



Project Summary

Organization:

Hunan Hydro & Power Design Institute

Solution:

Power Generation

Location:

Yicheng City, Hubei, China

Project Objectives:

- To advance multidiscipline lifecycle BIM practices to improve design accuracy and streamline workflows.
- To promote energy efficiency and environmental sustainability.

Project Playbook:

Bentley Raceway and Cable Management, Bentley Substation, LumenRT, MicroStation®, Navigator, OpenBuildings™ Designer, OpenPlant™, OpenRoads™, ProjectWise®, ProStructures, STAAD®

Fast Facts

- HDI implemented a digital 3D BIM process to deliver a CNY 3.35 billion project on the Han River.
- The team established a connected data environment using ProjectWise to seamlessly work across 12 disciplines with 32 designers.

ROI

- ProjectWise and Bentley's open applications improved overall design efficiency and accelerated drawing output by 50%.
- Bentley's civil modeling technology saved 200,000 cubic meters in excavated earthworks.
- Component libraries and parametric modeling eliminated model replication, to deliver the design two months early.
- Bentley's BIM solution shortened the construction period by three months, saving CNY 30 million.

Hunan Hydro Relies on BIM to Deliver Complex Shipping and Hydropower Hub

Bentley's Open Technology Applications Drive Efficiencies and Environmental Sustainability, Saving CNY 30 Million and Reducing Carbon Emissions

A Strategic Waterway Initiative

Located along the Han River in China's Hubei province, the Hanjiang Yakou Shipping Hub engineering project is part of a strategic development plan to establish a kiloton-capacity waterway stretching downstream from Danjiangkou City to the Yangtze River in Wuhan. The initiative will streamline navigation and expand shipping capacity, as well as facilitate irrigation, improve power generation, and promote tourism and economic development in the local region. The CNY 3.5 billion shipping complex includes a 75-megawatt hydropower plant, a 1,000-ton ship lock, a 44-hole sluice gate, cofferdams, and a fish breeding station and ladder. Hunan Hydro & Power Design Institute (HDI) was tasked with improving design quality and workflow efficiencies, reducing costs, lowering carbon dioxide emissions, and curbing the environmental impact.

With several building types to be designed amid a compact footprint and equipment space, the project presented numerous design challenges and site constraints compounded by working across 12 different disciplines with 32 designers and multiple technology interfaces. The project spanned bidding and design stages, and a long 49-month construction period. The overall landscape design had to highlight local and Asian-Chinese culture while minimizing earthworks and ensuring ecological and environmental sustainability. "We needed to determine how to ensure smooth workflow among different stages and among different participation units," said Zhongyuan Zuo, director, BIM technology center, HDI. To address these challenges and requirements, HDI implemented digital lifecycle BIM processes and established an open, connected data environment using Bentley's integrated applications.

Open Applications Facilitate Coordinated Design

Using ProjectWise and Bentley's open 3D modeling applications, HDI implemented a comprehensive BIM strategy to coordinate design of the different buildings and infrastructure elements among the multidiscipline team throughout all project stages. ProjectWise provided 2D and

3D design management, facilitating real-time access to accurate project data and seamless workflow processes. The team used OpenRoads and PowerCivil to generate the digital terrain model, perform earthworks calculations, and extract the cofferdam drawings directly from the model. To rationalize the power station equipment layout within the limited footprint, each specialty carried out detailed 3D modeling using Bentley's open structural, electrical, and plant design applications – including Bentley Raceway and Cable Management, OpenPlant, and Bentley Substation – to create discipline specific models. HDI imported these 3D models into OpenBuildings Designer to deliver a complete power plant engineering model, performing real-time collision detection to identify and resolve potential clashes. "The whole process uses the same model for digital cooperation to reduce the occurrence of human faults," said Zuo.

To accommodate the architectural geometry of the power plant, HDI relied on parametric modeling in OpenBuildings Designer to design 564 nonstandard windows of eight different types. By importing the BIM model into LumenRT to generate animated renderings, the project team optimized landscape design so that the overall design, natural environment, and surrounding buildings were more coordinated and reflected cultural characteristics. The digital visual solution facilitated communication of design intent and helped define customized material quantities prior to construction.

The project team also used Bentley's open BIM applications to establish a 3D model of the fish ladder and perform dynamic simulations on the fish pass effect, allowing team members to compare multiple schemes and determine an optimal design. The flexibility and interoperability of Bentley software streamlined real-time data and model circulation among different industries and various departments to guarantee successful implementation and assessment. The BIM model and fish monitoring platform extends data visibility to construction and operations management, eliminating ecological impacts of engineering construction to support a sustainable waterway environment.

