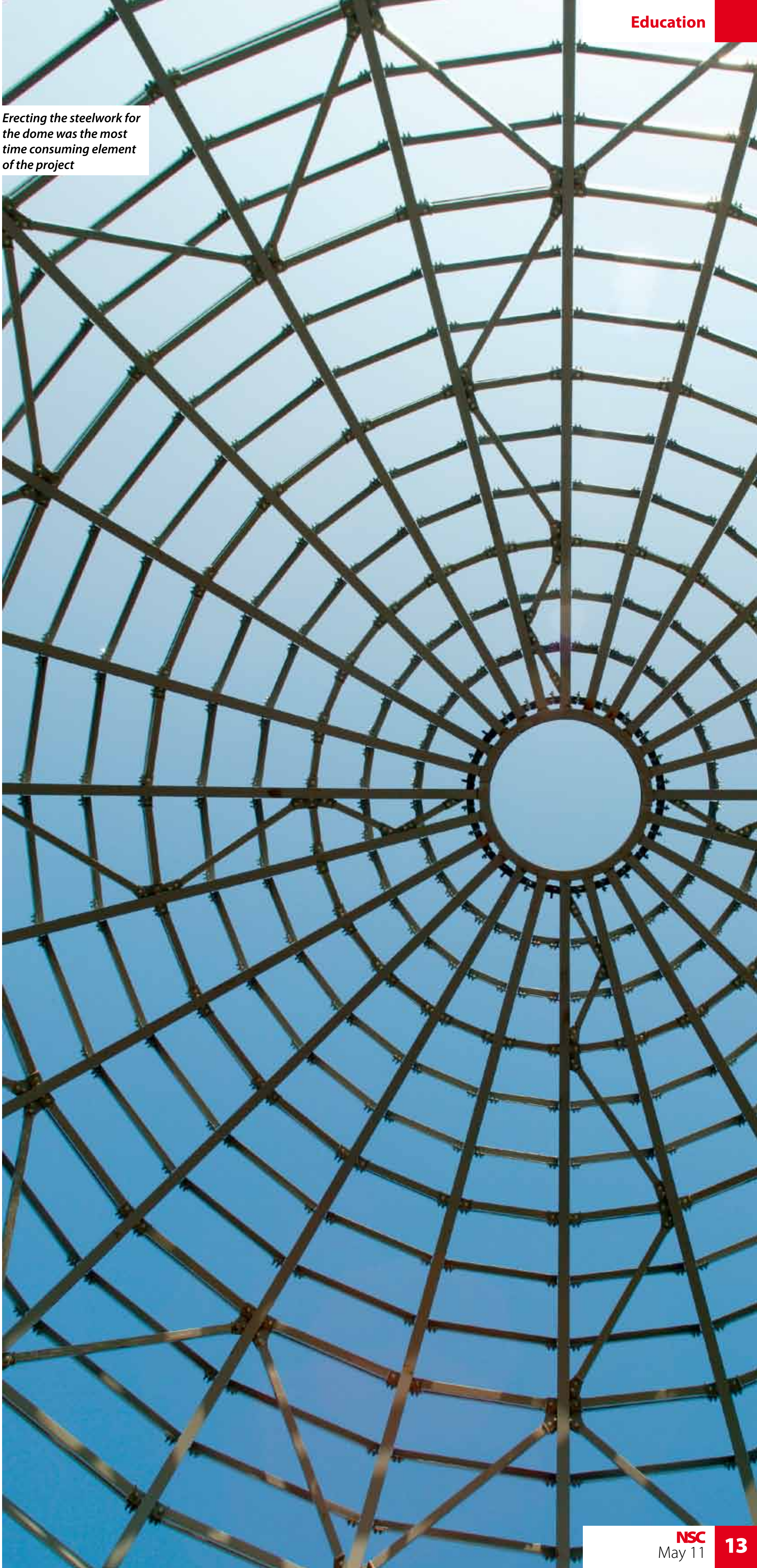
The front portion of the new building, which is incorporated into the crescent and links into existing structures on either side, contains three floors and a basement. Ground floor contains a double height entrance foyer with a first floor balcony offering access to the upper tier of auditorium seating, at second floor level there are storage areas and the third floor houses the music rehearsal room.

A series of 15m long Vierendeel trusses create the open plan entrance foyer, and at 3.2m deep they incorporate the second floor level within their depth and support the uppermost floor.

The top floor rehearsal room is also a double height space, but this floor is topped with a feature domed roof. The dome creates the open column free space for the students' music rehearsals while also replicating the style of the original crescent. With a 15m diameter, the roof dome structure contains more than 400 individual steel members.

"Erecting the domed roof was the most complicated part of the project," says Rob McGann, Robinson Steel Structures Contract Manager. "In order to make the construction process easier, and bring the on-site piece count down, we brought some of the steelwork to site in pre-assembled segments."

Having already erected the majority of the building's main frame, steelwork contractor Robinson constructed the dome on top →



Erecting the steelwork for the dome was the most time consuming element of the project

Impression of the new Bramall Building within the historic crescent

of the rehearsal room's upper gallery. This upper zone gives the room its double height space and eight steel columns support the domed structure. Mirroring the University's other domes, the upper gallery has a series of eight arched windows, brought to site as precast units and inserted between the steel columns.

Twenty four segments make up the entire dome, half of which were brought to site fully assembled. All of the segments are connected and tied together with a compression ring positioned at the apex. During the erection sequence Robinson had to build a temporary tower to support the dome's steelwork. This structure had to remain in place, until the final steel element was bolted into position, as only then did the dome have sufficient self stability.

Each segment consists of two curved radial members tied together by bracing. The fully assembled segments were erected by tying each one together via intermediate segments which were constructed on site.

During the design stage a number of material options were looked at for the dome. Masonry, which would have replicated the adjacent dome, was discounted as too heavy, while timber was uneconomical.

Accounting for approximately two-thirds of the building, the auditorium sits atop a concrete formed basement level - containing music recording studios, plant rooms and storage - with the main steelwork beginning at the ground floor slab.

This portion of the steel structure is 'very complicated' says Mr Marsh, as the auditorium features a number of cantilevering elements for balconies and the control room. The site is extremely tight and access is also limited due to a bridge with a low clearance. This meant steel deliveries were limited in size and had to arrive on a just-in-time basis.

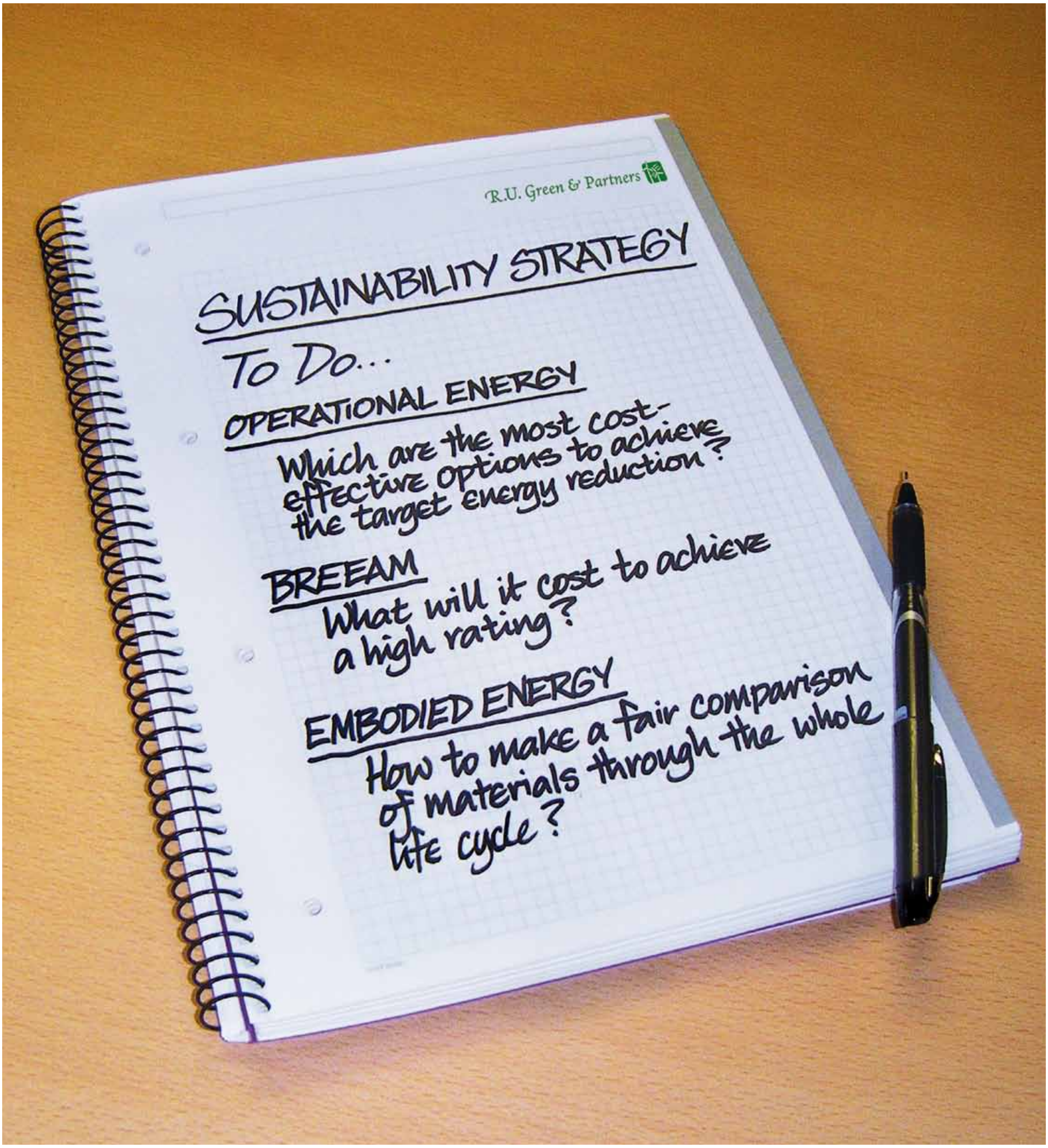
The auditorium features a retractable stage, a separate balcony for an organ and 450 seats arranged over two tiers. A series of 4.2m deep trusses span the auditorium, these vary in length due to the shape of the structure, and most of them were assembled on site from two pieces.

