

TR20425 - Do You Cross the Bridge or Fade Away?

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About Me

- Used AutoCAD® since release 9
- Teaching since 2000
- Writing courseware since 2007
- Books are sold in 67 different countries



Class summary

This class will help you to explore preliminary bridge design options by using Bridge Design for InfraWorks 360 software to visualize realistic civil structures in the context of the surrounding proposed site. Then Structural Bridge Design software is used to analyze the bridge in the cloud. We run a line girder analysis to verify the structural strength of the bridge girders and ensure they meet design standard requirements. Next, we take the design into Navisworks software to uncover design problems and constructability issues more effectively and plan the construction sequencing. The Autodesk InfraWorks 360 model is taken into AutoCAD Civil 3D software for precise grading. Then we round-trip the model back into Autodesk InfraWorks 360 for better design communication. This session features Autodesk InfraWorks 360, AutoCAD Civil 3D, and Navisworks Manage.

Key learning objectives

At the end of this class, you will be able to:

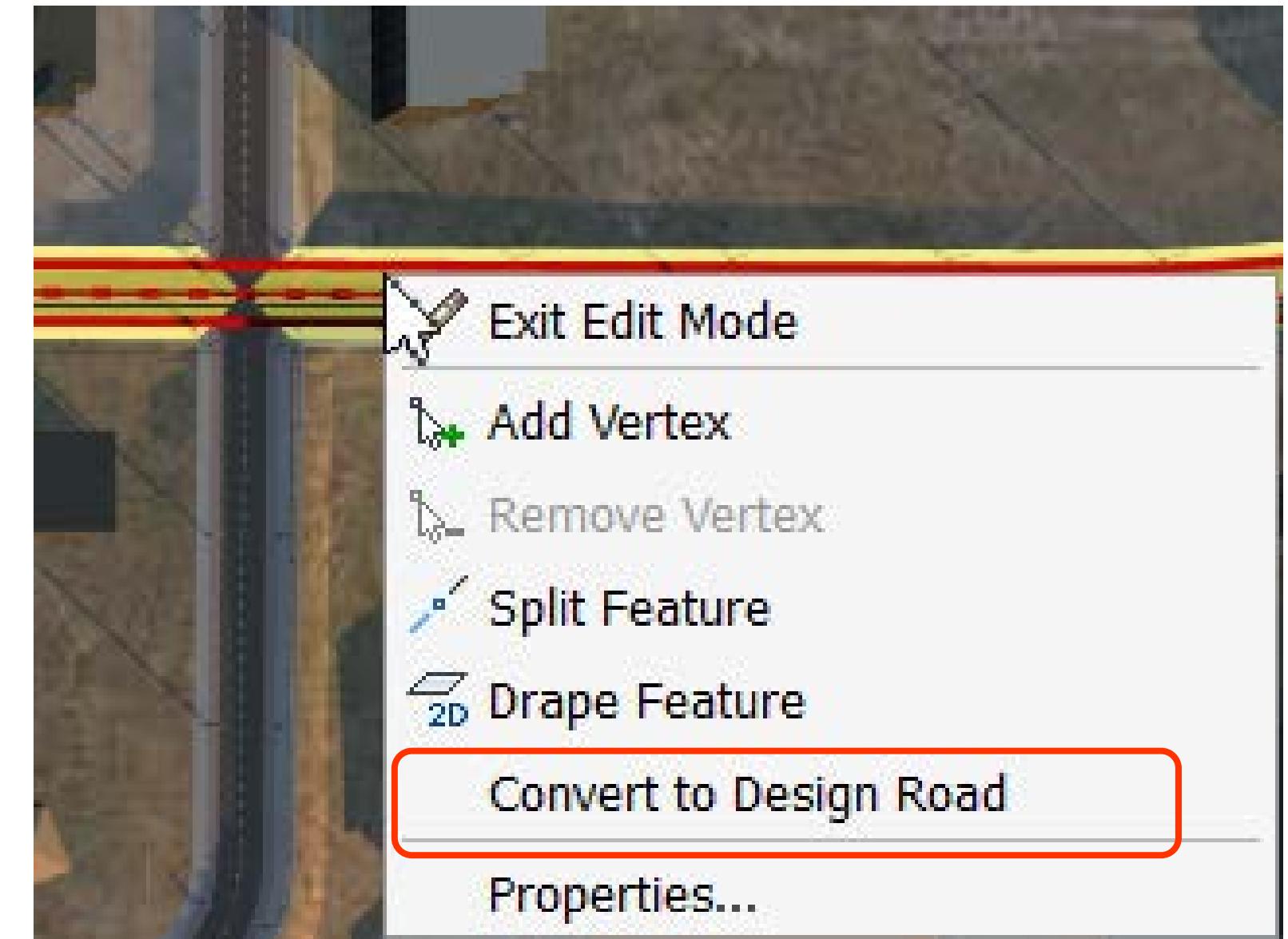
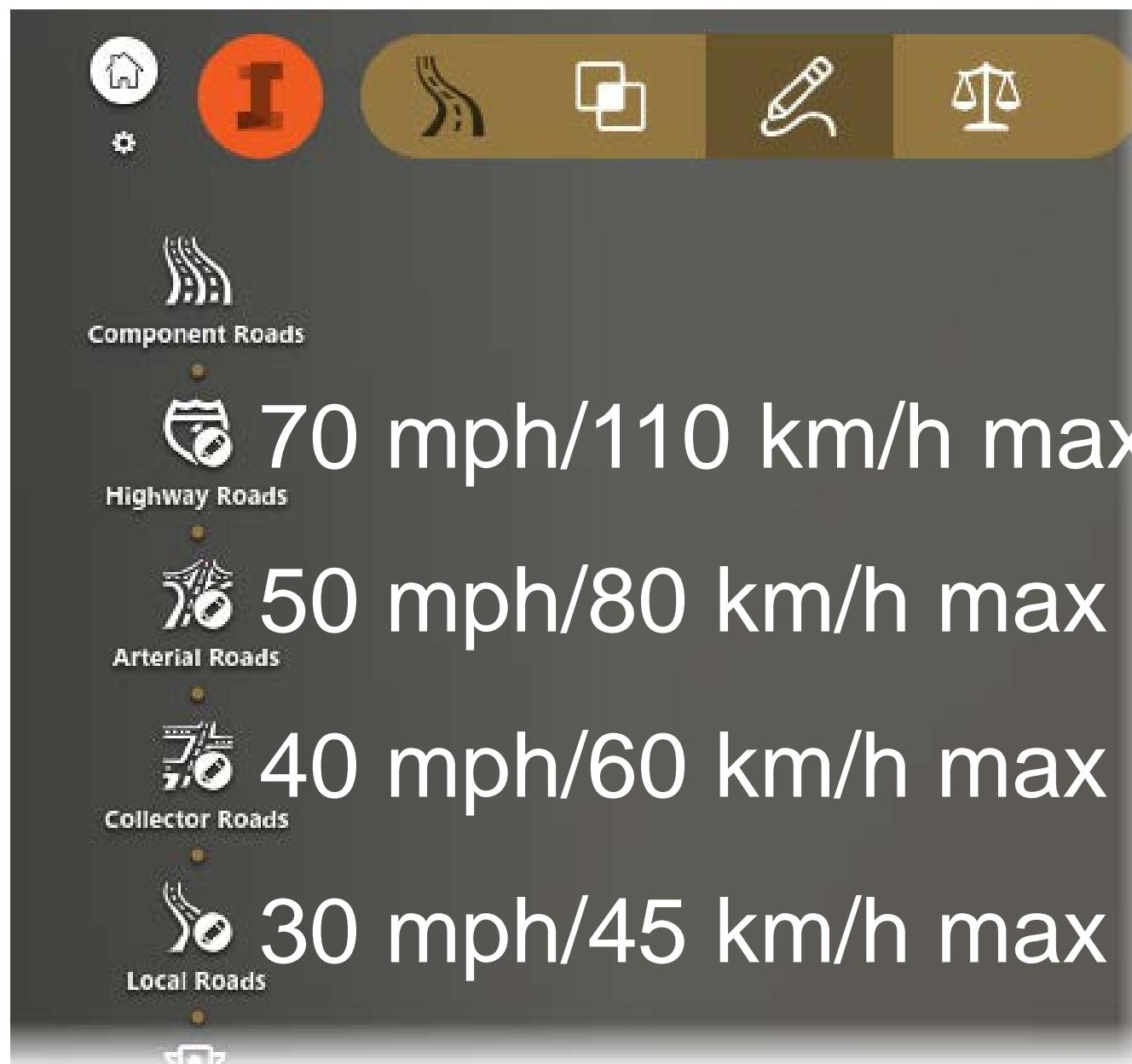
- Create engineered roads of the proposed design.
- Add bridges to design roads using Bridge Design for InfraWorks 360.
- Verify the structural strength of the bridge girders.
- Incorporate design changes from AutoCAD Civil 3D



