STEEL SPOTLIGHT: Structural Steel Design Awards 2016

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Kings of the castle

The medieval Harlech Castle in north Wales has a dramatic new entrance: a snaking steel bridge, engineered with an eye on the aesthetics of this historic site

WILL MANN

Harlech Castle in north Wales is one of the best preserved medieval castles in Britain.

The 13th-Century structure sits on a rocky outcrop overlooking the Irish Sea and is Grade I-listed, a Scheduled Ancient Monument and part of a World Heritage Site.

Historically, visitors entered the castle up a timber walkway, which had no provision for disability access. Recently, Cadw, the Welsh Government's historic environment service, purchased the nearby Castle Hotel with a £6m plan to transform it into a new visitor centre and improve access to the castle via a 'floating' steel footbridge.

"Cadw had a clear vision for the footbridge, with aesthetics an important consideration due to the sensitive nature of the site," explains David Perry, contracts manager at the project's design-and-build steelwork contractor SH Structures.

The bridge had to connect from the visitor centre into the castle's gatehouse while maintaining a gradient suitable for people with impaired mobility, which constrained both horizontal and vertical alignments. At the same time, visual impact on views over the distant Snowdonia mountains had to be minimised.

Client consultant Mott MacDonald opted for a low profile 'S'-shaped Vierendeel truss design, comprising three 15 m spans plus one shorter span over the gap once crossed by the castle's drawbridge.

The first key area of design development was in the truss and deck configuration. The deck is mostly 2 m wide, increasing to 3 m over the middle support to provide a viewing area.

"The original proposal was for fin plates welded to the back of CHS Vierendeel truss braces to form the tee web in the handrail upright," Mr Perry explains. "However, this was changed due to fabrication challenges and the possibility of weld distortion.

"Instead, SHS bracing was used and the handrail upright orientation was reversed. The face of the bracing then aligned with the flange of the tee for the balustrade, which was tapered to give an elegant transition to the handrail. The bracing also gives improved structural capacity."

To maximise headroom clearances under the bridge and give a more efficient structural solution at the supporting columns, the depth of the truss profile was modified with the bottom chord formed from a combination of curved and straight sections of tube. Tapering the bottom chords of the trusses and eliminating diagonal bracing also helped create a less cluttered appearance.

"The bridge columns needed to be very stiff in

INTRODUCTION

The objective of the Structural Steel Design Awards (SSDA) is to "recognise the high standard of structural and architectural design attainable in the use of steel and its potential in terms of efficiency, cost-effectiveness, aesthetics and innovation".

Twenty-one projects made the shortlist in this, the 48th year of the SSDA. Judges presented five awards, five commendations and two merits at a gala ceremony held in London on 5 October 2016.

The judging panel included: chairman David Lazenby, representing the Institution of Civil Engineers; Richard Barrett and Joe Locke, representing the steelwork contracting industry; Professor Roger Plank and Martin Manning, representing the Institution of Structural Engineers; and Christopher Nash, Bill Taylor and Oliver Tyler, representing the Royal Institute of British Architects.

AWARD Harlech Castle Footbridge
Concept Designer Mott MacDonald
Structural Engineer David Dexter Associates
Steelwork Contractor S H Structures Ltd
Main Contractor RL Davies & Son Ltd
Client Cadw


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© Robert Leslie & Fletcher Priest Architects

the transverse direction, so an elliptical hollow section was used, partly filled with concrete," Mr Perry adds.

BIM modelling was used throughout the design process, and before work started on site, the castle's façade was digitally scanned and the 3D survey incorporated into design model. "This ensured the critical dimensional interface between the castle entrance and the bridge was achieved," Mr Perry says.

The limited site footprint and restricted access through Harlech posed major challenges to the installation team. S H Structures used a multi-wheel steer mobile crane for the steel erection and rear-wheel steer trailers for transportation to site.

The bridge structure was completed with fitting of the hardwood timber deck, the handrail, parapets and state-of-the-art LED lighting built into the balustrades. A duct was added under the deck with a view to running services under the bridge at a future date, which would allow the castle to host events and performances.

The new footbridge opened in summer 2015.

COMMENDATION 6 Bevis Marks Roof Garden, London

Architect Fletcher Priest Architects

Structural Engineer David Dexter Associates

Steelwork Contractor Tubecon

Main Contractor Skanska Construction UK Ltd

Client Bevis Marks Developments Ltd

The roof canopy is the most striking feature of 6 Bevis Marks, a recently completed 16-storey building in the City of London.

