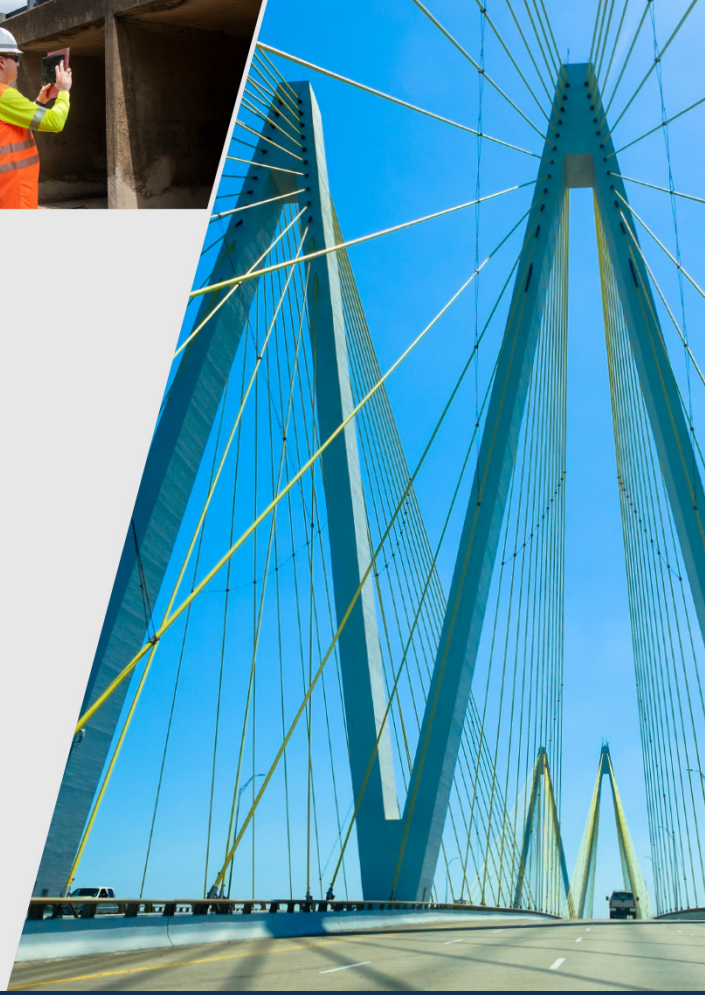
3D Design Efforts

Courtney Holle



May 17, 2022

Today's Agenda

1. TxDOT Bridge Design Manual – LRFD (Nov 2021 Release)
2. TxDOT Bridge Design Guide (March 2022 Release)
3. TxDOT Bridge Detailing Guide (April 2022 Release)
4. TxDOT Pier Protection Guide
5. TxDOT Bridge Standards Recent Updates and Future Efforts
6. QA/QC Processes – Improvements and Initiatives
7. **3D Design Efforts**
8. New Initiatives

3D Design Efforts – Table of Contents

1 Current Status

2 Workspace

3 Sheet Production Preview

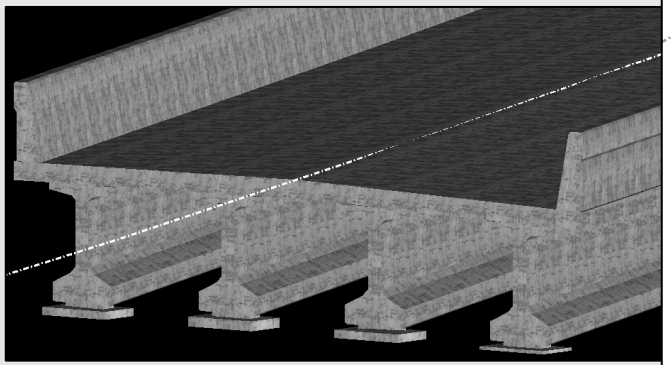
4 Connectivity

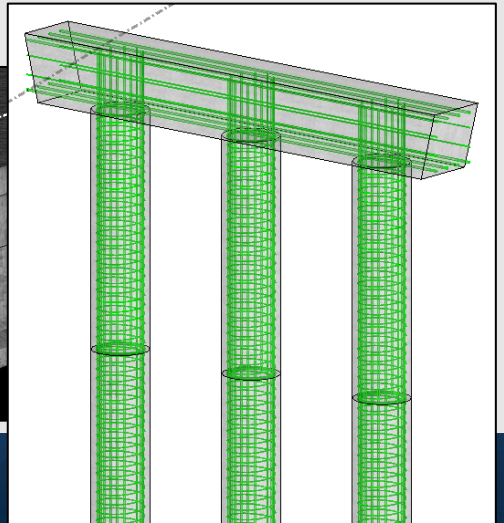
5 Future

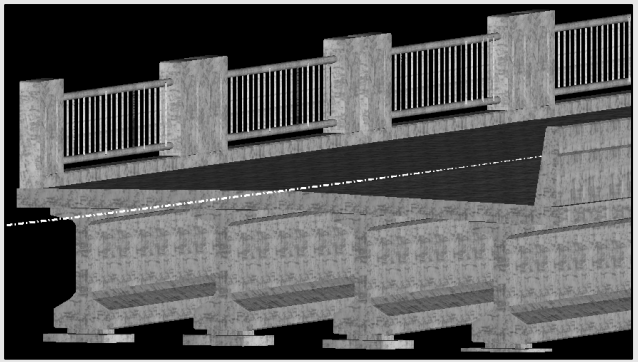
Current Status

TxDOT – Current Status

- 3D model for Bridge construction – Currently testing potential uses in the field
- Developing environment to cover standard bridges
- BIM Pooled Fund project working on IFC language
- Several Bridge 3D Models - public meetings, clearance checks, and presentations

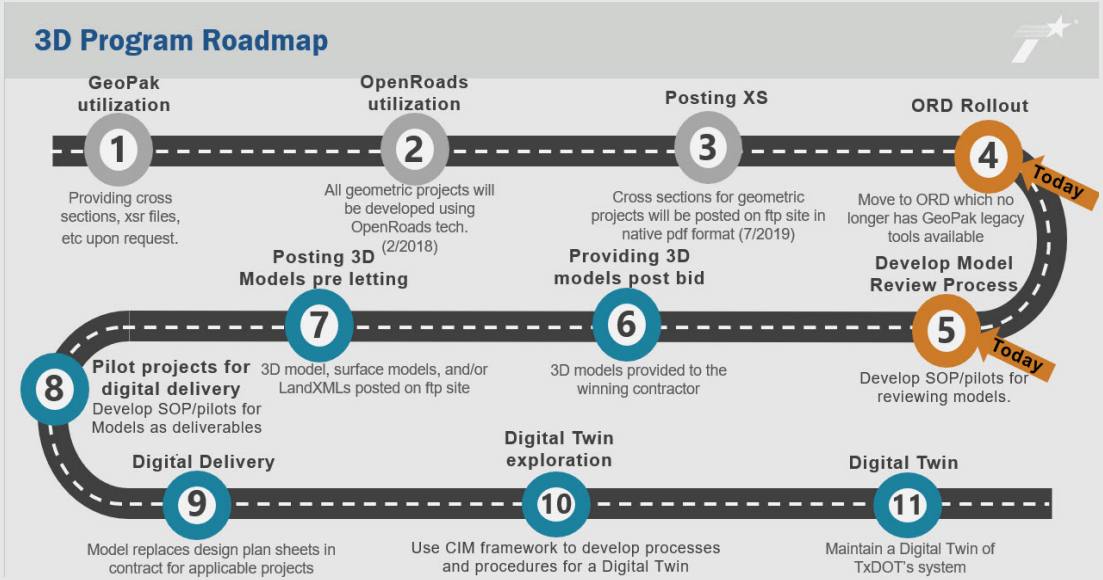






TxDOT – Current Status - ORD

- March 23, 2022: Expectation of Use of OpenRoads Designer (ORD)
  - June 1, 2022 all new projects will use ORD
  - “in-house” and consultant
  - Questions to 3DDesign@txdot.gov