The trusses will be used to hang lighting from, while within their depth there is a maintenance level formed from a tension grid system strung between the bottom booms. They also support the auditorium's 300mm thick concrete roof, which has two differing levels; a lower perimeter level and a higher mid section. The trusses' top boom supports the roof's high level, while the bottom boom supports the lower perimeter level.

The Bramall Building is scheduled to be open in 2012.

"In order to make the construction process easier, and bring the on-site piece count down, we brought some of the steelwork to site in pre-assembled segments."

The auditorium and stage area have been formed by a series of long span trusses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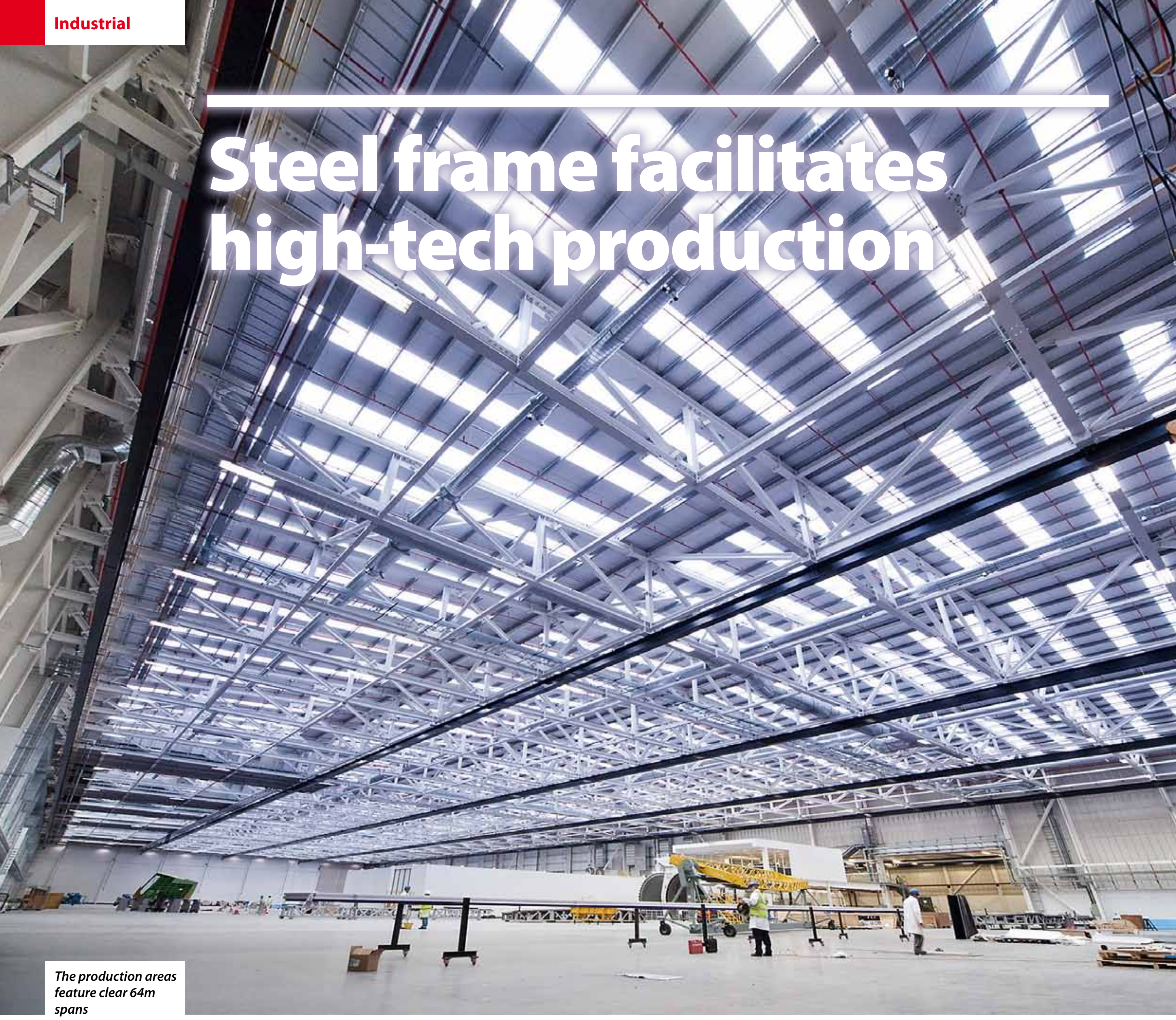
What will it cost to achieve a high rating?
EMBODIED ENERGY
How to make a fair comparison of materials through the whole life cycle?

Steel frame facilitates high-tech production



The production areas feature clear 64m spans

Bombardier has completed the first phase of a new factory for the production and assembly of high-tech wings for its C-series aircraft. NSC reports on how a steel frame created the necessary large open-plan manufacturing areas.

FACT FILE
Bombardier factory, Belfast
Main client: Bombardier Aerospace
Architect: URS Scott Wilson
Main contractor: John Sisk & Sons
Structural engineer: URS Scott Wilson
Steelwork contractor: Fisher Engineering
Steel tonnage: 5,000t

Passengers arriving or departing from George Best Belfast City Airport cannot have failed to notice the large steel framed structure, opposite the runway, which has recently been completed. This 55,742m^2 building represents the first phase of the new Bombardier wing manufacturing and assembly facility, a factory which will produce the advanced composite wings for its new C-series commercial aircraft.

The facility, which is part of a £520M investment by Bombardier in its Northern Ireland operation, is being built to meet high environmental standards. Its layout and design are optimised for energy efficiency and minimal environmental impact.

Bombardier plans to commence production of the advanced composite wings later this year. Consequently, time was of the essence as far as the construction programme for the new facility was concerned and the first phase was completed in just 17 months.

Several local Northern Ireland companies have been engaged in the design, construction and equipping of the new factory.

This list of locally sourced contractors included the steelwork contractor Fisher Engineering. It played a key role in the early stages of the construction programme, as the steel frame had to be completed on schedule to allow all of the follow-on trades to get started on time.

The building's floor was one of the tasks which was started once the frame was up, and the project team was later thankful for taking the decision to sequence the works in this order. Once the steel programme was finished and the building was watertight, the weather took a turn for the worse, but due to the quickly and efficiently completed steel frame, the concreting was able to be completed, unhindered by the inclement conditions.

"In order to get the clear open spans, a steel portal frame was the only solution for this project," points out Roger Knipe, URS Scott Wilson Project Engineer (Superstructure). "To make sure the tight construction programme was met, the steel was actually ordered from Fisher while the procurement process for the main contractor was still underway."

In this way, the steel programme was

"In order to get the clear open spans a steel portal frame was the only solution for this project. To make sure the tight construction programme was met, the steel was actually ordered while the procurement process for a main contractor was still underway."

guaranteed to be quick, as once John Sisk were appointed as the project's main contractor, Fisher were novated to them by Bombardier and, most importantly, Fisher had already begun fabricating the 5,000t of steelwork needed for this job. "This probably saved us three months in total," adds Mr Knipe.

The steel structure is a portal framed building incorporating two adjacent bays of 64m span roof trusses. Sharing the loads between the trusses are a series of spine girders (three in each bay) which run the full length of the building, in the opposite direction to the trusses. K-bracing is then located around the building's perimeter, to provide longitudinal stability.

Large open-plan areas are the order of the day on this project, as the building is basically split in half, with two huge workshop areas adjacent to each other and both featuring 64m wide spans. One of these workshops is known as the Limited Contamination Area (LCA) and is a 'clean room' environment where wing components are manufactured in highly controlled atmospheric conditions. To keep the air clean and within tight temperature and humidity tolerances, the area is served by a huge array of air handling equipment, all suspended within the steel roof trusses.

The roof trusses, for both the 'clean room' and the production area, are tapered and up to 6m deep, carrying up to 15t in weight, from the various air handling equipment and cranes. Both areas have overhead gantry cranes whose beams are attached to the roof trusses. The LCA has three overhead cranes, while the main production area (which houses large autoclaves and various other machinery) contains just one 20t gantry crane which runs the length of the facility.

Fisher had to make 64m long trusses in three separate assemblies, to make transportation to site viable. Two 20m long end-sections were fabricated and delivered to site as completed units, while the mid-sections, which are also the deepest parts (at 6m) of the truss, were delivered to site piece-small and assembled on the ground prior to the lifting procedure.

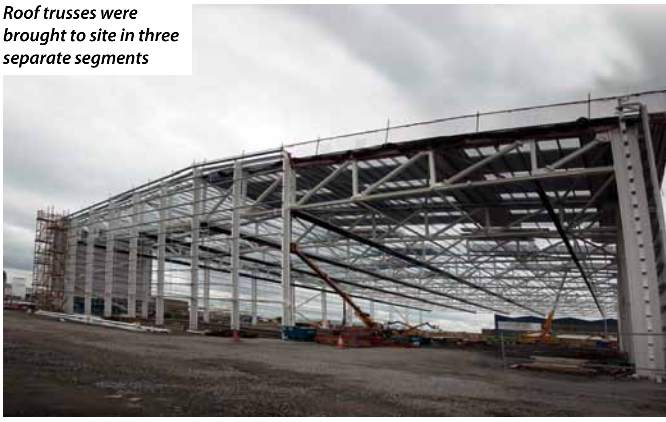
"Three cranes were needed for the truss erection sequence," explains Michael Moore, Fisher Engineering Project Manager. "Two cranes lifted one end-section each and allowed these to be bolted to the supporting columns. While the ends were being held in place, a third crane lifted the assembled mid-section and this was then bolted to the two end-pieces."

Separating the two workshops, which run the full length of the 200m long building, is one single row of 16m high internal columns, spaced at 8m intervals. These columns pick up the clean room trusses at a height of 9.7m and the other area's trusses at 12.5m. The columns then carry on upwards to form the building's distinctive roof.

'The roof trusses are at different heights because of the adjacent airport," says Mr Knipe. "The clean room area of the building is closest to the runway and was restricted by the Civil Aviation Authority's clearance line. It couldn't be higher than 9.7m, while the production area, as it's further from aircraft movements, was permitted to be higher."

All involved this job agree that the steelwork erection and procurement played a key role in the construction of this factory.

The close proximity of Belfast City Airport meant a height restriction was imposed on the building



Roof trusses were brought to site in three separate segments

Steel was the material of choice because of its speed of construction as well as the clients need for an early start to the construction programme

Advancing manufacturing expertise

The front elevation features a three storey office and administration area

FACT FILE
The Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) Sheffield
Main Client: University of Sheffield, University of Manchester and a consortium of industry partners.
Architect: Bond Bryan
Main contractor: BAM Construction
Structural engineer: Buro Happold
Steelwork contractor: Elland Steel Structures
Steel tonnage: 1,000t

An industrial centre of nuclear manufacturing excellence is under construction near Sheffield. Martin Cooper reports on how a steel frame has proven to be an integral part of the project's design.