Built with a lightweight steel frame, it provides all-weather protection for a 204 sq m sky court through a fritted ETFE covering, wrapping up and over the garden and extending four storeys down the south-west façade to assist solar shading. The canopy intentionally follows the same criss-cross diamond grid as the Gherkin, which it overlooks.

"The desired scale, lightness and transparency for this canopy structure could only have been achieved through the use of steel framing," says James Packer, associate structural engineer at David Dexter Associates.

The structure consists of a continuous CHS diagrid frame, supported on eight tree columns, which are positioned according to the main building grid below. The columns are 355 mm in diameter and each one supports up to seven rafters – typically 193 mm-diameter CHS members.

Additional struts extend from the ends of the cantilevered main building steelwork and restrain the clad sidewalls of the canopy.

Due to the site constraints, the only feasible option was to fabricate and deliver the structure in individual pieces for assembly on the roof. However, to give a seamless appearance to the structure, the roof grid joints are fully welded connections, achieved using complex laser-cuts. Joints in the steel diagrid use hidden 'hand-cup' splices, where bolted connections are formed within the tubes themselves. The roof framework was trial-erected at fabricator Tubecon's yard prior to being delivered to site to ensure that each piece fitted correctly.

The seven-week project was completed in March 2014.

An inspiring steel tribute

The striking new Memorial Spire in Lincoln, which commemorates the 25,611 aircrew who lost their lives during the Second World War, is an unusual structure built from weathering steel

WILL MANN

There is a new landmark overlooking the city of Lincoln.

The Memorial Spire at the International Bomber Command Centre (IBCC), constructed from weathering steel, is a striking and fitting tribute to the 25,611 aircrew who lost their lives in missions during the Second World War.

The site on Canwick Hill was chosen because of Lincolnshire's status as 'Bomber County' during the war, being home to a third of the UK's Bomber Command bases.

And the design of the steel spire has been influenced by the planes that flew sorties from the local airbases.

Marc Horn, managing director of structural engineer s h e d, explains: "The design was originally more conical, but we worked with the architect to transform the shape into wing-like blades which reference the airframe and wings of a Lancaster bomber, and which also work structurally."

The structure represents two wing fragments which taper towards the sky and are separated by perforated plates similar to those used in the aircraft's frame construction. The spire stands 31.9 m high – the same span as a Lancaster bomber's wing – while the base measures 5 m across, the same width as the aircraft's wing.

The spire's orientation was also carefully considered. "It is positioned so that visitors can look through the spire and see a framed view of Lincoln Cathedral," explains Tim Burton, sales and marketing manager at steel contractor S H Structures. "The cathedral spire was familiar to the aircraft as a welcoming landmark when they returned from sorties during the war."

AWARD The Memorial Spire, International Bomber Command Centre, Lincoln

Architect Place Architecture

Structural Engineer s h e d

Steelwork Contractor S H Structures Ltd

Main Contractor Lindum Group Ltd

Client The Lincolnshire Bomber Command Memorial Trust

Steel was the preferred choice of material for the structure, but the use of weathering steel meant the structural calculations were altered slightly. "We examined the Angel of the North sculpture, which also used weathering steel, to see how it had performed," Mr Horn explains.

"About 2 mm of the steel will weather at the surface, so you cannot rely on that for structural strength. But of course the weathering also provides protection, so the spire will be maintenance-free."

The plates were cut from S355J2W normalised rolled weathering steel plates, which satisfied all the structural and aesthetic requirements of the project. The external profiled plates had to be curved to create the wing-like form.

"This was achieved by press-breaking the individual plates to the desired shape, using files extracted from the 3D model," Mr Burton says.

"The digital model proved very useful," Mr Horn adds. "Initially, as a means of swapping ideas between ourselves and the architect, and then it was also used by S H Structures for their 3D plate model."

Once fabrication was complete, the two sections of the spire were taken to a local industrial painting facility. Here they were shot-blasted to remove fabrication marks and allow the sections to develop an even patina as the weathering steel turned its familiar rusty colour.

One area given careful consideration was the welding. The two sections were lifted into position on site and held in place using a temporary bolted connection until they were welded together.

"S H Structures volunteered to site weld it – which some fabricators are not keen on – but it gives the most elegant finish," Mr Horn explains. "That is one reason why we chose S H Structures. Site welding created the seamless effect we were looking for, whereas bolted connections would have detracted from the appearance."

