Steel raises the game

Exposed steelwork is the star player above the indoor pitch at the National Football Centre in Staffordshire, which is due to open soon

Large steel trusses create the open column space for an indoor football pitch

PROJECT REPORT
RUBY KITCHING

Project St George's Park, National Football Centre, Burton Upon Trent
Main client The Football Association
Architect Redbox Design Group
Main contractor Bowmer & Kirkland
Structural engineer Arup
Steelwork contractor Billington Structures

The Football Association's main aim when it first came up with the idea of a National Football Centre was to create a place where players and coaches would feel inspired to train and improve their game. Now just months away from opening, the £73 million centre, also known as St George's Park, is a dazzling spectacle in the Staffordshire countryside.

The centre is made up of a sports block to the south and hotel and conference facilities to the north, as well as 11 outdoor pitches, including one replica Wembley stadium pitch.

A 75 m-wide by 120 m-long structure houses the full-sized indoor artificial pitch. Its roof is made up of curved steel trusses and clad in a gleaming white tensile PVC fabric.

All the steelwork is exposed, so the highest quality finish has been specified. Many of the columns are tapered for architectural reasons and the glazed side walls slope outward at the eaves to add to the appeal of the building.

"This was clearly the most challenging part of the job," says Arup associate structural engineer David Bloomfield. He explains that the structure is a "portalised" truss, fixed at either end and supported on columns made from beams tapering from 800 mm at the base to 1 m at the top.

Each portal frame is spaced at 7.3 m centres and diagonal bracing is applied on all perimeter walls. The main columns sit on 3 m by 10 m by 2 m deep pad foundations supported off vibro-compacted ground.

"So much of the structure is visible – the trusses, columns, connections – that we spent a lot of time with the architect making sure everything was visually appealing," says Mr Bloomfield. Arup and architect Redbox Design Group worked closely together on the visual appearance of the building, developing the scheme to include curved trusses at rafter level which taper at each end as they meet the tapered columns.

The philosophy behind the design was to create a sense of lightness – natural light through the PVC tensile roof, and lightness in terms of the visual impact of the structure. Steel became the obvious material choice to achieve this.

Clever concealment

"We initially looked at circular hollow sections and square hollow sections for the trusses, but the architect decided a column section turned on its side would be better for the bottom boom. This allowed the upper channel of the H section to be used as a cradle to carry pipes and cables, conveniently concealed by the steel section when viewed from below," Mr Bloomfield says.

During the design stage, every steel section was scrutinised to check how its position, geometry and section type contributed to creating an elegant, light steel frame. Meanwhile, Arup used in-house software to model and analyse the structure.

3,500
tonnes of steel used for the project

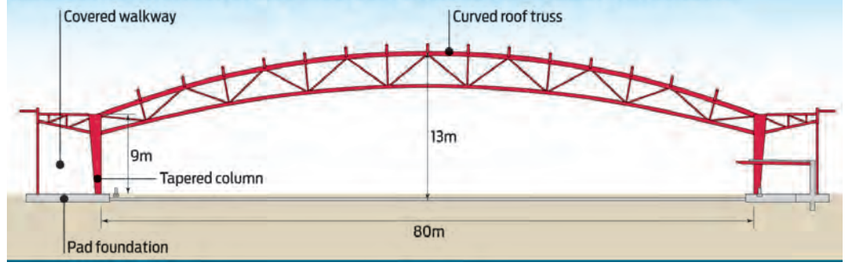
Steel cables were considered for the diagonals in the trusses, but the complexity of designing them for a reversal of wind loads ruled them out, so square or hollow sections were preferred. The upper boom of the truss is a circular hollow section.

Keeping the roof trusses as slim as possible was a major design criterion and resulted in them being 4.5 m deep in the centre of the span and 2.5 m deep at the ends. Purlins on the top boom which support the tensile roof also had to be curved to follow the profile of the trusses. The maximum height of the structure is 13 m in the centre while columns at the perimeter are only 9 m tall.

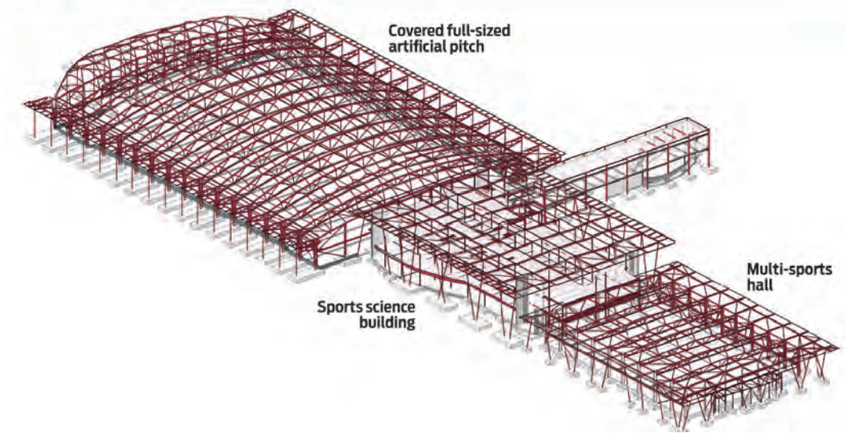
Main contractor Bowmer & Kirkland, with steelwork contractor Billington Structures erected the roof. Columns were initially connected via baseplates to pile caps before the roof was erected. "The trusses came in quarters," recalls Bowmer and Kirkland project manager Ian Woodall. "Two 100-tonne mobile cranes lifted up the central two sections and a further two 50-tonne mobile cranes put up the end sections."