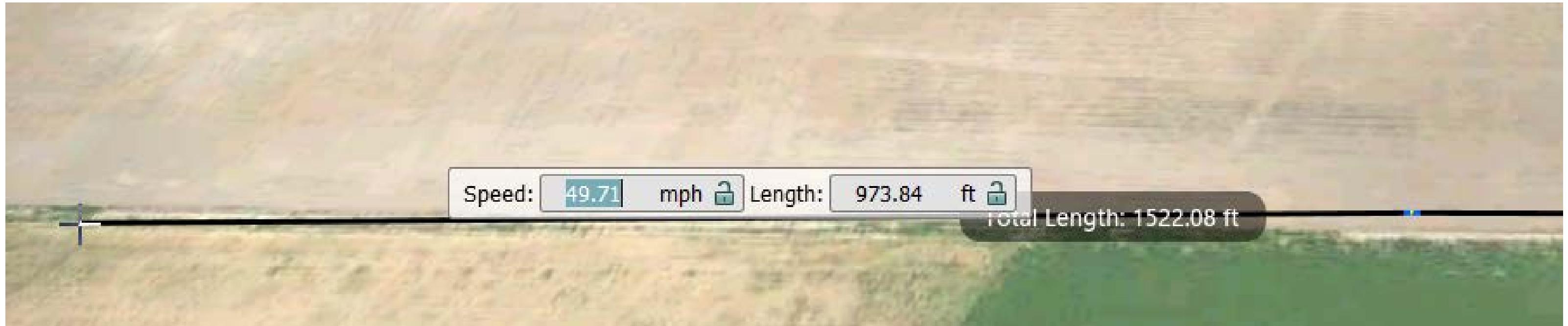
Create Engineered Roads of the Proposed Design

