APRIL 2008 VOL16 NO4

NSC

NEW STEEL CONSTRUCTION

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New museum in Capital of Culture
Ravenscraig regeneration
Wakefield steel makeover
Trusses for Somerset dairy

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Cover Image
Museum of Liverpool
Client: National Museums Liverpool
Architect: 3XN and AEW
Steelwork contractor:
Caunton Engineering
Steel tonnage: 2,100t

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T5 sets world standard

Congratulations to all members of the construction team that delivered BAA's new Terminal 5 at Heathrow on time and to budget. It is a great achievement given the scale and complexity of the project, and shows the world what the UK construction industry can deliver.

As BAA Chairman Sir Nigel Rudd said at the opening by the Queen: 'From every perspective, this is a landmark project and I am proud to think that Terminal 5 has become a model construction project, setting new, higher standards for an industry around the world.'

Watson Steel Structures has consolidated an already high reputation by its success in delivering the key steelwork package. It is testament to client BBA's confidence in steel as a construction material that it chose to get off to the best possible start for its £4,300M investment by selecting steel.

Watson Steel Structures has played a significant role over the years in establishing the reputation of steel as a constructional material and at T5 has set a standard for the sector to follow. That reputation is enhanced almost daily by the successful delivery of projects across the steel construction sector.

T5 demonstrates many of the features of steel construction that clients value, so it is worth outlining the scale of the achievement. The T5 team has created the UK's biggest free standing building, using some 45,000t of steel, all manufactured off-site and brought to site as needed, just as it would be on any steel project.

The long span roof on the main building – 400m by 150m – is the longest single span roof in Europe, manufactured off-site and fitted in six sections, each weighing 2,500t, that were jacked up because of height restrictions on the use of cranes. Since installation in April 2004 it has allowed construction work to take place virtually without interruption, unaffected by bad weather.

Extensive use was made of off-site trials and testing, which generated major cost and time savings. Part of the roof and façade for the main terminal building was constructed off-site in Yorkshire to ensure that all issues relating to tolerances and sequencing were tested and resolved before assembly on site. Potential problems were ironed out at an early stage and these lessons applied elsewhere.

The design minimises the number of internal columns required, giving BAA maximum flexibility in terms of future potential changes to the building. This success can only win steel construction new admirers.

Nick Barrett - Editor

SCI carries out successful fire test on light steel floor

The first industry sponsored fire test on a light steel floor has been carried out by SCI with the floor achieving 90 minutes fire resistance to BS EN 1365.

Mark Lawson, SCI Professor of Construction Systems at the University of Surrey, said light steel loadbearing frames are widely used in buildings of up to eight-storeys for which longer periods of fire resistance is increasingly needed.

"The introduction of BS EN 1365 has required an extensive programme of re-testing, as it is more severe than the former BS 476-20."

The test, held at the Building Research Establishment, supported the applied load for 93 minutes, although the designated failure of the test was at 92 minutes.

"Importantly, for the steel joists, their temperature remained at less than 100C for over 80 minutes and so the joists would be essentially undamaged and re-usable, even after a severe fire," said Mr Lawson.

The fire test was sponsored by Corus Strip and members of the Light Steel Framing Group. (See p32 for the full story.)

Steelwork ready for the Derby

Work is currently progressing on schedule for the £25M redevelopment of the Epsom Downs Racecourse. The centrepiece of the project is a new 11,000 capacity grandstand which will be partially opened for this June's Derby Festival.

Measuring approximately 95m-long and with a height of 22m, the new grandstand replaces a 70-year structure which was demolished last year.

The grandstand will include a large 960m^2 hall with catering outlets suitable for conferences and exhibitions. On the upper second level there will also be 14 private boxes and 'Super Box' catering for more than 100 people.

Working on behalf of main contractor Willmott Dixon, Graham Wood Structural is erecting approximately 800t of steelwork for the project.

Having erected the majority of the grandstand's steelwork, Graham Wood will finish its work by adding the large cantilever roof steelwork.

"We have to wait until the precast concrete terracing is installed before we put the cantilever up," said Paul Westbrook, Project Manager for Graham Wood.

Steelwork will be completed by the end of May, allowing spectators to use the 4,000 capacity terrace area of the grandstand for the Derby Festival. Once the race meeting is over the upper levels of the facility and external works will then be completed.

Busy bees bolt to world's highest apartment block

Fixing a sculpture, depicting a swarm of bees, to the facade of the 300m-high Eureka tower in Melbourne, Australia was recently achieved with Lindapter's Hollo-Bolt system.

Scott Brook, spokesperson for Lindapter, said: "The space behind the facade is quite cramped. Welding the mounts into place would have been difficult. Hollo-Bolts allowed the contractor to fix them in place easily, working just on the exposed face of the steelwork."

The contractor wanted a means of securing the bees that would be unobtrusive as well as tough.

"The Hollo-Bolts fitted the bill perfectly," added Mr Brook. "The patented expansion bolt design provided a simple solution for attaching to the hollow-section structural steelwork behind the facade - the bees' knees of fixing."

BCSA to open regional office

The BCSA is planning to open a new regional office on the outskirts of Leeds and two new staff members, a Welding and Fabrication Manager and a Certification Scheme Manager, will be appointed to work at this office alongside the Deputy Director General, who will be relocating to the new office. BCSA's Head Office will continue to be at Whitehall Court, London.

The workload of the Steel Construction Certification Scheme (SCCS) is growing and the scheme management needs to be strengthened, consequently a full-time Certification Scheme Manager is being appointed.

The new position of Welding and Fabrication Manager has been created to assist members with the forthcoming new welding specification and certification requirements. In order to comply with the Construction Products Regulations and CE Marking, steelwork companies will need to have a certified Welding Quality Management system, incorporating a designated Responsible Welding Coordinator (RWC). The RWC can either be an in-house staff member or someone sub-contracted, but will need to have appropriate experience.

The SCCS is putting procedures into place for providing a UKAS accredited Welding Quality Management audit and certification service to steelwork companies, which will incorporate a RWC interview and approval process to be undertaken by the new Welding and Fabrication Manager.

SCI to consult industry on Eurocode transition

British Standards (BSI) has contracted SCI to find out what designers need in making the switch to Eurocodes, with the aim of creating a new generation of standards-based products and information to ease transition to the new codes.

The initiative has been endorsed by the Institution of Civil Engineers, which has been calling for efforts to reduce the burden on its members in what it describes as 'undoubtedly the biggest change to our structural design standards for a generation'.

SCI's Senior Manager for Information Technology John Moran, said: "We need to talk to practical designers about how they use standards documents, what issues are likely to arise during the transition to Eurocode design and what they expect BSI to do."

SCI and BSI are planning a number of user workshops to look at how the Eurocodes work and assess what designers think should be done.

Those taking part in the workshops will be issued with free copies of the general parts of Eurocodes 2 and 3 for concrete and steel respectively. They will also be among the first to receive the new Burgundy Book, with Eurocode-compliant load-span tables for steel sections.

Terminal 5 up and running

Heathrow's £4.3bn Terminal 5 officially opened for business on 27 March, six years after construction work first started on the mega project.

The steel-framed structure, designed by Rogers Stirk Harbour and Partners, is officially the UK's biggest free-standing building.

The Terminal 5 complex features 60 new aircraft stands; two satellite buildings, the second of which (phase 2) will be completed by 2010; rail links to London Underground and Heathrow Express; a new multi-storey car park; and extensive landscaping.

Commenting at the official opening, BAA Chairman Sir Nigel Rudd, said: "From every perspective, this is a landmark project and I am proud to think that Terminal 5 has become a model construction project, setting new, higher standards for an industry around the world."

AROUND THE PRESS

Construction News
13 March 2008
Restoring a cast iron station to its former glory
Despite the exposure, the beam and column framework - supported by a simple mass concrete pad foundations - had managed to hold up the Victorian station for some years, together with an added access ramp.

Construction News
6 March 2008
Green, green grass returns to Welsh hotspot
Built by main contractor Laing O'Rourke (the nuclear storage unit) has a double skin which features a 200mm thick reinforced concrete outer wall with 190mm thick Welsh slate cladding tied to it. Above 6m this concrete wall is replaced by a steel frame that supports a metal wall cladding system which ties into a steel Kalzip roofing system.

Building Magazine
29 February 2008
What the Sheikh wants...
The 400m-high Lighthouse at the Dubai International Financial Centre aims to be the first skyscraper to achieve a platinum rating under the US LEED system, which is the equivalent of a BREEAM excellent rating. If it makes it, it will be only the 18th building in the world to do so.

New Civil Engineer
21 February 2008
A1 for technique
Keeping disruption to a minimum is key to the whole scheme. "Using steel and utilising the SMPTs has ensured we've met this target," sums up Dave Abraham, Inserserve Construction Manager.

The Structural Engineer
4 March 2008
Steel bridges enable innovation on improvements to A1(M)
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 which minimised working at height.

New European Standard for fabrication and erection

The European Standard for the fabrication and erection of structural steelwork, EN 1090-2, has passed its Formal Vote within Europe and will now be issued by CEN after certain editorial corrections are implemented. When issued as BS EN 1090-2 in a couple of months it will replace BS 5950-2 and BS 5400-6

Dr David Moore, BCSA Director of Engineering, said at the heart of the new fabrication standard is the concept of Execution Class which defines the level of assurance and workmanship to be applied to different structures.

In the final version of the standard the choice of Execution Class is linked to a number of criteria with different levels of traceability, welding management and weld acceptance.

Dr Moore went on to explain that for both bridges and buildings additional guidance will be issued to ensure that UK specifiers can use the standard safely. In particular an updated version of the BCSA's National Structural Steelwork Specification will be issued for building steelwork.

Four new schools for steel city

Caunton Engineering is supplying structural steelwork for four new schools in Sheffield under the Government's Building Schools for the Future (BSF) programme.

Working for the Paradigm Consortium, led by Taylor Woodrow, Caunton is a Strategic Alliance Partner.

Two of the schools - Newfield Secondary and Talbot Special Needs Secondary - are on the same site and all 215t of steelwork has been erected.

A third project, Silverdale Comprehensive school, consists of a greenfield development adjacent to the existing school, which will be demolished once the job is completed. Steelwork at Silverdale has been completed and used to construct a sports hall, a main hall building and covered street areas.

Phase one of steelwork erection has also been completed on the fourth school project, Yewlands Technical College. Caunton says it will begin phase two during September and a total steel tonnage of 145t with 520m^2 of metal decking will ultimately to be used on the project.

London's new landmark hotel

The steel frame for the Westminster Bridge Park Plaza Hotel in London is fast taking shape.

Located on the site of the old County Hall annex, the hotel forms an integral element of a larger regeneration scheme covering much of the adjacent south bank of the river Thames.

With 16-storeys containing 960 apartment style rooms and a basement housing the capital's largest column-free ballroom, the hotel is due to open for business by 2010.

Working on behalf of main contractor Gear Construction, Cleveland Bridge is fabricating and supplying two large Vierendeel trusses from which all hotel floors, from second level to 13th level, will be hung.

The trusses are being set at an angle and will form a V-shaped central hotel atrium.

These large steel structures will be encased in concrete and are being erected with studs to accept floors and diaphragm walls. The bottom level of the trusses (level 2) will have hangers on to which the concrete first floor will be hung.

Once steelwork is complete a further three floors, constructed with concrete, will be added to the top of the structure.

BREEAM awards green buildings

The greenest buildings in Wales were recognised in the first ever BREEAM Awards, specifically for the Principality, with two steel projects among the winners.

The awards were presented at the Greener Homes and Building Exhibition by Jane Davidson AM, Minister for the Environment, Sustainability and Housing, and Nick Tune of BRE Wales.