As a final detail, the steel panels were laser cut with the names of the aircrew who lost their lives during the Second World War.

The IBCC Memorial Spire was officially unveiled on 2 October 2015 in front of a crowd of 2,600, including 312 Bomber Command veterans, thought to be the largest gathering since 1945.

'The Diamond' is a new, 19,500 sq m undergraduate engineering facility for The University of Sheffield, which derives its name from its exterior façade of interconnected diamonds in anodised aluminium, fitted to the glass cladding.

Although much of the structural frame was built from reinforced concrete, steelwork was necessary for the many unusual design elements and complex bridging, including 25 m spans across the central atrium.

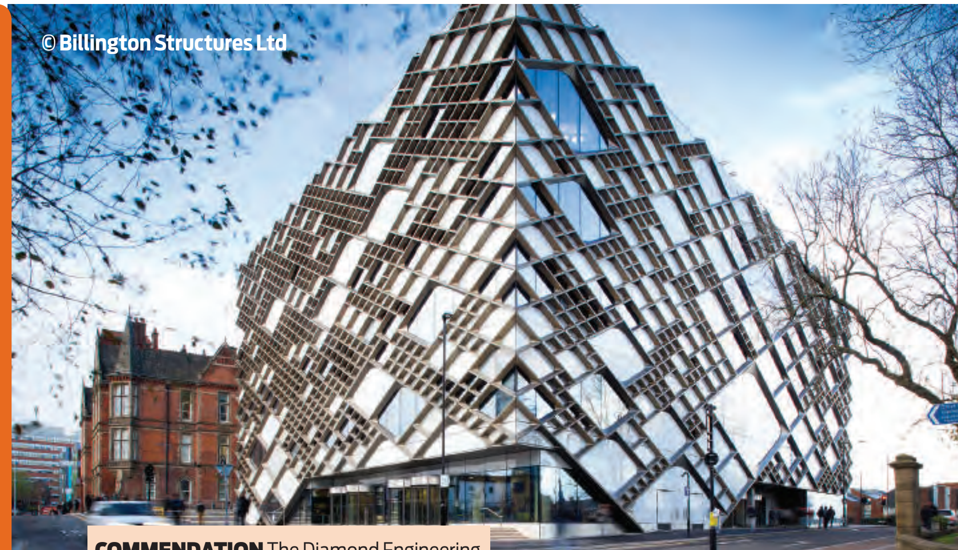
The interior of the six-storey building comprises a public access route at ground-floor level, the first-floor atrium, plus classrooms, laboratories and offices arranged to the north and south of the atrium with full-height glazing to maximise internal views. The atrium is criss-crossed with bridges and contains a spiral staircase as well as several enclosed learning pods on stilts.

"The Diamond is a showcase for innovative engineering, so important aspects of the structure have been exposed – for example, orange paint on bracing elements," explains Arup senior engineer Amy Boulton.

The signature diamond pattern on the façade continues in the atrium, with a diagonal grillage of steelwork used to provide lateral restraint. "By using a grillage rather than individual members, it was possible to maintain a shallow section," Mr Boulton says.

All steelwork below roof level was bevelled including the curved window frames. The vertical load from the five-storey glazing was carried by a pair of single-storey trusses integrated into the roof, which minimised the structural steel visible on the façade.

Work began in July 2013 and was completed in time for the autumn 2015 semester.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COMMENDATION The Diamond Engineering Building, The University of Sheffield

Architect Twelve Architects

Structural Engineer Arup

Steelwork Contractor Billington Structures Ltd

Main Contractor Balfour Beatty

Client The University of Sheffield

COMMENDATION Land Rover BAR America's Cup HQ Building, Portsmouth

Architect HGP Architects Ltd

Structural Engineer Reuby & Stagg Ltd

Steelwork Contractor T A Colbourne Ltd

Main Contractor Allied Developments Ltd

Client Land Rover BAR

Construction of the HQ for Sir Ben Ainslie's challenge to host the America's Cup in 2021 faced an immensely complex programme.

The team on the Land Rover BAR (Ben Ainslie Racing) Team building in Portsmouth Harbour were given barely 12 months to complete the project from the start date of February 2014. "This was before the planning application had been submitted and while the structural design was still being developed," explains Malcolm Reuby, director at structural engineer Reuby & Stagg.