TxDOT – Current Status - OBD

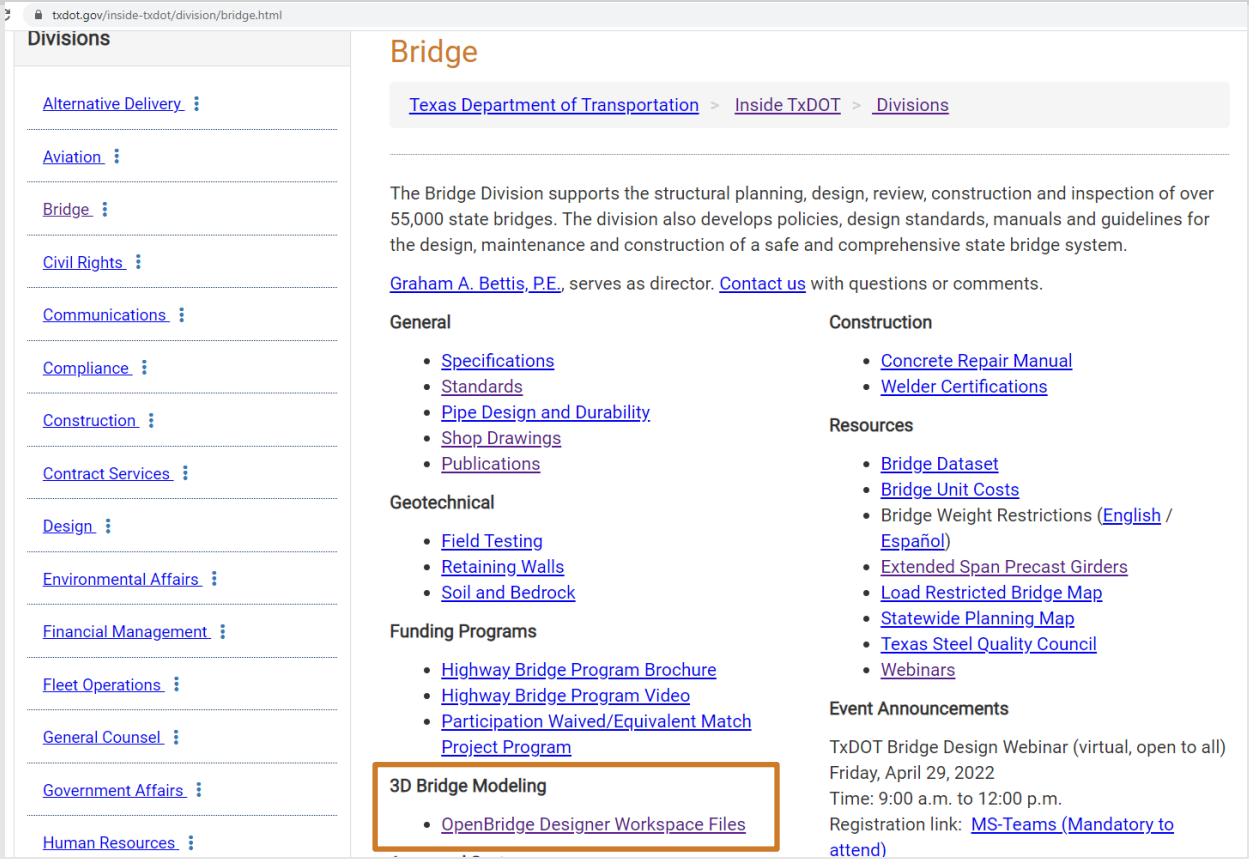
- Upcoming memo
- New projects that utilize ORD will be expected to use **OpenBridge Designer (OBD)** for the bridge modeling **starting June 1, 2022**.
  - OBD will be used utilizing **Open Bridge Modeler (OBM)** to create **intelligent 3D bridge models**.
    - The 3D bridge model will be a **deliverable to TxDOT**, but **not** used as a **contract document** at this time.
    - **Quantities and geometry** from OBD will need to be **verified** by other means.
  - The **contract document** will remain plan sheets with **2D details** as is current practice.

TxDOT – Current Status - OBD

- Upcoming memo
- The **other software** within the OBD package can be used for bridge design at the **discretion of the engineer**.
  - OBD includes **OpenBridge Modeler**, LEAP Concrete, LEAP Steel, and RM Bridge.
  - **PGSuper** will remain the preferred design tool for prestressed concrete **superstructure design**.
- Currently TxDOT is using the following versions of OpenBridge Designer and ProStructures:
  - OpenBridge Designer CONNECT Edition 2021 Release 1 v.10.10.0.26
  - ProStructures CONNECT Edition v.10.5.2.50

Workspace

Resource



txdot.gov/inside-txdot/division/bridge.html

Divisions

- Alternative Delivery
- Aviation
- Bridge
- Civil Rights
- Communications
- Compliance
- Construction
- Contract Services
- Design
- Environmental Affairs
- Financial Management
- Fleet Operations
- General Counsel
- Government Affairs
- Human Resources

Bridge

Texas Department of Transportation > Inside TxDOT > Divisions

The Bridge Division supports the structural planning, design, review, construction and inspection of over 55,000 state bridges. The division also develops policies, design standards, manuals and guidelines for the design, maintenance and construction of a safe and comprehensive state bridge system.

Graham A. Bettis, P.E., serves as director. Contact us with questions or comments.

General

- Specifications
- Standards
- Pipe Design and Durability
- Shop Drawings
- Publications

Geotechnical

- Field Testing
- Retaining Walls
- Soil and Bedrock

Funding Programs

- Highway Bridge Program Brochure
- Highway Bridge Program Video
- Participation Waived/Equivalent Match Project Program

