



Project Summary

Organization:

Foster + Partners

Solution:

Buildings

Location:

Glasgow, Scotland, United Kingdom

Project Objectives:

- Create the first national arena in Scotland.
- Build a 12,500 seat stadium on a complex, split-level site as part of the redevelopment of the Queen Anne's dock area.
- Design a flexible space that can accommodate a wide range of events, from concerts to theatrical shows and sporting events.

Products used:

MicroStation, Bentley Navigator

Fast Facts

- The SSE Hydro is Scotland's largest purpose-built public event arena.
- Overlaying 3D and 2D models facilitated collaboration between design, fabrication, and construction.

ROI

- Bentley solutions facilitated design coordination with live 3D and 2D models via video conferencing to promote creative collaboration among multiple disciplines and contractors.
- Bentley software helped to resolve the layout of 945 nodes and 3,312 connections in the 126-meter-span roof frame as well as to optimize the 157 facade panels for fabrication.
- BIM has saved time by reducing requests for information from consultants and fabricators and minimizing change orders.



Foster + Partners Competes for Gold at the SSE Hydro in Glasgow

Bentley's BIM Software Streamlines Multi-discipline Collaboration in Complex Geometric Design

Regenerating Urban Landscape

Scotland's SSE Hydro arena not only provides a world-class music arena for the city of Glasgow, but this key element of the regeneration of the Queen Anne's dock area also provides an iconic building to form part of the bid for the 2014 Commonwealth Games.

The 12,000-seat stadium, which is expected to attract over 1 million visitors each year, is located on a complex, split-level site, which demanded an iterative conceptual design process to explore alternate building forms. Cost control and effective use of resources throughout the project were also important factors in the design and build process; while the complex diagrid space frame roof, doubly curved concrete bank, and curved panel façade created additional design challenges.

Foster + Partners used Bentley's building information modeling (BIM) software to manage the complex geometry involved in this innovative design.

Resolving Complex Geometry

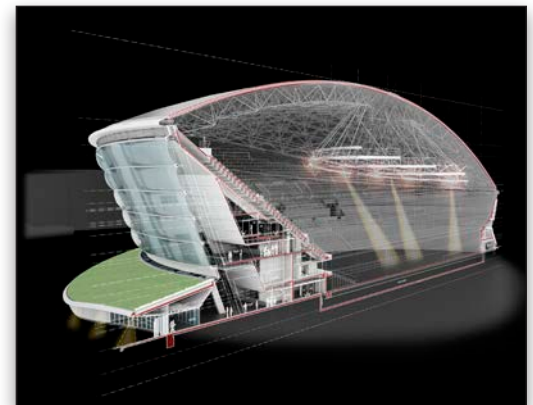
Conceived as a circular building to meet the requirements of an auditorium, the design had to optimize geometry in order to maximize front of house and minimize back of house space. The complex design includes concrete fins and a 126-meter diameter auditorium space spanned by a double-layered diagrid roof, as well as a twisting grass perimeter bank.

At the beginning of the project, Foster + Partners explored the use of dimension-driven design to rapidly explore a number of design options. Using GenerativeComponents enabled the team to rationalize the geometry while having precise control over the communication, control, and schedule of 945 individual roof node points and over 3,000 connections between the nodes.

Another challenge was creating the height for service entrances within the grass-covered concrete bank while dropping the bank down where an opening was not required. To demonstrate the feasibility of this model, Foster + Partners used GenerativeComponents to set the heights of the beams

around the arena and ascertain the cost savings that could be achieved by adjusting the geometry.

The resulting sloped bank also had implications for the interior glazed skylight. To reflect the slope, the skylight has to twist, so Foster + Partners modeled and subdivided stepped panelized glazed surfaces in order to maximize efficiency and measure construction tolerance.



Bentley's building information modeling (BIM) software managed the complex geometry involved in this innovative design.

Enabling Downstream Collaboration

One of Foster + Partners' most significant advances on the SSE Hydro project has been the use of Bentley's BIM software to facilitate complex coordination between multiple consultants, engineers, fabricators, and construction companies.

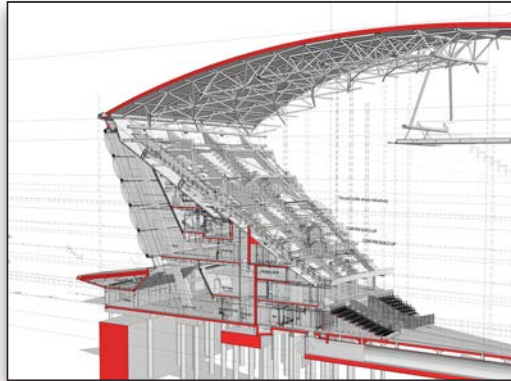
Critically, Foster + Partners has been able to work in 2D, 3D, and a hybrid of the two, to support the different software used by each collaborative organization. This allowed them to overlay different models – from 3D designs to mechanical engineering models – to evaluate the impact of change on different areas of the design, such as the effect of ducting changes on the angles.

The BIM solution helped avoid miscommunication of information, and thereby reduced the amount of risk associated with changes at a later design stage.

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Improving visibility has been key to improving the collaborative process, as has sharing this information via videoconferencing between the architects in London, and consultants and fabricators in Edinburgh and Glasgow. During this project, Foster + Partners piloted MicroStation's hypermodel technology to manage large models and dynamic views to enable the team to jump between 2D and 3D views.

BIM Helps Meet Unmovable Deadline

One of the benefits of this collaborative approach was the ability to flag and resolve potential issues at a much earlier stage in the design workflow, leading to a reduction in both requests for information (RFI) and clashes on site. The BIM solution helped avoid miscommunication of information, and thereby reduced the amount of risk associated with changes at a later design stage.

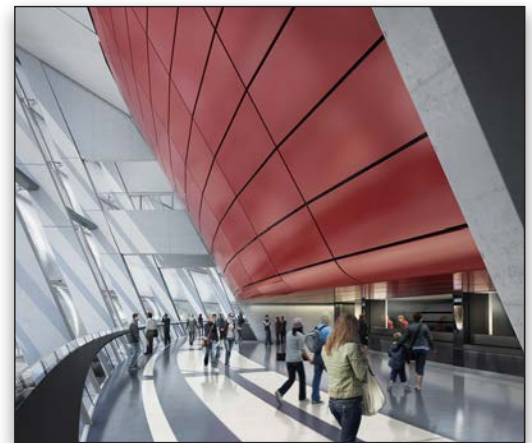
BIM proved valuable during the build stage as Foster + Partners managed the provision of information to the diverse

contractors on site – from highly technically aware fabricators taking the 3D designs directly from Foster + Partners to create the steel beams, to individuals who only want to know where to pour the concrete.

Other time-saving benefits of BIM included reduced requests for information from consultants and fabricators and a reduction in change orders. Predesign resolution combined with proactively addressing issues before they reach contractors led to a significant savings on this project, which was key given the unmovable deadline.

Technology Innovation

Many of the benefits Foster + Partners has gained from utilizing Bentley software on the SSE Hydro arena are being taken forward into projects around the current portfolio; while some of the learning Foster + Partners has taken from this project is already informing the evolving BIM processes.



The flexible space can accommodate a wide range of events, from concerts to theatrical shows and sports.