

Corporate name

Zhejiang Xicheng Engineering Design Company

Project address

China, Hangzhou

Application software

AutoCAD® Civil 3D**Autodesk® Dynamo****Autodesk® Revit®****Autodesk® Navisworks®**

As a frontier technology in bridge design and construction, BIM has shown outstanding value and won growing application. We used to struggle with precision modeling of elevated bridge, intersections and other complicated structures. By combining Civil 3D, Dynamo and Revit, however, we manage to overcome the difficulties and create accurate modeling with bridge “data”. The experience is also inspiring for the modeling of other infrastructure projects, such as tunnels and pipe corridors.

—**Xiaofeng Shen**

Chief Engineer

Zhejiang Xicheng Engineering Design Company

Design with seamless BIM data transferring

Rainbow Express-way of Hangzhou Transportation Hub



Company profile

Zhejiang Xicheng Engineering Design Company is an institution with multiple A-class qualifications, offering design and consulting services on public utilities, civil engineering and landscaping. Its BIM Research Institute was set up in 2015. After two years of research and development, the company set up Zhejiang Huiyuan Engineering Data Technology Firm, committed to applying and promoting BIM throughout project life-cycle.

The express-way network in Hangzhou consists of “four vertical and five horizontal” trunk roads, in which the 25.7 km Rainbow Express-way is an important horizontal component. This project covers 7.49 km of the main lane (Rainbow Avenue), and elevated roads, tunnels, interchanges and parallel ramps connected to it. Total investment is about RMB 5.2 billion.

The project owner mandated to use BIM technology, aiming to timely detect and

fix problems in initial design, design detailing and on-site construction. Moreover, the project needs BIM to address challenges such as complicated landscape, transfer connection with a railway under construction, precise clearance control between intersections of the main road and ramps, heavy load of drawing generation caused by frequent and complicated amendments in design, as well as high expectation of the project owner.

The project team used Autodesk AEC Collection as BIM solution, to constitute an end-to-end work-flow, enabling seamless data transfer from schematic design to detail design and to construction technical clarification.

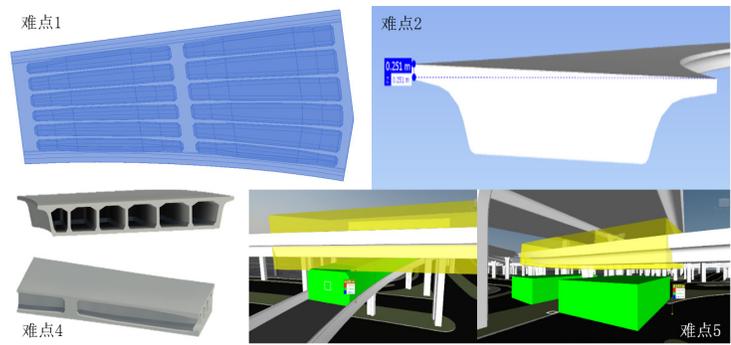
BIM+GIS-aided visualization to support efficient and precise decision-making.

The project team uses GIS and scan data



to generate models of the construction site, and then generate 3D digital scene to visualize the schematic design. Construction conditions are analyzed in the 3D scenarios, including the construction environment, field conditions, road network in the area and peripheral buildings. Related information is acquired with multi-angle roaming view and model-based measurement. BIM models also enable quantity take-off and construction simulation. Thanks to BIM application, options of construction are compared and key line positions and connections highlighted, to facilitate field construction and coordination with surrounding projects. The project owner convenes meetings, where relevant departments and entities study the 3D digital scene together for efficient and precision decision making.

Digital modeling workflow



based on a single data source. Dynamo is used as the data gateway between Civil3D and Revit.