3D Bridge Modeling

- OpenBridge Designer Workspace Files

Construction

- Concrete Repair Manual
- Welder Certifications

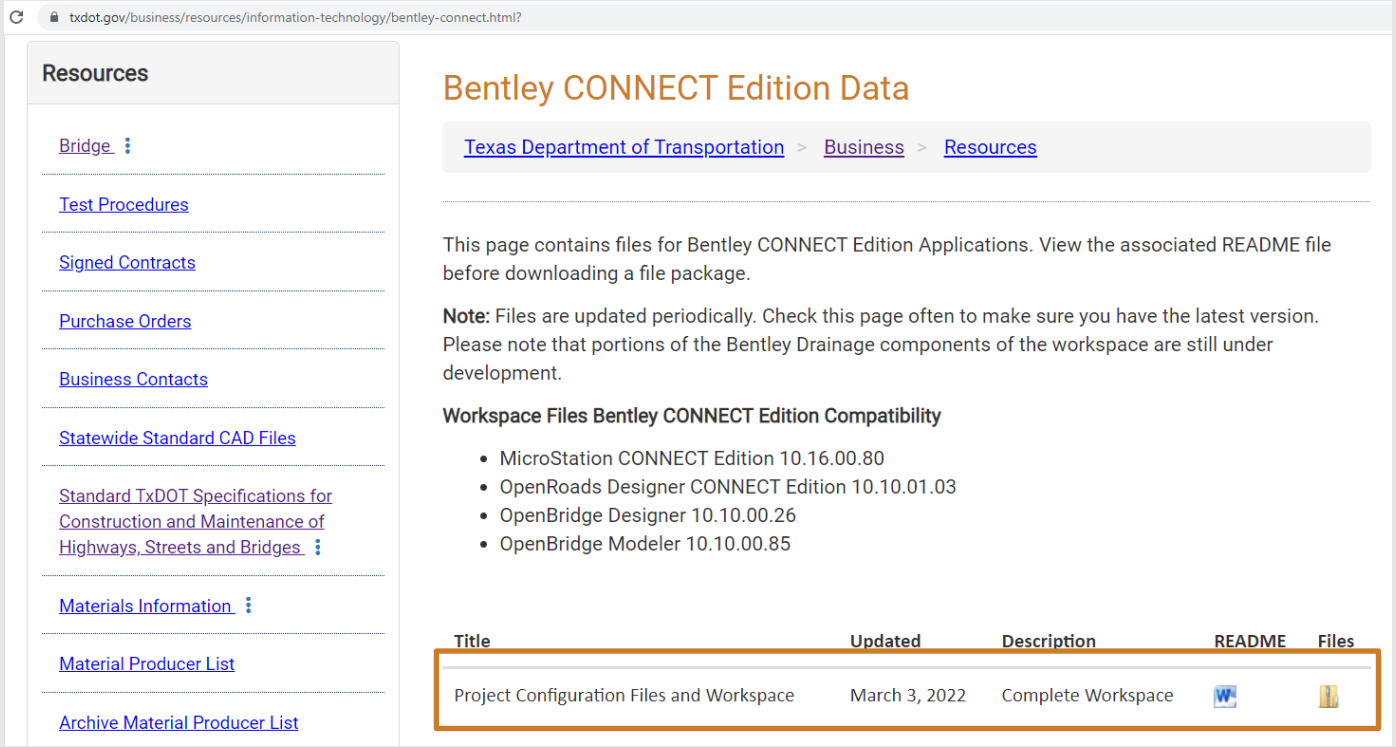
Resources

- Bridge Dataset
- Bridge Unit Costs
- Bridge Weight Restrictions (English / Español)
- Extended Span Precast Girders
- Load Restricted Bridge Map
- Statewide Planning Map
- Texas Steel Quality Council
- Webinars

Event Announcements

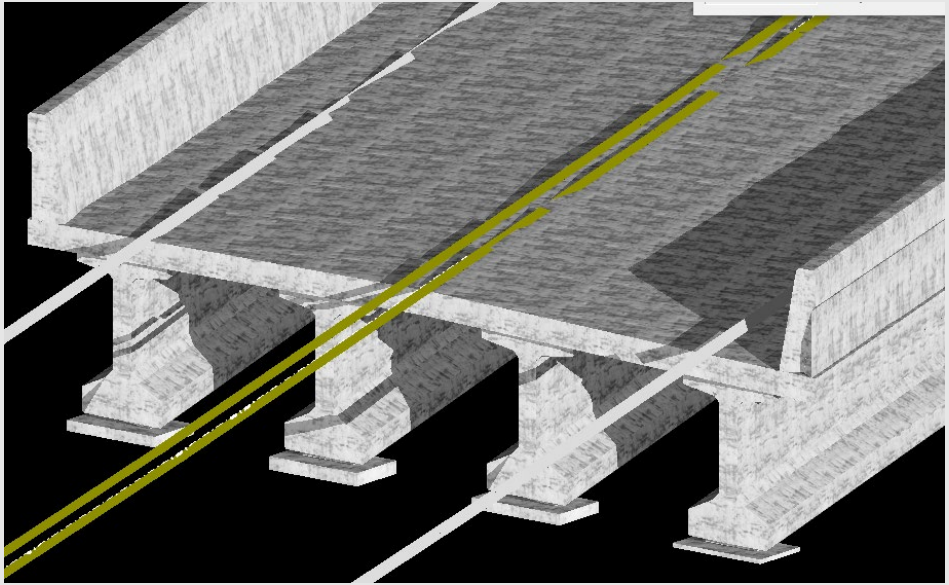
TxDOT Bridge Design Webinar (virtual, open to all)
Friday, April 29, 2022
Time: 9:00 a.m. to 12:00 p.m.
Registration link: MS-Teams (Mandatory to attend)

Resource


txdot.gov/business/resources/information-technology/bentley-connect.html?
Resources
Bridge
Test Procedures
Signed Contracts
Purchase Orders
Business Contacts
Statewide Standard CAD Files
Standard TxDOT Specifications for Construction and Maintenance of Highways, Streets and Bridges
Materials Information
Material Producer List
Archive Material Producer List
Bentley CONNECT Edition Data
Texas Department of Transportation > Business > Resources
This page contains files for Bentley CONNECT Edition Applications. View the associated README file before downloading a file package.
Note: Files are updated periodically. Check this page often to make sure you have the latest version. Please note that portions of the Bentley Drainage components of the workspace are still under development.
Workspace Files Bentley CONNECT Edition Compatibility
MicroStation CONNECT Edition 10.16.00.80
OpenRoads Designer CONNECT Edition 10.10.01.03
OpenBridge Designer 10.10.00.26
OpenBridge Modeler 10.10.00.85
Title
Updated
Description
README
Files
Project Configuration Files and Workspace
March 3, 2022
Complete Workspace

Templates

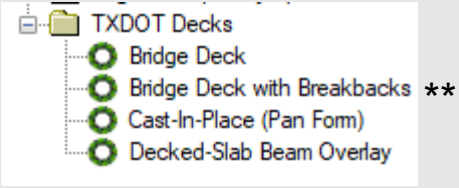
- We have been working with Bentley to develop our templates
- For now only Standard drawings are being used for templates
- Current templates
  - Deck
  - Railing
  - Beams
  - Bents
  - Abutments



Bridge showing Railing, Deck, Beams, Bearing Pads and Seats. Roadway and abutment turned off for clarity.

Templates: Decks

- Decks – This only sets the standard deck thickness (8.5”). Two templates are available.

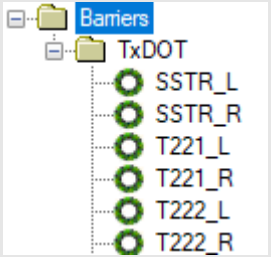


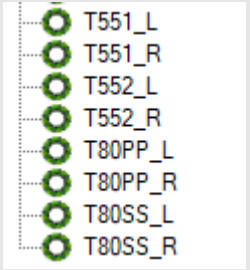
**

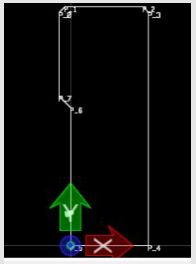
** The template contains the lines where the break back goes as a guide to use later in the modification of the solid to create the break back.

Templates: Rails

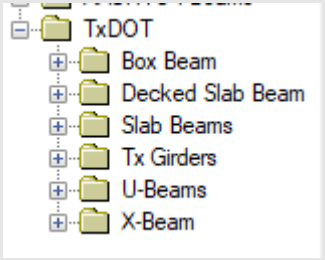
- Traffic Rails – OBM only supports solid elements so we only have the solid traffic rails as templates.

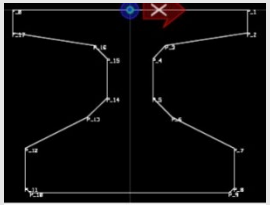






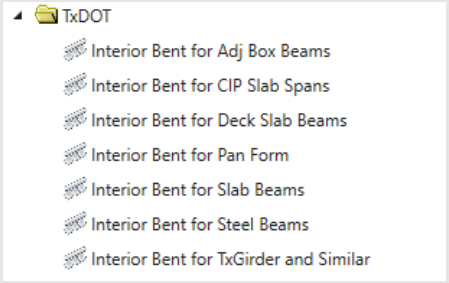
- All Standard Concrete Beams – Steel beams must be defined per case, rolled beams are available for selection.



