MARCH 2008 VOL16 NO3

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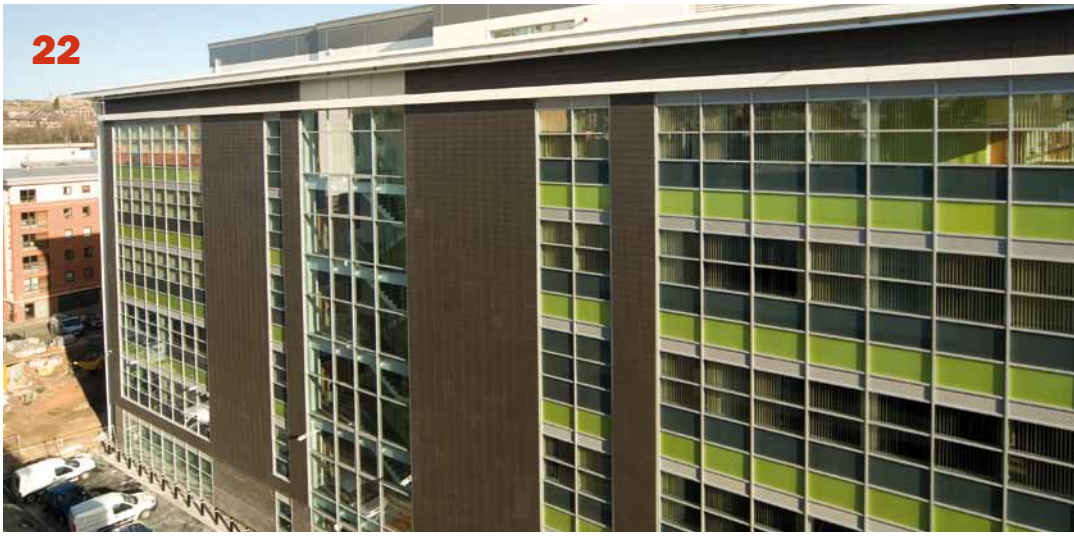

These and other steelwork articles can be downloaded from the New Steel Construction website at www.new-steel-construction.com

Cover Image
Vulcan House, Sheffield
Client: Home Office Property
Project consultant:
Mott MacDonald
Steelwork contractor:
Robinson Construction
Steel tonnage: 1,000t

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Sustainability underpins healthy market share

While the woes of the financial sector continue to excite the headline writers, more positive news is beginning to filter through from those who work in the real world of manufacturing and product and services provision. The growing message seems to be that away from credit crunches business seems to be largely going on much as usual.

Admittedly, some housebuilders seem to be struggling and there have been one or two stories about developments being put on ice until funding can be more easily raised, but the rest of UK industry, and certainly the construction part of it, seems to be in a positive frame of mind. Steelwork contractors at the BCSA's annual dinner (see News) seemed confident enough. Order books are healthy and, with the few exceptions already mentioned, business seems to be good.

The new Market Shares Survey from independent researchers Construction Markets (see News) provides grounds for confidence. Steel is holding its market share at what were pretty heady levels; the market appreciates that steel delivers substantial advantages quite apart from cost. These other advantages would often be significant enough to sway some towards steel, even if alternative materials somehow managed to make up some of the cost gap between themselves and steel.

Whatever the outcome for industry workloads this year, steel looks like being extremely well placed to at least hold onto its share of the market. The growing realisation that the world has to combat climate change should bring further gains. Sustainability has emerged as a strong business driver for the clients of the construction industry, for Corus and for all steelwork contractors. Unknown perhaps to most users of steel over the years, they were using a material with a strong sustainability case.

Visitors to the Futurebuild exhibition last month will have seen some of the sustainability benefits on two stands dedicated to steel. Corus produced a brochure specially for the event outlining those benefits and a major advertising campaign is about to get under way that will spread the message further.

The strength of steel's sustainability case may come as a pleasant surprise to some who had been happy to use it purely on grounds like health and safety, cost and flexibility. Factoring in sustainability benefits can only strengthen the appeal of steel as the first choice framing and bridge building solution.

Nick Barrett - Editor

Steel remains the competitive choice

Steel is confirmed as the structural framing solution of choice of the overwhelming bulk of the multi storey buildings market in the 2007 Market Shares Survey. The survey, by independent market researchers Construction Markets, shows that steel's total market share remained above 71%.

Steel enjoyed a near 72% share of the key multi storey offices market. Nearest rival, in situ concrete, remained at below a 20% market share, having first fallen below 20% in 2003.

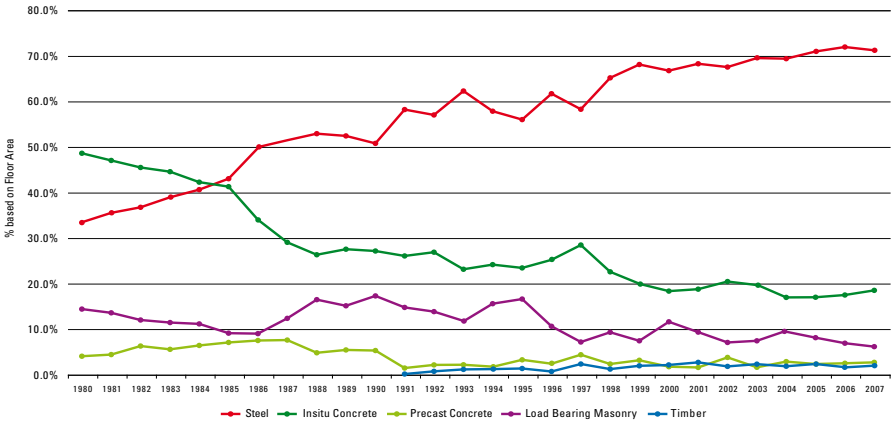
The survey is the 27th in a series going back to 1980, and charts the success of steel as the leading structural framing material, largely at the expense of in situ concrete. Some 600 specifiers are contacted by the researchers for the study, making it the biggest of its type in the UK.

The survey shows that the total multi storey buildings market showed growth of 8%. The offices market grew by over 22% in 2007 to over five million metres of floorspace. The 'other buildings' category, which includes retail, leisure, education and health buildings, grew by 1.6%, with rises in retail and leisure counter-balancing falls in education and health.

Alan Todd, General Manager Corus Construction Services and Development, said: "The performance of steel in the construction market has been one of the great industrial success stories of the post war period in the UK. It is no surprise that the 2007 survey confirms that the continuing competitive advantage of steel is appreciated by designers, clients and specifiers.

"There are a number of initiatives underway within the steel sector that will mean more designers and clients in the future will be convinced of the overwhelming advantages to be gained from using steel. Sustainability is growing in importance all the time and steel's solid credentials in this area are being increasingly appreciated."

Mr Todd added that Corus' successful launch of Advance as the new name for its range of structural sections 18 months ago was appreciated by designers for helping them comply with the Construction Products Directive (CPD). "Since September 2006 designers need to be sure that sections they specify comply with the CPD, and choosing Advance, the world's first CE marked section, is the simplest way to achieve this.'



The Market for Structures – Non-Residential Multi-Storey Buildings – Total.

Britain's tallest free-standing artwork unveiled

Designs have been revealed for a steel sculpture that will be the highest free-standing work of art in the UK.

Known as Aspire and designed by Ken Shuttleworth, the 60m-high artwork will be located on the University of Nottingham's Jubilee Campus.

The £800,000 red and orange steel structure will be set up by July this year and forms part of the site's regeneration.

The steelwork will be delivered to site in three sections - with a total weight of 50t - by Watson Steel Structures.

Foundation work will include 36 piles and 256m^3 of concrete which will form the base for the steelwork.

Designer Ken Shuttleworth, said: "The sculpture symbolises both the innovation and expertise that the University of Nottingham represents, and the exciting new era that the University enters as Jubilee Campus undergoes its transformation."

Steel provides boost for new hospital

Structural steel is fulfilling a key role in the progress of the Birmingham New Hospitals Project which is currently under construction by a joint venture between Balfour Beatty Construction and Haden Young, the building services arm of the Balfour Beatty Group.

The new Acute Hospital has three distinctive towers which will make a prominent addition to the city's skyline and provide state-of-the-art medical facilities for the University Hospital Birmingham NHS Foundation Trust and the Birmingham and Solihull Mental Health NHS Trust.

A total of 12,500t of steelwork is being fabricated, supplied and erected by Severfield-Reeve for the project. To date, approximately 90% of this has been erected, while cladding and internal fit out is well under way.

Completion of the project has been set for autumn 2012, and in the next four years the JV will erect the towers of the hospital and construct the mental health facilities around them, provide a large car parking area and refurbish some of the retained buildings - at a total cost of £570M.

Steel looks confidently ahead...

BCSA President Richard Barrett.

The steel construction sector was looking confidently to the future with healthy forward order books, to as far ahead as 2009 in some cases, BCSA President Richard Barrett told the National Dinner.

In his address to guests at the Dorchester Hotel on 28 February Mr Barrett said last year the sector achieved record sales of 1.6M tonnes of steel. Members were confident about their prospects despite recent troubles in the financial world.

He was pleased that the government was undertaking its review of the Construction Act, although he noted that the current review, underway now for four years, was taking longer than the original Act to prepare. Reforms to the payment regime were urgently needed. Mr Barrett urged members who found that their public sector clients were not behaving in accordance with the Office of Government Commerce (OGC) guidelines for fair payments to report them to the OGC.

Mr Barrett welcomed the publication by BCSA of the new Guide to the Allocation of Design Responsibilities in steel construction, which was designed to help clients by having projects delivered more efficiently, and to ensure that steelwork contractors know the extent of their liabilities. There was a programme of publications under way, for example with a guide to bridgeworks being prepared. Other design guides were being produced jointly by BCSA, Corus and the Steel Construction Institute.

Mr Barrett also announced a major drive by Corus and the BCSA to spread the sustainability messages about structural steel, through advertising and other promotional efforts.

He warned members that CE Marking of structural sections was coming in October this year and would be mandatory a year later. BCSA was producing courses to help members prepare.

Mr Barrett concluded by reaffirming BCSA's commitment to serving the steel construction industry.

...as more time promised for Eurocodes

Shadow Secretary of State for Business Alan Duncan MP has promised that a Conservative government would make it a priority to allow more time for the introduction of Eurocodes.

Speaking at the BCSA's National Dinner Mr Duncan said: "Steel faces a difficult transition from BSI to new European standards. The introduction of the Eurocodes is a nightmare for the industry." Mr Duncan said hurried training programmes were being forced on the industry. He said: "I assure you that a Conservative government would make it a priority to give more time to make that change."

Mr Duncan also congratulated the steel industry for massively increasing its market share in recent years. The industry's success was due to listening to what the market said it wanted, adapting to globalisation and proving that the UK's manufacturing sector is not dead.

Mr Duncan attacked the level of regulation faced by business and said more could be done to lift the burden. He criticised the government for having had seven construction ministers in the past ten years: "You need a dedicated minister for construction, someone who can fight your corner in Whitehall," he said.

Mr Duncan also acknowledged that 'serious changes' were required to the Construction Act, in particular to the payment related sections. Payment procedures need to understand the nature of the modern construction industry, he said. With the Olympics looming, the government could not afford to take the construction sector for granted, and issues such as payment and regulation needed to be addressed as urgent priorities.

Shadow Secretary of State for Business, Alan Duncan MP.

Museum of Liverpool gets iconic structure

X-shaped in plan, the new Museum of Liverpool will on completion be a striking addition to the fast changing Mersey riverfront.

Designed by Danish architects 3XN, the structure is located at Pierhead and will replace the existing Museum of Liverpool Life which is considered to be too small to house an ever-increasing collection.

Working on behalf of main contractor Galliford Try, Caunton Engineering is fabricating, supplying and erecting more than 2,000t of structural steelwork for the project.

Caunton's Contracts Manager Gary Hatton, said: "We are currently completing phase one of three phases which includes connecting steelwork to circular and square concrete cores.

"This phase also has a huge amount of complex steelwork, with a number of differing angles and shapes to form the centre of the structure's X."

The final two phases will see Caunton erecting the four fingers of the X-shape and this will involve temporary propping for two large cantilevers, one of which will house a viewing gallery overlooking the Mersey.

AROUND THE PRESS

Construction News
31 January 2008
Steelwork deal for Stratford centre
Severfield-Rowen is set to pick up a £75 million steel contract on Westfield's scheme to build the giant shopping complex that will go up in east London ahead of the 2012 Olympics. One source said: "The final amounts are still being decided, but it will be significantly larger than White City. It's looking like double."

Building Magazine
1 February 2008
Pilot project
A number of techniques were used at T5 to speed up construction. For example BAA wanted to improve productivity by 10-15% using off-site construction. The roof sections were made on the ground and jacked into position, which was a technique borrowed from bridge building.

