I-696 Update – MDOT's Bridge Model as Legal Document

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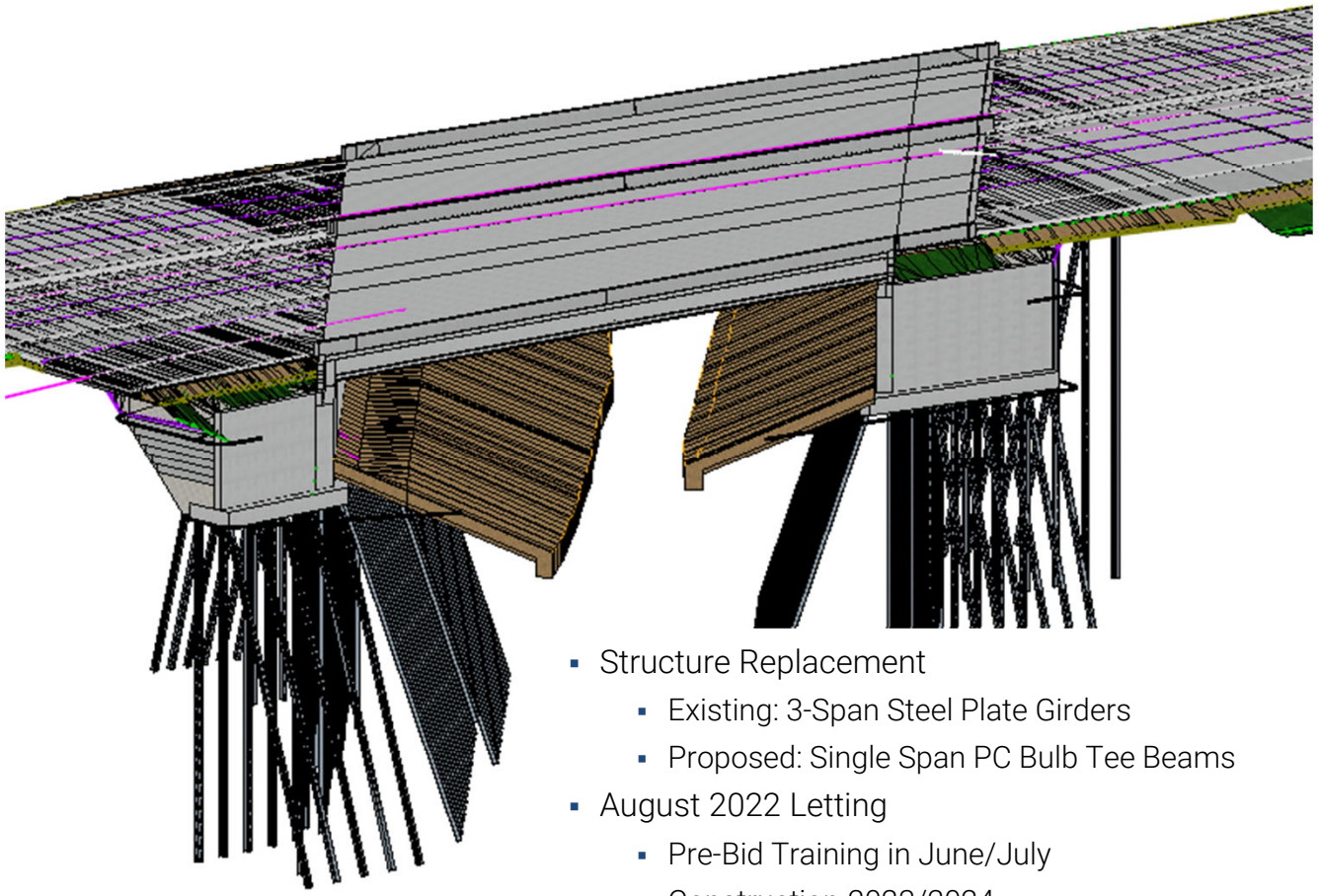
I-696 EB & WB OVER ROUGE RIVER

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
- August 2022 Letting
  - Pre-Bid Training in June/July
  - Construction 2023/2024

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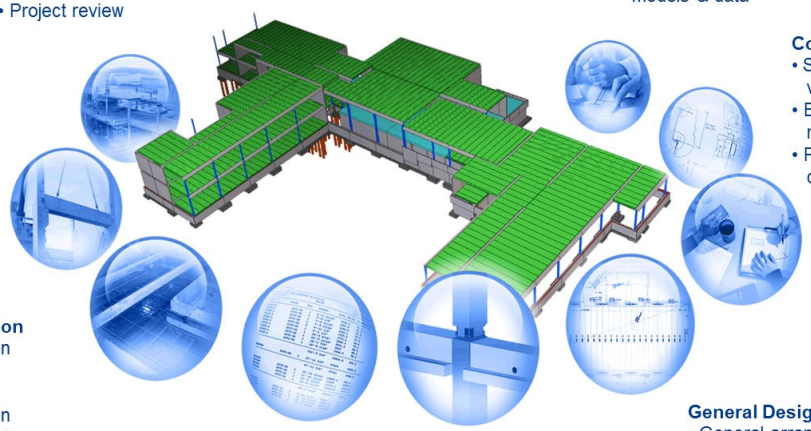
“WHAT’S IN IT FOR ME?”

Project Handover
- As-built data
- Project review

Interdisciplinary design collaboration
- IFC Data transfer (Arch,MEPF,…)
- Other reference models & data

Erection Management
- Erection planning & follow up
- Sequencing, lotting, delivery, production coordination



Conceptual design
- Sales models, visualizations
- Basic structure sizes materials, positions
- Preliminary drawings, documents

Sales & bidding
- Tendering quantities
- Alternative solutions
- Construction visualizations

Integration to Fabrication
- Integration to Production automation systems & machinery
- Integration to Production planning & ERP systems

Drawings, Reports, Data
- Shop drawings,
- reports, schedules
- Automation, ERP & Planning data

Detailing
- Multi-material detailing
- Reinforcements
- Detailed connections
- Embeds

General Design
- General arrangement drawings, 3 D visualization drawings, erection drawings
- Reports