The building houses a ground-level manufacturing facility for racing boats around three storeys high, plus three upper floors for support facilities and a visitor centre, each different in size and shape from the one below and with large external terraces at every level.

Steel offered many advantages on the project, Mr Reuby explains. "The layout of some areas was not fully resolved when fabrication commenced, but the adaptability of steelwork meant that the structure could still be completed without slippage of the completion date," he says.

"30-tonne overhead cranes had to be installed in the ground-floor manufacturing area, so steel was necessary to achieve the long spans required. The light structure enabled us to minimise pile numbers and sizes and foundation costs, and we could commence superstructure erection before below-ground construction work was complete."

The floors were constructed from insitu concrete cast on a metal deck for reasons of cost, speed and weight, with cellular beams accommodating services.

The manufacturing facility was ready for handover in March 2015 with the whole project completed in June 2015.

Raising the Olympic roof

One of the most complex legacy projects following the 2012 Olympic Games in London was the transformation of the main stadium – including construction of a vast 45,000 sq m cantilever roof

WILL MANN

The Olympic Stadium was the iconic centrepiece of the London Games in 2012, but since that memorable summer it has undergone a massive transformation to prepare for life in 'legacy mode'.

The venue still hosts athletics events, but is occupied primarily by West Ham United FC and used for other sporting events that require spectators to be closer to the pitch. Because of this, the reconfigured stadium now includes retractable seats and – in the biggest change of all – a 45,000 sq m cantilever roof.

This vast structure, with a maximum free-spanning length of 84 m, is nearly six times the weight of its predecessor. To meet UEFA rules, it extends fully over the retractable seating. Building this steel-framed structure has come with considerable challenges.

The roof includes 8 km of steel cables weighing 930 tonnes, 112 steel rafters, 2,308 purlins, 422 struts, 9,900 roof panels and 14 light towers or 'paddles' each weighing 43 tonnes. The whole structure weighs around 4,700 tonnes, meaning far greater loads had to be accommodated compared with the original roof.

"The structural design is primarily a gravity-stressed cable net roof," explains BuroHappold Engineering associate Tim Finlay. "The previous roof design was a lightweight tensile fabric system, but that would not have been suitable for the new roof because of its size. So the solution was a design where the steel cables carried most of the downward vertical loads, in similar fashion to a suspension bridge.

"Additionally, the supporting structure required considerable strengthening. Around 80 per cent of the existing columns were replaced, some were strengthened, while others were strong enough to remain in place."

Besides the existing structure, strengthening works were carried out to the foundations, V-columns and the perimeter compression truss that runs around the exterior of the stadium.

"The compression truss was the main structural element retained from the original roof and it gives the stadium its external identity," Mr Finlay says. "The cable net design allowed us to retain the truss. It has been strengthened, but we have not replaced any of the members."

The front and back roof structures have been designed to be independent of each other. At the front of the roof, pitch-side, the loads are carried by a tension ring.

"Because of the varying length of the spans, which obviously means the loads vary, the tension ring is not flat," Mr Finlay explains. "It is actually saddle-shaped, so it rises up in certain areas where the load is higher."

The oval shape of the stadium, and the varying movement and tolerance requirements, meant that single pieces could only be replicated twice, so half of the stadium structure was fabricated with unique members.

Steel contractor William Hare began work on the roof structure once the V-column and compression truss strengthening was complete. Starting at opposite ends of the stadium, the erectors worked in two teams in a clockwise rotation, constructing the back roof first, then the

AWARD London Olympic Roof Conversion
Architect Populous
Structural Engineer BuroHappold Engineering
Steelwork Contractor William Hare
Main Contractor Balfour Beatty Major Projects
Client London Legacy Development Corporation

front roof with lighting paddles and walkways.

The 14 new lighting paddles are positioned beneath the new roof, unlike during the Olympics, when they were on top. During installation, the front roof was temporarily tied to the back roof to ensure the lighting paddles did not overturn, until the full structural integrity of the front roof was achieved.

The front roof members were pre-stressed in their permanent condition. "Had the front roof been allowed to deform during installation, Hare would have found that the circumferential elements were too long when they came to install them," Mr Finlay says.

Four 600-tonne capacity cranes operated in tandem to lift the lighting paddles and the other roof members into position.

Construction was complete in May 2015 in time for the Anniversary Games the following July.

