TATA STEEL

Case study

Lansdown Stand, Ashton Gate Stadium, Bristol

End Client: Ashton Gate Stadium

Architect: KKA Architecture

Main Contractor: McLaughlin & Harvey Construction Ltd

Consulting Engineer: Jacobs

Structural designer and fabricator: J&D Pierce (Contracts) Ltd

Tata Steel Products: Celsius® 355 Circular Hollow Section

Year: 2016

The new Lansdown Stand at Ashton Gate Stadium in Bristol was opened in 2016 as part of a major redevelopment scheme. The stand utilises around 1,800 tonnes of structural hollow section and features an impressive, large-span roof. The roof is formed from a 108m long, triangular-shaped main truss supported by large tubular columns at the gable ends. The truss, weighing almost 250 tonnes, supports the roof members which span from the rear of the stand.

Tata Steel's Celsius® 355 circular hollow section was selected for the critical roof application. Hot-finished, this structural section is fully stress-relieved and delivers a minimum strength of 355MPa – for reliable performance in the most arduous conditions. The consistent strength and tolerance delivered by Celsius 355 were important factors in the successful design and fabrication of the bespoke truss arrangement. Throughout the detail design phase, Tata Steel's Customer Technical Services team was on hand to assist with the design of complex welded joints.

Raising the roof with Celsius® 355 hot-finished structural hollow section

The challenge

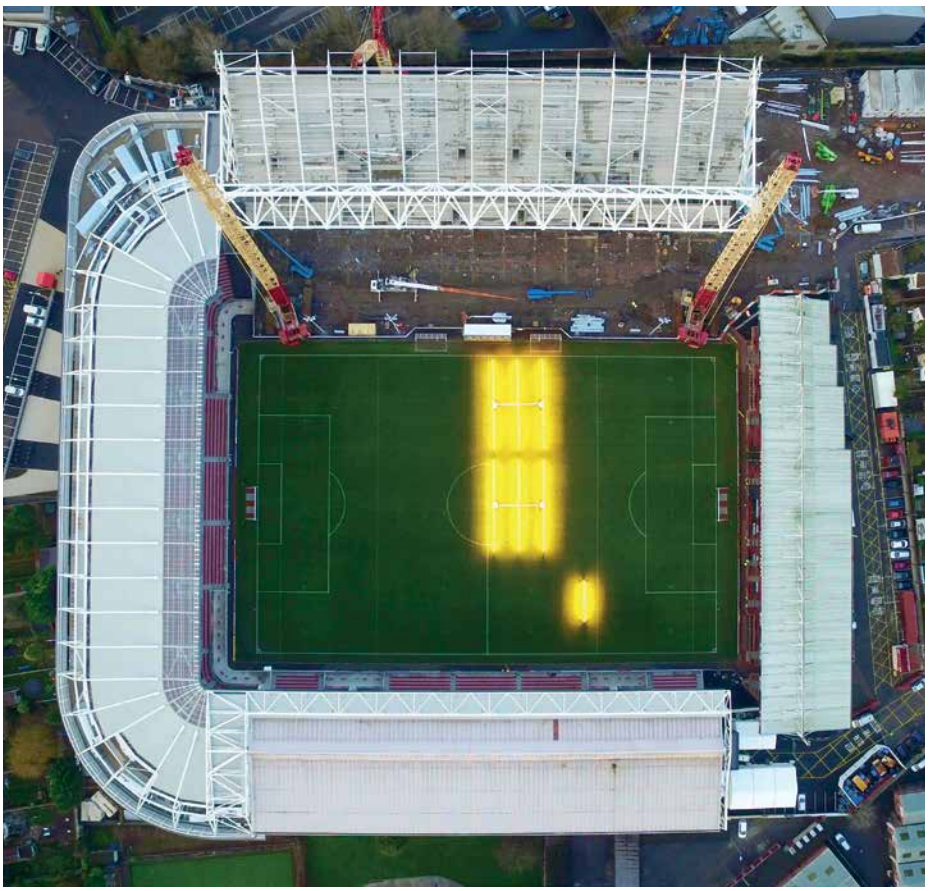
Ashton Gate Stadium is the home of Bristol City FC and Bristol Rugby and is the largest conference and events venue in the South West. The new Lansdown Stand is part of a £45 million re-development programme to create a state-of-the-art 27,000 capacity stadium. Work on the stand began in 2015 with the demolition of the old Williams Stand. The new replacement stand was officially unveiled in time for Bristol City's opening game of the 2016-17 season on 6 August 2016.

The stand, designed by consulting engineers, Jacobs, incorporates around 1,800 tonnes of structural hollow section. It features a complex, triangular-shaped roof truss spanning 108m. The large truss, with its highly engineered components, was fabricated by Ayrshire-based J&D Pierce (Contracts) Ltd.

"There were many challenges on this project – from designing connections for strength and then for aesthetics and then for fabrication. The fabrication detail itself was a major challenge and that led into a very difficult and heavily-planned site phase."
Angus Cormie, Chief Engineer at J&D Pierce.

