

STIC Grant – Development of Digital As-Built Model for I-80/I-380 Design 420 BIM

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Research Project Title: Development of Digital As-Built Model for I-80/I-380 Design 420 BIM

Sponsors: Iowa Highway Research Board Project Number ST-012, Iowa Department of Transportation (Iowa DOT) & Federal Highway Administration

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Introduction

The objective of this State Transportation Innovation Council (STIC) Grant study was to build on the three-dimensional (3D) Building Information Model (BIM) used as the deliverable for the construction of the Ramp B Bridge, Design Number 420, FHWA Number 700725, in the reconstruction of the I-80/I-380 interchange in Johnson County, Iowa. The Ramp B Bridge is a three-span, steel plate girder bridge supported by concrete hammerhead piers and a stub abutment. It is one of three bridges modeled as part of the original contract (Figure 1). The original model was created as part of a pilot project using Bentley's BIM software packages Open Bridge Modeler (OBM) and ProStructures (PS). It was created as an addendum to the bridge design contract as part of an effort by Iowa DOT to explore and push the boundaries of Bentley's BIM software as well as to investigate the benefits and shortcomings of its use during construction.

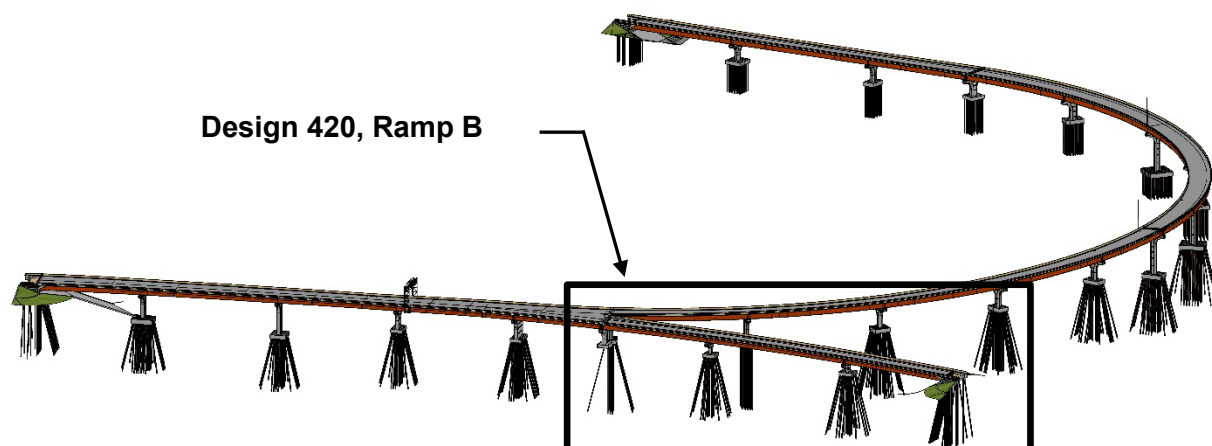


Figure 1: Location of Ramp B

Following construction of the bridge, this STIC Grant study was proposed to further advance the BIM model developed for the pilot project by incorporating as-built information and other associated construction data. The objectives were to capture the known construction



modifications to the design and to allow the data in the model to be used in the future for asset management applications.

Model Creation

The deliverable of this STIC Grant study is the 3D as-built model, which can be seen in part in Figures 2 and 3. The original model used to build the bridge was provided to the contractor in an i-model format. This format does not allow for editing or attaching information of the type required to convert it to an as-built model. Additionally, the Bentley modeling software used to develop this i-model is no longer compatible with the current versions of the software. Because of these limitations, the original software versions were used to add the as-built information and attachments. After the as-built updates were made, the model was republished to an i-model format. To ensure that the model could be used with future asset management software packages, the team explored non-proprietary open-file formats in which the model could be exported. Doing this eliminates the risk of Bentley's proprietary i-model format becoming obsolete, rendering the model inaccessible to modern software. A non-proprietary file format called International Foundation Class (IFC) was found to be the most advantageous. Conversion to the IFC file format will allow the model to be read by other 3D modeling software.

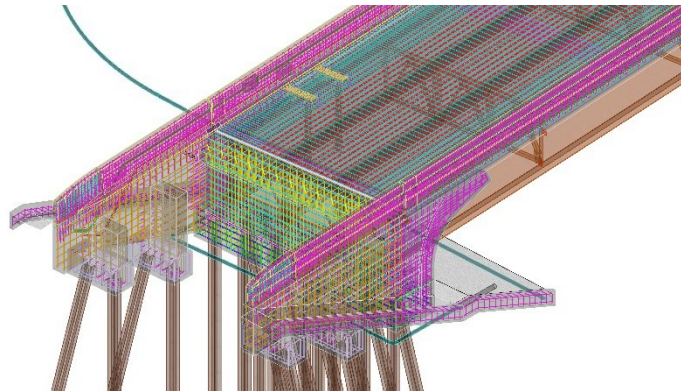


Figure 2: Transparent View near Abutment

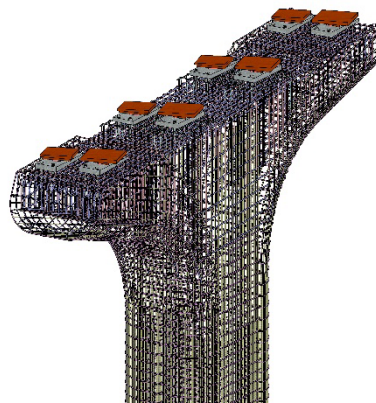


Figure 3: Pier Reinforcing



The original BIM model was updated with the known changes from construction, as follows:

- Updated the footing and pedestal elevations based on the disc bearing shop drawings.
- Updated the disc bearing geometry.
- Updated quantities.
- Added the location of the survey pins.
- Added girder haunch reinforcing in the deck where applicable.
- Added anchor bolt wells.
- Added an “Orb” with the following links:
 - As-built plan set with signed and sealed revision sheet.
 - Approved construction photos.
 - Approved shop drawings and material certifications.
 - Approved special provisions.

The model was delivered in the i-model format. The current disposition of Synchro, a Bentley software that allows for the transformation of the i-model into IFC, will likely be used to convert the model in the future, after this study has been completed. The reason for the delay is that the non-proprietary IFC format has yet to be finalized and conversion before this point could result in loss of data.

During model development, HDR had telephone conversations with Iowa DOT staff, including Cedric Wilkinson, Shawn Blaesing, Mike Nop, James Hauber, and Kelly Popp, to ensure that the items being incorporated into the model can be used by various parties now and in the future. This resulted in some additional construction data being included in the model as well as some adjustments to the way linked documents are handled. Unfortunately, some of the desired uses, such as being able to link the software to Iowa DOT’s Geographic Information System (GIS) database and the portability of the model to Iowa DOT’s rating software, are not currently supported uses of the i-model. Bentley is aware of these and similar desired uses and has noted them for future potential development.

The model currently resides on the Iowa DOT ProjectWise server. It can be moved to other locations as needed.

Conclusions and Implementations

The model captures the as-built information from construction of the Ramp B Bridge, Design Number 420, for future use and reference by Iowa DOT. However, the limitations of both the original model and the as-built model remain as previously noted based on the status of the BIM software. As further advancements in the software are made and as ongoing research regarding IFC file formats progresses, the potential for more of the desired uses of the model may be realized.

Iowa DOT continues to advance its use of BIM with the eventual goal of using digital models as deliverables for construction. This study was part of that advancement as it relates to the use of models as as-builts. When sufficient advancements in the BIM software have been made, additional research on this topic will be required.