



Project Summary

Organization:

Long Jian Road & Bridge Co., Ltd.

Solution:

Bridges

Location:

Heihe City, Heilongjiang Province, China

Project Objective:

- Construct a 19.9-kilometer roadway from Heihe, China to Blagoveshchensk, Russia with a 1,284-meter cable-stayed bridge across the Heilongjiang (Amur) River.
- Implement a BIM platform for collaborative modeling and management of civil construction.
- Achieve real-time visual tracking and monitoring of the bridge's incremental construction.

Products Used:

AECOSim Building Designer, ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBridge Modeler, OpenRoads, ProjectWise, ProSteel, ProStructures, RM Bridge

Fast Facts

- MicroStation® and ProjectWise® provided a common data and modeling environment for 5D construction information management and real-time collaboration.
- The bridge superstructure and 60 associated structures were precisely positioned and customized with OpenBridge Modeler®.
- ContextCapture helped reduce overall land use by 770 square meters, minimizing the impact on the sensitive river basin environment.

ROI

- Material waste was reduced by 1 percent, machinery and labor was used 15 times more efficiently, and cost of schedule deviations was limited to CNY 500,000.
- ProjectWise optimized coordination and improved project management efficiency by 25 percent.
- Bentley applications enabled a 30-ton reduction in material consumption, saving CNY 100,000.
- Construction coordination and inspection time decreased by 30 percent using Bentley applications.

Long Jian Road & Bridge Builds First Highway Connection in China-Russia Trade Route with Heilongjiang River Road Bridge

Collaboration Through ProjectWise Increases Efficiency by 25 Percent

China-Russia Connection

The CNY 2.4 billion Heilongjiang River Road Bridge connects Heihe, China to Blagoveshchensk, Russia, making it the first highway connection in the trade route between northeastern China and Far East Russia. The 19.9-kilometer route incorporates a 1,284-meter cable-stayed bridge spanning the sensitive Black River Basin. The location has extreme seasonal temperature variations and strict environmental protection. An ambitious, three-year construction schedule was planned to lessen the impact of these challenging conditions. As the contractor responsible for all civil construction, Long Jian Road & Bridge Co., Ltd. implemented a BIM approach based on Bentley applications during project delivery. ProjectWise's collaborative construction management and information sharing platform optimized project coordination and improved the contractor's project management efficiency by 25 percent.

Expanded Trade Route

Talk of a cross-border road bridge from China's Heilongjiang Province to Russia's Amur Oblast began over 28 years ago. Negotiators created a shared vision for the first road crossing of the Heilongjiang River (known as the Amur River in Russia), as well as the logistics of a collaborative design and construction project. The completed structure will be a vital link in the China-Mongolia-Russia Economic Corridor and part of the Silk Road Economic Belt. The bridge will shorten the trade route to Far East Russia by 3,500 kilometers and increase cargo turnover 10-fold, fueling expansion beyond the port cities of Heihe, China and Vladivostok, Primorsky Krai, Russia. The heads of state signed the protocol for construction of the Heilongjiang River Road in September 2015. Construction began in November 2016, with the bridge scheduled to open in October 2019. The agreement called for China to build approximately 6.5 kilometers of the structure, starting in Changfatun Village, a suburb of Heihe City. Russia will build 13.4 kilometers, starting in Canikulgan Village. The Russian team is also tasked with connecting the two bridge sections.

Incremental Launching

Part of the Heilongjiang Province Construction Group, Long Jian Road & Bridge is a state-owned enterprise with a global reputation for notable road and bridge construction projects. The contractor chose the incremental launching method for construction of the bridge, which is a low pylon, cable-stayed structure. This method can save time, money, and space while minimizing disturbance of environmentally sensitive areas.

The site posed numerous obstacles to construction progress, including seasonal weather extremes, ice flows, limited channel width, and a protected river basin. To overcome the hurdles and meet the project delivery deadline, the team had to accomplish key objectives: rapidly build a bridge model within tight time constraints; create a digital environment to manage and exchange all civil design information; and define a BIM strategy that enabled the 3D monitoring of incremental bridge launching.

The clear solution was adopting BIM methodologies to effectively manage the bridge construction. Bentley provided the applications that Long Jian Road & Bridge required to perform the civil construction tasks, while also providing technical support and comprehensive solutions to the other construction units on the project.

Bentley's BIM Technology

Long Jian Road & Bridge implemented Bentley's platform for BIM-enabled construction management and trained personnel in BIM methodologies. The goal was to meet well-defined objectives for cost, quality, and safety while reducing material waste, deploying machinery effectively, and utilizing manpower efficiently.

The project team researched and developed standardized 3D design modeling methods that enabled members to collaborate effectively. The design team leveraged OpenBridge Modeler's 3D parametric modeling capabilities to achieve the required degree of accuracy for the bridge's superstructure. The integration between OpenBridge

“Bentley’s comprehensive software solution provided the management and collaboration capabilities that allowed us to increase efficiency on the project by 25 percent, while coping with the engineering challenges faced in a complex construction environment.”