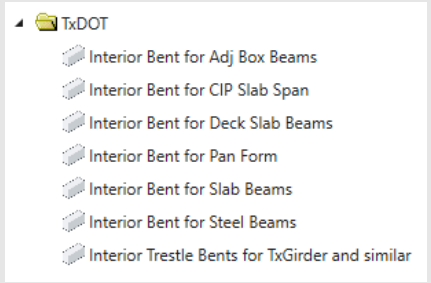


Templates: Interior Bents and Abutments

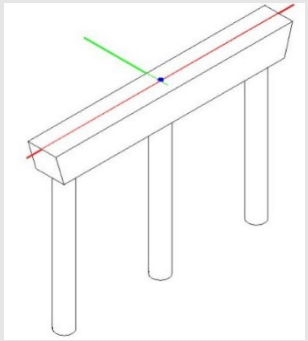
- Standard Interior Bents



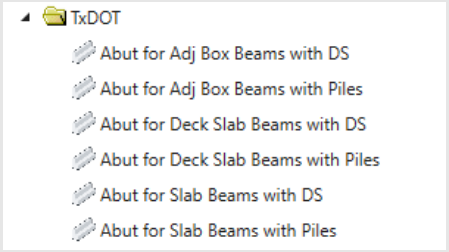
With Drilled Shafts

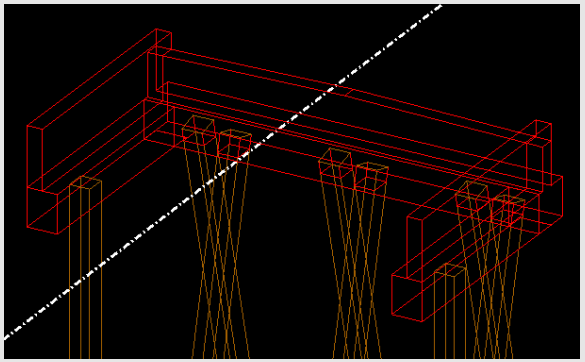


With Piles



- Standard Abutments – Only abutments that do not have break backs were created as templates.

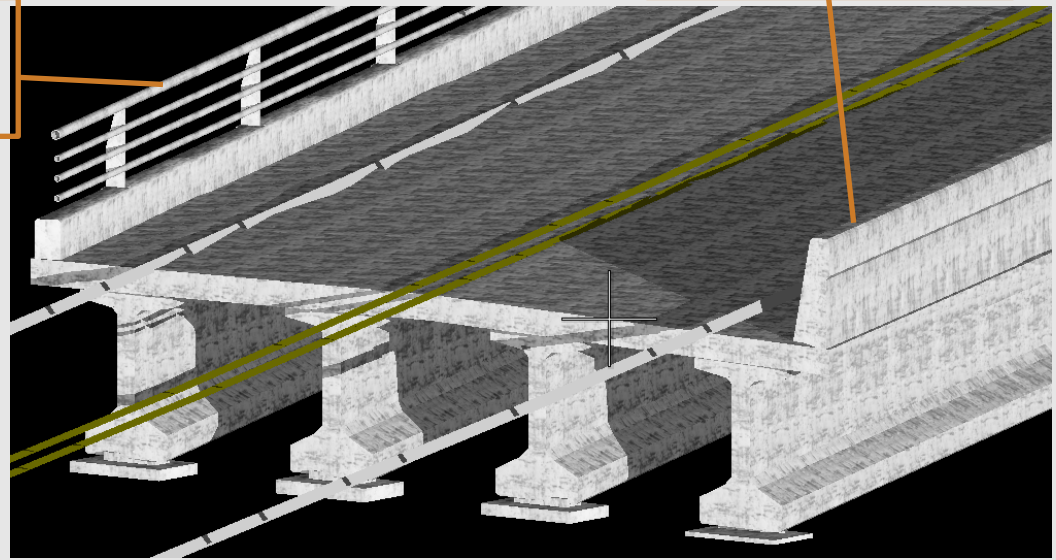




3D Line Styles

- The following rails have been created as 3D Line Styles

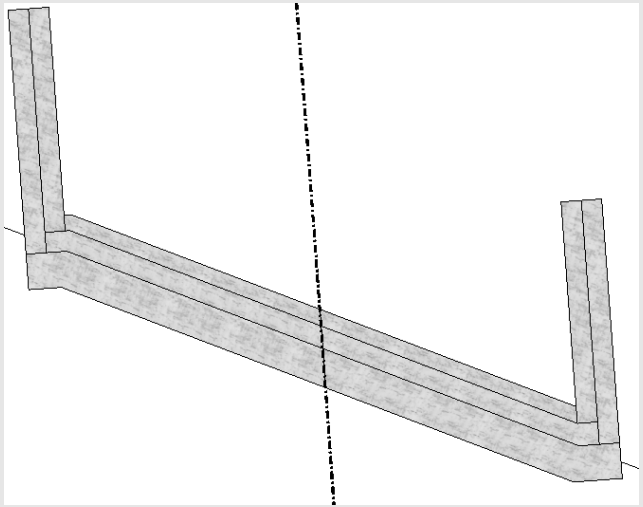
T1F	C1W
T1W	C2P
T2P	C221
T223	C223
T224	C402
T401	C411
T402	C412
T411	C66
T631	PR11
T631LS	PR22
T66	PR3
T80HT	

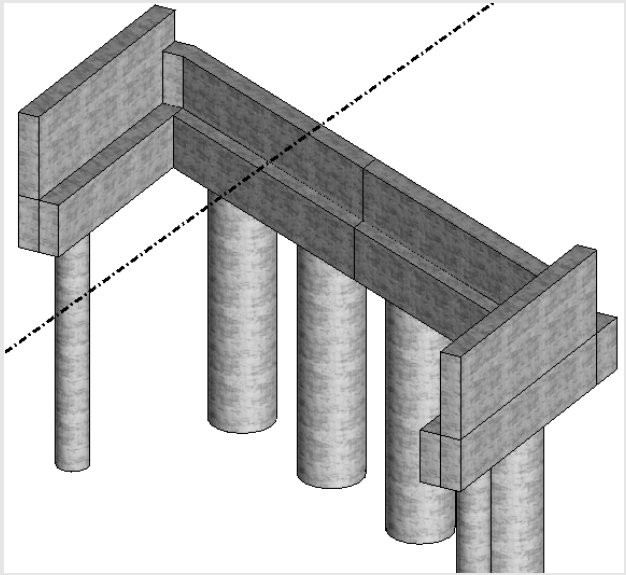


These are the rails created as 3D line styles. These do not reflect all rails used in TxDOT. Each rail was separated into Left and Right and their respective parapet line style.

Parametric Cells

- Parametric cells support cross slope, breakbacks, wingwalls, different number of columns/drilled shafts, and drilled shafts in wingwalls as applicable.





Parametric Cells

- The following abutments were created as parametric cells.

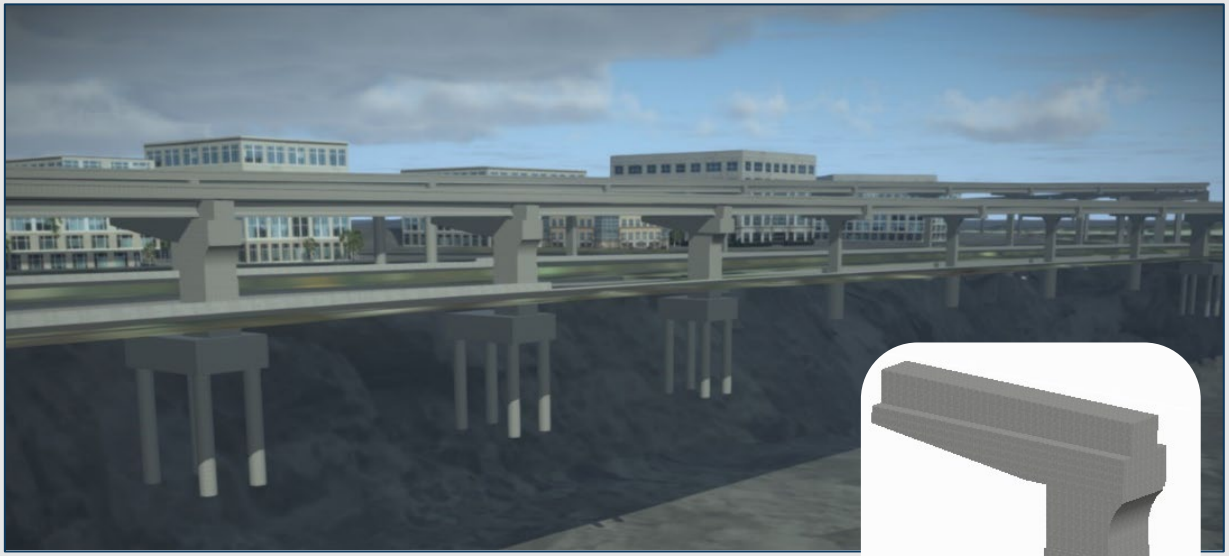
Abutment for TxGirders
Abutment for X Beams
Abutment for U Beams
Abutment for Slab Beams
Abutment for CIP Slab Spans
Abutment for Steel Beams
Abutment for Pan Forms **