All four sections were supported by crane until bolted together and connected to columns. Mr Woodall adds: "We were able to install three trusses a week and the whole structure was up in just six weeks."

CROSS SECTION THROUGH STEEL STRUCTURE FOR INDOOR ARTIFICIAL PITCH BUILDING



SPORTS BLOCK



The main truss structure continues past the translucent Kallwall cladding to form a canopy frame around the perimeter of the building and a covered walkway. Propping this canopy are circular hollow section columns which are cigar-shaped, tapered at their ends.

The indoor pitch building is connected at its northern edge to the sports science block. This is a composite steel structure with cellular steel beams allowing services to run through the openings, metal decking and concrete slabs.

The three-storey building will include hydrotherapy pools at ground level, offices, and a human performance laboratory which will monitor players' performance in different conditions.

Integrating services around the hydrotherapy rooms at ground floor was challenging due to the different types of services required, including specialist heating and cooling equipment to support the pools, pumps and backwash tanks as well as more regular mechanical and electrical equipment for offices and laboratories. The pool area also had to be sealed so that chlorine gas did not escape to other parts of the building. For this reason, above the pools, the steelwork had to be polyester powder-coated to make it more resilient to chlorine and a gas capture tank is located in the ceiling void.

Long spans

A 50 m by 80 m multi-purpose sports hall finishes off the sports block. This steel-framed hall is made up of 50 m-long spliced trusses spaced at 7.3 m centres that support the roof and northlights glazing. Trusses are more conventional here, being straight and of constant depth. The roof is clad with metal decking.

"We spent a lot of time with the architect making sure everything was visually appealing"
DAVID BLOOMFIELD, ARUP

"The truth is, when you have to design long spans, steel is the best option because it's very rare that you reach a span which cannot be achieved," says Mr Bloomfield.

While the indoor pitch, sports science and multi-sports hall are physically connected, the hotel complex is located 50 m to the north of the multi-purpose sports hall and will offer more than 200 rooms, conference and banqueting facilities, restaurants and an 18 m long swimming pool. The hotel complex is made up of two bedroom wings, a recreational wing and a dining and conference wing, radiating from a central reception area.

Precast concrete has been used for the structure on all the bedroom floors and steel used where longer spans are required. This is typically at first floor level over long-span areas such as conference and banqueting suites, the reception and swimming pool. The roof is also steel-framed to accommodate plant.

Currently on budget and programme, the project has involved careful coordination between the design team and contractors to ensure it is delivered to such a high standard in a short space of time.

A focus on quality

The new director general of the British Constructional Steelwork Association is determined to promote the high standards of work of its members

INTERVIEW
RUBY KITCHING

With the country in recession and private and public sector projects thin on the ground, the BCSA is having to work harder to ensure its members are first in line to win work when projects eventually get going. The BCSA's new director general Sarah McCann-Bartlett joins the organisation at a tough time, but says she looks forward to the challenges that lie ahead.

The BCSA is the national organisation for the steel construction industry. Its members are companies that undertake design, fabrication and erection of steelwork, or are companies associated with these activities.

"I'd like to see BCSA members widely acknowledged as the best steelwork contractors in the world," enthuses Ms McCann-Bartlett. "I'd also like to see contracts awarded across the public and private sector on a level playing field, based on high standards of quality assurance, health and safety and sustainability."

It is not the first time the international executive has been involved with supporting an industry that needed to remind its supply chain and clients of the importance of using native high-quality contractors.

She spent nearly ten years with the Woolmark Company, an Australian organisation that developed the widely recognised mark of wool quality found on textiles and clothing.

"Woolmark's objective was to increase the amount of Australian wool consumed against cotton and synthetic products," says Ms McCann-Bartlett. "We achieved this by providing technical support to wool processers, spinners, weavers and garment manufacturers, undertaking global marketing of wool as a fibre, and forming strategic partnerships with other stakeholders. We also explained to fashion houses, such as Hugo Boss, the importance of using the Woolmark to guarantee quality of product."