Road Types

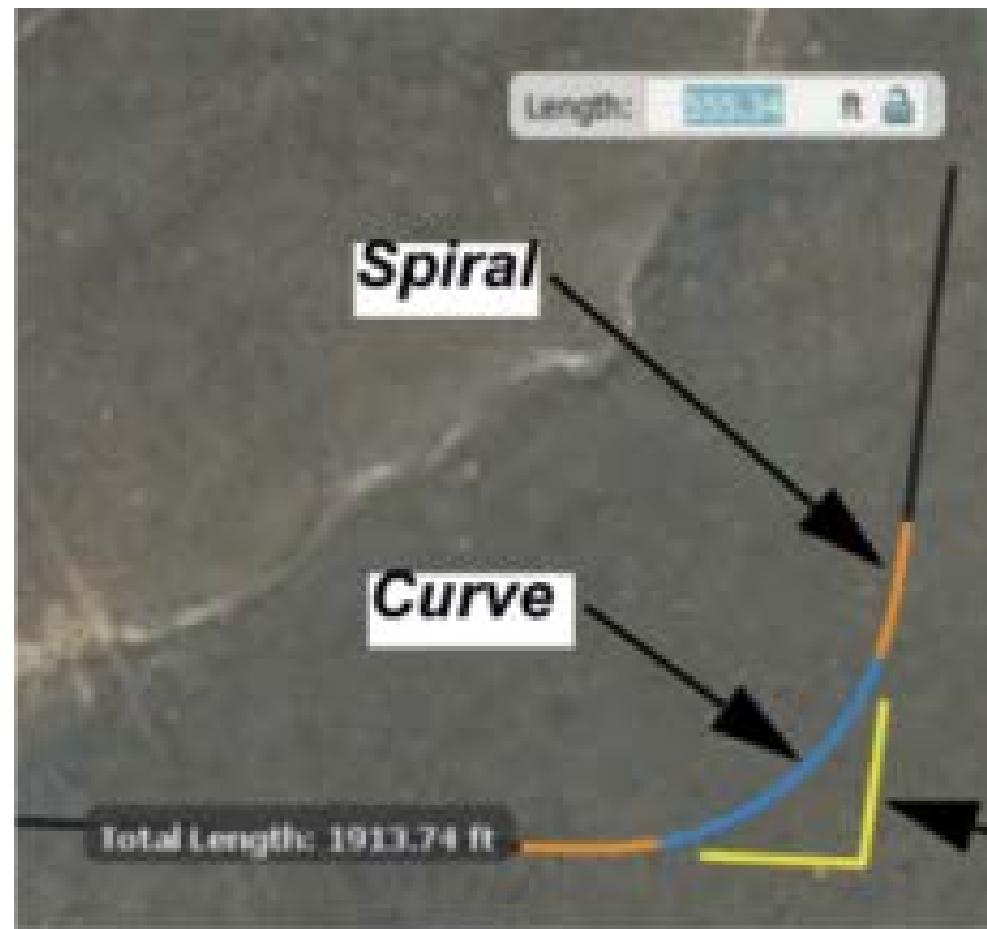
In Canvas Tools



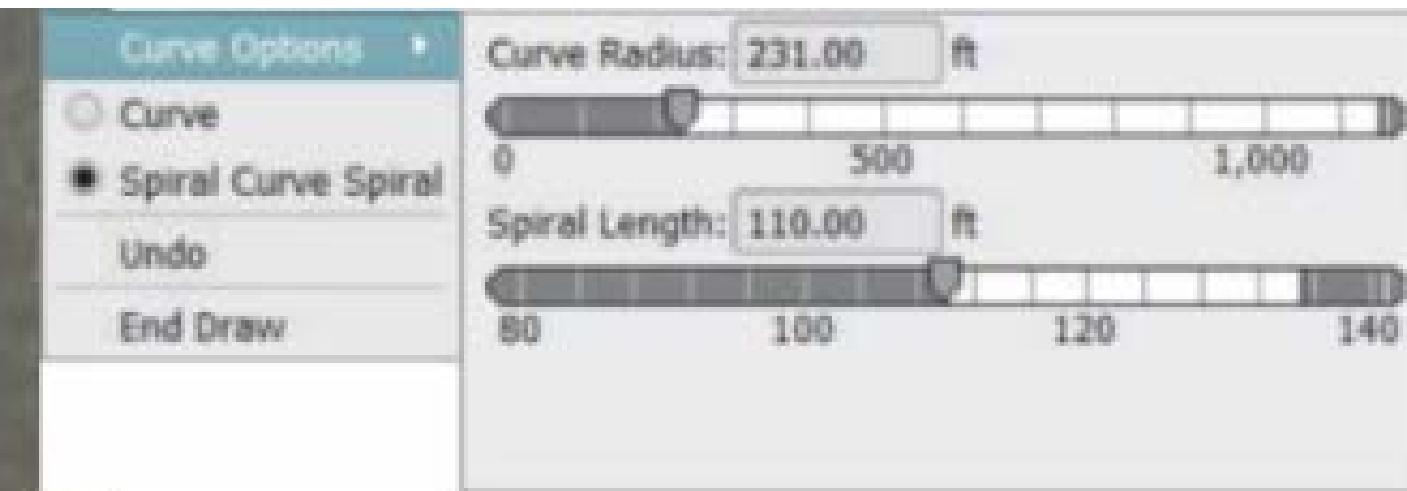
Set the design speed and tangent length



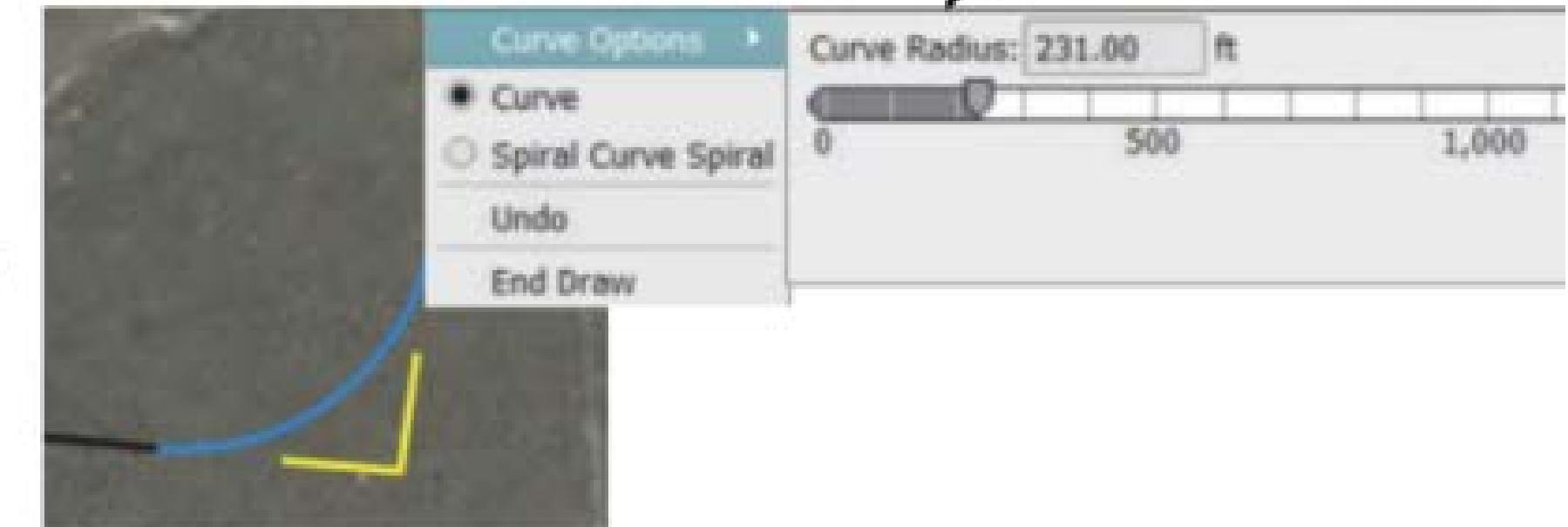
Horizontal curves and spirals



Spiral Curve Spiral



Fly-out Menu



Curve

See it in Action

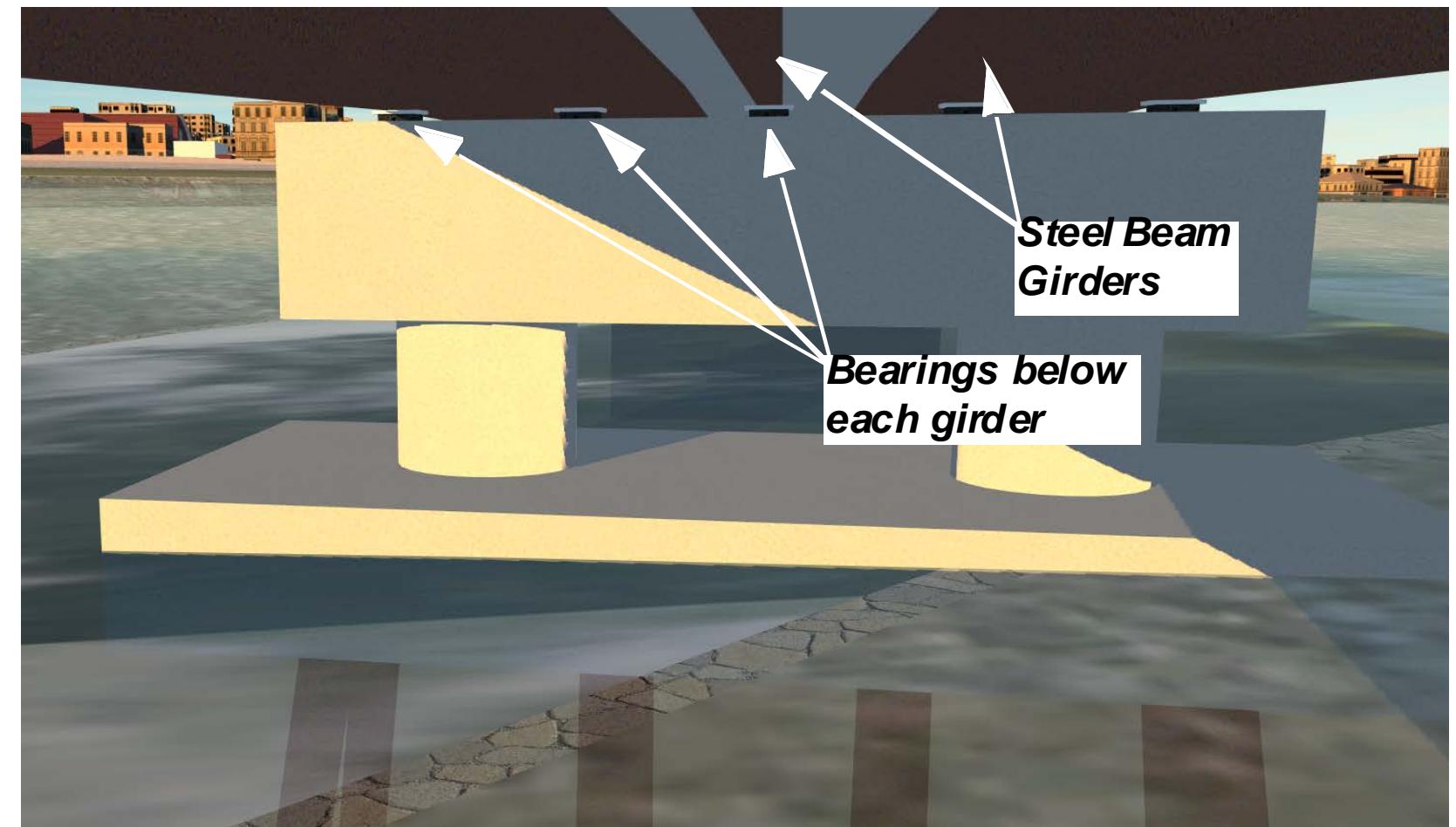
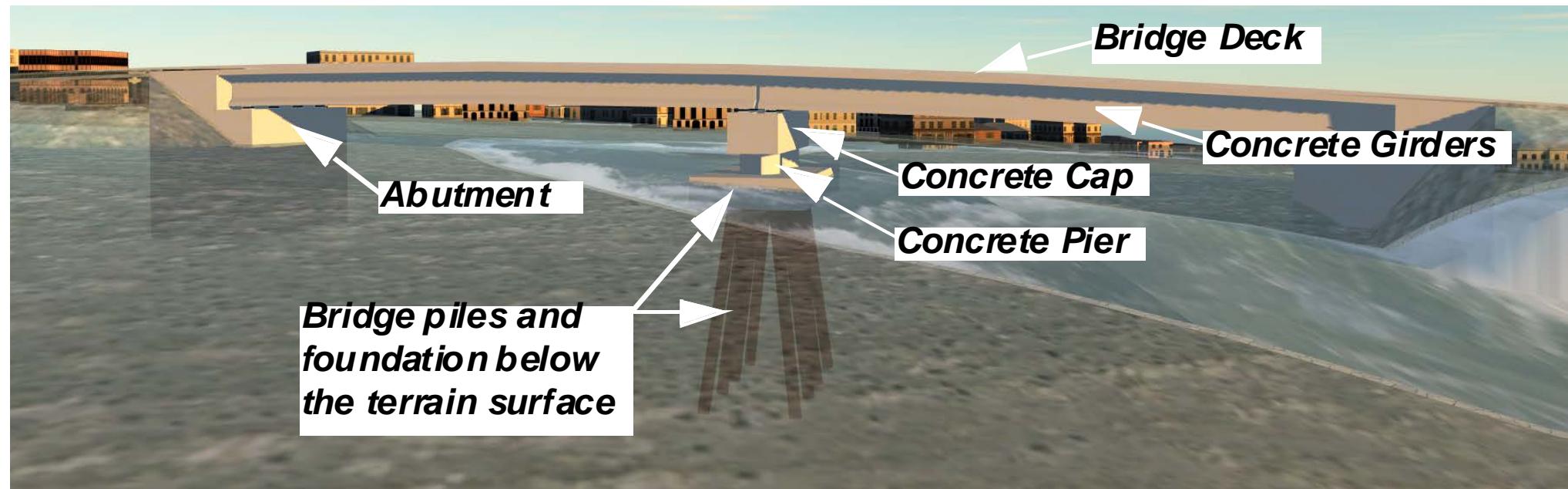


A 3D rendering of a city skyline with numerous skyscrapers. In the foreground, a bridge spans a wide river. The bridge has a multi-lane road with a yellow center line and a green and blue striped barrier. The river is blue and reflects the sky. The surrounding area includes green lawns, trees, and a road with a red car. The sky is clear and blue.