MERIT Energy from Waste Facility, Ardley
Architect Architecture and Planning Solutions and TSP Projects
Structural Engineer TSP Projects
Steelwork Contractor Bourne Steel Ltd
Main Contractor Clugston Construction
Client Viridor

The Ardley Energy from Waste Facility has an unusual undulating form which was designed to sit low in the Oxfordshire countryside.

The plant, which will generate enough electricity to power 38,000 homes, is 229 m long, with its width varying from 38 m to 70 m. Its height ranges between 15 m and 35 m, though the stack is some 70 m high.

"Steel was the natural choice for the main frame due to the curved, convex and concave shapes, both on plan and elevation, together with the internal clear height and space requirements," says Bourne Steel divisional managing director Nick Hatton.

"The use of steelwork meant the shape requirements could be created, while still providing large unobstructed internal space requirements for the plant and equipment."

The internal processing machinery takes up most of the facility's internal areas, and 3D modelling was used to avoid clashes between the plant, equipment, supporting secondary steelwork and the main frame.

As the internal process plant and associated secondary steelwork were built ahead of the main frame enclosure, modular assemblies weighing up to 40 tonnes were used for the roofing steelwork that supports the cladding.

"These were installed using 800-tonne mobile cranes, as we had to work over the plant areas and only had access along one side of the building," Mr Hatton explains.

Bourne Steel used more than 2,000 tonnes of structural steelwork on the project, most of it hot-dip galvanized to provide corrosion resistance and reduce future maintenance requirements.

The facility was completed, commissioned and became fully operational in mid-2015.

Steel drives Manchester

The soaring South Stand extension at Manchester City's Etihad Stadium is a complex piece of engineering – and had to be built during the football season

WILL MANN

AWARD South Stand Expansion, Etihad Stadium
Architect Populous
Structural Engineer BuroHappold Engineering
Steelwork Contractor Severfield
Main Contractor Laing O'Rourke
Client Manchester City Football Club

The South Stand extension to the Etihad Stadium is the latest statement of ambition from Manchester City Football Club.

Originally built for the 2002 Commonwealth Games then reconfigured for football use shortly after, this latest project at the venue will add an extra 6,000 seats and, with a further 1,500 at pitchside, take total capacity up to 55,000.

Arguably, construction of this third tier on the South Stand has been the most challenging of the three contracts delivered at the stadium.

"We had to create an architecturally sympathetic extension of the existing catenary-ringed structure, which did not compromise its integrity, while ensuring the stadium remained operational throughout," explains BuroHappold Engineering director Fergus McCormick.

Work got under way in April 2014 with a target completion date of August 2015.

Steel was the clear choice of material for the primary structure. Steelwork contractor Severfield fabricated and installed 4,000 tonnes of structural steelwork for the project.

"The strength-to-weight ratio of steel made it the only choice for the long-span roof, formed from steel box section girders 45 m long," Mr McCormick says. "Steel also provided an advantage over concrete for the bowl frame because it could be constructed rapidly."

The interfaces with the existing stadium structure posed considerable design challenges, most notably at the roof. The original roof was a cable net structure with a tension ring, from which the steel roof rafters hung.

"The structural integrity of the tension ring relies on it running around the whole circumference of the stadium, so this could not be affected by any modification to the roof," Mr McCormick says.

This issue was further complicated by the need for the stadium to remain operational during the 2014/15 football season.

"On comparable projects, an additional tier is often built behind the stand and a new roof constructed over the existing roof, with little interaction between old works and new," Mr McCormick explains. "This was not possible at the Etihad due to the roof profile and stand supports extending back behind the seating, meaning the new upper tier would have projected through the existing roof profile."

Instead, an interim roof solution was devised. This involved cutting and removing the back of the existing roof, including column supports, and meant that significant and complex temporary works were required.

"We had to install a system of temporary steel columns and bracing, which effectively mimicked the old support system," Mr McCormick explains.

"As we were changing the load path, it required considerable care and monitoring to ensure the performance of the new temporary structure was in accordance with the original structure."

The partial removal of the existing roof, along with installation of the temporary propping, was carried out in the 2014 close season, allowing work to proceed behind the existing roof on the structure for the new top tier once the 2014/15 season commenced.

The remainder of the existing roof was removed in the 2015 close season, an intensive work period that saw the new top tier completed and its roof added. "Around 7.5 weeks' of work was delivered in less than four weeks," Mr McCormick reckons.