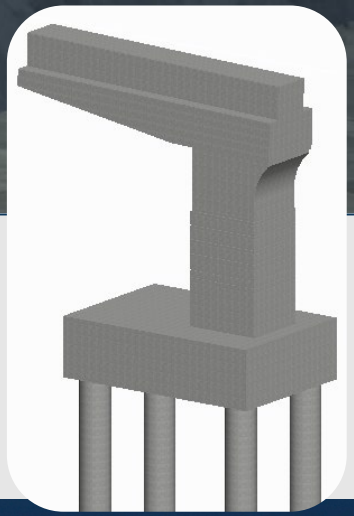
** The cells for Pan Forms are not parametric since the skews for these are always the same

3D Solids – When Workspace Doesn't Have What You Need

- When templates and parametric cells don't work…

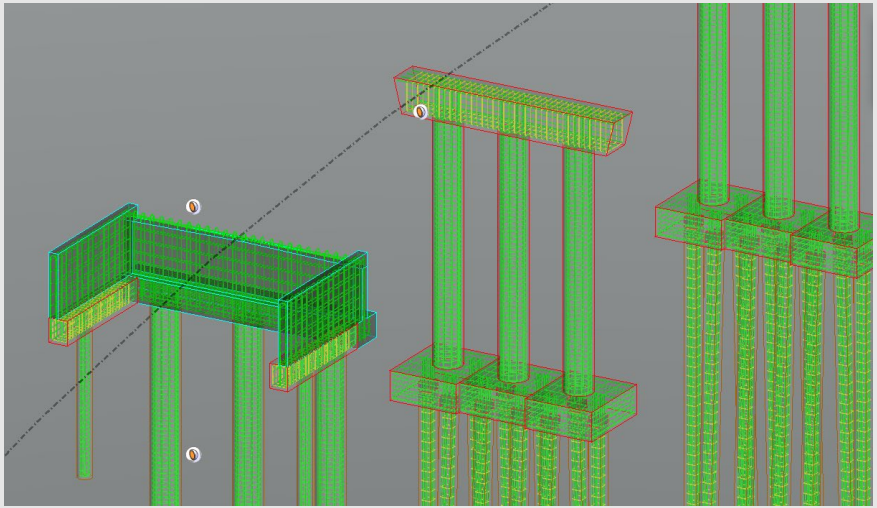
- There are always 3D Microstation cells.
  - Drawback – no OBM intelligence attached to the element