Constructive choices

Similarities between the wool industry and constructional steel can easily be drawn. While at the Woolmark Company she was all too aware of eastern manufacturing: "Its lack of focus on human rights, particularly health and safety, undercut local firms which were focused on doing the right thing."

For the constructional steelwork industry, she believes being a BCSA member is the equivalent of being branded with the Woolmark logo and the association is working to influence public sector procurement requirements to state that only quality-assured, audited steelwork contractors should win work.

"Clearly we aim to put across that being a BCSA member is the differentiator between a great steelwork contractor and a not-so-great one," she says, adding that The Highways Agency procures its steelwork contractors for bridge contracts only from the Register of Qualified Steelwork Contractors for Bridgeworks Scheme, which is administered by the BCSA.

"We want to see Network Rail, local government authorities and other public sector clients also choosing from the RQSC for bridges and coming to the BCSA for building work," she says. "BCSA is also hearing reports that contractual conditions are becoming more onerous."

Alongside its Specialist Engineering Contractors' Group colleagues, BCSA is monitoring the uptake of the recent amendments to the Construction Act and the government's fair payment initiative, both of which should have a real impact on payment across the whole construction industry. BCSA is also one of the groups supporting the introduction of the Construction Contracts Bill in the Republic of Ireland, which will improve contract conditions for its Irish members."

Popularity points

While steel's market share in construction is already high, staying ahead of the game relies on constantly developing the product to suit market needs and marketing its successes.

"Steel has inherent advantages which help its popularity – its high strength-to-weight ratio lends itself to efficient lightweight construction, it is aesthetically pleasing in bridges and buildings – it can take your breath away – and it's sustainable, recyclable and reusable in its existing form. You don't have to do anything with it to reuse it," says Ms McCann-Bartlett.

Through a joint marketing initiative with Tata Steel, the BCSA continues to work towards maintaining and, where possible, increasing steel's healthy market share. The single-storey, 'shed' market is almost 100 per cent and the multistorey market averages 70 per cent with some variation across different building types.

"We want to promote the efficiency of steel and that because you use less of it, the self-weight of a building is less, so the foundations are cheaper."

For constructional steel to stay at the top of its game, barriers to its uptake have to be addressed. For some, the sustainability of steel is its stumbling block, particularly around the energy of manufacture.

"This needs to be weighed up with the fact that the material has a long life and is endlessly recyclable,' says Ms McCann-Bartlett. "We're now looking at whole lifecycle analysis of steel as a structural material – and this is where steel comes into its own."

The whole picture

Simplified lifecycle analyses look at the carbon footprint of a material from cradle to gate – that is, from its point of manufacture to when it leaves the factory. In this situation, natural materials such as timber score well. But if a whole-life cradle-to-grave scenario is considered – the carbon footprint from manufacture until the material must be disposed of – other materials may score better.

"We're now talking about cradle-to-cradle timescales and are working in partnership with Tata Steel to understand this better," she says. "Steel can be reused if a building is carefully dismantled rather than demolished." This sustainability story is explored in the report *Target Zero*, which considers the factors affecting zero-carbon construction.

While the debate continues as to how a zero-carbon building should be assessed, the pace of building itself in the public and private sector has slowed down considerably. Ms McCann-Bartlett argues that the way out lies in public infrastructure spending.

"We strongly support the government's infrastructure spending plan as well as the nuclear programme. However, we are pressing government to ensure projects get started quicker and that a forward programme of projects be published so that the industry can feel bold enough to plan ahead."

MAKING HER MARK

Born to a British mother and Australian father, Sarah McCann-Bartlett grew up in Australia and studied international politics and economics at Melbourne University.

Her first job was with the forerunner to the Woolmark Company – her initial role was to analyse and forecast the demand for Australian wool from China and India.

After three years, she was posted to Ilkley, West Yorkshire. The picturesque Victorian spa town had been the centre of the wool trading industry, so the predecessors of the Woolmark Company had set up an office there. Here, her focus was on global marketing and research.

Following a three-year posting to New York with Woolmark, she retuned to Melbourne and began working for the Building & Plumbing Commissions, latterly as deputy commissioner.

She worked on programmes to get all professionals in the building and plumbing industries registered for quality assurance purposes and helped introduce the first sustainable building regulations into house building in Victoria.

In 2010, she returned to the UK to settle with her husband, four-year-old son and three dogs. In September 2011, she became director general of the BCSA, spending her time between London and Yorkshire, as well as visiting members around the country.

DELIVERING VALUE

The steel construction sector is looking forward to helping deliver the government's ambitious infrastructure growth plan, which includes a number of major structures – and steel is likely to be the choice for many of them. But the optimism is tinged with a worry that some clients may look further afield for a solution and squander the opportunity to kickstart the UK economy.

