I-696 Digital Delivery: Lessons Learned in Construction

Michigan Bridge Week

March 12-14, 2024

Muskegon, MI

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Agenda

- Background
- Overview of model
- Model Structure and Format
- Team Approach
- Lessons Learned

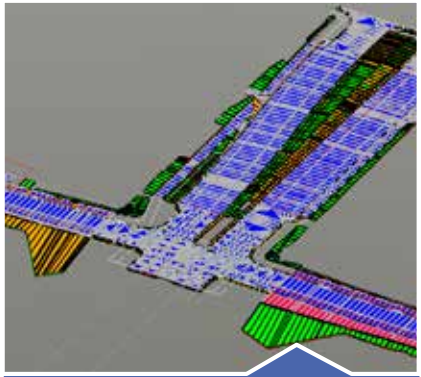
BACKGROUND

The Road to Model Delivery

Project Signature Sheet

- Move away from paper space
- Engineer can stamp any file type
- PDFs, DGNs, Spreadsheets, etc.

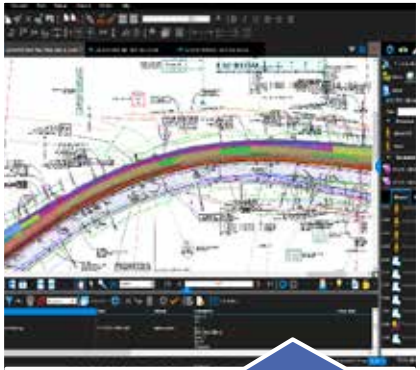
Link: Project Signature Sheet



Deliver RID Models

- Train designers to deliver models
- Develop review process
- Design to field data sharing
- Develop Champions

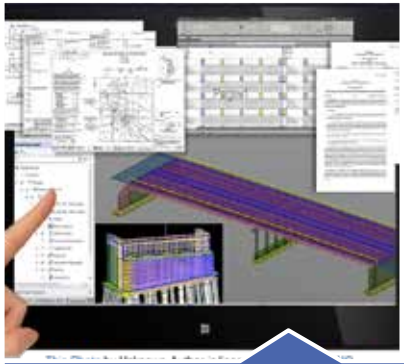
Link: RID Process



Project PDF

- Why 11x17?
- Encourage screens over paper
- Bid using Quantity Table or Model
- Learn Pain Points

Link: Project PDF



Piloting Model Delivery

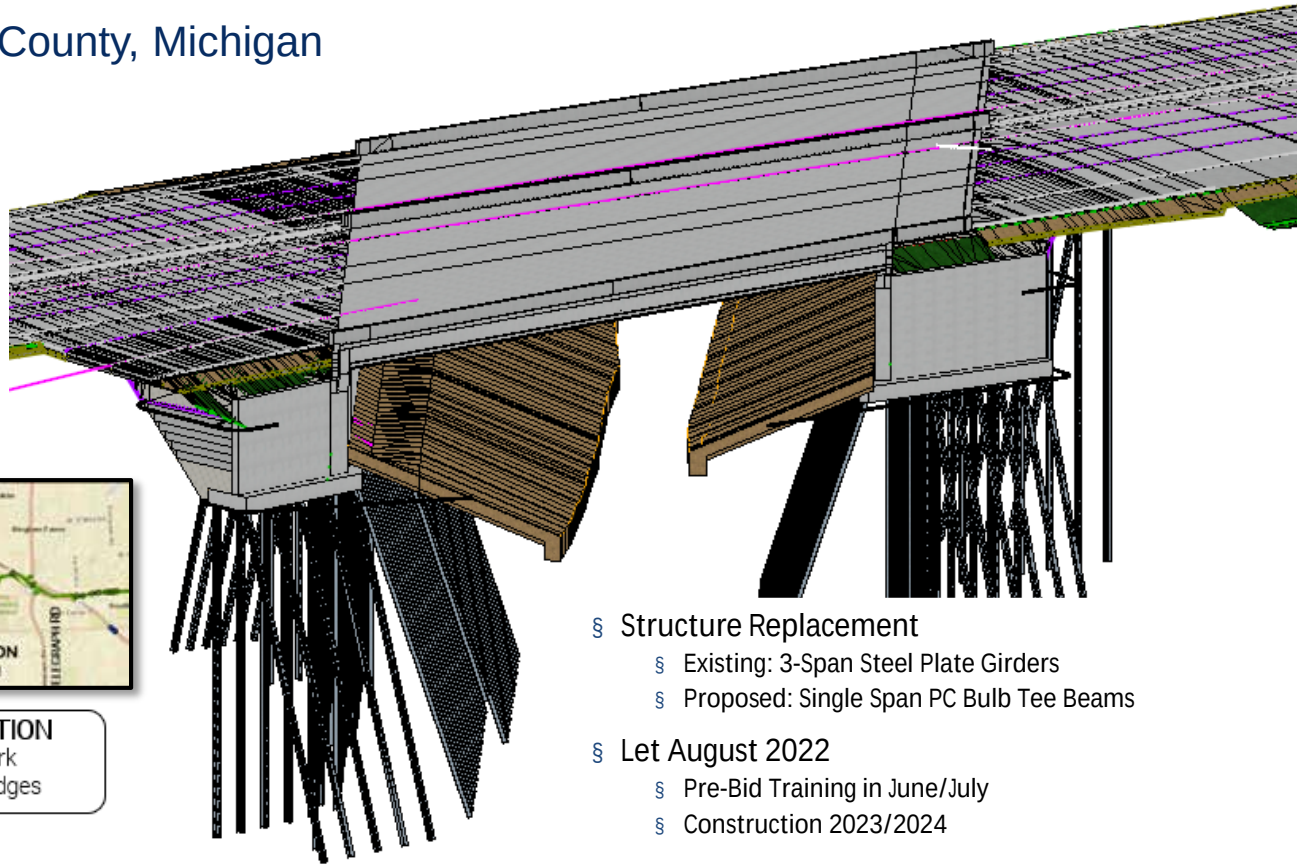
- Looked to other states
- Bid using Quantity Table or Model
- Stakeholder Engagement
- Identify model limitations