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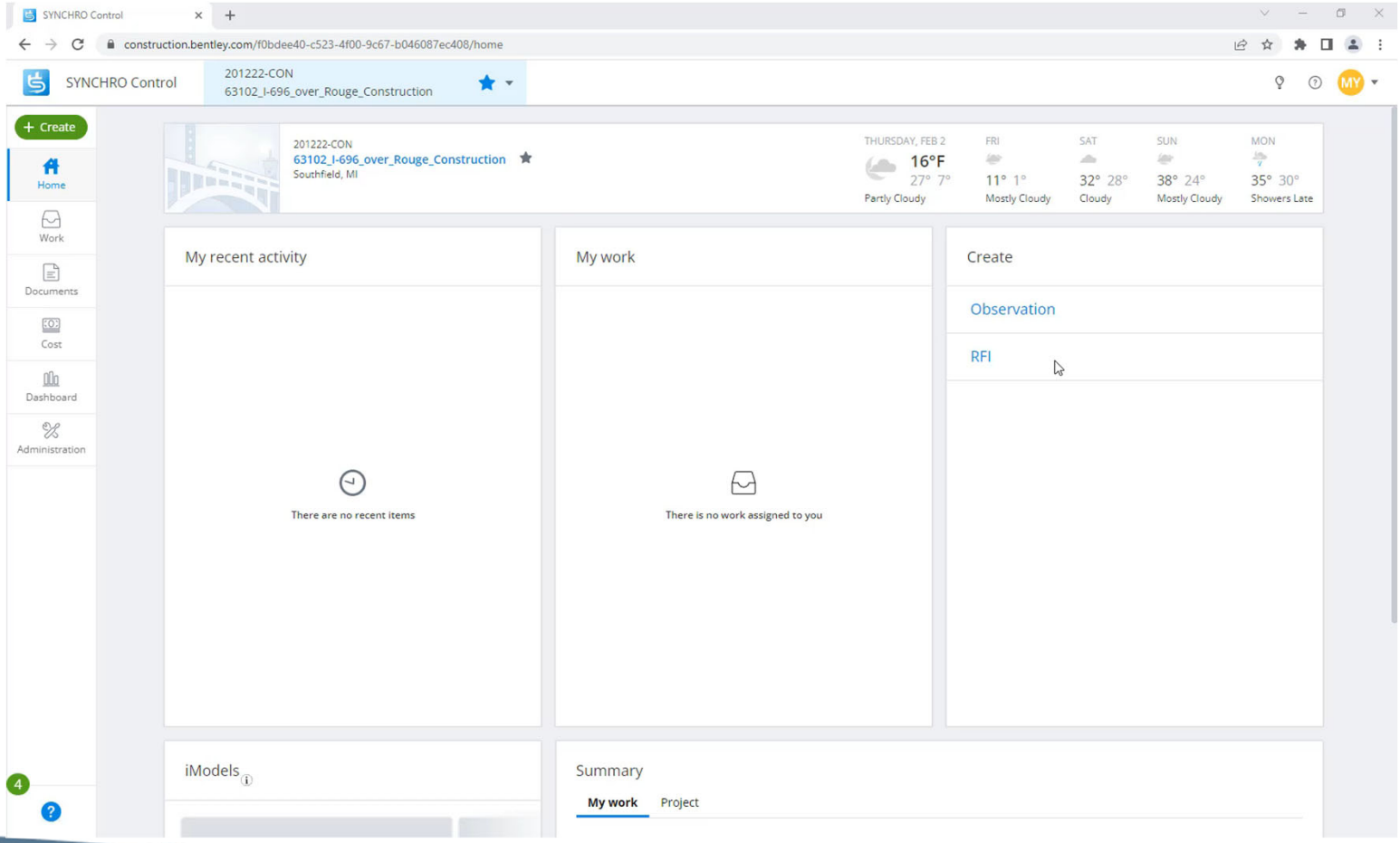
SYNCHRO – CONSTRUCTION VIEWER



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e-Proposal

Welcome to the MDOT Electronic Proposal site

Plans and proposal: Estimated pages for plans -

The proposal for this project includes all documentation shown in PDF format below:

131589_Addend1.pdf - 0.40 MB
131589_Addend2.pdf - 81.28 MB
131589_Addend3.pdf - 8.69 MB
131589_Addend4.pdf - 3.69 MB
131589_Addend5.pdf - 0.07 MB
131589_Bridge.pdf - 50.44 MB
131589_Project Signature Sheet.xlsm - 0.77 MB
131589_Proposal.pdf - 32.46 MB
131589_Road1.pdf - 19.91 MB
131589_Road2.pdf - 23.66 MB
131589_Road3.pdf - 38.25 MB
131589_Road_Plan1.pdf - 33.80 MB
131589_Road_Plan2.pdf - 25.23 MB
131589_Road_Plan3.pdf - 24.05 MB
131589_Road_Profile.pdf - 4.60 MB
B01_63102_Letting Plans and Proposal_v1.zip - 237.22 MB
Addenda A-MI1 Wage Decision Update.pdf - 0.47 MB
Federal Letting Requirements-05.pdf - 1.60 MB

Project Signature Sheet

Contract ID 201222PES-63102 - File Index

Plan Files

File Name	Description	Notes

Model Data

File Name	Description	File Type
B01_63102_DesignModel.dgn	Container file with all contractual and other RID information included or linked with additional saved views for convenience	OpenRoads Designer (.dgn)
B01_63102_EB_OBM.dgn	Eastbound structure model file containing all concrete and steel bridge model elements (excluding rebar)	OpenBridge Modeler (.dgn)
B01_63102_WB_OBM.dgn	Westbound structure model file containing all concrete and steel bridge model elements (excluding rebar)	OpenBridge Modeler (.dgn)
B01_63102_TypSection.dgn	Typical section 2D annotated view of superstructure	OpenRoads Designer (.dgn)
B01_63102_Elev.dgn	Elevation 2D annotated view of structure	OpenRoads Designer (.dgn)
B01_63102_ErectionPlan.dgn	Erection 2D annotated diagram of structure	OpenRoads Designer (.dgn)
B01_63102_ModelNamedBoundaries.dgn	Intermediate file used to create plan and other 2D views of structure to be annotated	OpenRoads Designer (.dgn)
B01_63102_Structures_Additional_Info.dgn	2D detail views, notes, and links to attached files.	OpenRoads Designer (.dgn)
B01_63102_StructuresData.xlsx	Spreadsheet with multiple tabs with tables/details for beam and bearing fabrication, placement, and associated notes; also includes elevations/details for deck construction	Microsoft Excel
B01_63102_ReinforcementDetails_EB.xlsx	Spreadsheet with EB rebar schedules, minimum bar laps, and additional details	Microsoft Excel
B01_63102_ReinforcementDetails_WB.xlsx	Spreadsheet with WB rebar schedules, minimum bar laps, and additional details	Microsoft Excel
B01_63102_Quantities.xlsx	All estimated quantity information	Microsoft Excel
B01_63102_EB_ProStr_AbutA.dgn	Eastbound Abutment A structural reinforcement model elements	ProStructures (.dgn)
B01_63102_EB_ProStr_AbutB.dgn	Eastbound Abutment B structural reinforcement model elements	ProStructures (.dgn)
	Eastbound Approach Slab structural	