"The money is being invested by the government for a specific reason, so we are hoping that authorities remember that during project procurement, research shows that for every £1 spent on construction, £2.84 is created in wider economic impact," says Sarah McCann-Bartlett.

"The UK steel construction industry is a world benchmark, with nothing to fear from competition on a level playing field. Our members have a modern business outlook and have invested a tremendous amount to ensure that we deliver the highest standards of quality, health and safety and sustainability. Clients must appreciate that lowest cost is unlikely to deliver best value."

The association is committed to quality and competence and it is a requirement of BCSA membership that all steelwork contractors are audited and classified by the types of work and project size that they are able to undertake.

The Register of Qualified Steelwork Contractors for Bridgeworks Scheme was developed by the BCSA. For many years, the Highways Agency has required its steelwork contractors for all its bridge contracts to be on the register.

"All the new infrastructure projects should adopt the RQSC scheme for bridges and BCSA membership for other structures," says Ms McCann-Bartlett. "Both take the guesswork out of procurement and give the client assurance that the steelwork contractor they employ is properly equipped to carry out the work."

The RQSC scheme is open to all steelwork contractors with a fabrication facility in the EU, subject to their successful completion of the assessment process.

Produced in association with TATA STEEL BCSA

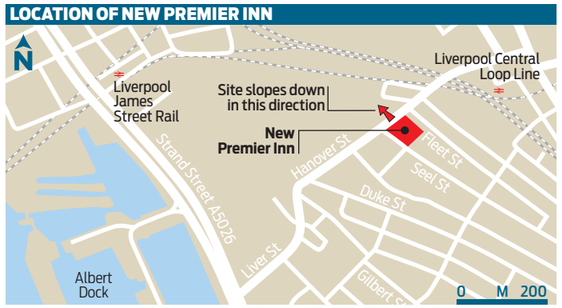
Steel is the premier solution for the inn

The steel frame of a new budget hotel in central Liverpool has been able to connect a complex façade of masonry, cladding and glazing

HOTEL
RUBY KITCHING

Project Premier Inn, Liverpool
Main client Whitbread Hotels & Restaurants
Architect Allison Pike
Main contractor Watkin Jones
Structural engineer Curtins Consulting
Steelwork contractor EvadX

LOCATION OF NEW PREMIER INN



Liverpool One is a 153,000 sq m shopping and leisure district just east of Albert Dock. It opened for business in 2008, providing a £1 billion investment for the city.

With more visitors, more accommodation is required and budget hotel operator Premier Inn is now building its third hotel in the city, on the edge of Liverpool One. Costing £12 million, it is the largest self-build project parent company Whitbread Hotels & Restaurants has undertaken in the UK. The steel-framed structure will also include three retail units and four restaurants at ground floor level.

Setting this hotel apart from others in the area is the attention to detail put into the design and construction of the glazed corner entrance foyer, which rises from first floor level to above the roof parapet. The prism-shaped structure cantilevers over the pavement and tapers out with height. Planning officials were keen to ensure that it expressed how the hotel related to the area – this is provided in the nautical and rope-making-themed artwork which is applied onto 18 panes of glazing in the foyer (see box).

15 months of programme

Steelwork for the main hotel and retail units has already been erected, with the trickier elements supporting the foyer glazing going up in the next few weeks. A single tower crane and mobile cranes erect the steelwork, cladding and masonry elements of the project.

Hotel location

The development is situated on a diamond-shaped plot of land surrounded by Hanover Street to the north-west, Fleet Street to the north-east, Seel Street to the south-west and a car park to the south east. A new service road called David Lewis Road will be built between the car park and new hotel, linking Seel Street with Fleet Street. The site naturally slopes down to its lowest edge along Hanover Street.

Retail units and stores occupy floors up to level two and four storeys of hotel accommodation sit on the streetside retail units. The development takes the shape of something like a squared doughnut from second floor level, with plant and drainage located at the centre on the second floor flat roof.

Liverpool was bombed extensively during World War II, so an unexploded ordnance specialist had been appointed to advise on specific project risks prior to site investigation, excavation and groundwork.

Through investigation of the site, consultant Curtins identified poor ground conditions that meant the ground floor would need to be suspended and piled foundations installed. But excavating, screening, crushing and re-compacting 12,000 sq m of made ground as part of the demolition contract improved its properties so that pad foundations onto sandstone bedrock and a ground-bearing slab need only be built.

Crushed and screened demolition rubble from a 1960s multistorey carpark on the site also helped provide material to create two levelled areas on a site, half of which Hanover Street side is about one storey lower. Excavation to about 2 m to 2.5 m below ground level ensured obstructions in the ground were also removed at this stage and a retaining wall was built halfway across the site to support the change in ground level.

