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They’ve got it all covered

Hopkins Architects’ Brent Civic Centre in north London brings together a range of public services in an elegant structure crowned by a stunning ETFE and steel roof.

Text by Pamela Buxton

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The main elevation is dominated by the ETFE roof canopy spanning over a feature lantern "chicane".

COMMUNITY HALL

A central, multi-use space was needed within the 220m-diameter community hall to support the load of the hotel three-floor stack above. To achieve this, a single layer of exposed braced steelwork, incorporating the challenges for steelwork contractor Bourne, was utilised. The structure is formed as a spider web, with 12 cross-braced trusses connecting the floor and radiating out to meet cambered roof plate at the structural cells. The cells are linked by steel rods that together form a tension ring. Further cross-connections were designed to cross-bolt the top of the adjacent members to provide adequate resistance across the span.

The atrium roof grid is formed by five, 30m-long plate girders, each measuring 800mm x 1,600mm. These were delivered in sections and worked on site and are linked by beams to form a 30m-wide and 45m-long grid. The beams are supported at their ends by 2.2m-diameter, circular hollow-section tapering columns, brought to site in two lengths and welded. At the top, the beams are fixed to a single level, the attic level roof. The structure is based on the grid, an additional element is provided to support the ETFE panels on all sides as well as dealing with rainfall run-off. The exposed nature of the steel structure and of the ETFE allows for a very high utilisation ratio, with no visual obstructions.

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Raising the main sails

Wilkinson Eyre’s Poole harbour crossing is a clever twist on the traditional drawbridge, with diagonal bascules that rise up like the masts of a ship

Text by Pamela Buxton

It takes just two minutes to open the latest Poole harbour crossing to allow busy maritime traffic to pass, and another two minutes to close it back down and allow road and pedestrian traffic to continue. Since it opened last year, the Twin Sails bridge at the entrance to Holes Bay has greatly reduced the severe road congestion that used to occur every time the existing bascule bridge rose up to allow vessels to pass. As well as these practical benefits, the bridge, designed by Wilkinson Eyre, adds a sail-like flourish when in open mode in reference to its context.

The Twin Sails opening, which spans a narrow stretch linking Poole harbour with the north-eastern control of Holes Bay, took 10 years to realised after Wilkinson Eyre won a design competition in 2003. The project was not only more visual innovation but also to encourage regeneration of a piece of coastline at Hamworthy on the north side of the mouth by linking it to the dual lanes of Poole.

“Tried to robust, open, simple and subtle but [the client] also wanted it to be the catalyst for regeneration and at a cost at the same time,” says Randall & Associates’ Thompson, who was design project manager on the Poole bridge.

An above-deck structure could have been too forceful or too heavy. A rising bridge over the dual carriageway would have rung a series of significant infrastructures needed to construct it in the water. Instead, the designers decided on a new style box section made up of pre-cut, fabricated steel sections to be assembled using fieldwork techniques which mean there were no rotations on height. Instead of the conventional single-sagged bascule, the lifting portion of the bascule, the lifting portion, is triangulated, creating a double-diagonal bascule, making it easier for vessels, matching that of the existing nine-metre-thick bascule, the lifting portions of the bascules to rise twice the height of a conventional bascule bridge. The carbon-fibre masts on either side add an extra 20m of height, accentuating the sail-like quality of the bridge when in its raised position.

The striking form of the raised bridge also evokes the sails of Poole, evoking the sails of the many vessels that sail through the channel in the international sailing events, says Eyre. “At 2.5m in height, it is the tallest of its kind in the UK, with a central span of 140m to cover a time that opening for vessels, matching that of the existing bridge.

Twin Sails open hourly (5,000 times a year) and reveal their triangular, sail-like forms. “One of the key features is that the height of the bascules is such that the bridge appears to cross, in a reference to the shape of the sail-like forms. “The striking form of the raised bridge evokes the sails of Poole, evoking the sails of the many vessels that sail through the channel in the international sailing events, says Wilkinson Eyre partner Jim Eyre. “The drama of Twin Sails has been created by turning the joining into a diagonal, longer, diagonal opening of two triangular leaves enables the bascules to cross 30m onto a pivot bearing on the other side of the span near the apex of each triangle. This gives more support and less differential movement, and meant the need for a mechanical interface. The hydraulic ram opening mechanisms are housed in the main pier, with each actuator and control unit, equipment and plant room. The 125mm high vertical LEDS at the top are contained off the top of the bascules to give an extra 20m of height, meaning the tensile arm that was used to anchor the sail-like bascule on its raised position.

THE DECK STRUCTURE

The road and segregated cycle and pedestrian structure with cantilevered steel armatures on both sides supporting the aluminium-decked, 2.6m-wide pedestrian walkways. The deck has a maximum depth of 1.4m. The deck is supported on its edge by a 120mm-deep box beam with a 100mm-deep cantilevered steel armature on both sides supporting the aluminium-decked, 2.6m-wide pedestrian walkways. The deck has a maximum depth of 1.4m. The deck is supported on its edge by a 120mm-deep box beam with a 100mm-wide steel armature.

