Montana Department of Transportation

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Memorandum

To: Bridge Design Section

From: Nathan Haddick, P.E.
Bridge Design Engineer

Date: May 21, 2021

Subject: Bridge Design 3D Modeling

Introduction

The Bridge Bureau recently implemented the use of 3D modeling software to aid in structure design and plans production. This represents a significant shift in the way we develop a project from start to finish. With these new tools comes an opportunity to work more efficiently, reduce the risk of errors on the plans, and collaborate more effectively. It also provides a means for the Bridge Bureau to keep pace with, and even help lead, department and industry initiatives which are quickly moving to digital project delivery.

The purpose of this memo is to define expectations and requirements for developing in-house design projects with this new delivery method.

A new workflow has been established to facilitate project development using the tools available with various Autodesk software applications. The workflow describes internal use of the applications within the bureau as well as information exchange with other design team partners within the department. The workflow, along with a variety of other helpful Autodesk information, is available in the Autodesk Guidance Document.

Training

Training and other resources have been, and will continue to be, provided to aid in the learning process for the new software and workflow. The goal of the provided training

is to demonstrate how to perform the basic tasks required to develop a typical project from conception to plans production in a 3D modeling environment.

Every effort will be made to ensure the training is high quality and is appropriately targeted to the audience. Keep in mind, however, it is the responsibility of each individual team member to take ownership of their own learning. Even beyond the officially provided training resources, there is a wealth of knowledge available to those who are willing to look. In many cases, it is as simple as performing an internet search for the desired function in a specific software application.

Some circumstances will undoubtedly be encountered during project development which are not explicitly covered in the training. In those cases, I would ask everyone to view it as an opportunity to further develop your individual skills as well as add to the "pool of knowledge" for the entire team. We have some fantastic team members who have spearheaded the launch of our 3D Bridge initiative, but it will take all of us working together to truly get the most out of this new way of doing business. Don't be afraid to ask questions, but also don't be afraid to look for possible solutions on your own to bring back to the team.

Minimum requirements for 3D project development

This section describes the modeling stages necessary for 3D project development and defines the roles and responsibilities of each bridge design team member.

The Area Engineer provides direction and oversight throughout the model development. The Area Engineer may create conceptual models early in the process at their discretion. The Area Engineer (in conjunction with the Bridge Design Engineer) designates a Project Engineer and a Project Detailer for each bridge as defined below.

Project Engineer – The primary structural engineer responsible for the design of a bridge.

Project Detailer – The primary CADD Designer responsible for the final model and plans production for a bridge.

Some high-level guidance is given below regarding the appropriate Level of Detail (LOD) for each stage of model production. See the Level of Detail Guide for more detailed information.

Conceptual Model

After some initial information gathering, the first stage of project development involves the creation of a conceptual model. Creating multiple models may even be beneficial to help compare alternatives. During this stage, the Project Engineer is responsible for the models.

The conceptual model is created as the first step in Activity 568 (Preliminary Bridge Layout). Depending on the complexity of the project, the conceptual model may be created prior to distribution of the Preliminary Field Review report (Activity 550).

The purpose of a Conceptual Model is to represent a rough type, size, and location possibility for the new structure. A relatively low Level of Detail is necessary at the conceptual stage. The following list summarizes a typical LOD appropriate at this stage:

<u>Level of Detail</u>

- Rough geometry
    - Bridge length
    - Deck width
    - Span arrangement
    - Superstructure depth
- Not necessary
    - Superstructure details
    - Substructure / foundation details
    - Reinforcement
    - Bearings

Preliminary Model

After a type, size, and location concept has been chosen to move forward, a Preliminary Model is developed. The Project Detailer is responsible for the Preliminary Model, which is based on information provided by the Project Engineer.

This model is used to create a General Layout plan sheet to complete Activity 568. The Preliminary Model is updated as necessary for the Scope of Work and Plan-in-Hand milestones. Boring logs provided by the Geotechnical Section may be incorporated into the model once available. A Footing Plan sheet is created from the Preliminary Model for use at the Plan-in-Hand milestone.

An appropriate Level of Detail for the Preliminary Model includes defining those elements necessary to complete the layout and footing plan sheets. Elements such as concrete reinforcing, bearing details, and expansion joint details are typically not necessary at this stage.

Final Model

The last stage involves development of a Final Model. The Project Detailer is responsible for the Final Model, which is based on information provided by the Project Engineer.

The Final Model is developed in phases as design information becomes available from the Project Engineer. Superstructure design information is used to finalize the superstructure modeling, which occurs during Activity 574. Substructure design information and final modeling is likewise completed during Activity 578.

Once the superstructure and substructure modeling is finalized, plan sheets are created based on the Final Model. As plans checking occurs during Activity 580, adjustments may be necessary to the model and plans.

Rehabilitation and Preservation Projects

The 3D modeling process described above is intended for new / replacement structures. Rehabilitation and preservation projects will typically be developed in a 2D environment using AutoCAD.

Model and Plan Reviews

Models should be shared openly with members of the internal design team to promote feedback and early discussion among the various functional areas throughout project development. When appropriate, the models may also be shared with external stakeholders, such as resource agencies and the public. When sharing a model, be sure to clearly communicate the stage to which the model has been developed.

For reviews and markups within the Bridge Bureau, BIM 360 should be used to the greatest extent possible. For staff reviews and commenting outside the bureau, the Department's standard project review protocols should be used.

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