The elevation along one street incorporates a step in the ground floor level to take in the site's slope

> **"We arrived at this solution as the best from a cost and programme point of view"**
> JOHN KELLY, CURTINS CONSULTING

Level best

Ground level is assumed to be along Hanover Street, with the lowest floor on the opposite side of the site starting at level one. Since the hotel floors all begin at level two on the streetside elevations, double-height units can be accommodated on the Hanover Street side, while only single-storey height units can be accommodated on the other half of the site.

With a tight 15-month programme, steel framed construction with composite metal floors was deemed both the quickest and most cost-effective way to build the hotel.

"We looked at timber-framed solutions and modular forms of construction, but we arrived at this solution as the best from a cost and programme point of view," says Curtins Consulting associate John Kelly.

"The façade is quite complex – incorporating a mixture of masonry, cladding and glazing. Some framing systems, particularly modular, would not be able to accommodate all the different sorts of connections required, but steel was more than capable of doing so."

Street-facing elevations are acoustically drylined to ensure hotel residents are not disturbed by street noise and fresh air for ventilation is drawn from the hollow in the centre of the doughnut-shaped building, rather than from the street. The project also includes traditionally built bathrooms, rather than pods, giving the client flexibility in design.

The majority of the steel frame is based around a regular column grid pattern of 7.2 m by 7.7 m. With a central corridor and equal-sized rooms either side, the design required three lines of columns including the perimeter members, with a central row positioned in the corridor. Transfer beams at second floor level helped distribute the more dense hotel structure on to fewer columns in the retail units.

This has meant that the columns at ground floor are fairly heavily loaded. Coupled with the fact that the building's footprint covers most of the site, there are some locations next to the boundary where a full perimeter baseplate cannot be accommodated. Here, the baseplates have had to be tied to adjacent column baseplates using steel struts. The solution meant that load is shared between columns and that deep foundations are not required.

Structural stability is derived from extra bracing in lift shafts, stairways and partition walls. Each side of the building has had to be designed discretely with its own stability system due to lack of continuity across the depth of the building.

Clear thinking

Clear spans were required for the retail units, with mezzanine levels hung from the underside of the second floor steelwork so that columns did not break up the space at ground floor.

"The ground floor retail areas needed to be large and open, so steel worked well, but it also suited the more regular and repetitive frame which was needed above level two," explains Curtins project engineer Dave Jones.

He adds that the scheme was modelled using 3D modelling software, which helped visualise the structure, particularly its level changes.

The model was also useful when it came to coordinating interfaces with cladding, glazing, internal blockwork and external brickwork as well as services and construction issues on site. "3D modelling gave us the ability to check and cross-check the structure. It took time and resources to build, but when the project started on site, it really helped with coordination issues and meant the building could fly up," adds Mr Jones.

Steelwork contractor EvadX has also installed the precast stairs using the onsite tower crane, which has a 2.8-t capacity.

Despite high winds and snow, the project remains on target for completion in autumn.

GRAND ENTRANCE

"The specification was very high on the [foyer] steelwork because the architect wanted to make the steel members part of the feature," explains EvadX project manager Steve Morris. Connections are mostly hidden, requiring onsite welding and grinding, removal of weld spatter and craters to be filled in for aesthetic reasons or are highly expressed bolted connections.

Curtins project engineer Dave Jones recalls that full-scale prototypes were produced with EvadX during the design development period to provide "high quality, visually aesthetic exposed steelwork connections". EvadX used computer software, Strucad, to help the design team understand the details which were then agreed upon by the architect. He adds: "The result is that connections are bespoke, discrete and create a very elegant frame."

The foyer steelwork also includes a 22 m-long and a 19 m tubular column which were both too long to be lifted in whole pieces by the tower crane. Instead, both columns arrived on site in halves and were site-welded. Pre-welded connections on the end of each tube helped locate the two halves.

The foyer steelwork is being lifted into position using the tower crane, with operatives assisting on mobile elevated working platforms. Since this corner is located in a pedestrianised area, the hoarding has been extended around the extra plant to allow safe erection.

Selection process key to success

Choosing the right steelwork contractor for the job could make the difference between a really successful project and one that is not so good

CHOOSING A CONTRACTOR

RUBY KITCHING

It's well known that changes made to a building or bridge's design when it is onsite have huge implications on the success of a project. Many sorry tales have been told about jobs which should be remembered as technically exciting and visually stunning, but became entrenched in bad feeling because of changes that resulted in claims. According to BCSA president Ivor Roberts, Building Information Modelling (BIM) could be the thing that irons out the details of a design before it gets onsite, while ridding the industry of the "claims culture". Assurance of design would also make fabricating a much more straightforward operation, he adds.

"Good steelwork contractors are very flexible and quick to respond to challenges. They work efficiently and have a quick turnaround between jobs. But if a client says, 'can you change this?' or 'can you add that?', it becomes very complicated – particularly when the finish date of a project is difficult to shift.

