Tech Brief

U.S. Department of Transportation
Federal Highway Administration

HYBRID APPROACH TO BIM IN IOWA

BIM AS PART OF THE CONSTRUCTION CONTRACT

This technical brief describes a hybrid approach taken to incorporate building information modeling (BIM) for infrastructure for the I-80/I-380 Systems Interchange Project in eastern Iowa. Considerations for BIM model development and the positive impacts on the project resulting from the use of BIM are also explored.

BACKGROUND

The Iowa Department of Transportation (DOT) used a hybrid approach to incorporate building information modeling (BIM) into the contract documents for the I-80/I-380 Systems Interchange Project in eastern Iowa (Figure 1). The project started in August 2018 and is scheduled to be completed in December 2022.

The I-80/I-380 Systems Interchange Project is a comprehensive redesign of a major interchange that is intended to improve travel in the area. The project includes the construction of three curved steel plate girder bridges with a combined total length of 4,200 ft. The first structure is a 5-span bridge with a diverging gore (Ramp BH), the second is a short 3-span bridge (Ramp B), and the third is a 13-span, 3-unit curved bridge (Ramp H) as illustrated in Figure 2.

Iowa DOT, used with permission

Figure 1. Section of the I-80/I-380 Systems Interchange Project during construction

HYBRID BIM FOR INFRASTRUCTURE APPROACH

The agency worked to develop the BIM models that were as detailed as possible for all three ramps (Figure 2) using three different Bentley® software products, namely, OpenBridge Modeler™, ProStructures™, and Navigator CONNECT™. The agency's goal in using three software tools was to evaluate each and identify their advantages and disadvantages in terms of BIM.

The Iowa DOT incorporated the BIM models into the construction contract documents using a hybrid approach. In this approach, for Ramp B the BIM model was provided to the construction contractors as part of the contract documents, while for Ramps BH and H the BIM models were provided for informational purposes only. Regardless, the Iowa DOT encouraged the contractors to use all three of the provided BIM models and become more familiar with the BIM software tools. Furthermore, the agency sought feedback from the contractors for future improvements to the models. When developing a conventional BIM model(s), all elements of the project use BIM models.

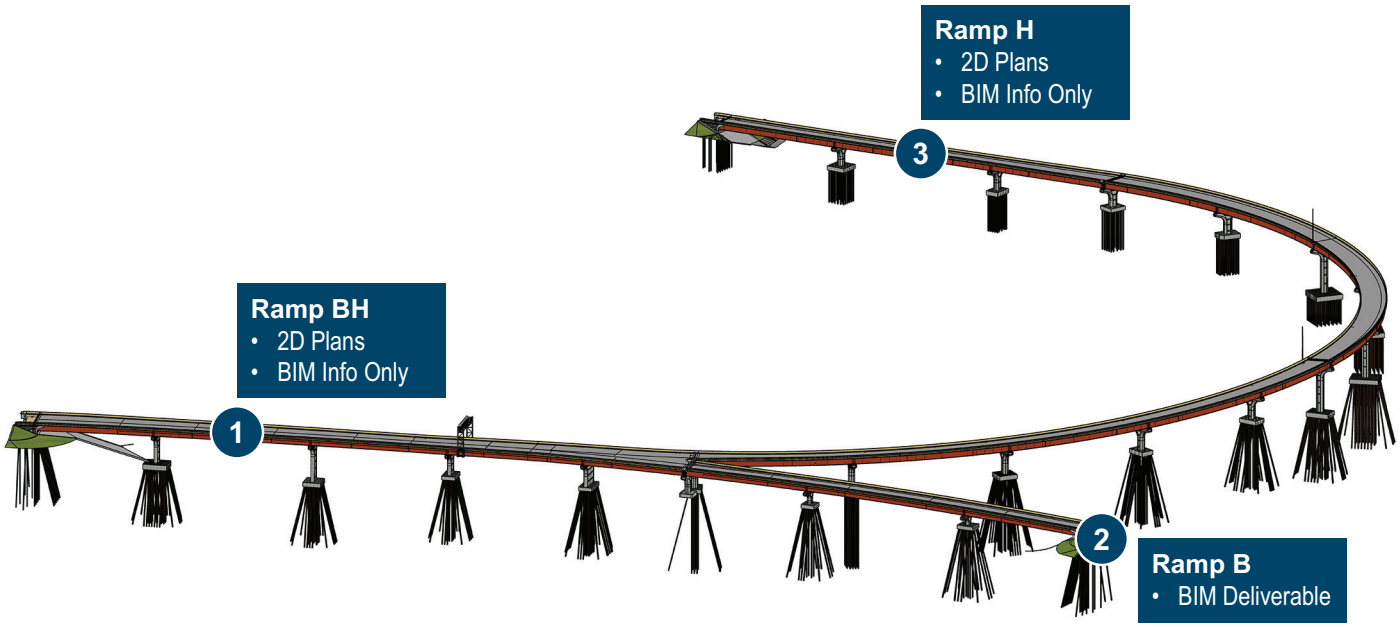

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Figure 2. Hybrid approach to BIM on the I-80/I-380 Systems Interchange Project