In Progress

I-696 EB & WB OVER ROUGE RIVER

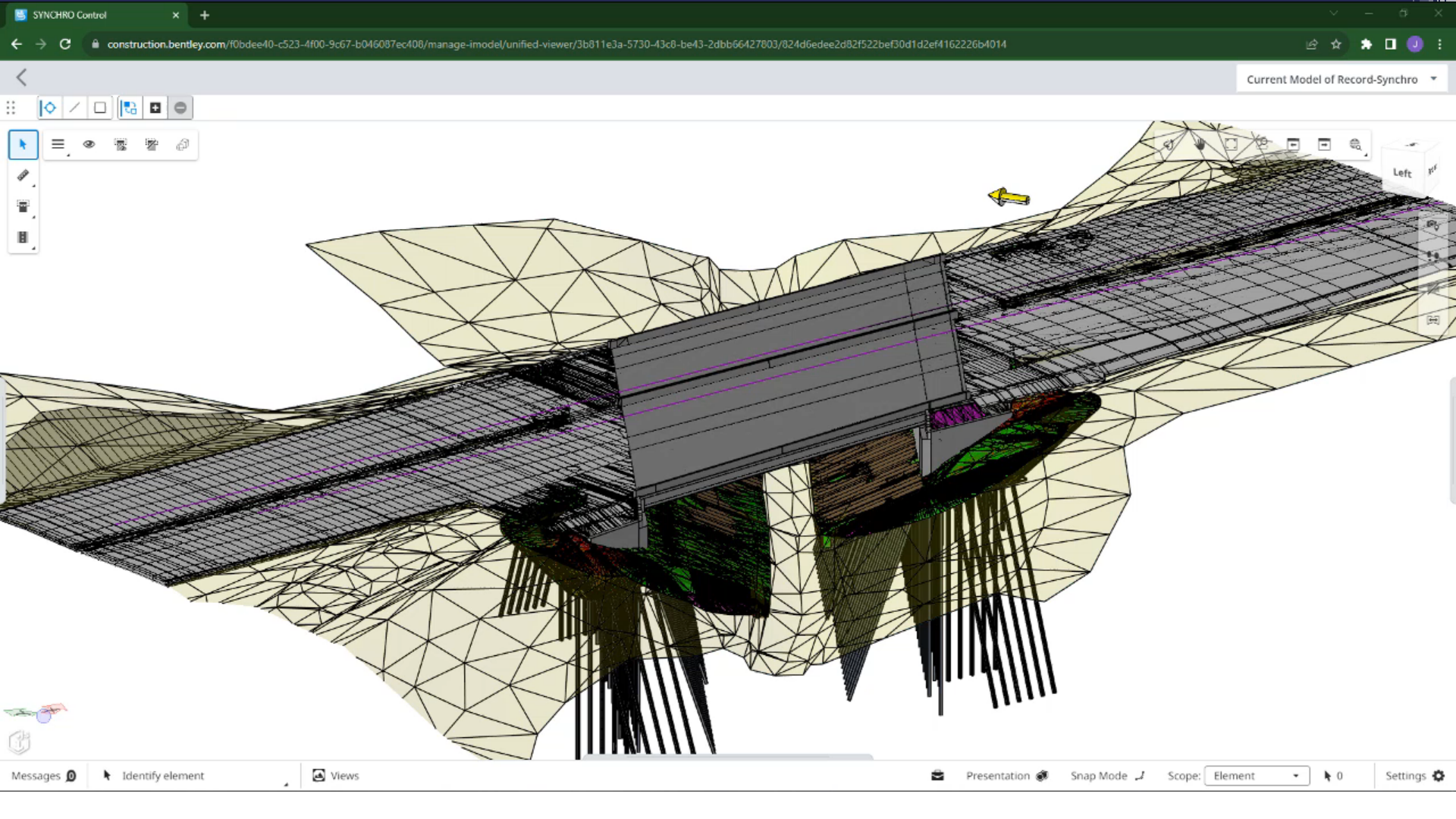
City of Southfield, Oakland County, Michigan

I-696 RECONSTRUCTION
8.5 miles of road work
Rehabilitation of 10 bridges



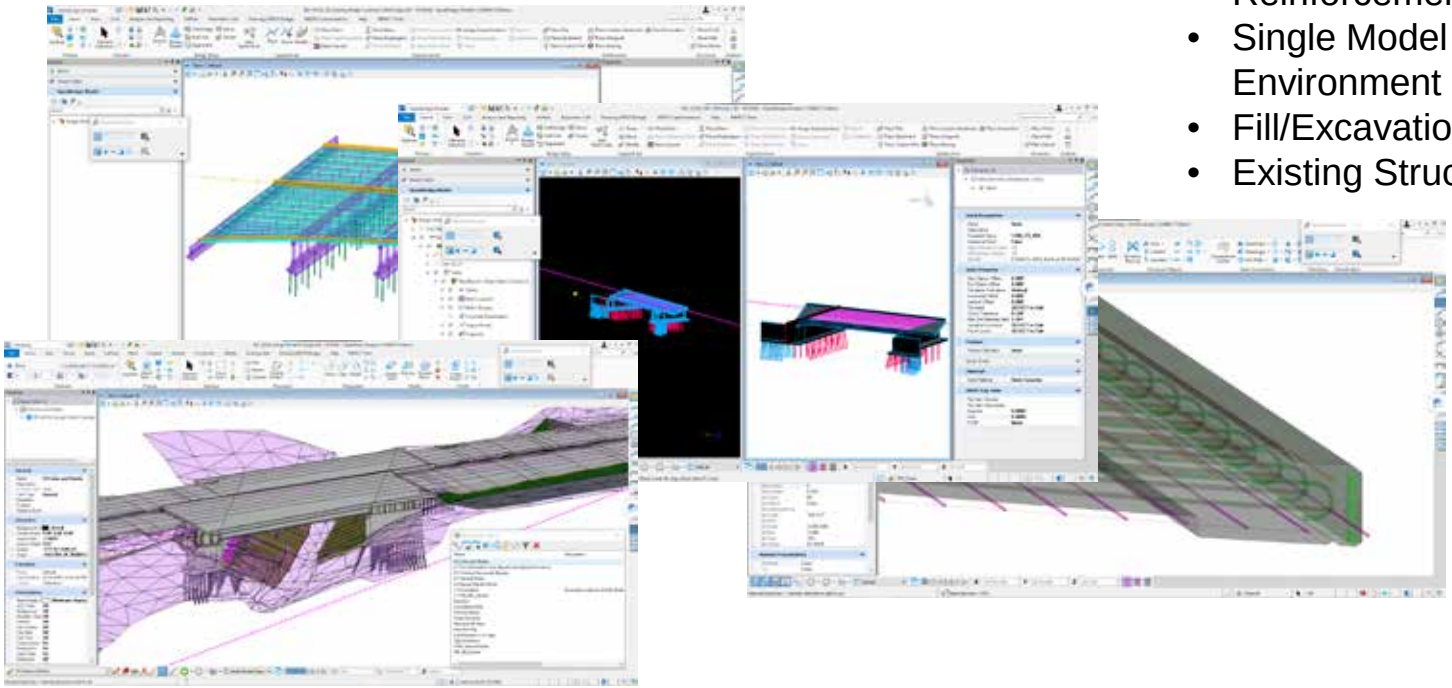
- Structure Replacement
  - Existing: 3-Span Steel Plate Girders
  - Proposed: Single Span PC Bulb Tee Beams
- Let August 2022
  - Pre-Bid Training in June/July
  - Construction 2023/2024