In order to win, each project had to have excelled in every environmental category within BREEAM and therefore winners represent a complete approach to delivering sustainability.

Unlike many construction awards, the BREEAM awards are not subjectively judged but reward developments that have been independently assessed and certified as scoring the highest number of credits in the relevant year and location.

Three developments were highlighted this year for their outstanding achievement in environmental design and management. They included two steel-framed projects, the New Construction & Technology Block at Pembrokeshire College (top) and the Unit 5 at the Great Oaks Business Park in Llanidloes (left). They obtained BREEAM scores of 72.54% and 73.43% respectively.

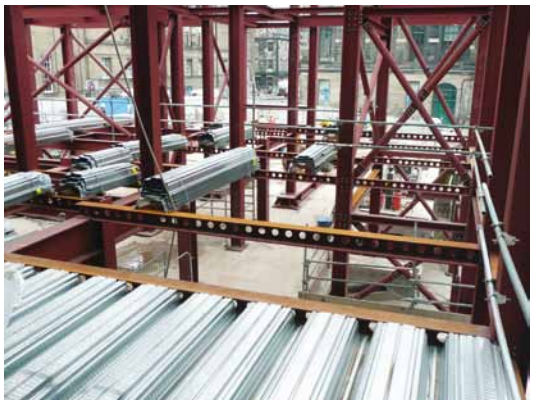
Improved engineering model for cold-formed steel

SCI engineers have developed an Improved Engineering Model (IEM) that more accurately predicts cold-formed steel product behaviour in a wider range of construction scenarios than traditional analysis models allow.

Specialist consultancy engineers from the SCI originally developed the IEM to support Corus Panel and Profiles with the development of their CF60 deck profile. The new analysis considerably increased the spanning capability of continuous cold-formed steel decking for multi-storey buildings, resulting in the use of fewer beams and a reduction in cost.

Dr Hicks, SCI Senior Manager, Building Engineering, said: "The IEM has a far wider application beyond decking; it can be used to more accurately model the behaviour of a variety of other products such as purlins and cladding. In fact, that of any cold-formed steel product."

New hotel for Royal Mile



A new 136-bed hotel will form the major element of a new 11,148m^2 mixed-use development currently under construction on Edinburgh's historic Royal Mile.

The steel framed project also includes a new headquarters branch for the Bank of Scotland along with 750m^2 of retail and restaurant units.

Situated on a prominent corner of George IV Bridge, the eight-storey project has an irregular layout of steel with very shallow floor depths. Project engineer SKM Anthony Hunt specified a large quantity of Westok beams, designed as 162mm deep for the shallowest areas, and up to 227mm deep in other sectors.

The project is being undertaken by a joint venture between Kilmartin Property and the Bank of Scotland and is expected to be completed by early 2009.

NEWS IN BRIEF

The following **National Annexes** have been approved for publication subject to minor amendment: EC3 Part 1.1 - General rules and rules for buildings; EC3 Part 1.2 - Structural fire design; EC3 Part 1.8 - Design of joints; EC3 Part 1.9 - Fatigue strength of structures; EC3 Part 1.10 - Selection of steel for fracture toughness and through thickness properties. Meanwhile, EC3 Part 1.3 - Cold formed, thin gauge members and sheeting and EC4 Part 1.4 - Stainless steels have been approved for public comment.

A competition draft for the **3rd International Architecture Competition for Sustainable Housing** is available via download from *www.livingsteel.org*

An independent report by Building Sciences Consultancy has been commissioned by **Architectural Profiles Limited**. Entitled 'Evaluation and Audit of Energy Savings for Non-Domestic Buildings using improved metal cladding systems' the report is in response to the introduction of Energy Performance Certificates due to followed up by Display Energy Certificates later this year. An abbreviated version of the report is available from *www.archprof.co.uk*

SCI is heading up a partially European funded project to develop a quality online Eurocode training resource for steel design and construction. The project will also review frameworks in partner countries and explore opportunities to standardise professional engineering qualifications and training materials. The project will culminate in the delivery of 12 e-training modules ready for autumn 2009.

The **BCSA's Sustainability Group** held its first meeting at Billington Structures' headquarters on 26 February. The event was well attended by member steelwork contractors and chaired by Dr Derek Tordoff, BCSA Director General. A delegation from the BCSA's sister organisation, the American Institute of Steel Construction, also attended.

FICEP innovations at MACH 2008

The MACH 2008 exhibition, held at the NEC from 21-25 April, will see a number of new machines on display from FICEP.

The company will use the exhibition to showcase new steel processing machines as well as three units which have recently joined its range available in the UK.

One of the main exhibits will be the FICEP TIPO C16, which will be making its first appearance in the UK. The machine is designed to produce components up to 20mm thick utilising punching, drilling, milling and high definition plasma cutting.

The FICEP 1004 DFTT CNC high-speed scribing, drilling and copeing machine will also be on display, along with a new ProCutter pipe cutting machine developed in the Netherlands by HGG.

Other exhibits will include products from new FICEP UK partner company Ursviken. These will include the unique variable die tool and the Ursviken high-speed press brake.

Updated steel industry information

The 2008 Directory for Specifiers and Buyers in the steel construction industry is now available.

This essential directory lists details of every BCSA member for 2008; from steelwork contractors to their suppliers.

RQSC (Registered Qualified Steelwork Contractors) listings are also included as are Quality Assurance Certification details.

The directory, which is illustrated throughout with a number of images of members' work, also contains details about steel as a material and its benefits from fire protection to design possibilities.

To receive your free copy email: Gillian.mitchell@steelconstruction.org

Diary

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

4 June 2008
Steel: The Show
Botley Park, Southampton. Free

The SCI provide a range of in-house training courses to both Members and Non-Members of the SCI. Courses can be customised to suit a company's CPD objectives.

SCI's In-House training is a cost effective approach to ensure your staff receive the most relevant and up-to-date training materials.

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For all BCSA events email: david.moore@steelconstruction.org telephone: 020 7747 8122

Countdown to Eurocode Implementation

March 2007 | April 2007 | May 2007 | June 2007 | July 2007 | August 2007 | September 2007 | October 2007 | November 2007 | December 2007 | January 2008 | February 2008 | March 2008 | April 2008 | May 2008

New European Fabrication Standard

EN 1090-2 is the European standard for the fabrication and erection of structural steelwork – or "execution" as it is now termed. Although not a Eurocode it is part of the suite of European standards for the design, fabrication and erection of steel structures. This standard was recently approved by Member States and it is anticipated that it will come in to force in June 2008. Unlike the Eurocodes there is no overlap period and when it comes in to force it will immediately replace current national standards such as BS 5950-2 and BS5400-6.

The scope of EN 1090-2 is much wider that the individual national standards for execution of steelwork as it covers buildings, bridges, towers and masts and most other land-based steel structures. EN 1090-2 is closely linked to the CE Marking requirements for steel structures and components which are given in its sister standard EN 1090-1 which has recently been circulated to Member states for Formal Vote.

Fabrication of Structural Steelwork

At the centre of both the new European execution standard and CE Marking is a concept with which most Steelwork Contractors and designers will not be familiar. This is Execution Class (EXC). The Execution Class defines the level of assurance and workmanship to be applied to different structures or the manufacture of components. The concept is also referenced in manufacturing standards for aluminium and precast concrete components. In EN 1090-2 the informative annex on Execution Class recommends different levels of traceability, welding quality management and weld acceptance criteria. It lists four execution classes from EXC 4 which is the highest required level of assurance to EXC 1 which is the lowest. The Execution Class can apply to the whole structure but it can also apply to individual details. For example a structure could be classified as EXC 2 but a particular detail (e.g., a detail subject to fatigue) could be classified as EXC 3. EXC 2 is the default class, and in broad terms the Execution Classes can be viewed as follows:

- EXC 1 – Farm buildings
- EXC 2 – Buildings (similar to the scope of the NSSS)
- EXC 3 – Bridges (and other structures with fatigue)
- EXC 4 – Special structures (long-span bridges, power stations)

The Execution Class is a client decision and will need to form part of the specification. Furthermore, CE Marking requires the Steelwork Contractor to have in place a certified the Factory Production Control (FPC) system (similar to ISO 9001) against his chosen Execution Class. Each Steelwork Contractor, therefore, needs to choose carefully the Execution Class to be included in his scope of registration. If it decides to choose EXC 2 (say, Buildings) it would not be able to CE mark structures or parts of a structure that are classified as EXC 3 or higher. Designers will also need to be aware of the limits on Execution Class particularly when associated with CE Marking.

Essential and Functional Tolerances

EN 1090-2 also gives a list of fabrication and erection tolerances many of which will be familiar to designers as they as similar to those given in our national standards. But unlike our national standards the tolerances in EN 1090-2 are split in to 'Essential tolerances' and 'Functional tolerances'. Both would be mandatory if invoked under a contract specification but the Essential tolerances are linked to the design assumption on structural stability given in Eurocode 3 and are relevant to the public safety requirements included in CE Marking. Thus the tolerance characteristics for CE Marking relate only to the Essential tolerances.

Welding Quality Management

EN 1090-2 also introduces in a more formal way the Welding Quality Management (WQM) system and the Responsible Welding Coordinator (RWC). The type of WQM system required and the knowledge and competence of the Responsible Welding Coordinator are themselves linked to Execution Class and the range of materials and welding processes carried out by the Steelwork Contractor. Like the National Structural Steelwork Specification, EN 1090-2 does not require the Steelwork Contractor to have in place a certified WQM system only that the WQM systems complies with the relevant part of BS EN 3834. However, the requirements for CE Marking given in EN 1090-1 do require the Steelwork Contractor to have the system certified.

Steelwork Fabrication – A Manufacturing Process

Another significant difference is that EN1090-2 places more responsibility on the Steelwork Contractor to get it right first time. The requirements are firstly to prove that a welding process can be implemented in production after which the amount of testing can be reduced. However, should a non-conformance be found the steelwork contractor must carry out additional tests to identify the cause of the problem and to change the process so that the problem does not recur.

Additional Guidance

Some of the concepts introduced in EN 1090-2 will be unfamiliar to designers and therefore the British Constructional Steelwork Association is producing additional guidance for buildings and bridges to ensure that UK specifiers and designers can use the standard safely. In particular an updated version of BCSA's National Structural Steelwork Specification will be issued for buildings.

FACT FILE
Museum of Liverpool
Main client: *National Museums Liverpool*
Architect: *3XN and AEW*
Structural engineer: *Buro Happold*
Main contractor: *Pihl Galliford Try*
Steelwork contractor: *Caunton Engineering*
Steel tonnage: *2,100t*
Project value: *£65M*

Iconic structure comes together

A new landmark is taking shape on Liverpool's waterfront. NSC takes the ferry across the Mersey to visit the city's new cultural museum.

Sydney has its opera house, Bilbao its Guggenheim art gallery. Now, Liverpool is joining them with its own iconic symbol of cultural tourism, a radical new history museum that will sit alongside some of the city's best known buildings on the historic Pier Head.

The site, on the eastern shore of the River Mersey, is home to what are known as the 'three graces', three landmark buildings constructed in the first 15 years of the 20th century – the Royal Liver Building, Cunard Building and the former offices of the Mersey Docks and Harbour Board. Liverpool has long wished to add a 'fourth grace' on the waterfront, and the new Museum of Liverpool meets that aspiration.

It is a striking building, a low, stone and glass-clad structure with sweeping "wing" roofs and huge glass picture windows at either end. On plan, it occupies the space of a partially closed X, and is symmetrical about the diagonal axis.