Construction News
7 February 2008
Demand for structural steel is still rising
The UK structural steel market was estimated to have grown by two per cent last year, with overall tonnages of steel up to 1,592,000 according to the latest report from research company MBD. The growth, which is part of an overall increase of 21 per cent since 2001, has been attributed to the part the steel fabrication sector has played in the overall growth of the UK construction industry during this period.

Building Magazine
8 February 2008
Golden wonder
Referring to Colchester arts centre - The most tricky aspect of the frame manufacture was bending the 600mm deep top steel sections of the frame to the correct radius. This was done by steel bending specialist the Angle Ring Company.

New Civil Engineer
14 February 2008
Beijing TV centre building soars to finish
The spectacular 223m tall building contains 10,000t of steel and has been designed to withstand an earthquake measuring 8.5 on China's seismic scale of 1 to 9.

Sustainability message loud and clear at London exhibition

Recycling and sustainability were the central themes at last month's Ecobuild/Futurebuild exhibition at London's Earls Court.

One of the most visible messages was displayed by a large steel recycling counter on the Corus stand. It was turned on at the three day show's start, continually displaying the amount of steel in tonnes that had been recycled globally as the show progressed. After 54 hours, the final figure on the counter was 3,057,534 tonnes.

The stand also showcased the many other benefits of steel in relation to sustainability and modern methods.

Adjacent to the Corus stand, the Steel Ideal stand included a full-size ManuBuild prototype steel-framed, pre-serviced module with demountable and moveable walls.

The stand also displayed winning entries from two Living Steel International Design competitions.

A seminar on steel and sustainability was introduced by Corus Construction Development Manager John Dowling.

The seminar included a case study of the large Pineham portal framed warehouse in Northamptonshire presented by Rodney Rice, Corus Product Development Manager and a summary of the ManuBuild initiative by Architect Steve Thompson of Corus Construction Services & Development.

Corus Chief Executive Philippe Varin (right) and General Manager, Corus Construction Services & Development Alan Todd under the steel recycling counter.

Heathrow T5 ancillary buildings completed

A Taylor Woodrow-led consortium, which included steelwork contractor Rowecord Engineering, has completed three important ancillary buildings for BA Operations on the new Terminal 5 campus at Heathrow Airport.

The three steel-framed buildings, split over two locations at the west and east ends of the T5 Development, provide facilities for support services, tug charging, de-icing and maintenance of aircraft.

To mirror the design code of the outlying buildings of the main terminal, a signature sinusoidal cladding has been used on all of the structures.

The Southern Airfield building is split over three floors and encompasses office and staff areas. It will operate 24 hours a day, seven days a week, and is designed for a shift capacity of 320 staff, totaling 960 people in any 24-hour period.

The De-icing facility is largely underground, housing process plant and equipment, while the third structure, the 8,100m^2 Eastern Airfield building, is an operational maintenance facility with a double height workshop and staff areas.

Hotel and retail project will rejuvenate Chelmsford town centre

Steelwork erection has begun on a mixed-use development in Chelmsford which includes an 81-bed Travelodge hotel, 12 residential apartments and approximately 2,400m^2 of retail and restaurant space.

The project, on the site of the former Army & Navy pub, features a steel frame with a maximum four-storey height and a range of architectural finishes to the building's facade, including curtain walling, polished metal cladding and brickwork.

Working on behalf of main contractor ISG Jackson, DGT Steel and Cladding is supplying and erecting approximately 320t of structural steelwork.

Mark Bird, DGT Technical Manager, said the project posed a number of challenging aspects including the main retail area's curved glass facade and the diagonally sloping roof. "As the roof slopes diagonally from corner to corner, not front to back, the purlins are running at approximately 45 degrees to the cell-beam rafters. This means every purlin to rafter connection is bespoke.

"The perimeter elevations of the hotel include galvanised feature channels which will be tied into the brickwork, and required an adjustment detail, utilising interlocking serrated plates, to ensure alignment with the brick coursing," he added.

The project is scheduled for completion by early 2009.

Steelwork contractor reduces carbon footprint

Barrett Steel Buildings has announced a 10% business footprint reduction and a manufacturing reduction of 7%, after measuring its overall carbon footprints against its figures for 2006.

"In November 2006 we utilised the expertise of SCI and carbon solutions company dcarbon8 to establish our carbon footprint for the first time," explained Sue Sharples, Barrett Steel Buildings Joint Managing Director.

"Our main objectives were to measure and then reduce our greenhouse gas emissions, and be able to offer carbon neutral building products to our clients."

Barrett Steel Buildings successfully completed the calculations and identified the main contributors to its carbon footprint, and then set up internal forums to set about reducing emissions.

The forums included evaluating electricity and gas consumption, looking at how the company sources, uses, and disposes of paper, and reducing the amount of paint used in its manufacturing process.

In late 2007, Barrett Steel Buildings measured its carbon footprint for a second time to see what progress had been made. "We are delighted to say we have reduced emissions across the board," said Mrs Sharples.

The company is currently in discussions with its landlord to ensure carbon emissions as well as cost are considered in the choice of energy supplier. Other initiatives for the coming year will include looking at how employees commute, and a new forum to look into more efficient steel design and procurement.

Wakefield city centre to get a make-over

Steelwork has been completed for the first phase of the Trinity Walk redevelopment, a £200M project which will transform Wakefield city centre.

Biillington Structures erected 290t of steel for the new Market Hall during a four week programme. Due to the complex nature of the design, the project team had to incorporate 65 sloping columns and hidden fixings.

As well as the Market Hall, the project also includes a large shopping mall, leisure facilities, residential blocks and a 957-space car park. Main contractor is Shepherd Construction and the entire project is due for completion by May 2010.

Cube office for Corby Council

Galliford Try has been awarded the £25.5M contract to build the 'Corby Cube', a six-floor civic building which will include council offices, an auditorium, a library, restaurant and terraced roof garden.

The steel framed and glass clad structure will be a landmark for the town's redevelopment and the choice of materials and the building's shape reflect Corby's steel-making heritage.

Architect for the project, Hawkins/Brown, said the building will be predominantly naturally ventilated using exposed thermal mass for night time cooling, and aims to meet a BREEAM rating of Excellent.

Work on the project begins this month and completion is due by the middle of 2009.

Illustration: Hawkins Brown

NEWS IN BRIEF

The BCSA and The Welding & Joining Society jointly held a seminar at the National Motorcycle Museum on 5 February entitled **New Welding Coordination Requirements for Structural Fabrication**. More than 120 people attended the seminar which was chaired by BCSA President Richard Barrett. Key messages of the seminar included: learning about the new welding requirements and how to demonstrate compliance; understanding the roles and responsibilities of welding coordination; learning about the knowledge and competence requirements of the Responsible Welding Coordinator (RWC), and how to achieve recognition as a RWC.

LaserTUBE Cutting has commissioned the world's largest tube laser, which is designed to process medium and large tubes up to 508mm x 16mm in finished lengths up to 15m. It can also process square and rectangular sections as well as ovals on application. The company has opened a new extension to house the machine along with all of its sawing and processing equipment. LaserTUBE will be holding a two day event - 22 and 23 April - to promote these developments. Invitations to this event will be posted to BCSA members and selected customers.

Architectural Profiles is now offering its second generation of the Strongbak structural wall framing system. It consists of structural panels inset between, or to the faces of, the verticals and horizontals of the frame.

Easi-edge has become the first edge protection provider to have been audited and joined the Steel Construction Sustainability Charter. The company has achieved Silver member status.

Following Gifford's recent standardisation on **CSC's Fastrak** software across the Group, the Southampton office utilised Building Designer to design the new Hastings College Building. The high level of automation provided by the software, gave significant time savings and commercial benefits on this prestigious, education-led project.

Metals leader signs skills pledge

Metsec is the latest organisation to adopt the government's Skills Pledge which aims to address the shortage of skilled workers by investing in the development of employees' skills.

Stephen Tilsley, Metsec Chief Executive, recently signed the Skills Pledge certificate in the presence of Skills Minister David Lammy MP and Lynn Tomkins, UK Director of Policy at Sector Skills Council, Semta, when they met to discuss skills needs in the metals, mechanical and electrical sector.

"A huge shift in skills levels is vital if the UK is to compete with other economies. Making the Pledge shows a company's readiness to invest in people and work with employees," said Ms Tomkins.

An early signatory of the Pledge, Semta is currently negotiating a sector agreement with the Learning and Skills Council which will secure training funding for employers, and aims to increase the number of companies adopting the Skills Pledge.

Mr Tilsley chairs the employer-led group which is driving the development of Semta's Sector Skills Agreement (SSA) for the Metals, Mechanical and Electrical (MME) sector, to be launched in April.

One of the SSA priorities, which employers in the MME sector have identified, is to increase the number and quality of apprenticeships.

"While up-skilling the existing workforce to meet the skills needs of the business is important, the value we derive from our apprenticeships is immense," said Mr Tilsley. "About 20% of our current workforce has come through our apprenticeship scheme and we aim to double this over the next 10 years."

Metsec's Stephen Tilsley (left) and Skills Minister, David Lammy MP.

New machines debut at UK exhibition

Kaltenbach will be demonstrating a number of new machines and processes for the first time, including what is said to be the world's fastest bandsaw, at the Mach 2008 exhibition, which is held at the NEC from 21-25 April.

The company's showpiece line-up will include the HBM440 ALU, which is the fastest bandsaw ever developed and a machine designed for automatic straight cutting of non-ferrous materials. There will also be a mix of Behringer straight and mitre cutting bandsaws on display.

Also on show will be the Intelligent Blade Control (IBC), a fully integrated blade management and control system that influences cut accuracy and overall cycle times of straight cutting bandsaws.

The KBS750DG/KDS615 sawing/multi-axis drilling, close coupled system will be demonstrated on Kaltenbach's Stand 4750 located in Hall Four. The machine features the latest solid carbide drills which cut five times quicker than high speed steel, and three times faster than tungsten carbide tipped units.

Diary

For all Corus events visit www.corusevents.com, email events@corusgroup.com telephone: 01724 405060
For all BCSA events email: david.moore@steelconstruction.org telephone: 020 7747 8122

12 March 2008
Steel: The Show 2008
Thorpe Park, Leeds.
Free

9 April 2008
Sustainability Seminar
Hawthorden Lecture Theatre, Edinburgh. Free

22 April 2008
Corrosion Control of Steel Structures
Joint Seminar with Institute of Corrosion. Oxford. £176.25 per delegate

23 April 2008
Sustainability Seminar
The Lowry, Manchester. Free

29 April 2008
CE Marking of Structural Steelwork
National Motorcycle Museum, Birmingham, £100 for members, £150 non-members

7 May 2008
Sustainability Seminar
Thinktank, Birmingham.
Free

21 May 2008
Responsible Welding Coordinator Seminar
Boyne Valley Hotel & Country Club
Drogheda, Republic of Ireland. £100 for members, £150 non-members

22 May 2008
Sustainability Seminar
Cavendish Conference Centre, London.
Free

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Andrew Mannion says the BCSA will provide a huge boost to the Irish steel construction sector.

The Irish connection

Andrew Mannion, the first Chairman of the BCSA's Republic of Ireland Region, tells Martin Cooper how his engineering career, along with the local construction industry, has gone from strength to strength.

"Croke Park was the turning point in AMSE's history."

A Wednesday evening in February and the Dublin football crowd is already streaming towards Croke Park for the night's glamourous match against Brazil. Since the completion of its redevelopment this 85,000 seat stadium, which now towers above all else in this inner city area, has become a city landmark.

"This project was the turning point in AMSE's history," explains Andrew Mannion as he drives us past the stadium. "It was a major coup to get this large prestigious job and it made people sit up and take notice of us."

Andrew Mannion is proud and justifiably so of the work AMSE successfully undertook on this project, fabricating and erecting one of the largest and most complex roof structures in Ireland with a span reaching a mighty 44m.

Up to this point in the company's history it had concentrated on small to mid-sized projects which also contained a certain amount of complexity. From this point forward the scale and focus of the firm radically altered. "We've always prided ourselves on our design expertise and our ability to do complex projects, but we can now handle the larger jobs as well."

Andrew is driving me through the evening rush hour traffic taking me from our interview rendez-vous, that afternoon at a city centre hotel, to a presentation at the Dublin Institute of Technology (DIT).

Once our interview had run its course he suggested I attend the presentation and on the way he would show me Croke Park. At the DIT he presented a new steel beam testing device to the college's structural engineering department. The machine can test steel members with loads of up to 100t, the biggest piece of equipment of its kind in Ireland, and was fabricated by AMSE and then donated to the Institute.

Andrew graduated with a Diploma in Structural Engineering from the DIT in 1978 and says the donation is a good way of putting something back and helping the future generation of Irish engineers.