Add Bridges to Design Roads

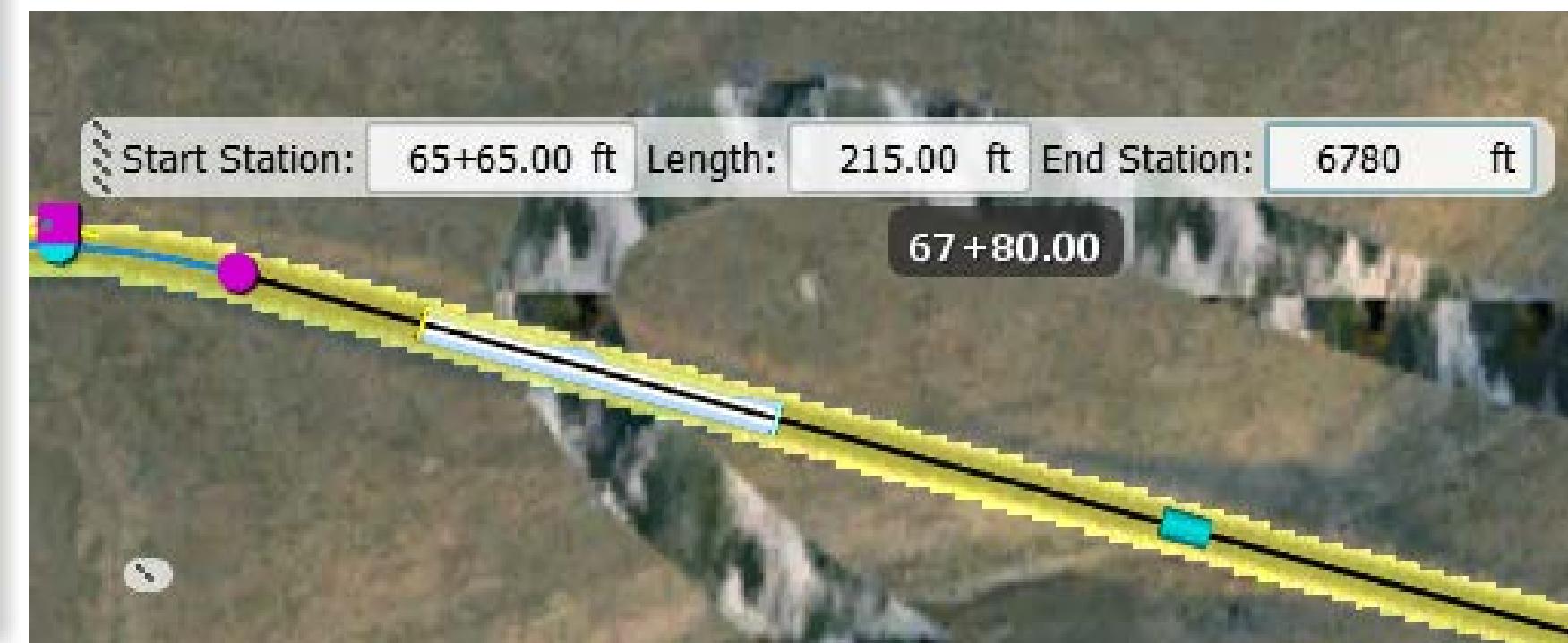
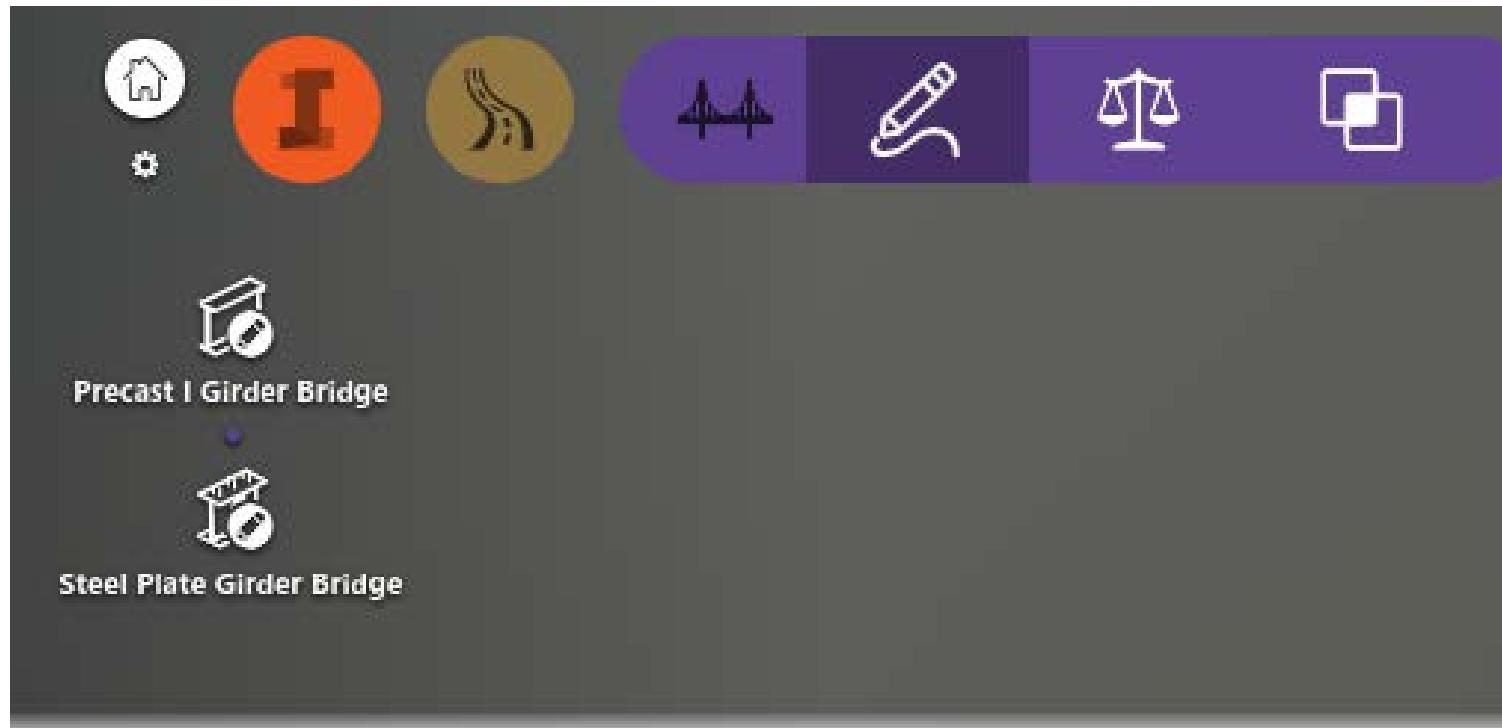
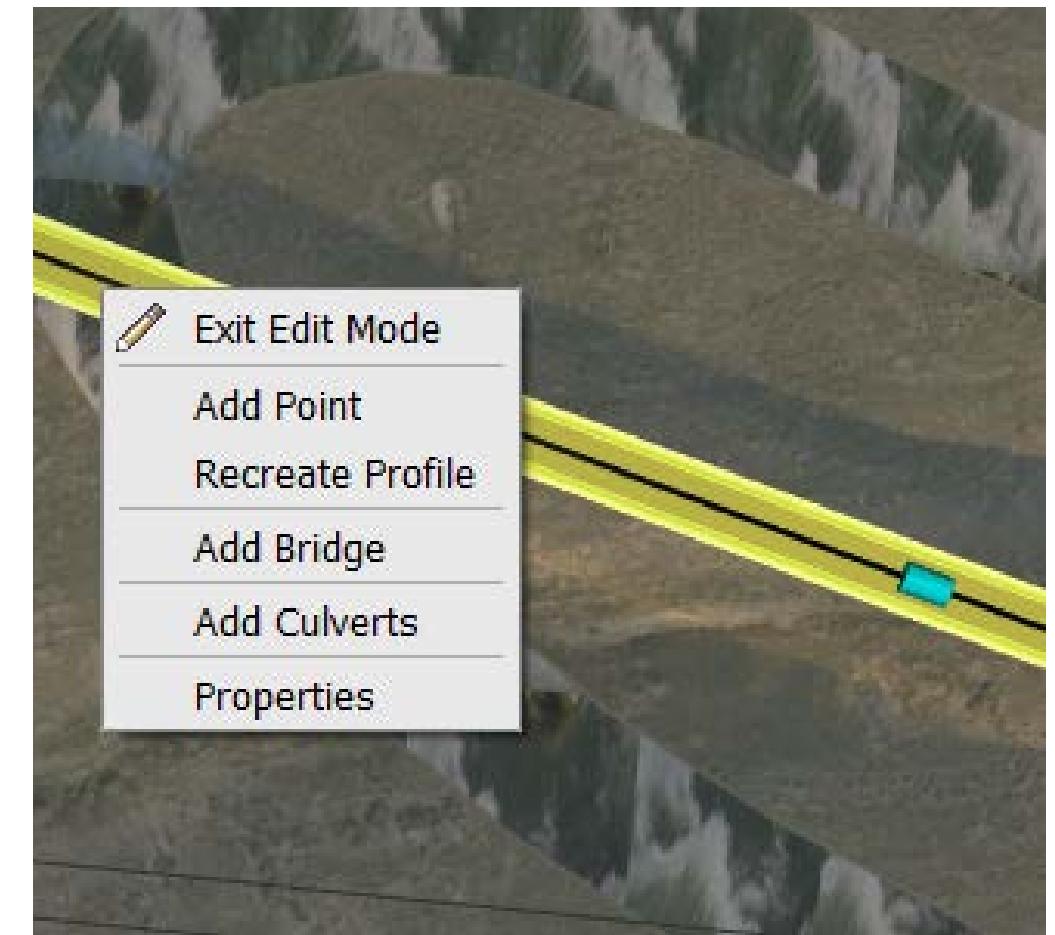
Bridge Components