Inside will be three levels of exhibition space built around a full height central atrium dominated by an elliptical spiral staircase. Although the museum will predominantly be clad in stone, natural light should flood into the building both from a large skylight above the atrium and from the glazed north and south elevations on the second floor.

The concept for the building came from Danish architect 3XN, although Manchester-based executive architect AEW has now taken over responsibility for delivering the design. A joint venture of Danish construction company Pihl and UK contractor Galliford Try has a £41M to build the museum, with the total cost of the project – including fit-out – set at £65M.

Engineering consultant Buro Happold has the task of turning the architect's vision into a workable structure. "It's a very complex, unconventional form," explains the company's Structural Engineer David Taylor. "The client was looking for large, open spaces, and the architect has come up with a scheme which provides this, and within a very unusual form."

Those clear spans are at their most significant on the second floor, where there are two 40m long, column-free main galleries – one at either end -with the beams above spanning 28m across the width of the structure. "The clear spans required were achieved by the use of a steel frame," explains Mr Taylor.

There is a total of 2,100t of steel in the building's

The museum will be an iconic steel addition to the Mersey waterfront.

Top: Artists impression of the completed museum.

Above and below: Clear spans and a complex geometry are the main features of the steel frame.

main structure, which has been designed to resist not just self-load and the weight of exhibits and visitors, but also the substantial horizontal and uplift forces from the high winds that affect the Mersey's shores. All of this load is taken into the ground via a 4m deep reinforced concrete raft structure, consisting of top and bottom slabs joined by a series of vertical walls.

"It's a very complex unconventional form."

"The raft solution was arrived at because of the various constraints on the site," explains Buro Happold Structural Engineer Matt Barron. "With a building of this size, piling would often be the first thing you would look at, but the Mersey Rail Tunnel runs right under the building and so piling had to be ruled out. The intention is to minimise the net increase in loading above the tunnel. Instead, the design of raft ensures the load is spread as much as possible, and so that the weight of building replaces the weight of soil that is excavated.

"The objective of the raft is to withstand all the superstructure loads and act as a beam, so the reinforcement has been designed to take the different bending moments that the superstructure puts on it," he adds.

The exact shape and plan area of the raft were arrived at by analysing the bearing pressures from the superstructure loads, and it extends beyond the footprint of the building itself in order to take the large point loads at each corner created by the 15m cantilevers of the main second floor galleries. Uplift loads on the foundations are up to 5,000kN and vertical forces into the main cantilever columns are 16,000kN.

Buro Happold's structural design splits the building into three sections – the centre and the two ends – with movement joints separating them. The split is necessary as there is the possibility of differential thermal expansion across the length of the structure. Although vertical forces can be transferred across the joints, the frame has been designed to ensure horizontal and rotational movement is contained within each section.

The centre section of the building is stabilised by two circular concrete lift cores, while the horizontal stability at the two ends comes from one lift/stair core and a shear wall in each section to combat torsional rotation from the prevailing winds. Stability also comes from the composite metal deck and in situ concrete floors – particularly the second floor, which acts as a diaphragm, providing restraint for the cantilever sections of the building.

The client's understandable demand for clear, open spaces has resulted in some very large steelwork sections being fabricated and supplied by steelwork contractor Caunton Engineering. The roof above the second floor galleries is supported by Westok cellular beams spanning 28m, and there are also two 2.3m deep x 26.5m long plate girders in the central section of the building. "They sit very close to the movements joints, and carry loads from the plant room roof and also from the roofs of the two outer sections," explains Caunton Director Allan Younger."

The girders are supported at one end by the circular concrete lifts cores and at the other by articulated columns that are held in place by 80mm diameter pins. Originally there were to be four of these massive plate girders, but two were taken out of the design during a value engineering exercise prior to construction when the client accepted a design change that involved introducing four columns into the central atrium. "That allowed us to take out two of the plate girders and create a lighter structure in the roof," explains Mr Taylor.

The construction sequence involves working from the centre outwards, based on the design philosophy of trying to build symmetrically around the Mersey Tunnel.

The remainder of the frame involves an extremely wide range of

steel sections – from 127 x 76 beams right up to 1,016 hollow sections. There are also some cold rolled sections used as purlins in the roof and to support services below the second floor. "I wouldn't be surprised if there is every section in the book somewhere in the building," says Mr Younger. But, he explains, the lack of repetition in the building is not a problem when it comes to manufacture. "We operate a just in time system of making erectable loads of steelwork, so we don't batch manufacture too much. On this job we've broken it down into the three phases, and then broken those into bite sized chunks, which are then designed, drawn and manufactured in the same sequence."

Pihl Galliford Try's construction sequence involves working from the centre outwards. "That is based on Buro Happold's design philosophy of trying to build symmetrically about the tunnel," explains the joint venture's Project Manager Christian Lundhus. "We did that with the raft, and now we're doing it with the structural steel."

Steel erection started in November, and has now reached the stage where Caunton is ready to fix the cantilever sections on either end. These are made up of triangulated braced bays on either side, with a single beam spanning between them top and bottom. The bracing for these bays is made from 500mm deep x 30mm thick double plate sections.

Top: Steelwork is connected to circular and square concrete cores.
Left: The completed project will be Liverpool's 'fourth grace'.

Until construction is complete and the walls are cast, the four corners of the structure must be propped on temporary steel towers supported by piled foundations. The towers will be fitted with 400t jacks that can be used to counteract deflection effects during construction. But once the floor is cast, deflection is anticipated to be no more than 20mm.

In the permanent condition, the load from the cantilevers comes back through the triangulated truss arrangement into columns that take the tension load straight down to the base of the raft. This has been achieved by installing steel plunge columns into the concrete during construction of the raft foundation.

"Two sections of column were cast into the foundation very accurately, and a cap plate was left projecting out of the concrete for connection of the column above," explains Mr Taylor. "Accuracy of the casting was essential as the main columns sit on top."

Caunton's directly employed team of specialist erectors are set to finish on site in May in a contract that includes not just the main frame but also support steelwork for both internal and external finishes. Pihl Galliford Try is scheduled to complete construction next year, with the new Museum of Liverpool due to open at the end of 2010.

New college heralds rebirth of Ravenscraig

An old steelworks site in Lanarkshire is now one of Europe's largest regeneration projects. Martin Cooper reports on the first construction job to get under way at the former home of Scottish steel making.

FACT FILE
New Motherwell College campus
Main client: *Motherwell College*
Architect: *BDP*
Main contractor: *Miller Construction*
Structural engineer: *Struer*
Steelwork contractor: *Bone Steel*
Steel tonnage: *1,500t*
Project value: *£46M*

Set in the heart of Scotland's central belt, Ravenscraig will be the UK's first new town in more than 50 years. Covering an area of 450 hectares, the overall scheme, at the former steelworks site near Motherwell, is one of the largest regeneration projects in Europe.

This enormous industrial site, which closed down in 1992, has been largely cleared of all buildings and the land remediated and levelled. A number of large construction projects, including a sports centre and residential estates, are now planned which will transform the site and create a new town with over 10,000 inhabitants.

Fittingly, the first major development to get under way is a new, predominantly steel-framed, campus for Motherwell College which is set to open in August 2009 and will replace an existing 40-year old college in Motherwell town centre.

The new campus comprises four buildings: a 16,000m^2 four storey teaching block; a 6,590m^2 two storey workshop block; a cylindrically shaped accommodation building and a large nursery for pre-school children.

The main focus of the development will be the

Above: The slightly higher south elevation of the teaching block has five levels.

Below: Ravenscraig is a large open site which is exposed to the elements.

Above: Feature CHS columns in front of the atrium.

Above: Steelwork for the project will be completed this month.

seven-storey student accommodation block and the adjacent steel framed linear teaching block. Within the teaching block there will be conference facilities, a public learning centre, a training restaurant and bar, performing arts space, job shop, and a plaza which is intended to provide student social space.

Construction work for the new campus started when main contractor Miller came on site last September.

Once groundworks and piling had been completed the site was ready for the steel construction to begin in early November. However, the most noticeable feature of the site is its exposed nature and this has been one of the most challenging aspects of the job to date.

"The site is an extremely large open space and there is no, or little, shelter form the wind," explains John Downey, Project Manager for Miller Construction. "But despite the inclement weather conditions we are still on schedule."

"The weather, particularly the wind, has been pretty bad throughout the winter. But we've still had no problems keeping to the programme schedule."

Bone Steel will eventually erect 1,500t of steelwork and is scheduled to complete its work this month [April]. The steelwork comprises two large buildings, the superstructure for the teaching block and the adjacent workshop building.

Bone Steel's fabrication yard is only a few miles down the road in Wishaw, and this has made deliveries and supply of materials to site a lot easier than on many other jobs.

Dave Preston, Bone's Site Manager, agrees that the weather has played a large part in the construction programme. "The conditions, particularly the wind, has been pretty bad all through the winter. But we've still had no problems keeping to the programme schedule."

Using mobile cranes on site instead of tower cranes for all steel erection has helped keep stoppages due to high winds to a minimum.

Steel erection began with the teaching block, which is rectangular in shape and measures 160m long x 31m wide. The main feature of the building is the covered atrium which runs the length of the structure along the south elevation. Another interesting and noticeable feature is its roof-top step, which takes into account the disparity in floor levels between the front elevation which has five floors and the back (south) elevation's four floors.

The steel construction for this central and prestigious building includes 20m x 6m bays with the grid pattern generally staying the same all the way up the structure. Stability is provided through braced frames acting with the composite floors.

Architecturally, the main elevation (containing four levels) has a row of feature 406mm diameter CHS columns along the perimeter wall. These large steel members support the roof, and will also support a large glass clad facade behind which will be the large building-high open atrium area.

This feature of the teaching block was one of the main reasons why steel was specified for this part of the project. "Large open areas with feature columns lends itself to steel construction," comments Struer's Project Engineer, Neil MacDonald.

"We looked at all options for each individual building on the project and steel was the most suitable for the teaching and workshop areas," adds Mr MacDonald. The speed with which the teaching block could be erected and the adaptability of steelwork were major considerations.

The other large steel element of the campus site is the workshop block, which includes three distinct, but interlinked, sections. These include a large two-storey 120m long main workshop and classroom area, a 46m x 30m portal framed automotive line structure and a small one-storey plant block.

"The workshop will house some heavy equipment and the upper floor level is supported by some 22m long beams, which weigh 5t each," explains Mr Preston.

The portal framed area has no internal columns and was erected with 15m long beams spliced together to give the building its 30m spans.

The portal framed automotive area is basically a large workshop which will contain a lot of machinery, and the design for this part of the building is a typical warehouse design with a lightweight roof. "Again, a design which is best suited in steel," adds Mr MacDonald.

Summing up the project, Pamela Woodburn, Director of Ravenscraig Limited, the overall project coordinator, said: "This is an important milestone in the development of the Ravenscraig site. The establishment of a new college and learning environment is a significant step towards the creation of a new community in Lanarkshire."

Sustainability drives steel market share

Constructional steelwork is still the framing material of choice for the overwhelming majority of the market. This is proven by the latest annual Construction Market Shares survey – the 27th in the series - from independent researchers Construction Markets.

"People are waking up to the fact that steel has a very strong sustainability case."

Prices of all construction materials have risen but steel has retained its competitive advantage in the market place, even when only crude initial cost comparisons are made. Factoring in the many other financial, construction programme, flexibility and sustainability benefits of steel gives an overwhelming advantage that few would want to resist.

The survey is conducted by contacting some 600 specifiers, making it the biggest of its type carried out in the UK. Steel passed the 70% level for share of the multi storey buildings market for the first time in 2004, and the 2007 survey shows that steel remains at these record levels.