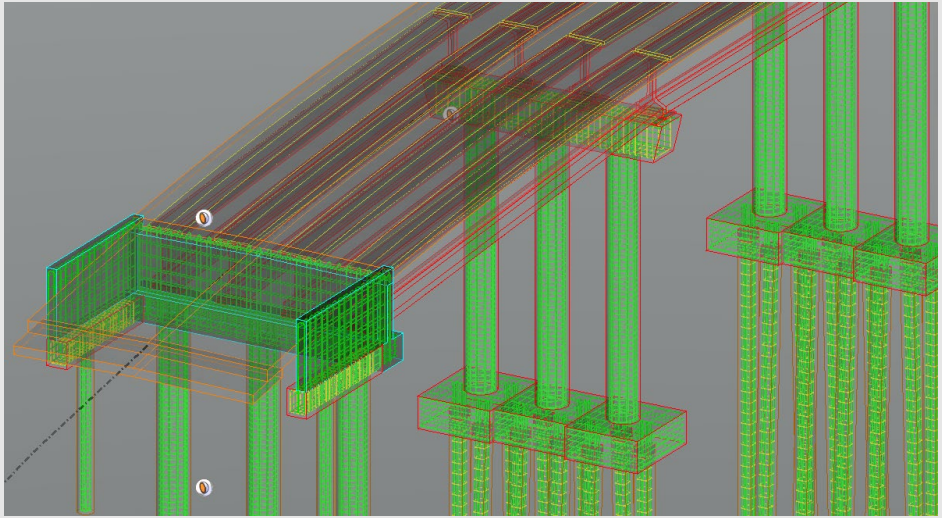




Reinforcing

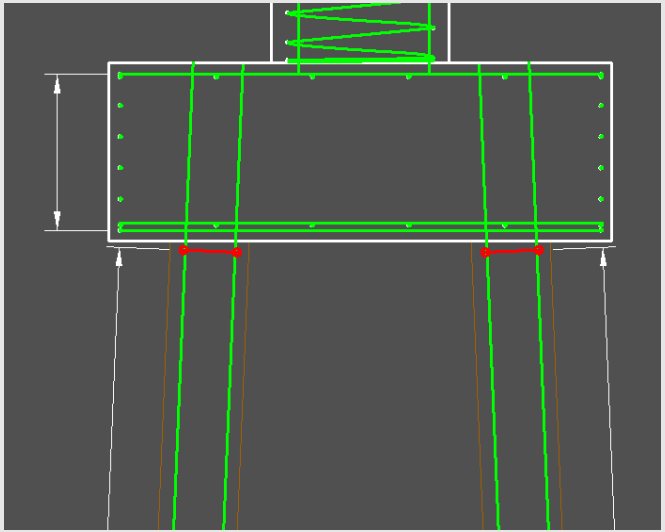
- Reinforcing added using Prostructures



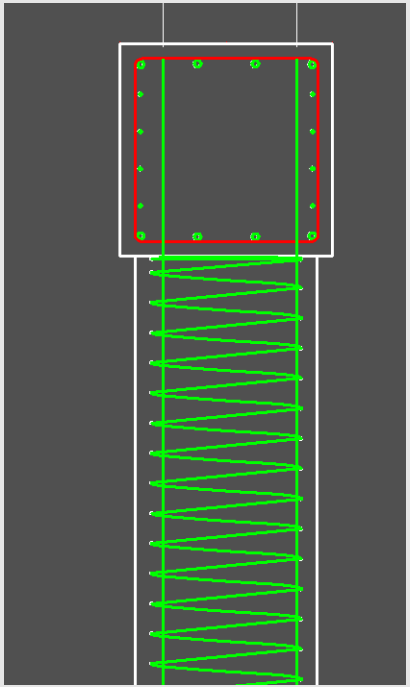


Sheet Production

Sheet Production - Cross-sections from the Model

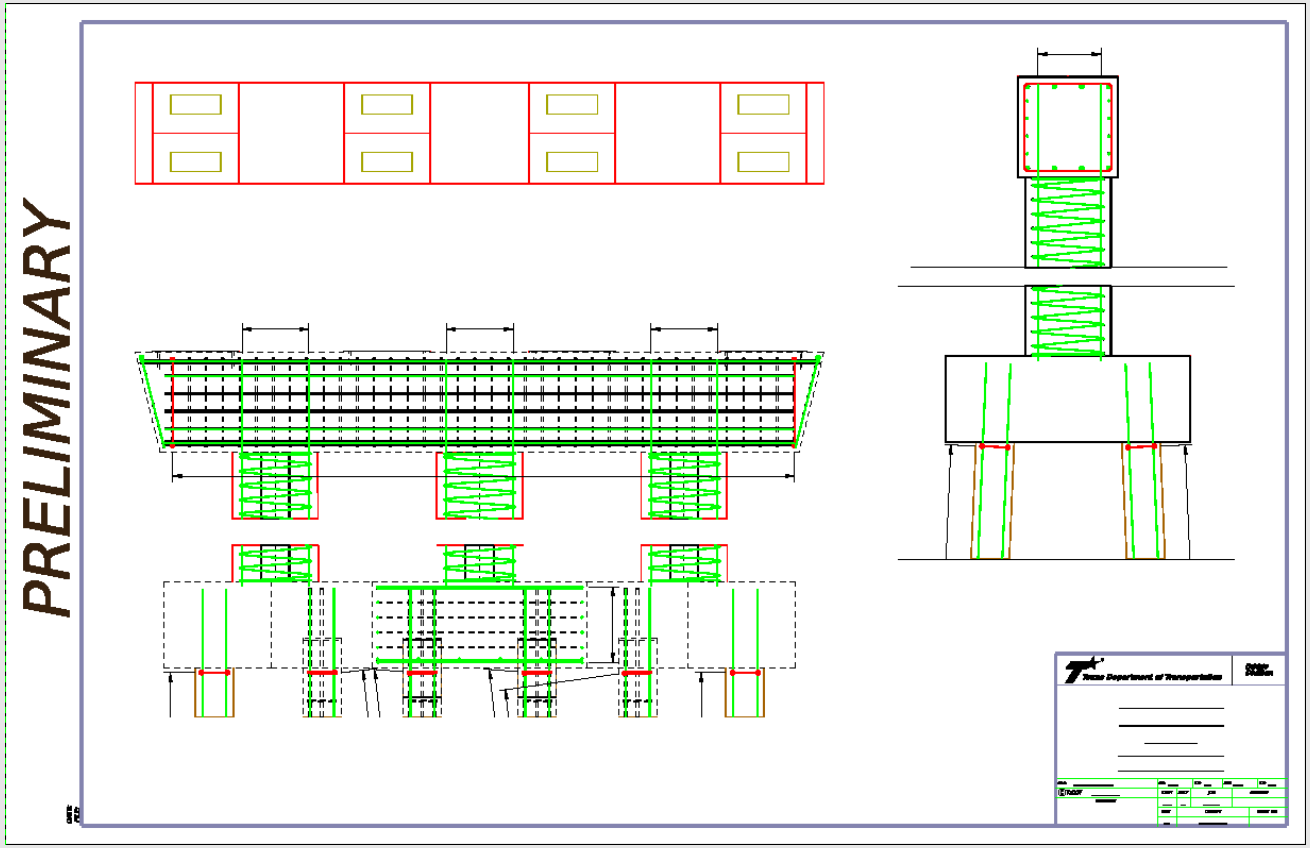


Footing and Piles

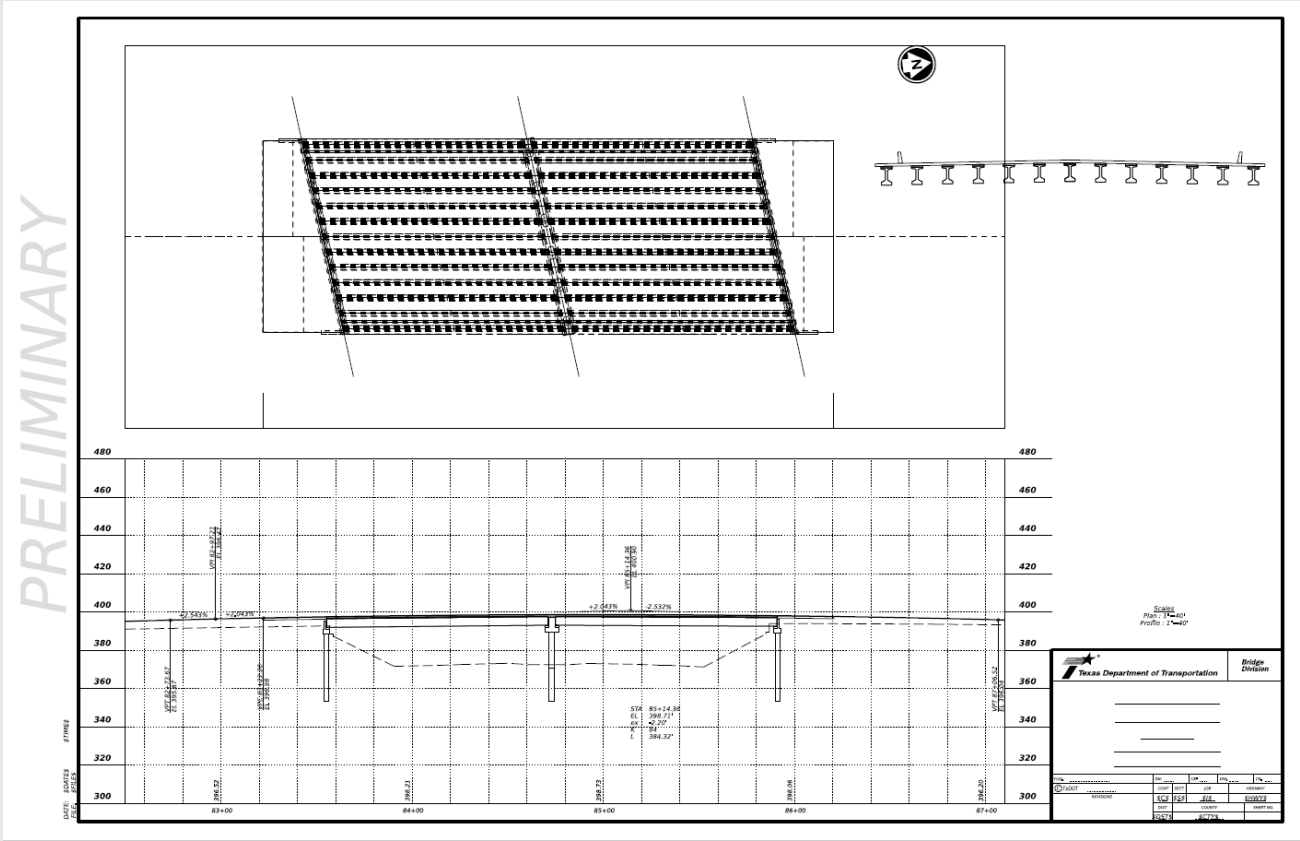


Bent Cap and Column

Sheet Production – Substructure Sheet Creation from Model



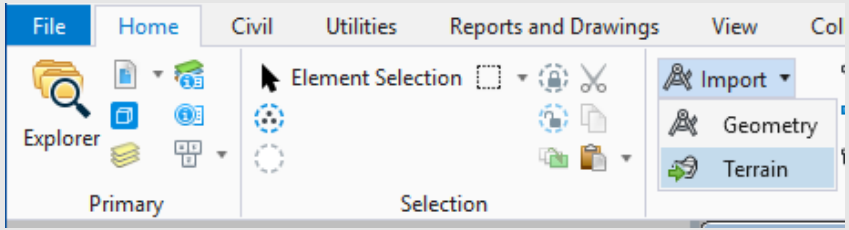
Sheet Creation - Bridge Layout Creation from Model



Connectivity

Connectivity – OBM with ORD

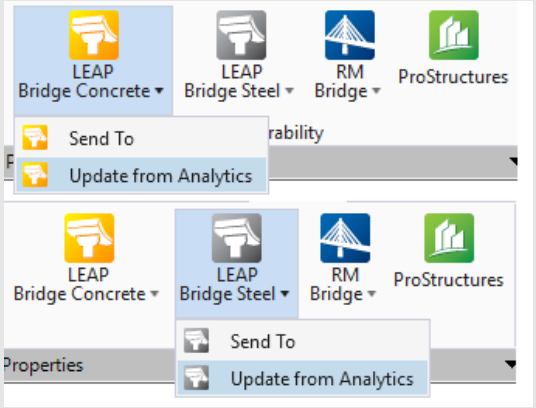
- OpenBridge Modeler (OBM) communicates with OpenRoads Designer (ORD) to get updates on horizontal and vertical geometry, including terrain data.