The appeal of the structural engineering profession in Ireland has steadily grown over the last 20 years as increased construction activity has driven demand for such expertise. "When I graduated there was no tradition of the engineering profession in my family, nor indeed was engineering as popular a career path as it is now."

The last fifteen years or so have seen the emergence of the 'Celtic Tiger' economical boom, which has led to a huge upswing in construction activity. The upturn is based on high-tech and knowledge based industries with structural engineering at the sharp end.

After graduation he started his working career by spending three years at Collen Construction, in a position with responsibility for design, in both reinforced concrete and structural steel.

Becoming more interested in the design aspects of steel construction, his next job - from 1981 to 1984 - at Patrick Kelly & Co. involved technical as well as commercial duties. "Working here I picked up commercial skills which helped with setting up and running AMSE later in my career."

Patrick Kelly was a subsidiary of Abbey plc and in 1984 the UK-based company decided to divest itself of all of its Irish assets. "They put all of their resources into housebuilding, which was good for the South East of England, but not for me," he says wryly. "As I was left without a job."

Thoughts turned to emigration but he says this ultimately wasn't an option for family reasons. However, he swiftly found at new job with a small engineering works based in Athlone, which is pretty much slap bang in the middle of the island. A location which has more than grown on him.

After gaining even more valuable experience of all engineering functions including design and execution, moving to Athlone also proved to be

"There has never been so much steel construction activity in Ireland."

rather fortuitous. In 1988 Andrew, purchased a burnt-out factory in the town.

To cut a long story short Andrew went it alone and started his own steel fabrication company. After refurbishing the factory, installing equipment and hiring staff, Andrew Mannion Engineering began operations in 1988.

Andrew is Dublin born and bred but has now lived and worked in the Athlone area for more than 20 years. "It is a great location and being so central means we are ideally placed to deliver steel and work anywhere in Ireland," he explains.

From an early stage he says the company wanted to offer the industry an alternative to large steel construction companies. "With my engineering expertise we decided to go for the small difficult jobs."

The 1980s had not been kind to the Irish steel construction industry, and during the decade's recession many fabricators had gone bust. Andrew Mannion Engineering entered the market just as things started to look up. Again some fortuitous timing was involved, but Andrew says he has simply just taken opportunities as they have presented themselves.

"Nothing has been too pre-planned, I've always had broad and achievable career aspirations and these have been achieved," he adds.

The company's phoenix-like rise from the factory ashes was well timed and the firm grew generically through the 1990s completing more than 1,300 projects, right across the board, by the end of the decade.

Since completing the Croke Park project AMSE has gone from strength to strength and Andrew says its design department is unrivalled in Ireland.

As the firm was now at the forefront of the Irish steel construction industry Andrew's thoughts turned to how he could improve the local sector. "I initially became aware of the BCSA by seeing and using the NSSS Black Book."

He says the BCSA gives excellent technical advice and assistance and joining could only help the Irish construction market.

"There has never been so much steel construction activity in Ireland, we've experienced 10% to 15% growth per annum in the last 10 years," says Andrew. "This growth has been right across the board and I encouraged other Irish steelwork contractors to join the BCSA as a way of helping the sector mature, because of all this activity."

A total of nine Irish steelwork contractors, which represented the nation's leading steel firms, were initially offered a year's BCSA trial membership. Once this was completed the entire block joined to form the Ireland Region.

Andrew concludes that through seminars and publications more local consultants will be educated and informed about the advantages of steel construction. "The parameters of cost compared to concrete may be slightly different here from the UK, but steel is still the right material for many many projects."

Above left: AMSE's completed steelwork at Croke Park.

Above: Taoiseach Bertie Ahern and Andrew Mannion at the opening of AMSE's production facility extension.

Below: Andrew Mannion surrounded by staff and students of the DIT during the presentation and donation of a steel testing machine.

Leicester Grammar School is moving out of the city centre to a new suburban location.

School for the future

The decision to use steel for a new school in Leicester allowed the construction team to meet very tight deadlines, as well as lending an important degree of flexibility to the structures.

FACT FILE
Leicester Grammar School
Main client: *Land Securities Trillium*
Architect: *Pick Everard*
Structural engineer: *Pick Everard*
Main contractor: *Norwest Holst*
Steelwork contractor: *Caunton Engineering*
Steel tonnage: *800t*

The buildings are sustainable, affordable, energy efficient, ergonomic and future-proof.

Leicester Grammar School is relocating from its present city centre location to a new suburban purpose-built premises at Great Glen.

Steelwork for the school has recently been completed by Caunton Engineering and the project is scheduled for completion in time for the September autumn term.

The new school consists of three separate steel framed buildings, a main teaching block, a sports hall and a pavilion.

The two-storey teaching block will contain a library, 14 science laboratories and a lecture theatre, a music school and recital room, a drama studio, an assembly hall to seat 900 people and a refectory that will accommodate 450 diners. The new premises will accommodate 1,250 pupils, and includes a linked, but self-contained, junior school complex which is relocating from nearby Evington.

Tony Goodman, Contracts Manager for Caunton Engineering, says the interesting aspect of the teaching block, as far as steel erection is concerned, are the hubs or fingers which protrude from the main structure. There are six of these in total, five housing classrooms and one, the smallest, will be used as an administration block.

"Each looks very similar, but their pitched roofs slope in different directions and internally they are all structurally and architecturally different," he says.

The complex nature of the structure, as well as a very tight timescale, were the main reasons for choosing steel as the framing material. "Steel allowed us to meet very tight project deadlines for design and construction, crucially achieving a watertight envelope in an advantageous time while maintaining an acceptable economic balance," explains Pick Everard Project Partner Duncan Green.

Pick Everard has used steel on a number of other school projects, and Mr Green adds: "The whole process with a steel frame was much, much faster - from procurement, through to getting the skeleton up and the roof on. It also provides a degree of design flexibility, not available with other materials, for future redevelopment."

A distinctive feature of the hubs is that each has a different grid pattern to cater for their unique classroom configuration and layout. All of the hubs will house a different teaching faculty and they each require a different number and size of classroom.

The school's new sports hall contains a six-lane 25m-long swimming pool in one half of the building, while the remainder of the structure contains a gymnasium, a dance studio, six badminton courts and changing rooms.

"Over the swimming pool we had to erect 30m-long beams, the project's longest members, to get the necessary clear spans," explains Mr Goodman.

Meanwhile, the project's third structure is a pavilion which contains changing rooms and an upstairs club house and viewing platform. This structure will serve sports taking place on the adjacent 75-acre playing fields. This two-storey building has a pitched roof and a balcony which wraps-around three of the elevations. A row of feature columns along the fourth elevation, which also houses the pavilion's entrance, provide an architectural feature. These fabricated columns are 150mm x 150mm box sections.

The large playing fields include two floodlit all-weather pitches, hard tennis/netball courts and football and rugby pitches.

Pick Everard says its objectives were to create buildings that inspire the users and blend innovative design and practicality. The buildings are sustainable, affordable, energy efficient, ergonomic and are future-proof to take into account safety and future needs.

"We are delighted that the plans we developed with Norwest Holst have come to fruition and

Above: Caunton erected 800t of structural steel during a three month programme.

Below: A steel frame was chosen for its time and flexibility advantages.

that they satisfy both the planning needs and the educational requirements of the school," adds Mr Green.

Land Securities Trillium (part of the Land Securities Group) has provided the funding for the purchase of land and construction of the school. The new premises will be owned by Land Securities Trillium and leased to the school over a 35-year period.

Christopher King, Headmaster & Chief Executive of Leicester Grammar School, comments: "The school is excited at the prospect of its long term association with Land Securities Trillium. This partnership opened up an imaginative means of financing the school's development to the benefit of existing and future staff and pupils."

Once the new school is open, Land Securities will work with Leicester Grammar School to maximise the value of existing sites.

Also commenting on the funding of the project Ian Ellis, Chief Executive of Land Securities Trillium, said: "We are always looking to become involved in more socially responsible projects where we can use our skills and financial strength to benefit the community."

Below: The sports hall contains a 25m-long swimming pool.

Creating a retail destination

Steelwork's flexibility has come to the fore on a new retail development in Livingston town centre. Martin Cooper reports.

The growth in large retail developments, right across the UK, shows no sign of slowing down and one of the largest on-going schemes is The Elements, a £90M extension to the Almondvale Shopping Centre in Livingston, West Lothian.

The project will provide more than 34,000m^2 of new shopping space including 30 new shops and two anchor department stores, 2,322m^2 of leisure space and a winter garden.

The existing Almondvale Centre was built in two main phases, during the 1970s and 80s, and contains around 120 shops, most of which are well known high street retailers. It also includes one of the UK's largest superstores, an ASDA, which is located at the east end of the mall.

However, according to the project's developers, the town's shopping population has grown by 70% since 1998 to around 150,000, and is predicted to increase further during the next few years.

Livingston's core catchment area is centred on West Lothian, which has the youngest population and the highest projected population growth of any local authority area in Scotland. The town is also ideally placed to attract shoppers from both Edinburgh and Glasgow.

Consequently the retail expansion is regarded as a necessary step and forms an integral element of a much larger development of Livingston's town centre, which also includes a new multi-storey car park.

Construction work for The Elements is taking place on the site of a former Safeway store and its adjoining carparks. Once the project is completed Livingston will have one of Europe's largest indoor shopping complexes with more than 92,000m^2 of retail space.

Main contractor Miller Construction started work on site early in 2007, and began by demolishing the existing structures and clearing the site. Steelwork contractor Severfield-Reeve was then able to begin its programme in March, erecting approximately 4,000t of steel by the end of 2007.

The project features four malls which all converge at a central plaza, which will contain a large open public space and an array of restaurants overlooked by a rooftop level winter garden. Each mall will have two trading levels, a ground floor and a mezzanine level within the retail blocks. All of the malls will be covered by a transparent ETFE roof, which will allow natural daylight to penetrate into the shopping areas.

Martyn Wakefield, Site Construction Manager for Severfield-Reeve, says that one of the most challenging aspects of the project is the fact that there are six individual steel-framed structures which form the retail development.

"Each of the blocks are structurally independent

Top: Once complete The Elements, combined with the existing Almondvale Centre, will create one of Europe's largest indoor shopping malls.

FACT FILE
The Elements shopping mall, Livingston
Main client: *Land Securities*
Architect: *BDP*
Structural engineer: *Arup*
Main contractor: *Miller Construction*
Steelwork contractor: *Severfield-Reeve*
Steel tonnage: *4,000t*
Project value: *£130M*

Above: Covered by an ETFE roof, the mall will have two trading levels.

Top right: Bisecting the project (left to right) a covered pedestrian walk-way is located within two malls and connects two existing centres.

and so they were all individually erected," he says. "In many other similar malls the entire structure would be just one building."

There is very little connection between the blocks apart from at roof level where steel trusses span the malls to support the ETFE grid roof structure. Each steel framed building has its own tolerances and setting out had to be exact to take into account the roof which sits on steel plates above each block.

"By incorporating six blocks the design will break-up an otherwise regimented streetscape, as each block will be clad with a different combination of cladding," adds Allan Driscoll, Arup's Project Engineer.

A temporary covered pedestrian walkway bisects the construction site, effectively cutting it into two seperate entities.

Where the four malls converge they form a cross and in each corner, abutting two malls, there is one of four steel framed blocks (B, C, D and E). One of the malls leads directly into the existing Almondvale centre, while another leads directly to a new entrance foyer. The other two malls lead directly into anchor department stores (Blocks A and F).

All of the steel framed blocks are two-storey high, including the Debenhams (Block A) anchor store, with the exception being Marks & Spencer (Block F) which has three levels.

Marks & Spencer were not the original tenant of Block F and once they were lined up for the tenancy the design was changed at their behest. "This block was the most time-consuming for steel erection," explains Mr Wakefield. "We already had most of the steel for this anchor store erected when the design was altered. We had to do a lot of variation work including adding an extra floor."

Steelwork's inherent flexibility came to the fore during the alteration work as a number of columns had to be moved to allow for new voids to be created as lifts and stairwells were repositioned.

"By using steel we designed a fair amount of flexibility into the structures," adds Mr Driscoll. "We also wanted to make allowance for possible changes in tenant requirements and this made the alteration work a lot easier."

Alteration work aside, Severfield-Reeve's steel erection work went smoothly. It is predominantly stick and beam construction on a 7.5m x 7.5m grid, with a slightly larger grid pattern for the two anchor stores.

Stability is provided for all of the structures by concrete cores, with two or three in each block. "This was the best option as there is no room - because of the glazed shopfronts - for any perimeter cross-bracing," explains Mr Driscoll. "So all steelwork is tied back to the reinforced cores."

