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

The main truss structure continues past the translucent Kalwall cladding to form a canopy frame around the perimeter of the building and a covered walkway. Propming 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 hotel complex is made up of the sports science block to the south and hotel and conference facilities to the north, as well as an outdoor pitches, including one replica Wembly stadium pitch.

A 75 m-wide by 120 m-long structure houses the full stand 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 45° to add to the appeal of the building.

“Steelwork is 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 480 mm at the base to 150 mm at the column.

Each portal frame is spaced at 13 m centres and diagonal bracing is applied on all perimeter walls. The main columns sit on 3 m by 3 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 vertical columns.

The main columns sit on 3 m by 3 m deep pad foundations supported off vibro-compacted ground.

“Almost all the columns are cigar-shaped, tapered at their ends. Purlins on the top boom are designed to be polyester powder-coated to match the trusses,” says Mr Bloomfield. The roof, including the central two sections, was fitted with 120,000 square meters of Kalwall cladding.

“Two 100-tonne mobile cranes lifted up the central two sections, which are connected via baseplates to pile caps before the roof was erected. ‘The trusses came in quarters,’ recalls Bowmer & 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.”

Steelers were able to install three trusses a week, and the whole structure was up in just six weeks.”

The main truss structure continues past the translucent Kalwall cladding to form a canopy frame around the perimeter of the building and a covered walkway. Propming 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 pool, the steelwork had to be polyester powder-coated to make it more resilient to chlorine gas 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 made up of curved steel sections when viewed from below,” Mr Bloomfield says.

While the indoor pitch, sports science and multi-sports hall are primarily steel, there is more conventional here, being

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 banquet suites, the reception and swimming pool. The roof is also steel-framed to accommodate plant.

Currently on budget and on schedule, 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.
The new director general of the British Constructonal 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 news 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 sectors 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 chains 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 processors, 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 Europe, the former Yugoslavia, as a market for exports of Australian wool. “I saw first-hand the impact that we had on the industry and constructional steel industry as well as on the Woolmark logo and the association is being branded with the Woolmark,” says Ms McCann-Bartlett. “I’m sure that the Woolmark Company, an Australian organisation that developed the widely recognised mark of wool quality found on textiles and clothing.”

“We want to promote the efficiency of building 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 materials at cradle to gate – that is, from its point of manufacture to when it leaves the factory. 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.
The steel frame of a new budget hotel in central Liverpool has been able to connect a complex façade of masonry, cladding and glazing. The hotel related to the area – this is provided in the nautical and rope-making-themed artwork which is applied onto 18 panels of glazing in the foyer (see box). Steelwork for the main hotel and retail units has already been erected, with the tricker 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, 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 Seel 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 street-side 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 unplanned 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 supported and piled foundations installed. Fear of excavating, screening, crushing and re-compacting 12,000 sq m of made ground as part of the demolition contract improved its properties so that piled foundations onto sandstone bedrock and a ground-bearing slab need only be built.

Crushed and screened demolition rubble from a 1960s mansion block 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.

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 street 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 floor 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,” explains Curtins project engineer 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 of the different sorts of connections required, but steel was more than capable of doing so.”

Street-facing elevations are accurately dried out 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 7.2 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 onto 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 columns 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
Spars 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 Curtis 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 brickwork 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 to get this right, but when the project started on site, it really helped with coordination issues and 3D modelling on site could fly up,” adds Mr Jones.

Steelwork contractor Evadix also installed the precast stairs to be designed discretely with its own stability system due to lack of continuity across the depth of the building.
CHOOSING A CONTRACTOR

RUBY KITCHING

It’s well known that changes made to a building or bridge’s design when it is under construction have huge implications on the success of a project. Many sorry tales have been told about jobs which should have been remembered as technically exciting and visually stunning, but became entrenched in bad feeling because of changes that resulted in claims. According to BCSA president Ever Roberts, Building Information Modelling (BIM) could be the thing that iron out the details of a design before it gets onsite, while ridding the industry of the “claim 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 upfront, 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 on 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 referrals 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 feel for the 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 2004 (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 is 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.

The BCSA is preparing for CE marking (CEM) of structural steelwork to be mandatory across all member EU countries in July 2001 (including the UK and Republic of Ireland). CEM is a way of ensuring a product meets the minimum requirement for health and safety. All sections and structural bolts are assessed against a “harmonised” standard. This is different to the same across all member states.

“The standard is the performance characteristics for the product, the values for which are declared by the manufacturer on ECE/EN 1090-1 – EN 1090-2 – EN 1090-3 standards. This is the same across all member states.

“It is really about health and safety because the performance characteristics identify how the product performs in service, how strong and durable it is and how the characteristics identify how the product performs.”

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

BCSA GETS READY FOR CE MARKING

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

- EN 10029 – Cold formed tubes and sections
- EN 10399 – Preloadable bolts
- EN 10348 – Non-preloadable bolts

To satisfy the requirements on CEM for fabricated steel, steelwork contractors need to have complied with a certified Factory Production Control (FPC) system. This may require adoption of a Tower Quality Management (WQM) system for steelwork products with BSI EN 10 344.

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 a European Technical Assessment report and guidance to setup and implement CEM, FPC and WQM systems.

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 of the six criteria the 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 personal training, development and communication
6. A published health and safety 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

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 (RQCS).

Approximately 100 steelwork contractors are BCSA members. Each are assayed 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.

“BCSA members are steelwork contractors which is not a BCSA member or is 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.

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

**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 Cheltenham fire and rescue teams at Gloucester Sauch station’s life skills centre include putting 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 beams.

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.”

**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**

**RLBY KITCHING**

Gloucestershire Fire & Rescue Service is overseeing construction of four new fire stations to replace two older stations which date back to the 1960s and 60s. The project has been procured under a 20-year, 640 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.

**Keynsham Road and College Bath**

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, to go with 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 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 14 m-wide appliance bay 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 firefighting 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 beam, but partition walls can be moved about to suit future needs.

The centre is prepared to use the public on fire risks and other emergency situations which can arise, such as flooding. New stations are required to serve the community and ensure that the fire service deals with many emergency situations, other than fires.

The 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 fire fighters’ operational skills.

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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 four-floor steel beams of the main block and community block have been designed compostively 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 suspended ceilings that will accommodate services in the ceiling void. The design team felt this, as opposed to feeding services through openings in section deeper 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 appliance bay to the community block is a covered walkway, created using glulam rafters and glazing.

The new station is being built using steel frames to ensure they are ready for action as soon as possible.