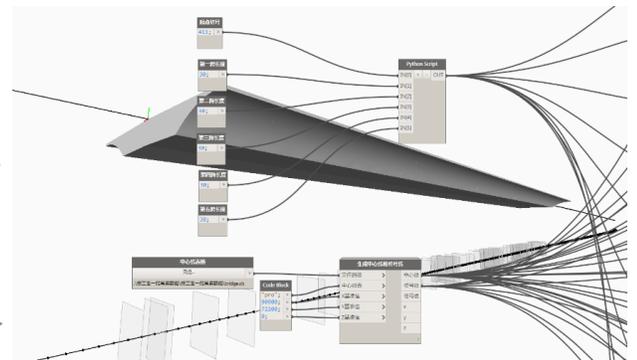
The project team takes a data-based approach and addresses challenges in traditional 2D design with BIM. Dynamo is used as the data gateway between Civil3D and Revit. A modeling workflow is set up for the entire process, based on a single data source. At the same time, a set of methods to model viaduct structure intersections is developed. These efforts help standardize design process, improve modeling efficiency and enact corporate standards for viaduct bridge modeling. Visualization programming of Dynamo makes it possible to model viaduct structure intersection in Revit with 3D curve drawing, component positioning and irregular components

modeling. Moreover, parameters of each cross section in the bridge model are standardized for data import and storage.

Horizontal and vertical curves of the bridge are modeled in Civil3D, before being exported to Excel spreadsheets, where data type for each row and column is configured in advance.

Dynamo is used to program bridge models, access design data and create the upper, lower and auxiliary structure models of the bridge.

Upper structure modeling. By reading data of the axle-center and section profile within the program, the project team defines starting pile number and span, and then quickly generates a standard model for section units. For extended sections,



Technical roadmap

Software used	Lnfraworks	Civil3D	Dynamo	Revit	Navisworks
Purpose	Schematic design	Modeling for bridges & data extracting	Parametric programming modeling & data capturing	Modeling with imported data	Construction simulation

Excel spreadsheet data is used to generate parametric cross-section profiles and adjust the size and parameters by data modification. The upper structure has very complex intersection parts, making it necessary to model separately the solid and hollow parts of the box girder. When modeling the solid part, bridge data is used to create the positioning line, locate and place each section with the Revit adaptive family and finally generate the model of approaching noses. When modeling the hollow part, the adaptive profile family is used to create the hollow box room and finally cut it out to get the box girder model.

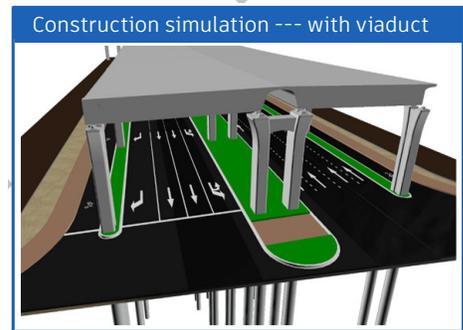
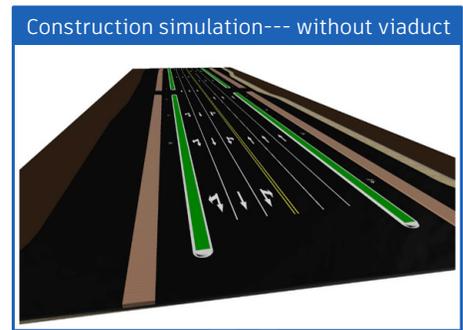
Lower structure modeling. The program accesses design data of bridge piers in standard Excel format, and automatically generates parametric model of the piers. With pile number and offset data of the piers, their layout is automatically scripted.

