Bentley
Advancing Infrastructure

Project Summary

Organization:
Guangdong Hydropower Planning & Design Institute

Solution:
Reality Modeling

Location:
Foshan, Guangzhou, Dongguan, Shenzhen, Guangdong Province, China

Project Objective:

- Construct 114.9 kilometers of water delivery lines from the Xijiang River, branching into four nearby regions.
- Implement BIM advancements for a collaborative design process.
- Limit the impact on the surrounding community and environment with 3D reality modeling.

Products used:
Bentley Map®, AECOsim Building Designer, Bentley Raceway and Cable Management, ContextCapture, Descartes, LumenRT, MicroStation®, Navigator, OpenRoads, OpenRoads Navigator, Bentley Substation, ProjectWise®

Fast Facts

- Guangdong Hydropower planned and designed a CNY 34.7 billion water delivery line system in the Pearl River Delta.
- The project team used reality modeling applications to design 114.9 kilometers of delivery lines.
- When completed, the delivery lines will increase flow to these areas, counteracting the effects of rapid urbanization.

ROI

- AECOsim Building Designer reduced the design period by 1,500 resource hours.
- ProjectWise's collaborative design platform helped finish the design 23 days ahead of schedule.
- The team saved CNY 250,000 using Navigator for early clash detection in delivery system lines.

Guangdong Hydropower Planning & Design Institute Optimizes Design of Underground Waterway System

Bentley Applications Helped Deliver the Project 23 Days Ahead of Schedule

Rapid Urbanization in Guangdong Province

The Pearl River Delta is located in the Guangdong Province in South China, north of Hong Kong and Macau. The river flows directly into the South China Sea. The area is known for its farming and is regarded as one of the most productive and sustainable ecosystems in the world because of its integrated dike-rice paddy-fish agricultural system. Guangdong province, particularly the Pearl River Delta area, saw a sharp rise in population in 2005, when it reached 110 million people for the first time. The population has continued to grow, leading to rapid urbanization in the area. Water shortage is one of the consequences of this population boom. The State Council approved the Pearl River Delta Water Resources Allocation Project to address this concern by erecting a far-reaching modernized water network.

Increased Water Distribution

Guangdong Hydropower Planning & Design Institute (GPDI), an engineering design consultancy, was retained by the Ministry of Water Resources to plan and design a solution to the water shortage crisis surrounding the Pearl River Delta area. Since its establishment in 1956, GPDI has won many awards and is well recognized in China for its design projects. The GDPI project team set out to create 114.9 kilometers of water delivery lines, drawing water from the nearby Xijiang River and sending it to the Foshan, Guangzhou, Dongguan, and Shenzhen regions. The team decided to use building information modeling (BIM) technology and a collaborative design process across many participants to formulate the water network design.

This complex, CNY 34.7 billion project needed to be built with a minimal impact on the surrounding environment and community. The delivery line system will include one main line with two branches, one regulating reservoir, and three pump stations. The lines are arranged alongside municipal roads and designed to be as far underground as possible to reduce land requisition and demolition. A few of these lines will run deep beneath farmland so they do not affect the land or the crops.

Some lines will also run under civil houses, which will require house reinforcement or demolition. Additionally, the team also planned to have a working well every three kilometers alongside the shield tunnels. The section of the network from water intake to the Gaoxinsha Reservoir utilized two shield tunnels with 6-meter outer diameters and one shield tunnel with an 8.5-meter outer diameter was used for the portion of the system transporting water from Gaoxinsha Reservoir to Luotian Reservoir. Constructing the underground lines with incredibly long shield tunnels was a challenge for GDPI as these tunnels are extremely complicated to build.

LumenRT was used to render high quality virtual reality meshes and visualizations, which helped stakeholders make more informed decisions.

3D Models

GPDI turned to reality modeling to help create a design that minimally affects the Pearl River Delta region. Models of the planning areas were essential for the team to visualize where the new delivery lines should be located. To begin, GPDI created 3D reality meshes of the planning areas. The team took pictures of the communities and environment and used ContextCapture to create the 3D model. This model was visible by all project participants and updated in real-time, improving communication between all contributors during the planning and design stages.

"Using Bentley software and services enables all the disciplines of our institute to perform 3D design in the whole process. It not only improves the technological level and design quality of our institute, but it also lays a solid foundation for the appreciation of our designs and the launch of the whole lifecycle."

— Yi Yang,
Director of Digital Center,
Guangdong Hydropower Planning & Design Institute

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The project team also used Descartes to integrate asset information into the models, providing a basis for analysis and statistics of the areas. Using Descartes, the team linked important information about the site and surrounding areas directly on the 3D reality mesh. Team members could visually display information about the surrounding farmland right onto the farms themselves. The 3D reality mesh made it easy for the project team to view an accurate depiction of the whole project. Members could see the advantages and disadvantages of proposals by adjusting the model, and recommend proposals based on the predicted results. This practice saved design reporting time and accelerated the design review process.

Interoperable Software Created Comprehensive Designs

After integrating data into the models, they were exported to LumenRT to render high-quality visualizations and virtual reality models, so decision makers can have a comprehensive understanding of the project. In the next phase of design, GPDI used OpenRoads to create physical designs of the models and design the construction site, roads, and excavation layout based on information created through GEOPAK SITE and PowerCivil, vastly improving the accuracy of the design. The hydraulic structure and BIM visualizations will then be established through AECOsim Building Designer. Bentley applications and other interoperable software arranged cable bridges, created pipeline drawings, and generated information on resources to keep material costs down.

The project team also used MicroStation, along with AECOsim Building Designer, to create holo-information models of water pipelines that were more than 100 kilometers long, as well as pump stations and reservoirs. By improving design accuracy and reducing redundancies, the design team saved about 1,500 resource hours.

Preventing Collisions and Errors

Navigator also helped save time during the design process by allowing users to detect clashes among the electromechanical internal facilities and pipelines. Another capability of the application was that the project team could discover conflicts in the hydraulic and architectural structures. This functionality promoted the quality of the design and increased efficiency.

On previous projects, when the team did not use Bentley BIM applications, GPDI often found that data got lost when being converted between formats. With Bentley's AECOsim Building Designer, however, that data format stayed the same, avoiding this issue entirely. This capability reduced the amount of errors and omissions, and the number of steps during data input.

The entire project was designed, planned, and managed with the ProjectWise collaborative design platform, where information was easily exchanged between designers and stakeholders, ensuring that everyone had the right information exactly when they needed it.

Bettering Environment and Community

GPDI used Bentley applications to overcome the many challenges of this complex project. Overall, the project team saved design costs and reduced design time by 1,500 resource hours. The team delivered their designs and plans 23 days ahead of schedule and expects to complete the project by April 2022.

When completed, the project will maintain and improve the living standards of people residing in the area by providing them with enough water. The project will also reduce the impact on downstream water users. Lastly, the project will significantly benefit the surrounding environment. By optimizing and adjusting the water delivery lines, the team can ensure that environmentally sensitive areas are not damaged and still receive the necessary water. The new water delivery lines will also reinforce prevention and control measures for regional water pollution.

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