- Deck
- Girders
- Bearings
- Piers
- Caps
- Piles
- Foundation
- Abutment



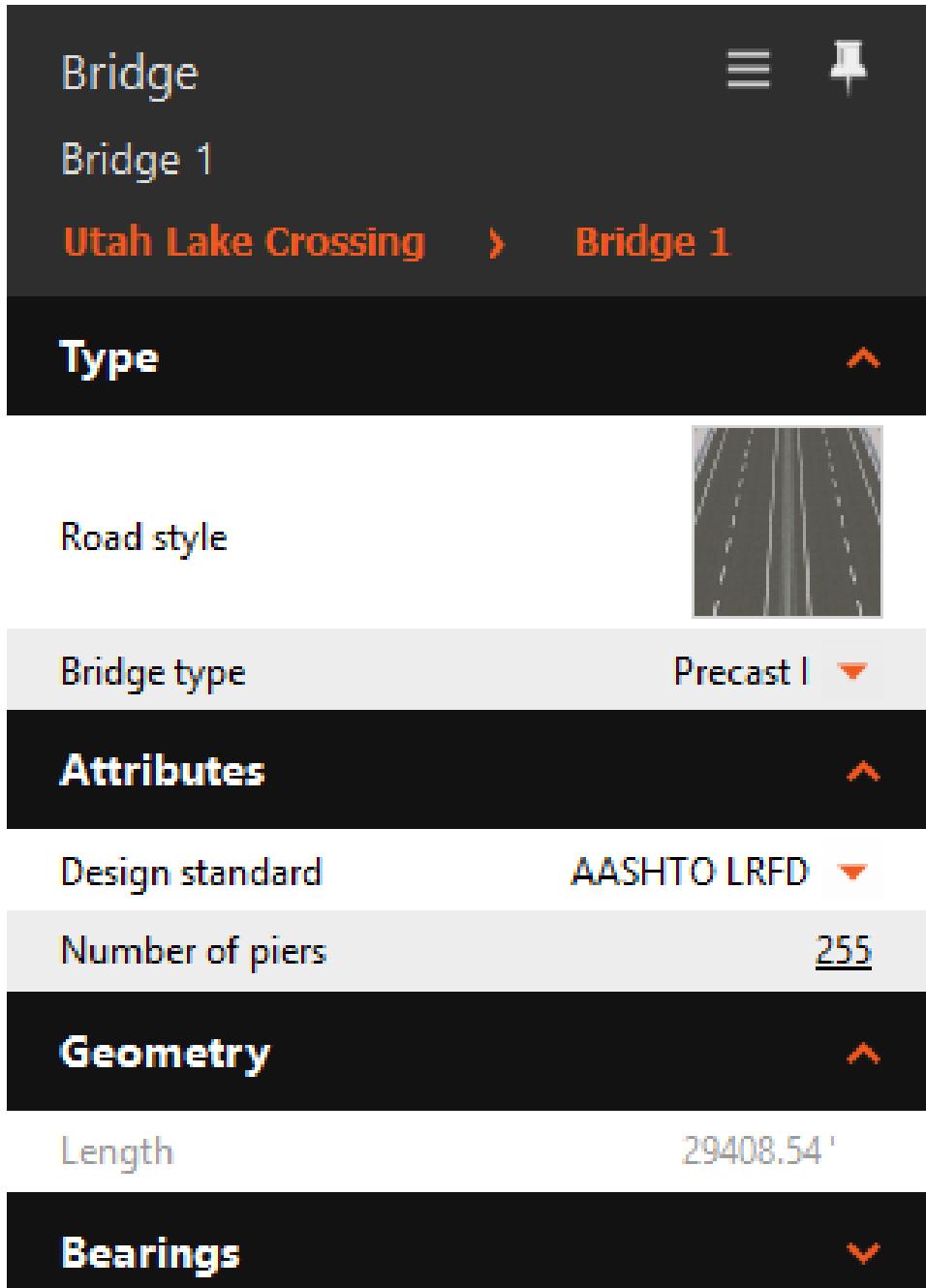
Create Bridges

- Select the Design Road and Right-click
- In Canvas Tools
- Set Start and Ending Stations