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Unique Special Provisions

Spec Book Modifications

- Add definition of Model
- Expand the definition of Plans
- Incorporate “Model” language
- Order of precedence for model elements

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Model Coordination & Training Special Provision

- Create Model Coordinator role
- Training after award
- Model coordination meetings
- Develop BIM Execution Plan
  - Viewing, verifying, and using the model files
  - Supplementing model data
  - Sharing data
- Lessons Learned

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Stakeholder Engagement

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Level of Development

100	Derived from a database, or other generic representation. Size, shape and orientation cannot be derived reliably. Does not include analysis.
200	Graphically represented as a specific system in the XY plane. Size, shape, and orientation can be derived directly minimal need for plan sheet notes or dimensions. May include analysis.
300	Graphically represented in a specific system in the X, Y and Z plane. Interfaces with other objects without the need for plan sheet notes or dimensions. Asset Information and analysis to the standard of care for that element are included.
400	Fabrication instructions can be derived. Includes sub-elements such as steel reinforcement and connection details. Non-Graphical information has been attached to the modeled element.
500	This represents the Digital Twin of the constructed asset. Major transportation asset class attributes are linked. Modeled objects or assets are useable and updatable.

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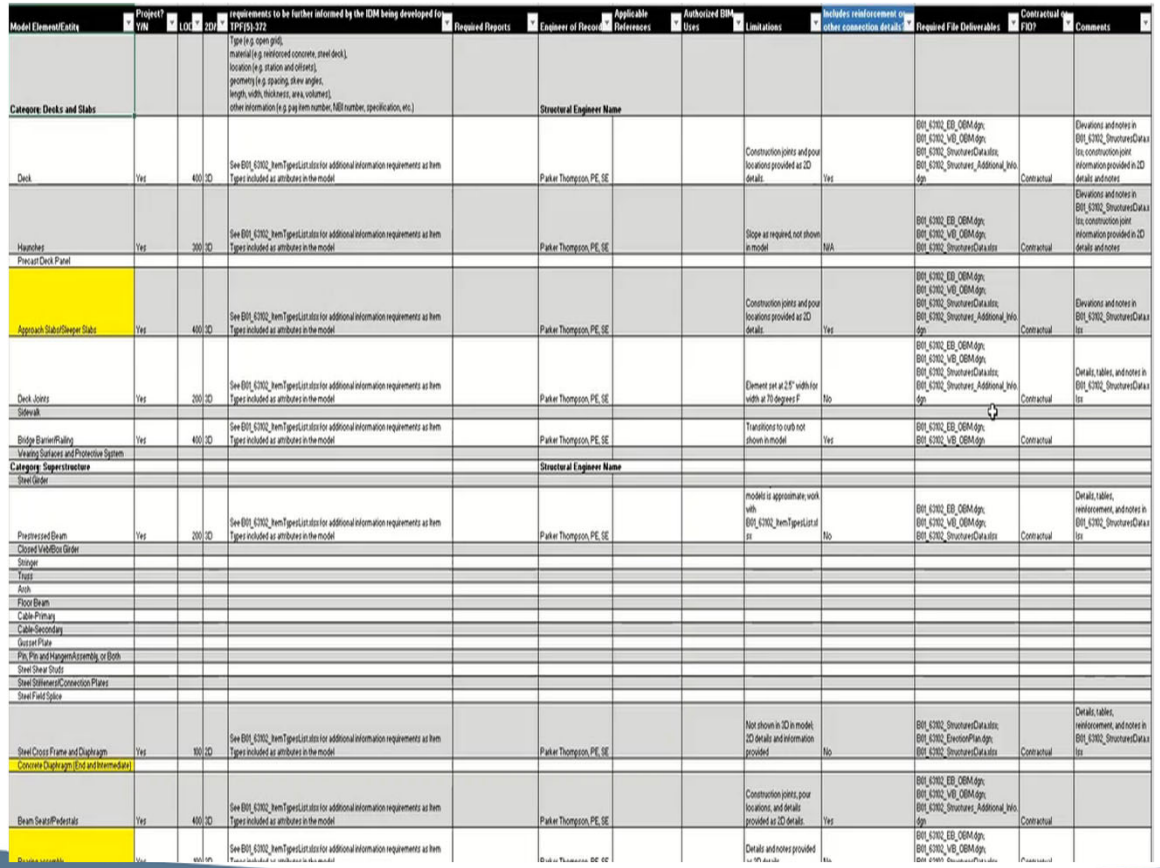
Model Element Breakdown (MEB)



