



# Advancing Digital Delivery at the Vermont Agency of Transportation



February 07, 2025

# Presenting today



**Andrew Lemieux, P.E.**



**Jeff Bachiochi, P.E.**

An aerial photograph of a complex highway interchange, likely Exit 17 on I-89 in Colchester, New Hampshire. The image is overlaid with a semi-transparent green filter. The text is centered over the image.

The Vermont Agency of Transportation (VTrans) leveraged the I-89 Exit 17 Interchange project - *Colchester NH 028-1(31)* - to advance digital delivery at the Agency with the development of a robust ORD Workspace and a fully 3D Model for use in construction.

# Agenda

- **Background**
  - 3D Modelling / Digital Delivery at VTrans
  - Colchester Exit 17 project
- **ORD Workspace Development**
- **Use of 3D Model in Construction**
- **Next Steps for VTrans**
- **iTwin Demo**

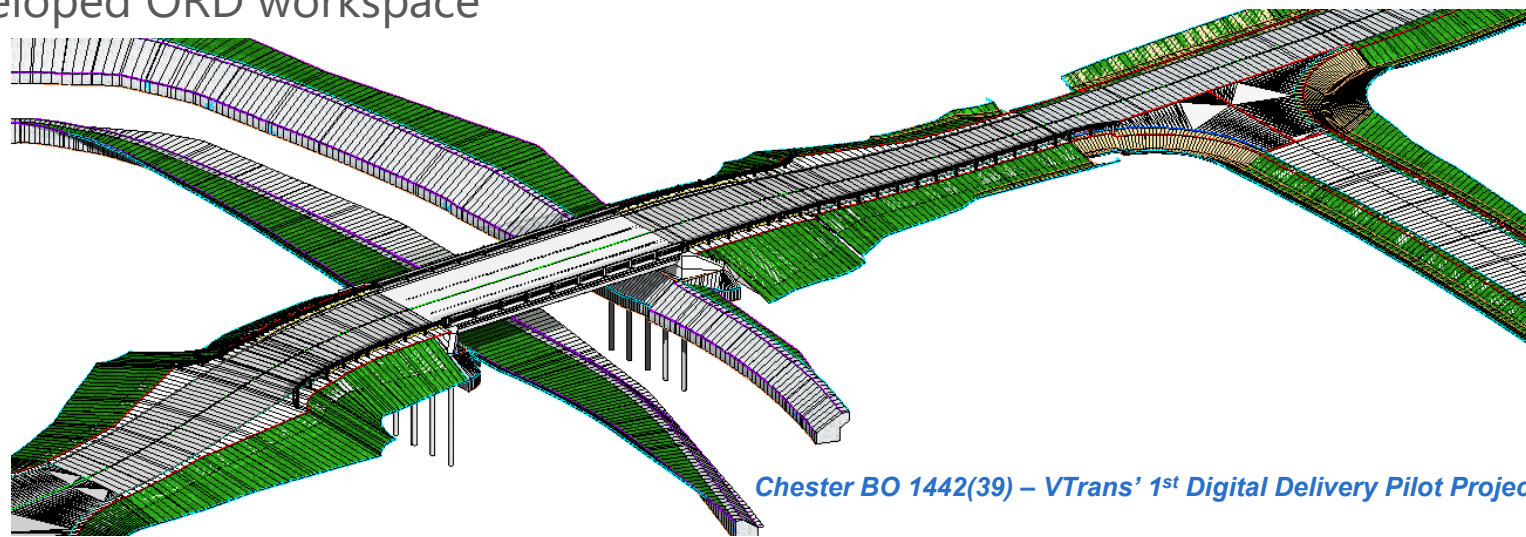
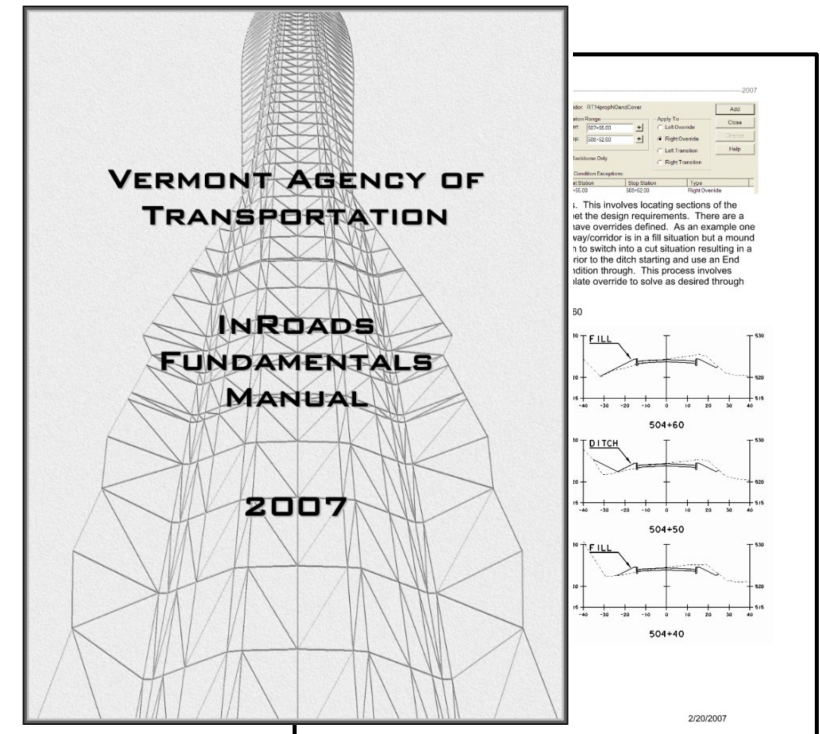


An aerial photograph of a complex highway interchange, including a bridge and several ramps, overlaid with a semi-transparent green filter. The word "Background" is centered in white text.