"We back BIM because there is so much information up front, which means that changes are less likely to happen further down the line. Everything should have been thought through – even down to where lighting brackets should be located. With BIM, there is a level of confidence that the information is final and correct. On receiving a design, a good steelwork contractor can cut down the fabrication programme."

With construction programmes already tight, it pays to have a good or competent steelwork contractor on board.

BCSA members are steelwork contractors involved in building and bridge work, who are regularly audited for the type and size of job they can undertake. The BCSA also assesses firms' quality assurance, technical capabilities, health and safety and sustainability practices (see box, far right).

"Crucially, track records and details of referees are also included on the register, so former clients such as local authorities, consultants and main contractors may be contacted for an unbiased recommendation," adds Mr Roberts.

He advises clients to visit the workshop to get a better feel for a contractor's capabilities because there is a huge range – "from a single building workshop with limited handling facilities, to ones with multiple large buildings with state-of-the-art technology for sawing and drilling".

He believes contractors which are BCSA members are also better placed to understand the impact of new trends, such as BIM, or new legislation which can impose different ways of working. Under European Union legislation for example, CE marking will become mandatory in July 2014 (see box, left). The legislation requires manufacturers to make an explicit declaration that their products are safe, always requiring another organisation to validate it.

"In contrast, if you choose a steelwork contractor which is not a BCSA member or on the Register of Qualified Steelwork Contractors Scheme for Bridgeworks, then you risk not knowing whether they are technically and financially sound," adds Mr Roberts.

Quality steelwork is assured from BCSA members' workshops

BCSA GETS READY FOR CE MARKING

The BCSA is preparing for CE marking (CEM) of structural steelwork to be mandatory across all member EU states in July 2014 (including the UK and Republic of Ireland).

CEM is a way of ensuring a product meets the minimum requirement for health and safety. All steel sections and structural bolts are assessed against a "harmonised" standard. This standard is the same across all member states.

"The standards list the performance characteristics for the product, the values for which are declared by the manufacturer on CE marking," says BCSA director of engineering David Moore.

"It is really about health and safety because the performance characteristics identify how the product performs in fires, how strong and durable it is and how the product is made, amongst others."

For non-standard or proprietary products, which fall outside the scope of the harmonised standard, a European Technical Assessment may be developed and used to assess and CE mark the product.

The main harmonised standards for the constructional steel industry are as follows:

- BS EN 10025-1 – Steel open sections, I , H channels
- BS EN 10210-1 – hot finished tube sections
- BS EN 10219 – cold formed tubes
- BS EN 1090-1 – fabricated steel
- BS EN 14399-1 – preloadable bolts
- BS EN 15048-1 – non-preloadable bolts

To satisfy the requirements on CEM for fabricated steel, steelwork contractors need to have in place a certified Factory Production Control (FPA) system. This may require them to put in place a Welding Quality Management (WQM) system that is in line with BS EN ISO 3834.

The most difficult and challenging aspect related to the introduction of CEM is the requirement for a knowledgeable and competent responsible welding co-ordinator, adds Moore.

The BCSA provides members with the necessary technical support and guidance to setup and implement CEM, FPC and WQM systems.

USING THE BCSA TO FIND A COMPETENT STEELWORK CONTRACTOR

Prequalifying steelwork contractors for tenders can be easily done using the membership list of the BCSA, or the Register of Qualified Steelwork Contractors Scheme for Bridgeworks (RQSC).

Approximately 100 steelwork contractors are BCSA members. Each are assessed by the BCSA against their capabilities in 14 categories of building steelwork and eight sub-categories of bridge construction. The categories give guidance on what type of steelwork activities the company is competent to undertake, which relates to the company's work facilities, its track record and its technical and management experience. Cross-checking these categories against specific project requirements is an easy way of shortlisting contractors.

The listing also classifies each company by suggesting the size of steelwork contract that the company has the financial and management resources to undertake.

Bridgework contractors can be found specifically on the RQSC for bridges, which is administered by the BCSA and is open to any competent steelwork contractor with a fabrication facility in the EU. It was developed to fulfil the needs of the Highways Agency. All the agency's contracts involving structural steelwork require a contractor to be on this register.

To select a suitable steelwork contractor for type and scale of work; visit www.steelconstruction.org/directories or use the new 'Find a steelwork contractor' App for smartphones which will shortly be available for download at www.steelconstruction.org.

Both of these options have search functions where various criteria, such as sustainability, can be selected.

SUSTAINABILITY CHARTER

The BCSA was one of the first organisations to establish a Sustainability Charter for its members. The Steel Construction Sustainability Charter scheme has been running since 2005 and helps identify companies which practise sustainable steel construction. Members are assessed against 12 criteria and can apply for different levels of recognition. To become a member six of the criteria need to be satisfied, silver membership needs nine, and gold needs all 12.