Model Element/Entity	Project? Y/N	LOD	207	requirements to be further informed by the IDM being developed for TPF(5):372	Required Reports	Engineer of Record	Applicable References	Authorized BIM Uses	Limitations	Includes reinforcement or other connection details	Required File Deliverables	Contractual or FIO?	Comments
Category: Decks and Slabs				Type (e.g. open grid), material (e.g. reinforced concrete, steel deck), location (e.g. station and offsets), geometry (e.g. spacing, skew angles, length, width, thickness, area, volumes), other information (e.g. pay item number, NBI number, specification, etc.)		Structural Engineer Name							
Deck	Yes	400	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Construction joints and pour locations provided as 2D details.	Yes	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx; BIM_63102_Structures_Additional_Info.dgn	Contractual	Elevations and notes in BIM_63102_StructuresData.xlsx; construction joint information provided in 2D details and notes
Haunches	Yes	300	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Slope as required, not shown in model	N/A	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx	Contractual	Elevations and notes in BIM_63102_StructuresData.xlsx; construction joint information provided in 2D details and notes
Precast Deck Panel													
Approach Slab/Sleeper Slabs	Yes	400	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Construction joints and pour locations provided as 2D details.	Yes	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx; BIM_63102_Structures_Additional_Info.dgn	Contractual	Elevations and notes in BIM_63102_StructuresData.xlsx
Deck Joints	Yes	200	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Element set at 2.5" width for width at 70 degrees F	No	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx; BIM_63102_Structures_Additional_Info.dgn	Contractual	Details, tables, and notes in BIM_63102_StructuresData.xlsx
Sidewalk													
Bridge Barrier/Railing	Yes	400	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Transitions to curb not shown in model	Yes	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn	Contractual	
Wearing Surfaces and Protective System													
Category: Superstructure						Structural Engineer Name							
Steel Girder													
Prestressed Beam	Yes	200	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			models is approximate, work with BIM_63102_ItemTypesList.xlsx	No	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx	Contractual	Details, tables, reinforcement, and notes in BIM_63102_StructuresData.xlsx
Closed Web/Box Girder													
Stringer													
Truss													
Arch													
Floor Beam													
Cable-Primary													
Cable-Secondary													
Gusset Plate													
Pin, Pin and Hanger Assembly, or Both													
Steel Shear Studs													
Steel Stiffeners/Connection Plates													
Steel Field Splice													
Steel Cross Frame and Diaphragm	Yes	100	2D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Not shown in 3D in model, 2D details and information provided	No	BIM_63102_StructuresData.xlsx; BIM_63102_ElevationPlan.dgn; BIM_63102_StructuresData.xlsx	Contractual	Details, tables, reinforcement, and notes in BIM_63102_StructuresData.xlsx
Concrete Diaphragm (End and Intermediate)													
Beam Seats/Pedestals	Yes	400	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Construction joints, pour locations, and details provided as 2D details	Yes	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_Structures_Additional_Info.dgn	Contractual	
Bearing assembly	Yes	100	3D	See BIM_63102_ItemTypesList.xlsx for additional information requirements as Item Types included as attributes in the model		Parker Thompson, PE, SE			Details and notes provided in 2D details	No	BIM_63102_EID_OBM.dgn; BIM_63102_VID_OBM.dgn; BIM_63102_StructuresData.xlsx	Contractual	

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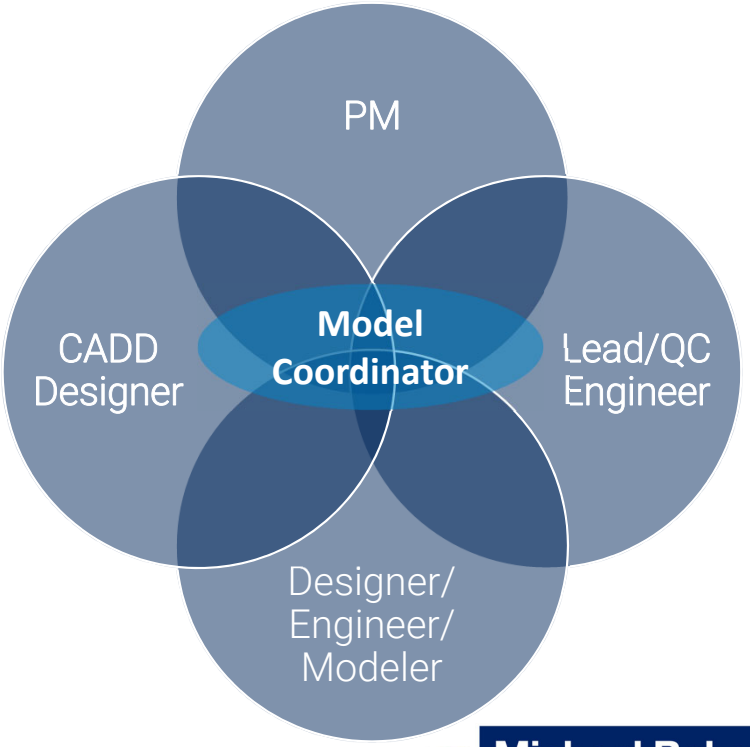
Role Changes

PM | Lead/QC Engineer | Designer/ Engineer | CADD/ Tech



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Adjusted Workload

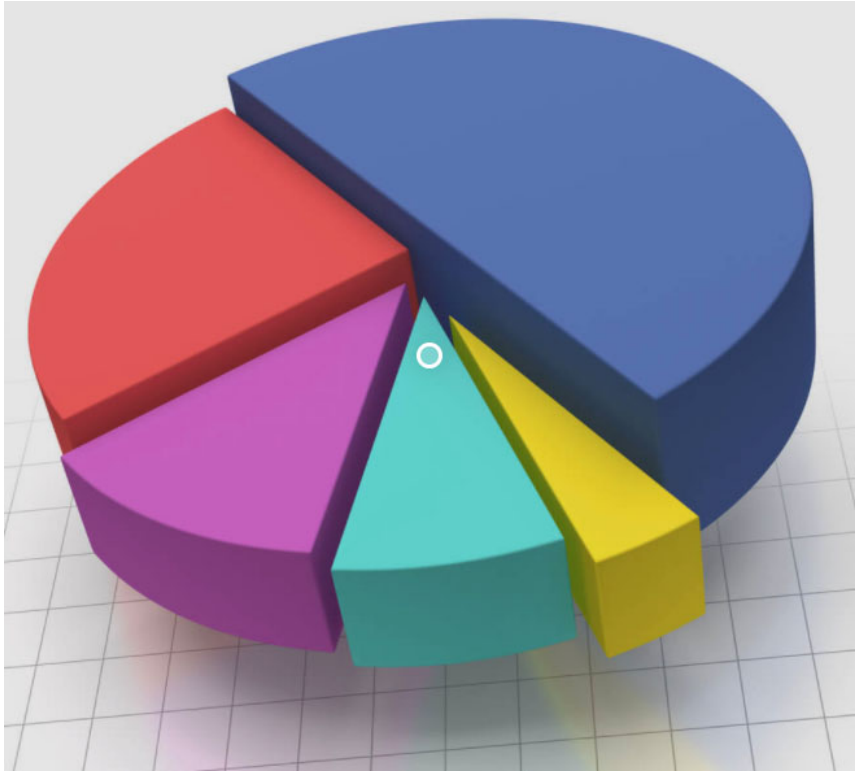
Stakeholder Engagement
- Contractors, Permitting Agencies