# Background

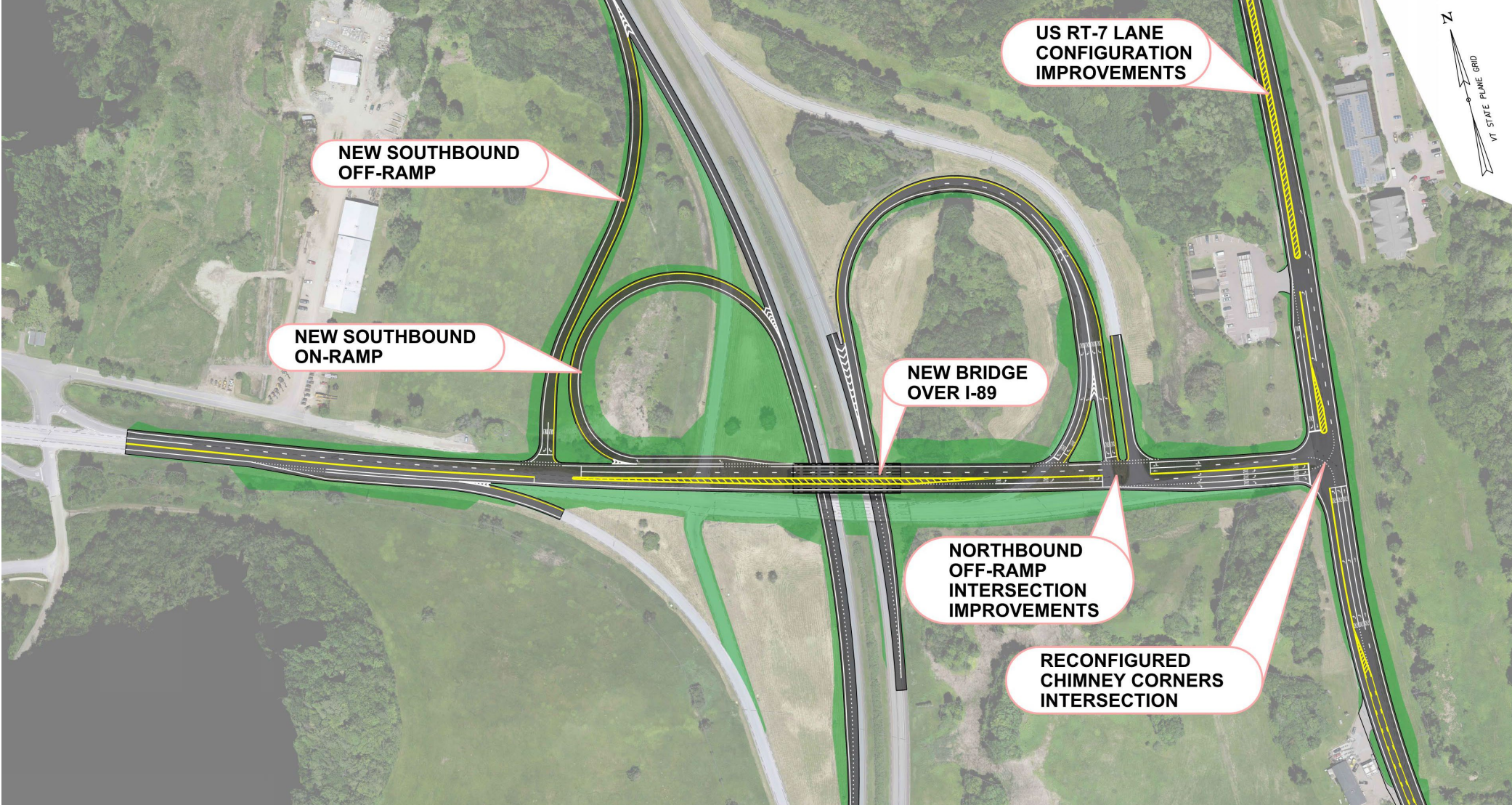
# VTrans Digital Delivery

- Pre-2020: MicroStation v8i SS10 / InRoads
- 2020: OpenRoads Designer CE adopted
  - 1<sup>st</sup> gen ORD Workspace developed under the *Benson STP 017-1(17)* project
- 2020: **Chester BO 1442(39)** project identified as a MALD pilot project
  - iTwin Design Review (2022)
- 2021: est. Digital Delivery Working Group
  - Identified the need for a more developed ORD workspace



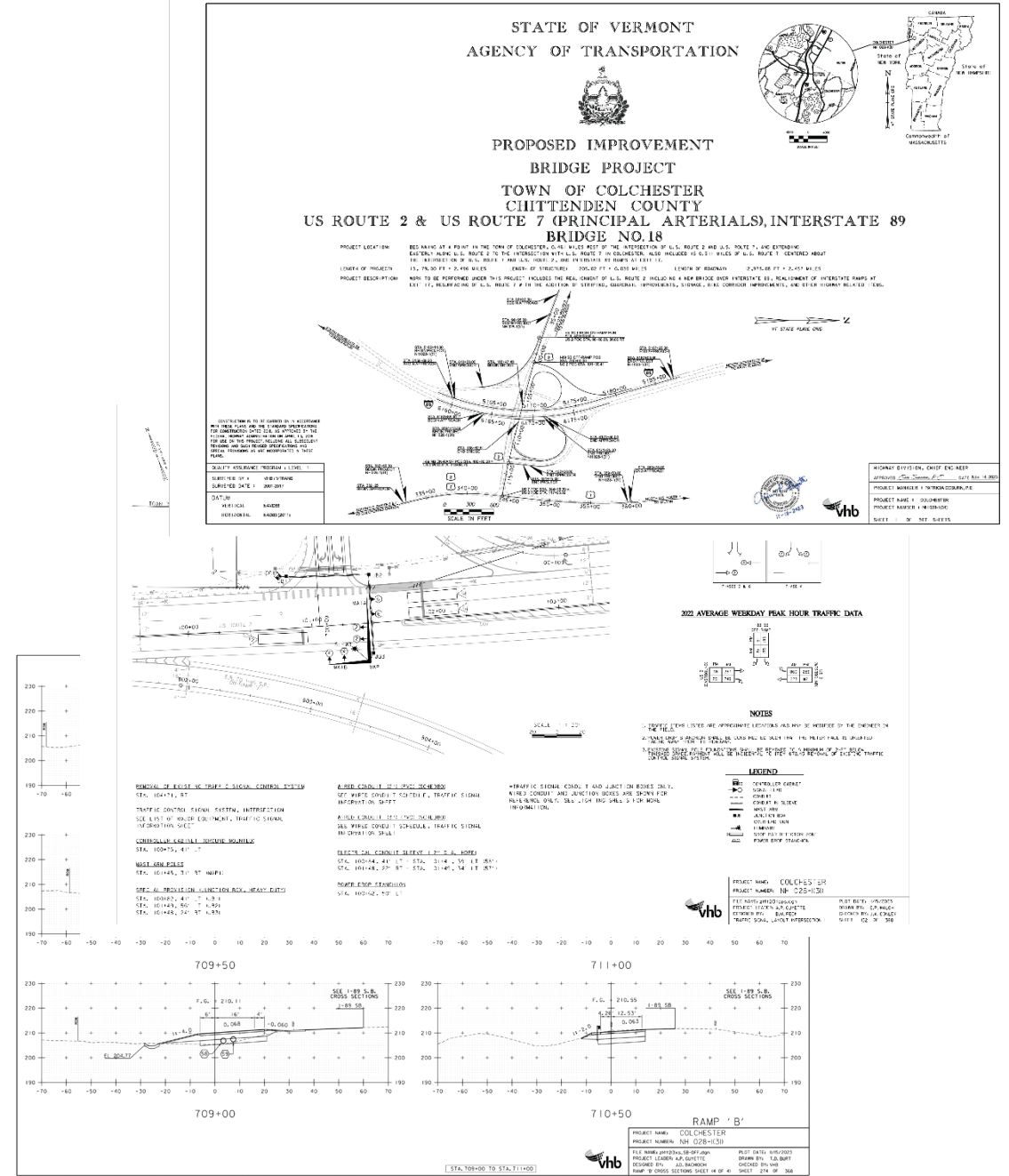
Chester BO 1442(39) – VTrans' 1<sup>st</sup> Digital Delivery Pilot Project