The criticality of the roof members demanded circular hollow section with proven, consistent strength and reliable tolerance. Precise and reliable loading calculations were vital to the successful design of welded joints in the complex truss design. The architectural requirement for visible truss connections – with no outstands and a continuous 'look' to the hollow section – also posed challenges, with complicated details required for the fabricated steel-to-steel connections.

Ashton Gate Stadium remained live during the development of the Lansdown Stand. Site constraints, coupled with the need for safe, timely and cost-effective roof installation, called for a well-considered approach to erecting the main support truss.



The solution

Tata Steel's Celsius 355 was selected for construction of the Lansdown Stand roof. Fully normalised for reliable performance in critical applications, this high-strength structural section offers a range of benefits including weight savings and dimensional consistency for efficient fabrication.

Celsius 355 – in sizes up to 711mm – was used in the roof's main support truss which spans 108m onto large raking tubular columns at the gable ends. The rafters span from the rear of the stand, underneath the truss, and project beyond to provide additional spectator protection. Roof and building stability was gained through use of an extensive diagonal bracing system in the plane of the roof transferred to the rear and the gables.

The bespoke truss arrangement required careful consideration of the welded joint design – especially for the most critical joints with the highest loadings. Angus Cormie said: "We were required to carry out the CIDECT validity checks. The configurations did not match standard software output so we had many discussions with Tata Steel's technical advisory team as we strived for acceptable output. Timescales were challenging and the Tata Steel team assisted and offered good suggestions to get us over the line on occasions when we were close to an acceptable result. Their support was critical in enabling us to complete the connection design."

Kieran Butroid, Technical Advisory Engineer at Tata Steel, assisted in the welded joint design. Kieran said: "For customers using our Celsius structural hollow sections, Tata Steel offers a joint design manual and proprietary software, compliant with Eurocode EN1993-1-8, as an aid to joint design and checks. At Ashton Gate, we were faced with a non-standard

arrangement of chords and braces – overlaid with aesthetic considerations – which posed a complex challenge for the most complicated joints and loading calculations. It was very satisfying to be able to assist J&D Pierce in reaching a satisfactory solution."

Commenting on the aesthetic requirement for visible truss connections with a 'fluid' appearance, Angus Cormie said: "It resulted in some complicated details for the main top chord splices with cruciform plate connections for the upper truss internals."

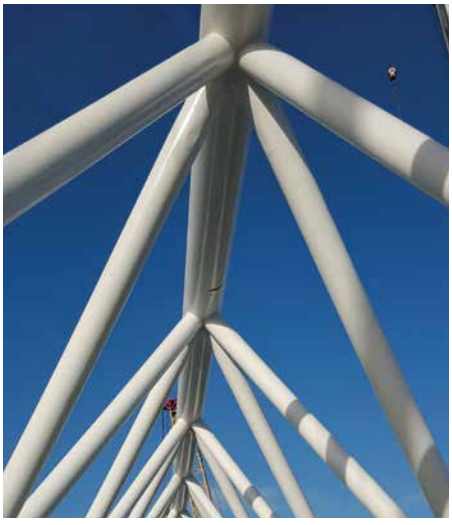
The consistent dimensional tolerance offered by Celsius 355 was an important factor in fabrication. Angus said: "Tolerance was critical. As fabricators, we need to know that we will have consistency of material – with assurance that each side of the joint is the same – when we are cutting and welding."

Getting off the ground

Following a suggestion from J&D Pierce, there was a change to an original proposal to erect the main support truss on temporary trestles up in the air. Angus Cormie explained: "The original methodology posed a number of challenges which could possibly be mitigated with a different concept. Using our experience of large module builds, we decided to assemble the truss on the ground, to its final profile, and lift it into place with large cranes.

"The concept of module build on the ground was then extended to the rafters as well to give concurrent working at ground level for safety and for programme gain. The final output was the installation of the complete roof on the stand in less than 24 hours."

J&D Pierce worked closely with Jacobs and main contractor, McLaughlin & Harvey Construction, to develop the roof installation method. Careful planning and execution ensured that, once off the ground, the truss followed its defined shape. The temporary design and management required for the roof installation was shortlisted for an award by The Institution of Structural Engineers in 2016.



Tata Steel products:

Celsius® 355 is a hot-finished hollow section suitable for all construction and mechanical applications – performing reliably in even the most arduous conditions.

With a minimum strength of 355MPa, it allows the highest fabrication factors and enables material cost savings and lighter structures.

Available in a wide range of circular, square, rectangular and elliptical hollow sections, Celsius 355 offers dimensional consistency, high levels of formability and excellent weldability.

Celsius 355 products are traceable, CE-marked and fully compliant with the Construction Products Regulation.

Celsius 355 is the first structural hollow section to be certified to BES 6001, allowing projects to maximise credits under the 'Responsible Sourcing of Materials' sections of BREEAM.

For technical advice on the application of Celsius 355 for your project, please contact our Customer Technical Services Team:
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Images courtesy of J&D Pierce

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