Steel had a near 72% share of the key multi storey offices market in 2007, with nearest rival in-situ concrete remaining below 20%, a level it fell below in 2003 after having a market share of over 28% about a decade ago. The strong performance of steel is all the more valuable for being achieved in a growing market. The total multi storey buildings market grew by 8%, but the offices market grew by over 22% to over five million metres of floorspace.

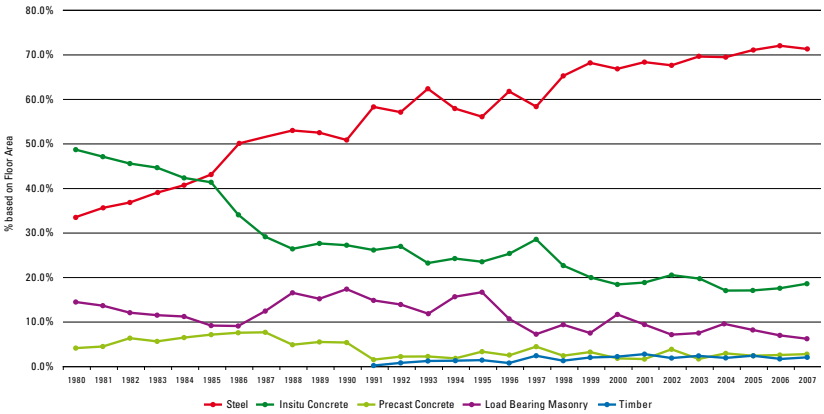
There was less marked growth in the 'other buildings' category, which includes retail, leisure, education and health buildings, but rises in retail

and leisure counterbalanced falls in education and healthcare so overall growth in that sector was 1.6%.

The sheds market is still strong and remains dominated by steel. Steel sheds are getting bigger, reflecting fundamental shifts in the UK economy and trading patterns that demand more and larger logistical facilities. Shed developers are increasingly driven by sustainability, and when they come to assess their sustainability cases for projects are finding that steel has benefits that they hadn't even noticed before.

"Throughout the market, people are waking up to the fact that steel has a very strong sustainability case that has perhaps been overlooked when the focus was more on things like the cost and programme advantages of using steel," says Alan Todd, General Manager Corus Construction Services and Development. "Corus and the rest of the steel supply chain are working hard to ensure that there is a continuous improvement in the sustainability benefits of steel.

"Independent studies show that steel construction causes less carbon emissions than alternative framing materials. When you also consider the recyclability and reusability advantages of steel we can only expect to benefit more as the market shifts to sustainable solutions."



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

Mr Todd added that there are a number of initiatives under way within the steel construction sector that will enlighten more designers and clients on the benefits of selecting steel as a structural framing solution. "The competitive advantage of steel is already well appreciated by designers, clients and specifiers, as the Market Shares Survey shows, but there are other advantages, many associated with sustainability, that we will be trying to get across through marketing efforts and the technical support that we provide to designers."

Top marks for steel

Phase one of a complete redevelopment of Anniesland College in Glasgow has begun with the construction of a new steel-framed teaching block.

Situated three miles from Glasgow city centre, Anniesland College has a reputation as a community friendly institution and has in recent times been awarded the Charter Mark for its customer care as well as an Investors in People award.

Established in 1964, the college has two campuses with some 8,000 students, studying further education courses in subjects as diverse as languages, computing, design and construction, engineering and community studies.

One of the campuses, Hatfield, is currently under going a complete re-build which involves demolishing the existing buildings and replacing them with brand new structures.

In order to keep the college functioning as normal, there is a three-phased construction programme with completion set for 2010. Phase one is under way and this involves constructing a new teaching block. Once students have de-camped into the new building, phase two will kick-off with the demolition of the old buildings which will then be replaced with a new workshop block. Finally, phase three consists of constructing a new campus car park and demolishing the old workshop block.

Phase one is scheduled for completion by the end of the year, although the college will start its own fit-out of the teaching block in October.

"Speed of construction is an essential part of this job," says Wilson McCracken, HBG Project Manager. "The last two months of this phase will require us to work around the client's fit-out team, so it's vital we are on schedule and just finishing off some external works by then."

As well as the quickness of the programme, the construction team are also challenged by the fact that they are working within a functioning college campus, which is also located in a busy residential area of Glasgow.

The teaching block is being built on land previously occupied by a car park and it is positioned directly in front of the existing college buildings. "Working around students and staff means noise and pollution are even more important factors than normal," says Mr McCracken.

These considerations will be even more important next year once students have moved into the new teaching block. "Work will then begin on demolishing the old buildings, once we start putting up the second block we have to make sure access out of the college isn't obstructed."

"The last two months of this phase will require us to work around the client's fit-out team, so it's vital we are on schedule…"

The college's community friendly reputation has been at the forefront of HBG's campaign to keep local residents informed about the works, while the company has also improved the accessibility of the surrounding roads.

The streets around the site are usually full of parked cars so HBG has negotiated with the local authority and put double yellow lines down the minor road leading directly to the site's entrance.

"I think the local residents are pleased with this development as it means there are now no parked cars obstructing their driveways," adds Mr McCracken. "And all deliveries can now be made easily without the possibility of scratching vehicles."

As well as keeping residents, college staff and students on side, there is also a building programme to complete. Steelwork and decking for the new teaching block's superstructure are now complete and external works, such as cladding have begun.

Above: The college is surrounded by busy congested roads and deliveries have been made easier by adding new double yellow lines to one street.

Below: The new teaching block is situated on land previously occupied by a car park.

FACT FILE
Anniesland College, Glasgow
Main client: *Anniesland College*
Architect: *BDP*
Structural engineer: *Faber Maunsell*
Main contractor: *HBG Construction*
Steelwork contractor: *Atlas Ward Structures*
Project value: *£35M*
Steel tonnage: *1,200t*

The building will be clad with a number of various materials including stone and render, but zinc will predominate the main elevation. The roof is slightly pitched and will be clad with Corus Kalzip steel panels.

Steelwork contractor Atlas Ward Structures has erected 700t of structural steel for the new 140m long four-storey teaching block. Included in this total are 140t of Fabsec cellular beams which have been used for all of the structure's floors.

"As the building is a college teaching block with lots of computer ports we wanted a bespoke beam to accommodate the large amount of services."

The building's layout is fairly regimented with all bays approximately 6m wide, while internally there are two spans, one 11.5m and the other 4.5m. These grid lines stay constant all the way up through the structure.

Cellular beams were specified because of the length of spans as well as the need to keep all services within the ceiling void.

"Cellular beams offer the best strength to weight ratio and as the building is a college teaching block with lots of computer ports, we wanted a bespoke beam to accommodate the large amount of services," explains Steven Ferguson, Faber Maunsell Project Engineer.

"By limiting the structural depth on these 11.5m long primary beams to less than 800mm meant we could negate the need for smoke detectors in the ceiling voids hence reducing access requirements, simplifying the ceiling solution and saving money."

The building is rectangular in shape with a 9m cantilever at the western end. "This makes the structure a little more challenging," adds Mr Ferguson. "Although this feature is purely architecturally, rather than structurally, driven."

Stability for the structure is derived from four steel braced cores which are all positioned along the south elevation. The north elevation, which faces the street and contains a new drum-shaped entrance hall, has no steel bracing as it will be predominantly glazed.

To remove the need for bracing in the north facade Mr Ferguson explained that Faber Maunsell carried out extensive 3D analysis of the structure, taking into account the structure's diaphragm action, to prove that the combination of composite slabs on a steel frame provided sufficient lateral stability.

Faber Maunsell also produced a Building Information Model (BIM) of the project early in design and development stage. This interactive 3D model allowed the construction team to view the entire structure, including all steelwork connections, in a virtual environment well before any work was due to start.

"The model greatly reduces draughting, fabrication and on-site errors and has contributed to the steelwork going up so quickly," explains Mr Ferguson.

Once the college's students have moved into the new teaching block, work will immediately begin on demolishing the existing teaching block to make way for the second phase of construction.

The second building will be a two-storey structure connected to the new teaching block at two points, and so forming a large internal courtyard.

Atlas Ward will be fabricating, supplying and erecting a further 500t of structural steelwork for the second phase of the project. The company is scheduled to begin this phase of its steel package in May 2009.

Above: Fabsec cellular beams have been used for all floors.

Below: The new teaching block is a 140m long four-storey structure.

Sustainable steel aims at Olympic gold

Our Case for Steel series continues with an overview of the strong sustainability benefits that flow from selecting steel. Demountability is one of the key benefits, which featured in the winning bid that secured the 2012 Olympic games for London.

The sustainability case for steel is the strongest of any construction material. Unlike other building materials steel is multicyclable, meaning that it is available to be recycled and used in building projects as the structural element again and again.

Regardless of the number of times it is recycled, steel's performance as a structural material is not impaired. The basic raw material is the most plentiful element on our planet – and given that steel can be recycled indefinitely little of it will ever be truly wasted.

Virtually no steel ever ends up in a landfill site – it always has a value and some construction materials, reinforced concrete for example, only have value because of the steel that can be recovered from them.

Some 99% of structural steelwork used in the UK is recycled, as is 94% of all steel construction products. Recycled material comprises 40% of steel manufacture globally. The amount of steel that is recycled each year – almost 500Mt – could be used to make 180 Eiffel Towers every day. The UK's steel-framed buildings and other structures represent a strategic material resource that will benefit future generations when they reclaim it for reuse or recycling.

Sustainability demands balancing the social, economic and environmental benefits of developments – this implies, among much else, careful design, care in selecting materials and approaches to construction that minimise impacts on local communities. Steel solutions score highly on all these criteria while increasing the likelihood of projects being delivered on time and within budget. The steel sector provides a great depth of technical advice and other market support to enable designers to capitalise on these potential benefits.

Sustainability is a strength of the entire supply chain that creates the steel framing solutions that are the first choice of UK architects and structural engineers. Raw materials are sourced in an environmentally responsible way, and steel manufacturing processes have a continuous improvement culture built in.

All steel construction products benefit from off-site manufacture, which creates many sustainability benefits. Steelwork contractors' fabrication plants allow production in factory controlled conditions, removing activities from the potentially hazardous conditions of busy construction sites. There is very little waste arising and all steel that is not used is recycled.

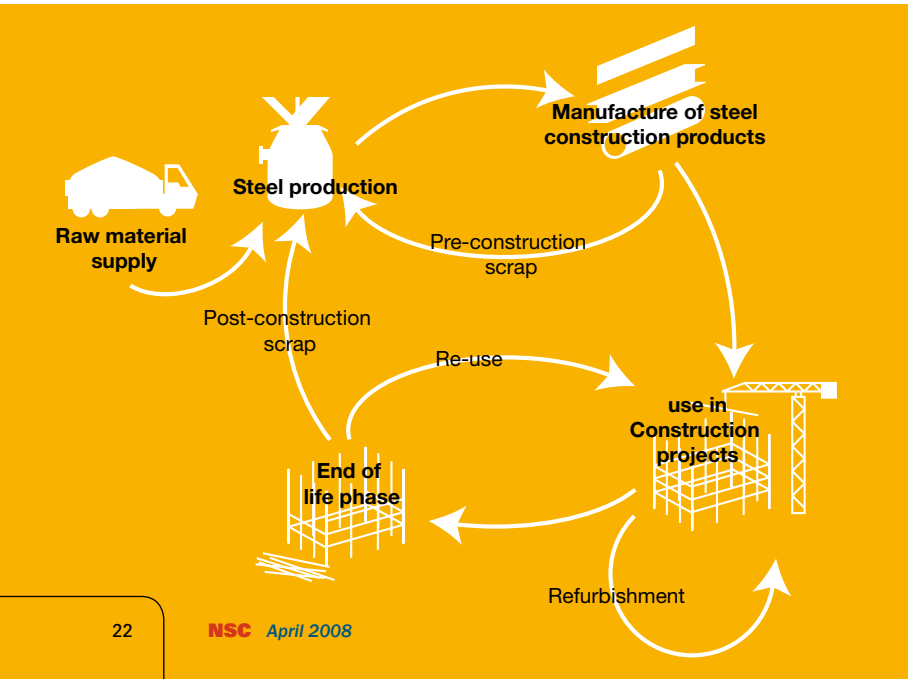
Steelwork contractors employ trained workforces in factory conditions. There are benefits to the welfare of the on site workforces involved in steel construction as well. There are fewer journeys to work than would be the case with in-situ produced alternatives. There is less requirement for construction workers to spend extended periods away from home. On site, experienced and trained specialist steel erectors quickly and safely assemble pre engineered, quality assured steelwork. The outcome is high quality, low defect construction with minimal waste.