MODEL OVERVIEW


SYNCHRO Control
construction.bentley.com/f0bdee40-c523-4f00-9c67-b046087ec408/manage-imodel/unified-viewer/3b811e3a-5730-43c8-be43-2dbb66427803/824d6edee2d82f522bef30d1d2ef4162226b4014
Current Model of Record-Synchro
Left
Messages
Identify element
Views
Presentation
Snap Mode
Scope:
Element
0
Settings

MODEL STRUCTURE & FORMAT

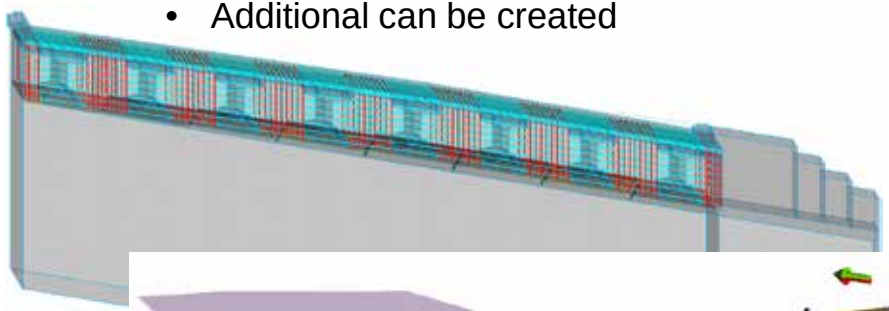
Federated Model to the Contractor

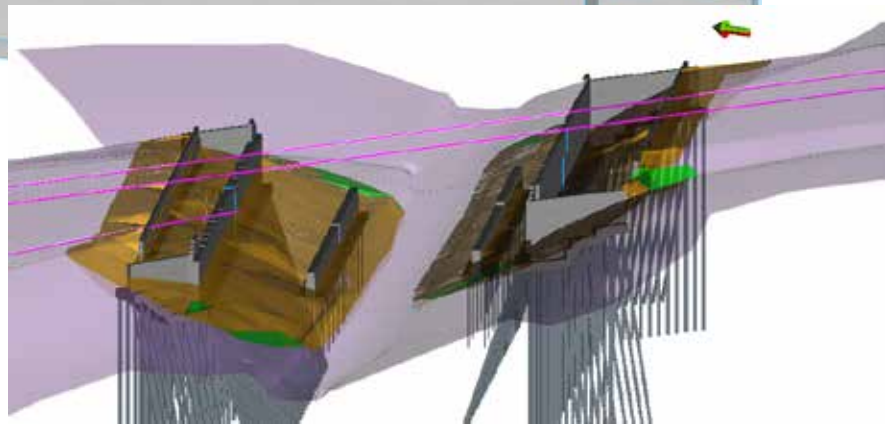


- All Discipline Files
- Reinforcement
- Single Model Environment
- Fill/Excavation Quantities
- Existing Structure