As a new generation of nuclear power stations are potentially in the offing, not only in the UK but also worldwide, opportunities will arise for British based businesses to cement their places in the nuclear supply chain.

The Government and major industrial players have recognised that it has been some time since the last domestic nuclear power plant was built, and many UK companies have not maintained or developed their expertise. To help reverse this trend and enable UK companies to seize the opportunities this growing sector will present a Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC) is under construction near Sheffield.

The £25M Centre will be operated by the University of Sheffield and University of Manchester, in collaboration with industrial partners led by Rolls-Royce. It is expected to draw together some 30 partner high-tech manufacturing suppliers who are committed to meeting UK demand and playing a significant part in global markets through the production of high-value, low volume systems and components. In short, it will be a centre of excellence for research and development, combining the expertise of academia and manufacturing.

The Nuclear AMRC is a 8,000m^2 building, adjacent to the existing Advanced Manufacturing Research Centre (AMRC), both are located on the Advanced Manufacturing Park, which is on the boundary of Sheffield and Rotherham.

Approximately 1,000t of structural steelwork has been erected to form this large building, which is apt as steel will play a significant role in the construction of any new nuclear power facility. It has been estimated that at least 50,000t of structural steel will be required for each new nuclear plant.

As well as advancing the UK's low carbon manufacturing technologies, the building will also take advantage of a number of sustainable features, adding to its potential 'BREEAM' Outstanding rating. The structural steel frame is of course recylable and can be reused in the event that the building was ever demolished.

A twin bladed wind turbine will deliver 500KW of renewable power and ground source heat pumps will heat and cool the facility. A total of twenty ground source heat loops penetrate 100m below the ground and will provide a free source of sustainable energy.

Construction work on the former Orgreave coal mine site began last year, with BAM Construction completing its piling programme and casting the building's concrete slab prior to steelwork erection commencing in December.

"The project team have worked wonders keeping this job on schedule, particularly working through the extremely harsh winter conditions we've had," comments BAM Construction Project Manager Nick Howdle.

The structure's slab was poured in eight phases and each one was completed overnight, as this guaranteed the materials delivery. The slab's thickness varies from 800mm up to an impressive 2.4m in places, due to the large machinery which will be located within the building.

Once the slab was done, steelwork was able to begin, with steelwork contractor Elland Steel Structures having the benefit of being able to position its cranes and MEWPs on the completed concrete surface. Starting in December, the nine week steel erection programme was then completed on schedule, despite the inclement conditions which even required the site to be closed for two days.

The steel frame consists of a three storey office section at the front of the building and two large open plan workshop and research areas to the rear. The workshops are only separated by two rows of columns, which will remain exposed, and both areas will be served by its own overhead gantry crane;

Pin connections have been used to connect all the trusses to the main frame

A twin bladed wind turbine will deliver 500KW of renewable power and ground source heat pumps will heat and cool the facility.

Both of the large workshops will be serviced by an overhead crane running along beams incorporated into the main steel frame

units that run along crane beams attached to the structural main frame.

Elland Steel supplied the crane beams which then have a crane rail system clipped to the top of the heavy column member. Tolerances were extremely tight and had to be within 7mm for the beams which are 23m long.

Bracing provides the stability for the building which is arranged around a regular 7.5m grid pattern. The only exception being the two workshops which run the full 100m length of the building and are both 23m wide column free spaces.

One of the workshops is topped with a feature northlight roof which consists of two rows of sawtooth wedges, which will be glazed on the north side to allow natural daylight to penetrate the building.

To form this section of the roof Elland Steel fabricated 12 frames, with each one consisting of four individual sections, each measuring 13m x 5m. These were erected individually and as each piece was not free standing, temporary bracing was installed until each spanning frame was completely erected.

"The roof frames are joined to the supporting columns by pin connections, chosen for their architectural appearance," says Mr Howdle. "Slotting the frames into position went extremely well, and having the prepared slab to work off of probably helped with the problem-free erection."

The other workshop area, (the one furthest from the offices) features a flat roof, formed by a series of 23m long plate girders, each weighing 6.5t.

The front portion of the structure is occupied predominantly by a three-storey office and administration block. Approximately two-thirds of the front elevation is occupied by all three office levels, with the top floor extending onwards right across the frontage.

Steelwork for this zone was erected around the same 7.5m grid pattern, but the structural design incorporates anti vibration and movement joints, to isolate the offices. Although both parts of the building are in fact one structure, they need to be semi independent due to the work which will be undertaken in the workshops.

"In order to isolate the office block, we had to install steel plates bonded with a PTFE and elastomeric pad, between one row of columns and the connecting beams to facilitate a movement and anti vibration solution," explains Paul Kitching, Elland Steel's Technical Director.

Fronting the office's main entrance are a row of five feature columns, each 10m high. These 200mm diameter CHS members have a tapered conical shape, top and bottom, and are connected to the main frame via pin connections.

These columns are a feature element and will highlight the building's main entrance welcoming visitors and staff into this highly important facility. Construction work is scheduled to be completed by the end of the year and Nuclear AMRC will be operational in 2012.

One of the workshop areas features a wedge shaped roof, with north lights which will allow natural daylight to penetrate the interior

System design quickens construction

The car park is being erected around a regular grid pattern and in 15 zonal phases

FACT FILE
ASDA car park, Weymouth
Main Client: ASDA
Architect: HGP Architects
Main contractor: ISG
Structural engineer: Bourne Engineering
Steelwork contractor: Bourne Parking
Steel tonnage: 340t

A large supermarket in Weymouth is expanding its operations and a cost effective steel framed twin decked car park is central to its plans.

The retail construction sector has had a bumpy ride of late, but there are signs that new projects are in the offing and those much talked about green shoots of recovery may now actually be visible.

On the south coast for instance, ASDA is expanding its operations in the town of Weymouth. Its large town centre supermarket is being enlarged and a crucial element of the store's plans revolve around the construction of a new customer car park.

A new twin deck steel framed car park, with more than 300 parking spaces, is under construction adjacent to the existing store and although it is structurally independent, it will be linked into the ASDA supermarket via a first floor footbridge.

The car park measures approximately 60m wide by 80m, and will feature three levels, ground, first and an open second floor level. The main steel frame is based around a 16m x 2.4m grid pattern, with each bay equal to one parking slot.

Bourne Parking is erecting the car park using its modular Montex system, which it says offers customers modern, cost effective and low maintenance structures. According to the company the main advantages of the system are the reduced time required for construction, minimal disruption during the construction phase, while its lightweight frame minimises foundation costs.

Montex car parks are erected sequentially, in a phased method to full height. For this project everything is being delivered to

The main stair core is braced internally and tied into the main steel frame

site on a 'just in time basis' which eliminates on site storage of materials and allows the contractor to quicken the construction programme.

The system consists of precast slabs which act compositely with a supporting steel frame of columns and beams. All columns used on this project are 12m-long members, reaching the full height of the structure. Meanwhile, all of the 16m-long steel beams are precambered and the deck structure is laid to incorporate a 1:60 slope, either side of a central column line to allow for rainwater run-off.

All beams arrive on site with attached shear studs and once they have been erected a precast slab is positioned between these studs. The joint between adjacent slabs is then filled on-site with a high strength grout completing the composite joint. "The composite beam and slab system allows for a slimmer beam to be used, which is a significant cost saving to the customer, while also allowing for long clear and uninterrupted parking areas," explains Dave Pope, Bourne Parking Operations Director. "The 110mm thick slabs, which are made to our own bespoke design, require no further topping, and arrive on site pre-finished, greatly increasing efficiency."

Structural stability for the car park is provided in the form of chevron bracing bays located around the car park's perimeter.

"The stability of the structure is achieved by the diaphragm action of the composite deck transferring applied horizontal loads to bracing systems located symmetrically throughout the structure," says Mr Pope.

Extra stability is needed during the erection programme when the newly erected steelwork has not been braced. Bourne Parking are inserting temporary knee braces using Lindapter 'clamp' type connections. These have the advantage of easier installation and removal, while also not requiring any holes to be drilled into the new steelwork.

The main stand is the first structure to take shape

Flexible stadium provides community boost

FACT FILE
City of Salford Community Stadium
Main client: Salford City Council/Peel Holdings
Project manager: ARCADIS
Architect: AFL Architects
Main contractor: Buckingham Group
Structural engineer: SKM
Steelwork contractor: Barrett Steel Buildings
Steel tonnage: 800t
Project value: £24M

The City of Salford Community Stadium is set to be a leading venue in Greater Manchester and will provide a new facility for all the local communities to use as well as providing the new home for Salford Reds Rugby League Club.

A 45 acre plot of derelict land, adjacent to the Manchester Ship Canal and the M60 motorway, is being brought back to life as a new community stadium takes shape, a structure which is expected to be a leading sport and events venue for the region.

As well as a modern new home for Rugby League side Salford Reds, the stadium will boast 1,000m^2 of modern conferencing facilities and a large banqueting suite able to cater for up to 750 people. The development also includes parking for 600 cars, two community outdoor pitches - one grass and one artificial - and community changing rooms for these pitches, housed within one of the stadium's four stands.