Steelwork contractors are skilled at just in time delivery, which means there is little need for on site storage of materials, and deliveries to site can be timed to avoid peak periods of congestion. Local communities appreciate the reduction in deliveries by heavy lorries that is achieved, with less noise

A multicycled material

There is a significant recycled content in all new steel – we refer to this as multicycling. The modern steelmaking process requires recycled steel and it is not possible to produce steel without it. The average recycled content of structural steel used in the UK is 60%.

There is virtually no such thing as waste steel – all steel has a value and it will never be knowingly sent to landfill. There is never any degradation in the quality of the material when steel is recycled. This multicycling ability means that steel has a sustainable economic life cycle that is unrivalled by any other construction material.



and dust overall than would otherwise be possible.

Developers value the fact that steelwork construction is fast and predictable; construction programmes are reduced and there are fewer delays to production caused by adverse weather. Steel is also the sustainable option when whole life costs are considered. Steel structures are durable and low maintenance. This means that building owners can rely on seeing a return on their investments sooner. Cost effective steel buildings generate higher initial returns, and as steel buildings are easily updated to stay looking modern and welcoming long term returns are higher.

Steel frames lend themselves to easy demountability – a key element of London's winning bid to stage the 2012 Olympic Games. Re-using a steel frame means that a new facility can be created with very little addition to the carbon footprint.

Steel buildings provide inherently flexible clear-span spaces that can be easily and economically expanded to meet changing needs of building owners and tenants, whether it is hospitals, factories, offices, schools or shopping and leisure developments. This future proofing is especially valued by building users in rapidly developing sectors like healthcare.

As attention switches away from how to heat buildings towards recognising the carbon impact of keeping them cool, designers increasingly value the ability of steel-framed buildings as efficient stores of thermal energy, containing sufficient mass to allow designs to maximise fabric energy storage. This means excess energy can be absorbed during the day and expelled at night, which reduces the need for energy to be used to heat and cool buildings.

The steel sector has taken a lead in demonstrating its commitment to the sustainability agenda by developing a Sustainability Charter for British Constructional Steelwork Association members. The Charter sets out a coherent strategy of prioritised sustainable development objectives, against which progress is annually reviewed. Signatories commit to a wide range of sustainable practices across their operations and agree to an annual audit of their performance against the commitments made.

Off-site on top of Mount Snowdon

Sustainability conscious clients increasingly demand off-site construction. All steel construction involves off-site construction. On some projects this virtue is a necessity however, as was the case at the new visitor centre on the summit of Mount Snowdon in North Wales.

The summit of Snowdon can be very inhospitable so the benefits of off-site fabrication, like speedy and safe erection and creation of a weather proof working area, was appreciated by the entire construction team.

All structural elements had to be brought up on the mountain railway in 14m long 'packages'. Steelwork contractor EvadX undertook trial erections to ensure that all the elements would fit together easily once brought to site. The Hi-Point modular roof was trial installed at the Corus Shotton facility, and delivered to site in 35 segments.

Re-use designed in

Steel-framed structures can be easily disassembled and the sections re-used elsewhere. This demountability is a major sustainability virtue of steel framed structures that clients value more and more. Being able to avoid creation of white elephant structures by taking them down, completely or in part as required, and reassembling them elsewhere in the country was a key part of the winning London bid for the 2012 Olympic games.

Industrial buildings are now designed and built to accommodate easy re-use when buildings reach the end of their working lives, or a valuable site is needed for a new activity. Barrett Steel Buildings for example worked closely with client ProLogis Developments to design a building with eventual disassembly and re-use in mind.

The highly sustainable building, a 99m long, 10m high, 50,000ft^2 warehouse at ProLogis Park, Heathrow, also includes a 5,000ft^2 office as well as goods and entrance canopies and is let to airport operator BBA plc. Value engineering by Barrett Steel Buildings during the design stage allowed re-use potential to be maximised at no extra cost to the client.

Steel. The sustainable facts

Multicycling. Steel can be recycled repeatedly without loss of property or performance.

Due to its inherent value and the existence of a well-established recovery infrastructure, steel accounts for virtually none of the 20 million tonnes of construction waste sent to landfill each year.

N O P Q R S T U V W X Y Z

To find out more about the material of the future contact **www.sustainablesteel.co.uk**

FACT FILE
Market Hall, Wakefield
Main client: *Modus and Simons JV*
Architect: *Adjaye Associates*
Structural engineer: *Acuity Consulting*
Main contractor: *Shepherd Construction*
Steelwork contractor: *Billington Structures*
Steel tonnage: *300t*

Leaning columns create visual masterpiece

It's all change in the Yorkshire city of Wakefield which is in the midst of a large regeneration programme, with one of the initial phases centred around a new and innovatively designed market hall.

Above: One outer row of columns is skewed to take into account the curvature of a road.

Over the next two years the Trinity Walk project will transform a substantial area of Wakefield city centre into a new retail quarter. But overall it is a truly mixed-use scheme, as it also includes a new outdoor market area, a city library, two superstores, apartments and two public squares.

The project is scheduled to be completed in its entirety by May 2010, but the first phase is already well under way and centres around a new and visually impressive market hall building.

Award winning architect David Adjaye has come up with the designs for the market hall. His ambition is to create a new civic architecture which owes little to Victorian and Edwardian buildings and design. The new market hall will replace a rather rundown Victorian structure. Adjaye's design is inspired by buildings in the developing world, using light and the texture of materials to heighten people's experience.

The market hall building is a steel-framed structure formed by five rows of sloping columns which lean inwards by eight degrees. One of the outer rows of columns is constrained by an adjacent road and is consequently skewed and not parallel with the other column rows.

Above the columns, the building is topped with a clear plastic roof supported on a series of glulam (timber) rafters which in turn are connected to the main steel framework.

The sloping columns lend a visually unusual aspect to the project as well as forming three main spans of 8m, and two perimeter spans of 3m, which run the entire length of the 56m-long structure.

Mike Vaughan, Shepherd Construction Site Manager, says the building's visual appeal is extremely important and has dictated the construction programme.

"The columns give the market hall a unique look, but they are also integral to the structure, for instance those along the gutter line contain rainwater down pipes from the roof."

Hiding pipework within the columns was not just done for aesthetic reasons, but does mean the building has done away with ugly and unappealing gutter pipes around its perimeter.

"All columns are connected at the top with hid-

Below: The market hall is the first phase of Wakefield city centre's regeneration.

den fixings," adds Mr Vaughan, explaining another measure the construction team have undertaken to make the building as visually pleasing as possible.

Structurally, the building looks extremely complex but Matt Paxton, Project Engineer for Acuity Consulting, says the architectural brief for large chunky columns made the design slightly easier.

"The larger the members the easier it is to design stiff connections between them," he adds.

The geometry of the project presented a number of design challenges, not the least of which is the pitched roof, which also slopes at a number of angles. The building's perimeter has no room for bracing, as an eye-level row of windows - which are intended to give the impression of a floating roof - doesn't permit extra steelwork.

Consequently, the structure's bracing is derived from its portal frame design with all joints at roof level, where the columns meet the rafters. Because the maximum stress is at this point, large bolted connections have been added, and to maintain the visual appearance they are all hidden.

Steelwork contractor Billington Structures cut a hole in each rafter to enable access for bolting to the column. This connection was then hidden behind a plate which was subsequently welded to the column.

The portal frame design also takes into account any stability concerns, while sway was taken care of by using large columns. "Square hollow sections measuring 350mm x 350mm are used," says Mr Paxton. "And these were also ideal for taking the gutter pipework."

The market hall is divided into two sections, a larger indoor sector and an outdoor area, both under the same roof. A partition wall, approximately two thirds along the structure, separates the two sections.

"All columns are connected at the top with hidden fixings."

Connected to the market hall there is a small steel-framed administration and storage building, while adjacent there is another new building which has been designed as a fresh produce market.

The site of the new market hall was originally the site of Wakefield Bus Station, which has recently relocated to an adjacent plot. Shepherd Construction initially came on site during September 2007 and started by ripping up old concrete roadways and generally preparing the ground for the steelwork, which was then completed in March.

As well as providing a visual landmark structure, the market hall will also kick-start the rest of the Trinity Walk project. Once the hall is in use this summer, the existing market across the road will be demolished and the land cleared and readied for construction of retail and residential elements of the scheme.

Summing up the project, Mr Adjaye says he is very excited to be involved in Wakefield's transformation. "This is an important regeneration project and I am honoured to have designed the market hall, which will be a public place for the community to do business, engage, debate and celebrate."

Top: The indoor sector features an upper mezzanine level.

Above: All columns slope by eight degrees.

Left: Hidden fixings at the top of the columns enhance the structure's visual appeal.

Multiple trusses span complex dairy

Above: The dairy is situated adjacent to the M5, junction 24.

Accommodating various processing facilities over four floors required some complex steelwork and a number of large lattice truss arrangements. Martin Cooper reports from a distribution centre with a difference.

FACT FILE
Robert Wiseman Dairy, Bridgwater, Somerset
Main client: Robert Wiseman Dairies
Architect: Stone & Partners
Structural engineer: Kiloh Associates
Main contractor: A & H Construction & Developments
Steelwork contractor: Rowecord Engineering
Steel tonnage: 6,000t
Project value: £40M

Driving along the M5 motorway in Somerset, you can not fail to notice the giant new Robert Wiseman Dairies milk processing and distribution centre nearing completion close to Junction 24 at Bridgwater.

From a distance the huge structure looks like many other large steel warehouses that can be seen from the UK's highways and by-ways. But inside it is a completely different story, as hidden behind the facade is a structurally complex building which required 6,000t of steel, including numerous heavy trusses, to support the various open-plan column-free areas that are spread out over four floors.

Housed within the vast structure are a number of milk processing facilities. "Everything will be done here except actually milking the cows," explains Fred Handy, A & H Construction's Project Manager.

Inside the facility there is a raw milk storage space; a milk pasteurisation unit; a blow moulding plant for bottle production; a large bottle filling hall; a fully automated bottle store area; and packaged milk production and distribution chill stores.

Although the structure has a large footprint many of the dairy's function areas are still located, one on top of another, on various floors. This is where structural engineering expertise came to the fore, as many of the processing areas need a large column-free area which required a myriad of trusses to be located throughout the building.

"Everything will be done here except actually milking the cows."

Jim McLaren, Project Manager for Kiloh Associates - the company which designed the structure's frame and foundations - points out that finding the right software package was a key element in the initial stages of the job.