Saved Views

- Allows user to quickly access oriented information
- Additional can be created



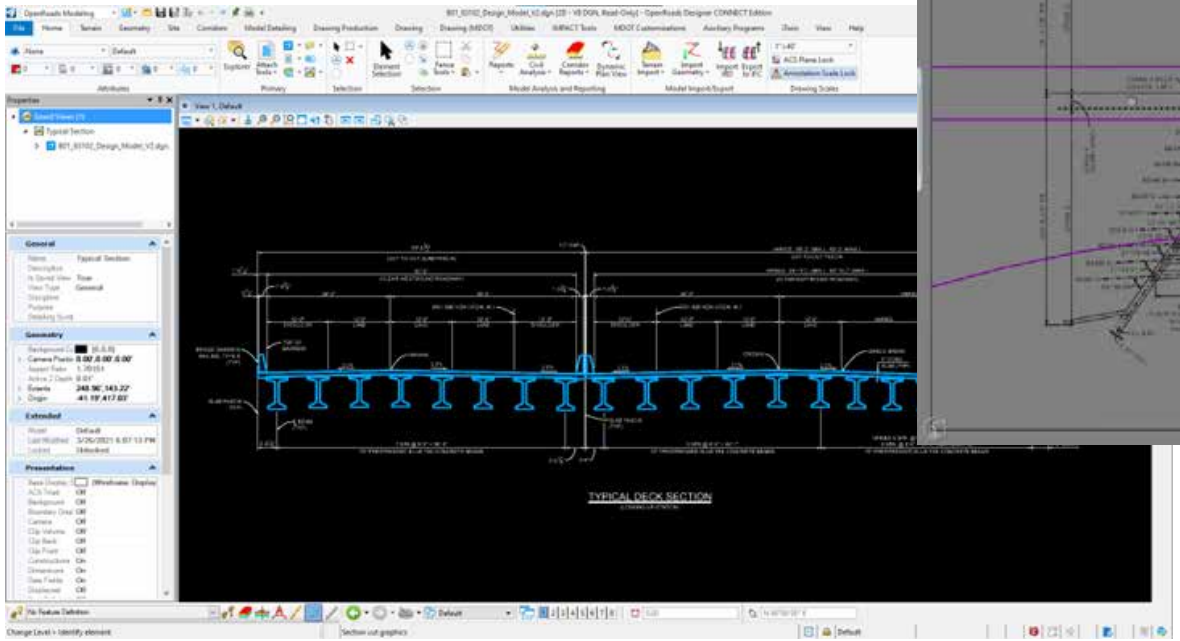


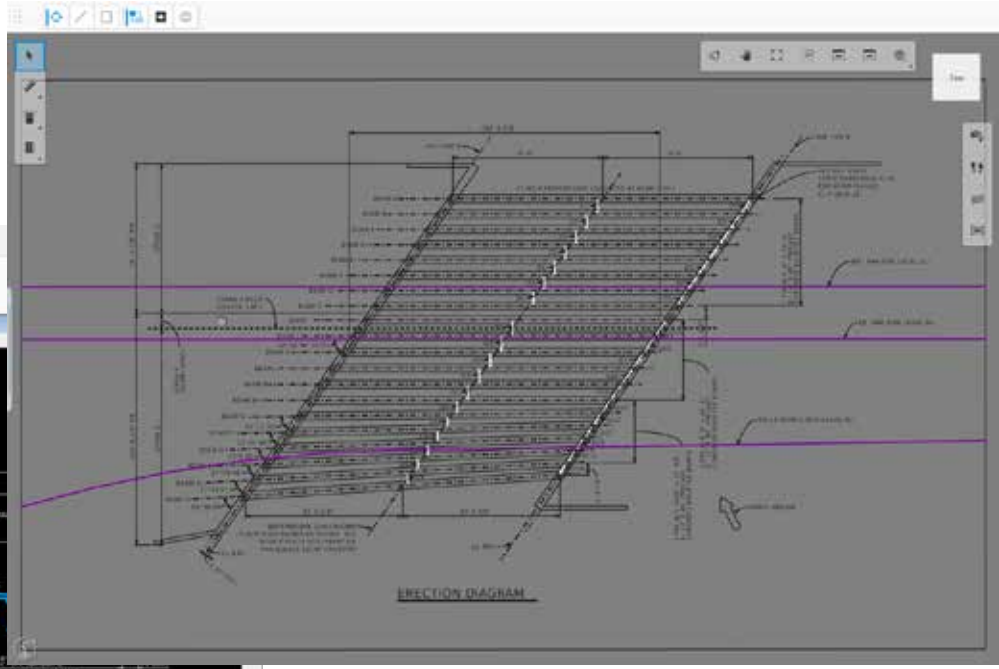
Saved Views - View 1

Name	Description
1.00 Plan Overview	Overall general plan of structure and approaches
1.04 Structure 3D View	Isometric view of the structures
1.05 Earthwork	Excavation and fill limits in 3D with only pertinent surfaces and subs
1.07 Pile Layout	Plan view of pile layout including location of test piles (red circles ar
1.08 Utilities Existing	Plan view of existing utilities near the structure
0.04 General Notes	General notes for overall bridge construction
0.05 Riprap Header Details	2D details and notes of the riprap header placement and limits at abu
0.06 Construction Joints - Superstructure	2D details of longitudinal construction joints for superstructure inclu
0.07 Joints - Substructure	2D details of construction and expansion joints (including expansion
0.09 Superstructure Coating Detail	2D detail and notes for barrier & deck fascia coating limits
0.13 Abutment pour diagram	Proposed pour locations and designations in 2D elevation views
0.10 Deck pour diagram	Proposed deck pour locations and designations in 2D plan view
0.11 EPS Block Lightweight Fill Details	2D details and notes for placement of EPS block lightweight fill
0.12 Slopewall Details	2D details and notes for placement of slopewall adjacent to abutmen
0.08 East Approach Section	2D details including at abutment, approach/sleeper slabs, and under
1.03 Typical Section_a	Annotated superstructure typical section
1.01 Elevation_a	Annotated general elevation views along the alignment and normal
1.02 Erection Plan_a	Annotated erection plan with dimensions for setting beams along sk
WB_2.01 Abutment A Footing View	Combine traditional views into an isometric of the abutment footing
WB_2.01 Abutment B Footing View	Combine traditional views into an isometric of the abutment footing
WB_2.02 Abutment A View	Combine traditional plan and elevation views into an isometric of th
WB_2.02 Abutment B View	Combine traditional plan and elevation views into an isometric of th
WB_2.03 Abutment A Section	Traditional abutment section view with reinforcement (perpendicula
0.14 Project Title	View with Project Location and other information traditionally shown
0.00 Model Elements Included as Links	Extents of Model Elements Included as Links section (overview)
0.01 Contractual Model File Links	Links to project contractual model file links
0.02 Special Provision and NTB Links	Links to project Special Provisions and Notice to Bidders
0.03 RID File and Report Links	Link to the RID review checklist and index and other RID files and rep
1.09 Utilities Proposed	Plan view of proposed utilities near the structure
WB_3.02 Deck Plan	Traditional deck plan view with reinforcement
WB_3.02_1 Deck Plan_Top	Traditional deck plan view with reinforcement with only top mat of r
WB_3.02_2 Deck Plan_Bottom	Traditional deck plan view with reinforcement with only bottom mat
WB_3.04 Deck and Barrier View	Isometric view of deck and barriers with reinforcement
WB_3.03 Deck Section	Traditional deck section view with reinforcement (perpendicular to a
WB_3.05 Dependent Backwall View	Isometric view with only the backwall concrete and reinforcement sh
WB_4.01 Approach Slab View	Isometric view of approach slab with reinforcement
1.11 Phasing View-1	Phase 1 isometric view with shape element showing extents of EB sta
1.10 Phasing Section-1	Phase 1 Section with shape element showing extents of EB structure
1.12 3D Boring Logs	3D soil boring logs with representative data from gINT export

Annotated Views

- Saved views with dimensions, tags, and notes
- To scale and model attributes are available





Model Properties

- Added directly to model “solids”
- Includes customized Item Types
  - Design information and pay items/specs
- List per bridge element
- Pay Items

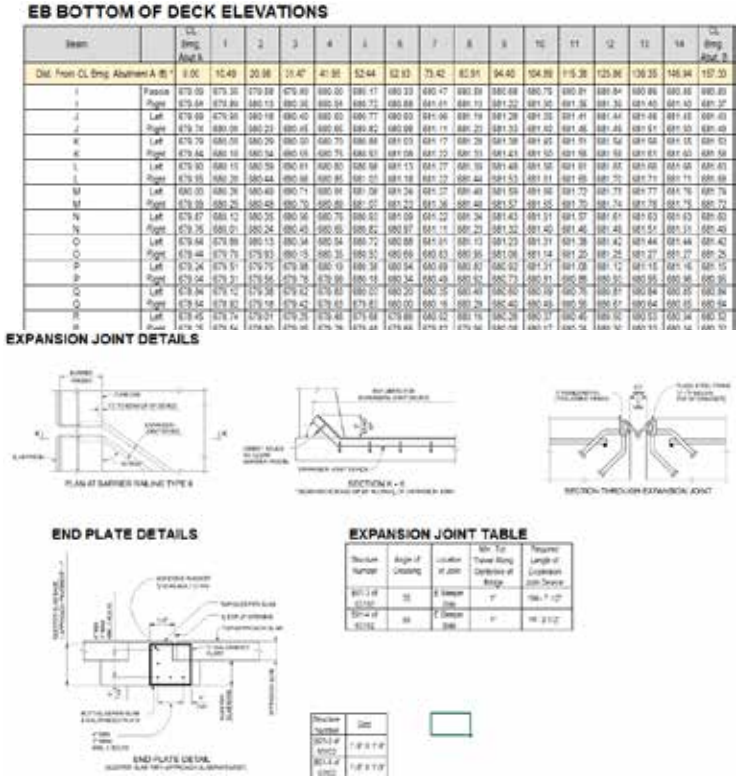
Element	*NBI#*	*Attribute 1*	*Attribute 2*	*Attribute 3*	*Attribute 4*	*Attribute 5*
Abutment Stem		Concrete Grade	f'c (psi)	Pour #	Fixity	
example data:	219	3500HP	3500	B	Exp	
Concrete Deck		Concrete Grade	f'c (psi)	Bevel dim. (in.)	Barrier Key/Water Stop	Drip Edge
example data:	12	4000HP	4000	0.75	6" x 4" Trap. Key (see model for detail)	3/4" triangle molding
Concrete Haunch		Concrete Grade	f'c (psi)	Slope		
example data:	13	4000HP	4000	Slope as required for form removal		
Concrete Parapet		Concrete Grade	f'c (psi)	Bevel dim. (in.)	Barrier Key/Water Stop	
example data:	331	4000HP	4000	0.75	6" x 4" Trap. Key (see model for detail)	
PS Concrete Beams		Type	f'c (psi)	f'ci (psi)		
example data:	109	72" Bulb Tee	8000	6500		

