VERMONT AGENCY OF TRANSPORTATION

FACT SHEET

PROJECT TITLE

BIM FOR BRIDGES AND STRUCTURES

STUDY TIMELINE

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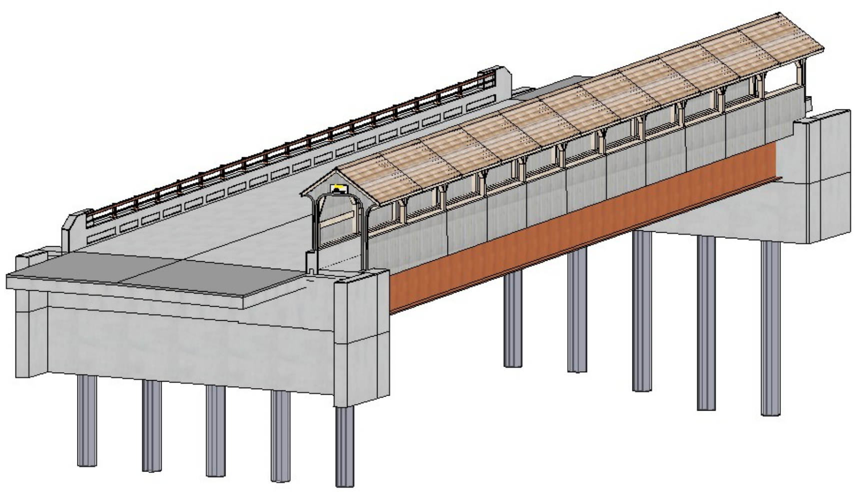
More information about the VTrans Research Program, including additional Fact Sheets, can be found at: http://vtrans.vermont.gov/planning/research

BIM FOR BRIDGES AND STRUCTURES

Problem Statement

BIM is a growing technical process in the Bridge and Highway Structures industry. BIM involves building a 3D digital model of the bridge/structure that can be used for design, construction, and asset management. This process is intended to streamline the Design to Construction to Asset Management cycle for bridge/structures with a common data set used from the inception of a project to the eventual replacement of the project i.e. the entire life cycle of the asset.



Methodology

VTrans Structures section has been creating 3D Models of bridges and structures for a decade, in multiple applications. We have used analytical models and design models throughout the project design process. These models are typically application specific, rarely used for construction, and not used for asset management. Models of the past did not have the level of detail needed to be used beyond design aids and were generally unable to be transferred between applications.

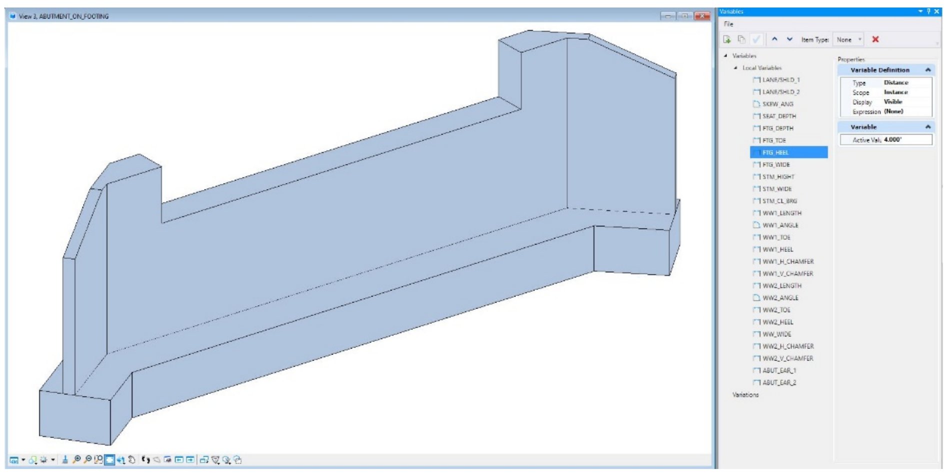
This project involves investigating new software applications that work together from the analytical structural analysis to the bridge geometry and details needed to create a buildable 3D model. We are investigating training, software, and agency process needs, to provide 3D models that can be used throughout the bridge/structure life cycle. A candidate project was selected to pilot the new software and process. It will be designed and delivered in the traditional method utilizing plans and drafted details, as well as being developed using Bentley OpenBridge Designer software suite to design, analyze and detail. The two delivery methods provide a means and method to compare the two processes.

Next Steps

The OpenBridge Designer software suite can build a 3D bridge model with significant structural and geometric detail. The software suite can perform design and analysis for most bridges that the Structures Section delivers, including steel and concrete girders. While the model developed in the software includes some good details, it does not provide all necessary details to build a bridge. Specifically, wingwall details and end bridge details are simplified. Bearing details and other connection details are simplified. These capabilities in the software have improved over the past few years and we expect more improvements to follow.

The platform graphic application MicroStation has full 3D modeling capabilities and most any detail can be modeled. The 3D graphics created using MicroStation will not participate in the analytical analysis side of the process. But they can provide the details needed for construction.

One of the major benefits of using these new software applications is the parametric definitions for geometric dimensions. Defined named variables (parameters) can be attached to the 3D objects in the model to control length, width, height, etc. Once we have a typical abutment or bridge, we can reuse the bridge model on other bridges where we are basically using the same bridge model in a different location with different dimensions. We did build a parametric 3D abutment that is a typical Vermont bridge abutment using MicroStation. This abutment model can fit nearly any bridge width, skew, or bridge span and height (image below).



The analytical portion of the software suite utilizes updated versions of Bentley bridge design applications. The primary advantage of the BIM process is twofold. It eliminates the need to input the bridge geometric data in the design software, and at the conclusion of the design phase the 3D model can be automatically updated from the analytical software. These capabilities are powerful and can save time in design, but it also makes the software more complex. The 3D model needs to be set up in a precise way for the analytical software to read it correctly. This leads to extra time, frequently switching from the modeler to the analysis to correct the inputs. As experience is gained with the software, efficiency should increase.

Potential Impacts and VTrans Benefits

This research has demonstrated that creating detailed 3D Engineered Model for Bridges and Structures is the future of bridge design and delivery for construction. We do have uphill challenges. We have the technology and can create detailed content rich 3D models that can be used to generate BIM data for Bridges and Structures. We currently have the software needed but have limited licenses. Generating BIM for Bridge and Structures involves several different software applications. Bridge design software is a specific skill that requires training and practice to develop. Generating the 3D Engineered BIM data is also a specific skill that will take time to learn. Best practice may be to have a set number of BIM for bridges and structures specialists that can develop and refine the skills needed to efficiently produce BIM for Bridges and Structures.