*“Bentley’s
hydropower
solutions have solved
problems, such as
difficult discipline
coordination, compact
equipment space, and
difficult engineering
arrangements.
They also helped
us visualize and
coordinate the overall
project design.”*

*— Zhongyuan Zuo, Director of
BIM Technology Center, Hunan
Hydro & Power Design Institute*

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Establishing Innovative Collaborative Processes

Developing a unified workspace via the ProjectWise platform enabled all specialties to work in a consistent connected data environment and improve the level of collaboration. The design models for each specialty were updated and accessible in real-time to streamline modeling and design workflows. HDI extended the collaborative capabilities of ProjectWise, integrating it with mobile and web applications to enable designers in the field office to more effectively communicate with the institute’s headquarters. “The use of internet technology has realized the remote collaboration of ProjectWise,” said Jun Ouyang, senior engineer at HDI. The expanded, web-based digital application of ProjectWise shortened communication and coordination time between the two locations, improved resolution of design issues, and enhanced design efficiency.

HDI developed additional collaborative processes for document management and communication with external stakeholders. The team established a file management folder in ProjectWise for design and construction data, helping uniformly manage the previously scattered and fragmented project data. The integration of Bentley’s open project management technology with a mobile communication application provided on-site staff with the ability to capture construction photos through their phones and upload them in real time to ProjectWise. This optimized collaboration, facilitating a new working model for on-site photo collection and file management, improved design efficiency by 30%.

Lastly, HDI not only extended its application of ProjectWise to optimize collaboration. The institute also relied on the interoperability of Bentley’s modeling technology to hyperlink design data, technical information, and calculations to the 3D BIM model. Using LumenRT, the project team presented visual interactive animations of the design model to relevant external stakeholders and authorities for review and approval. Bentley’s visual reality modeling application enhanced and transformed the mode of external communication, enabling seamless collaboration that improved design efficiency and helped accelerate approvals.

BIM Drives Savings and Sustainability

Using ProjectWise and Bentley’s BIM applications improved cooperation among disciplines while ensuring uniqueness and accuracy of design results. The collaborative digital technology standardized design processes and industrialized workflows, improving overall design efficiency by 50% and accuracy by 17%. The 3D discipline-specific models are developed and updated in real-time, avoiding rework caused by inaccessibility to information. Importing these models into OpenBuildings Designer to generate a comprehensive BIM model for collision detection identified and resolved

92 collisions and enabled the design work to be completed in 45 days. Bentley’s 3D integrated technology streamlined multidiscipline design, eliminating design errors and material shortages to reduce on-site change orders by 80%. By advancing digital BIM, HDI optimized project layout, shortened the design cycle, and realized electricity generation three months ahead of schedule, helping to save an estimated CNY 30 million.

In addition to achieving improved efficiencies and cost savings, HDI delivered a sustainable, ecological, and environmentally friendly design. Using Bentley’s civil applications to generate a digital terrain model and perform earthworks calculations reduced excavation by 200,000 cubic meters. Compared to thermal power, the new hydropower plant will reduce coal consumption by 81,000 tons, carbon dioxide emissions by 212,100 tons, and sulfur dioxide emissions by 700 tons, while alleviating the power supply shortage in the Yakou and surrounding area. The new shipping hub was designed to support gravity irrigation, improving irrigation to 80,000 farms and reducing operating costs to raise the water level. These benefits help facilitate more efficient and economic agriculture, equivalent to saving about CNY 15 million per year. Finally, the parametric modeling and simulation enabled the team to create fish pass structures and a fish breeding station to ensure ecological sustainability and protect fish habitats, both during and after construction of the shipping hub.

A Digital Benchmark for the Future

HDI used Bentley’s integrated applications to deliver a complex, multidiscipline design and construction project that enabled provision of better design consultancy services and digital works for the client. The technology facilitated parametric modeling and simulation, as well as automated and streamlined previously manual processes to optimize collaborative design and eliminate errors through visual digital deliverables. Implementing an open, digital modeling solution advanced BIM processes to comprehensively improve the design quality and efficiency while meeting requirements. HDI improved energy efficiency, reduced costs, and eliminated its impact on the surrounding environment. “Moreover, the solutions enabled us to develop demonstrative and transferrable BIM design experience on navigation projects to improve overall design quality and project efficiency,” said Zuo. The successful application of Bentley’s BIM software on the Hanjiang Yakou Shipping Hub project serves as a digital benchmark for similar projects, demonstrating the potential for savings and environmentally sustainable design. It sets new standards that will transform workflows and industrialize project delivery in the power generation and navigation industry.