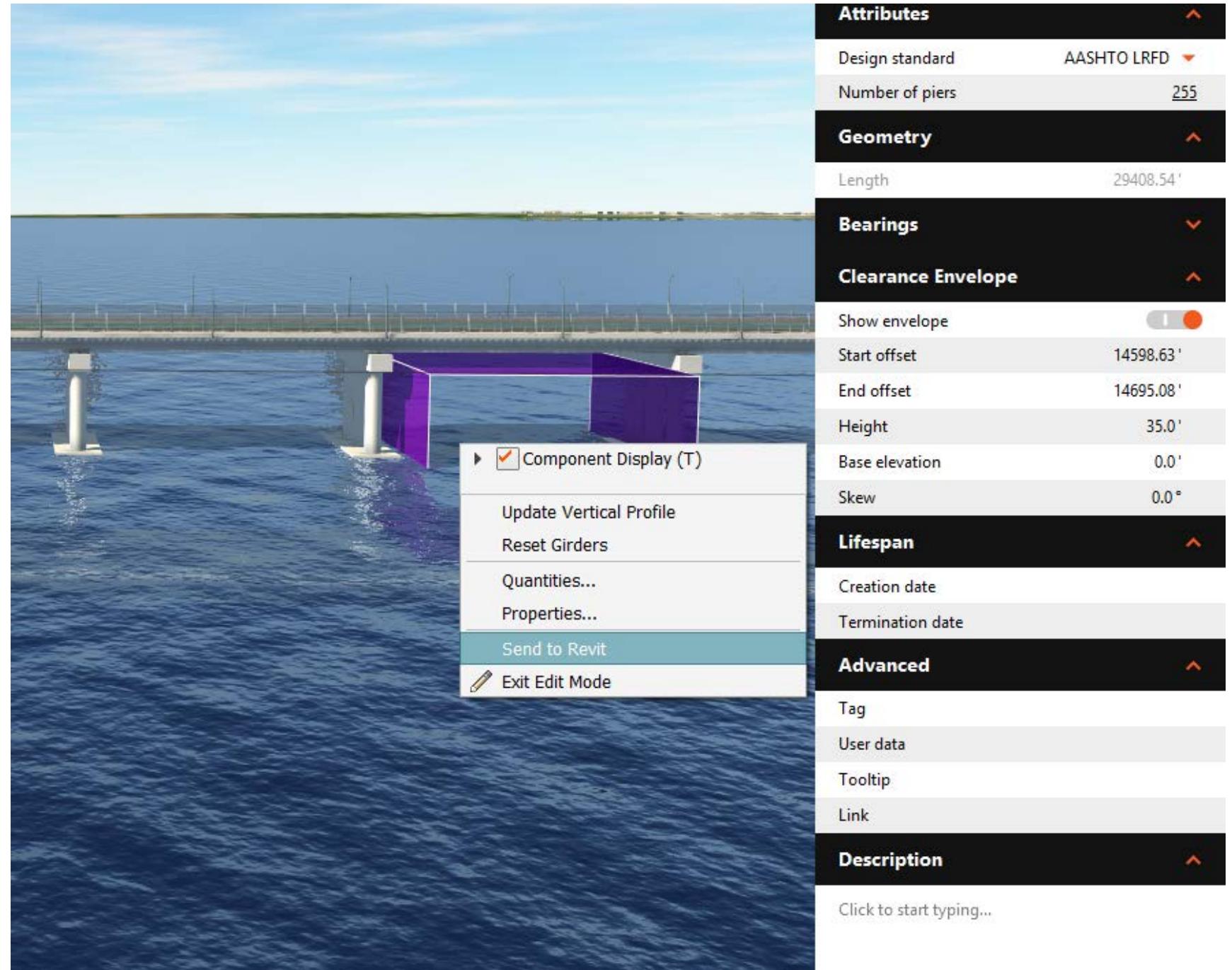
Modify Bridges - Bridge Asset Card

- Change type
- Set # of piers
- Show clearance envelope



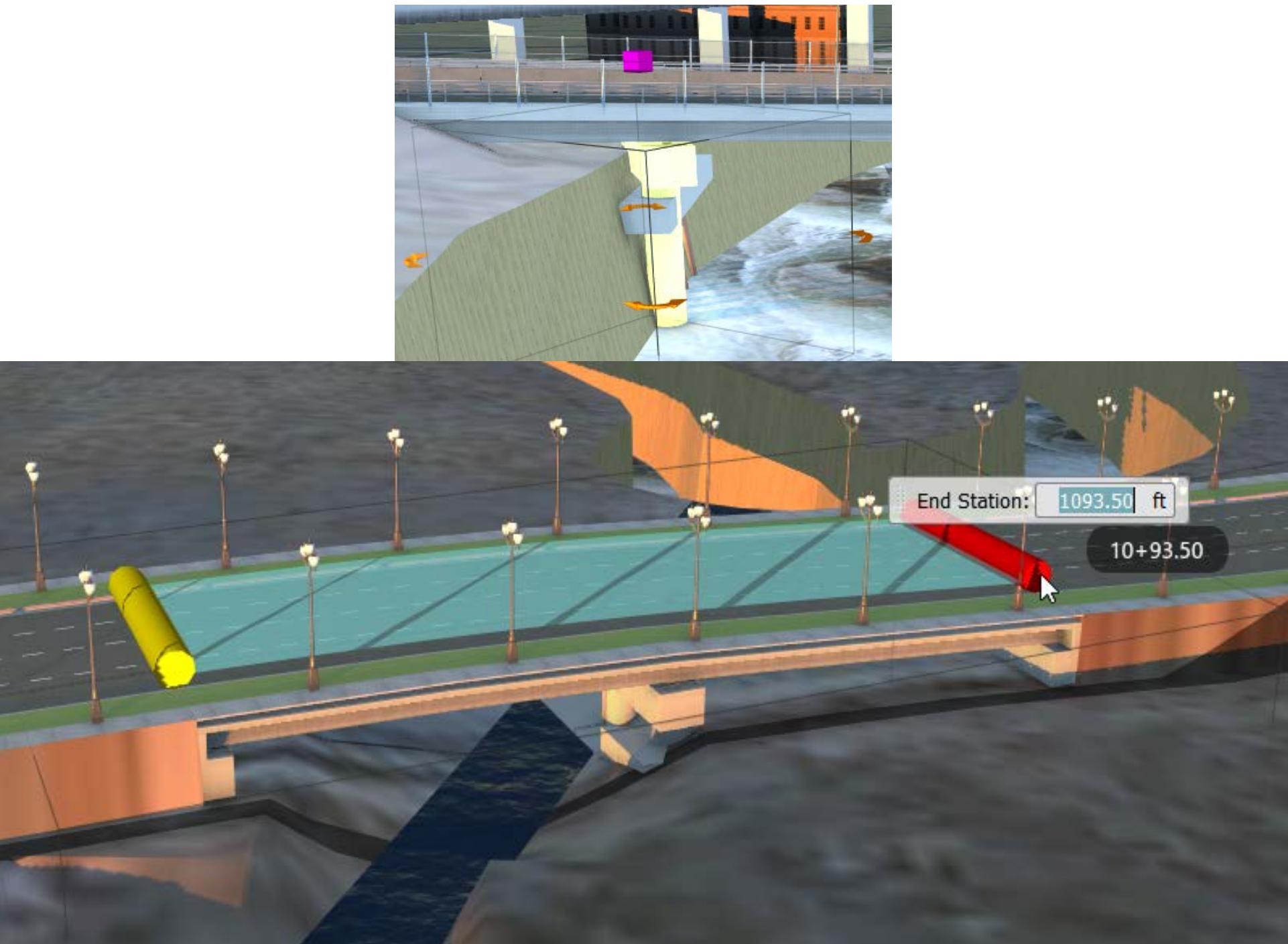
Modify Bridges - Bridge Clearance

- Show clearance envelope
- Make Adjustments
- Update Vertical Profile



Modify Bridges – Bridge Gizmos

- Using Gizmos
 - Control gizmo
 - Rotate gizmo
 - Start/End gizmos



Modify Bridges – Bridge Stack

Bridge
Bridge 1
Utah Lake Crossing > **Bridge 1**

Type

Road style 

Bridge type **Precast I**

Attributes

Design standard **AASHTO LRFD**

Number of piers **255**

Geometry

Length **29408.54'**

Bearings

Clearance Envelope

Show envelope

Start offset **14598.63'**

End offset **14695.08'**

Height **35.0'**

Base elevation **0.0'**

Skew **0.0°**

Lifespan

Creation date

Termination date

Advanced

Tag

User data

Tooltip

Link

Description

Click to start typing...

Girder Group
Girder group 1
Bridge 1 > **Girder group 1**

Type

External: 

[AASHTO Type VI](#)

Internal: 

[AASHTO Type VI](#)

Attributes

Number of girders **255**

Material Properties

Strength (final) **8.0 ksi**

Strength (transfer) **6.0 ksi**

Tendon strength **270.0 ksi**

Initial prestress **75.0 %**

Geometry

Nominal length **119.3'**

Start station **0+04.31'**

End station **3+96.78'**

Start gap **0.33'**

End gap **0.0'**

Start spacing **8.93'**

End spacing **8.93'**

Lifespan

Creation date

Termination date

Advanced

Tag

User data

Tooltip

Link

Description

Click to start typing...

