CASE STUDY

Marina Bay Sands Integrated Resort

Bentley Structural Modeler and GenerativeComponents Empower Arup to Deliver a Complex, Demanding Resort Project on Time and on Budget.

Project Summary

Organization: Arup

Solution: Bentley Structural

Location: Singapore

Project Objective:
- Improve the quality of life for the population relying on the piece of infrastructure

Products Used:
Structural Modeler, ProSteel, RAM Concept, MicroStation, GenerativeComponents

ROI, Cost and Time Savings derived from the Use of Bentley Products:
Benefits were realized throughout the project because of the design and documentation delivery process, which included:

- Coordinated Documentation – increase in accuracy and coordination as a result of the 3D modeling and analysis approach.
- Increased Efficiency – Increase in the number of design iterations possible in any given timeframe.
- Reduction in Construction Schedule of approximately two to three months due to the major steelwork being handed over as fabrication models.

Fast Facts

- The technically challenging project made utilizing 3D modeling technology crucial for Arup.
- The Singapore office leveraged Arup designers in Boston, Hong Kong, and Melbourne to work concurrently on different parts of the model.
- The use of Bentley 3D BIM resulted in well-coordinated execution, which made it possible to deliver an extremely complex design in a short amount of time.
- Using GenerativeComponents, the Arup team integrated the parametric model into the 3D design. The documentation process was then used to rapidly reflect modifications to the geometry.

Technically Challenging Project

From the beginning, the Marina Bay Sands (MBS) Integrated Resort was planned to become a key element in Singapore's tourism market, integrating a waterfront promenade with civic space, shopping, indoor and outdoor spaces graced with city skyline views, daylight and plant life. State-of-the-art meeting, incentive, convention and exhibition (MICE) facilities, a massive event plaza, two theaters, and a multi-level retail arcade lining the waterfront promenade comprise the development. Stepping, wave-form podium roof and canopy structures embrace the buildings.

The technically challenging project made demanded the effective use of innovative 3D modeling technology as crucial for Arup. Using Bentley Structural Modeler, ProSteel, and RAM Concept, the project goal was to fully deliver all the structural design and documentation from a fully coordinated 3D Building Information Model (BIM), and deliver all the primary steelwork portions of the project as fabrication level models. They could then be taken directly into the construction process, which would reduce construction time by two to three months. The project team also used GenerativeComponents, Bentley's parametric design software, to model the complex steel structure's configurations and explore design options.

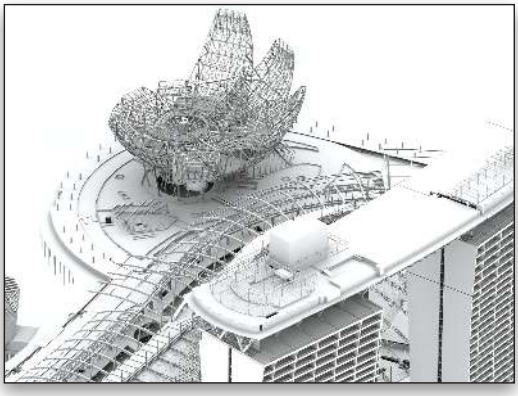
Primary Challenges

The sheer size and complexity of the geometry was the initial challenge facing the design team. Coupled with that was the need for Arup to ramp up a team of technicians who could deliver the model within the intended construction timeline.

"At the outset of the project, we had only one 3D modeler with Bentley Structural experience in Arup's Singapore office," said Christopher Pynn, leader, Building Modelling, Arup. "At the height of the design, we had a team of 15 modelers working on the project." Although the transition from 2D CAD to full 3D documentation required training and investment, the technical knowledge and expertise gained paid off on the project and have helped shape the future of the office.

In order to deliver a project of such scale, the Singapore office enlisted the help of other Arup locations, so that designers in Boston, Hong Kong, Melbourne and Singapore could work concurrently on different parts of the model. The involvement of all the offices presented a challenge in itself, with regard to model setup, dataset management, and project coordination. The interoperability of Bentley's technology, however, enabled Arup to effectively integrate a design team distributed over multiple locations.

A side view perspective of the monochrome rendering produced using Structural Modeler.



An aerial perspective view of the monochrome rendering.

This workflow saved considerable time by avoiding re-drawing the model manually each time a modification was made.

