

TATA STEEL



Case study

first direct arena, Leeds

Client: Leeds City Council

Venue Operator: SMG Europe

Design & Build Contractor: BAM Construction Ltd

Architect: Populous

Structural & Acoustics Engineer: Arup

Structural Steelwork Contractor: Severfield

Building Envelope Contractor: Lakesmere Ltd

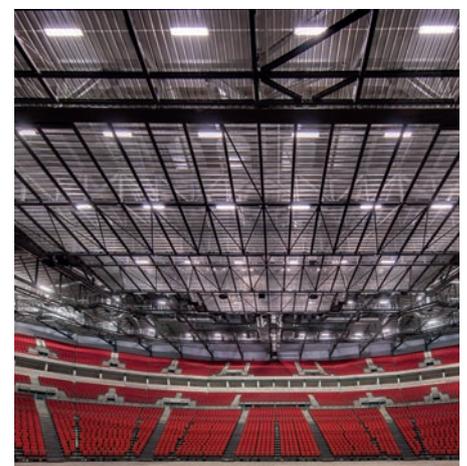
Tata Steel products:

ComFlor® 60, ComFlor® 51+

Year: 2013

The first direct arena in Leeds is the UK's first purpose built arena with a fan-shaped seating bowl layout - it has achieved a BREEAM 'Very Good' rating and is Britain's most sustainable arena.

A structural steel frame was specified to enable the time-challenging building programme to be met. The level of noise emitted from the arena had to be 10 dB lower than ambient levels outside making acoustics a key driver for the design - specifically the roof. ComFlor® was chosen to form the base of the external roof, providing excellent acoustic performance and fire protection.





Winner of the Institute of Structural Engineers Award for Sports / Leisure Structures 2013, the judge's said of the arena: "The roof solution in particular, with main trusses located in the air gap, is a highly effective innovation that both reduces cost and increases acoustic insulation."

Shaping the UK's most sustainable arena

Located in the heart of Leeds, the first direct arena is a 13,000 capacity, internationally acclaimed, multi-purpose venue built for live music and entertainment which is anticipated to bolster the local economy by staging over 140 events each year. Commanding a major gateway into the city and built on a tightly confined 5 acre site, the impressive building is also expected to act as a catalyst for further economic regeneration.

Operated by SMG Europe, the first direct arena was a design and build project delivered for Leeds City Council within a budget of some £60 million by the main contractor, BAM Construction Ltd with architect, Populous. The building achieves the highest BREEAM 'Very Good' rating of any arena in the UK to date, making it Britain's most sustainable. The success was very much a result of the close cooperation between all the parties involved in the design and development of this BIM integrated project and crucial for delivery of the contract.

Based on the design of ancient Greek amphitheatres and influenced by its sloping site, the venue is the UK's first purpose-built arena incorporating a fan-shaped seating bowl layout. Elliptical on plan, this unique and instantly recognisable landmark building has a curved appearance externally with a faceted façade to its front and side elevations whilst an easily accessible rectangular stage area protrudes at the rear. Despite its huge size and unlike other UK arenas, the semi-circular auditorium provides a surprisingly intimate experience with performers and audience feeling more connected as a result of their close proximity and the perfect sightlines available from each seat.

Complex steel frame solution

In order to achieve the long spanning requirements of the design and the desired speed of construction, a structural steel frame solution was specified so that the time-challenging building programme could be met.



Apart from its obvious strength, structural steel is extremely cost effective and well able to cope with the long spans needed to satisfy one of the major functional requirements of the venue, a column-free auditorium. Steelwork design is also very flexible, enabling a shallow, material-saving structure to be created around and over the huge seating bowl while still leaving sufficient space above the audience.

Arup designed the complex structural steelwork and Severfield was appointed as the structural steelwork contractor. Much of Severfield's fabrication work was completed off-site and delivered as completed truss sections where required. This included the application of the appropriate thickness of intumescent coating to the relevant steelwork commensurate with fire protection requirements, enabling significant cost savings to be made on the project.

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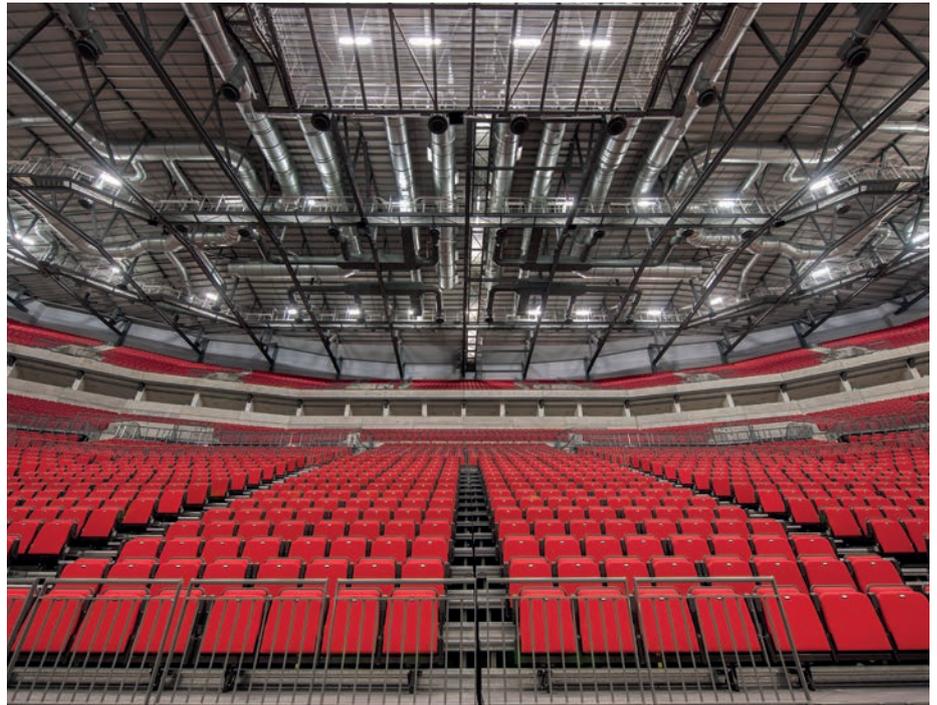
Severfield's Projects Director, Adrian McCoy says, "We put the package out to competitive tender which was won by Tata Steel. We have a long-established relationship with Tata Steel and whilst cost was paramount, there were many good reasons for choosing them. They're a valued local supplier, we know how they operate and have always found them to be extremely reliable. The level of customer service is excellent and the company offers an unsurpassed range of quality products."