THE SAILS

As the two 35m-long bascules rise through 90 degrees to open the bridge, the bascule height is increased by about 8m, giving the bridge a sail-like appearance. The sails of the traditional drawbridge rise to a height of 19m above the bridge to allow vessels to pass. The bascules are on new standard double-diagonal bascule, the lifting portions of the bascules to give an extra 20m of height, accentuating the sail-like quality of the bridge when in its raised position.

The triangular sections rise up to twice the height of a conventional bascule bridge. The carbon-fibre masts on either side add a further 20m.

THE SAILING

The 2.4m-wide walkways on either side of the bridge are separated from traffic by a stainless-steel screen that is designed in a wave form.

CONSTRUCTION

The bridge was fabricated in large sections by Cleveland Bridge and assembled on site. The sections were cast into place by the construction team on the site where they were fixed by the time the tide fell.

SECTION OF THE BRIDGE DECK
When Hawkins\Brown’s biochemistry building was under construction, structural and civil engineer Peter Brett Associates carried out carbon dioxide audits of three design scenarios. This led to the choice of steel for the structural frame, with the whole building back-hauling 2500m³ of concrete from above ground level to the site. The building was an advantage given the congested nature of the site. The construction programme was also faster. In a steel composite frame, the embodied carbon figure was 8% less CO₂ than the concrete option. This was an advantage given the congested nature of the site.

The research found that embodied carbon is also being given more attention in the current draft of BREEAM assessments. Fresh Steel, a building systems specialist, recently appeared in the government’s report ‘The Next Industrial Revolution’. It is predicted that the steel industry will continue to be one of the leaders in innovation and development, as the industry is also heavily invested in R&D. An ability to be re-used and re-cycled means that steel is an essential structural element for future buildings.

EMBODIED CARBON

Although the construction industry is not the only sector to benefit from this, it is one example of embodied carbon. The embodied carbon of buildings is an issue for now. As we make our materials and build our buildings, carbon is emitted which will only contribute to the overall embodied carbon of the building. Buildings that are efficient in their use of materials and energy will need to find new ways to reduce the embodied carbon of their buildings. The use of more efficient and less carbon-intensive materials and energy will result in a decrease in the overall embodied carbon of a building.

Where the embodied is buried

PBA’s graph shows the rise in embodied carbon as a proportion of total carbon emissions for a hypothetical building project. This demonstrates that embodied carbon is an issue for now. As we make our materials and build our buildings, carbon is emitted which will only contribute to the overall embodied carbon of the building. Buildings that are efficient in their use of materials and energy will need to find new ways to reduce the embodied carbon of their buildings. The use of more efficient and less carbon-intensive materials and energy will result in a decrease in the overall embodied carbon of a building.

CASE STUDY 1: TYPICAL CITY-CENTRE OFFICE BUILDING

Peter Brett Associates (PBA) carried out embodied carbon analysis of steel and concrete structural solutions for a hypothetical office building, as part of Steel & Style research commissioned by Cement & Concrete, compiled by the RIBA. The study showed that embodied carbon was significantly lower (between 50-70%) for the steel frame than for the equivalent concrete frame for that particular building scenario. In the research, the base building was constructed both using steel and composite steel and concrete. The building had a 30m floorplate with a 4.5m ceiling height. The building was assumed to have four-pipe fan-coil air conditioning without natural ventilation. The building envelope was lined with cold rolled metal studwork, insulation and plasterboard. The building was assumed to have four-pipe fan-coil air conditioning without natural ventilation.

The steel-framed version was constructed using composite slabs and beams and composite slab and has 60 minutes fire resistance. The concrete uses post-tensioned band beams and slab with in-situ columns. The overall floor-to-floor height is 4.18m for the steel option and 4.375m for the concrete option. The steel-framed option is 60% cheaper and 8% lower in embodied carbon than the concrete option.

New Life

Steel’s ability to be re-used and re-cycled and that embodied carbon is significantly lower between 18-30% for the steel frame compared to concrete. The figures are based on benchmark figures and estimates for the 2009 Olympic stadium in London. In this, 2,500 of the 3,850 tonnes of steel tubing used to make the roof trusses was reclaimed and recycled. This was done to ensure that the steel would not lie around in scrap yards and could be recycled. The building had a recycled materials content of 30%.

The Olympic stadium was designed by Populous. In this 2,500 tonnes of steel tubing used to make the roof trusses was reclaimed and recycled. This was done according to the London 2012 Sustainability Plan. The plan was to ensure that the steel would not lie around in scrap yards and could be recycled. The building had a recycled materials content of 30%.

While reclamation is extremely rare, more buildings are now being designed with re-usability in mind. This is in response to the growing awareness of embodied carbon and the need to reduce the environmental impact of buildings. Buildings are now being designed with re-usability in mind. This is in response to the growing awareness of embodied carbon and the need to reduce the environmental impact of buildings.