



Project Summary

Organization

Beijing Institute of Water

Solution

Water and Wastewater Plants

Location

Beijing, China

Project Objectives

- Increase water capacity to 2.8 times that of 2011 and drop reliance on groundwater from 74.2 to 21.4 percent.
- Create a design that improves building energy efficiency, reduces construction costs, and eliminates the impact on the surrounding environment.
- Beijing Institute of Water designed 2D construction plans and established a 3D model of digital waterworks.

Products Used

AECOSim Building Designer, LumenRT, Bentley Raceway and Cable Management, Bentley Substation, MicroStation, Navigator, OpenPlant, OpenRoads Designer, ProConcrete, ProjectWise, ProSteel, ProStructures

Fast Facts

- This CNY 354 project required the design and construction of many complex, irregular concrete structures.
- Using Bentley's 3D modeling approach, it took 26 engineers a total of 40 days to complete all 3D modeling, 2D drawings, and engineering statistics work.
- Bentley's 3D design software improved design accuracy, quality, and efficiency throughout the project.

ROI

- Producing engineering statistics using Bentley software saved 10 percent in cable materials' costs and took 50 percent of the time.
- The automatically generated engineering statistics increased calculation accuracy, which saved more than 50 percent of the design effort.

Beijing Institute Implements Infrastructure to Bolster Water Supply in Tongzhou District

Bentley's 3D Design Software Reduced Design Work by 50 Percent

Laying the Foundation for New Land Development

In southeast Beijing, China, declining groundwater supplies were causing water shortages for the Tongzhou District, which is part of a cultural tourism zone designated for future urban sub-centers. To meet current and future water demand and supply continuous water to residents, Tongzhou Water Works needed to increase capacity to 2.8 times that of 2011 and drop reliance on groundwater from 74.2 to 21.4 percent.

As part of the Beijing South-to-North Water Diversion Project, a CNY 354 million project that would ultimately deliver 600,000 cubic meters of water per day was initiated. Beijing Institute of Water was contracted by the Water Affairs Bureau of Tongzhou District to design the waterworks and ancillary buildings. The project, which would serve as an important infrastructure guarantee for future land development projects, needed to improve building energy efficiency, reduce construction costs, and eliminate the impact on the surrounding environment, as specified by the Chinese government. It would also require the design and construction of many complex, irregular concrete structures.

Using ProjectWise to Support a Collaborative Design Process

If a traditional, 2D design was employed on this project, the designers in electrical and automation professions would not have been able to unify easy-to-use design software. In addition, a 2D approach would require the designers to spend a great deal of time running calculations, performing analyses, and manually mapping. Therefore, the project team decided to use Bentley's ProjectWise and MicroStation® software to establish a collaborative 3D design management platform. This platform was used to centrally store and manage design information for 13 professions as well as the extraction of 2D construction drawings and engineering statistics. The 3D design management platform also enabled the project team to enforce production standards for the 26 engineers working on the design, securely share data and models, and minimize design errors while improving work efficiency.

Design Optimized with Bentley Applications

ProjectWise® was complemented by a wide variety of other integrated Bentley applications. For example, the electrical and automation engineers used Bentley Substation and Bentley Raceway and Cable Management for cable laying, cable tray, and electrical component modeling. Utilizing these applications improved design efficiency and provided designers with a real-time understanding of the cable bridge layout, which it needed to optimize the design. HVAC, water supply, drainage, and water machine professionals used OpenPlant for the design and drawing of the water machines and pipes.

Similarly, AECOSim Building Designer and ProStructures were used to design 3D information models of standard and complex irregular concrete structures and carry out 3D reinforcement work. Designers were able to easily and intuitively draw all types of concrete structure models by first copying a 2D drawing to establish the general profile and then subsequently used opening and cutting capabilities to conform the 3D model to the depth of the construction drawing.

Greater Efficiency, Quality with Collaborative Process

Through the development of a 3D collaborative design, the design team was able to comprehensively improve the design, progressively implement design standards, and verify construction drawings and engineering statistics. The team comprehensively improved design quality and efficiency while meeting the government's requirements to improve building energy efficiency, reduce construction costs, and eliminate the impact on the surrounding environment.

Bentley's BIM technology enabled Beijing Institute of Water to enhance the entire design in many ways – most notably, to reduce environmental impacts. The layout of the water purification technology structures and plant terrain were optimized to reduce operational electricity consumption by 5 percent and the heat pump placement saved more than 40 percent on summer cooling and winter heating costs. By planning to take advantage of favorable sun exposure, the team was able to implement solar heating to reduce fossil

“Using MicroStation, the design of each profession participating in the project can complete their design work by creating a common and shared information model so that designers can intuitively, beautifully, efficiently, and accurately build a 3D model that shows the design intent and generates the construction drawings.”

– Qi Jiang, Information Center Director, Beijing Institute of Water

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fuel energy usage by more than 45 percent, and by placing a catchment area within the plant footprint of the site, the facility is now able to collect and store 80 percent of rainwater for reuse.

Beijing Institute of Water used Navigator for collision inspection and review of the 3D models due to the complexity of the project and the large number of engineers and contractors involved in the design. In addition to finding more than 40 design omissions and errors, the team provided timely feedback on accurate material statistics to the construction unit, saving approximately 10 percent of the construction cost in cable material.

Maximizing Efficiency and Quality While Reducing Project Costs

The 2D construction drawing and engineering statistics completed during the 2D design phase required six months to implement and involved more than 50 engineers. However, using Bentley's 3D design software, it took just 26 engineers a total of 40 days to complete all 3D modeling, 2D drawings, and engineering statistics work, saving more than 50 percent of the design effort by automatically generating engineering statistics and increasing the accuracy of calculations.

In addition, more than 40 model collisions were found during collision checking of multi-disciplinary models, with findings consistent with construction site feedback.

Delivering a Design that Meets Current and Future Water Demands

The final design achieved its objective by providing 62.9 percent of domestic water and production water supply to 900,000 people in a service area of 155 square kilometers. This effectively raised the regional water supply capacity to 2.8 times that of 2011 and increased the water supply safety coefficient to 1.3. Additionally, by replacing local surface water with diverted groundwater, the proportion of local, underground water supply fell from 74.2 percent in 2011 to 21.4 percent. This has resulted in an annual reduction of 4.77 million cubic meters of groundwater exploitation, thus conserving underground water.

Since Tongzhou Water Works has been completed and is operational, the city's subcenter and Tongzhou New Town will be incorporated into the South-to-North diversion water supply range to enhance the regional water supply quality, volume, and pressure and reach the water supply level of the central city. Water quality will be even with, or above, the WHO and the U.S. EPA standards. Finally, the project will greatly enhance the water conditions of the Tongzhou area, which will allow the government to relocate the city government to Tongzhou and make it a vital population sub-center in the future.



Bentley's 3D design applications allowed designers to work in a collaborative management platform, improving design accuracy and efficiencies.

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