Bentley View® software, a free software tool that provides visualization capabilities similar to those of MicroStation CONNECT™ and ProStructures™, was made available to all the bidders during the advertisement period. The software provided the bidding contractors with read-only BIM models detailing the project. With this being a demonstration project, the Iowa DOT did not want to require the contractors to purchase expensive software licenses, and this product allowed multiple contractors to bid on the project.

Furthermore, because the contractors and subcontractors were unfamiliar with the software, the Iowa DOT made sure to provide training before and after letting to avoid excluding any contractors or subcontractors from bidding due to software issues. HDR provided training to both Iowa DOT staff and contractors and recorded and posted online an hour-long training video using the Ramp B model as an example. Additionally, Bentley® agreed to provide free support.

BIM MODEL DEVELOPMENT

As mentioned above, the Iowa DOT worked with the design team to develop a complete BIM model for each ramp using the OpenBridge Modeler™, ProStructures™, and Navigator CONNECT™ software tools. OpenBridge Modeler™ was chosen to define the primary elements using horizontal and vertical geometry, including elements such as the bridge deck, barriers, girders, cross-frames, and some substructure elements. Because OpenBridge Modeler™ is only capable of a fairly low level of detail, ProStructures™ was used to add more detailed elements to the models (Figure 3). Navigator CONNECT™ was not actually used to create any elements but rather was used to provide multiplatform viewing on laptops and tablets in the field.

The I-Model Transformer™ and MicroStation CONNECT™ software tools were also used in the model development stage. I-Model Transformer™ was used as a cleanup tool to filter out unwanted information, modify descriptions, and adjust software-generated data. MicroStation CONNECT™ was then used as a customization tool to add custom element information, organize data into different categories, and link data to spreadsheets using item types.

Because the resulting BIM models could not provide all of the information needed for the project, the models were supplemented through element information dialog boxes with links. This brought the models up to par with the traditional two-dimensional (2D) plan sets. The supplemental information was provided in the form of PDFs, spreadsheets, Word documents, and website links.

The Iowa DOT initially considered providing all three BIM models for informational purposes only, given that this is the first project for which the agency developed detailed BIM models for the entire project. After further consideration and discussions with the local Associated General Contractors (AGC) member companies, the agency decided on this hybrid approach and provided the BIM model for only one of the ramps as part of the contract documents. For the other two ramps, 2D plans were provided as part of the contract documents, and the BIM models were provided for informational purposes only. However, as mentioned above, the Iowa DOT encouraged the contractors to use the provided BIM models and become familiar with the software tools for future projects so that the eventual transition to full BIM implementation would be easier.