The roof's structural steelwork is made of a series of long span trusses with a third of the roof being supported by a 54 metre long by 10.5 metre deep proscenium arch truss which weighs 170 tonnes and spans across the full width of the stage. With limited space available onsite, this truss was assembled on the ground and lifted up into position by two 500 tonne mobile cranes and held in position for 72 hours to allow the main stage steelwork to be built around in order to stabilise the structure before the cranes could be moved. The remainder of the roof's steelwork is made up of 13 long-span trusses spanning from 40 to 70 metres with the heaviest weighing some 65 tonnes.

Innovative acoustic roof structure

As well as coping with the complex geometry that was required to squeeze the building onto a tightly confined, sloping site, the structural engineer Arup had to ensure that their design was affordable and able to deal with a number of specific planning conditions. Perhaps the most significant and challenging of these being the need to meet the building's acoustic requirements by preventing break-out noise affecting nearby residents, particularly in relation to the close proximity of high rise student accommodation.

The level of noise emitted from the arena had to be 10 dB lower than ambient levels outside which therefore made acoustics a key driver for the design engineering of the building overall, and of the roof in particular. So after careful planning and testing, a complex dual roof solution was chosen with an inner roof comprising of a perforated liner tray supporting two layers of insulation and an



acoustic barrier sandwiched between two layers of plywood topped with an additional layer of insulation. Above this and providing an additional acoustic and fire protection barrier is the main external weatherproof roof with a 1.2 metre deep void between.

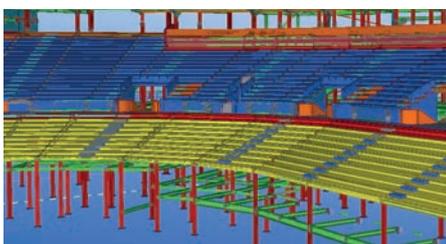
Although designed as a profiled steel floor deck with exceptional spanning capabilities, ComFlor® was chosen to form the base of the external roof. Able to provide a cost-effective, quick-fit roofing solution with minimal slab depth for fire design purposes, the ComFlor® deck was installed with a steel mesh reinforced 150 mm concrete slab which was then sealed with a heavy duty weatherproof membrane.

Forming the base for the large main roof area, ComFlor® 60 with closed ends provided excellent acoustic performance and fire protection with no requirement for filler blocks. ComFlor® 51+, a traditional dovetail re-entrant composite deck was deemed more suitable for the adjacent, gently sloping mansard roof areas - this was because it provided an excellent mechanical key with the concrete slab and offered a strong shear bond performance which was augmented by longitudinal stiffeners located in the profile

trough. Importantly, the dovetail opening of the ComFlor® 51+ is very small and so has minimal contribution to heat transfer through the slab in the event of fire.

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SMG Europe's Ben Williams, General Manager for the venue says, "We are delighted with the first direct arena and very proud to have received the prestigious accolade of 'New Venue of the Year' at the Stadium Business Awards 2014. The award reflects the excellent feedback that we are getting from ticket holders, promoters and the extensive list of top international artists who have already graced our stage."





Photographs courtesy of: Giles Rocholl, Severfield and Paul White Photography

Tata Steel products:

ComFlor® 60 (8,000m²) a composite deck, manufactured with closed ends for exceptional fire protection and improved acoustic performance, forms the base of the building's main external roof. ComFlor® 51+ (1,000m²), a traditional re-entrant composite deck with a virtually flat soffit, was used for adjacent mansard roof areas. Both ComFlor® profiled steel decking systems were installed with a 150mm steel mesh reinforce concrete slab sealed with a heavy duty weatherproof membrane.

For technical design advice regarding the featured products please contact:

ComFlor®

T: +44 (0) 1244 892199

E:

technical.structuralproducts@tatasteleurope.com

Tata Steel
Shotton, Deeside
Flintshire, CH5 2NH

T: +44 (0) 1244 892199
F: +44 (0) 1244 892121
E: construction.marketing@tatasteleurope.com

www.tatasteelconstruction.com

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