Pier
Pier 1
Bridge 1 > **Pier 1**

Type



Legacy Pier

Attributes

Offset **120.94'**

Skew **0.0°**

Azimuth **177.34°**

Diaphragm width **4.92'**

Cap

Offset: Left **0.0'**

Offset: Right **0.0'**

Depth **8.2'**

Height **6.56'**

Columns

Width **6.56'**

Depth **6.56'**

Spacing **19.69'**

Round

Lifespan

Creation date

Termination date

Advanced

Tag

User data

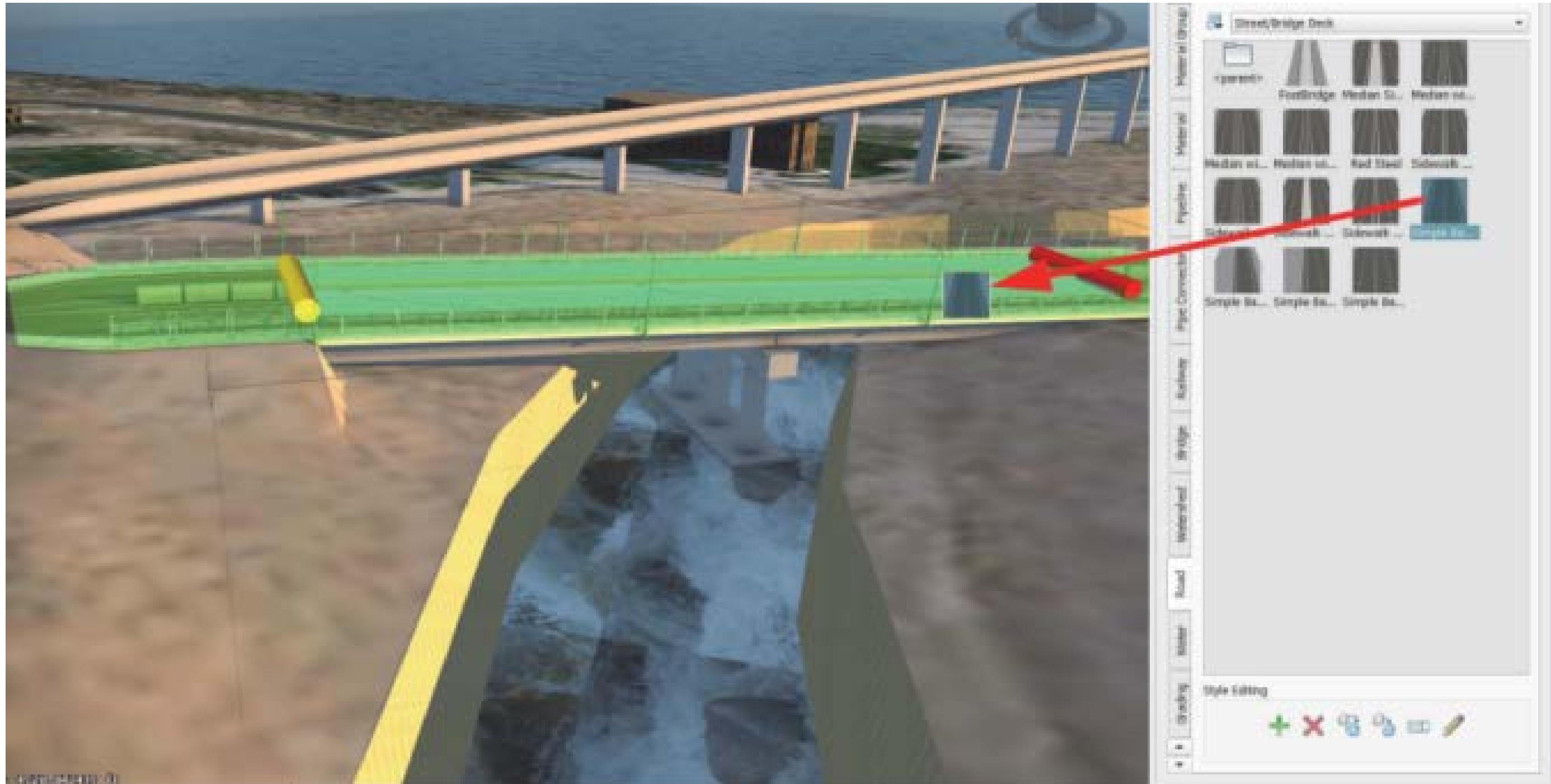
Tooltip

Link

Description

Click to start typing...

Modify Bridges – Style Palette



See it in Action

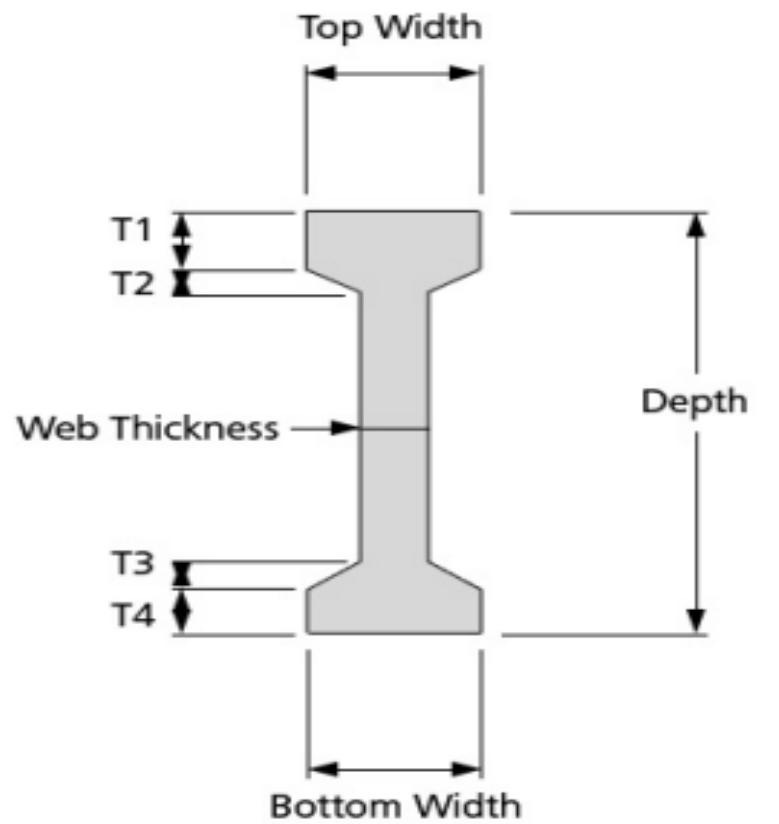




Verify the Structural Strength of the Bridge Girders

Girders

■ Girder asset card



Girder Group

Girder group 3

Bridge 1 > Girder group 3

Type

External: [AASHTO Type VI](#)

Internal: [AASHTO Type VI](#)

Attributes

Number of girders: 7

Material Properties

Strength (final): 8.0 ksi

Strength (transfer): 6.0 ksi

Tendon strength: 270.0 ksi

Initial prestress: 75.0 %

Geometry

Nominal length: 114.83'

Start station: 7+73.51'

End station: 11+50.25'

Start gap: 0.0'

End gap: 0.0'

Start spacing: 8.93'

End spacing: 8.93'

Lifespan

Creation date

Termination date

Advanced

Tag

User data

Tooltip

Link

Description

Click to start typing...

Girder

Left exterior

Girder group 3 > Left exterior

Type

[AASHTO Type VI](#)

Attributes

Length: 114.83'

Start offset: -26.78'

End offset: -26.78'

Section Dimensions

Top width: 3.5'

Bottom width: 2.33'

Depth: 6.0'

Web thickness: 0.67'

T1: 0.42'

T2: 0.33'

T3: 0.83'

T4: 0.67'