# Colchester NH 028-1(31) - Exit 17



# Background

- Colchester NH 028-1(31) – Exit 17
- 2016: Design begins with MicroStation & InRoads v8i
- 2016-2022: Preliminary/Final Design and ROW Acquisition
- 2022: Colchester NH 028-1(31) project identified as pilot project
  - 2D Contract Plans
  - 3D Model for reference
- 2023: ORD Workspace & 3D Model
- 2024: Construction Began





An aerial photograph of a complex highway interchange, likely at O'Hare International Airport (ORD), is shown with a semi-transparent green overlay. The image features multiple levels of overpasses and ramps, with yellow lines highlighting specific lanes or paths. The text 'VTrans ORD Workspace Development' is centered over the image in a white, sans-serif font.

# VTrans ORD Workspace Development

# VTrans ORD Workspace

- VTrans ORD Workspace was **overhauled**
  - Teamed with EnvisionCAD for development
  - Tested by VHB and VTrans
  - Reviewed by Bentley
- Bi-Weekly VTrans Working Group Meetings
  - VTrans (Structures, Roadway, Traffic)
  - Consultants
- Test workspace deployed through Sharepoint so updates were pushed out to testing team in real time
- **Workspace needed to support ongoing pilot projects AND the future of digital delivery at VTrans**



# VTrans ORD Workspace

- Feature Definitions and Annotations
  - VTrans\_Road.dgnlib
  - VTrans\_Drainage.dgnlib
  - VTrans\_Uilities.dgnlib
  - VTrans\_Survey.dgnlib
- Template Library (.itl)
- Civil Cells
  - Guardrail End Terminals
  - Skewed Bridge Approach
  - Driveways
- 3D Cells (Traffic, Lighting)
- Item Types & Report Definitions

The screenshot displays the VTrans ORD Workspace interface. On the left, a tree view shows the project structure under 'VTransPayItems', including 'Estimate Category', 'Pay Item - Barrier', and 'Pay Item - Bridge Rail'. Below this is a 'Reports' window with a 'Utilities' section containing folders for 'IPD Report Drainage', 'IPD Report Roadway', and 'IPD Report Utilities'. The main area shows a 3D view of a roadway with a toolbar and a 'Properties' window. The 'Properties' window displays 'Elements (1)' and 'TYPE IVS'. A 'Roadway Pay Items' window is open, showing a table of 11 items with columns for Item Number, Item Quantity, Item Description, and Estimate Category. Below the table is a 'Station Offset From Corridor' section with details for 'I-89 EB to SB On-Ramp A'.

Item Number	Item Quantity	Item Description	Estimate Category
	4.870 ft (US Survey)		1011
301.1500	742.224 ft (US Survey)	Subbase Of Gravel	1011
301.2600	698.513 ft (US Survey)	Subbase Of Crushed Gravel, Fine Graded	1011
312.5100	8.960 ft (US Survey)	Emulsified Asphalt For FDR, Emulsion	1011
402.1200	26.142 ft (US Survey)	Aggregate Shoulders	1011
404.65	4.870 ft (US Survey)	Emulsified Asphalt	1011
404.1100	13.246 ft (US Survey)	Tack Coat, Emulsified Asphalt	1011
406.35	363.889 ft (US Survey)	Superpave Bituminous Concrete Pavement	1011
406.0310	213.546 ft (US Survey)	Bituminous Concrete Pavement, Type IIIS, QA Tier I	1011
651.1500	31.000 ft (US Survey)	Turf Establishment, General Seed	1011
651.3500	111.526 ft (US Survey)	Topsoil	1011

**Station Offset From Corridor**

Start Alignment Corridor	I-89 EB to SB On-Ramp A
Start Station Corridor	800+00.000 [I-89 EB to SB On-Ramp A]
Start Offset Corridor	0.00 Lt.
End Station Corridor	803+25.000 [I-89 EB to SB On-Ramp A]
End Offset Corridor	0.00 Lt.

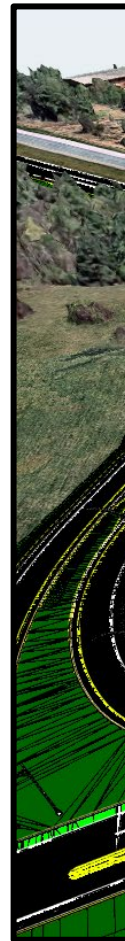
A 3D architectural rendering of a highway interchange under construction. The model shows multiple lanes of road, overpasses, and ramps, all highlighted in a light yellow color. The surrounding terrain is rendered in shades of green and brown, with some trees and buildings visible in the background. The text is centered over the model.

