

## Project Summary

### Organization:

Shanghai Investigation, Design & Research Institute Co., Ltd.

### Solution:

Government

### Location:

Ningbo, Zhejiang, China

### Project Objective:

- Design and construct a high-volume sluice and pump station to prevent future flooding in Ningbo's urban areas, and improve the city's infrastructure services.
- Complete the emergency project in an eight-month time frame, setting the BIM standard for a project of this complexity.

### Products Used:

AECOSim Building Designer, AssetWise ALIM, Bentley Descartes, Bentley Navigator, Bentley Map Mobile, Bentley Pointools, Bentley Raceway and Cable Management, Bentley Substation, GEOPAK, OpenPlant, MicroStation, Navigator Mobile, ProjectWise, ProjectWise Explorer Mobile, Promis.e®, GenerativeComponents®

## Fast Facts

- Ningbo Yongxin's sluice and pump station was designed and constructed using three pit tubular pumps capable of discharging 20 cubic meters of water per second.
- The Institute met the client's compressed project delivery timeline using Bentley's integrated BIM applications, which enabled a collaborative, efficient 3D design process involving over 20 disciplines.

## ROI

- Project information was effectively integrated through AssetWise ALIM, which increased information access efficiency by 15 percent.
- Bentley Pointools, Descartes, and GEOPAK modeled point-cloud data to visualize important structures, improving efficiency over 2D cut profiles by 50 percent.
- Computational modeling in GenerativeComponents increased design efficiency by 20 percent.
- Bentley Navigator's clash detection decreased the error rate by 95 percent, reducing construction costs.

# Shanghai Investigation Sets BIM Standard on Ningbo Yongxin's Urban Flood Control Project

Interoperability of Bentley Software Helps the Institute Reduce Design Time by 33 Percent and Cut Project Delivery Costs

## Mitigating Future Flood Losses

In response to the devastation from a 2013 typhoon that caused the Yongxin and Yongjiang rivers in Ningbo, China to overflow, Ningbo Raw Water Group Ltd. commissioned the detailed design and construction of a CNY 178 million emergency sluice pump. The pump would provide flood control measures and mitigate future flood losses to improve urban infrastructure services within the Zhejiang province. To avoid the risk of additional flooding from another typhoon, the Raw Water Group required the urban flood control project to be delivered in a demanding eight-month schedule—a process that would ordinarily take 24 months to complete.

As the EPC contractor, Shanghai Investigation, Design & Research Institute integrated Bentley software to support the full lifecycle of the water conservancy project, from planning, design, and construction through to operations and management. Leveraging Bentley's BIM advancements in conjunction with AssetWise ALIM and ProjectWise®, the Institute was able to seamlessly access project information, facilitate collaboration, improve work efficiency, and promote resource sharing. The unique 3D design approach allowed the contractor to continuously compare and perfect design and construction schemes against a BIM methodology. This process maximized flood control and utilized natural resources, and reduced environmental impact.

## Massive Environmental Challenge

Ningbo Yongxin's sluice and pump station is located at the confluence of the Yongxin and Yongjiang rivers, an area with extremely harsh environmental conditions. The layout of the project was constrained due to several

engineering geological factors, including existing structures of Ningbo's downtown and the foundation's muddy, silty clay. Vertical excavation had to be carried out using foundation pit support, all while working around the surrounding roads and buildings (both commercial and residential) and the foundation pit. In addition, given soft soil foundation, the Institute needed to meet strict requirements for foundation pit deformation control.