— Xuyuan Liang
Director, Technology
R&D Center, Long Jian Road
& Bridge Co., Ltd.

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Contact Bentley

1-800-BENTLEY (1-800-236-8539)
Outside the US +1 610-458-5000

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Modeler and OpenRoads enabled precise positioning of the substructure and customization of more than 60 structures. As a result, the team improved efficiency by 50 percent, compared to traditional methods, by implementing parametric modeling techniques. Finite element analysis with RM Bridge simulated the pile foundations, main beams, and other structures to optimize structural strength, rigidity, and stability. Modeling steel structures and structural reinforcements with ProStructures helped to reduce material waste and construction rework, saving 30 tons of material.

ProjectWise enhanced collaboration and coordination among the different disciplines involved in construction of the bridge, roads, culverts, civil works, and related infrastructure. Together with MicroStation, ProjectWise became the platform for 5D construction information management (CIM), creating a common data environment that allowed all participants to share, review, and update information in real time. This collaboration improved modeling efficiency by 35 percent and accelerated decision-making among management teams.

MicroStation provided the comprehensive modeling environment that enabled 5D progress tracking, incremental launch monitoring, inspection and quality reporting, plus cost control. Real-time inspection review and approval allowed follow-up work to proceed quicker. The project team used Navigator to coordinate construction orders, reduce scheduling conflicts, and improve progress management.

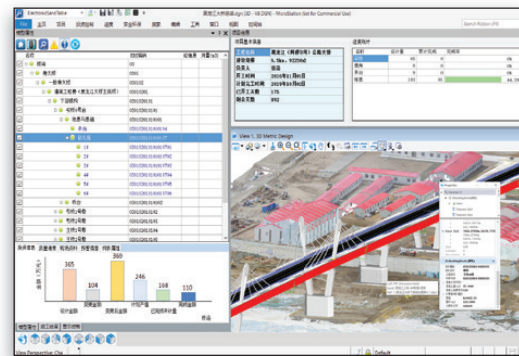
Visualizing Reality

Reality modeling with ContextCapture was instrumental in digital terrain modeling and site planning, as well as managing safety, security, and digital assets. The 3D reality mesh of the site was used to optimize earthworks and site utilization. LumenRT enabled the project team to create life-like visualizations for improved project understanding and communication with government officials and members of the public.

The project team used visualization capabilities to communicate complex working procedures and provide visual data. iModels, 3D PDFs and printing, construction simulations, and virtual reality applications improved understanding of design intent, project progress, and desired outcomes. These capabilities were especially helpful when communicating with the many levels of management on each side of the China-Russia border. The visualization technology for technical project management decreased time spent on meetings and inspections and increased quality assurance. With fewer conflicts, construction progressed on schedule.

Measurable Returns

Long Jian Road & Bridge leveraged Bentley applications to meet the dual challenges of a short construction period and a complex working environment. BIM workflows allowed the management team to perform 25 percent more efficiently. The team also achieved benefits at each phase of the project,



MicroStation’s comprehensive modeling environment was utilized during the design phase and enabled 5D progress tracking and quality reporting.

including accurate 3D models, optimal material quantity calculations, and efficient deployment of personnel and machines, which reduced rework and costs.

Bentley applications optimized the bridge design, which will ensure that the structure fulfills its form and function goals, as well as achieve economy of scale and resource use. From the start, careful site planning reduced the construction area by 620 square meters, making a smaller footprint in the sensitive river basin. The project team reduced overall land use for the bridge and civil infrastructure by 770 square meters, saving an estimated CNY 100,000 as a result. Bentley’s parametric modeling capabilities conserved engineering resources by reducing errors and rework. The team saved a total of 40 working days to date and construction coordination and inspection also took about 30 percent less time. Calculating material quantities with Bentley applications ensured that procurement was supplied with accurate amounts. Material consumption was reduced by 30 tons, saving a further CNY 100,000 on the project.

The project’s successful progress on site is mostly due to BIM-enabled construction management. To date, Long Jian Road & Bridge has achieved a number of critical objectives, including reducing material waste by 1 percent, using machinery and labor 15 times more efficiently, and limiting the cost of schedule deviations to under CNY 500,000. Upon completion, the project team will turn over the reality model-based asset management database to the owner for use in the operation and maintenance management phase. Long Jian Road & Bridge will continue to apply BIM advancements on a company-wide basis, defining standards, processes, and specifications for its future bridge projects.

Chinese officials estimate that the Heilongjiang River Road Bridge will allow the transport of more than 3 million metric tons of cargo and 1.5 million passengers per year between China and Russia. The increase over present day totals of 10 times the cargo and two times the passenger traffic will make an important contribution to China’s One Belt and One Road Initiative, serving to revitalize northeastern China.