# Colchester Exit 17 3D Model in Construction

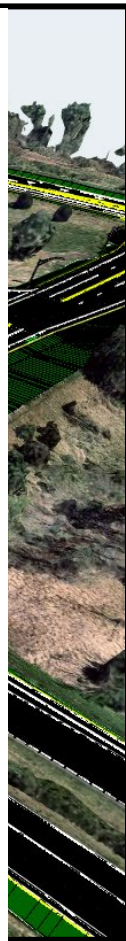
# Use of 3D Model in Construction

## What we delivered

- Design files
  - ORD & OBM 3D models (dgn)
  - Alignments (xml)
  - Surfaces (xml)
  - Index of files
- Access to iModel
  - SYNCHRO Control
  - SYNCHRO Field



Z14t213_Existing.dgn	Description	Includes
z14t213_og.dgn	Original Ground Terrain Model	
z14t213sv.dgn	Ground Survey Basemap	
z14t213_Ex_Util_US-2	3D Existing overhead utility poles - US-2	Poles (no wires)
z14t213_Ex_Util_US-7	3D existing overhead utility poles - US-7	Poles (no wires)
<b>z14t213_Bridge.dgn</b>		
z14t213_OBD.obdx	OpenBridge Designer File	
z14t213_bridge.dgn	Bridge Concrete and Substructure Elements	Deck, Barriers, Approach Slabs, Moment Slabs, Substructures with Piles, Bearings and Girder Leveling Assemblies
z14t213_sup.dgn	Steel Superstructure Elements	Haunch and Shear Connectors
z14t213_deck.dgn	Deck Reinforcing	
z14t213_deckpanels.dgn	Deck Panels with Reinforcing	
z14t213deck_end.dgn	Deck Reinforcing at Ends	
z14t213railing.dgn	Bridge Railing Reinforcing	
z14t213_abut1.dgn	Abutment No. 1 Reinforcing	
z14t213_abut2.dgn	Abutment No. 2 Reinforcing	
z14t213_appslab1.dgn	Approach Slab No. 1 Reinforcing	
z14t213_appslab2.dgn	Approach Slab No. 2 Reinforcing	
z14t213_momslab1.dgn	Moment Slab No. 1 Reinforcing	
z14t213_momslab2.dgn	Moment Slab No. 2 Reinforcing	
z14t213_momslab3.dgn	Moment Slab No. 3 Reinforcing	
z14t213_momslab4.dgn	Moment Slab No. 4 Reinforcing	
z14t213_pier.dgn	Pier Reinforcing	
z14t213_mse_east.dgn	MSE Walls at Abutments	
z14t213_mse_west.dgn		
<b>z14t213_Roadway.dgn</b>		
z14t213_geom_[road].dgn	Roadway Alignment Geometry	
z14t213_corr_[road].dgn	Roadway Models - Corridors	Pavement, Subbase, Sand, Curb, Aggregate Shoulder, Stone Fill, Topsoil and Turf
z14t213_intersect_[road].dgn	Roadway Models - Intersections	