Early Phases of Design
- Increased time due to modeling
- Hydraulics and Grading

Final Draft Phase
- Reduced time from items completed in study

Final Plans
- Contractor previews

Letting Plans
- Training/Pre-Bid Meeting
- Videos/Workspace



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Software Structure

Bridge Model Files

ProConcrete
Steel Reinforcement
Design & Quantities

OpenBridge Modeler
3D Structure Models
(Existing and Proposed)

Other Disciplines

Others

Other Discipline Files

OpenRoads Designer
3D Road Models
Survey and Earthwork Models
gINT Geotechnical Data

PDF
Reports (SP, etc.)

Excel
Tables (deck elevations, beam details, etc.

MicroStation
2D details

"Container" File

DGN (OpenRoads Designer or Bentley View)

Construction Software

SYNCHRO
Trimble
Leica Geosystems

Others

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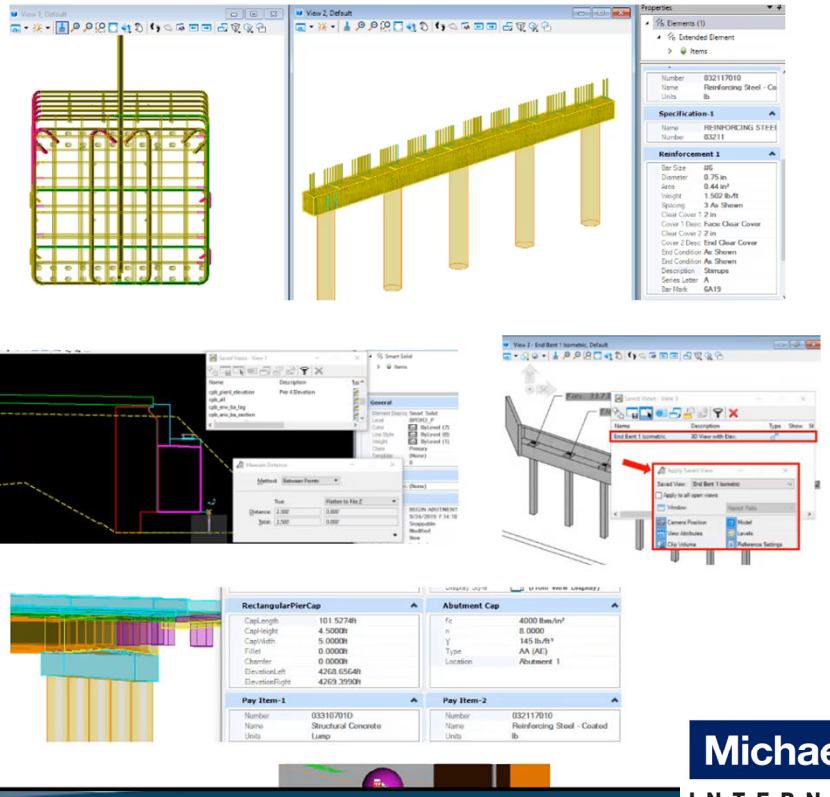
Model Element Designation Guide

MODEL ELEMENT DESIGNATION KEY

Reinforcement shown in model with attributes attached for bar mark, spacing, and cover. Saved views will be added for reinforcement per element and annotated as necessary for hard to determine situations (staggered deck bars, etc.).

Geometry and key information included in model and shown in saved views. Annotation will generally not be provided for this information, and it is assumed that user will be able to measure within the model environment and obtain this information without explicit annotation in views.

Added as named element attributes, item types in model, and/or assigned specific levels (utilities).



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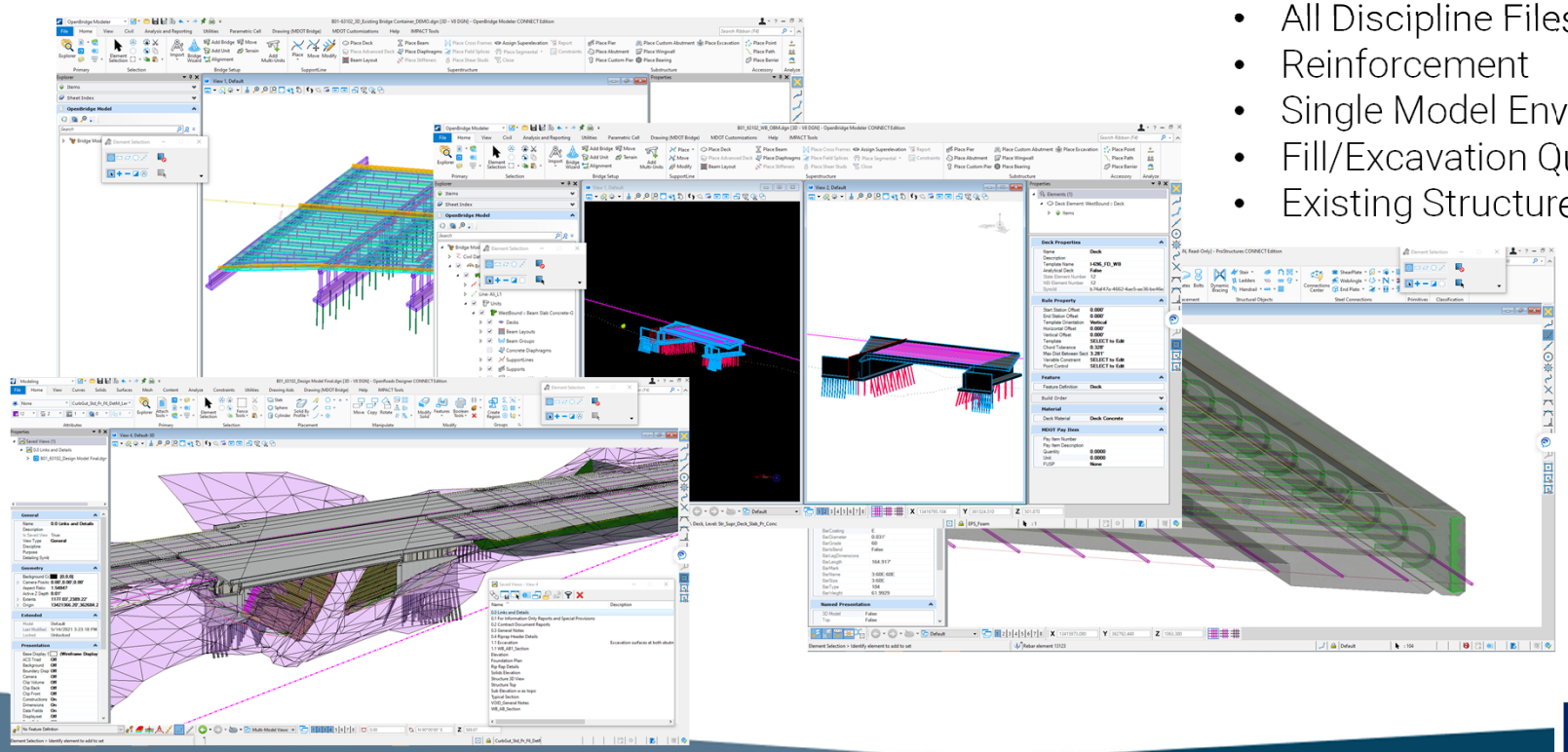
Federated Model to the Contractor