Service yards for The Elements are located beneath Blocks A and F, and large 19t plate girders were needed to support the shop floors. "These were the largest steel members we had to erect," says Mr Wakefield, before explaining that there was one other aspect of the project which was unique and impacted on all construction work.

Because of the project's location, midway between the existing shopping centre and a designer outlet, a temporary covered pedestrian walkway, positioned in two of the malls, bisects the construction site. This allows shoppers free access between the two existing malls during construction work and effectively cuts the site into two separate entities.

This meant all deliveries had to be planned and sent to the correct half of the site, and Severfield-Reeve had two separate workforces. As the walkway had no protective crash deck, no materials, including steel, could be lifted over it and all erection was done in such a way as to avoid going over or near the walkway.

Taking everything into consideration, such as a tight timescale and accommodating all of the variation work, the team members all agree the project has gone extremely well and The Elements is due to open on time this November.

Steel writes a new chapter for Tyneside

Newcastle's new City Library incorporates a complex steel and glass design and is set to be a stand-out civic building when it opens in Summer 2009.

Above: The steel frame accommodates a traditional layout as well as the open atrium.

Traditionally, public libraries do not advertise themselves; they tend to be functional buildings that appear to be quietly getting on with the serious business of educating and improving the lives of people who use their facilities, rather than bold statements of architectural design.

That all changed with the opening in 2000 of the Alsop & Stormer-designed Peckham Library in South London, which has won countless design awards and features a striking exterior that makes its presence very much felt in the local community. Now, Newcastle City Council is following suit, with the construction of a new library in the city centre that is sure to catch the eye.

The new Newcastle City Library is being built as part of a £40.2 million PFI initiative between the local authority and a consortium led by Kajima Partnerships, the developer and sponsor, in what is the largest library PFI undertaken in the UK to date. It is currently under construction on the site of Newcastle's old library – itself designed by iconic architect Sir Basil Spence – and is due to open in Summer 2009.

Architect Ryder has come up with a design that announces itself in bold terms, meeting the client's desire for a high quality civic building that will

FACT FILE
Newcastle-upon-Tyne City Library
Main client: *Newcastle City Council*
Architect: *Ryder*
Structural engineer: *Mott MacDonald*
Main contractor: *Tolent*
PFI concessionaire: *Kajima Consortium*
Steelwork contractor: *Conder Structures*
Steel tonnage: *900t*
Project value: *£40.2M*

The 'glass box' frontage as visualised by the architectural model.

Far left: The largest beams span the atrium and performance space.
Left: The new library is set to be a landmark in the city centre.

attract both new and existing library users.

"We wanted the City Library to be a symbol of creative design and a model for 21st century library facilities," explains Ian Kennedy, Ryder Architectural Director. "It will be an inspirational place, with spaces for reading, learning, research, relaxing, meeting and working."

One of the most striking features of the new building is the glazed grid on John Dobson Street which returns on to New Bridge Street at the front of the building, giving passers-by the impression of a large open library bookcase. Behind this box is a four storey, 23m x 15m atrium that will fill the library with light. Artist Kathryn Hodgkinson has created an etched design that runs across the entire area of the glazing on the John Dobson Street elevation, inspired by interviews with 2,000 Newcastle residents about their hopes and dreams for the city.

Internally, the glass box and atrium account for about one third of the space, with the remainder of the six storey building designed to the standard of a modern office development, with raised access floors, to give it as much flexibility as possible for use of the space. While this enables much of the structure to be built on a regular grid – measuring 7.2m x 9m – there are exceptions, for example to accommodate a 180-seat performance space on the third floor.

Initially the structure was designed as a concrete frame, but it has since been re-engineered in steel to reduce costs. "The steel frame has been designed around the architectural constraints, so there are a lot of rolled hollow sections," explains Gerry Gray, Project Engineer at structural designer Mott MacDonald.

For the areas that will contain offices and book collections, the frame is being constructed using 533 x 210 x 82 main beams with 406 x 178 x 54 secondary beams. Columns vary in height and size, with the largest - adjacent to the library's main walkways and brise soleil – being 406mm diameter hollow sections constructed in a single 25.8m length.

Three transfer beams at high level enable the loads to be carried above the larger spans of the atrium and the performance space. All three are formed using plate girders, with two measuring 14.4m in length x 1,250mm in depth. The third also spans 14.4m, but is 2m in depth, has 45mm thick flanges and web, and weighs 17t. "The largest transfer beam is positioned at roof level and has five floors suspended below," explains Mr Gray.

The "glass box", which runs the whole length of the John Dobson Street elevation, is principally separate from the main structure. It sits on 6m long 762 x 267 x 147 beams with short ties back to the main structure. The supporting columns are CHS 457mm diameter, reducing to 355mm at the top to create an architectural feature.

Inside the box all the steelwork is exposed, and consists of 300 x 200 x 12.5 RHS beams and 250 x 250 x 8 SHS columns. Because they are on display, the connections between these beams and columns are an important element in the architectural expression of this area of the building. Detailing these connections was the job of the project's steelwork contractor Conder Structures.

"The main criteria was the requirement that no bolts would be showing, so that the entire structure of the glass box appears to be of continuous steelwork," explains Conder's Managing Director Jason Hensman.

The company developed two prototypes for the client to choose from, the winning design involving the welding of hollow 300 x 200 x 16 RHS brackets with their own 6-hole end plates that matched the beam ends. Access hatches measuring 120mm x 120mm were cut into both the beams and the columns so that the erection teams could fix the bolts between the two. These hatches are closed with 3mm thick 200mm x 170mm cover plates so that the bolts are not visible, and the steelwork appears to be continuous.

Conder – which is working for main contractor Tolent – began design and fabrication of the Newcastle City Library frame in July 2007, and has just completed erection of all 900t of steelwork. To catch up on time lost due to high winds in December, the erection team worked over the Christmas holiday period.

"The job has gone extremely well with the exception of the weather," says Mr Hensman. "However, we have worked extremely closely with the main contractor, Tolent; we used mobile cranes to accelerate the programme in a number of areas, which has limited the delays caused by high winds."

The entire project is due to be completed in Summer 2009. Its facilities will include a crèche, café, internet access, dedicated areas for children and meeting rooms for community groups. Among the items on display will be the collection of 18th century engraver Thomas Bewick and the Thomlinson Library, whose 17th and 18th century collection of books formed the core of Newcastle's first public library.

"The steel frame has been designed around the architectural constraints, so there are a lot of rolled hollow sections."

The safety solution

In the second part of our Case for Steel series Nick Barrett explains why steel construction is the safety solution. Inherently easy site erection is one reason why steel construction sites are safer places to work.

The accuracy of steel means fewer erectors are needed on-site.

Designers putting safety first need to consider whether a project can be safely executed, and since constructional steel is inherently safer than other framing materials steel is increasingly the solution of choice.

Steel is safer for a wide range of reasons. Starting with the design process, in-house design teams at steelwork contractors will share their special knowledge of steel structures by working with structural engineers and architects to develop steel framed solutions that enhance a project's safety case.

Steelwork is an off-site manufactured, pre-engineered quality assured product that arrives on site when it is needed, ready for erection. Pre-planning of on-site operations is much easier with steel. The accuracy of the fabricated product delivered to site means that errors that could generate site hazards are minimised.

Steel components can be pre-assembled or fabricated into modules either off-site or at low level, which reduces many potential hazards.

This accuracy is achieved by the widespread use of sophisticated software driven computer numerically controlled fabrication equipment. 3D models of steel frames are routinely created, helping with detailed planning of erection procedures. Planning is further aided when unorthodox or complex fabrications are involved by trial erections before delivering to site. Risk can be removed from site activity by this process.

The accuracy of modern steelwork makes possible high levels of productivity on site, without the sort of undue rush that can give rise to unsafe behaviour. The shorter and more predictable construction programme advantages of using steel in fact take pressure off other site activities, helping them to be executed more safely as well. The accuracy of steel has almost totally eliminated the need for re-work, and means fewer erectors are needed on site. Far less temporary works is needed than with other framing systems.

Weather causes relatively few problems for steelwork as much of the work has already been carried out in the dry conditions of the fabricators' workshop. Steel components can be pre-assembled or fabricated into modules either off-site or at low level, which reduces many potential hazards.

Steel construction – the qualified industry

Steel construction is carried out by specialist site erection teams who hold recognised qualifications under several safety related schemes:

- An accredited qualification, Constructional Steelwork NVQ level 2, is available to steel erectors, metal deck installers and studwelders.
- The Register of Qualified Steelwork Contractors (RQSC) classifies all participating firms according to the type of work they are competent to undertake and the size of contract that they can resource and manage.
- The Safe Site Handover Certificate identifies key site conditions to be checked before erection starts in order to minimise site risks.
- The UKAS accredited Steel Construction Certification Scheme offers a Health and Safety Certification service, which is an audit certification to OHSAS 18001 specifically designed for steel construction.
- The Safety in Steel Construction service provides the 'competent person' requirement of the management of Health and Safety Regulations, as well as a helpline and inspection services.

Greater certainty of safe site practice is achieved because steelwork is standardised in a way that lends itself to repetition of site tasks. Steelwork contractors are specialists with highly trained and experienced skills in design, fabrication and erection. The site erection teams are highly specialised and skilled, and hold recognised qualifications (see box on opposite page).

Erection programmes for steel frames are short, involving relatively few on-site personnel and so less exposure to potential hazards. A typical steel erection team would comprise four or five trained, competent erectors - as opposed to as many as 20 for an equivalent in-situ concrete frame.

Steel frames can be self stable so the full strength of the material can be immediately available. There is no delay while the steel gains strength and no risk of placing reliance on an under-strength component. Already erected parts of the structure provide safe access to working positions, for use by other trades if required. Decking for composite slabs provides a safe platform after installation as well as protection to lower storeys, and access stairs can be immediately supported from columns and beams as required.

At the end of a steel framed building's useful life it is easily and safely demountable, the sections being either re-used elsewhere or recycled to provide steel of the original quality.

The steel construction sector provides an extensive range of free advice and Health and Safety Guidance covering design and workshop practice. BCSA publishes an extensive range of Codes of Practice for the erection of:

- Low Rise Buildings
- Multi-storey Buildings
- Metal Decking & Stud Welding
- Steel Bridges
- Steelwork in Windy Conditions
- Work at Height during Loading and Unloading

and also Health & Safety Guides covering:

- On site
- In the workshop
- In the office
- For Managers & Supervisors

For further information please visit: www.SteelConstruction.org

High level steelwork can be assembled at ground level and then lifted into place, minimising work at height.

Health and Safety benefits of steel

- ☑ Using steel reduces site based activity
- ☑ Less on-site congestion due to fewer site personnel
- ☑ Off-site fabrication eliminates many on-site activities and so reduces potential hazards
- ☑ Reduces exposure to bad weather conditions
- ☑ There is virtually no steel waste arising on site, so no hazard generating on-site stores are needed, and there are fewer vehicle movements involved in handling waste
- ☑ Fewer delivery movements to site also reduces hazards
- ☑ Steel is not a hazardous material for workforces to handle
- ☑ There is no 'use by' date on steel as there is with concrete

Edge protection erected along with the steel frame provides a safe working environment.

Safety innovations

A range of safety related innovations have been pioneered by steelwork contractors and are in common use on sites.

- Dedicated lifting points and lifting brackets are fabricated into steelwork
- Support frames that allow mobile elevating working platforms (MEWP's) to be used on erected steelwork
- Edge protection systems can be attached to sections before erection
- The use of nets to protect following trades is widespread
- Composite floor decking can be cut off-site
- Bridge sections are now being sub assembled to include the access systems, significantly reducing work at height risks

Super green building

Vulcan House is one of the UK's greenest buildings. The Home Office's new Sheffield headquarters has also received the city's first Excellent Rating in a BREEAM award.

FACT FILE

Vulcan House, Sheffield

Main client: *Home Office Property*

General project consultant and advisor: *Mott MacDonald*

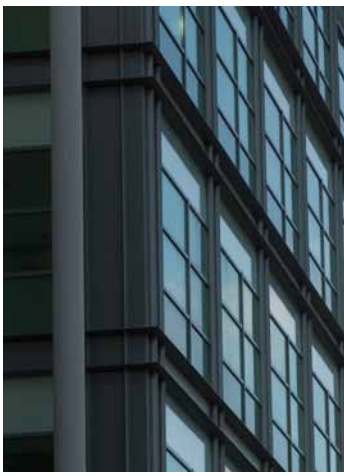
Architect: *Hadfield Cawkwell Davidson*

Structural engineer: *White Young Green*

Main contractor: *Wilson Bowden Developments*

Steelwork contractor: *Robinson Construction*

Steel tonnage: *1,000t*



Above: A steel frame was chosen for its speed of construction.
Right: Feature architectural elements adorn most facades.
Below: One elevation has a large weathering steel facade.
Left: The building is cube-shaped as this offers the best way of regulating its internal climate.