Links to Supplemental Documents

CONTRACTUAL ITEMS

CONTRACTUAL MODEL FILES	FILE TYPE	DESCRIPTION
B01_63102_StructuresData.xlsx	EXCEL	SPREADSHEET W
B01_63102_ReinforcementDetails.xlsx	EXCEL	SPREADSHEET W
B01_63102_Quantities.xlsx	EXCEL	SPREADSHEET W
B01_63102_Project Signature Sheet.xlsm	EXCEL	FILE LIST WITH DI

- Files linked to model space
- Can be any type of .pdf, excel or word file



TEAM APPROACH

Approach in construction phase

- Designer on-board for construction services
  - Model updates
  - Lessons Learned
  - Training
- Model Coordination Special Provision
  - BIM Execution Plan
  - Lessons Learned
  - Training

20BR800(A785)

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
MODEL COORDINATION AND TRAINING FOR JOB NUMBER 201222
(ROUGE RIVER)

BRG:BMW 1 of 5 APPR:JJG:MJC:05-27-22

a. Description. This work consists of furnishing all labor, equipment, training, qualifications, meetings, engineering, supplemental details, submittals, and other services necessary to utilize electronic or other computer generated models to construct I-696 Eastbound and Westbound over the Rouge River. Perform all work in accordance with the standard specifications and the contract except as modified herein. This work includes but is not limited to:

1. Participate in training for the Contractor, subcontractors, and other participants selected by the Contractor on use of model files.

2. Participate in all meetings required to properly construct the bridges utilizing the model files.

3. Develop and work in accordance with an approved Building Information Model (BIM) Execution Plan.

4. Develop and work in accordance with any supplemental details or documents developed by the Contractor and approved by the Engineer.

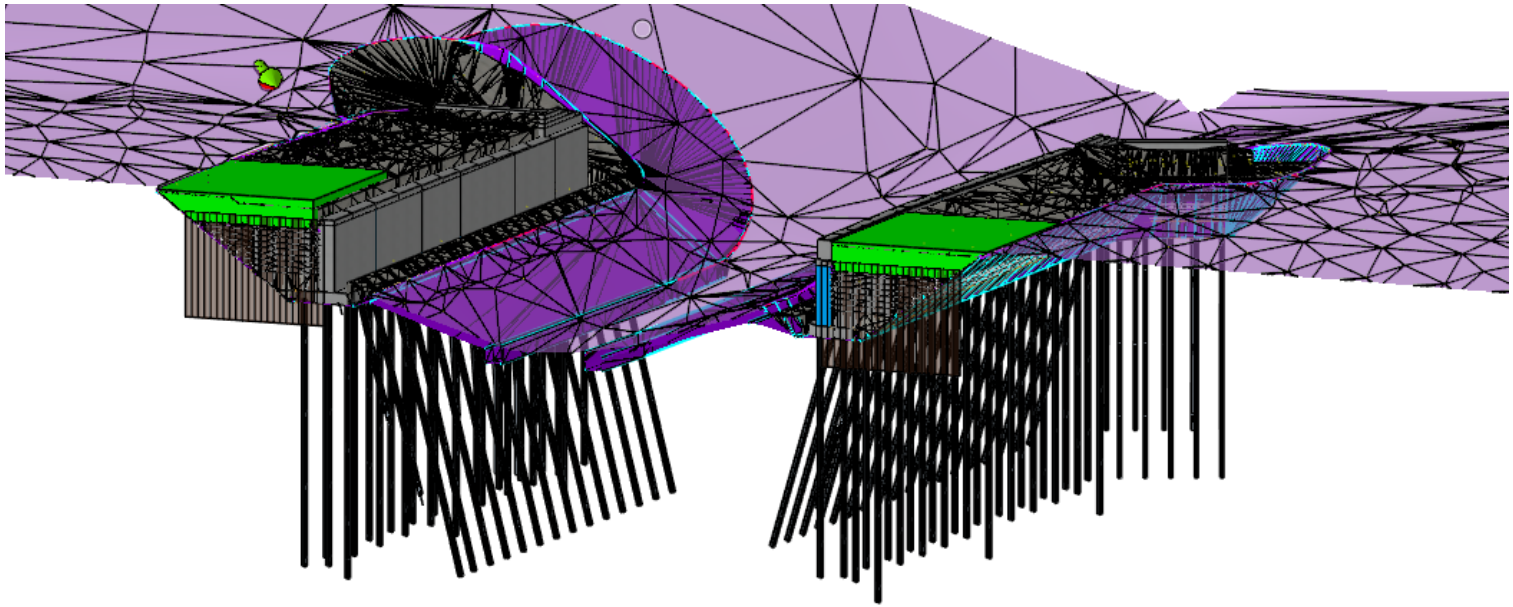
5. Furnish as-built information for Department incorporation into the final as-built model.

6. Quality Assurance and Acceptance.

LESSONS LEARNED

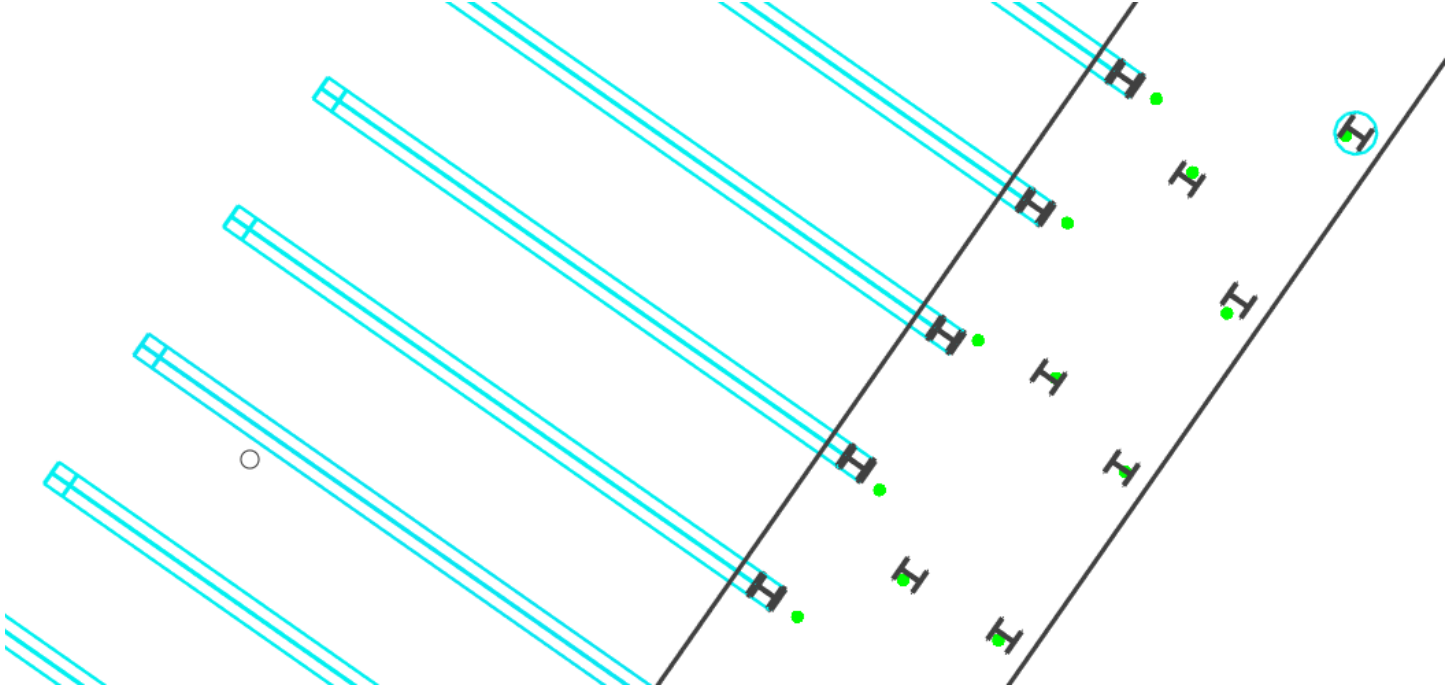
Designer – What went well?

