COMPANY

Chongqing Municipal Research Institute of Design

LOCATION

Chongqing, China

SOFTWARE

Autodesk® Architecture, Engineering & Construction Collection
Autodesk® AutoCAD® Map3D
Autodesk® InfraWorks®
Autodesk® Civil 3D®
Autodesk® 3ds Max®
Autodesk® Navisworks® Manage
Autodesk® Revit

$4+ billion expressway connects busy city

Huangjueping Yangtze river bridge. Image courtesy of Chongqing Municipal Research Institute of Design.

BIM-powered integrated workflows improve 28-kilometer project

Located in Chongqing, China, the Parallel Line of the Fourth Diversion Expressway will add much-needed transportation capacity to a growing municipality. Chongqing is a mountainous city bisected by the Yangtze River, and river crossings and mountains make up much of the 28-kilometer-long project. The project also includes 7 interchanges—one of which intersects 8 roads and contains 35 ramps. From start to finish, the project team relied on BIM (Building Information Modeling) tools in the Autodesk® Architecture, Engineering & Construction Collection—including Autodesk Civil 3D® engineering design software, Autodesk Navisworks® project review software, Autodesk InfraWorks® infrastructure design software, and Autodesk Revit® building design software—to help them integrate their workflows as they planned and designed the complex project.

Through mountains and across rivers

Chongqing Municipal Research Institute of Design delivered the Parallel Line of the Fourth Diversion Expressway design with a large, multidisciplinary team. The total costs were expected to exceed USD$4 billion, so the team was determined to optimize every aspect of the high-profile project. They were especially committed to making the expressway user friendly while harmonizing with the surrounding urban environment and existing infrastructure.

The team decided that they needed a way to capture and share existing conditions as they designed the many aspects of the project. This required that they bring together existing maps of infrastructure and aerial imagery of the city. Just as important, they wanted a way to see the high-level design and engineering implications of their design options.

Gaining an integrated view

The team decided to use a combination of BIM tools to help them plan the overall project. They turned to drones to gather aerial imagery of the area and to GIS (geographic information system) data for

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maps of existing infrastructure. Bringing that into InfraWorks gave them a 3D view of existing conditions. With a combination of Civil 3D and Revit, they designed and engineered concepts of the new expressway. They could then bring this design information into InfraWorks and blend it with the existing conditions model.

Dynamo, a computational design tool that integrates with BIM design applications like Revit, let them use programmatic rules to refine the expressway. This approach helped the team explore multiple design options in just a few days—something that could have easily taken months, considering the length and complexity of the expressway.

Xiaoyang Zhang, professorate senior engineer on the project, explains: "The combination of drones for aerial photography and BIM tools—including Revit, InfraWorks, Dynamo, and Civil 3D—helped us complete map data acquisition and the initial planning faster. It took only 5-7 days, and the scheme is better and the environmental impact is smaller."

Simulation improves driving conditions

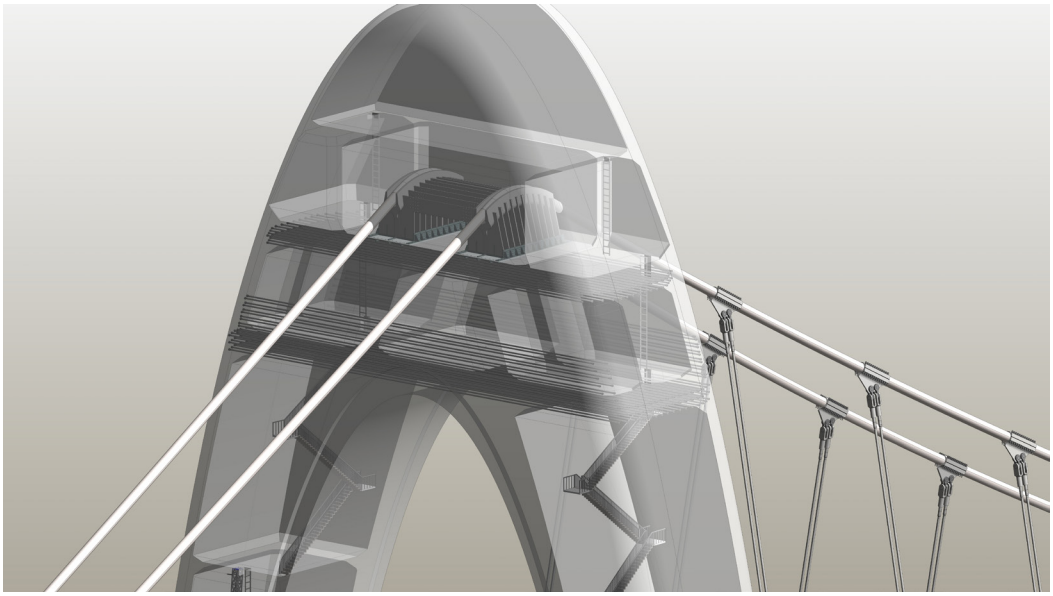
The Huayan Interchange segment of the project proved to be one of the most complex to plan and design. Intersecting 8 roads and containing 35 ramps, the interchange had the potential to confuse drivers. Drawing the complex web of ramps—even in 3D with Revit, Civil 3D, and InfraWorks—could only provide limited insight into how a driver would navigate the ramps. The team turned to BIM-compatible virtual reality (VR) technology to simulate the driving experience. They brought design models created with Civil 3D and Revit into VR tools to explore the best way to configure the ramps.

"In the interchange design, by combining design models created in Civil 3D and Revit with VR technologies, we made the interchange better for driving," says Xiaoyang Zhang. "We could experience the line of sight in the driving process. The simulation results were used to guide the optimization of the design. It would have taken 6 months to design with the traditional design method. But with BIM, it took us about 3 months."

Bringing together insights from 20 disciplines

The project team points to its multidisciplinary approach and the BIM tools in the AEC Collection as keys to the speed and success of the design. They estimate that the close collaboration enabled by using compatible tools—such as InfraWorks, Revit, and Civil 3D—helped shorten the design time on the project by 15%. With the team easily able to incorporate the input from more than 20 disciplines—including specialists in roads, bridges, tunnels, architecture, transportation, and more—they were empowered to make better decisions and gain a whole-project view on a project that generated more than 5,300 files.

> "Large infrastructure projects like the Parallel Line of the Fourth Diversion Expressway have complex environmental conditions and many design elements. Beyond the challenges of the design program, communication and coordination across a large team can be difficult. The BIM process helped us see the project as a whole and work together more seamlessly.
>
> – **Xiaoyang Zhang**
> Professorate Senior Engineer
> Chongqing Municipal Research Institute of Design



The main tower of the bridge. Image courtesy of Chongqing Municipal Research Institute of Design.

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