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

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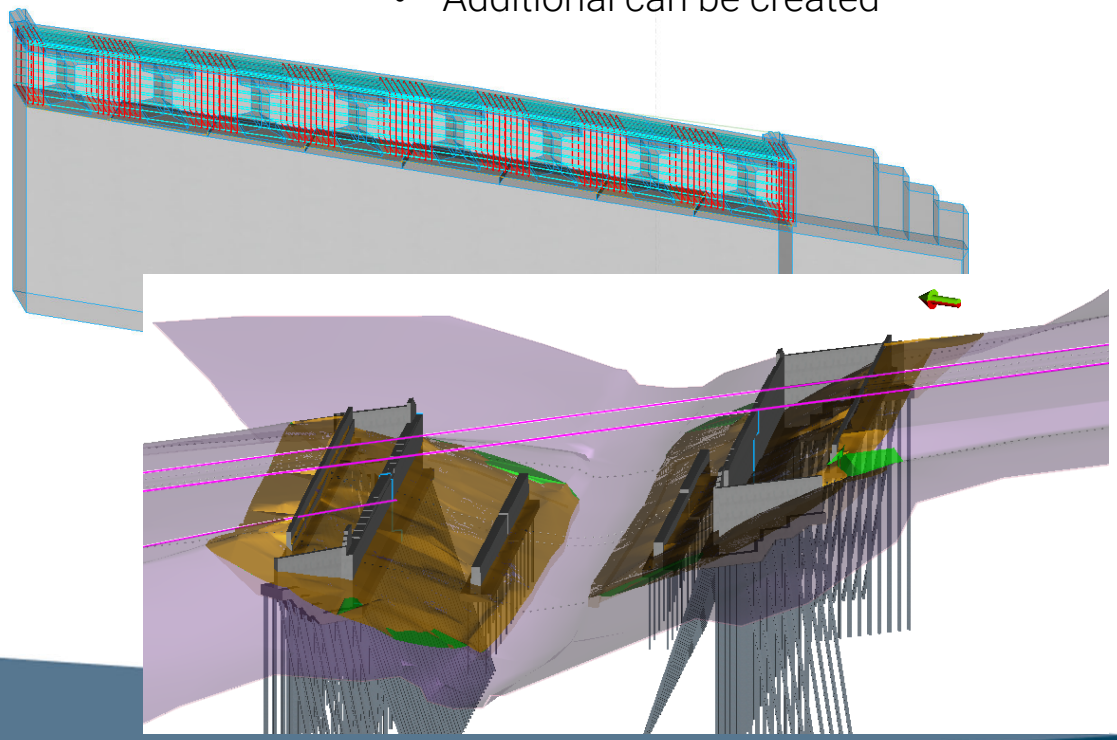
Saved Views

- 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 subst
1.07 Pile Layout	Plan view of pile layout including location of test piles (red circles arc
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 t
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 the
WB_2.02 Abutment B View	Combine traditional plan and elevation views into an isometric of the
WB_2.03 Abutment A Section	Traditional abutment section view with reinforcement (perpendicular
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 re
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 al
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 str
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

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Model framework and documentation

- Model attributes
  - 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		

Supplemental Documents

CONTRACTUAL ITEMS

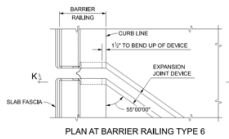
CONTRACTUAL MODEL FILES	FILE TYPE	DESCRIPTION
B01_63102_StructuresData.xlsx	EXCEL	SPREADSHEET WI
B01_63102_ReinforcementDetails.xlsx	EXCEL	SPREADSHEET WI
B01_63102_Quantities.xlsx	EXCEL	SPREADSHEET WI
B01_63102_ProjectSignature Sheet.xlsm	EXCEL	FILE LIST WITH DI