Appearances can sometimes deceive as Vulcan House is an attractive, though not a spectacular addition to Sheffield city centre. However, what makes this building special is mostly on the inside as every detail has been fine tuned to deliver optimum environmental performance.

The building is rated as one of the country's greenest ever structures and was awarded Building Research Establishment's environmental assessment method (BREEAM) Excellent Status in May 2006. At this time there were only 560 office blocks in the UK that had attained a BREEAM rating of any kind.

Vulcan House is a test bed for the Home Office, which has set out to minimise its ecological footprint, measuring CO_2 emissions through construction, operation and, eventually, demolition. It has also become a benchmark for future government construction projects because of its outstanding green credentials.

There are around 2,000 Home Office staff based in Sheffield, scattered across five sites. The Home Office wanted to centralise its operations in a brand new, purpose-built headquarters. And it wanted not just to meet but exceed the government's own environmental targets. Government has committed to becoming carbon neutral by 2012.

Every detail has been fine tuned to deliver optimum environmental performance.

But it did not want to become an owner occupier and instead it chose to ask speculative developers to bid for the project. Construction of Vulcan House was ultimately awarded to speculative developer and contractor Wilson Bowden.

"This is a key point," says Mott MacDonald Technical Director Eddie Murphy. "We've achieved the BREEAM rating and shown that sustainability can be incorporated in a speculative project, a sector which is traditionally only interested in cost."

Mott MacDonald drew up a competition brief for construction of the green office building along with project manager and architectural consultants Drivers Jonas.

"BREEAM ratings are won or lost in the first 10% of the design phase," says Mr Murphy. "We asked bidders to look at integrating building services with the fabric," he adds. "It's not enough to put up a building and slot services in afterwards. You have to treat the building as a whole from the moment you start."

The reasoning being that if you have a building that is well insulated, protected from solar gain and airtight, you create an internal environment that's much more stable and passive.

Vulcan House's shape was then dictated by the desire to put 10,000m^2 of work station space, a 515m^2 public area, training facilities, toilets, tea-rooms, kitchens and a restaurant, arranged over seven floors, into as efficient an envelope as possible.

"A cube offers the best external area per internal square meterage in terms of regulating the building's climate," adds Murphy. The block is

punctured by a central light well and this allows lots of daylight into the building. Floor to ceiling height was set at a relatively high 2.9m to aid daylight distribution across the floors. A natural green sedum roof keeps heat in and also minimises rain run-off.

"We asked bidders to create virtual thermal models of their design and subject it to a year's worth of local weather data. By changing the orientation of the building we found we could save 5% energy," explains Mr Murphy.

Structurally the building is fairly standard with a steel frame built on CFA piles with composite floors composed of 150mm concrete over metal decking.

"Steel was used for speed of construction - the frame went up in 12 weeks," comments Wilson Bowden Developments Senior Construction Manager David Wragg. "It makes the building lightweight, though there is still enough thermal mass to help stabilise the building's temperature.

Along with concrete construction comes a multitude of other materials, such as formwork, and space was also at a premium at Vulcan House. "Steel was brought to site in 20t loads and immediately erected that day," adds Mr Wragg.

Steelwork contractor Robinson Construction erected more than 980t of structural steel during their brief programme. Cellular beams were used throughout to minimise the structural void and give the building its maximum possible floor to ceiling heights.

The cellular beams span up to 15m in places, and by keeping all services within their depth the beams allowed for column free zones between the structure's perimeter facade and the internal lightwell.

"By using long span steel beams the building can change configuration in the future," comments Mr Murphy. "Bearing in mind it's a speculative building, the Home Office could end its tenancy in 15 years time and then the building could be easily divided into a multi-tenant office block."

Externally there are no sunscreens or thermal buffers to suggest Vulcan House is environmentally honed. But it is wrapped in argon-filled double glazing to minimise heat transfer through radiation. Solar protective glass is designed to allow through light but prevent heat gain. Insulated ceramic panels minimise thermal loss or gain on non-glazed areas.

"At first glance the building services are nothing to get excited about," adds Mr Murphy. "The building isn't even naturally ventilated."

By using long span steel beams the building can change configuration in the future.

This makes the building's achievement of a BREEAM Excellent rating all the more remarkable. The speed of computer modelling and analysis has offered previously unheard of freedom to manipulate the building's elevations and interior spaces to balance services with the environmental demands placed on them.

The relationships between different spaces within the building have been modelled, which means the completed structure does not have a small room requiring heating while the rest of the building needs cooling.

Local ventilation combined with heat reclaim systems, in which warmth from extracted air is used to heat cool incoming air, enhance energy reductions. Power savings are improved further by circulating air locally rather than ducting it over large distances.

Heating and cooling plant specification has also been closely scrutinised. "There are no

Above: Steel has helped maximise floor to ceiling heights.
Below: The building is wrapped in argon filled double glazing.
Left: Incoming air is heated to aid energy reduction.

hydrofluorocarbons (HFCs) in the chillers," says Mr Murphy. "HFCs are used as a refrigerant, and largely replaced chlorofluorocarbons (CFCs) in air conditioning plant because of the huge damage they do to the ozone layer."

A typical office air conditioning system will have upwards of 30kg of HFC refrigerant in it, which leaks out and has to be topped up regularly. In Vulcan House ammonia chillers have been installed. Ammonia is completely benign to the atmosphere in its effect on global warming, and it is also a better refrigerant. It is lighter than HFCs, so it is easier to pump around the system, which means it is using less energy in operation.

To further emphasise the project's construction green credentials, Wilson Bowden has chased down the global warming impact of the scheme through every part of the process. Every material used on site has been checked to make sure that it is free of HFCs, CFCs or hydrochlorofluorocarbons. All sub-contractors have also been checked to make sure they are using approved materials.

Now that construction is nearing completion and the Home Office to preparing to set up residence in its new headquarters, it is engaged in a hearts and mind campaign. The biggest threat to Vulcan House's in-use environmental performance comes from the behaviour of the occupants.

All Home Office staff are being given simple user manuals and guided tours before they move into their new workplace. The reasoning being that understanding the design principles will help them conserve energy.

It will begin moving staff into Vulcan House during March and then a slightly smaller adjacent block, also speculatively built by Wilson Bowden will come on-line in May, with full occupancy of both buildings expected by July.

Built along similar lines as Vulcan House, but without the column-free floors, the smaller block will be linked to its larger neighbour via a steel bridge.

Meanwhile, the Home Office is screening prospective facilities managers. A thorough grasp of the building's design will be required; low energy and environmentally benign work methods and maintenance/repair products will have to be demonstrated.

Another part of its CO_2 reduction strategy hinges on cutting the number of journeys made by car. Centralising all its staff in a single building will eliminate local work-related travel. However, it wants to take this further, by restricting the number of available car parking spaces to encourage staff to leave their vehicles at home.

Bridges will keep the traffic flowing

The Apleyhead junction bridge was the first to be completed.

An innovative approach is being used to construct and erect bridges across the A1 between Peterborough and Blyth, where six roundabouts are being replaced with two-level junctions to ease congestion and delays. Martin Cooper reports.

The A1 is a north-south trunk route of strategic importance and in some ways iconic, as it is one of the UK's longest highways. Linking London with Edinburgh via the East Midlands and the North East of England, the route is for much of its length a motorway - A1(M) - grade highway.

However, one of the longer stretches of dual carriageway, linking the two A1(M) sections at Peterborough in the south and Blyth in the north is currently being upgraded. According to the Highways Agency, this 110km-long section, although of satisfactory standard, suffers from severe localised congestion at six roundabouts, so they are now being replaced with grade separated junctions incorporating steel bridges.

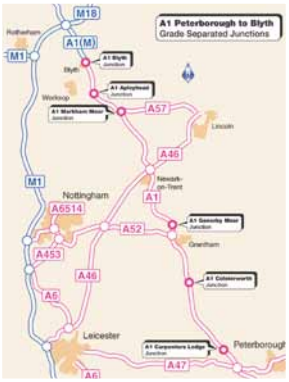
"There is quite often a lot of queuing and delays on this stretch and the works will alleviate this by allowing motorists on the A1 a clear run without roundabouts," explains Dave Abraham, Construction Manager for main contractor Interserve.

The most northerly junction of the scheme is the Blyth A1/A614 interchange near Retford. Here, as with all the other five junctions, a new steel 30m-

Below: SPMTs transported the steel bridge deck at Blyth 200m from its assembly point to its final position.

FACT FILE
A1 Peterborough to Blyth upgrade
Main client: *HIghways Agency*
Structural engineer: *Atkins*
Main contractor: *Interserve*
Steelwork contractor: *Fairfield-Mabey*
Steel tonnage: *900t*
Project value: *£83M*

Above right: Multi-axle SPMTs lifted, carried and jacked the completed steel bridge into position.



The Markham Moor bridge is being constructed on a busy roundabout with heavy traffic circulating around it continuously.

long bridge is being constructed over the existing A1 with new roundabouts either side.

Interestingly at this location an innovative and time-saving procedure has been used for bridge construction. In order to reduce disruption and speed up the works process, the new bridge was fabricated on an adjacent site, at the same time as the abutments were being built. Once both were finished the bridge deck was transported as one large structure, over a distance of 200m, and jacked into its final position.

While the bridge abutments were being readied, steelwork contractor Fairfield-Mabey was busy assembling the bridge steelwork on a temporary platform to the side of the new bridge position. The composite steel and concrete deck consists of six longitudinal steel beams, each 1.2m-deep arranged in three braced pairs forming a 30m-long, 13.5m wide structure. It was assembled 1m above grade and this also had the benefit of minimising working at height.

The new bridge was fabricated on an adjacent site at the same time as the abutments were being built.

Once the entire bridge deck was assembled, along with the concrete decking and edge protection, the lifting, jacking and transportation process was undertaken to transfer the structure to its final position.

"Luckily there was enough space close to the bridge to construct the deck," comments Richard Selby, Project Manager for Fairfield-Mabey. "Interserve didn't want to transport it too far in order to minimise time and any potential damage to the bridge."

Interserve employed heavy lifting specialist Mammoet to carry out this procedure. This technique is rarely used with a steel bridge deck in the UK, but Interserve reckons it reduced the construction programme at Blyth by approximately two months.

The fully assembled deck weighed 550t and to move this huge section into place Mammoet used its self-propelled modular transporters (SPMTs). These remote controlled multi-axle units transported the deck, over the recently levelled ground, to its final position were it was then jacked up and lowered on to the abutments.

In the end the whole transportation and jacking process was completed in one night time operation. "The whole process went very well," comments Mr Abraham. So well in fact that a similar operation will be carried out at the Colsterworth A1/A151 and Carpenters Lodge A1/B1081 junctions in April.

These two junctions are the most southerly in the scheme and again involve new steel bridges to replace at grade roundabouts. In fact Colsterworth will require two steel bridges, one for the junction and another which will replace a troublesome A1 cross-over.

Using steel for the new bridges has brought a number of benefits to the project according to Interserve. "We have saved time by using near-site fabrication and steel certainly lends itself to this kind of construction," says Mr Abraham. "Plus, for these 30m span structures steel is a more economical material."

The other three steel bridges on the A1 project are being erected in a more traditional manner. Directly south of Blyth, the Apleyhead A1/A614/A57 bridge has been completed and open to traffic since October 2007.

At this junction a new dual carriageway for the A1 was constructed in fields to the east of the existing A1. New southbound on and off slip roads were built, and the new bridge connects the existing roundabout with a new western roundabout, completing a new dumb-bell shaped junction.

As the new bridge was constructed over a new road, traffic disruption wasn't an issue, but all bridge beams were still delivered to site by Fairfield-Mabey at night, to minimise congestion.

Likewise, the works at the Gonerby Moor A1/B1174 junction, which includes site clearance, top-soil stripping, bulk earthworks and bridge construction, have also had limited impact on the existing A1 as the majority of work has been carried out off-line.

Markham Moor, the A1/A57 junction, has proven to be the most complex. The new steel bridge has been constructed in the middle of the existing roundabout, with live traffic circulating around it both day and night.

Once complete the new A1 will run right through the Markham Moor roundabout with new junctions either side of a new over bridge. After the bridge abutments were constructed Fairfield-Mabey brought the steelwork to site and erected braced beams in pairs.

"It's the location which makes this bridge so complex," says Mr Abrahams. "Getting the equipment and materials to site has been challenging.

But if the bridge was built with concrete we would have had twice as much traffic and materials going to site, adding to an already busy and at times congested junction."

Keeping disruption to a minimum during the works, with the least amount of closures and contra-flows, is key to the whole scheme. "Using steel and utilising the SMPTs has ensured we've met this target," sums up Mr Abraham.

All six junctions are scheduled to be completed by October 2008.