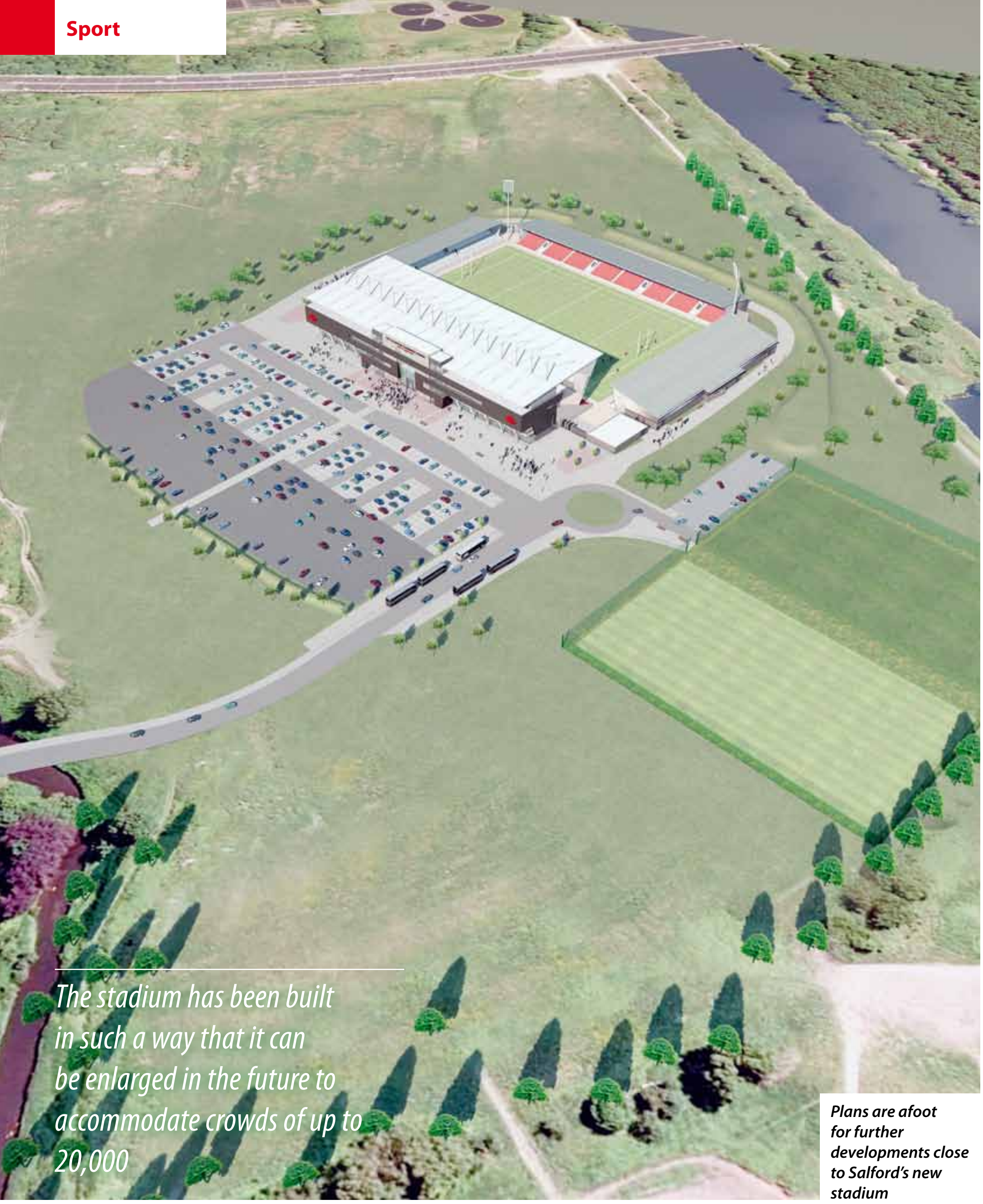
Flexibility and future expansion have played a key role in the design of the stadium. Initially the ground will have a capacity of 12,000, which consists of standing terraces behind each end (north and south) and two all-seater stands. However, the stadium has been built in such a way that it can be enlarged in the future to accommodate crowds of up to 20,000.

As with many modern stadiums, steel is playing an important role in the construction of the project's four structurally independent stands. Steel rakers support precast concrete planks for the terracing and seating areas, while long span cellular beams form the cantilever roofs. For the main stand (West), a traditional beam and column layout has been used, with long span beams creating the large open grid for the banqueting and function areas.

The site had been underused for many years and most recently it had been used as a tip for building waste. The phase one remediation works were carried out by Buckingham, and this commenced last May. This required the company to flatten the uneven ground and form a plateau with none of the inert waste leaving the site.

The construction programme then began in December and prior to the steelwork erection beginning in January much of the piling work had already been completed.

"As the site is predominantly made ground, the conditions change quite radically," explains Brett Kanjurs, Buckingham's Agent. "The west and south stands have piled foundations - down to 14m, while the north and east stands are founded on a ground bearing slab."



The stadium has been built in such a way that it can be enlarged in the future to accommodate crowds of up to 20,000

Plans are afoot for further developments close to Salford's new stadium

Working on a design and build contract for the project's steelwork, Barrett Steel Buildings is programmed to complete its work in 12 weeks. Starting in early March, the west or main stand was the first structure to be erected.

The largest of the four structurally independent stands, the West Stand features four levels. Ground floor will house team changing rooms, offices and circulation areas with concessions. First floor, is similar to a mezzanine level with no access to the stand's seating areas above, but stairs allow access from the ground floor. This level will accommodate shops and offices for Salford Reds RFC.

Second floor is the Stadium's 'dine and view' area, a hospitality suite with a capacity for 750 people. This floor can either be hired as one large open plan area, or divided into individual boxes with the aid of sliding partitions. The uppermost third level accommodates 12 hospitality boxes, two of which can be combined into one, again via a sliding partition.

"Steelwork for the entire main stand is based around a regular gird pattern of 7.3m," says Chris Heptonstall, Associate Director (Design) for Barrett Steel Buildings. "We were then able to work around this grid pattern as it suited the upper level's function areas and boxes as the column lines fall within the partition walls. For the upper level of the Stand, the grid pattern allows two executive boxes per 7.3m grid."

The only exception to the regular grid is the third level, where two rows of internal columns have been omitted for the hospitality suite. Long span Westok beams support this level, as these members provided the most economical solution as well as offering the added benefit of also having service holes.

As the Stadium is also expected to host concerts as well as sporting events, vibration had to be taken into account. "Both vertical and horizontal frequencies differ for various events and more design consideration had to be taken with this Stand using the Green Book,' adds Mr Heptonstall.

Topping the West Stand is a 39m deep roof, 27m of which is cantilevering. The roof is formed from three separate 13m long Westok cellular beams, each member lifted into place with the aid of two mobile cranes, one used for lifting the beams, and the other utilised to hold the other connected members in place.

All of the stands, except the West Stand, have been designed with the possibility of expansion in mind. The three smaller stands' roofs can be removed and more terracing can then be added behind the existing structure.

'The three smaller stands are all of a simpler design, consisting of two rows of columns with the front row supporting the rakers which in turn support the precast terrace units," explains Mr Heptonstall. "With minimal work, the roofs can then be refitted, with the necessary extensions added."

The City of Salford Community Stadium is scheduled for completion by the end of the year and the first Rugby League match will take place in early 2012.

The main stand features a 39m deep cantilevering roof

The back and innards of the main stand will house banqueting and conference facilities

Steel frames for airport expansion

New departures and arrivals buildings form the centrepiece for Bournemouth Airport's ambitious growth plans.

After nearly four years Bournemouth Airport's redevelopment programme has been completed, with much of the work having taken place behind the scenes while passengers came and went as usual.

Completing a major project, which included a new arrivals hall and a new departures building, while not interfering with the airport's day-to-day business, has been a unique challenge for main contractor Warings.

Andy Matthews, Project Manager for Warings, says the biggest obstacle which had to be overcome was coordinating construction around an operational airport. "We built around the existing departures terminal while demolishing parts of it, in order to build the new departures hall.

"Around sixty per cent of the building had to be demolished, but the check-in desks had to be kept open, so we had to maintain the services to that part of the building to keep the flow of passengers going."

Collaboration between the contractor and client was important, because the airport wanted the programme delivered as quickly as possible. Warings initially planned the building of the new structures would be delivered in phases. This phased programme would have allowed the team to gradually work around the project and demolish sections as they went along.

"The airport wanted us to develop the whole thing in one go, rather than in stages. They wanted to make sure that the departures area was fully operational by May last year and then the arrivals hall was ready for May this year," explains Mr Matthews.

Delivering to this timescale involved the use of temporary buildings. The company carried out enabling works to place temporary buildings on the airport apron, with most of the airport's facilities being placed within these structures.

Covered passageways for passengers, running across the site, also had to be installed, to link the check-in areas with the temporary departure gates. These tunnel-like structures had to be worked around and had to be secure enough to prevent any outside intrusion for security reasons.

Steelwork played an integral role in this part of the project's quick delivery. "Both the departures and arrivals halls lent themselves to being steel framed buildings," adds Mr Matthews. "The client wanted open plan flexible spaces and we needed them to be erected quickly, which is what we both got from our steelwork contractors."

The 6,000m^2 departures building consists of five interconnected halls, all topped with barrel vaulted roofs. The four smaller halls feature 13m spans, while the slightly taller

The departures area has five barrel-vault roofed halls

Both the departures and arrivals halls will be linked by a walkway

"The client wanted open plan flexible spaces and we needed them to be erected quickly, which is what we both got from our steelwork contractors."

The arrivals hall takes shape

central hall has a 19m span. This larger hall is a double height space containing a mezzanine level and a first floor plant area.

Steelwork contractor for the departures building was H Young Structures and it erected the structure around a regular 6.5m grid pattern, using columns with connecting 21m long triangulated bowstring tubular trusses to form the roof.

The taller hall is also longer than the other halls, six x 6.5m grids longer in fact. This takes into account the departure building's L-shaped configuration, as it wraps around the portion of the existing terminal that was not demolished.

Stability is derived from bracing, inserted into each of the hall's bays. However, the larger hall - the only part of the new build to actually form part of the airside frontage - had to be designed for potential bomb blasts.

"After careful analysis we decided that the first five bays of the longer span hall had to have bigger steel sections with larger connections," says Darren Piper, Graham Garner and Partners Project Engineer.

The departures area was completed and opened last year, which allowed Warings to turn its attention to the new arrivals building.

"This part of the project was slightly easier as it was all done landside, but we still had to demolish the old arrivals hall, once the new building was operational," Mr Matthews adds.

The 2,000m^2 arrivals building is a three span portal frame with a six degree pitched roof. This is a standalone structure which will eventually be linked to the departures hall via landside glazed walkway.

Snashall Steel Fabrications erected the 140t of structural steelwork for the arrivals area earlier this year. Using one 50t mobile crane, the company installed the steelwork around a regular 6.5m grid pattern, using a combination of columns and rafters to erect the braced spans.

The arrivals building is 7.5m high and contains two 9.5m wide spans, and one 12.5m span. As the building is a double height structure, the middle span easily accommodates a mezzanine level.

The structural design of the arrivals hall takes advantage of the building's orientation to make maximum possible use of solar gain, solar shading and natural ventilation. Part of the reason for these features is Bournemouth Airport's provisional target to be carbon neutral by 2015. This is being delivered through a combination of the aforementioned features and photovoltaic panels and underfloor heating, all of which will reduce the need for mechanical and electrical installations which, in turn, will lessen the building's energy requirements.