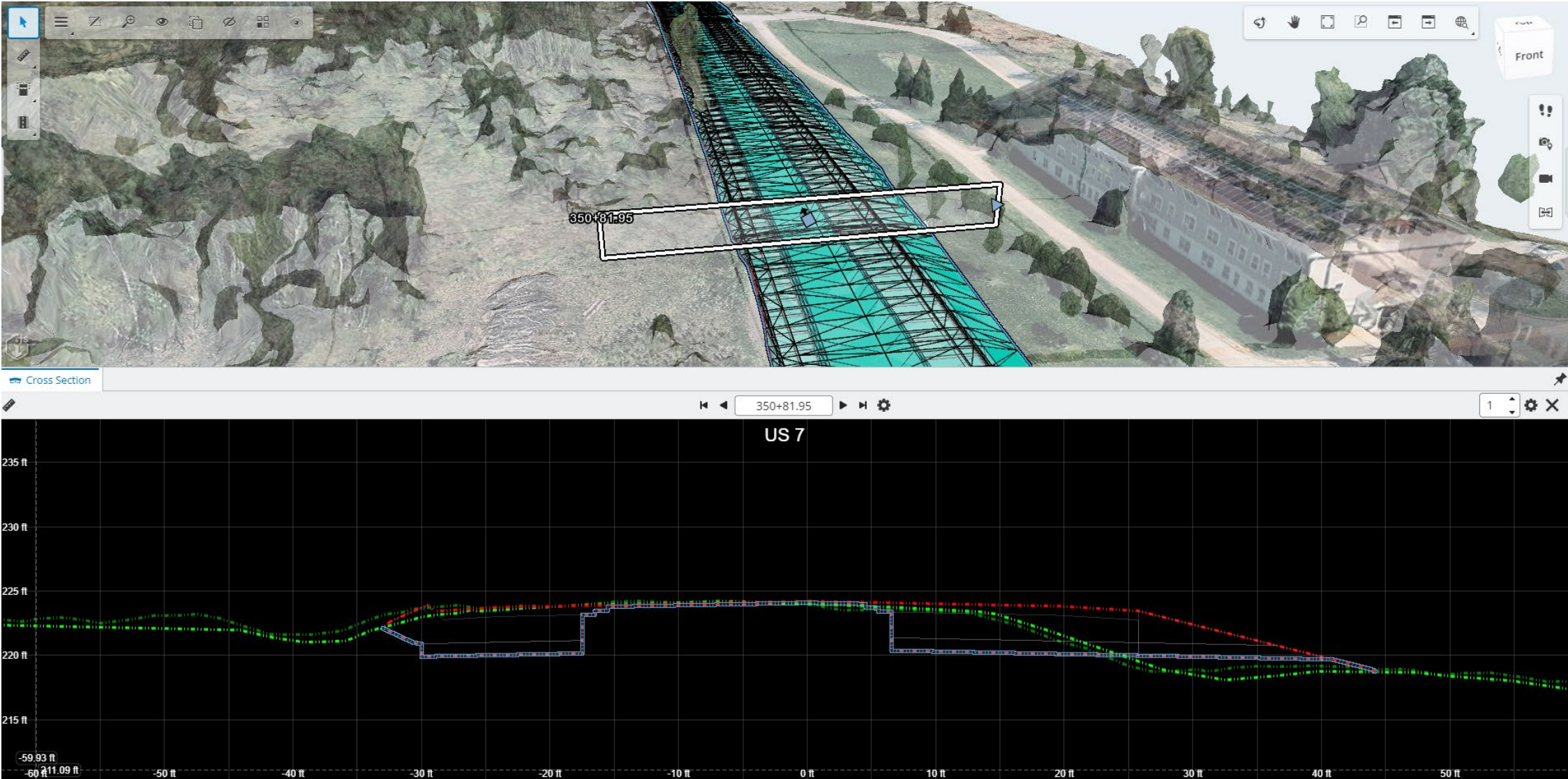
# Use of 3D Model in Construction

## How it was used

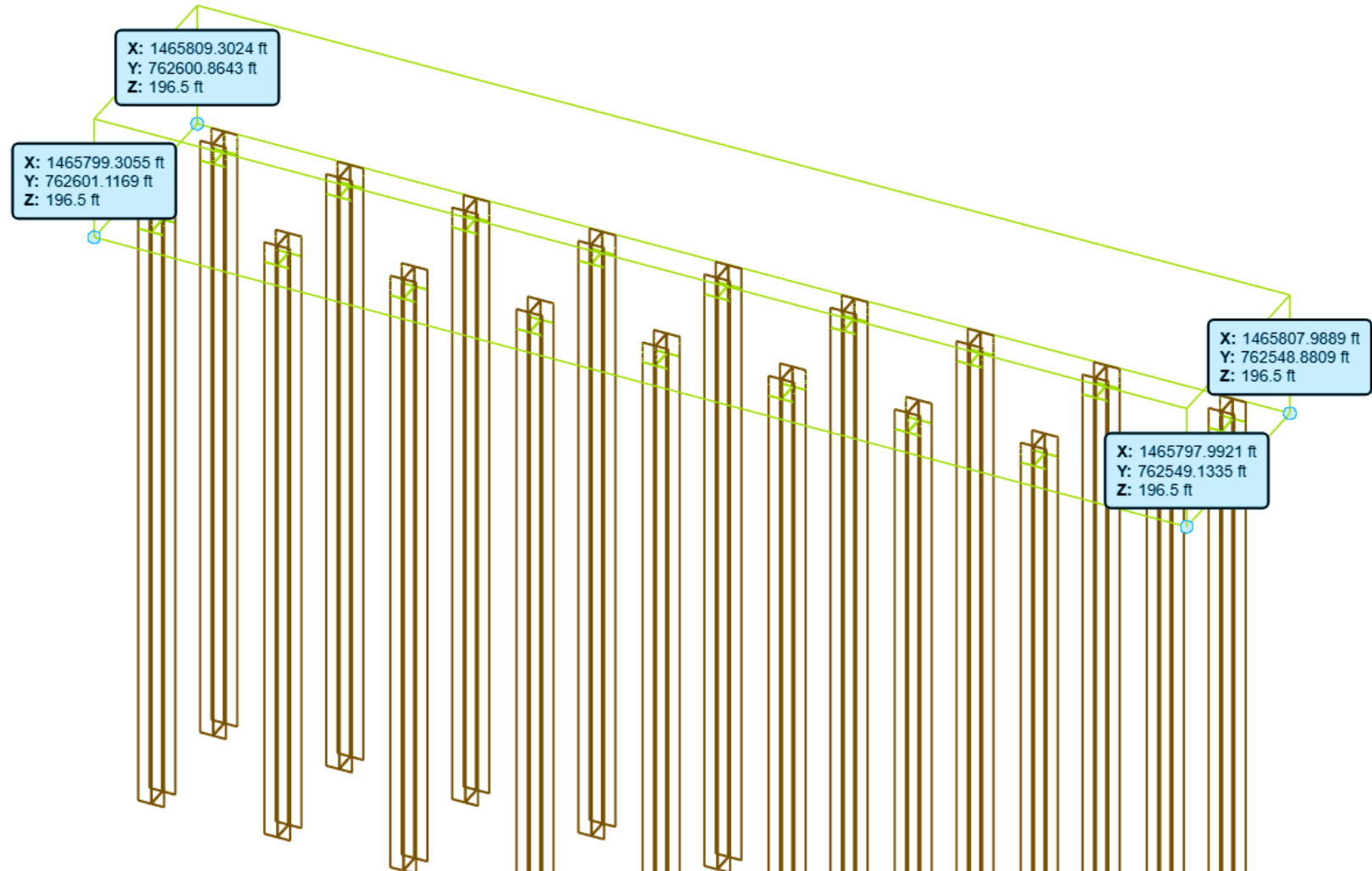
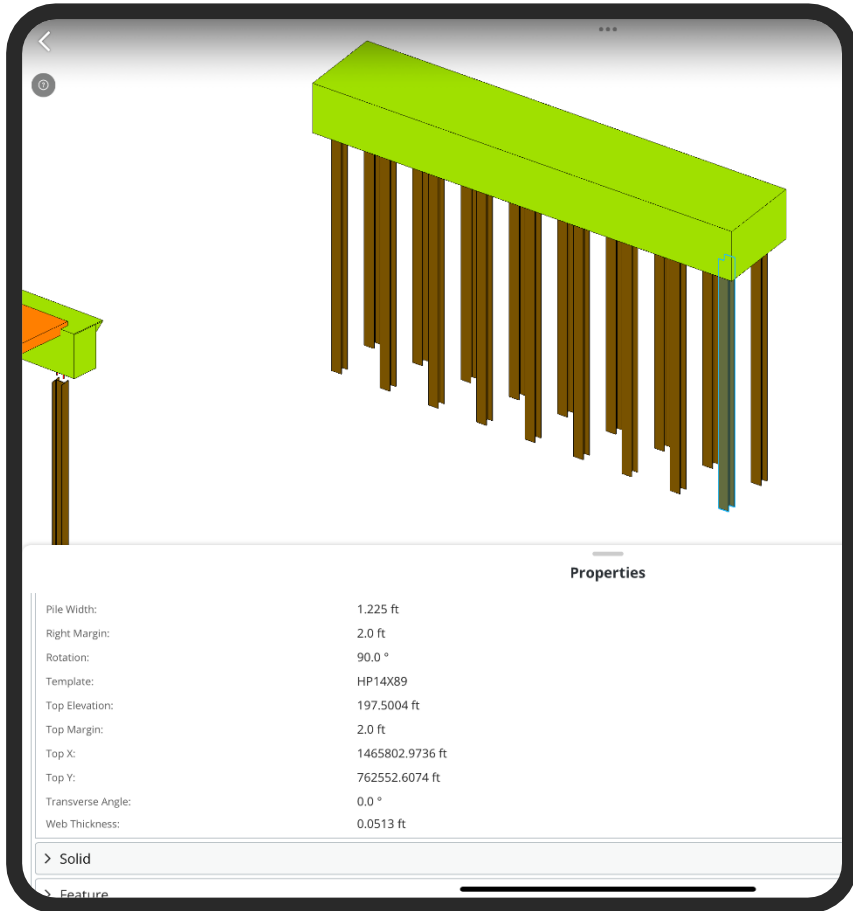
- Top & Subgrade Surfaces for AMG
- Layout of Substructure
- Visualize Reinforcing Steel
- Calculate Rebar & Concrete Volumes
- Layout of select backfill materials
- Create Saved Views for communication with field staff
  - SYNCHRO Control → SYNCHRO Field