Tanks roll in to world class home

Part of a £16M Heritage Lottery Fund sponsored project, the world's largest tank collection will soon be housed in a new steel framed hall replete with improved display areas, new amenities and most importantly, much more space.

Located at Bovington in Dorset, on a site acknowledged as the home of armoured warfare - as the Royal Armoured Corps (the first corps to deploy tanks in battle) still reside there - the Tank Museum has the world's most historically significant collection of tanks.

More than 250 military vehicles, some dating back to before WW1, can be seen at the museum and more than 100,000 visitors per year flock to the site.

Known as AT Close Quarters, the redevelopment project aims to provide the collection with more space and allow each exhibit to be placed alongside supporting collections and archive material.

The project is also designed to improve access to the exhibits and to provide a better visitor experience. The major part of the development is the 14,500m² Display Hall. A number of options were investigated by the design team for the location of this building, with the final position being in the south west corner of the site which is bounded by a sweeping road following the site boundary.

This allowed best use to be made of available space and offered greatest flexibility for potential future development. It did however require that the building occupy a distinctive quadrant shape. This was turned to best effect by architect Kennedy O'Callaghan who located the central hub of the structure which houses the cafe, shop, entrance and administration offices, to give access to both new buildings and existing buildings as well as the external display area.

A 20m-high tower structure is located at the centre of this hub and will be a landmark as well as a structural focal point for the entire project. The display hall in fact radiates and fans-out from the tower.

AKS Ward Project Director, David Perkins, said: "We have worked on this project for over five years and have seen it through a number of different forms before settling on the current structure which meets all of the client's aspirations."

The roof of the display hall is configured by a

"The roof is extremely complicated and required a lot of bolted connections to take into account all of the slopes."

FACT FILE
The Tank Museum, Bovington, Dorset
Main client: *The Tank Museum*
Project manager: *Drivers Jonas*
Project quantity surveyor: *Turner & Townsend*
Main contractor: *Norwest Holst*
Structural engineer: *AKS Ward*
Architect: *Kennedy O'Callaghan*
Steelwork contractor: *Bourne Special Projects*
Steel tonnage: *350t*
Project value: *£10.5M*

The new structure radiates out from the viewing tower.

series of trusses, eight in total, which span 36m and radiate from the tower providing a large column-free area. These tapered trusses have a maximum depth of 5.1m, weigh approximately 2.5t each and are supported on a row of 406mm diameter CHS columns at their outer end and 323mm members at the support closest to the tower.

Truss centres vary from 4.2m at their closest to 10.4m at their widest. Stability of the roof and trusses is provided by the rafters which are arranged diagonally to perform the dual function of vertical support member and brace, giving the most efficient use of steelwork.

From the outer row of CHS columns there is then another 14m span to the perimeter columns, and this extra bay is covered by a mono-pitched roof which is then connected back to the display hall roof structure.

"A north light roof was designed for the hall to allow natural daylight to easily penetrate the display area below," explains Ivor Robinson, Contracts Manager for Bourne Special Projects (BSP). "However, with the roof being radial in form, this arrangement means the roof slopes in a number of directions and we had to design some time-consuming connections."

BSP worked closely with the project's structural engineers AKS Ward on the design of the connections for the roof structure.

"Close cooperation was key," says Mr Robinson. "The roof is extremely complicated and required a lot of bolted connections to take into account all of the slopes."

Because the hall needed to be largely column-free to aid the movement of exhibits in, out and around the hall, bracing was ruled out in most areas.

"We were able to insert only one bay of vertical bracing, that was co-ordinated with the display designers, near to the perimeter wall which, due to its prominence, was configured to become a feature," explains Mr Perkins.

Designing a large open long span structure isn't necessarily a complicated procedure, but when there is also little room for bracing, another arrangement has to be found. Working on the steel frame AKS Ward conducted a 3D analysis to determine the wind loading and where best to locate bracing.

"The majority of the wind loading on the structure is transferred by the roof to the large concrete base which supports the building's entrance, cafe and admin block," adds Mr Perkins.

The concrete base is formed by a large retaining wall which was built-up when Norwest Holst started on site last April. The sloping greenfield site was leveled and the overburden was then used to form a retaining wall which then supports the cafe and administration block which also overlook the main display area, so forming a two-level structure.

Also overlooking the entire structure and acting as a beacon for the entrance to the museum is the steel tower that supports the pod from which external displays will be controlled. The tower is supported by a 6m-high concrete base, while the remaining 16m is made from steel and is being fabricated off-site in two large pieces.

The main steel tower, housing a spiral staircase, is 12m-high and was delivered to site by BSP as a complete piece. "This is formed by six circular columns attached with helical bracing," says Mr Robinson. "We brought it to site and Norwest Holst then clad it with mesh, installed the stairs and lifted the 10t piece into place."

Once the steel tower was up, BSP brought the viewing gallery or pod to site. This arrived as two sections which were site welded to form a complex seven-sided, 4m-high final piece of the tower.

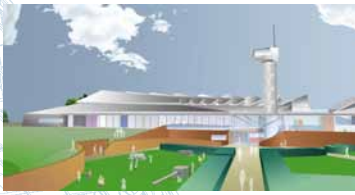
"This was the final piece of our work," explains Mr Robinson. As of February the steel frame was up and the tower was being readied for lifting into position. "The pod was far too complex to do on-site so once it was delivered to site, we welded it and then handed it over to the main contractor."

Once the pod was clad it was then lifted into place and BSP then connected it to the steel mast section of the tower.

Construction work is set to be completed in June 2008, with new exhibitions installed by winter of the same year.

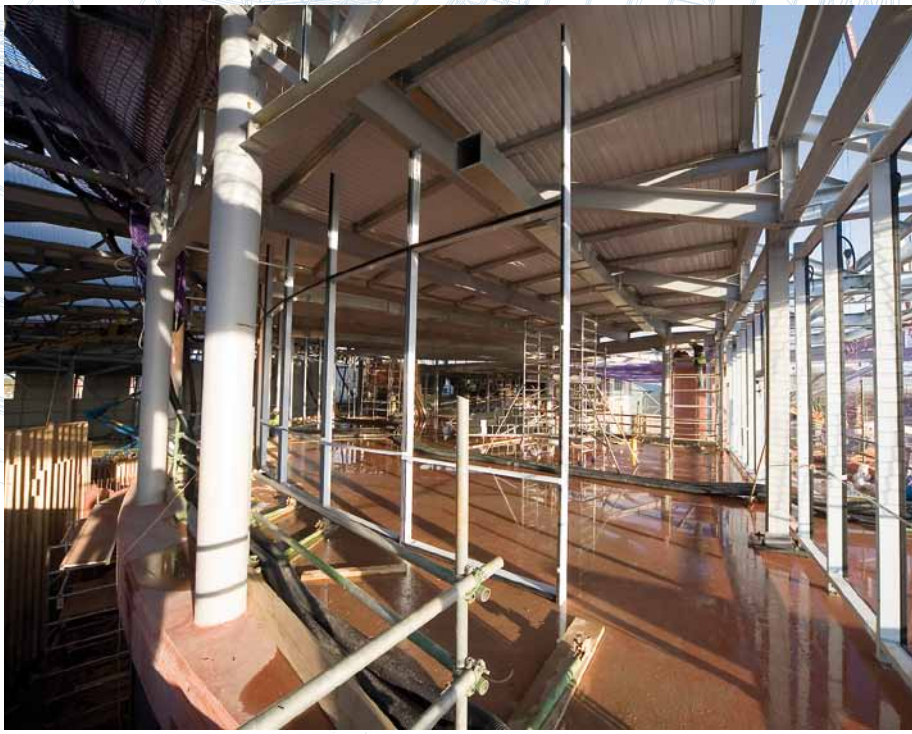
"The associated benefits of this project will see the Tank Museum reinforcing its place at the front rank of the world's finest military museums," summed up Museum Director Richard Smith.

"The work will provide a world class home for our world class collection."



Top: External displays will be controlled from the tower.
Above: The tower will act as a beacon above the new entrance hall.

Below left: The roof design allows natural daylight to penetrate the display hall.
Below: The entrance hall, café, administration area and tower are located on a large concrete retaining wall.



Loads and ULS Load combinations to the Eurocodes

In the language of the Eurocodes, 'dead loads' become 'permanent actions', imposed loads, snow loads and wind loads are collectively called 'variable actions' and 'load combinations' becomes 'combinations of actions'. David Brown, SCI Deputy Director, explains the Eurocode system.

Actions

Actions are determined from the relevant part of BS EN 1991 *Actions on Structures*, not forgetting that designers will need to consult the National Annex for each part. BS EN 1991-1-1 covers densities, self weight and imposed loads – and will be used for such things as imposed loads on floors and roofs – although note that snow loads may be more onerous and are determined from a different Eurocode part. Reduction factors are available for large areas of floors and when calculating the load in a column from several storeys. BS EN 1991-1-1 also gives quite detailed allowances for moveable partitions, which are often accounted for in design.

Snow loads are to be taken from BS EN 1991-1-3 and wind loads from BS EN 1991-1-4. Unfortunately, the National Annex to BS EN 1991-1-4 *Wind Actions* is not yet published – it is expected later in the year. For UK designers, this National Annex is very important as it presents some quite significant changes from the Eurocode.

Combinations of actions at ULS

BS EN 1990 *Basis of Structural Design* requires that structures and members are designed for all possible combinations of actions that can occur simultaneously. Fortunately for building designers, a note in clause A1.2.1(1) allows the maximum number of variable actions to be limited to two. Some judgement may need to be exercised in choosing which two variable actions to combine – in doubt, alternatives should be considered.

Four Ultimate Limit States are considered relevant in BS EN 1990; EQU, STR GEO and FAT, concerned with equilibrium, strength, ground and fatigue. Mostly, designers will be concerned about EQU when considering sliding or overturning, and STR for the strength of frames and members.

Two methods of determining the combination of actions are allowed for the STR Ultimate Limit States. In the UK, the National Annex allows either approach. For good economic reasons, it is likely that UK designers will adopt the second approach. All loading expressions take some digesting.

The first approach is to use expression 6.10.

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_P P+\gamma_{Q,1}Q_{k,1}+\sum_{i\geq 1}\gamma_{Q,i}\psi_{0,i}Q_{k,} \quad (6.10)$$

G represents permanent actions. These are to be summed and multiplied by a partial factor, γ_G

P represents prestressing, and is probably of little interest in steel design!

The first Q represents the 'leading' variable action, and is multiplied by a partial factor, γ_Q

Finally there are the 'other' variable actions, which are to be summed, factored by a partial factor γ_Q but also multiplied by a combination factor, ψ_0.

Actions are combined so long as they do not serve to relieve the effect being considered.

The National Annex to BS EN 1990 must be consulted for the values of the partial factors γ_G and γ_Q and the combination factors ψ_0. The combination factors, ψ_0 depend on the type of load – so care must be taken when extracting these from the National Annex. The UK partial factors for actions are shown below, with some typical ψ_0 factors, all taken from the UK National Annex.

Partial Factor	Permanent action, $\gamma_G = 1.35$
	Variable action, $\gamma_Q = 1.5$
Combination factor	Office areas, $\psi_0 = 0.7$
	Roofs, $\psi_0 = 0.7$
	Snow loads (at lower altitudes), $\psi_0 = 0.5$
	Wind loads, $\psi_0 = 0.5$

The second approach is to use the more onerous of expressions 6.10a and 6.10b.

$$\sum_{j\geq 1}\gamma_{G,j}G_{k,j}+\gamma_P P+\gamma_{Q,1}\psi_{0,1}Q_{k,1}+\sum_{i\geq 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \quad (6.10a)$$

$$\sum_{j\geq 1}\xi_j\gamma_{G,j}G_{k,j}+\gamma_P P+\gamma_{Q,1}Q_{k,1}+\sum_{i\geq 1}\gamma_{Q,i}\psi_{0,i}Q_{k,i} \quad (6.10b)$$

The subtle attraction of this pair of expression derives from two important changes from 6.10s:

- the application of the ψ_0 factor to the leading variable action in expression 6.10a (not applied in 6.10)
- The introduction of a reduction factor ξ applied to the permanent actions in expression 6.10b (not applied in 6.10)

The value of the reduction factor ξ is given in the UK National Annex to EN 1990 as 0.925. If considering the EQU ULS, (sliding or overturning,) the use of 6.10a and 610b is not allowed.

Example 1

The following numerical example examines the combination of actions for a floor beam, subject only to permanent and variable actions.