Commenting on this major redevelopment project, Bournemouth Airport's Managing Director, Rob Goldsmith, says: "It's wonderful to see the airport of the future starting to take shape. Although the recession is going to have an affect on passenger numbers this year, it's a great sign of confidence that our owners are looking to the future and developing the airport."

FACT FILE
Bournemouth Airport new terminal buildings
Client: Manchester Airport and Bournemouth Airport
Architect: Terence O'Rourke
Main contractor: Warings
Structural engineer: Graham Garner and Partners
Steelwork contractor for departures building: H Young Structures
Steelwork contractor for arrivals hall: Snashall Steel Fabrications
Steel tonnage: 440t
Project value: £30M

Practical application of the "General Method" of EN 1993-1-1

In the second article of this series, Dr József Szalai of ConSteel Solutions demonstrates practical examples where the "General Method" of EN 1993-1-1 shows advantages compared to the conventional approaches.

The key component: general elastic stability analysis

When verifying the stability of a structural component the critical issue is always the correct assessment of the possible forms of buckling. In conventional design procedures the buckling forms are taken into account by calculating the elastic critical resistances (N_{cr} and M_{cr}) for the associated buckling shapes. Thus the determination of the appropriate elastic critical force is the most significant step of the design method (Step 3 in the previous article) but at the same time has the potential to be the most complicated step. It is very important to recognise that the calculation of an elastic critical force always implies an assessment of the buckling shape – the resistance and the buckling shape are linked.

Designers are used to the concept of using an effective length (to determine a buckling length) though this can be a significant simplification of the problem, particularly if the system of applied forces and the restraint system is complex, because the buckling mode in these circumstances is not easily identified or assessed. In the general method the elastic critical load amplifiers are calculated considering the complex system of forces based on more realistic compound buckling shapes. Thus the general method provides solutions for a number of design irregularities – irregular members such as tapered or haunched members, irregular buckling shapes due to special (for example eccentric) supports or restraints on the member – by the calculation of the compound buckling shape of a realistic structural model.

The general method requires that designers consider the buckling behaviour, which in turn has the advantage of placing the designer more directly in control of the frame behaviour, which may well lead to more appropriate solutions.

Although elastic critical forces calculated using the buckling length are suited for simple hand calculation, the determination of the elastic critical load amplifiers required for the general method are usually much more complicated and the use of some appropriate numerical method or software is necessary. The efficient use of the general method requires the use of software in which the all the necessary compound buckling modes – lateral, torsional, lateral-torsional buckling, buckling about an eccentric restraint axis etc. – can be calculated properly. Currently, such software products are quite rare since the general analysis of buckling which includes torsional modes requires particular analysis tools. One solution is to use shell finite elements when creating the global structural model. This can make modelling the building very complicated and the analysis results can be difficult to handle, meaning this option is practically never used by engineers.

Another solution is the use of special beam finite elements which are able to accommodate torsional buckling modes. There are a number of published finite elements fulfilling these requirements, including a 7 degree-of-freedom finite element which includes the effect of torsion and warping of the cross section. This element is implemented into the structural design software ConSteel which has been used in this article to calculate the design examples.

Design examples

Two simple examples are presented to examine the consequences of the two main simplifications of the conventional stability design method: the isolation of the structural member from the surrounding structure and the separation of the flexural and lateral-torsional buckling modes.

Example 1: Influence of buckling mode separation

The first example, shown in Figure 1, is a simple column fixed at the bottom and pinned at the top subjected to compression and bending. The column has two intermediate (eccentric) supports to one of the flanges.

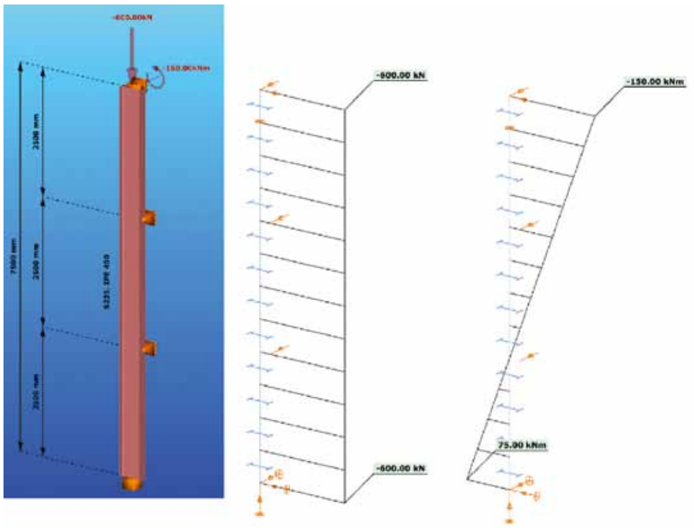


Figure 1. Geometry, loading and internal forces of Example 1

The primary problem with this simple column is that the eccentric intermediate supports generate an irregular buckling situation where neither of the well-known pure buckling forms (pure lateral or pure torsional buckling for compression or pure lateral-torsional buckling for bending) can be separated. EN 1993-1-1 provides some simplified design formulas for beams supported on the compression flange (Section 6.3.2.4) but only for those subjected to pure bending. For pure compression there are no applicable rules for columns with intermediate restraints to only one flange. Moreover these formulas cannot be applied in any procedure that includes interaction of the pure buckling forms. If the conventional method is to be applied considering the pure buckling forms, the problem should be somehow modified in order to be able to determine the pure elastic critical forces. Two usual simplifications are considered: (1) to assume concentric intermediate lateral supports and (2) to assume concentric intermediate lateral and torsional supports. In Table 1 (over page) the actual configuration is illustrated by the elastic critical forces and associated buckling shapes for →

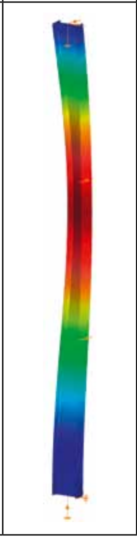
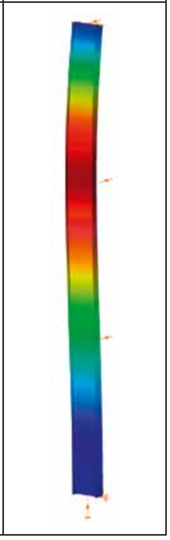
supports	actual eccentric support conditions		
loading	$N + M$	pure N	pure M
elastic critical forces	$\alpha_{cr} = 2.05$		
	$N_{cr} = 1230$ kN	$N_{cr} = 2052$ kN	
	$M_{cr} = 307.5$ kNm		$M_{cr} = 712.5$ kNm
buckling shapes			

Table 1

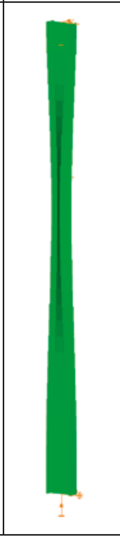
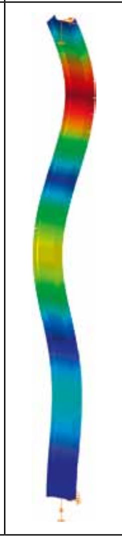
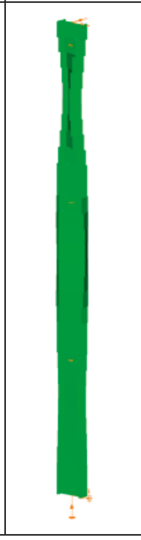
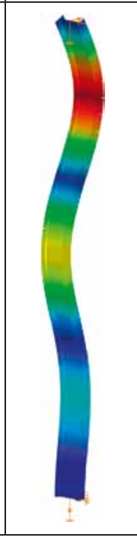
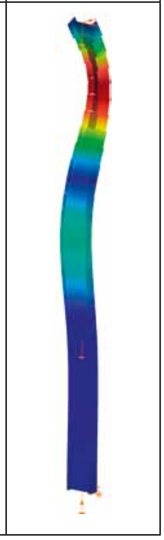
supports	concentric intermediate lateral restraints			concentric intermediate lateral and torsional restraints		
loading	pure N		pure M	pure N		pure M
elastic critical forces	$N_{cr,x} =$ 3192 kN	$N_{cr,z} =$ 6306 kN	$M_{cr} =$ 1647 kNm	$N_{cr,x} =$ 9732 kN	$N_{cr,z} =$ 6306 kN	$M_{cr} =$ 2246 kNm
buckling shapes						

Table 2

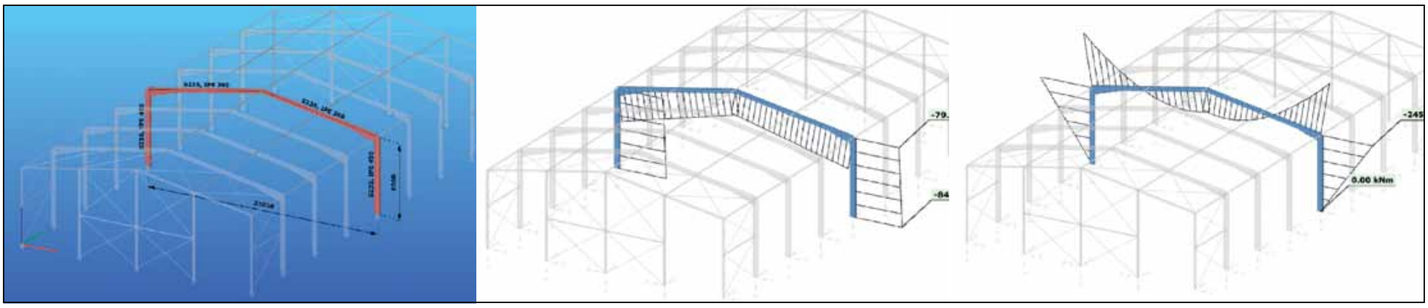


Figure 2: Geometry and internal forces of Example 2

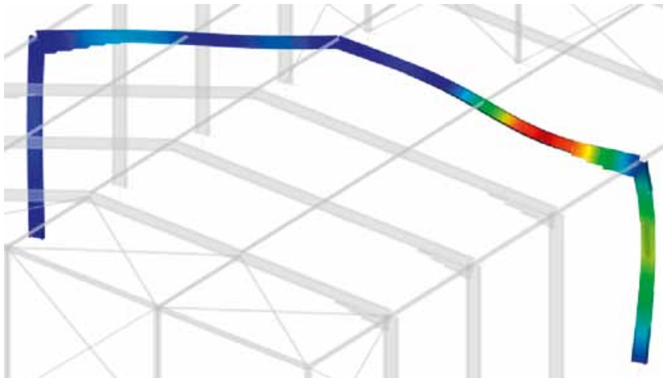
the combined loading – used in the general method – and for the pure cases (N; compression, M; bending). It can be seen that even the pure cases do not belong to pure lateral and lateral-torsional buckling shapes so the appropriate pure mode separation and accordingly the determination of the buckling lengths are impossible.