The availability of a CTL 1600, one of the world's largest tower cranes, was a big help. "It allowed much larger lifts, speeded up construction and reduced the need for working at height splicing components," Mr McCormick says.

Again, temporary propping was required to support the rafters of the new roof, before the loads were transferred to the new cable stays.

The extension, completed in 16 months, was opened on the 16 August 2015 in front of a record crowd of 54,331 people.

City's ambition

The new Lagan Weir Pedestrian and Cycle Bridge is an elegant, curved structure in central Belfast, built to replace an existing footbridge. The steel bridge has a length of 120 m and is 8 m across at its widest point.

The design concept was "a blade crossing the River Lagan" to provide views to the sea and weir cascade, according to Aecom senior structural engineer James McCann.

"This was realised by detailing metallic silver aluminium cladding with a bull-nosed tapered edge profile, which wrapped around the steel structure and minimised the apparent depth of the bridge," he explains.

"The primary deck and supporting 'tree' structures were designed to appear as slender as possible, and the deck is curved in both plan and elevation."

The 'trees' rest on four reinforced concrete piers that supported the old bridge. The new deck is wider than the original and cantilevers beyond the front face of the support piers, so had to be as lightweight as possible. "The design considerations meant steel was the obvious choice of material," Mr McCann says.

Local steelwork contractor M Hasson supplied 270 tonnes of structural steel for the project, which was transported to the river bank and assembled into sections prior to installation. Ten deck modules, weighing up to 25 tonnes, were lifted into place using a 750-tonne capacity mobile crane.

The support 'trees' were laser-cut from CHS sections, each weighing 6-8 tonnes. Some 725 aluminium cladding panels were required, many with unique dimensions.

The 46-week project was finished in June 2015 in time for the arrival of the Tall Ships Race in Belfast the following month.