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Creation of Manageable File Sizes

Using Bentley's reference management capabilities, the distributed team was able to break the model into manageable portions, which they could then standardize by using the Bentley software datasets. Bentley Structural Modeler made it possible to carry a consistent data structure across all the models. In addition, using the common file structure of Bentley products, the project team was able to bring the model together as a central repository for review, and clash and coordination checks. The smaller file sizes made working across the global network a non-issue.

"Through the use of MicroStation and Bentley Structural Modeler, Arup delivered a streamlined, innovative, 'right-first-time' structural design and documentation model on a project scale and timeline never seen before."

— Christopher Pynn, leader, Building Modelling, Arup.

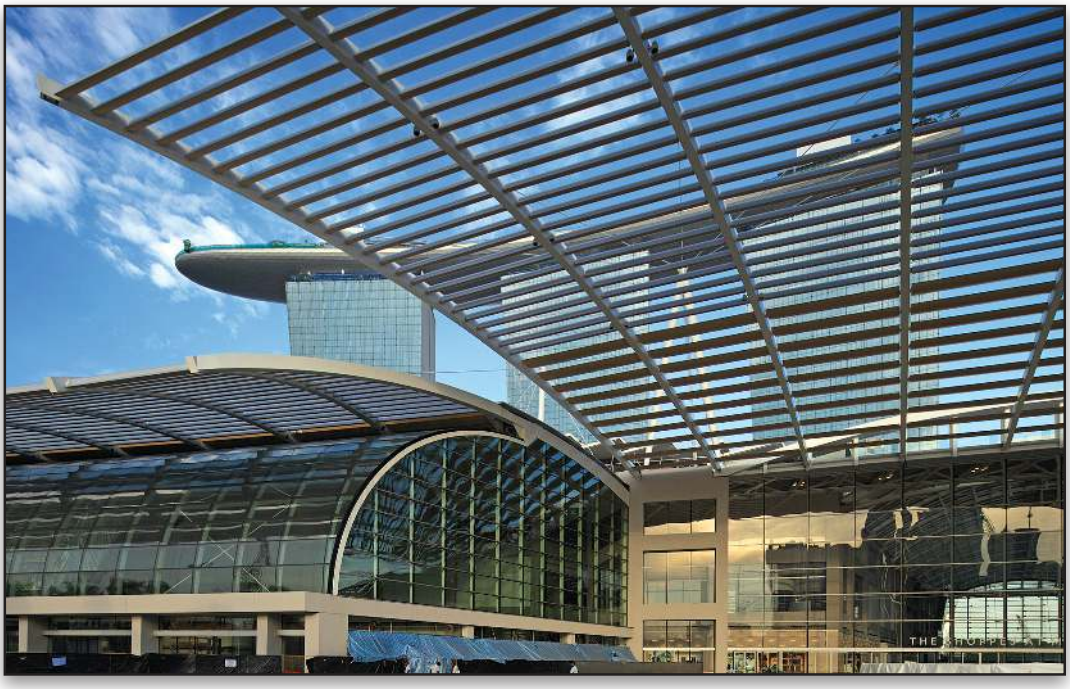
Using GenerativeComponents, the Arup team integrated the parametric model into the 3D design. The documentation process, mentioned previously, was then used to rapidly modify the geometry where needed. Changes in geometry were easily incorporated into the existing structural analysis model and any changes in member section sizes, along with the new geometry, were directly translated into 2D and 3D documentation. This workflow saved considerable time by avoiding re-drawing the model manually each time a modification was made.

Well-Coordinated Execution

Arup was the only design-team member to deliver its portion of the project in 3D BIM. The use of these tools resulted in well-coordinated execution, which made it possible to deliver an extremely complex design in a short amount of time.

"Through the use of MicroStation and Bentley Structural Modeler, Arup delivered a streamlined, innovative, 'right-first-time' structural design and documentation model on a project scale and timeline never seen before," said Pynn. "No other platforms could provide a product capable of delivering the required model, and no other firms would have believed it possible to deliver with such benefit and impact."

Pynn continued, "From the outset of the project in June 2006 through to its opening in June 2010, the success of the Marina Bay Sands project has been responsible for a 500 percent increase in the size of our building modeling team in the Singapore office. To illustrate this, the modeling/documentation team was just six people at the start of 2006 and at the height of the project in 2008 that team had grown to 30."



Marina Bay Sands Resort completed façade.

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