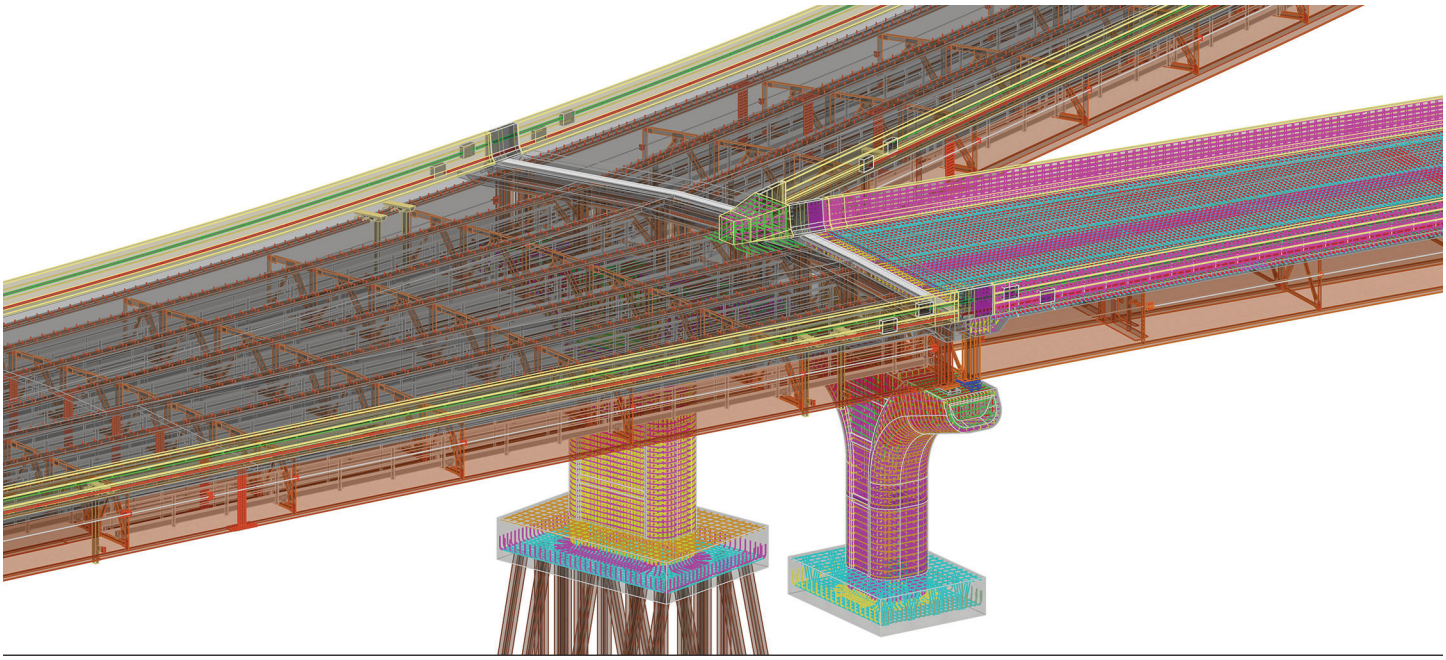

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Figure 3. Detailed BIM model for Ramp B developed using OpenBridge Modeler™ and ProStructures™

For the contract documents in which the BIM model was included, the use of the BIM model was covered in the special provisions portion of the contract, which included a list of files and instructions for access, recommended software, an information hierarchy, a level of detail (LOD) table for each element type, a list of known deficiencies within the model, and an appendix with a seal, a list of covered digital files, and referenced files pertaining to, for example, borings and ground surfaces.

LESSONS LEARNED

One of the major benefits of BIM is the ability to incorporate multiple disciplines into the design process, which would enable the Iowa DOT to coordinate among different disciplines and address conflicts during design. An important objective of using BIM for this specific project was to evaluate the capabilities of the available software for implementing such BIM practices. As stated above, OpenBridge Modeler™ and ProStructures™ were used together to develop the detailed BIM models.

A variety of issues came up during model development regarding both software tools. In OpenBridge Modeler™, elements could not address all the design issues of the project, and only simple native elements were readily available for use, each with limited quantities and parts lists. Meanwhile, ProStructures™ is a building-based program that is not intended for modeling highway geometry. The use of a more bridge-specific tool may have been very useful for this project; it was time consuming to develop a detailed bridge model using ProStructures™.

Furthermore, a significant amount of data generated by both OpenBridge Modeler™ and ProStructures™ is not used in the models developed. This also includes additional information, which results in an increase in the time needed for model coordination. The project needed to add customized element information, including bid item numbers, embedment depths, batter angles, etc. To overcome some of these data issues the project used another software to clean up and customize the model.

Additionally, as mentioned under the BIM Model Development section, the software tools' capabilities did not allow all information about the project to be obtained from the models. Furthermore, the detailed information needed to help define welding details and vendor-supplied items such as bearings and expansion joints were not available in the developed models. In an ideal implementation of BIM, specifications and notes should be able to be linked to the models as well. In this project, the solution was to embed links to data files to supplement the models.

However, it is important to note that all of the software issues described here were encountered in 2016 and 2017, during the model development stage of this project. Software vendors regularly update their products, so some of these issues may have been resolved already.

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3D modeling, building information modeling (BIM), digital data, modeling software

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Another important objective of this demonstration project was to get feedback from the contractors selected for the project regarding the use of the BIM models. The contractors raised several concerns regarding both the software and the models. One of the issues raised regarding the software was the fact that specialized software is needed to take full advantage of the models. The contractors also had issues with generating prints for specific views and the lack of dimensions in the models. To help alleviate some of these problems, the prime contractor is helping suppliers obtain information from the models. In addition to the data information concerns, the contractors mentioned that getting buy-in from senior field staff was difficult.

After letting of the project, the Iowa DOT assessed the hybrid approach it used and determined that given quality software tools and adequate training, the industry is ready to embrace new technologies and tools and has the expertise to develop successful workflows. As the Iowa DOT encourages the local construction industry to utilize BIM for infrastructure projects, both the agency and contractors will become more accustomed to the process.