- Partnership attitude and approach
- Staging visualizations



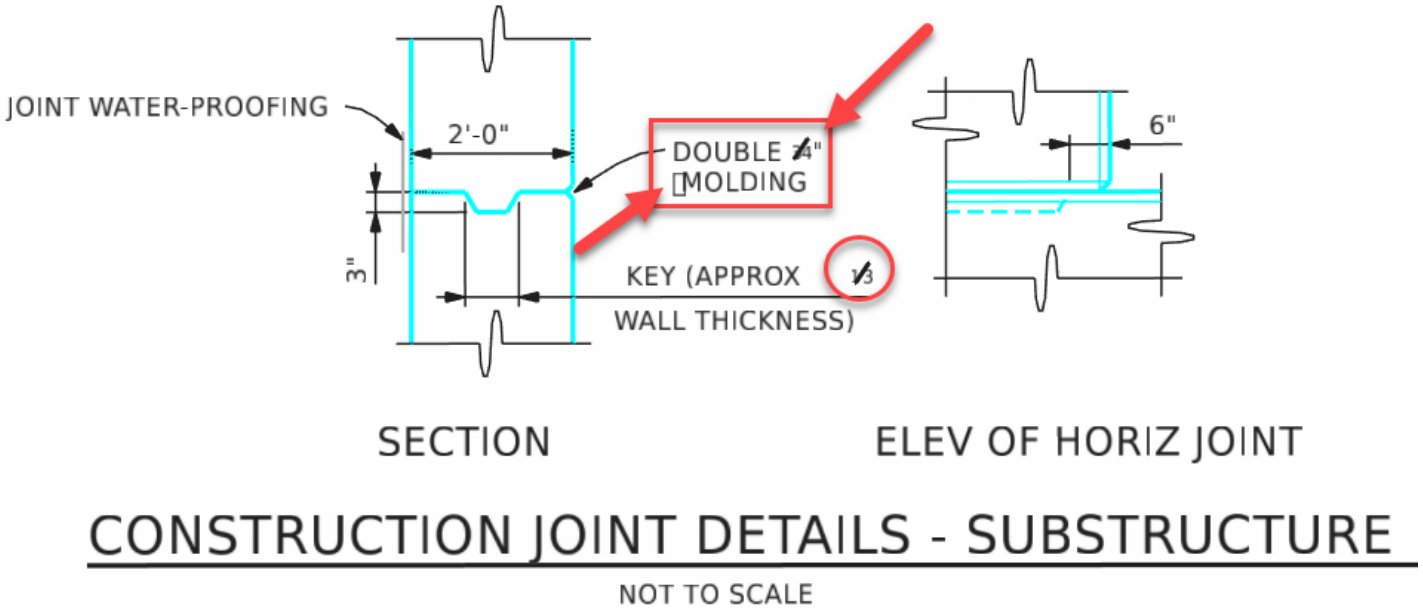
Designer – What went well?

- Model revisions and as-builts



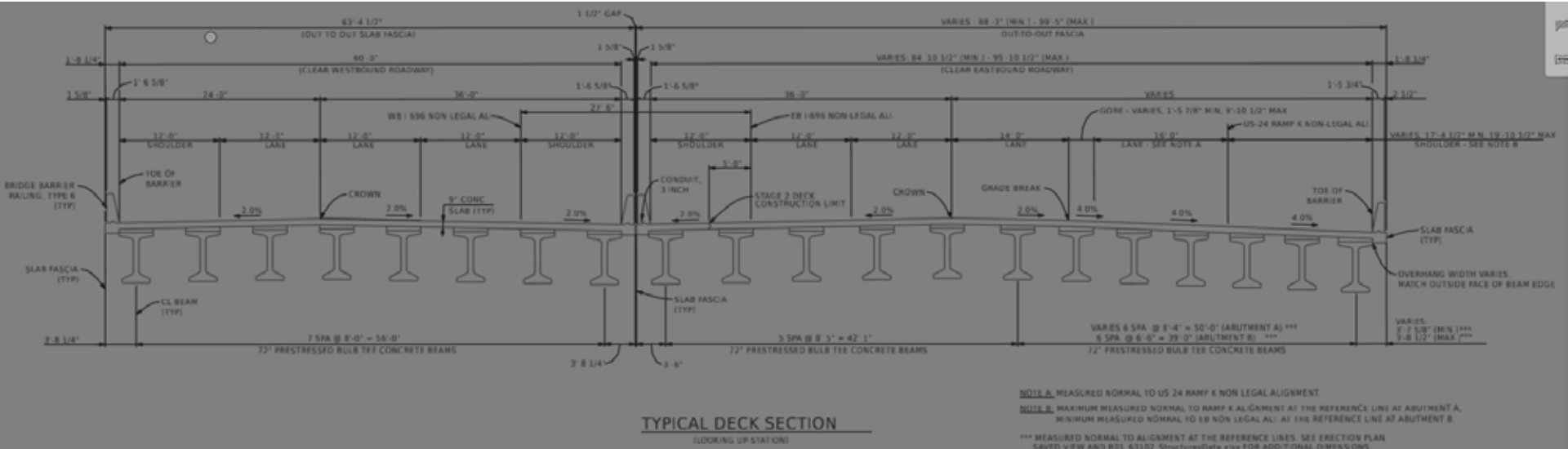
Designer – What was challenging?