Permanent action = 3.5 kN/m²
Variable action (office) = 5 kN/m²

Using expression 6.10
3.5 × 1.35 + 5 × 1.5 = 12.23 kN/m²
Use 12.23 kN/m²

From expression 6.10a
3.5 × 1.35 + 5 × 1.5 × 0.7 = 9.98 kN/m²
From expression 6.10b
3.5 × 1.35 × 0.925 + 5 × 1.5 = 11.87 kN/m²
Use 11.87 kN/m²

Combination of actions including wind load

When members are subject to wind load in addition to permanent and (for example) variable actions from floor loads, the situation becomes slightly more complex as both the imposed floor load and the wind load can be considered, in turn, as the leading variable action. The combinations of actions are illustrated below. In each row, the leading variable action is shaded. Pedantically, the shaded zones in expression 6.10a indicate the 'main accompanying variable action' rather than the 'leading variable action'. When using the expressions, each combination will have to be considered – taking firstly one variable action as 'leading' and then considering the combination with the other variable action as 'leading'.

Expression	Permanent action	Variable actions	
	Self-weight	Imposed floor	Wind
(6.10)	$\gamma_{G_j,sup}$ = 1.35	$\gamma_{Q,1}$ = 1.5	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.5 = 0.75
	$\gamma_{G_j,sup}$ = 1.35	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.7 = 1.05	$\gamma_{Q,1}$ = 1.5
(6.10a)	$\gamma_{G_j,sup}$ = 1.35	$\gamma_{Q,i}\psi_{0,1}$ = 1.5 x 0.7 = 1.05	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.5 = 0.75
	$\gamma_{G_j,sup}$ = 1.35	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.7 = 1.05	$\gamma_{Q,i}\psi_{0,1}$ = 1.5 x 0.5 = 0.75
(6.10b)	$\xi\gamma_{G_j,sup}$ = 0.925 x 1.35 = 1.25	$\gamma_{Q,1}$ = 1.5	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.5 = 0.75
	$\xi\gamma_{G_j,sup}$ = 0.925 x 1.35 = 1.25	$\gamma_{Q,i}\psi_{0,i}$ = 1.5 x 0.7 = 1.05	$\gamma_{Q,1}$ = 1.5

Note that in Expression 6.10a, the results are identical whichever variable action is identified as the main accompanying variable action, because the UK National Annex specifies the same value for $\gamma_{Q,1}$ and $\gamma_{Q,i}$.

Example 2

The use of expressions 6.10a and 6.10b is demonstrated in Figure 1 for a very simple bracing system shown with its unfactored vertical and wind loads. The equivalent horizontal forces (EHF) must be calculated for each combination, because they depend on the design (factored) vertical loads and

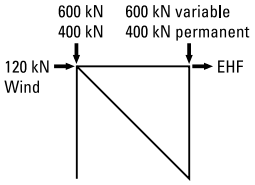


Figure 1 Unfactored actions

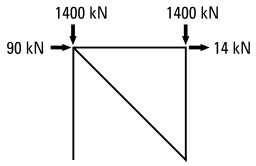


Figure 2 Design values, 6.10b, imposed floor load 'leading'

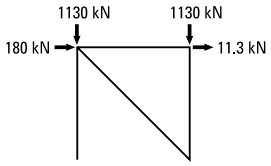


Figure 3 Design values, 6.10b, wind load 'leading'

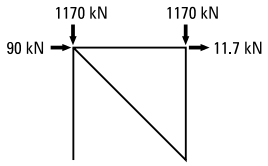


Figure 4 Design values, 6.10a

will be simply taken as 1/200 of the total vertical load. The partial, combination and reduction factors are taken from the table above. In Figure 2, the design values are shown using expression 6.10b, with the imposed floor load as the leading variable action. In Figure 3, expression 6.10b is again used, but with the wind as the leading variable action. For completeness, and because the design must be based on the most onerous of expression 6.10a and 6.10b, the design values using expression 6.10a are shown in Figure 4.

In this example, the maximum design force in the bracing member is determined from expression 6.10b with wind as the leading variable action. The maximum axial load in the column is also determined from expression 6.10b, but with the imposed floor load as the leading variable action. This however is a very simple example – and it would be easy to conceive a structure where the results were not so straightforward. In general, all possible design combinations of actions must be checked.

For designers, the simplest solution is to use expression 6.10, which will be conservative. If more economy is required, the use of expressions 6.10a and 6.10b will be beneficial.

Comparisons with BS 5950.

For members subject only to vertical loading – usually the vast majority of members in a structure, there is an obvious attraction in the Eurocode design combinations. Instead of the design load being based on 1.4 × dead + 1.6 × imposed, the load may be based on the more onerous of expression 6.10a or 6.10b. Unless the permanent action is greater than the variable action by a factor of 4.5 (quite an unusual situation!) expression 6.10b will be more onerous, and the result will be a design based on 1.25 × dead + 1.5 × imposed load. With typical loads of (say) 3.5kN/m² permanent and 5 kN/m² variable, this represents a reduction in design loads of 8%. If the imposed floor loads are storage loads, expression 6.10b will not necessarily be the more onerous, because a different ψ_0 factor is applied.

The lateral design loads according to the Eurocodes will increase compared to BS 5950. The maximum design loads are based on a partial factor of 1.5 in the Eurocode system, rather than 1.4 in BS 5950. This will affect all the systems (bracing or moment-resisting frames), that provide stability. In addition, the EHF appear in all load combinations, and will increase the lateral loads still further by a modest amount, compared to BS 5950 when the wind loads alone were usually the dominant load combination for bracing design.

Further Help

A host of SCI design guides are to be published through 2008. Loading is explained in the Introduction to Eurocodes (P361). Examples of loading are covered in worked examples for students (P376), and in a guide covering the design of multi-storey braced frames (P365). Also in 2008, BCSA are to publish a Guide to Eurocode Load Combinations for Steel Structures.

40 Years Ago in

BUILDING WITH STEEL

'Back-to-back' Cantilever Hangar

Aeroplanes get larger and larger, consequently hangars to house them must grow at a similar rate – and this inevitably means greater cost.

The Lockheed company had such a problem with the housing of its latest transport aeroplane, the largest transport yet built. But it has been solved by an ingenious patented gigantic steel framed double cantilever hangar large enough to house simultaneously four aircraft, each of which is 246 ft long, 65 ft high and measures 223 ft wing tip to wing tip. And it shows savings in cost!

The design of the hangar envisages two back-to-back cantilevered canopies, one for static and fatigue ground testing, the other to house aircraft undergoing actual flight tests. The two areas are completely column free and provide a clear-span height of 78 ft throughout. Offices, laboratories and workshops are contained in the central core of the hangar occupying five storeys and a total area of 240,000 sq ft. This central core is the supporting structure for the two massive cantilevered roofs: one roof extends 261 ft, the other 271 ft.

The outstanding structural feature of the hangar is a superstructure extending above the roof of the central core and holding the cantilevered trusses in position. This superstructure is supported by one hundred 14-in. columns which extend from the foundations up through the central core. To achieve the full height of the superstructure – 142 ft from the ground – these main columns which are 87 ft long below the roof, are spliced above the roof of the centre core. Two exposed main tension and compression members – 24-in. wide flange beams with 18-in. channel caps – extend down at an angle from the tops of the columns and connect to the trusses forming a triangular structural system.

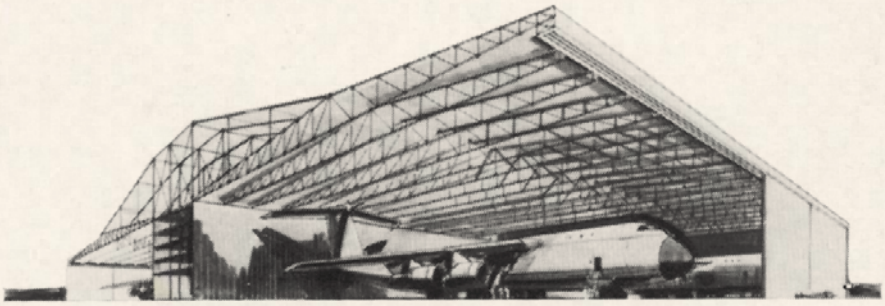
The object of the superstructure – in addition to holding the cantilevered trusses in shape – is to provide resistance against uplift in abnormal wind conditions. This means that the ends of the trusses will move up and down a few inches and no more, under maximum wind or live load conditions.

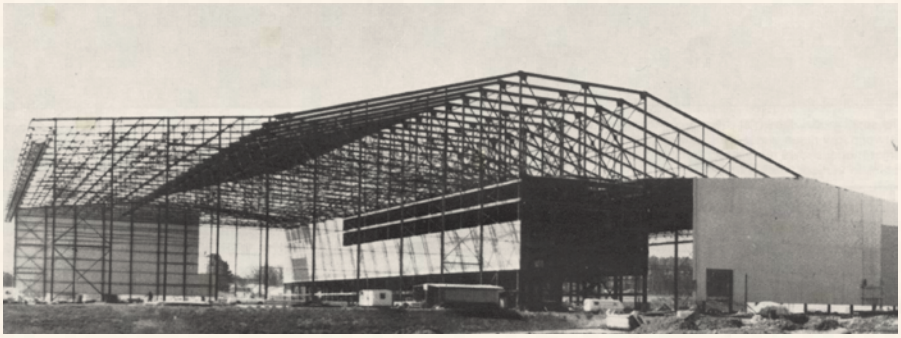
It is estimated by the designers that the advantage in saving of steel with this hangar over conventional cantilever design, lacking the superstructure, can be as high as 32 per cent with a maximum saving in cost of 24 per cent – very substantial indeed.

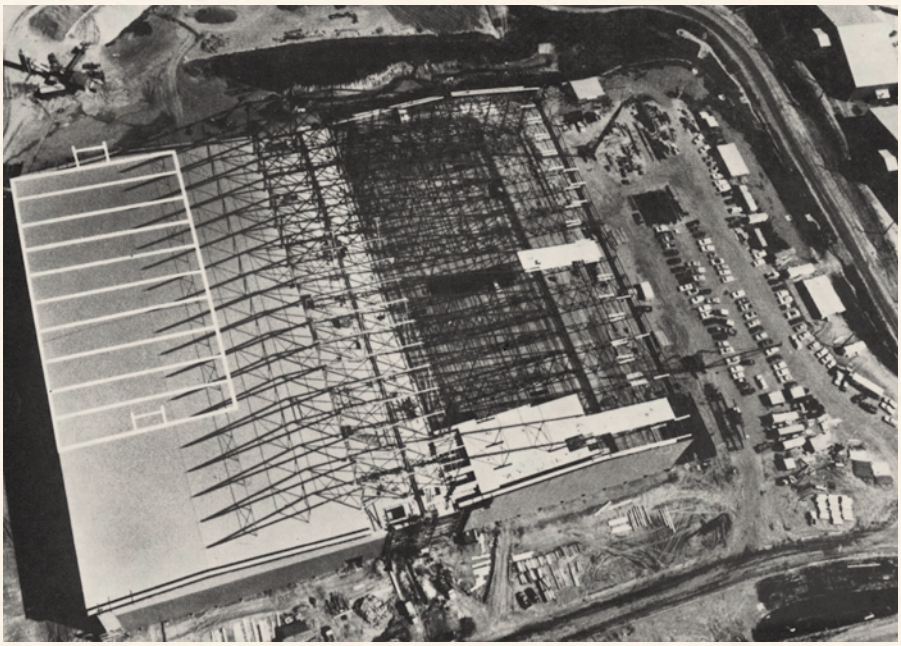
The designer draws special attention to the fact that each cantilever canopy supports a full coverage, bridge crane system of 10 ton capacity.

The hangar illustrated in this article is equipped with enormous structural steel sliding doors on each of the two 480 ft hangar ends: these doors are 70 ft high and 80 ft wide but it is emphasized that experiments are now being carried out with doors of up to 100 ft clear height.

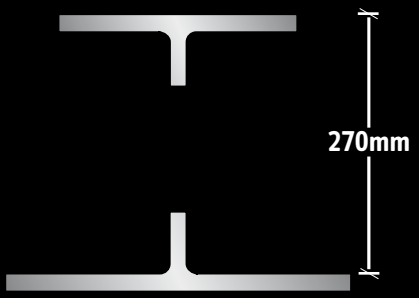
Five thousand tons of steel are being used in this structure which became fully operational in February 1968. Complete dimensions of the hangar: 630 ft by 480 ft with a height of 142 ft.