In Table 2 the two modified support situations are illustrated. If concentric lateral supports are assumed, a pure lateral buckling resistance can be determined, but this is clearly a different buckling behaviour than under the actual restraints. The intermediate lateral supports do not prevent the twist of the member, with different buckling lengths for flexural and torsional buckling, meaning conventional calculation of the elastic critical bending moment is impossible. Also, the relevant mode (torsional) is not taken into account in the interaction formula.

Example 2: Influence of structural member isolation

In this example the frame shown in Figure 2 is examined as a part of a complete structure. The frame is haunched and has pinned bases, braced at the corners and in the middle of the rafters and subjected to 6.75 kN/m distributed vertical load on the rafters. The stability design of the right column is presented. In Figure 3 the buckling of the frame is illustrated due to the compression and bending moments in the members and the results of the general method are shown calculated at the top section of the column.

It can be seen that according to the general method the column is slightly inadequate (105.6%). The column resistance may be recalculated by the conventional interaction method defined in EN 1993-1-1 6.3.3 using the Method 1 (Annex A) for the calculation of the interaction factors. The buckling lengths for both the lateral and lateral-torsional buckling are taken as the system length, assuming that this is a correct estimation. The final utilization →37



Global Stability resistance (dominant)			
Utilization	105.6%		
Applied part of standard	6.3.4 (2)-(3), (4)b - (6.63, 6.64, 6.66) formula		
$\alpha_{ult,k}$	1.522	β	0.750
$\alpha_{cr,op}$	1.450	χ_{LT}	0.624
λ_{op}	1.025	N_{Ed}	-79.5 kN
α	0.340	$M_{y,Ed}$	-249.3 kNm
Φ	1.165	$M_{z,Ed}$	0.0 kNm
χ	0.582	N_{Rk}	2 322.3 kN
α_{LT}	0.490	$M_{y,Rk}$	400.3 kNm
Φ_{LT}	1.047	$M_{z,Rk}$	61.9 kNm
λ_0	0.400	γ_{M1}	1.0

Figure 3: Buckling shape and the results of the general method for the column

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Steel for Ecclesiastical Buildings

From Building with Steel, May 1961

Temples and, later, churches were probably the world's first architect designed buildings. Art flourishes best when dedicated and, once our ancestors had accepted the existence of spiritual values, men used their minds and imaginations to translate working skills into statements of faith; to infuse working materials with symbolic meanings.

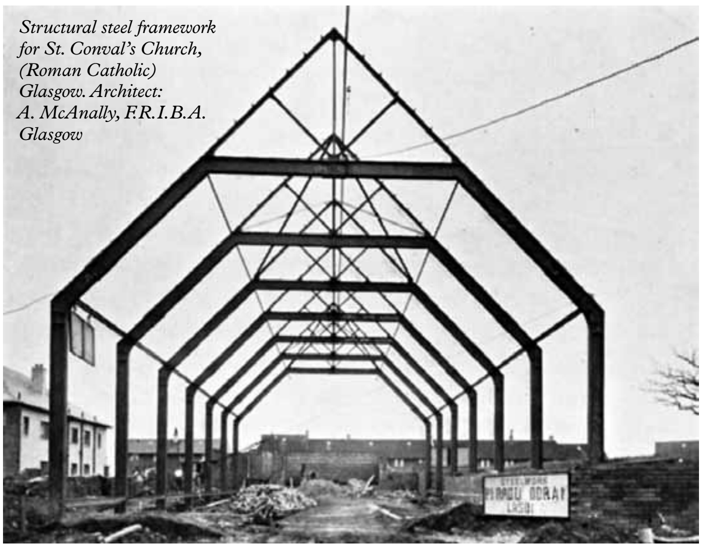
Many architects believe that the design of religious buildings is not only the forerunner but is still the foremost of all forms of architecture. Most other structures command an impersonal respect or express a purely practical function. Religious buildings are deliberately designed to foster subjective feelings; to express in terms of art and craftsmanship, a communal devotion to spiritual values together with a community's identification with the source of these values. Factories may become redundant, public buildings may fall into disuse, private houses may crumble or be relegated to the status of museum exhibits but a church is expected to last at least a thousand years.

Because of the strong emotions involved, religious architecture has aroused more hostility than - and has consequently lagged behind - architecture as a whole. A church is the structural embodiment of an emotional experience and those who share this experience tend to dislike 'functional' or 'rational' forms as they are understood today.

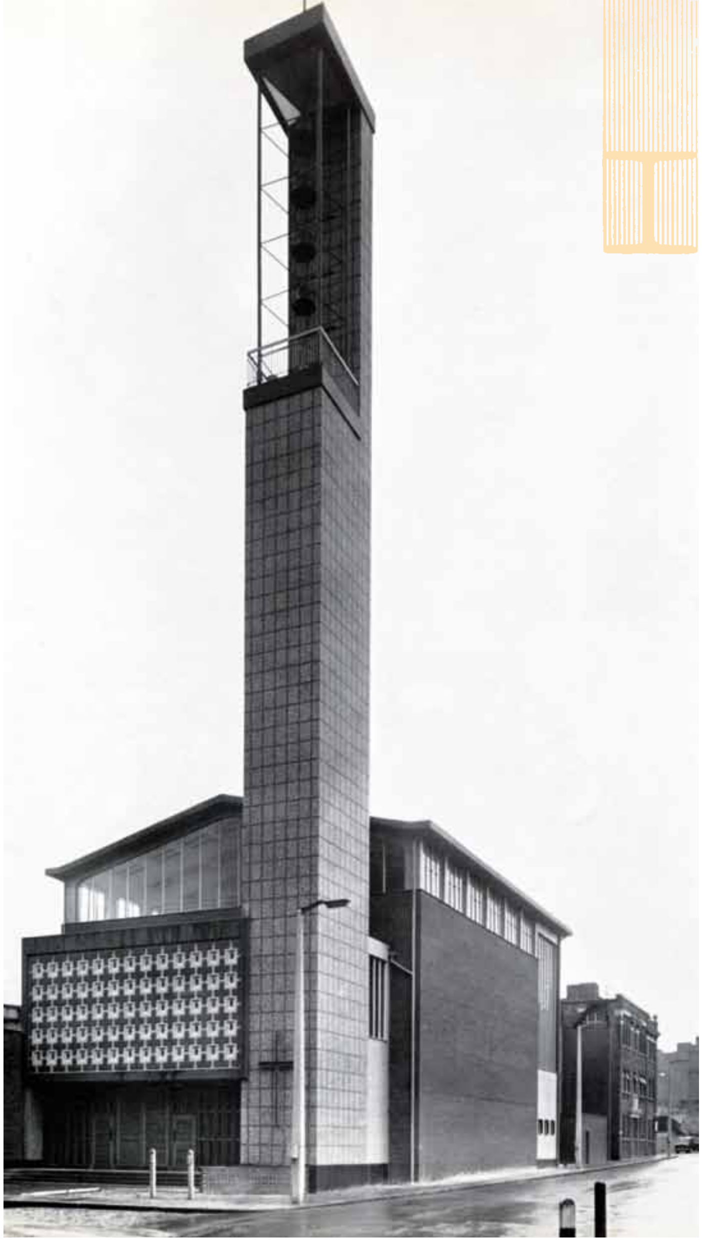
Indeed, there is no reason why they should accept these forms. The function of ecclesiastical buildings is spiritual, not practical. Equally, there is no reason why churches should be built in a hybrid of 'traditional' styles as if they were cheap furniture. There are no short cuts to venerability. When an industrial community erects a church in the manner devised by their pastoral forefathers, tradition has been allowed to degenerate into theatricality and the result is morally and artistically unconvincing. Good architecture is based upon the honest use of materials and a true reflection of contemporary life - without descending to the decorative tricks which have debased the word 'contemporary'. The monumental grandeur of early churches are best matched, not by artificially massed effects, by a graceful arrangement of today's fine building materials. A noble sense of spaciousness can carry more weight than massed solids.

Gracefulness is the prime advantage of steel as a building material for churches. Exposed steel members, in a proper spatial relation to the rest of the structure, form patterns of unsurpassed delicacy. A steel skeleton provides support for architectural expressions of surprising fluency. Rigidity is present, but it is confined to the strength of the material.

Because structural steel is strong a steel frame will endure for generations, standing patient and firm but proudly against practically all conditions: a testament to posterity of the spirit and matter of our times.



Structural steel framework for St. Conval's Church, (Roman Catholic) Glasgow. Architect: A. McAnally, F.R.I.B.A. Glasgow



Above and below: The imposing tower and the interior of St Boniface's Church, Stepney, London, E.1. Architect: C. Plaskett Marshall, F.R.I.B.A.

Above: Interior of Park Church (Church of Scotland), Ardrossan, Ayrshire. Architects: James Houston and Son, Kilbirnie.

Below: Roman Catholic Church at New Malden, Surrey. Architects: F.G. Broadbent & Partners, London, W1. Consulting Engineers: Thomas Bedford and Partners, London W1

Below Right: Framework for St Mark's Episcopal Church, East Kilbride. Architects: Moad and Wallace, Glasgow.

Aircraft Hangars

by Rollo Reid, BSc, CEng, MICE

A mystery is lurking in the swamps in which airfields are built. From the murky miasmas of many Much-Bindings-in-the-Marsh have risen the skeletons of elaborate entities of a type unable to survive in the harsher environments of commercial buildings. The bones of these skeletons, like Pterodactyls, Pterododous and Quetzelcoatluses, are often hollow, but unlike these dinosaurs, they will never fly; the hollow bones have not been used to save weight; on the contrary they have often been arranged in perverse patterns unknown in the rest of nature making them heavier than simpler and more viable structures. Reproduction of these various species is rare; very often the parent dies in the throes of birth; but even if it survives, the pain of disgorging such unnatural lumps often prevents to participants from trying again.

The mystery is: why?