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

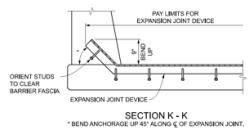
EB BOTTOM OF DECK ELEVATIONS

Beam		CL Bmg, Abut A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	CL Bmg, Abut. B
Dist. From CL Bmg, Abutment A (ft) *		0.00	10.49	20.98	31.47	41.95	52.44	62.93	73.42	83.91	94.40	104.89	115.38	125.86	136.35	146.84	157.33
I	Fascia	679.09	679.35	679.58	679.80	680.00	680.17	680.33	680.47	680.58	680.68	680.75	680.81	680.84	680.86	680.85	680.83
I	Right	679.64	679.89	680.13	680.35	680.54	680.72	680.88	681.01	681.13	681.22	681.30	681.35	681.39	681.40	681.40	681.37
J	Left	679.69	679.95	680.18	680.40	680.60	680.77	680.93	681.06	681.18	681.28	681.35	681.41	681.44	681.46	681.45	681.43
J	Right	679.74	680.00	680.23	680.45	680.65	680.82	680.98	681.11	681.23	681.33	681.40	681.46	681.49	681.51	681.50	681.48
K	Left	679.79	680.05	680.29	680.50	680.70	680.86	681.03	681.17	681.28	681.38	681.45	681.51	681.54	681.56	681.55	681.53
K	Right	679.84	680.10	680.34	680.55	680.75	680.93	681.08	681.22	681.33	681.43	681.50	681.56	681.59	681.61	681.60	681.58
L	Left	679.90	680.15	680.39	680.61	680.80	680.98	681.13	681.27	681.39	681.48	681.56	681.61	681.65	681.66	681.66	681.63
L	Right	679.95	680.20	680.44	680.66	680.85	681.03	681.18	681.32	681.44	681.53	681.61	681.66	681.70	681.71	681.71	681.68
M	Left	680.00	680.26	680.49	680.71	680.91	681.08	681.24	681.37	681.49	681.59	681.66	681.72	681.75	681.77	681.76	681.74
M	Right	679.99	680.25	680.48	680.70	680.89	681.07	681.23	681.36	681.48	681.57	681.65	681.70	681.74	681.76	681.75	681.72
N	Left	679.87	680.12	680.35	680.56	680.76	680.93	681.09	681.22	681.34	681.43	681.51	681.57	681.61	681.63	681.63	681.60
N	Right	679.76	680.01	680.24	680.45	680.65	680.82	680.97	681.11	681.23	681.32	681.40	681.46	681.49	681.51	681.51	681.49
O	Left	679.64	679.89	680.13	680.34	680.54	680.72	680.88	681.01	681.13	681.23	681.31	681.38	681.42	681.44	681.44	681.42
O	Right	679.44	679.70	679.93	680.15	680.35	680.53	680.69	680.83	680.95	681.06	681.14	681.20	681.25	681.27	681.27	681.26
P	Left	679.24	679.51	679.75	679.98	680.19	680.38	680.54	680.69	680.82	680.92	681.01	681.08	681.12	681.15	681.16	681.15
P	Right	679.04	679.31	679.56	679.78	679.99	680.18	680.34	680.49	680.62	680.73	680.81	680.88	680.93	680.95	680.96	680.95
Q	Left	678.84	679.12	679.38	679.62	679.83	680.03	680.20	680.35	680.49	680.60	680.69	680.76	680.81	680.84	680.85	680.84
Q	Right	678.64	678.92	679.18	679.42	679.63	679.83	680.00	680.16	680.29	680.40	680.49	680.56	680.61	680.64	680.65	680.64
R	Left	678.45	678.74	679.01	679.25	679.48	679.68	679.86	680.02	680.16	680.28	680.37	680.45	680.50	680.53	680.54	680.52
R	Right	678.25	678.54	678.80	679.05	679.28	679.48	679.66	679.82	679.96	680.08	680.17	680.24	680.30	680.33	680.34	680.32

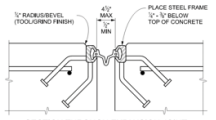
EXPANSION JOINT DETAILS



PLAN AT BARRIER RAILING TYPE 6

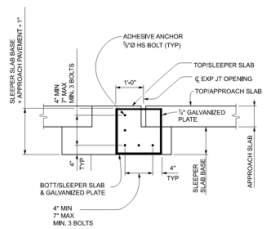


SECTION K - K
* BEND ANCHORAGE UP 45° ALONG ℄ OF EXPANSION JOINT.



SECTION THROUGH EXPANSION JOINT

END PLATE DETAILS



END PLATE DETAIL
(SLEEPER SLAB WITH APPROACH SLAB/PAVEMENT)

EXPANSION JOINT TABLE

Structure Number	Angle of Crossing	Location of Joint	Min. Tot. Travel Along Centerline of Bridge	Required Length of Expansion Joint Device
B01-3 of 63102	55	E Sleeper Slab	1"	104'- 7 1/2"
B01-4 of 63102	55	E Sleeper Slab	1"	74'- 3 1/2"

Structure Number	Size
B01-3 of 63102	1'-9" X 1'-9"
B01-4 of 63102	1'-9" X 1'-9"

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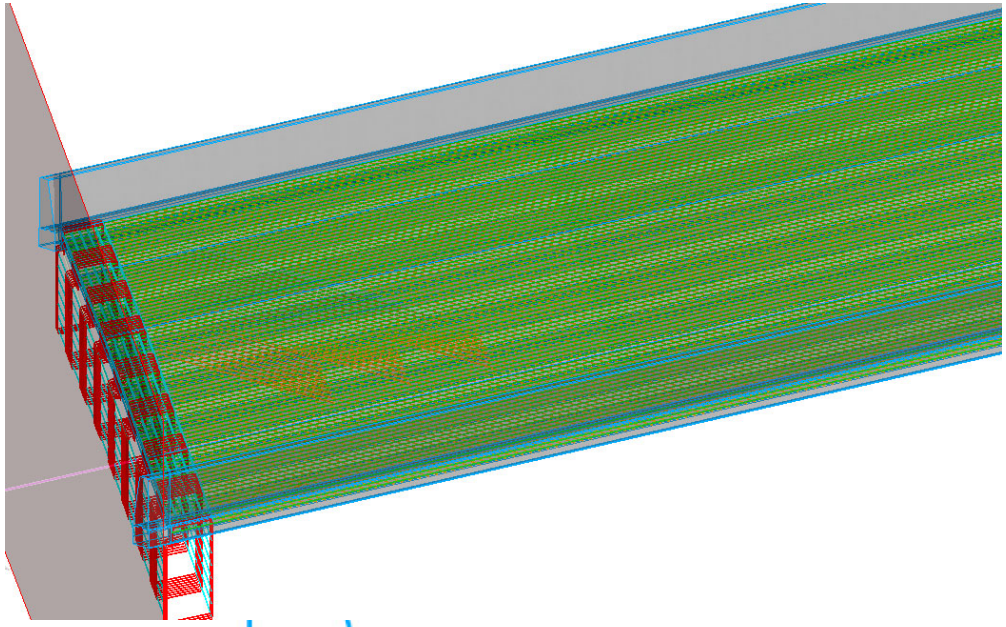
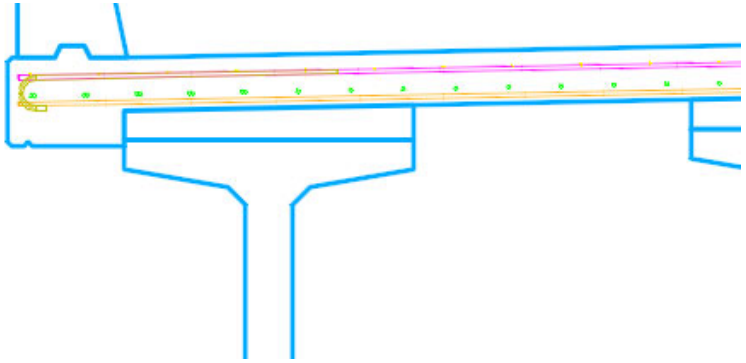
Reinforcement