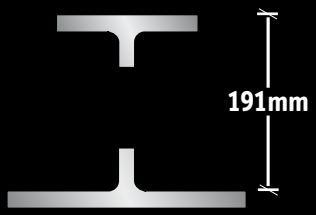




SHALLOW.. SHALLOWER.. ULTRA SHALLOW



USFB®	294 x 254/368 x 154 kg/m
Span	8.5m
Centres	5.3m
Top Tee	254 x 254 x 132
Bottom Tee	356 x 368 x 177
Project	Ormeau Road, Belfast



USFB®	206 x 152/254 x 55 kg/m
Span	5.5m
Centres	3m
Top Tee	152 x 152 x 37
Bottom Tee	254 x 254 x 73
Project	Dawson Place, London

USFB®	165 x 152/254 x 51.5 kg/m
Span	4.3m
Centres	2.5m
Top Tee	152 x 152 x 30
Bottom Tee	254 x 254 x 73
Project	The Bridge, Perth

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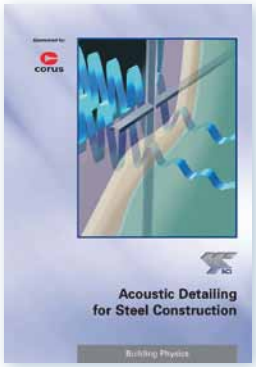
Acoustic detailing for steel construction

Comprehensive and up-to-date guidance for achieving effective sound insulation within steel framed buildings



Catalogue Reference: P372
Author: A G J Way and G H Couchman

This publication gives acoustic details for steel framed buildings with a range of floor and wall constructions. The guidance is based on acoustic test results and information published by manufacturers and suppliers of plasterboard, light steel framing, acoustic systems and associated products. It provides advice to architects, designers and other construction professionals on detailing to achieve the required acoustic performance. It explains and provides information on:

- The general principles of sound insulation.
- Regulatory requirements for modern residential buildings.
- Generic acoustic solutions using steel construction technologies.

The acoustic solutions include constructions suitable for separating walls and floors between dwellings.

- Recommended junction details for separating floors supported on hot-rolled steel frames
- Integration of building elements into separating walls and floors.
- Expected acoustic performance for walls and floors (as airborne insulation values) and for floors only (as impact sound values).

It supersedes the previous main SCI publication, P336, *Acoustic detailing for multi-storey residential buildings* and updates and extends the guidance on several other publications on the subject.

PRICES:
Non-member £50. (plus P&P)
Member £25 (plus P&P)
ISBN 978-1-85942-178-9; 90 pp, A4, paperback; February 2008

New and Revised Codes & Standards

(from BSI Updates February 2008)

BS EN PUBLICATIONS

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

Note: The date referenced in the identifier is the date of the European standard.

NA to BS EN 1994:-
UK National Annex to Eurocode 4. Design of composite steel and concrete structures

NA to BS EN 1994-2:2005
General rules and rules for bridges
No current standard is superseded

PUBLISHED DOCUMENTS

PD 6696-2:2007
Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2. Eurocode 4. Design of composite steel and concrete structures. General rules and rules for bridges

AMENDMENTS TO BRITISH STANDARDS

NA to BS EN 1997-1:2004
UK National Annex to Eurocode 7. Geotechnical design. General rules.
CORRIGENDUM 1

NEW WORK STARTED

PD 6698
Background paper to the UK National Annexes to Eurocode 8

CEN EUROPEAN STANDARDS

EN 14399:-
High strength structural bolting for preloading

EN 14399-7:2007
System HR. Countersunk head bolt and nut assemblies

EN 14399-8:2007
System HV. Hexagon fit bolts and nut assemblies

AD 319
Update on the fire protection of beams with web openings.

In the last five years there have been many developments in the fire protection of beams with web openings. For most cellular beams, that is beams with circular openings, fire protection requirements can be ascertained using simple tabular guidance. However, there are limitations on the opening geometry covered by existing simple guidance and for beams with rectangular openings or with a combination of circular and rectangular openings, there are no straightforward methods for assessing the fire protection requirements. The issue of fire protection for all beams with web openings must therefore be addressed at the design stage, as the structural designer needs to ensure that a fire protection solution can be achieved for the proposed opening geometry. Failure to identify a fire protection solution prior to fabrication of the steelwork is often expensive to rectify. Structural designers need to be aware of the limitations of current fire design guidance when designing beams with web openings that will require fire protection, and if the beam geometry does not conform to those limits then the structural designer should make arrangements to supply the appropriate limiting temperatures to the fire protection specialist.

This advisory desk note provides an overview of the publications that have appeared and in some cases been withdrawn as the work on the fire resistance of these structural members has progressed. It also reviews the design options that are available for beams with web openings and provides advice on sources of further information where required, but it provides no new guidance.

The procedure for testing and assessing the performance of intumescent coatings for use on cellular beams has now been developed by ASFP in consultation with SCI and the fire testing laboratories. A number of intumescent manufacturers have tested their products in accordance with this testing protocol and given this development it is now appropriate to withdraw generic guidance for the fire protection of cellular beams in favour of product-specific guidance.

Published Design Guidance

Research on beams with circular and rectangular web openings has shown that the design rule that had been developed for use with castellated beams and non reactive fire protection materials would underestimate the thickness of fire protection for cellular beams. As research in the area has developed, a number of documents offering design guidance have been produced; these are summarised in the adjacent table and their status given.

Ref	Description	Status
AD269	Interim guidance on the fire protection of beams with circular web openings	Withdrawn
RT983	Interim guidance on the fire protection of beams with circular web openings	Withdrawn
RT1006	Commissioned by Westok Ltd to extend the scope of the guidance given by RT983 for beams designed using Cellbeam	Withdrawn (see AD308)
AD299	Provides background information on the development of RT1085	Current
RT1085	Published as a replacement to RT983.	To be withdrawn April 08
AD308	Notification of the withdrawal of RT1006. Generic temperatures for Westok beams are no longer required as Cellbeam Automate V6.1 now includes a fire design module.	Current
RT1187	This document will describe the basis of the product-specific design guidance currently available from intumescent manufacturers	To be published

Design Methods

For optimum economy and structural safety, the structural engineer should give the fire protection supplier appropriate limiting temperatures for each structural member, on the drawings and in the fire protection specification. This is particularly important for beams with large web openings, as the limiting temperatures depend on the beam geometry, load level and load distribution properties with which the structural designer will be more familiar than the fire protection specialist.

The SCI recommends that limiting temperatures for beams with web openings protected using an intumescent coating are obtained using one of the following three options. These design options are not new guidance and have been described previously in AD299. In all cases SCI recommend that the fire protection product applied to the steelwork should be tested and assessed in accordance with the ASFP protocol for cellular beams.

If fire protection requirements cannot be ascertained using Option 1 (limited to beams with circular openings) or Option 2, structural designers should take responsibility for determining limiting temperatures using the advanced analysis methods described in Option 3.

Option 1 – Tables of limiting temperatures

Simplified guidance is available from the fire protection manufacturers in the form of tables of limiting temperatures, but only for beams with circular web openings and geometrical limitations apply to the positions and sizes of the openings. The structural designer should supply suitable information on the geometry and loading, to enable the fire protection manufacturer to determine an appropriate limiting temperature for the beam. Further advice is given in RT1187.

Option 2 – Proprietary Software

Proprietary beam design software that explicitly calculates the load carrying capacity for beams with web openings at the fire and ultimate limit states may be used. The development of such software should be based on the observed temperature distribution throughout similar beams for different coating thicknesses and the observed performance of beams in loaded fire resistance tests. The software will give the values of limiting temperature that are needed for the structural drawings and the fire protection specification.

Proprietary software that covers the room temperature and fire design of their particular product is currently available from Fabsec and Westok. It should be noted that the results of analysis based on proprietary software are only applicable to that structural product protected in accordance with the guidance provided by the software supplier.

Option 3 – Advanced analysis

Beams that are outside the scope of the fire protection manufacturers product-specific limiting temperature tables (notably beams with rectangular or elongated circular openings) and which have not been designed using proprietary software will need to be evaluated using advanced analysis in order to determine the appropriate limiting temperature. As this advanced analysis is closely related to the structural design it should be undertaken by the structural designer or a suitability qualified consultant.

The structural model used for this purpose should take account of all practical modes of failure for beams with web openings and the thermal model should permit a suitable temperature distribution to be applied to the cross section. The thermal model should take account of the increase in temperature of the web posts relative to the flanges and the effect of section asymmetry on top flange temperature. The performance of the intumescent coating applied to the beam should be compatible with this assumed temperature distribution used in the structural analysis. Data on the appropriate temperature distribution may be obtained from fire tests on protected sections or alternatively the thermal distribution given in RT1187 may be applied.

References

Fire Protection for Structural Steel in Buildings', 4th ed, is available from www.asfp.co.uk

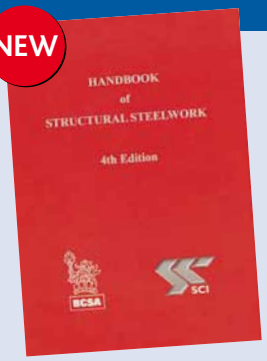
All the Advisory desk notes (including the withdrawn notes) and current SCI reports are available on www.Steelbiz.org.

Contact: Dr Ian Simms
Tel: 01344 636557
Email: i.simms@steel-sci.com

Steel Construction Books

Health & Safety • Specification • Assessment • Erection • Design

NEW

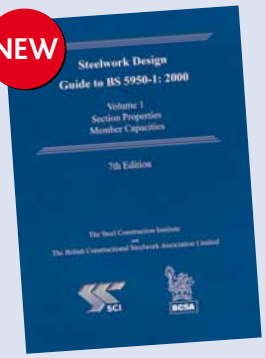


DESIGNING - The Red Book

The Handbook of Structural Steelwork

This handbook gives practical design advice, worked examples, section properties and member capacities. This edition includes the additional 21 new Advance sections produced by Corus and the section property and member capacity tables have been dual titled to reflect the relationship between BS 4 sections and the Advance range of sections. The tables for hot formed tubes have also been dual titled. The handbook is in accordance with the recommendations given in BS 5950-1: 2000.

NEW



DESIGNING - The Blue Book

Steelwork Design Guide to BS 5950-1: 2000

This edition of the Blue book gives a comprehensive range of member property and capacity tables in accordance with BS 5950-1: 2000. It includes the 21 new Advance sections produced by Corus and the section property and member capacity tables have been dual titled to reflect the relationship between BS 4 sections and the Advance range of sections. This edition also includes a wider range of hollow sections. The tables for hot finished hollow sections have also been dual titled to show the relationship between BS EN 10210-2 sections and the Celsius range of sections.

NEW

SPECIFYING - The Black Book

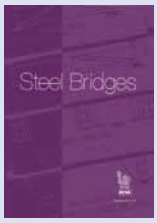
National Structural Steelwork Specification

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

SPECIFYING - The Grey Book

Commentary on the 4th edition of the National Structural Steelwork Specification

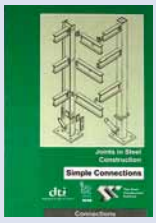
This publication provides useful guidance to both specifiers and contractors and can be used as an informative reference.



BRIDGES - The Purple Book

Steel Bridges

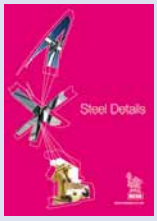
A practical approach to the design of steel bridges for efficient fabrication and construction.



CONNECTING - The Green Book*

Joints in Steel Construction: Simple Connections

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



STEEL DETAILING - The Magenta Book*

Steel Details

This book provides practical advice on the issues that affect the efficient detailing of steelwork connections. The publication contains a rich array of details from actual structures and allows both engineers and architects to interrogate them.

STEEL BUILDINGS - The Silver Book

Steel Buildings

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

GALVANIZING - The Beige Book

Galvanizing Structural Steelwork

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

ASSESSING - The Brown Book

Historical Structural Steelwork Handbook

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

Code of Practice for Erection of Multi-Storey Buildings

The document provides guidance to clients, planning supervisors, principal contractors, designers and steelwork contractors on management procedures and methods, erection method state-ments, site preparation, delivery, storage, stability, lifting etc and aids compliance with the Health and Safety at Work Act.

Code of Practice for Erection of Low Rise Buildings

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

Code of Practice for Metal Decking & Stud Welding

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

Guide to the Erection of Steel Bridges

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

Guide to Steel Erection in Windy Conditions

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

NEW

Guide to Work at Height during the Loading and Unloading of Steelwork

The aim of this guide is to improve health and safety during loading and unloading of steelwork from lorries and trailers that takes place either at the steelwork factory or on sites. It describes the management procedures and methods to be adopted for access and working at height and is intended to serve as a standard reference when drafting site-and project-specific method statements.

Health and Safety in the Office

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

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

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

Health and Safety On Site

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

Health and Safety: a Pocket Guide for Managers & Supervisors

This booklet covers topics such as risk assessment, method statements, policies, setting up the workplace, inspections, training, statutory test etc and provides a useful, easy to understand, reference on Health & Safety Law.

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

BCSA is the national organisation for the steel construction industry. Details of BCSA membership and services can be obtained from Gillian Mitchell MBE, Deputy Directory General, BCSA, 4 Whitehall Court, London SW1A 2ES
Tel: 020 7839 8566 Email: gillian.mitchell@steelconstruction.org

KEY

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

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

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

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

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