Simple structures are almost always best. Regular portal frames can accommodate most aircraft types very cheaply; the old myth that space frames are more economical on 60m or 70m spans cannot be demonstrated in commercial practice – look at the picture of the Emirates hangar, designed, fabricated, galvanised and shipped in eight weeks, and erected in another eight weeks! But portals two have three problems: that of deflections - both relative and absolute - the need for horizontal reactions needed in the columns - and availability of big enough sections.

Out of plane members eliminate relative deflections - but absolute deflections can be a problem. Large apertures hinder horizontal restraints which can only be achieved with ties or load sharing horizontal beams. And above about 70m the economical beams run out.

These were the problems faced by John Reid & Sons Lid (REID) of Christchurch in their design-and-build contract for F R Aviation at Hurn. The 85m clear span (20m wider than the biggest commercial jets!) made portals just economical. The requirements to limit deflections led to the use of welded truss rafters, made from simple hot rolled sections; out of plane trusses of light tubes made these into an effective space frame eliminating relative deflections. The main trusses produced small horizontal reactants, thus making it easy to miss out columns above the side-opening aircraft doors. The completely open 85m front door frame made it necessary to brace the whole structure into a torsional box, with union jack bracing in the roof and three sides - wind loads, spread across the entire width and depth of the hangar, disappeared without trace into the footings - an important point as REID was contracting a design and build package and there was no point in saving money on steel if it necessitated huge cantilevered bases, especially if these cantilevers were to use up part of the door space.

Incidentally REID also designed and made the 85m electric doors including the tall boom door - putting all these together led to a cost effective solution all round.

All site connections were simply bolted with 8.8 tensile bolts. The erection was carried out using normal cranes and cages. The cladding is straightforward two-skin industrial cladding.

If space is needed between the trusses, there is space for squash courts between the members!

Vital statistics are:

Clear span: 85m

Depth of rafters: 4m

Weight of roof structure: 40kg/m^2 including the door trusses

Timetable: 7 months from inception to commissioning.

Price, complete, including doors, foundation, floor slab, cladding and insulation: £265/m^2

This structure is far too simple and straightforward to win awards: but it works! So why are complex, obesely overweight structures regarded as the norm and, like the freak from Devizes, do they win prizes?

***Above top:** One of the eight electrically operated doors being hoisted into place*

***Above:** The finished job. This hangar will be used for converting big jet liners into fuel carriers for refuelling in flight*

***Left:** The steelwork was complete within five weeks*

Taken from STEEL CONSTRUCTION, February 1991

Practical application of the "General Method" of EN 1993-1-1

continued from p32

value was 82.1%, meaning that according to the conventional method the column is adequate. The reason for the big difference between the two utilization values is that the buckling shape of the frame involves both the column and the rafter, so these two members should form a consistent unit in stability design. The separation of the column and the determination of the buckling length independently of the rafter produce an overestimation for the column buckling resistance. This can be understood clearly if it is appreciated that as one unit, the column and the beam together reach the elastic critical state at a lower level of load than the column alone.

Conclusions

This article presented some examples of the application of the general method. It was demonstrated that if a more realistic modelling and structural analysis is possible – i.e. a general stability analysis – then a more realistic and natural way for the stability design is to use the general method. The examples also showed the importance of an accurate assessment of the buckling shapes and the associated elastic critical values which can lead to safer – and in other cases more economic – structural design.

AD 358
Design thickness of cold formed members and sheeting

The purpose of this Advisory Desk Note is to highlight the existence of, and explain the implications of, an important but often over-looked definition in BS EN 1993-1-3:2006 – the design thickness of cold formed members and sheeting. It is crucial that designers use the correct design thickness for cold formed members and sheeting because small differences between design and nominal thicknesses can lead to significant differences in section properties and design resistances.

The definition concerned is in clause 3.2.4 (3) of BS EN 1993-1-3. The wording in the clause is slightly confused but it does provide two expressions for the design thickness, depending on the specified tolerance on thickness. If the negative tolerance on the material thickness, *tol*, (expressed as a percentage of the nominal thickness) is less than or equal to 5%, expression (3.3a) gives the design thickness as:

$$t = t_{cor} \qquad (3.3a)$$

where the core thickness, $t_{cor} = t_{nom} - t_{metallic\ coatings}$, in which t_{nom} is the nominal material thickness and $t_{metallic\ coatings}$ should be taken as the total coating thickness on both faces.

However, if the negative tolerance, *tol*, is greater than 5% then the design thickness is given by expression (3.3b) as:

$$t = t_{cor} \times (100 - tol) / 95 \qquad (3.3b)$$

(Note that the above expression corrects a typographic error in the published Standard.)

The tolerances on dimensions and shape for continuously hot-dip coated steel sheet and strip are given in BS EN 10143: 2006. There are two types of thickness tolerance given in BS EN 10143 - "normal" and "special". The actual tolerance value is dependent on several factors such as the steel grade, nominal material thickness and the width of the strip.

Where "normal" tolerances apply, the negative "normal" tolerance values are generally greater than 5% of the nominal material thickness, meaning that expression 3.3b should be used. Where "special" tolerances apply, although the negative tolerance values are also greater than 5%, according to BS EN 1993-1-3, 3.2.4 (4) the design thickness may be taken as the core thickness, t_{cor}, irrespective of the magnitude of that tolerance.

The designer therefore needs to know, in addition to the nominal thickness and the coating thickness, whether "normal" or "special" tolerances will be specified for coated steel to BS EN 10143. To illustrate the difference between the two alternatives, consider the following example.

Example

Consider a cold formed member manufactured from S350 strip steel with a nominal thickness of 1.8 mm and with a Z275 coating (for which the metallic coating thickness is 0.04 mm).

According to BS EN 10143:2006, for nominal thicknesses between 1.6 mm and 2.0 mm, for a width of strip between 100 mm and 1500 mm, the "normal" tolerance is +/– 0.15 mm and the "special" tolerance is +/- 0.09 mm.

The core thickness is thus:

$$t_{cor} = t_{nom} - t_{metallic\ coatings} = 1.80 - 0.04 = 1.76 \text{ mm}$$

Design thickness for "normal" tolerance

The "normal" tolerance of – 0.15 mm is equivalent to 8.3% of the nominal thickness (i.e. tol = 8.3). Therefore, the design thickness is given by expression (3.3b) as:

$$t = t_{cor} \times (100 - tol) = 1.76 \times (100 - 8.3) / 95 = 1.70 \text{ mm}$$

Design thickness for "special" tolerance

It might be noted that the negative tolerance is equivalent to 5.0% of the nominal thickness (i.e. *tol* = 5.0) but, irrespective of its value, the design thickness is given in this case by expression (3.3a) as:

$$t = t_{cor} = 1.76 \text{ mm}$$

Specification of different positive and negative tolerances

The approach described above to determine design thickness is based on the assumption that the positive and negative tolerances for the material thickness are the same, which is true when either "normal" or "special" tolerances in accordance with in BS EN 10143: 2006 apply. However, it is common practice to specify material with different positive and negative tolerances. Where this is done, the value of t_{nom} should be taken as the mid-point of the extreme values, rather than the specified nominal value. The negative tolerance *tol* should then be taken as the difference between the modified nominal thickness and the extreme minimum thickness.

Consider the above example but with a positive tolerance of 0.0 mm and a negative tolerance of 0.1 mm. The minimum and maximum thicknesses to this specification are thus 1.70 mm and 1.80 mm, respectively, giving t_{nom} = 1.75 mm. The core thickness is thus given by:

$$t_{cor} = t_{nom} - t_{metallic\ coatings} = 1.75 - 0.04 = 1.71 \text{ mm}$$

The negative tolerance from the mid-range of nominal thickness is 0.05 mm, which is equivalent to 2.9% of the nominal thickness (i.e. *tol* = 2.9). Therefore, the design thickness is given by expression (3.3a) as :

$$t = t_{cor} = 1.71 \text{ mm}$$

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Tel: **01344 636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Update April 2011

BS EN PUBLICATIONS

BS EN ISO 14341:2011
Welding consumables. Wire electrodes and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels. Classification
Supersedes BS EN ISO 14341:2008

BS IMPLEMENTATIONS

BS ISO 5952:2011
Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance
Supersedes BS ISO 5952:2005

PUBLISHED DOCUMENTS

PD 6688-2:2011
Background to the National Annex to BS EN 1991-2. Traffic loads on bridges
No current standard is superseded

UPDATED BRITISH STANDARDS

BS 7371-6:1998+A1:2011
Coatings on metal fasteners. Specification for hot dipped galvanized coatings
AMENDMENT 1

BRITISH STANDARDS WITHDRAWN

BS EN 10002-5:1992
Tensile testing of metallic materials. Method of test at elevated temperatures
Superseded by BS EN ISO 6892-2:2011

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- **E** Large span portals (over 30m)
- **F** Medium/small span portals (up to 30m) and low rise buildings (up to 4 storeys)
- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
- **K** Towers and masts
- **L** Architectural steelwork for staircases, balconies, canopies etc
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- **N** Large grandstands and stadia (over 5000 persons)
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- **R** Refurbishment
- **S** Lighter fabrications including fire escapes, ladders and catwalks
- **QM** Quality management certification to ISO 9001