The 12 criteria for sustainability charter membership

1 A published sustainability policy (mandatory).
2 Progress towards sustainability monitored using specific management targets.
3 Involvement with the local community on social issues and with the steel construction community generally.
4 An accredited health and safety management system to BS OHSAS 18001, or health and safety management as an integral part of a quality management system accredited to BS EN ISO 9001.
5 Investors in People accreditation or a structured programme for personnel training, development and communication.
6 A published equal opportunities policy.
7 A published ethical trading policy.
8 An accredited environmental management system to BS EN ISO 14001.
9 Use of environmental impact assessment for process improvement.
10 A policy to manage energy and vehicle fuel usage in the business.
11 A policy to question whether suppliers have published sustainability policies.
12 An accredited quality management system to BS EN ISO 9001.

Sustainability in Steel Construction

Steel to the rescue

Gloucestershire's four new fire stations are being built using steel frames to ensure they are ready for action as soon as possible

PROJECT REPORT
RUBY KITCHING

Project Cheltenham East Fire Station, Keynsham Road, Cheltenham, Gloucestershire
Main client Gloucestershire Fire and Rescue Service
Architect CalderPeel
Main contractor Kier Moss
Structural engineer WYG
Steelwork contractor Adstone Construction

Gloucestershire Fire & Rescue Service is overseeing construction of four new fire stations to replace two older stations which date back to the 1950s and 60s. The project has been procured under a 25-year, £40 million PFI contract with consortium Blue 3, which includes contractor Kier Moss.

The new stations have been located strategically around Gloucestershire to ensure that incident response times in the county can be reduced to eight minutes, in line with the ambulance service. All four are of steel-framed construction, with composite steel floors. The steelwork contractor is Adstone Construction.

One, Cheltenham East fire station, will be located on the site of the former Cheltenham fire station at the junction of Keynsham Road and College Bath Road. During construction, fire service operations have been temporarily shifted to a nearby factory building.

Since the new stations are required to serve the community as soon as possible, a cost-effective and speedy form of construction was required. "The [Cheltenham] fire service is working from a temporary facility, so they want to be in the new station as soon as possible," says consultant WYG technical director Jim Seagar. "It was a no-brainer, really, using steel-framed construction, because it meant that the structure could be up quickly – in less than six weeks."

Each fire station, including the Cheltenham East station, is made up of a single-storey appliance bay that houses the fire engines, and a three-storey main office block.

Flexibility first

The 30 m-long by 15 m-deep appliance bay structure at Cheltenham East is formed from steel portal frames spanning 15 m and spaced at 5 m centres to accommodate six fire engines. There is also a 15 m-deep cantilevering canopy attached to the appliance bay which is supported along its length by a 30 m-long steel truss. Again, with future flexibility in mind, these canopies can later be used as part of a permanent roof, should the appliance bay need to be extended to accommodate more fire engines. Clear spans were also essential in this building to provide the engines with room to manoeuvre.

The main office block is of steel-framed construction with composite floors. At ground floor, rooms are used to store fire-fighting equipment and provide cleaning and drying areas, changing rooms and offices for the station manager and other personnel. Accommodation, including dining and recreational areas, is located on the first floor and plant is located on the second.

"The new buildings are also steel-framed for future flexibility," explains Mr Seagar. "The structure is built off a primary grid, but partition walls can be moved about to suit future needs. We don't know what a modern fire service will look like in the future, so flexibility and robustness had to be built in at the outset."

For example, there is no longer a "fireman's pole" connecting the living accommodation and appliance bay. Instead, stairs and a lift do the job.

The few internal columns which remain within the depth of the building in the main block have been carefully positioned within internal walls, so that they do not encroach on clear spans. Stability will be provided to each structure through horizontal and vertical bracing systems incorporated into the structural frame. The location of posts and column bracing were agreed with the architect to avoid conflicts with windows and doors. Most internal walls are non-load-bearing so they can be removed or repositioned to accommodate future modifications.

The first-floor steel beams of the main block and community block have been designed compositely, with the metal decking and reinforced concrete slab using shear studs. This has ensured that beam depths – and therefore floor depths – are kept to a minimum, allowing room for a suspended ceiling that will accommodate services in the ceiling void. The design team felt this, as opposed to feeding services through openings in deeper section beams, would make it easier to carry out alterations in the future.

The curved community block is also a steel-framed structure and has function rooms at ground floor level, which can be hired out by the public. A fitness suite occupies the first floor. Its curved elevation allows the adjacent listed building to be viewed more prominently and was a key part of the building's planning consent, since the previous station obscured this view.