- Communicating model changes
- Design to construction software data sharing



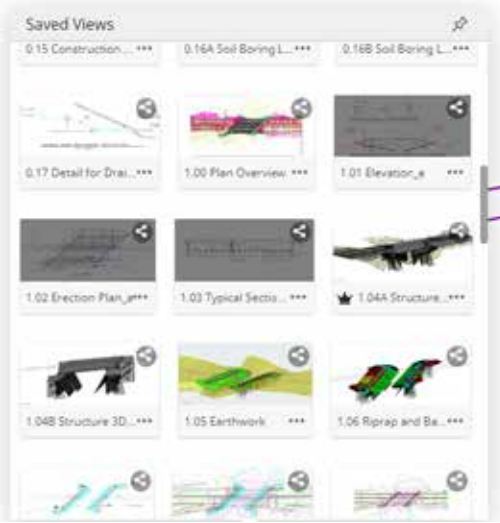
Designer – What would you change?

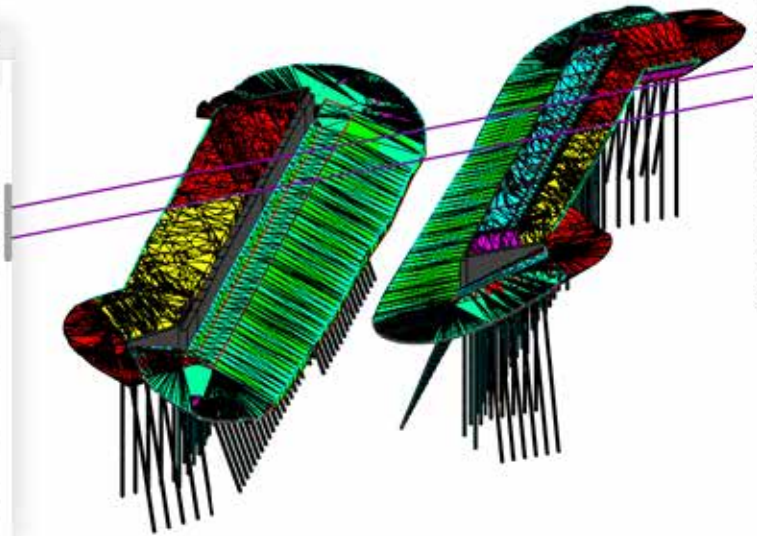
- Add more annotated and section views
- Include staging in contractual model

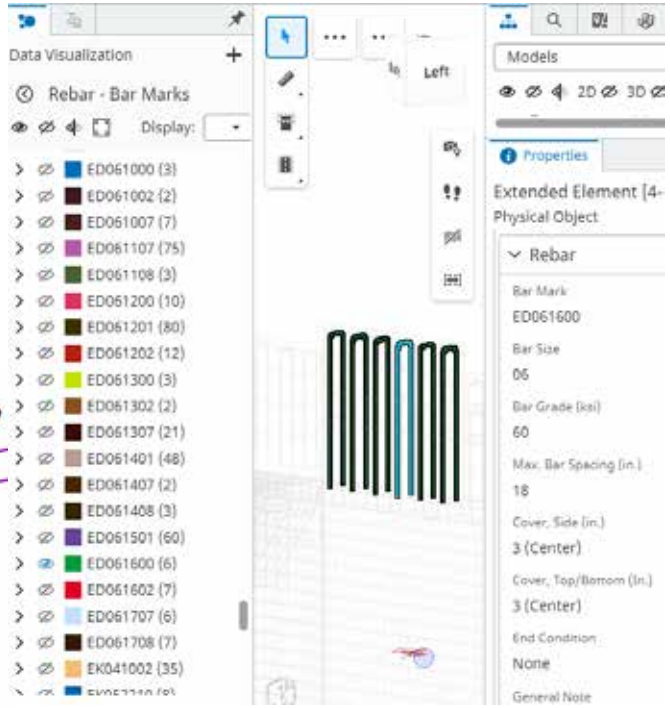


Owner – What went well?

- Consistent collaboration between owner/contractor/design team
- Saved views & data visualization