# Surfaces for AMG



# Layout of Substructure





# Rebar Visualizations

The image displays a software interface for rebar visualization. On the left, a 'Data Visualization' panel lists various rebar elements with their respective colors and counts. The central area shows a 3D model of a rebar structure, with a vertical section highlighted in green. On the right, a 'Properties' panel provides detailed information for the selected 'Rebar element 10:40B [4-63D]'. The properties are organized into sections: 'Selected Item(s)', 'Source Information', and 'Rebar Properties'. The 'Rebar Properties' section includes details for 'RebarSet' and 'RebarShape'.

**Data Visualization Panel:**

- Rebar element 10:40B (130)
- Rebar element 14:40B (20)
- Rebar element 5:40B (1020)
- Rebar element 5:60E (84)
- Rebar element 5:60G (4792)
- Rebar element 6:40B (695)
- Rebar element 6:60B (24)
- Rebar element 6:60G (3793)
- Rebar element 7:40B (138)
- Rebar element 7:60B (1)
- Rebar element 7:60G (700)
- Rebar element 8:60G (124)
- Rebar element 9:40B (152)
- Rebar element 9:60E (149)

**Properties Panel:**

Rebar element 10:40B [4-63D]  
Rebar

**Selected Item(s)**

Category: OBM\_Stiffeners  
Model: Master Model  
User Label: Rebar element 10:40B

**Source Information**

**Rebar Properties**

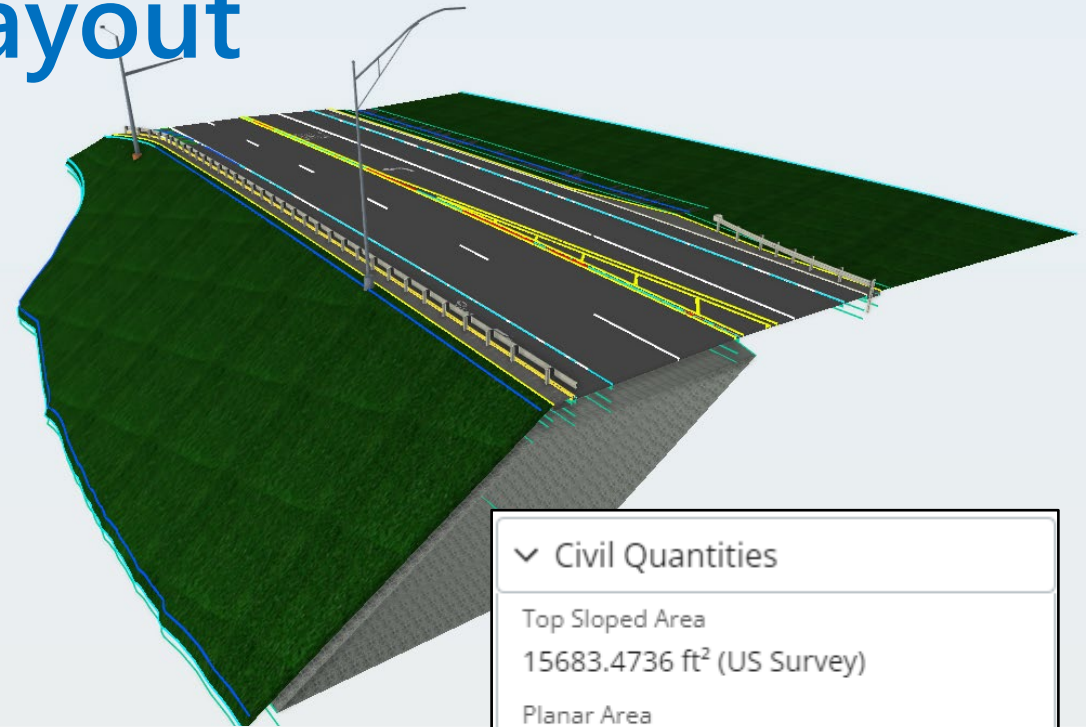
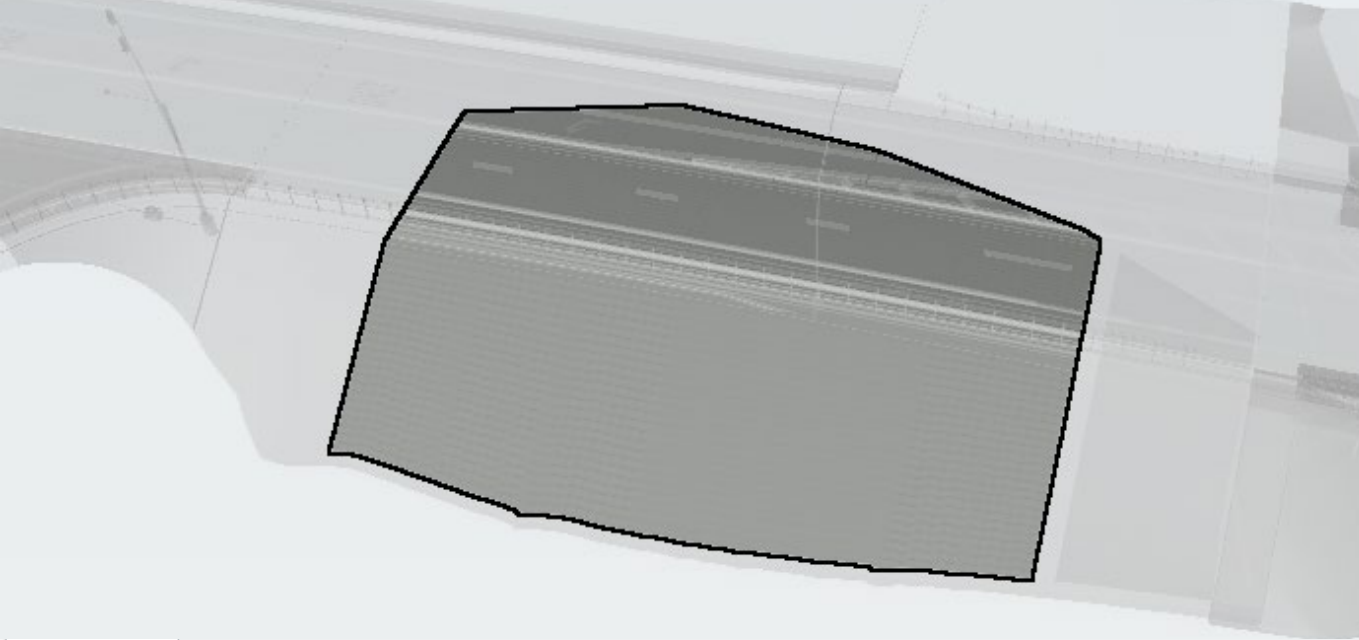
**RebarSet**