Steel lent itself to the curved two-storey building, because it could form the curve effortlessly, says Mr Seagar. He adds that the community buildings on the other two sites use glulam beams, but have orthogonal elevations and are only single-storey. Connecting the main and community blocks is a covered walkway, created using glulam rafters and glazing.

30 m
steel truss supports feature canopy

> **"We don't know what a modern fire service will look like in the future, so flexibility and robustness had to be built in at the outset"**
> JIM SEAGAR, WYG

The stations were modelled using three-dimensional software to help designers understand the interaction between the three main blocks that make up the new station.

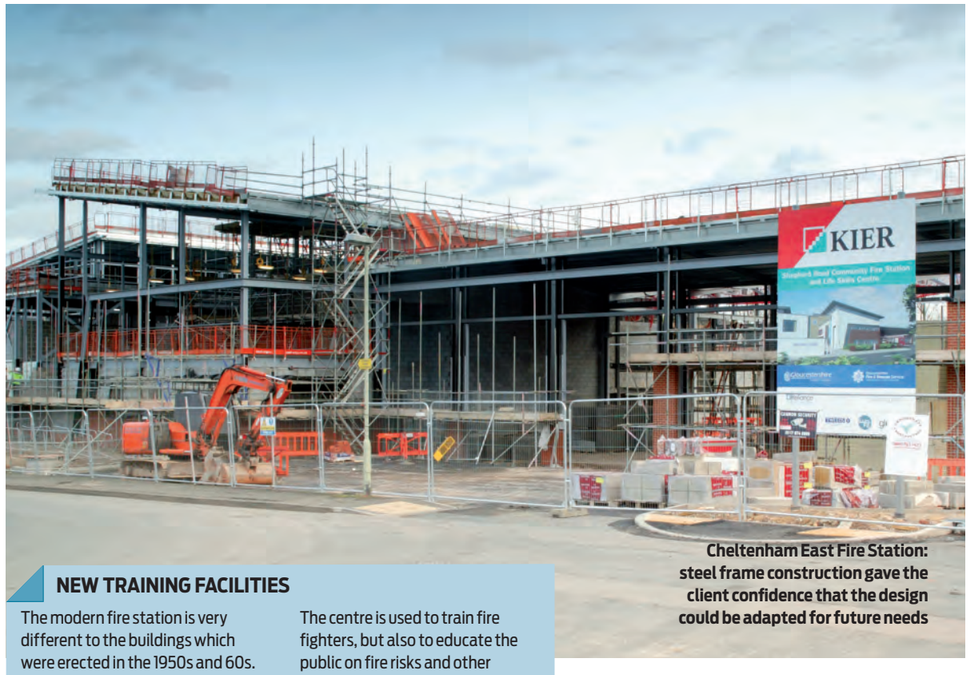
BIM win

Drawings were easier and quicker to reproduce for construction, explains Mr Seagar, because design changes only had to be made once on the model, and all the drawings would be automatically updated. "This is part of the move towards Building Information Modelling and a way of making us work more efficiently," he adds.

Demolition of the existing fire station at Keynsham Road was carried out last April, followed by site clearance and construction of pad foundations. The main block was the first to be erected. The Cheltenham East site is almost entirely occupied by the building's footprint, so there is limited space for materials storage during construction. This meant steel sections were delivered in relatively small bundles, so could be erected almost immediately

"Everything is delivered just in time, and we've put a lot of effort into going through the build programme and understanding the structural requirements ahead of ordering deliveries," explains Kier Moss senior site agent Paul Ingram. This saw steel erection carried out using mobile lifting plant rather than a static tower crane, due to the lack of space.

But, even with a tight programme and a tight site, Cheltenham East fire station is still due to open in April.



Cheltenham East Fire Station: steel frame construction gave the client confidence that the design could be adapted for future needs

NEW TRAINING FACILITIES

The modern fire station is very different to the buildings which were erected in the 1950s and 60s. Gone are the fireman's pole and drill towers, to be replaced by a lift and more sophisticated and appropriate training facilities. Emergency scenarios which can be recreated by the Gloucestershire fire and rescue teams at Gloucester South station's life skills centre include pulling a car out of a ditch or rescuing people from road traffic or rail incidents.

The centre is equipped with vehicles and railway track, street furniture and traffic lights, and even a four-bedroomed house. This is housed under a 23 m spanning monopitch roof made up of 610 mm-deep beam sections.

The centre is used to train fire fighters, but also to educate the public on fire risks and other emergency situations which can arise, such as flooding. The new stations recognise the fact the fire service deals with many emergency situations, other than fires.

Gloucester North station will also include a state-of-the-art road traffic collision training area for fire fighters to test their operational skills. Cheltenham West will have a purpose-built training building that will provide a range of practical scenarios, such as ladder work, breathing apparatus search and rescue, basement firefighting and flooding to test firefighters' operational skills.

CHELTENHAM EAST FIRE STATION