

Sichuan Road and Bridge Sets New Benchmark for Regional Smart Highways

Bentley's Digital Applications Industrialize Project Delivery, Saving CNY 17.5 Million in Costs

AN INTELLIGENT ROADWAY INITIATIVE

As one of the pilot projects in the Sichuan province to promote developing an integrated regional transportation system, the Chengdu-Yibin Expressway is an intelligent roadway initiative that aims to establish a safe, convenient, green, and modern main traffic artery. The CNY 24.6 billion project focuses on building a smart road, integrating artificial intelligence and a cooperative vehicle infrastructure system into the expressway construction. Sichuan Road and Bridge (SRB) was awarded the engineering, procurement, and construction contract, which required that they follow strict landscape and environmental protection directives, as well as complete construction within three years.

Located in a mountainous area, the highway is 155 kilometers long, featuring 154 bridges totaling 39.7 kilometers and four tunnels spanning 7.3 kilometers. There are 17 interchanges and five service areas along the route as well. The scope of the work included numerous controlled elements and presented site constraints passing through scenic, protected spots. Given the bridge's long length and complex works amid a tight schedule, compounded by resource allocation and coordination issues when managing dozens of subcontractors, construction planning and management proved difficult.

PILOTING DIGITAL WORKFLOWS AND MANAGEMENT PROCESSES

To effectively improve inspection, design, production, and management efficiencies, SRB sought to pilot BIM along the entire route throughout the project lifecycle. They wanted to streamline and digitalize modeling and construction workflows by developing a cloud-based construction and information management platform, as well as

establish a smart beam fabrication factory for intelligent steel processing and production. However, SRB knew that traditional workflows would be insufficient for this project. "It is difficult to [resolve] these problems with traditional 2D means," said Chunwei Qin, BIM engineer at SRB.

To implement these digital methodologies and enable visual, real-time, smart management practices, they needed reality modeling technology and a BIM methodology. While the sheer scale and short timeline of this roadway project presented numerous difficulties, SRB faced further challenges in addressing the sloping mountainous terrain and inefficient beam fabrication process. Specifically, with 30% of accidents along mountain expressways due to poor line-of-sight, they were confronted with various line-of-sight issues at the 17 interchanges where visual blind spots would negatively impact the safe operation of the Chengdu-Yibin highway. Furthermore, the steel beam fabrication factory employed costly, labor-intensive processes that required a large temporary land acquisition often resulting in environmental damage. SRB realized that their conventional design, fabrication, and construction management methods would only inevitably increase the overall project difficulties, as well as costs.

LEVERAGING BIM AND REALITY MODELING APPLICATIONS

After considering the challenges of this project, SRB chose Bentley's open BIM and reality modeling applications to model, inspect, visualize, and correct traffic line-of-sight problems at all the interchanges along the expressway. They used OpenRoads Designer and OpenRoads ConceptStation throughout conceptual and detailed design to model the highway. They then imported the 3D model into LumenRT to perform

PROJECT SUMMARY

ORGANIZATION

Sichuan Road and Bridge (Group) Co., Ltd.

SOLUTION

Roads and Highways

LOCATION

Chengdu, Sichuan, China

PROJECT OBJECTIVES

- ◆ To pilot BIM technology and digitalize workflows, construction, and production.
- ◆ To establish a smart highway model for integrated regional transportation development.

PROJECT PLAYBOOK

LumenRT, MicroStation[®], OpenRoads[™], OpenRoads Designer, OpenRoads ConceptStation, ProStructures

FAST FACTS

- ◆ Chengdu-Yibin Expressway is a pilot project in Sichuan to promote developing an integrated regional transportation system.
- ◆ The CNY 24.6 billion mountainous roadway presented technical and coordination challenges amid a tight timeline.
- ◆ SRB used OpenRoads and LumenRT to model, visualize, and correct line-of-sight issues at the 17 interchanges along the 155-kilometer route.

ROI

- ◆ SRB developed a construction management platform and smart beam fabrication system to help save CNY 17.5 million.
- ◆ The Bentley-based digital solutions improved efficiencies in process by over 50%, production by over 20%, and modeling by 15%.
- ◆ It is the first expressway in Chengdu to apply BIM across the entire line, providing a model for smart highways in the region.



Using [Bentley] BIM technology saved CNY 17.5 million and reduced the construction period, making the whole project more efficient.

-Wang HaiZhu, Project Leader, Sichuan Road and Bridge (Group) Co., Ltd.

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SRB used OpenRoads and LumenRT to model, visualize, and correct line-of-sight issues at the 17 interchanges along the 155-kilometer route.

driving simulation and virtual inspection of overpasses, entrances, and exits. Using Bentley's civil design and visualization technology, SRB leveled the slope to ensure better visibility for merging traffic and eliminate line-of-sight risks along the route.

To manage the construction process, they also used Bentley applications to develop a construction management platform that helped optimize construction drawings, coordinate scheduling and workflows, and provide greater visibility into construction methods among the multiple subcontractors. "We have developed a construction management platform based on [Bentley] BIM technology and have built a set of intelligent BIM integrated management systems for the construction period," stated Qin. Working in a digitally connected, visual environment enhanced understanding of SRB's design intent and improved coordination of on-site construction.

Finally, to further streamline and improve construction, SRB used ProStructures to build a T-beam reinforcement model and imported it into their Bentley-based intelligent beam fabrication system, enabling real-time insight into steel processing and production. The newly developed information management system now automates previously manual production processes, extracting all data from the BIM model to establish a smart, factory-based environment for fabrication and closed construction.

DIGITALIZATION ESTABLISHES SMART HIGHWAY MODEL

Deploying a BIM methodology and reality modeling to deliver the Chengdu-Yibin roadway, SRB identified more than 103 potential design problems that saved CNY 4.5 million in costs associated with on-site construction changes. Using the 3D model for digital inspection and simulation resolved over 14 potential line-of-sight issues and facilitated

intelligent expressway construction, saving CNY 7 million in operations costs. By establishing the construction management platform and smart beam information system, SRB converted offline management to online management, reducing the entire construction period by 124 days and saving CNY 6 million in production costs. The digital Bentley-based solutions improved process efficiency by more than 50%, production efficiency by over 20%, and modeling efficiency by 15%. The applications also allowed SRB to reduce land acquisition and, therefore, the project's environmental impact.

Through innovative application of Bentley technology, SRB piloted intelligent BIM workflows across the entire 155-kilometer highway for the first time in Chengdu, transforming highway construction in the region. They maximized data potential, realized technical achievements through visual sight distance inspection and 3D modeling, and established smart management processes working in a digitally connected environment. "BIM technology based on Bentley has been applied for the project and resulted in good achievements," commented Xie Zhongtao, highway engineer at SRB. Through digitalization and visualization, SRB industrialized delivery of the Chengdu-Yibin Expressway, promoting integrated regional transportation and setting a new benchmark for smart highways in the region.



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