



Project Summary

Organization:

Hubei Electric Power Survey and Design Institute

Solution:

Utilities Transmission and Distribution

Location:

Macheng, Hubei Province, China

Project Objective:

- Generate 49.5 megawatts of wind power to supply Macheng.
- Develop the site scheme for a 24-turbine wind farm in the Dabie Mountains abutting the city.
- Design and construct wind power generating sets, pylons and bases, booster station, maintenance platform, and maintenance road.

Products used:

AECOSim Building Designer, LumenRT, Bentley Raceway and Cable Management, Bentley Substation, ContextCapture, Navigator, OpenRoads®, ProjectWise®, ProStructures, STAAD.Pro®

Fast Facts

- Reality meshes provided context for site plan development and 3D digital design.
- Integrating the digital terrain model with the 3D design model for the maintenance road minimized earthwork, produced accurate quantities, and guided construction.

ROI

- ContextCapture shortened field investigations by 10 days and OpenRoads shortened road design and construction by 10 days.
- Bentley Substation and AECOSim Building Designer improved booster station design quality.
- ProjectWise streamlined project information management, saving at least 10 days.

ContextCapture Reality Mesh Optimizes Hubei Wind Farm Site Scheme

Bentley Technology Reduces Design Time, Shortens Construction Period on Turbine Project

Windy Peaks

The Hubei Energy Group's Macheng Caijiazhai Wind Farm Project is part of the growing wind power industry in China's Hubei province. The 24-turbine farm is generating 49.5 megawatts of the planned capacity for supplying power to Macheng City. As general contractor, Hubei Electric Power Survey and Design Institute developed the site scheme for the mountainous location and designed and constructed the wind power generating sets (turbines), pylons and bases, 110-kilovolt booster station, and associated equipment. Hubei Electric Power Survey and Design Institute also designed and constructed the maintenance road that accommodated transport of the massive turbine components and construction equipment. Using Bentley technology for reality modeling, 3D modeling and design, and project management saved a total of 50 resource days, shortened construction by 20 days, and reduced project delivery costs by CNY 200,000.

Site Challenges

Hubei Energy Group New Energy Development Co., Ltd., was established in 2014 as an integrated business platform for the research, application, project investment, construction, and operation of new energy technologies. The now completed and operational Macheng Caijiazhai Wind Farm Project will contribute to the development of wind power in central China, eventually generating 80 megawatts of green energy for about 700 villages and towns. The wind farm will also help reduce power transmission loss from the Macheng grid.

The city of Macheng is in northeastern Hubei, overshadowed by the Dabie Mountains. The site selected for the Macheng Caijiazhai Wind Farm is in the mountains near Futianhe Town, Macheng City. The location presented difficult terrain along mountain ridges up to 700 meters high and steep slopes with gradients of 20 to 45 degrees or more. The challenge was not just to position 24 wind turbines at optimal points, but also to design an access road capable of transporting massive equipment to each position. The generating sets included

51-meter fan blades and 63-ton tower sections.

Hubei Energy Group looked to a leader in the power industry to serve as general contractor and complete this complex project within 12 months.

Reality Check

With nearly 60 years of industry experience, the Hubei Electric Power Survey and Design Institute's expertise in power supply projects included the use of advanced digital design technology, including software from Bentley's portfolio of applications. Bentley technology was implemented throughout the project to achieve the expected precision, accuracy, quality, schedule, and cost.

To collect accurate and complete information about the project site, the design institute conducted topographic reconnaissance over a large portion of the mountainous area. The organization used an unmanned aerial vehicle (UAV) to perform oblique photography and LiDAR surveying to capture precise data and images of otherwise inaccessible locations. ContextCapture, Bentley's reality modeling application, provided an intuitive modeling environment to build a landform reality mesh of the entire site. Entering wind resource analysis data into this 3D engineering-ready model enabled the Design



UAV oblique photography and LiDAR point cloud data were used to create reality meshes, which helped the project team plan site development and 3D digital design.

“We used the hybrid model consisting of landform reality modeling and 3D models of the booster station and fan to demonstrate the final panorama. In conjunction with decomposition of the model’s details and simulation of construction and transportation, we enabled the management team to have a full understanding of the whole project’s construction process before construction started.”

— Pingzhong Ding,
Project Manager,
Hubei Electric Power Survey
and Design Institute

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Institute to identify the ideal locations for the wind power generating sets.

The reality mesh also aided in aligning the maintenance road, which had to meet the requirements for transporting large-scale turbine components and construction equipment. Platforms at each installation also had to provide minimum space for hoisting and installing the long blades. The Hubei Electric Power Survey and Design Institute designed the road using OpenRoads, Bentley’s civil design application, then merged the digital design with the reality mesh. This integration allowed the team to discover the optimal route across the mountainous terrain and avoid design modifications during project execution. For the detailed road design, OpenRoads was used to import topographic point cloud data from the LiDAR survey to create a highly accurate digital terrain model. This integrated 3D design model was used to minimize earthwork, calculate earthwork quantities, and guide construction.

Digital Design Data

A 3D digital model of the booster station was designed using Bentley Substation and AECOsim Building Designer. This ensured a high-quality design with accurate material quantities and provided digital design data for use in procurement and construction management.

At the construction stage, iModel work packages made the required design data accessible to the construction team. Annotation within the 3D models linked to supporting data and documents, providing more guidance as needed. Bentley technology enabled 4D modeling and construction simulation of complex tasks such as the hoisting of turbine components. Reality meshes were used to support inspection in the field, enabling the engineers to evaluate work progress and assets at any location.

ProjectWise Management

The Hubei Electric Power Survey and Design Institute chose ProjectWise as the platform for project information

management and collaboration, setting up a centralized, connected data environment. ProjectWise managed the input and output of project-related design documents, procurement materials, and project management materials. ProjectWise provided the capabilities required to control all aspects of construction, such as scheduling, procurement, quality, cost, safety, and environmental protection. As a result, personnel, equipment, materials, and documents were readily available at each stage of construction and transportation.

Publishing iModels for information exchange allowed centralized access to the engineering team’s 3D design models and made project data available in an open format that could be reviewed and commented upon by project team members as well as the owner.

Accumulated Savings

Bentley technology provided the precise information management that the Hubei Electric Power Survey and Design Institute required to maintain transparency and quality control. Throughout the project, Bentley applications saved 50 resource days in design, shortened the construction period by 20 days, and reduced project delivery costs. These savings included shortening field investigations by 10 days using reality meshes, shortening road design and construction by 10 days using 3D digital design, and improving booster station design quality. Finally, efficiencies gained using ProjectWise as the centralized project information management platform saved Hubei Electric Power Survey and Design Institute at least 10 days.

The Macheng Caijiazhai Wind Farm Project installed 23 wind turbines, each capable of producing 2 megawatts of stand-alone capacity. One additional turbine has a 1.5-megawatt stand-alone capacity. Together, the turbines are producing 49.5 megawatts of wind power for the Macheng grid. When it achieves its full generating capacity, the wind farm will provide 89.595 million gigawatts per hour of clean energy, saving 30,471.8 tons of coal used by a standard coal-fired power plant each year.