"The frame is very complex, with various

Below: Pipework above the filling hall is supported on more than 200t of steelwork.

loadings over the four working levels of the building," he says. "We started off designing the columns and beams in one programme and then had to design many other elements manually as no package was completely suitable."

Once the design team had come to grips with the complexity of the frame the various loadings also had to be worked out.

Many of the processing areas need a large column-free area which required a myriad of trusses to be located throughout the building.

"There isn't a blanket loading throughout the structure, that would have been very easy and not economical," says Mr McLaren.

The solution was for Kiloh Associates to liaise with the different contractors who were to install the dairy's equipment. All of the machinery and storage will generate a unique weight and from the information supplied by the client's specialist contractors, the building's various loadings were then calculated.

The largest column-free area is the bottle filling hall on the ground floor which measures 57.5m x 64m and occupies the full height of the structure. To accommodate this space a series of lattice girder trusses were installed. These sections are each 4.6m deep and 57.5m long, and were brought to site in two pieces and then bolted together.

Above the filling hall, and housed within the truss layout to make use of available space, is an attic floor containing air-handling equipment and services. All of the associated pipework is supported above the floor to aid access for maintenance and more than 200t of steel has been installed to support these pipes and the open grid floor.

Because of the complex arrangement of the structure, a number of structural solutions were used. "We were able to use conventional beam and stick in some areas, others required large lattice trusses and the roof is a portal frame construction," explains Mr McLaren.

Stability for the structure is predominantly provided by bracing located along the perimeter and internal walls using the major gridlines. Consequently, all of the internal columns, picking

Left: The entire steel frame was erected in less than four months.

Right: A number of structural solutions were used for the frame.

Below: Large open column-free areas are a feature of all levels.

up the trusses or otherwise, are also taking much of the structure's stability.

Large trusses have also been installed at a number of other locations. "Working out the steelwork and trusses to cater for the different functions is a bit like 3D chess," explains Mr Handy. "Some trusses are even supported by other trusses where they criss-cross each other."

The floor between the trolley storage area and the chiller area also required 2m-deep trusses to accommodate the two column-free areas. "Conveniently, all the required services for these areas run inside the trusses," explains Mr Handy.

"Working out the steelwork and trusses to cater for the different functions is a bit like 3D chess."

Meanwhile, the more conventional beam and column configuration was used for the bottle moulding area, albeit with some substantial roof beams to take heavy loadings from above. "This is another large open area," says Mr Handy.

On a project as complex as this one, teamwork and cooperation are vital. "Key to our success was our weekly sub-contractors meetings, without these we wouldn't be where we are now," sums up Mr Handy.

The use of steel has also played an integral role in the quick construction programme needed for this job. Wiseman wanted to start milk production by December 2007, and this was primarily achieved because the frame was completed in less than four months.

Although production has already begun at the Bridgwater dairy, it will be some months before it reaches its capacity production.

Successful fire test on light steel floor

The Steel Construction Institute carried out the first industry sponsored fire test on a light steel floor that achieved 90 minutes fire resistance to the BS EN 1365 fire test. The work was sponsored by Corus Strip and members of the Light Steel Framing Group. Mark Lawson, SCI Professor of Construction Systems at the University of Surrey writes.

Light steel load bearing frames are widely used in buildings of up to eight storeys, for which fire resistance periods of 60 and 90 minutes are mainly required: the former for buildings of up to five to six storeys. It is important that the light steel and modular industries have economic solutions for load-bearing floors and walls to achieve fire and acoustic requirements to meet new Regulations and modern design and test standards.

The introduction of the BS EN 1365 fire test regime requires an extensive programme of re-testing, as it is more severe than the former BS 476- 20 test due to the use of plate thermocouples. This is particularly important as wall and floor configurations that just achieved a given fire resistance rating may now not do so. Furthermore, the advent of Eurocode 3-1 will mean that design and test standards are linked and not covered by 'deemed to satisfy' provisions that were historically accepted by Regulations in the UK.

Recent fire tests on load bearing light steel walls show that 2 × 15 mm fire resistant boards fixed to resilient bars are necessary to achieve 90 minutes fire resistance. For floors, the fire performance is more sensitive to the particular details and boards used because in fire, there is a tendency for the boards to bow or break away under their own weight. Furthermore, the load ratio acting on the joists is another variable, given that floor joists are generally not loaded to their full capacity when designed for control of deflections and vibrations.

In 1993, SCI had commissioned two generic fire tests on light steel floors which achieved 30 and 60 minutes fire resistance with single or double layers of 12 mm fire resistant plasterboard. This was fundamental in the preparation of SCI Publication 129: *Fire resistance of cold formed steel sections*, which is being updated currently. Importantly for the light steel and modular industries, no fire test on lightweight flooring using C section joists with plasterboard had achieved 90 minutes to the new BS EN standard.

As part of the Light steel and Modular Framing Group activities, an industry sponsored fire test to BS EN 1365 was carried out at the Building Research Establishment on 4th March with a target of 90 minutes fire resistance in order to provide generic guidance for the light steel framing industry. The configuration of the light steel floor also satisfies the proposed Robust Standard Detail for acoustic performance in order that the information is widely applicable to practice.

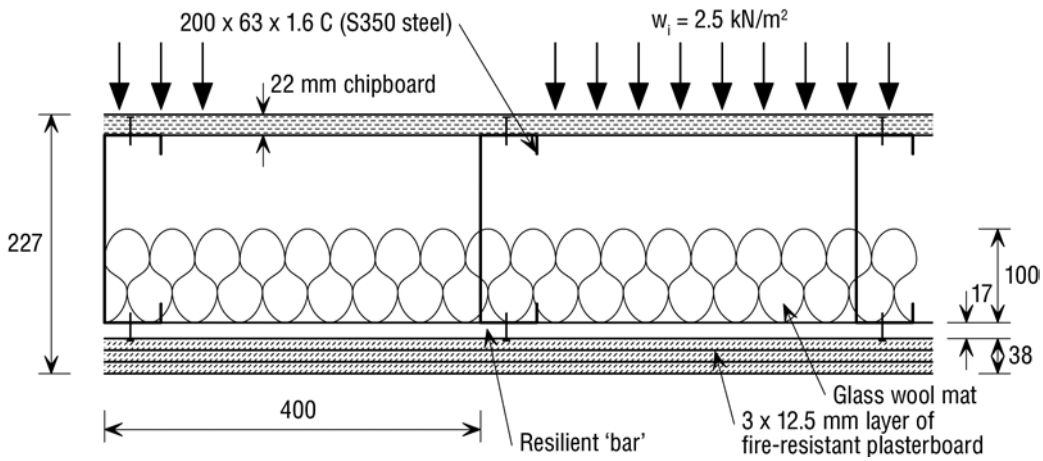


Figure 1. Cross section through the light steel test floor for 90 minutes fire resistance.

Figure 2. View of the light steel floor under a load of 250 kg/m² at the end of the 90 minutes fire resistance test at BRE.

Details of the floor fire test

The agreed parameters of the fire test to BS EN 1365 were:

- Floor of 4.5 m span × 3.5 m width to fit in the BRE Test furnace
- Imposed loading to 2.5 kN/m² plus self weight for residential or light commercial applications
- C section joists - 200 mm deep × 63mm flange x 1.6 mm thick C - placed at 400 mm centres.
- Three layers of 12.5 mm fire resistant plasterboard to Type F BS EN 520 that was screw fixed to acoustically resilient bars placed at 400 mm centres along the joists.
- 100mm thick glass-wool placed between the joists, primarily required for acoustic insulation.
- chip-board screw fixed to the top flange (in practice an acoustically built-up floor is necessary, but this makes little difference to the performance of the floor in fire).

The calculated load ratio for the floors joists in the tests was 0.3 (using S 350 steel) to BS 5950-8, based on acceptable serviceability design for this floor span and loading. Using this load ratio, the test results may be extended to other joists sizes, loads and spans. The cross section through the test floor is shown in Figure 1.

Fire test results

The fire test at the Building Research Establishment supported the applied load for 93 minutes, although the designated failure of the test was at 92 minutes in terms of the integrity criterion. Importantly, for the steel joists, their temperature remained at less than 100°C for over 80 minutes and so the joists would be essentially undamaged and re-usable, even after a severe fire. At 90 minutes, the joist temperature reached 280°C, at which point the furnace temperature was over 1000°C. The mean temperature of the upper surface was less than 60°C, which was well within the 140°C limit for the BS EN test.

During the first 80 minutes of the test, the increased deflection of the floor was less than 5mm, in addition to a 9mm static deflection when the 250 kg/m² imposed load was applied initially. Even at 90 minutes, the deflection had only reached 30mm, which was well below the span/30 limit of 140mm to the fire test standard. At the eventual failure at 93 minutes, the deflection was 230mm due to the rapidly increasing steel temperature, which had reached approximately 400°C at this stage. This critical temperature correlates with the load ratio of 0.3 or a strength retention of 30% for the cold formed steel sections to BS 5950-8. The floor after testing and still under load is shown in Figure 2.

The information from this test will be used in the update of SCI publication 129: *Fire Resistance of Cold Formed Steel Members*, and can be used immediately by the light steel manufacturers to support their multi-storey design project work and development strategies.

The sponsors of the fire test were: Corus Strip, Ayrshire Metal, Fusion Building Systems, Metek Building Systems, Metsec, Kingspan Off-site and Lafarge Plasterboard.

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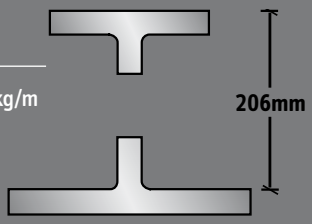

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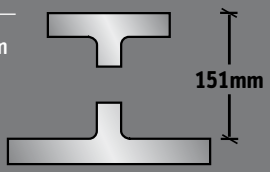

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a panorama of steel

One dictionary definition of panorama is 'continuous passing scene' and this pretty well sums up structural steelwork in the world today. The scene on these two pages shows steel at its most versatile — illustrations depict a modern departmental store, a high rise block of dwellings, a multi-storey office block embodying some very recently developed techniques, part of the ultra-modern national Giro Centre, an office block and hotel and a flyover bridge relieving city traffic congestion.

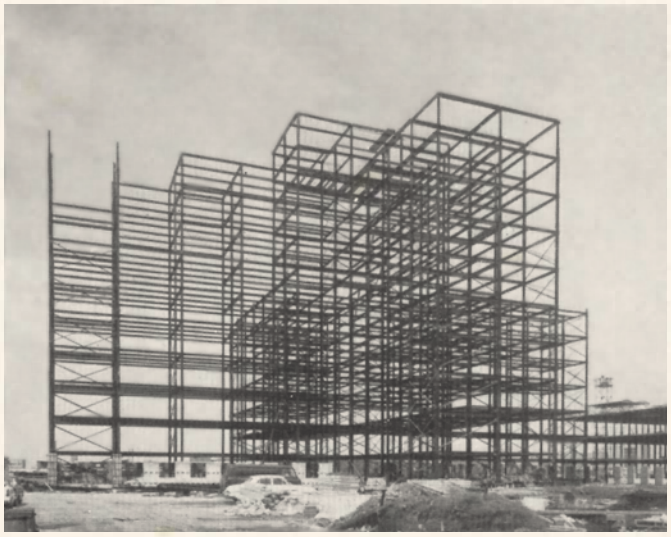
These examples identify steelwork with the very core of life today — steel, the structural material of yesterday, today and tomorrow.