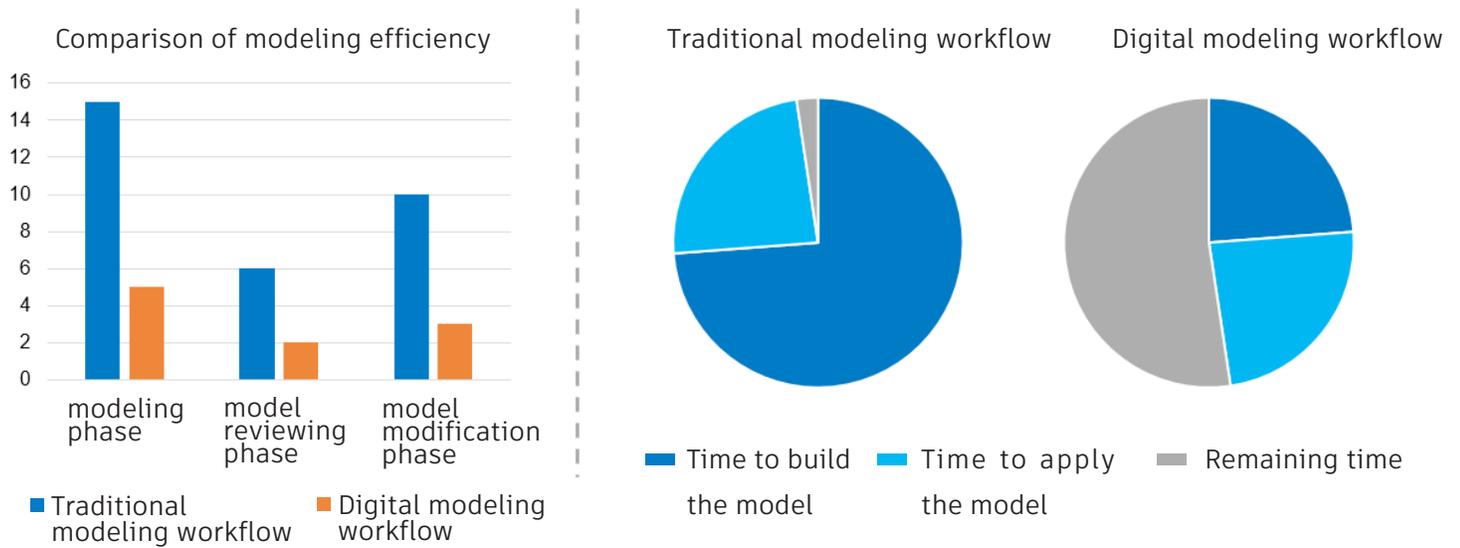
Auxiliary facilities modeling. Design of the marking lines is a major challenge. Dynamo is used to project CAD plane markings to the 3D upper structure. Digitalized modeling can also be used to quickly set up models of crash barriers, street lights and other auxiliary facilities.

Finally, Dynamo is used for quick elevation inspection, so as to detect potential problems and make the design more accurate.

BIM-aided construction technical clarification. Navisworks is used for construction simulation and Dynamo is used to capture and export data from BIM models.

Construction needs are front-loaded in





the design phase. The team analyzes feasibility of construction for complicated intersections, traffic plan during construction, deployment of large-sized equipment and so on. Navisworks is applied to simulate construction sequences and methods, and visualize construction steps, duration and scope of impact. This project is divided into sections and commissioned to multiple contractors, so the coordination between sections is also factored in during design. BIM visualization tools and construction animation are used to accurately present the design concepts, offering clarity to contractors. This practice is also recognized by the project owner.

Another challenge in BIM application is how to capture data quickly and effectively. Accurate BIM models and interoperable information exchange are instrumental for contractors to capture specific information on progress and time control. This project uses Dynamo to capture and export data to common Excel spreadsheets which are both viewer-friendly and editable. The spreadsheets deliver core data to contractors, ensuring access to key formation such as materials, engineering work amount and spatial relationships, making it easier to organize construction and meet the requirement of data disclosure.

BIM boosts quality and efficiency. The program makes modeling 3 times efficient and can be re-used in similar projects.

In detail design phase, Autodesk AEC Collection is used. By visualized programming, a whole set of bridge modeling programs based on accurate data is developed. This reduces the workload of repetitive modeling and makes it easier to design bridge in 3D environment. This approach is 3 times more efficient than traditional practice. It simplifies the workflow of model checking and modification and also enables data capture. In future projects of similar profile, designers only need to update data and models can be created with a click of the mouse. The efficiency will be further improved.

Summary and prospect

BIM application in the Rainbow Express project shows that the earlier, wider and deeper BIM is deployed, the more value can be harvested. In the future, we will conduct more in-depth explorations on data format standardization between BIM and other platforms, so as to enhance data interoperability among disciplines and

domains for seamless data transfer. Deeper penetration of BIM will redefine and optimize the work-flow of infrastructure projects, breeding industry-wide innovation and disruption.

The project team used Autodesk AEC Collection as BIM solution, to constitute an end-to-end work-flow, enabling seamless data transfer from schematic design to detail design and to construction technical clarification. We implemented a modeling workflow based on a single data source, which makes modeling process 3 times efficient. We are trying our best to innovate new design model with advantage of BIM technology, which for sure, will generate new value for our industry.

— **YanJun Xu**
 Chief Designer
 Zhejiang Xicheng Engineering Design Company