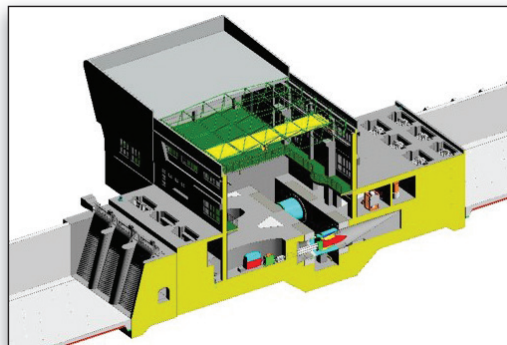
The sheer size and complexity of the project required more than 20 disciplines to generate the massive amounts of information and drawings needed for team members and stakeholders to access and work on simultaneously. For example, just the project survey and design process itself involved multiple disciplines, including measurement, project estimating and budgeting, geology, planning, water conservation, water and wastewater management, HVAC, and construction as well as use of hydraulic machinery and other resources. The Institute estimated that more than 1,000

design drawings and reports would need to be produced in the construction drawing stage alone—in addition to the large volumes of process management information on project progress, quality, expenses, security, and contracts during construction.

## BIM Advancements at Work

Using Bentley software to support a comprehensive BIM methodology, the Institute designed and constructed a high-volume sluice pump

on the west side of the Yongxin River. The team used ProjectWise as the single source of truth, integrating data, roles, and processes with the record configuration and change management capabilities of AssetWise ALIM. The interoperability of Bentley software enabled the team to quickly



*Continuously comparing and perfecting design schemes using a BIM methodology maximized flood control, optimized the utilization of natural resources, and reduced environmental impact.*

*“Our extensive application of Bentley technology greatly contributed to the completion of the Ningbo Yongxin sluice and pump station EPC project within eight months.”*

— Sun Weiyue, Assistant General Manager, Deputy Chief Engineer, Director of Information and Digital Engineering Center, Shanghai Investigation, Design & Research Institute

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incorporate various sources of project information, such as laws and regulations applicable to the pumping station, increasing information access efficiency by 15 percent.

ProjectWise and MicroStation® enabled simultaneous, collaborative 3D and iterative design involving the 20 disciplines, as well as effective resource sharing, efficient work processes, and better decision making. The collaborative 3D design process made it easy to compare designs, assess layout alternatives, and create an optimized layout plan.

Strategic use of other Bentley technology for 3D visualization accelerated project execution while improving overall quality. Bentley Pointools, Bentley Descartes, and GEOPAK Civil Engineering Suite modeled point-cloud data to visualize important structures such as the Yongxin sluice, pumps station, and adjacent buildings, helping designers compute precise earthwork quantities—even in dangerous areas—with minimal effort. The results enabled the Institute to conduct a detailed, contrastive analysis of the 3D models and physical models, and design more accurately given the complexities of the site.

### **Fast, Convenient 3D Modeling**

Project design and construction schemes were continuously compared and perfected using a BIM process to maximize flood control, optimize the utilization of natural resources, and reduce environmental impact. At every step, the team used Bentley Navigator to detect mistakes, design omissions, and model collisions and oversights. This reduced the number of project errors by 95 percent and largely eliminated the need for costly construction rework.

With digital designs accessible through ProjectWise, the Institute’s construction teams could use technologies like Bentley Map® Mobile to review the latest 3D drawings while in the field. The final pump construction, which was completed and ready to pump water on July 30, 2014, used three pit tubular pumps capable of discharging 20 cubic meters per second. As part of the asset handoff to the



*The final pump construction used three pit tubular pumps capable of discharging 20 cubic meters per second.*

operator, the Institute provided a digital engineering model containing AssetWise information, which will help them improve operational efficiency and reduce operating costs.

### **Cost and Time Savings**

Using a BIM-driven design and construction process, the Institute successfully completed this project on time and with a high level of quality. Moving from a 2D to 3D collaborative design environment enabled the contractor to cut design time from 60 days to just 40 days—the equivalent of a 33 percent reduction. By using Bentley Pointools, Descartes, and GEOPAK to analyze point-cloud data and visualize important structures, the project team improved efficiency (compared to 2D cut profiles) by 50 percent. Similarly, the computational modeling performed using GenerativeComponents increased design efficiency by 20 percent.

In July 2015, the emergency sluice pump successfully protected the city of Ningbo from potential flooding caused by a typhoon, further proving the station’s effectiveness in mitigating flood threats. Given the pump’s success on this project, the Institute has begun applying it on water conservation projects.