- Can be exported to .ifc
- Fully accurate for conflict mitigation.
- In separate files to allow for concurrent work.





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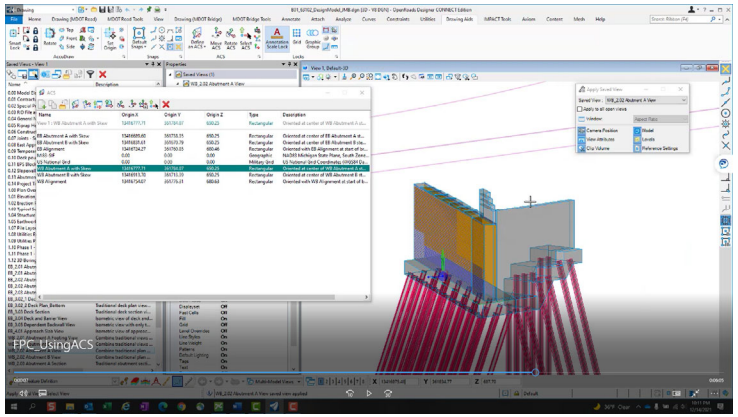
Guidance and Training

- Training Video
  - Short demonstration and instruction
  - Tool or task-specific
- Contractor Sessions



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Contractor Training

Pre-Bid Meeting

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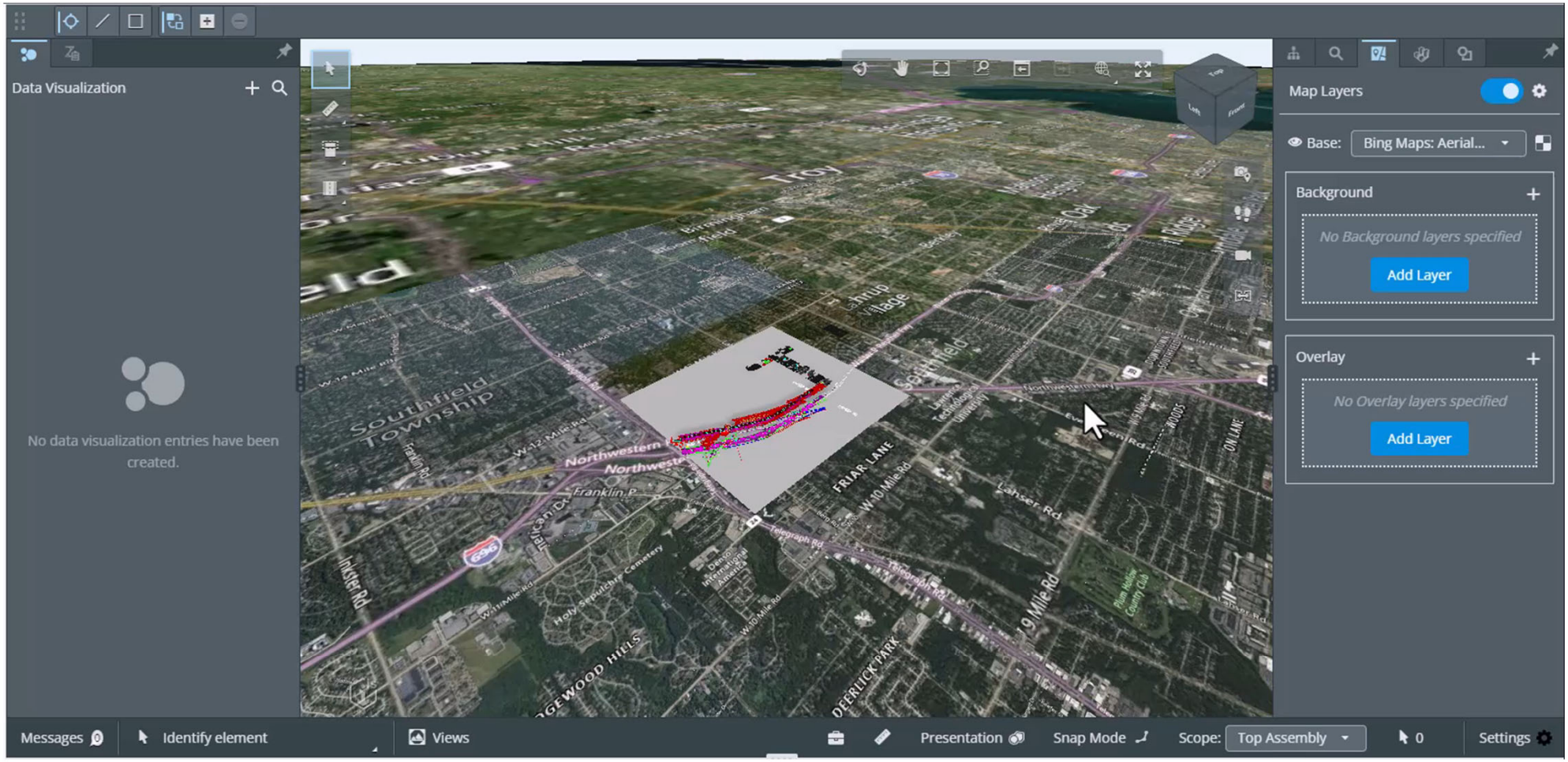

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QUESTIONS?

MDOT Michigan Department of Transportation

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