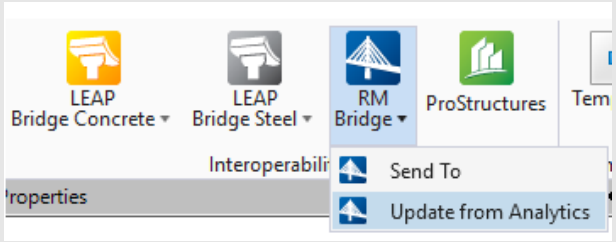


Updates from ORD are automatic when the ORD file is used as a reference. The user can also import geometry and terrain data, but it does not get updated automatically when it is imported.

Connectivity – OBM with Analysis Software

- OpenBridge Modeler can update models back and forth with LEAP Steel, LEAP Concrete, and RM Bridge.
  - This allows for OBM to get updates on substructure and superstructure** once it has been analyzed and/designed.

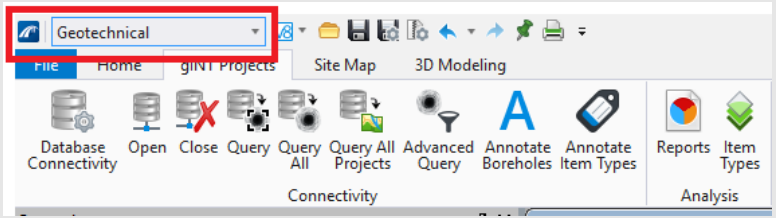


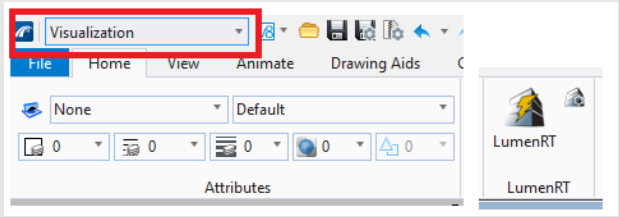


**TxDOT's Concrete Superstructure solution is PGSuper

Connectivity – OBM with gINT and LumenRT

- OpenBridge Modeler supports the gINT tools for bore logs for placement on Bridge Layouts.
- OBM also works with LumenRT for renderings, as well as exports to other formats to create animations in 3rd party applications.





Connectivity – OBM with ProStructures

- OpenBridge Modeler exports the final model to ProStructures for modeling the reinforcing in the solids.
- ProStructures is the Rebar/Reinforcing solution for 3D modeling in OBM.
- ProStructures also can model details for steel superstructures

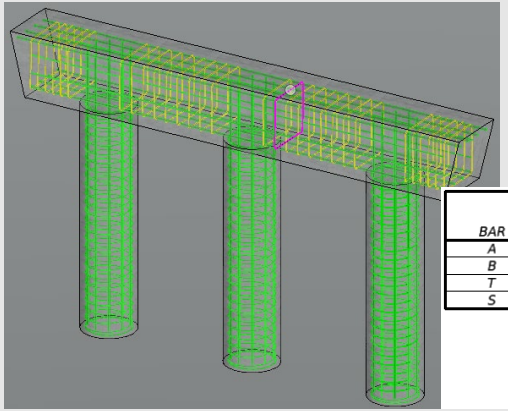


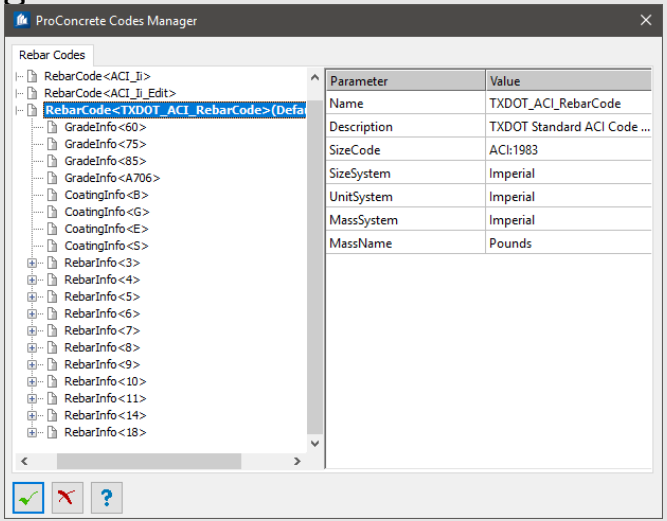
TABLE OF ESTIMATED QUANTITIES

BAR	NO.	SIZE	LENGTH	WEIGHT
A	4	11	26'-7"	564.96
B	4	11	24'-10"	527.76
T	4	5	24'-10"	103.6
S	30	5	12'-4"	367.10

REINF. SUMMARY

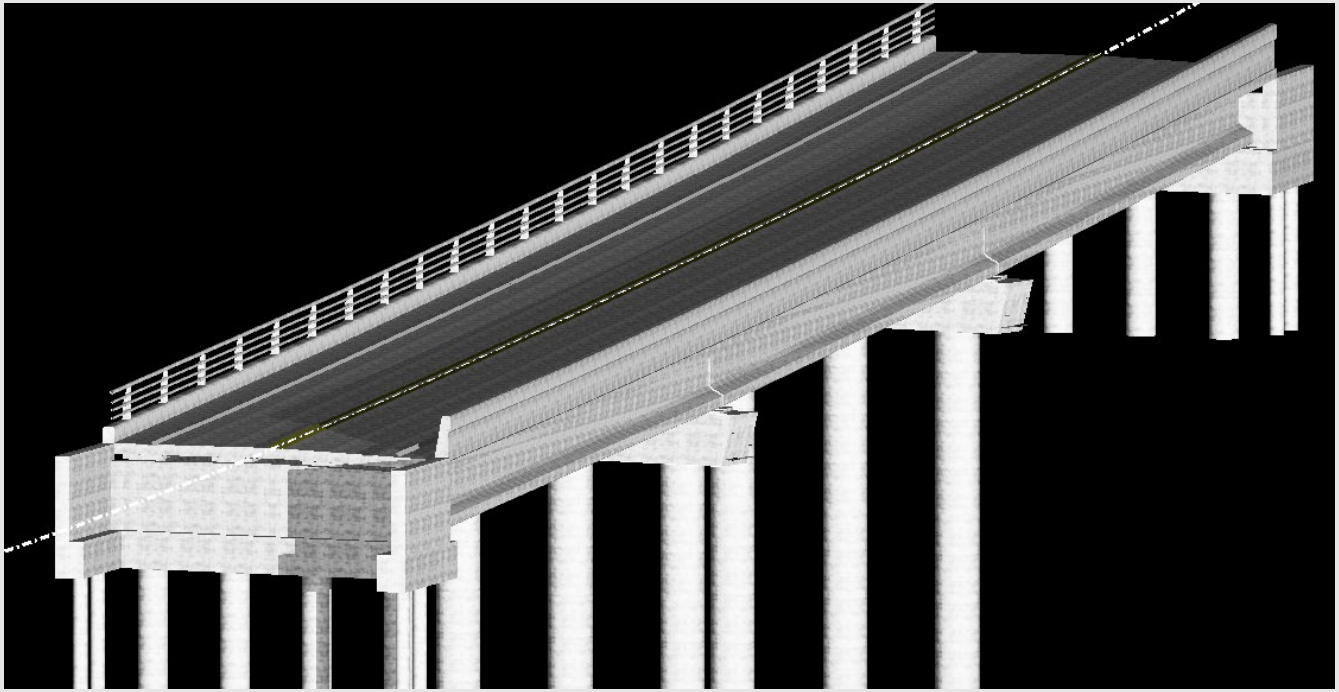
CONC. MEMBER	CONC. QTY	TTL WT
Concrete 3.5000x3.5000	1	1563.42

Reinforcing and Tables were created using ProStructures.
- *One limitation is that ProStructures does not add the concrete quantity.*



Rebar information in the upcoming TxDOT OBM workspace is per the TxDOT Bridge Detailing Guide

Final Product



The Final Bridge Model is contained in a separate file than the Roadway model. When referenced into the Roadway Model the bridge matches seamlessly where the road stops and the bridge begins.