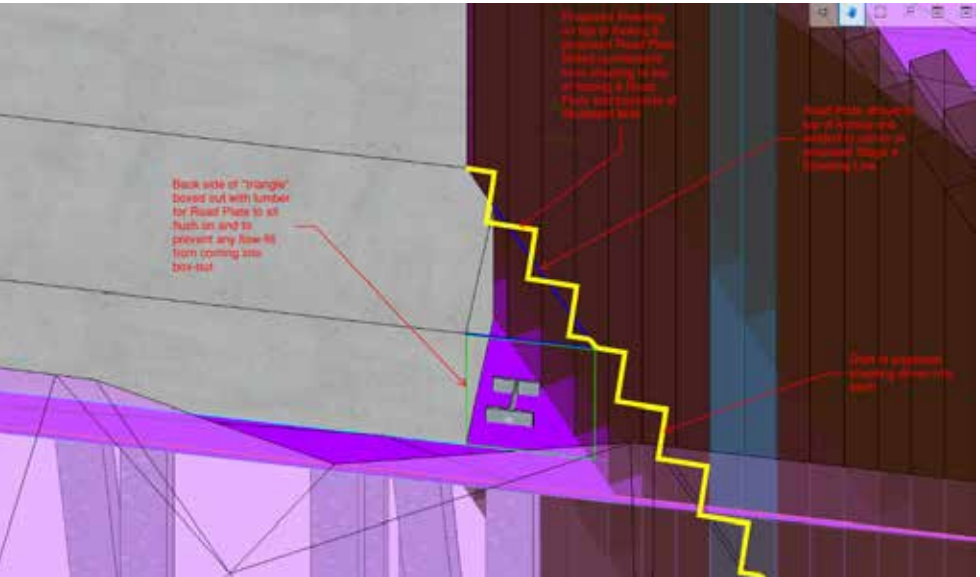


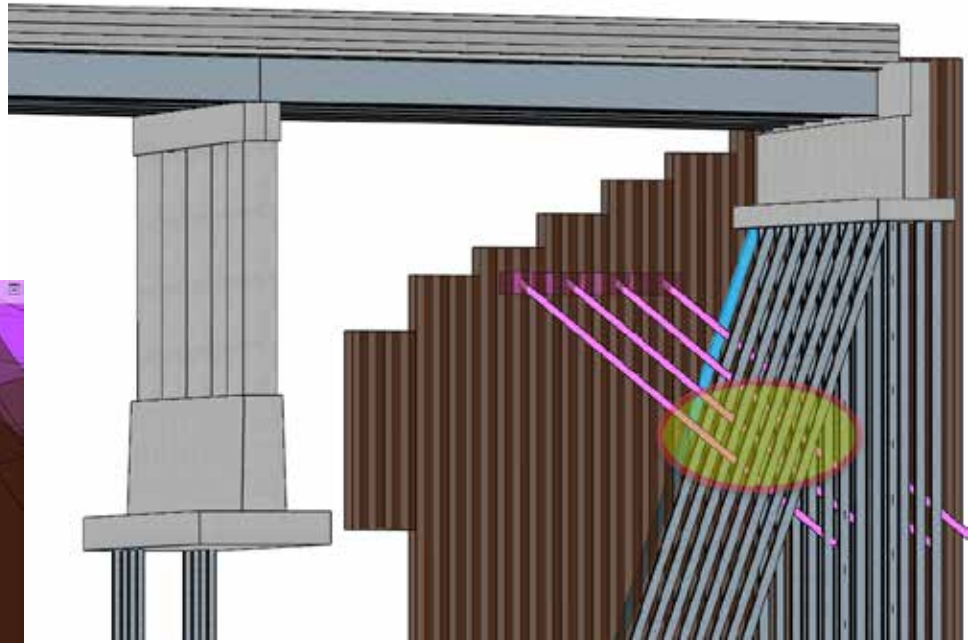




Owner – What went well?

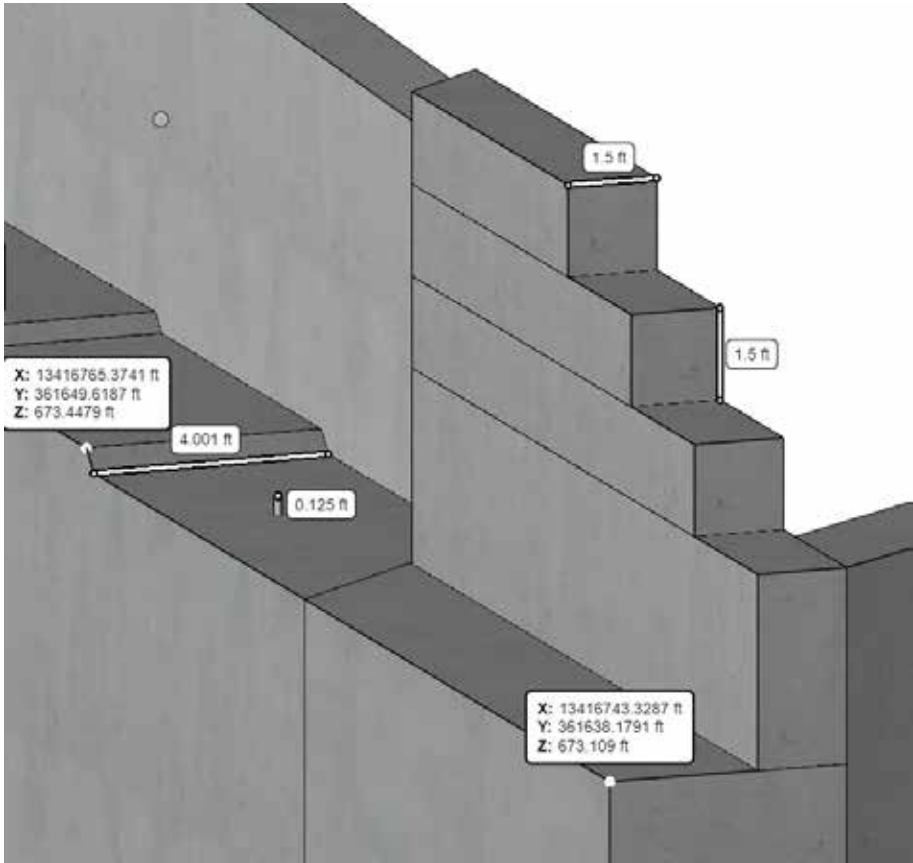
- Visualization of risk areas
- Sharing content between design and field





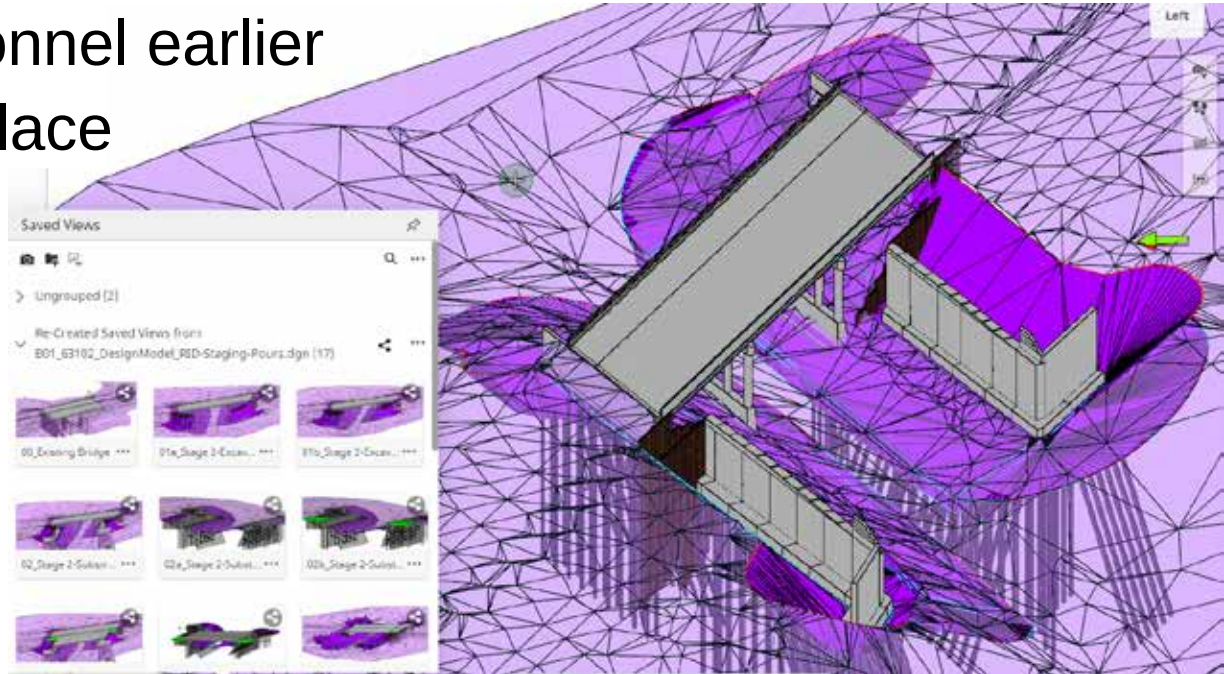
Owner – What was challenging?

- Learning curve
- Field model use with tablets
- Staging info



Owner – What would you change?

- Add more saved views from the start
- Staging info better defined
- Train internal personnel earlier
- Keep data in one place



Contractor – What went well?

Contractor – What was challenging?

Contractor – What would you change?

QUESTIONS?