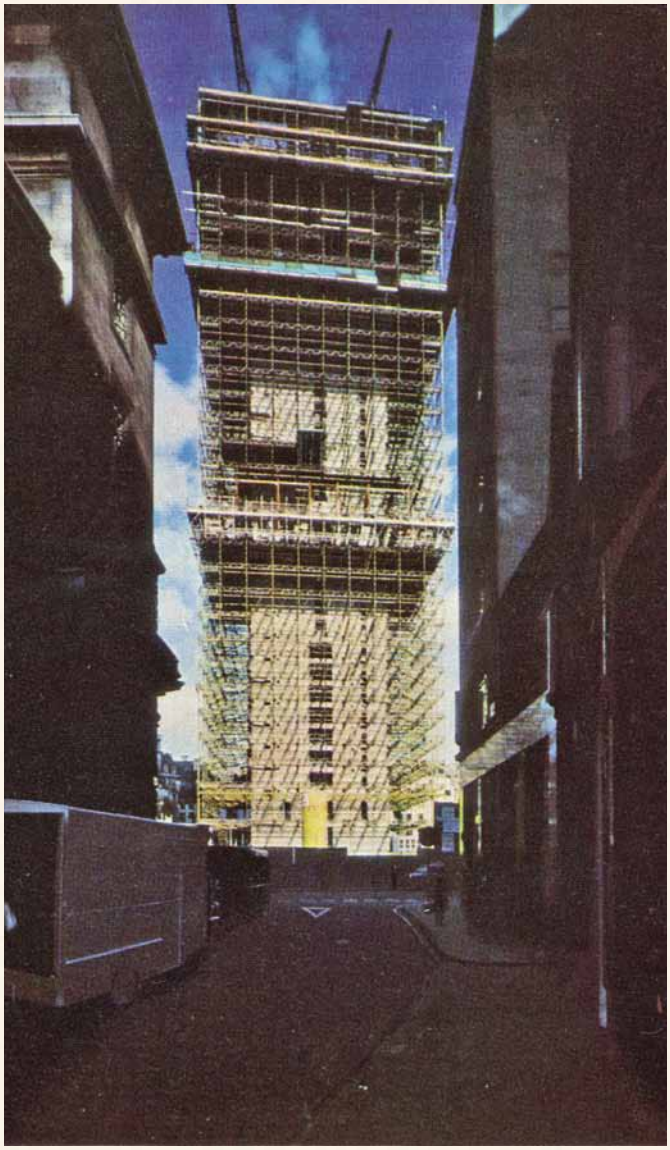
Above: A total of 2,000 tons of structural steelwork were used in the construction of this attractive departmental store at Guildford. The store was designed and built for Messrs. Plummer Roddis, a part of Debenhams Ltd.
Architects: George Baines & Syborn, ARIBA; Consulting Engineer: R.H. Thomason, MIStructE.

Right: Steel framed block of high flats rising to 18 storeys in the borough of Paisley, Scotland.
Architects: Sam Bunton, LRIBA, ARIAS and Associates.

40 Years Ago in

BUILDING WITH STEEL



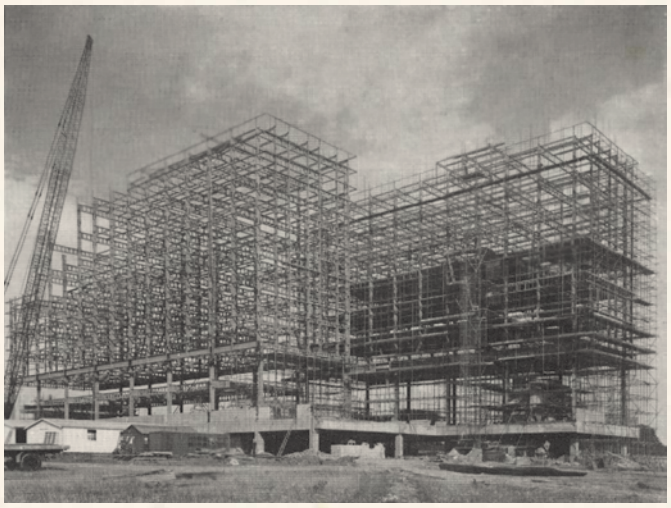


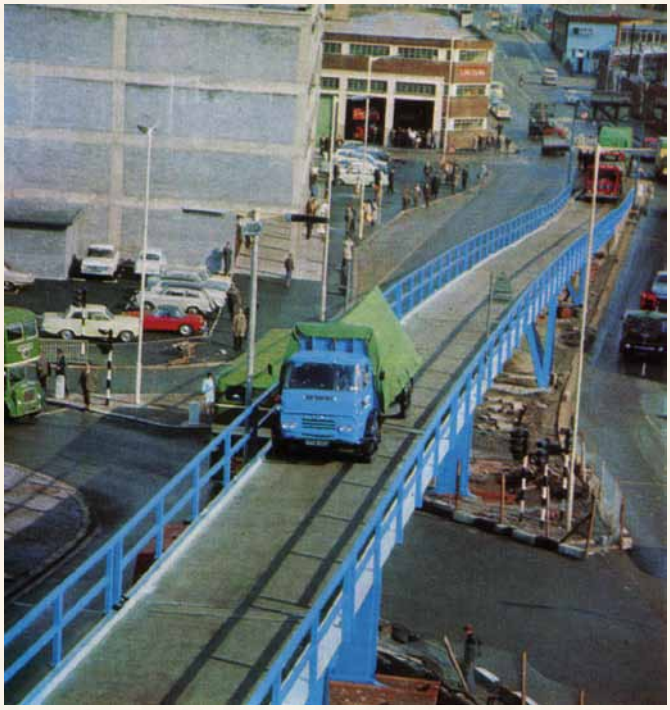
Above: Steel frame for the 10-storey office block at the national Giro Centre, Bootle. The whole complex is made up of a group of six buildings covering an area of 546,000 sq. ft. Industrialised building techniques, contributing to great speed in erection, have been developed here by the Ministry of Public Works.
The Ministry's senior architect and project manager, E. H. Banks, FRIBA, FRSA is responsible with project architect, E. B. Power, DCS and senior structural engineer S. G. Silhan MIStructE.

Top right: The new Commercial Union Assurance Company's new office tower in the City of London. Built in composite construction, the structure is 387 ft. high.
Architects: Gollins, Melvin, Ward & Partners. Consulting and structural engineers, Scott Wilson Kirkpatrick and Partners.

Bottom right: The steel re-erectable flyover at Bristol, shown complete and in action. The picture shows, much better than any written description, the practical contribution that a structure of this sort makes to the easing of municipal traffic problems.

Below: The steel frame of what will be a modern office block and hotel — Killingworth Citadel being built for the Northumberland County Council. Approximately 900 tons of steel are being used in multi-storey castellated construction. A feature of the structure is that it is in two blocks erected on top of a 20ft high concrete podium.
Architects: Ryder and Yates and Partners.





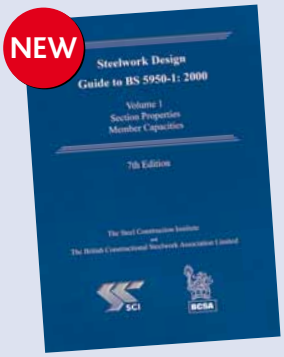
Steel Construction Books

Health & Safety • Specification • Assessment • Erection • Design

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.



DESIGNING - The Blue Book

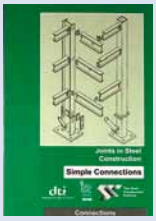
Steelwork Design Guide to BS 5950-1: 2000

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.

SPECIFYING - The Black Book

National Structural Steelwork Specification

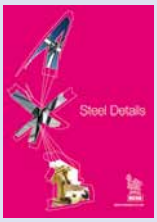
The 5th edition is a half-way house between the 4th edition and requirements of the forthcoming European standard EN 1090-2. Some of the changes include updating the specifications for steel sections, bolts and welding, the introduction of BS EN 3834 for the management of welding activities, a section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



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

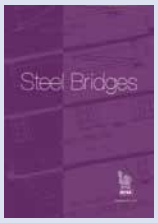
Galvanizing Structural Steelwork

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.

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.



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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.

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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.

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.

For help and advice on steel construction and information about companies and suppliers visit www.SteelConstruction.org

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AD 320
Correction to Amendment 1 to BS 5950-1:2000

In Annex G.4.3 of the published amendment, there are two errors that would generally lead to unsafe values for the parameter n_t. The errors are in the equation for n_t. The multiplier on the R_3 term should be 4 not 5 and the power to 0.5 should be outside the square bracket and not outside the curly bracket.

The whole clause, in its corrected form, is given below. It is understood that BSI will be issuing a corrigendum. The key points of Amendment 1 were addressed in AD 316.

G.4.3 Slenderness correction factor

A slenderness correction factor n_t may be used to allow for non-uniform moments in a member or segment with one flange laterally restrained and compression in the non-restrained flange, provided that the equivalent uniform moment factor m_t is taken as 1.0

The value of n_t should be determined from:

$$n_t = \left[\frac{1}{12R_{max}}\{R_1 + 3R_2 + 4R_3 + 3R_4 + R_5 + 2(R_S - R_E)\}\right]^{0.5}$$

In which R_1 to R_5 are the values of R at the ends, quarter points and mid-length, see Figure G.6, and only positive values of R should be included.

In addition, only positive values of $(R_S - R_E)$ should be included, where:

R_E is the greater of R_1 or R_5

R_S is the maximum value of R anywhere in the length L_y

R_{max} is the maximum of the absolute values of R anywhere in the length L_y

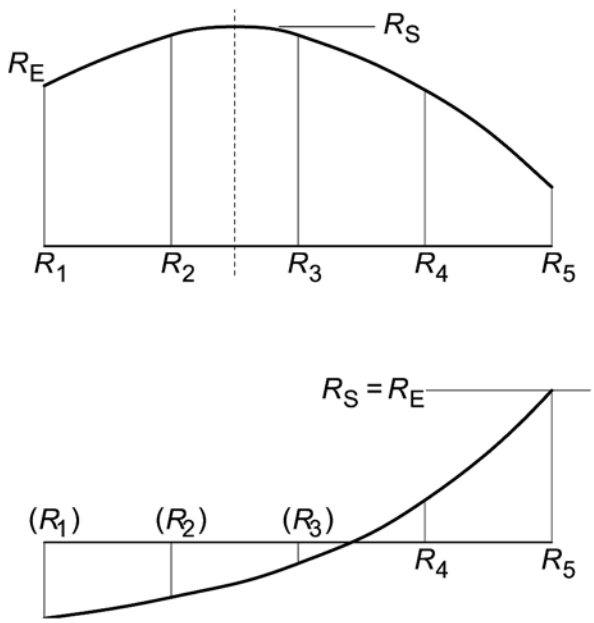

Figure G.6 Moment ratios

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Email: a.malik@steel-sci.com

AD 321
Long joints – reduction factor

BS 5950 -1: 2000 (clause 6.3.2.5) reduces the shear capacity of a joint when the length of the joint exceeds 500 mm. BS EN 1993-1-8:2005 (clause 3.8 (1)) makes a reduction to shear resistance when the length exceeds 15 times the bolt diameter. However, there is some debate whether these reductions should be applied to the slip resistance of pre-loaded bolts, as well as to the shear resistance of non-preloaded bolts.

The reduction for long joints should be made for all connection categories. This means that the reduction should be made for connections with preloaded bolts that are designed to be "non-slip in service" and "non-slip under factored loads" according to BS 5950-1, and for Category B (slip resistant at SLS) and Category C (slip resistant at ULS) connections according to EN 1993-1-8.

The need for reduction arises because of the local strain incompatibility between the plies of the connection, in the presence of limited deformation capacity. These effects apply irrespective of the nature of the force transfer, i.e. by bolt shear or by interface friction.