Layer:	Default
NominalSpacing:	0' 4 3/8"
Number:	14

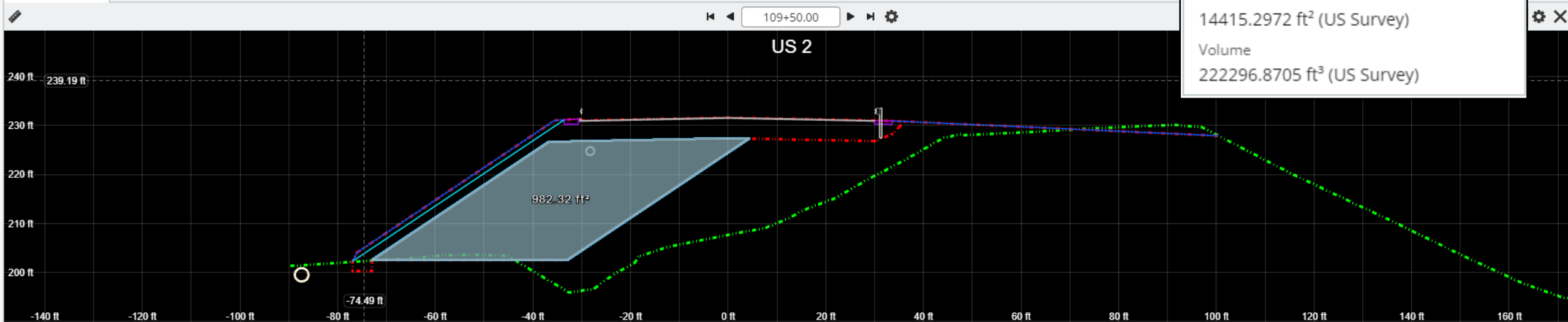
**RebarShape**

BarDiameter:	0' 1 1/4"
BarsBend:	True
Coating:	B
Grade:	40
IsStirrup:	False
Length:	27' 5"
NominalLength:	27' 5"
NumDevices:	0
NumDimensions:	0
SizeKey:	10:40B
Surface:	D
VarySetId:	0
Weight:	109.00

# Foamed Glass Backfill Layout



Civil Quantities	
Top Sloped Area	15683.4736 ft <sup>2</sup> (US Survey)
Planar Area	14415.2972 ft <sup>2</sup> (US Survey)
Volume	222296.8705 ft <sup>3</sup> (US Survey)



# Construction Continues



# Construction Continues



An aerial photograph of a complex highway interchange with multiple overpasses and ramps, overlaid with a semi-transparent green filter. The text "Lessons Learned & Next Steps" is centered in white.

# Lessons Learned & Next Steps

# Next Steps for VTrans

## Lessons Learned

- Walk before you run
- Bring everyone along together
  - Internal and external partners, all disciplines and departments
- Always upgrade to the latest software (ORD, OBM, iTwin)

## Next Steps

- VTrans Digital Delivery Working Group continues
  - Developing a 5-year road map
  - Need to learn how to review 3D Models
  - Need to learn how to navigate ROW and permitting
  - Looking to identify future pilot projects
  - ADCMS Grants