COMMENDATION Lagan Weir Pedestrian and Cycle Bridge, Belfast

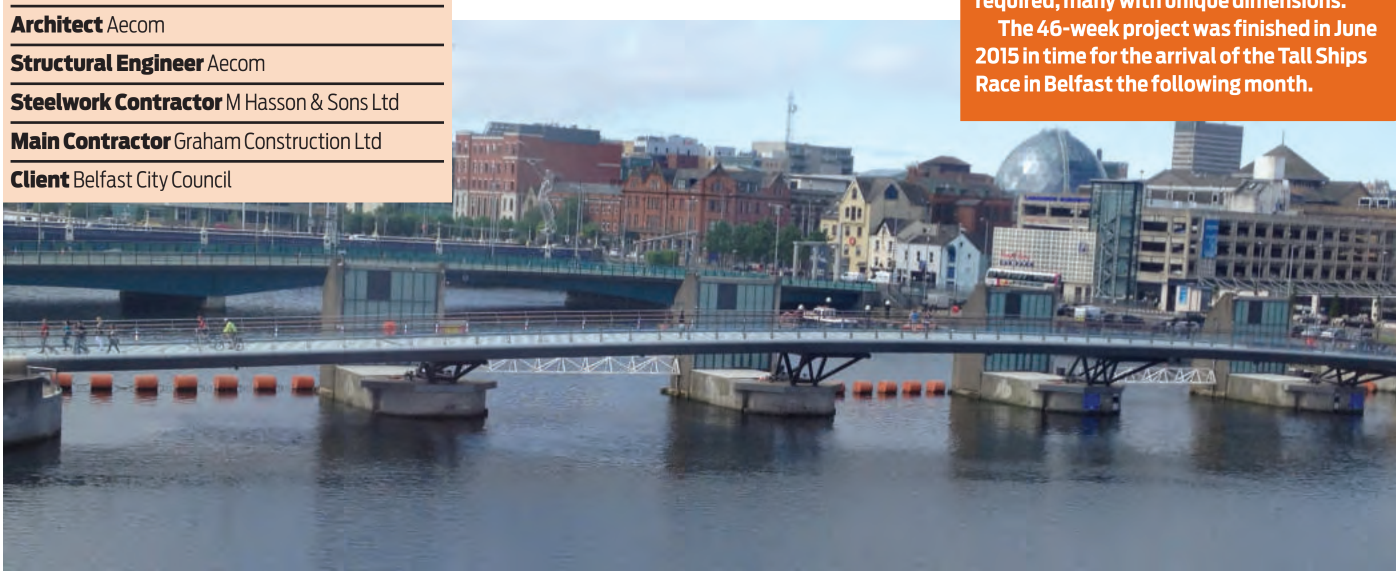
Architect Aecom

Structural Engineer Aecom

Steelwork Contractor M Hasson & Sons Ltd

Main Contractor Graham Construction Ltd

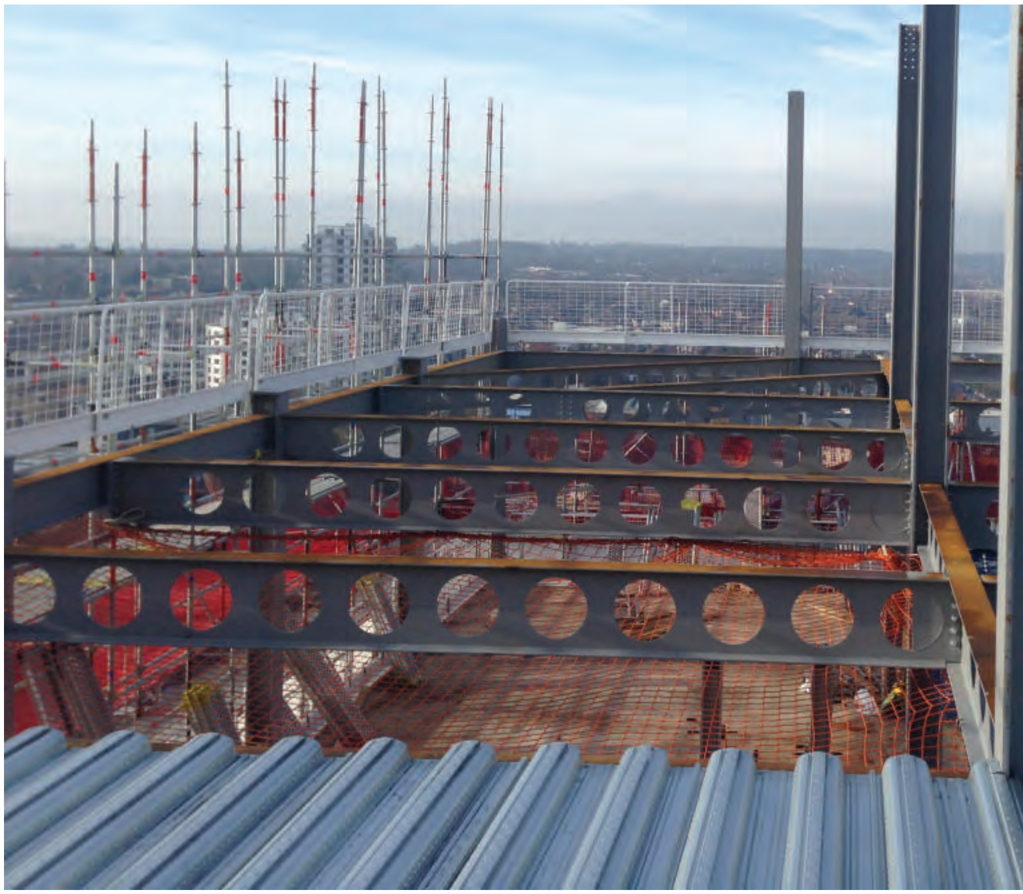
Client Belfast City Council



Steel revamps old block

A 1970s concrete office block has been given a complete makeover thanks to clever use of structural steel

WILL MANN



The Thames Tower in the centre of Reading, a once unlovely 1970s office block, has been given a new lease of life thanks to an ingenious steel-led refurbishment.

The 11-storey concrete-framed structure was set for demolition, with a 25-floor tower earmarked for the site. However, structural engineer Peter Brett Associates came up with an innovative design proposal which retained the existing core, strengthened the frame and added a five-storey extension above the roof.

The outcome is an enlarged footprint at each floor level which, along with the new floors, substantially increases the lettable space, while providing significant cost savings compared with the new-build proposal.

Steel, including the use of a lightweight frame for the new upper floors, was central to Peter Brett's refurbishment plan.

"Steel framing using composite floors provided a lightweight solution for the upwards extension, and made the project more cost-effective both in terms of a fast programme and avoiding the need for strengthening the existing foundations," explains Peter Brett Associates engineer Roderick Wilson. "Some strengthening of the existing frame was required, using steel plate bonding, but the lightweight steel frame extension meant these were kept to a minimum, with only the internal columns of the upper four storeys and the perimeter columns on two storeys requiring these works."