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New and Revised Codes & Standards

(from BSI Updates March 2008)

BS EN PUBLICATIONS

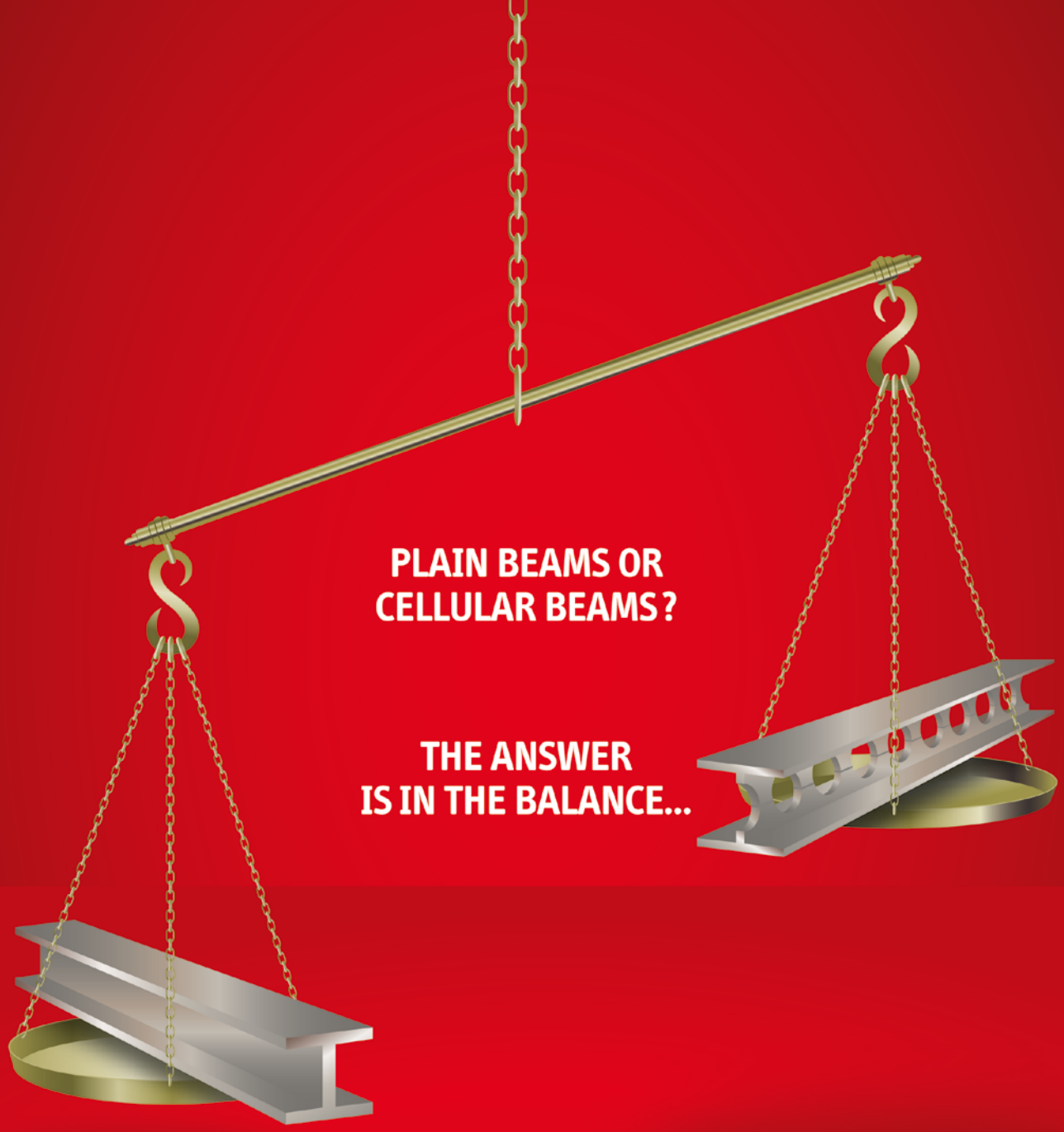
The following are British Standard implementations of the English language versions of European Standards (ENs). BSI has an obligation to publish all ENs and to withdraw any conflicting British Standards or parts of British Standard. This has led to a series of standards, BS ENs using the EN number.

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

BS EN 14399:-
High-strength structural bolting assemblies for preloading

BS EN 14399-7:2007
System HR. Countersunk head bolt and nut assemblies
No current standard is superseded

BS EN 14399-8:2007
System HV. Hexagon fit bolts and nut assemblies
No current standard is superseded



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The British Constructional Steelwork Association Ltd

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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Tel 01952 200377 Fax 01952 292877

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Tel 020 7476 9444 Fax 020 7476 0239

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Tel 01752 263636

The Register of Qualified Steelwork Contractors

BUILDINGS SCHEME

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

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

Company Name	Telephone	A	C	D	E	F	H	J	K	L	M	N	S	QA	Contract Value (1)
ACL Structures Ltd	01258 456051				●	●	●				●				Up to £2,000,000
A&J Fabtech Ltd	01924 402151		●			●								●	Up to £400,000
Advanced Fabrications Poyle Ltd	01753 531116					●	●	●	●	●	●			●	Up to £400,000
Allslade PLC	023 9266 7531				●	●	●			●					Up to £4,000,000
Atlas Ward Structures Ltd	01944 710421	●	●	●	●	●	●	●	●	●	●			●	Above £6,000,000*
B D Structures Ltd	01942 817770				●	●	●				●				Up to £1,400,000
B & K Steelwork Fabrications Ltd	01773 853400		●		●	●	●	●	●		●			●	Up to £4,000,000*
A C Bacon Engineering Ltd	01953 850611				●	●	●								Up to £1,400,000
Ballykine Structural Engineers Ltd	028 9756 2560				●	●	●	●				●		●	Up to £2,000,000
Barrett Steel Buildings Ltd	01274 266800				●	●	●							●	Up to £6,000,000
Billington Structures Ltd	01226 340666	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744		●		●	●	●					●			Up to £2,000,000
Bourne Steel Ltd	01202 746666	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Brooksby Engineering	01707 872655					●		●	●	●	●				Up to £200,000
Cairnhill Structures Ltd	01236 449393		●			●	●	●		●	●			●	Up to £1,400,000*
Caunton Engineering Ltd	01773 531111		●		●	●	●	●			●			●	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000*
Compass Engineering Ltd	01226 298388		●		●	●	●		●						Up to £2,000,000
Conder Stuctures Ltd	01283 545377			●	●	●	●							●	Up to £6,000,000
Leonard Cooper Ltd	0113 270 5441		●			●	●		●		●			●	Up to £800,000
Curtis Engineering Ltd	01373 462126					●									Up to £800,000
Frank H Dale Ltd	01568 612212			●	●	●								●	Up to £6,000,000
EAGLE Structural Ltd	01507 450081				●	●	●	●	●	●					Up to £400,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●		●					●	Up to £4,000,000
Elsome Structures Ltd	01664 813234					●				●	●				Up to £800,000*
Emmett Fabrications Ltd	01274 597484					●				●	●				Up to £800,000
EvadX Ltd	01745 336413	●	●	●	●	●	●	●	●	●	●	●		●	Up to £3,000,000
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Fisher Engineering Ltd	028 6638 8521	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
GME Structures Ltd	01939 233023				●	●	●	●		●	●		●		Up to £800,000
Gibbs Engineering Ltd	01278 455253					●	●	●		●	●				Up to £800,000
Glentworth Fabrications Ltd	0118 977 2088					●	●	●	●	●	●	●			Up to £2,000,000
Graham Wood Structural Ltd	01903 755991	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
D A Green & Sons Ltd	01406 370585	●	●	●	●	●	●	●	●	●	●	●		●	Up to £6,000,000
William Haley Engineering Ltd	01278 760591				●	●		●			●			●	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456		●		●	●	●	●	●	●	●			●	Up to £6,000,000
Hills of Shoeburyness Ltd	01702 296321									●	●		●		Up to £800,000
James Bros (Hamworthy) Ltd	01202 673815				●	●	●	●					●	●	Up to £1,400,000
James Killelea & Co Ltd	01706 229411		●	●	●	●	●					●			Up to £6,000,000*
Leach Structural Steelwork Ltd	01995 640133		●		●	●	●	●			●				Up to £1,400,000
Mifflin Construction Ltd	01568 613311			●	●	●	●				●				Up to £2,000,000
Nusteel Structures Ltd	01303 268112						●	●	●	●				●	Up to £2,000,000*
Oswestry Industrial Buildings Ltd	01691 661596				●	●	●		●		●				Up to £400,000
Harry Peers Steelwork Ltd	01204 558500		●		●	●	●	●	●	●	●			●	Up to £4,000,000
Pencro Structural Engineers Ltd	028 9335 2886				●	●	●	●			●			●	Up to £2,000,000
RSL (South West) Ltd	01460 67373				●	●	●				●				Up to £800,000
John Reid & Sons (Strucsteel) Ltd	01202 483333	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
J Robertson & Co Ltd	01255 672855									●	●		●		Up to £100,000
Robinson Construction	01332 574711		●	●	●	●	●							●	Above £6,000,000
Roll Formed Fabrications Ltd	028 7963 1631				●	●	●	●		●	●	●		●	Up to £800,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Rowen Structures Ltd	01623 558558	●	●	●	●	●	●	●	●	●	●	●			Up to £6,000,000
SIAC Butlers Steel Ltd	00 353 502 23305		●	●	●	●	●	●				●		●	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●							●	Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121		●	●	●	●	●	●							Up to £4,000,000
The AA Group Ltd	01695 50123		●	●	●	●	●				●				Up to £1,400,000
Traditional Structures Ltd	01922 414172			●	●	●	●	●	●		●	●		●	Up to £2,000,000*
Warley Construction Company Ltd	01268 726020				●					●					Up to £400,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	Above £6,000,000
H Young Structures Ltd	01953 601881		●		●	●	●	●				●			Up to £800,000

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

RQSC
The Register of Qualified Steelwork Contractors Scheme

BRIDGEWORKS SCHEME

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

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

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

Company Name	Telephone	FG	PT	BA	CM	MB	RF	X	Contract Value (1)
A&J Fabtech Ltd	01924 402151	●	●	●			●		Up to £400,000
Allerton Engineering Ltd	01609 774471	●	●	●	●	●	●		Up to £1,400,000*
Briton Fabricators Ltd	0115 963 2901	●	●	●	●		●		Up to £1,400,000
Cleveland Bridge UK Ltd	01325 381188	●	●	●	●	●	●		Above £6,000,000*
Concrete & Timber Services Ltd	01484 606416	●	●		●	●			Up to £800,000
Costruzioni Cimolai Armando SpA	01223 350876	●	●	●	●	●			Up to £6,000,000
Fairfield-Mabey Ltd	01291 623801	●	●	●	●	●	●		Above £6,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●		●		Up to £6,000,000
Interserve Project Services Ltd	0121 344 4888						●		Above £6,000,000
Interserve Project Services Ltd	020 8311 5500		●	●		●	●		Up to £400,000*
Meldan Fabrications Ltd	01652 632075	●	●	●	●	●	●		Up to £4,000,000
'N' Class Fabrication Ltd	01733 558989	●	●	●		●	●		Up to £1,400,000 (CVA)
Nusteel Structures Ltd	01303 268112	●	●	●	●		●		Up to £2,000,000*
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●					●		Up to £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●		Above £6,000,000
Taylor & Sons Ltd	029 2034 4556	●	●	●	●	●	●		Up to £1,400,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●		Above £6,000,000

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

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- Fire Engineering
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