# Next Steps for VTrans

## Chester BO 1442(39) project final design MALD

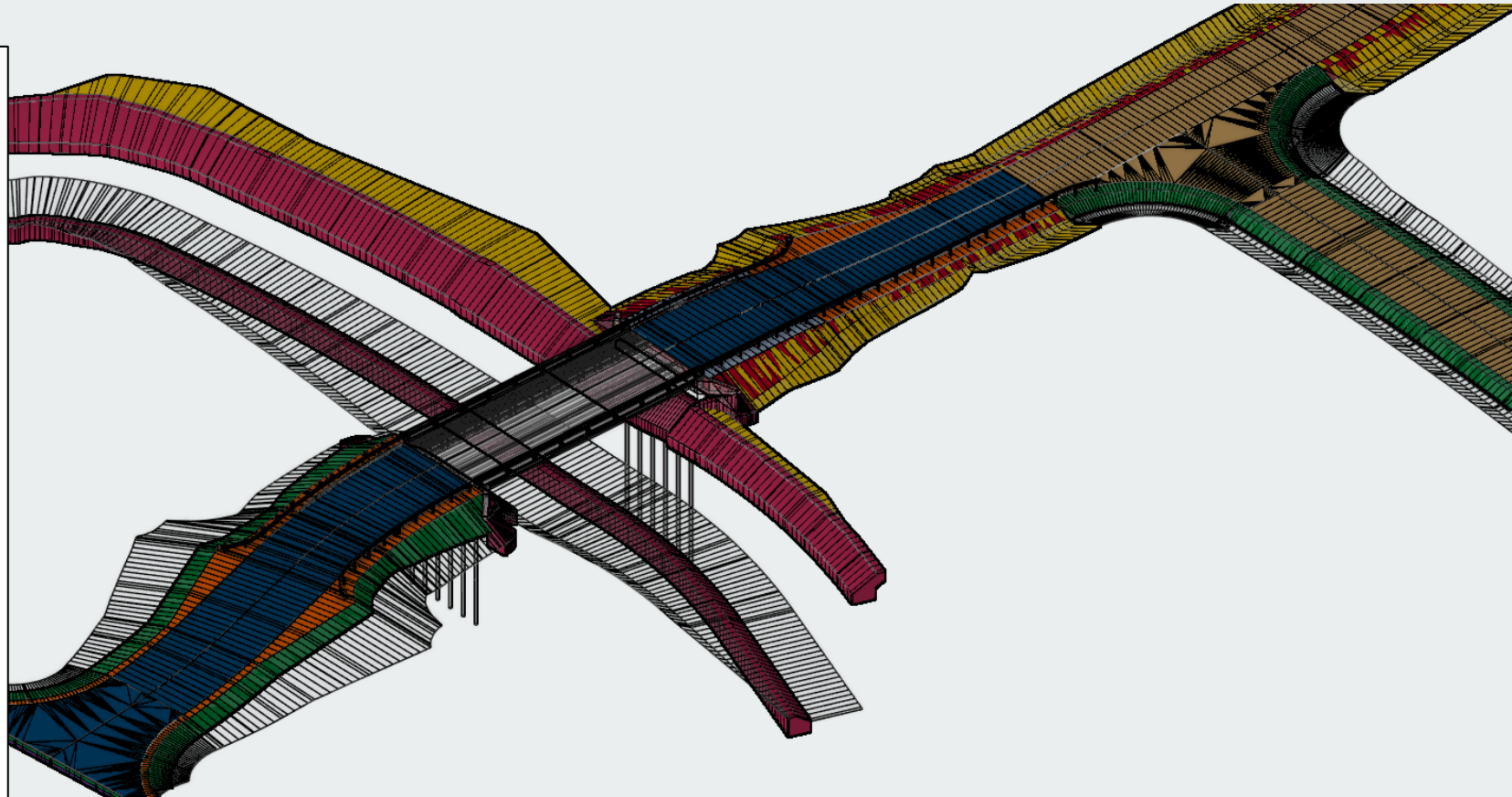
- Contractor Input During Design (2024)
- Construction (2026-2027)

### Data Visualization

⏪ All Items

👁️ 🔍 📏 🗨️ Display:

- > 👁️  Aggregate Shoulders (2)
- > 👁️  Aggregate Shoulders, RAP (9)
- > 👁️  Aggregate Surface Course (4)
- > 👁️  Bituminous Concrete Pavement, Type IIIS, QA Tier III (3)
- > 👁️  Bituminous Concrete Pavement, Type IIS, QA Tier III (3)
- > 👁️  Coarse-Milling, Bituminous Pavement (2)
- > 👁️  Sand Borrow (7)
- > 👁️  Stone Fill, Type I (2)
- > 👁️  Stone Fill, Type III (9)
- > 👁️  Subbase Of Dense Graded Crushed Stone (23)
- > 👁️  Subbase Of Gravel (13)
- > 👁️  Tack Coat, Emulsified Asphalt (6)
- > 👁️  Topsoil (51)



An aerial view of a complex highway interchange with multiple overpasses and ramps. The scene is overlaid with a semi-transparent green filter. The text 'iTwin Demo' is centered in white. 

# iTwin Demo

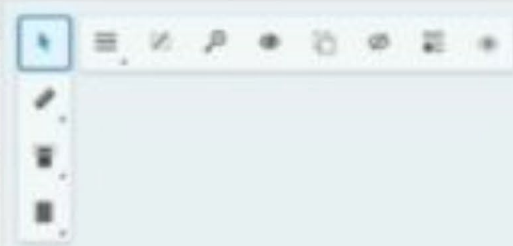


Data Visualization

Rebar Size, Grade & Coating

Display: Isolate

- Rebar element 10:40B (130)
- Rebar element 14:40B (20)
- Rebar element 5:40B (1020)
- Rebar element 5:60E (84)
- Rebar element 5:60G (4792)
- Rebar element 6:40B (655)
- Rebar element 6:60B (24)
- Rebar element 6:60G (3793)
- Rebar element 7:40B (138)
- Rebar element 7:60B (1)
- Rebar element 7:60G (700)
- Rebar element 8:60G (124)
- Rebar element 9:40B (152)
- Rebar element 9:60E (149)



Rebar element 5:60G [4-500]  
Rebar

Selected Item(s)

Category: PC\_REBAR  
Model: Master Model  
User Label: Rebar element 5...

Source Information

Source Elem...: 4771

Document Link

Code Value: 91505649-42A...  
Name: 214213\_mom...  
Path: <https://connect...>

Model Source

Name: 214213\_mom...  
Path: <https://connect...>

Rebar Properties

RebarSet

Layer: Default  
Num...: 0' 12"  
Num...: 7

RebarSh...

Bar Dia...: 0' 0 5/8"  
Bar ID...: False  
Bar No...: 24  
Coat...: G  
Grade: 60  
Iden...: False  
Length: 7' 8"



# Questions/Discussion



Andrew Lemieux, P.E.  
andrew.lemieux@vermont.gov



Jeff Bachiochi, P.E.  
jbachiochi@vhb.com