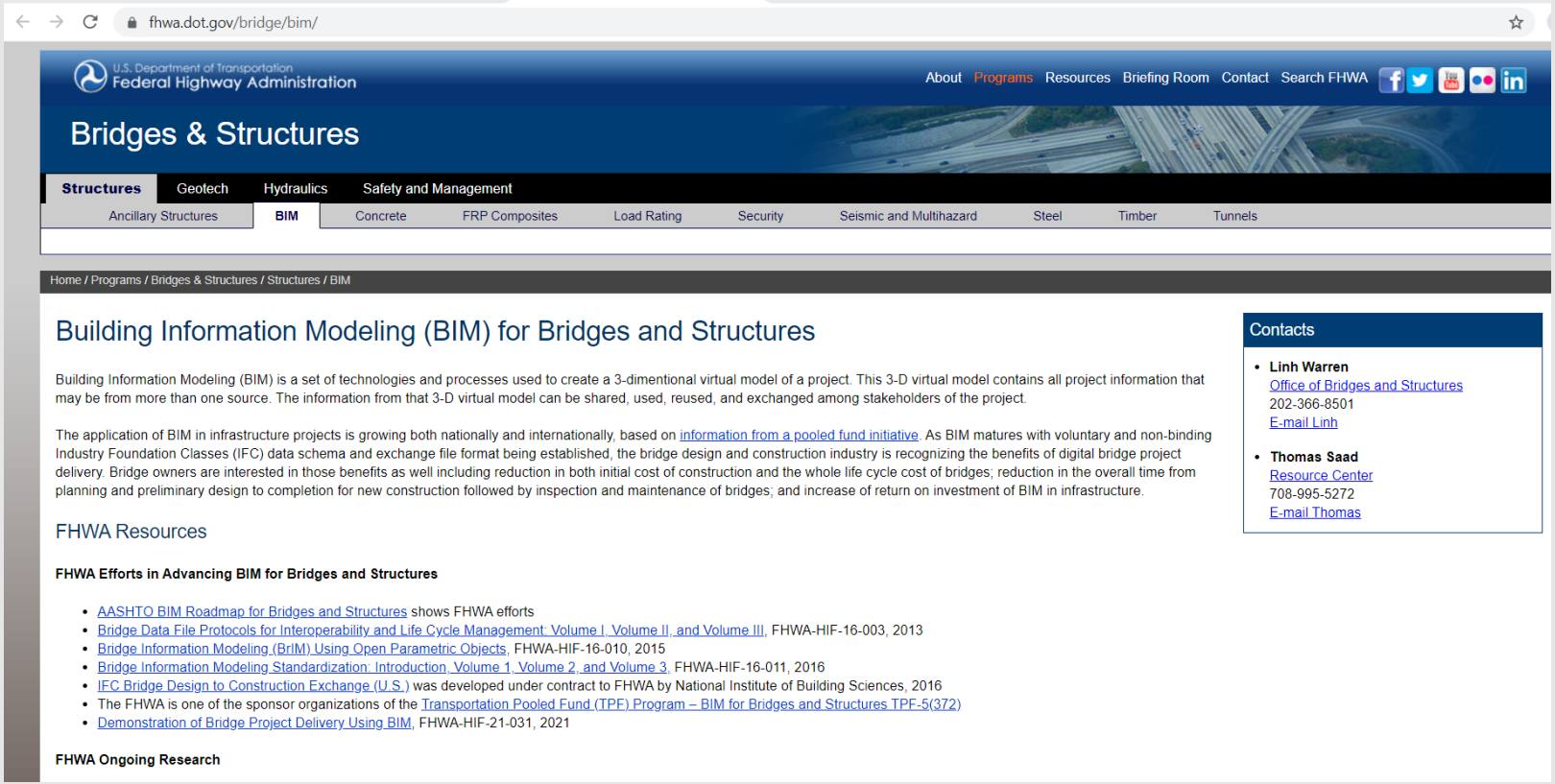
Future

Digital Delivery

TxDOT Moving Forward

- Develop a formal model review process so we can ensure thorough reviews of our models.
- Develop guidelines for level of detail needed for the model
- Pilot Projects
  - 3D Models after letting (Contractor's information only)
  - 3D Model posted pre-letting
  - 3D Model as contract document

Resource


fhwa.dot.gov/bridge/bim/
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Federal Highway Administration
About Programs Resources Briefing Room Contact Search FHWA
Bridges & Structures
Structures Geotech Hydraulics Safety and Management
Ancillary Structures BIM Concrete FRP Composites Load Rating Security Seismic and Multihazard Steel Timber Tunnels
Home / Programs / Bridges & Structures / Structures / BIM
Building Information Modeling (BIM) for Bridges and Structures
Building Information Modeling (BIM) is a set of technologies and processes used to create a 3-dimentional virtual model of a project. This 3-D virtual model contains all project information that may be from more than one source. The information from that 3-D virtual model can be shared, used, reused, and exchanged among stakeholders of the project.
The application of BIM in infrastructure projects is growing both nationally and internationally, based on information from a pooled fund initiative. As BIM matures with voluntary and non-binding Industry Foundation Classes (IFC) data schema and exchange file format being established, the bridge design and construction industry is recognizing the benefits of digital bridge project delivery. Bridge owners are interested in those benefits as well including reduction in both initial cost of construction and the whole life cycle cost of bridges; reduction in the overall time from planning and preliminary design to completion for new construction followed by inspection and maintenance of bridges; and increase of return on investment of BIM in infrastructure.
FHWA Resources
FHWA Efforts in Advancing BIM for Bridges and Structures
AASHTO BIM Roadmap for Bridges and Structures shows FHWA efforts
Bridge Data File Protocols for Interoperability and Life Cycle Management: Volume I, Volume II, and Volume III, FHWA-HIF-16-003, 2013
Bridge Information Modeling (BrIM) Using Open Parametric Objects, FHWA-HIF-16-010, 2015
Bridge Information Modeling Standardization: Introduction, Volume 1, Volume 2, and Volume 3, FHWA-HIF-16-011, 2016
IFC Bridge Design to Construction Exchange (U.S.) was developed under contract to FHWA by National Institute of Building Sciences, 2016
The FHWA is one of the sponsor organizations of the Transportation Pooled Fund (TPF) Program – BIM for Bridges and Structures TPF-5(372)
Demonstration of Bridge Project Delivery Using BIM, FHWA-HIF-21-031, 2021
FHWA Ongoing Research
Contacts
Linh Warren
Office of Bridges and Structures
202-366-8501
E-mail Linh
Thomas Saad
Resource Center
708-995-5272
E-mail Thomas

Questions?

Courtney Holle, P.E.
TxDOT--Bridge Division
bridge3ddesign@txdot.gov