Beijing Institute of Architectural Design Creates Innovative Stadium for the 2022 Hangzhou Asian Games

Bentley Applications Reduced Design Time by 50 Percent

Designing for the Future
In 2022, the city of Hangzhou in Zhejiang, China will host the Hangzhou Asian Games. The Hangzhou Olympic and International Expo Center Construction and Investment Co., Ltd. wanted to provide a high-quality cultural and physical location to be used by Hangzhou citizens when the games are over. The organization contracted Beijing Institute of Architectural Design to generate the designs for the architecture, landscape, and interior portions of the Hangzhou Olympic Sports Center. Beijing Institute decided to establish a building information modeling (BIM) process with a database of all control points to guide on-site construction. The swimming pool facility will be the main component in this important milestone project.

The team needs to complete construction of the Hangzhou Olympic Sports Center by May 2021, because the Hangzhou Asian Games will begin in 2022. The project site is bordered by two rivers: the Qiantang River in the north and the Qijia River in the west. The sports center will cover nearly 400,000 square meters and will include a stadium, swimming pools, commercial facilities, and parking lots. The main building will consist of upper and lower sections. The lower component will contain the commercial facilities and parking lots while the upper section will house the stadium and swimming pools. The upper area is a massive nonlinear surface shaped by a series of cutaway ovals with a continuously changing major and minor axis. The inside and outside structural support will help create a rhombus grid, producing a net-like shell to surround the structure.

Overcoming Design Challenges
This project faced many challenges, including figuring out the optimal method of constructing this complex structure. The team realized early in the process that traditional design methods would not be sufficient. Consistency between the multifaceted steel structure and the architecture was necessary for the complex to blend seamlessly. As a result, it was essential to write a parameterized script to transform abstract mathematical logic into surface space and shape.

The geographic area surrounding the sports center was another challenge. There are rivers on two sides of the complex while the other sides include a heavily populated urban environment.

The project team overcame the difficult design challenges by implementing a BIM process using Bentley applications. Team members introduced parametric methods throughout the project to optimize and produce the final structure. They applied a series of mathematical methods to determine the shape of the outer net-like shell and the details of each part. This practice allowed them to effectively divide and locate the internal and external sides of the net shell structure and locate space builders. It also enabled them to design and control the envelope enclosure and the internal and external nodes, successfully optimizing components in practical processing. Additionally, the parametric models helped with automatically generating complex surface models, allowing users to closely align the complex steel structures with the building.

In addition, the project team created all-terrain models and established a comprehensive model that aligned with its BIM process, which included AECOsim Building Designer and MicroStation to make logic modeling possible; ProStructures and STAAD® to optimize structural calculations and shorten steel structure and concrete design cycles; and Navigator to provide electromechanical integration and conduct collision detection of electromechanical pipelines. These models helped the team achieve success while remaining on schedule.

Sharing and Collaborating Effectively
Another benefit realized by the project team was its ability to easily share information with all participants, improving collaboration. Beijing Institute’s BIM process was used throughout the project to enhance close cooperation among the owner, designers, and construction teams. Team members updated information and managed the project with ProjectWise on-site. Key information was collected, updated, and managed from different software via data interfaces.
“[AECOsim Building Designer’s] powerful capabilities create a space that, in the past, could only be imagined. Using MicroStation, we achieved seamless links between the complex 3D model and traditional 2D drawings. MicroStation integrates with ProjectWise to organize complex file management and process controls.”

– Yapeng You, Director Architect, Beijing Institute of Architectural Design Huyue Studio

The project team also used visualization capabilities to better envision the final product and shared those models with the manufacturing unit, directly using the models to create components and detailed 2D drawings. All these proficiencies garnered user confidence, providing a reliable data foundation that also acted as an accurate reference for all users.

This assurance of storing data in a single location made collaboration easier among the team and with stakeholders. ProjectWise’s collaborative platform enabled design teams to work together and enhanced efficiency. The team shared project model and drawing information, all located in a single place. With all participants seeing the most updated information, the team quickly created a multi-view 3D model through various display methods to showcase the designs. Then, the model was shared with stakeholders, providing them with a clear understanding of the final product. This digital workflow improved collaboration and helped the team meet its tight deadlines.

Saving Significant Time

The Beijing Institute realized significant time savings by using Bentley applications. With 3D collaboration, the team created accurate 3D models and shared them with all participants, which saved 50 percent of the time estimated to solve design issues. Designing the complex was expected to take a year. However, the BIM process shortened that time by 60 percent. The team completed the 3D model, 2D sectional review, 3D design atlas, and other relevant project materials. Creating BIM standards for design specifications helped reduce time-wasting design modifications, saving 50 resource days to modify the design and 10 resource days spent checking and reviewing those modifications. The team expects to save about 100 resource days spent processing site errors.

Improving Quality of Life

Besides producing a high-quality cultural location for the area, the Hangzhou Olympic Sports Center also provides significant benefits for the surrounding environment and local community. By storing all data in a single location, the project team easily shared construction plans and data with surrounding factories. Most of the external metal roof will be made in advance and installed on the construction site, reducing dust haze and noise produced during construction to protect the site environment.

Beijing Institute wanted to create a building that would enhance the vitality and attractiveness of the city. As the prime location for the 2022 Hangzhou Asian Games, the center’s completion and successful operation will significantly enhance the international influence of Hangzhou as well as its attractiveness as an international tourist destination. The project will also help activate development in the southern region of Hangzhou, which is in a period of transition and looking to develop further. The structure’s successful construction will also provide a prime example of how to complete a project of this magnitude properly, leading the way for architectural design of similar projects around the world.