Notes

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

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

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●										Up to £2,000,000
ACL Structures Ltd	01258 456051			●	●	●	●				●				●		Up to £2,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●		Up to £3,000,000
Adstone Construction Ltd	01905 794561			●	●	●											Up to £1,400,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●	✓	Up to £400,000
Angle Ring Company Ltd	0121 557 7241												●				Up to £1,400,000
Apex Steel Structures Ltd	01268 660828				●		●			●	●						Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●		●	●					Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●		Up to £800,000*
ASD Westok Ltd	01924 264121												●				Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●					●	●			●	●	✓	Up to £1,400,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	Above £6,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●		●							●			Up to £2,000,000
B&B Group Ltd	01942 676770	●		●	●	●	●	●		●	●	●		●		✓	Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●			Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✓	Up to £1,400,000
Barnshaw Section Benders Ltd	01902 880848												●			✓	Up to £800,000
Barrett Steel Buildings Ltd	01274 266800			●	●	●	●									✓	Up to £6,000,000
Barretts of Aspley Ltd	01525 280136			●	●	●				●	●			●	●	✓	Up to £3,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●							●			Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●		Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✓	Up to £3,000,000
Browne Structures Ltd	01283 212720				●			●							●		Up to £400,000
Cairnhill Structures Ltd	01236 449393				●	●	●	●		●	●			●	●	✓	Up to £2,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●		Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓	Up to £3,000,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●		Up to £1,400,000
Crown Structural Engineering Ltd	01623 490555			●	●	●	●		●		●			●		✓	Up to £800,000
D H Structures Ltd	01785 246269				●						●						Up to £40,000
Discain Project Services Ltd	01604 787276				●					●	●				●	✓	Up to £1,400,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●					✓	Up to £6,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	Up to £3,000,000
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	Above £6,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●						Up to £3,000,000
GME Structures Ltd	01939 233023			●	●		●	●		●	●			●	●		Up to £400,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●			Up to £800,000
Graham Wood Structural Ltd	01903 755991		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000
Grays Engineering (Contracts) Ltd	01375 372411				●			●		●	●				●		Up to £100,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●				✓	Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●						Up to £2,000,000
Had Fab Ltd	01875 611711								●		●				●	✓	Up to £2,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●					Up to £2,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121			●	●	●	●	●									Up to £4,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●		Up to £4,000,000
Hills of Shoeburyness Ltd	01702 296321									●	●				●		Up to £1,400,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)
J Robertson & Co Ltd	01255 672855									●	●				●		Up to £200,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●		●			Up to £6,000,000*
Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✓	Up to £4,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						Up to £1,400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓	Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●		Up to £1,400,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✓	Up to £800,000
Maldon Marine Ltd	01621 859000				●			●	●	●					●		Up to £1,400,000
Mifflin Construction Ltd	01568 613311		●	●	●	●	●				●						Up to £3,000,000
Newbridge Engineering Ltd	01429 866722			●	●	●	●								●	✓	Up to £1,400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✓	Up to £4,000,000
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●		Up to £200,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●		Up to £400,000
Paddy Wall & Sons	00 353 51 420 515			●	●	●	●	●	●	●	●					✓	Up to £6,000,000
Painter Brothers Ltd	01432 374400								●		●				●	✓	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●		●	●			●				●	✓	Up to £2,000,000
Peter Marshall Steel Stairs Ltd	0113 307 6730									●					●		Above £6,000,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●		Up to £1,400,000
REIDsteel	01202 483333		●	●	●	●	●	●	●	●	●	●		●			Up to £6,000,000*
Rippin Ltd	01383 518610			●	●	●	●	●									Up to £1,400,000
Robinson Steel Structures	01332 574711		●	●	●	●	●		●	●	●	●		●	●	✓	Above £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Rowen Structures Ltd	01773 860086		●	●	●	●	●	●	●	●	●	●		●			Above £6,000,000*
S H Structures Ltd	01977 681931						●	●	●	●						✓	Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Shipley Fabrications Ltd	01400 231115			●	●	●	●		●	●	●				●		Up to £200,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●	●		●	●				✓	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●				●	●				✓	Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●		Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●		Up to £1,400,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●	●			●		Up to £200,000
The AA Group Ltd	01695 50123			●	●	●	●			●	●	●		●	●		Up to £4,000,000
Traditional Structures Ltd	01922 414172		●	●	●	●	●	●	●		●	●		●		✓	Up to £4,000,000*
Tubecon	01226 345261						●	●	●	●				●	●	✓	Above £6,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●		Up to £4,000,000
W I G Engineering Ltd	01869 320515				●					●					●		Up to £400,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✓	Up to £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●			●		●	●	●	●	●				●	✓	Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●					✓	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●		✓	Above £6,000,000
Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	Contract Value (1)

Corporate Members

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

Company name	Tel
Balfour Beatty Utility Solutions Ltd	01332 661491
Griffiths & Armour	0151 236 5656
SUM	0113 242 7390
Roger Pope Associates	01752 263636
Highways Agency	08457 504030

Associate Members

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

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

Company name	Tel	1	2	3	4	5	6	7	8	9
AceCad Software Ltd	01332 545800		●							
Albion Sections Ltd	0121 553 1877	●								
Andrews Fasteners Ltd	0113 246 9992									●
ArcelorMittal Distribution – Birkenhead	0151 647 4221								●	
ArcelorMittal Distribution – Birmingham	0121 561 6800								●	
ArcelorMittal Distribution – Bristol	01454 311442								●	
ArcelorMittal Distribution – Manchester	0161 703 9073								●	
ArcelorMittal Distribution – Mid Glamorgan	01443 812181								●	
ArcelorMittal Distribution – Scunthorpe	01724 810810								●	
ArcelorMittal Distribution – Wolverhampton	01902 365200								●	
Arro-Cad Ltd	01283 558206			●						
ASD Interpipe UK Ltd	0845 226 7007								●	
ASD metal services - Biddulph	01782 515152								●	
ASD metal services - Bodmin	01208 77066								●	
ASD metal services - Cardiff	029 2046 0622								●	
ASD metal services - Carlisle	01228 674766								●	
ASD metal services - Daventry	01327 876021								●	
ASD metal services - Durham	0191 492 2322								●	
ASD metal services - Edinburgh	0131 459 3200								●	
ASD metal services - Exeter	01395 233366								●	
ASD metal services - Grimsby	01472 353851								●	
ASD metal services - Hull	01482 633360								●	
ASD metal services - London	020 7476 0444								●	
ASD metal services - Norfolk	01553 761431								●	
ASD metal services - Stalbridge	01963 362646								●	
ASD metal services - Tividale	0121 520 1231								●	
Austin Trumanns Steel Ltd	0161 866 0266								●	
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●								
BAPP Group Ltd	01226 383824									●
Barnshaw Plate Bending Centre Ltd	0161 320 9696	●								
Barrett Steel Ltd	01274 682281								●	
Cellbeam Ltd	01937 840600	●								
Cellshield Ltd	01937 840600							●		
CMC (UK) Ltd	029 2089 5260							●		

Steelwork contractors for bridgework

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

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

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

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

BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	Contract Value [1]
B&B Bridges Ltd	01942 676770	●	●	●	●	●	●	●	●	✓	Up to £1,400,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓	Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●	●		●			●	●	✓	Up to £2,000,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●	●	●	●			●	●	✓	Up to £800,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓	Up to £4,000,000
Painter Brothers Ltd	01432 374400	●		●					●	✓	Up to £6.000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	✓	Above £6,000,000
S H Structures Ltd	01977 681931	●				●			●	✓	Up to £3,000,000
SIAC Butlers Steel Ltd	00 353 57 862 3305	●	●	●	●	●		●	●	✓	Above £6,000,000
TEMA Engineering Ltd	029 2034 4556	●	●	●	●	●	●	●	●	✓	Up to £1,400,000*
Varley & Gulliver Ltd	0121 773 2441	●						●	●	✓	Up to £4,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Non-BCSA member											
ABC Bridges Ltd	0845 0603222	●								✓	Up to £100,000
A G Brown Ltd	01592 630003	●						●	●	✓	Up to £800,000
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●	●	✓	Up to £1,400,000
Carver Engineering Services Ltd	01302 751900	●	●	●	●		●	●	●	✓	Up to £2,000,000
Cimolai Spa	01223 350876	●	●	●	●	●	●			✓	Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●		●	●		●	✓	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	Up to £800,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	Up to £2,000,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓	Up to £6,000,000
Hollandia BV	00 31 180 540540	●	●	●	●	●	●	●	●	✓	Above £6,000,000
Interserve Project Services Ltd	0121 344 4888							●	●	✓	Above £6,000,000
Interserve Project Services Ltd	020 8311 5500	●	●	●	●		●	●	●	✓	Up to £800,000*
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		✓	Up to £800,000
N Class Fabrication & Installation	01733 558989	●	●	●	●			●		✓	Up to £800,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓	Up to £3,000,000*
The Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	Up to £2,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9
Composite Metal Flooring Ltd	01495 761080	●								
Composite Profiles UK Ltd	01202 659237	●								
Computer Services Consultants (UK) Ltd	0113 239 3000		●							
Cooper & Turner Ltd	0114 256 0057									●
Cutmaster Machines UK Ltd	01226 707865					●				
Daver Steels Ltd	0114 261 1999	●								
Development Design Detailing Services Ltd	01204 396606			●						
Easi-edge Ltd	01777 870901							●		
Fabsec Ltd	0845 094 2530	●								
FabTrol Systems UK Ltd	01274 590865		●							
Ficep (UK) Ltd	01924 223530					●				
FLI Structures	01452 722200	●								
Forward Protective Coatings Ltd	01623 748323						●			
Hadley Rolled Products Ltd	0121 555 1342	●								
Hempel UK Ltd	01633 874024						●			
Hi-Span Ltd	01953 603081	●								
Highland Metals Ltd	01343 548855						●			
Hilti (GB) Ltd	0800 886100									●
International Paint Ltd	0191 469 6111						●			
Jack Tighe Ltd	01302 880360						●			
Jamestown Cladding and Profiling	00 353 45 434288	●								
Kaltenbach Ltd	01234 213201					●				
Kingspan Structural Products	01944 712000	●								
Leighs Paints	01204 521771						●			
Lindapter International	01274 521444									●

Company name	Tel	1	2	3	4	5	6	7	8	9
Metsec plc	0121 601 6000	●								
MSW	0115 946 2316	●								
National Tube Stockholders Ltd	01845 577440								●	
Northern Steel Decking Ltd	01909 550054	●								
Panels & Profiles	0845 308 8330	●								
John Parker & Sons Ltd	01227 783200								●	●
Peddinghaus Corporation UK Ltd	01952 200377					●				
Peddinghaus Corporation UK Ltd	00 353 87 2577 884					●				
PMR Fixers	01335 347629	●								
PP Protube Ltd	01744 818992	●								
PPG Performance Coatings UK Ltd	01773 837300						●			
Prodeck-Fixing Ltd	01278 780586	●								
Rainham Steel Co Ltd	01708 522311								●	
Richard Lees Steel Decking Ltd	01335 300999	●								
Schöck Ltd	0845 241 3390	●								
Structural Metal Decks Ltd	01202 718898	●								
Studwelders Composite Floor Decks Ltd	01291 626048	●								
Tata Steel	01724 404040				●					
Tata Steel Distribution (UK & Ireland)	01902 484100								●	
Tata Steel Service Centres Ireland	028 9266 0747								●	
Tata Steel Service Centre Dublin	00 353 1 405 0300								●	
Tata Steel Tubes	01536 402121				●					
Tekla (UK) Ltd	0113 307 1200		●							
Tension Control Bolts Ltd	01948 667700									●
Wedge Group Galvanizing Ltd	01909 486384						●			

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