The 15 mm-thick stiffening plates were installed to the full width of the internal columns between the block's top four levels. The columns were initially ultrasonically scanned to avoid clashes with the steel reinforcement. The 282 stiffening plates, which required bespoke fabrication, were fixed to the columns with 14 resin anchor bolts and resin-bonded to the concrete face. 'Cruciform' stiffening brackets at the column heads helped disperse the upper load transfer.

In the existing structure, the main floor areas did not extend as far as the perimeter columns, and the corners were chamfered.

"To increase internal floor space, we removed the concrete parapets running between the perimeter columns, replacing these with steel support beams and a lightweight composite deck infill to extend the floorplate to the perimeter columns," Mr Wilson explains. "The corners were squared with another triangular section of infill, carried by a new steel column extending the full 60 m height of the building."

This work has increased the tower's floor space from 13,600 sq m to approximately 17,740 sq m of offices and 740 sq m of restaurant space.

The strengthening works, along with further stiffening plates and brackets at level 11, also meant it was possible to use a roof-mounted tower crane for the five-storey extension.

"The tower crane was installed approximately halfway through the steel site programme," says Glynn Shepperson, director at steelwork contractor Shipley Structures. "So all the internal steel members for the strengthening works had to be hoisted through the existing internal lift cores."

The new upper steelwork extension is connected to the existing frame at level 11, and is based around a 6.3 m x 5.8 m internal grid to match the columns below.

"Each floor is formed with Westok cellular beams that have kept the steel weight to a minimum, limiting the dead load on the existing structure below and allowing M&E services to be distributed within the structural depth of the steel members," Mr Shepperson explains.

Due to limited storage space on site, the upper extension was built on a floor-by-floor basis, starting with the primary steel frame, followed by the metal deck flooring and concrete topping at each level. The steelwork for the new floors was finished in December 2015. The whole project is due for completion in early 2017 and will be finished with new terracotta cladding to give the revamped building a more contemporary feel.

AWARD Thames Tower Redevelopment, Reading
Architect dn-a
Structural Engineer Peter Brett Associates LLP
Steelwork Contractor Shipley Structures Ltd
Main Contractor Bowmer and Kirkland Ltd
Client Landid Property Holdings Ltd

MERIT Leeds Station Southern Entrance	
Architect AHR Architects	
Structural Engineer Mott MacDonald	
Steelwork Contractor William Hare	
Main Contractor Carillion Rail Ltd	
Clients Network Rail Infrastructure, Ltd West Yorkshire Combined Authority	

The site of Leeds station's new southern entrance posed considerable challenges for the project team: a busy station environment, close proximity to live rail lines and the requirement to build above the River Aire.

The new entrance, constructed using a steel superstructure, aims to relieve congestion in the station and improve access to the south of Leeds. Architecturally it is striking, with a curved form, a glass and gold shingle effect in the cladding, plus an exposed steel diagrid structure in the interior.

The superstructure is supported by piled foundations and two concrete piers that have been built in the river. A 600 mm steel transfer structure at river deck level supports the superstructure columns, comprising a series of galvanized beams spanning 10.2 m between the piers and cantilevering 3.5 m beyond each pier to support the columns above.

"Offsite fabrication of the steel deck helped reduce construction time above the river, and offered health and safety benefits," says Mott MacDonald project manager Jon Svikis.

The entrance superstructure is a series of portalised arches at 1.8 m centres up to 20 m high and with a horizontal span of 12.5 m. There are 11 at river deck level and nine more over three railway lines to link with the main concourse.

"Modularisation also helped with construction above the railway; we worked in 10-hour possessions so as not to disrupt train services," Mr Svikis says.

To support the concourse extension, a new column was introduced on platform 15 over a Victorian masonry viaduct, which required strengthening with four plate girder ribs.

The project was completed in autumn 2015.

IMAGE COURTESY OF AHR ARCHITECTS/ DANIEL HOPKINSON

OTHER FINALISTS

- **Energy from Waste Facility, Peterborough**
- **New Watford Market**
- **University of Cambridge Primary School**
- **Sports Hall & Sixth Form Centre, Channing School, London**
- **South Bank Tower, London**
- **Whyke Horizon Footbridge, Chichester**
- **Strabane Pedestrian and Cycle Bridge, Co Tyrone**
- **Information Age Gallery, The Science Museum, London**
- **Kiosk and Shelter, Bournemouth Pier Approach**