Lifespan

Creation date

Termination date

Advanced

Tag

User data

Tooltip

Link

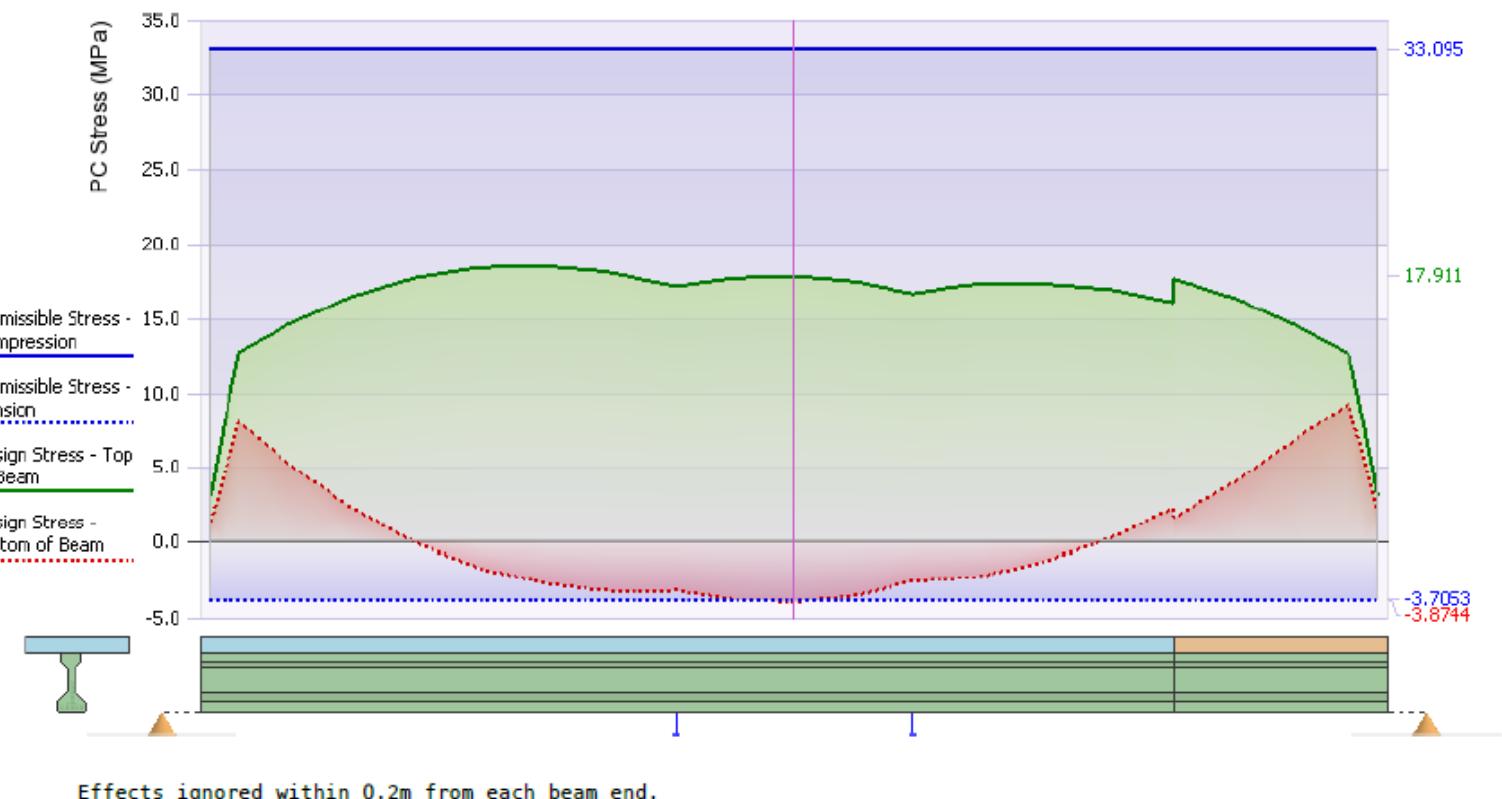
Description

Click to start typing...

Girder Analysis

- Verify structural strength of concrete bridge girders
 - Show results in model
 - Get Full Report (uses cloud credits)

Girder Design Calculations: Live Load Bending



Performance ratio = $-3.87 / -3.71 = 1.05$

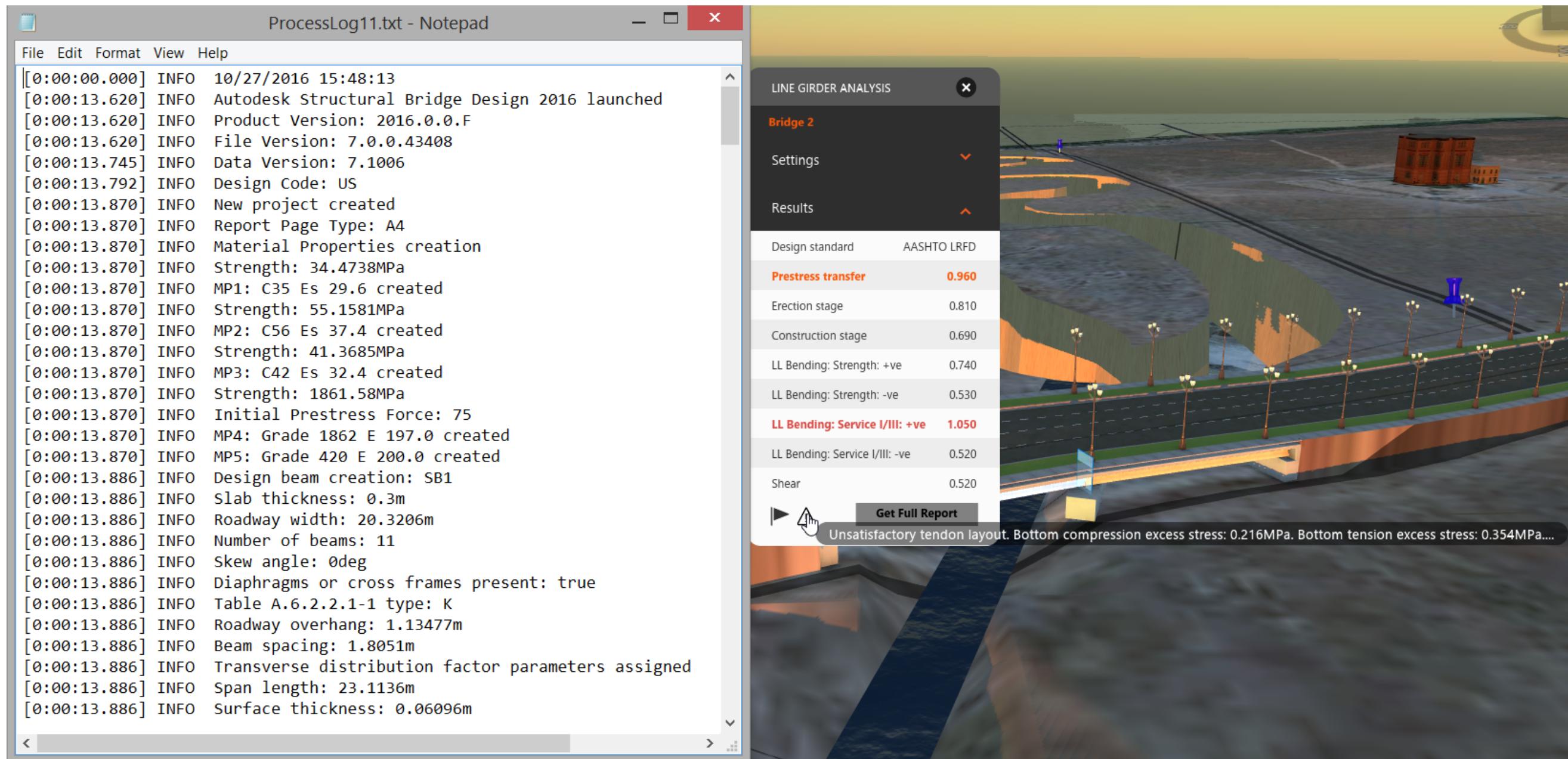
Section details:

Ref 1 "Section 1"
at $0.5 \times \text{span} = 0.5 \times 23.1136 = 11.5568 \text{ m}$ from left end of beam

Design Code:

AASHTO LRFD Bridge Design Specifications
Sixth Edition with 2013 Interim Revisions

See it in Action



The image shows a dual-monitor setup. The left monitor displays a Notepad window titled "ProcessLog11.txt" containing a detailed log of the bridge design process. The right monitor displays the Autodesk Structural Bridge Design 2016 software interface, showing a 3D model of a bridge over water with a road and rail track. A modal dialog box titled "LINE GIRDER ANALYSIS" is open, showing results for "Bridge 2". The results table includes columns for "Design standard" (AASHTO LRFD), "Prestress transfer" (0.960), "Erection stage" (0.810), "Construction stage" (0.690), "LL Bending: Strength: +ve" (0.740), "LL Bending: Strength: -ve" (0.530), "LL Bending: Service I/III: +ve" (1.050), "LL Bending: Service I/III: -ve" (0.520), and "Shear" (0.520). A tooltip at the bottom of the dialog box states: "Unsatisfactory tendon layout. Bottom compression excess stress: 0.216MPa. Bottom tension excess stress: 0.354MPa....". A "Get Full Report" button is also visible in the dialog.

ProcessLog11.txt - Notepad

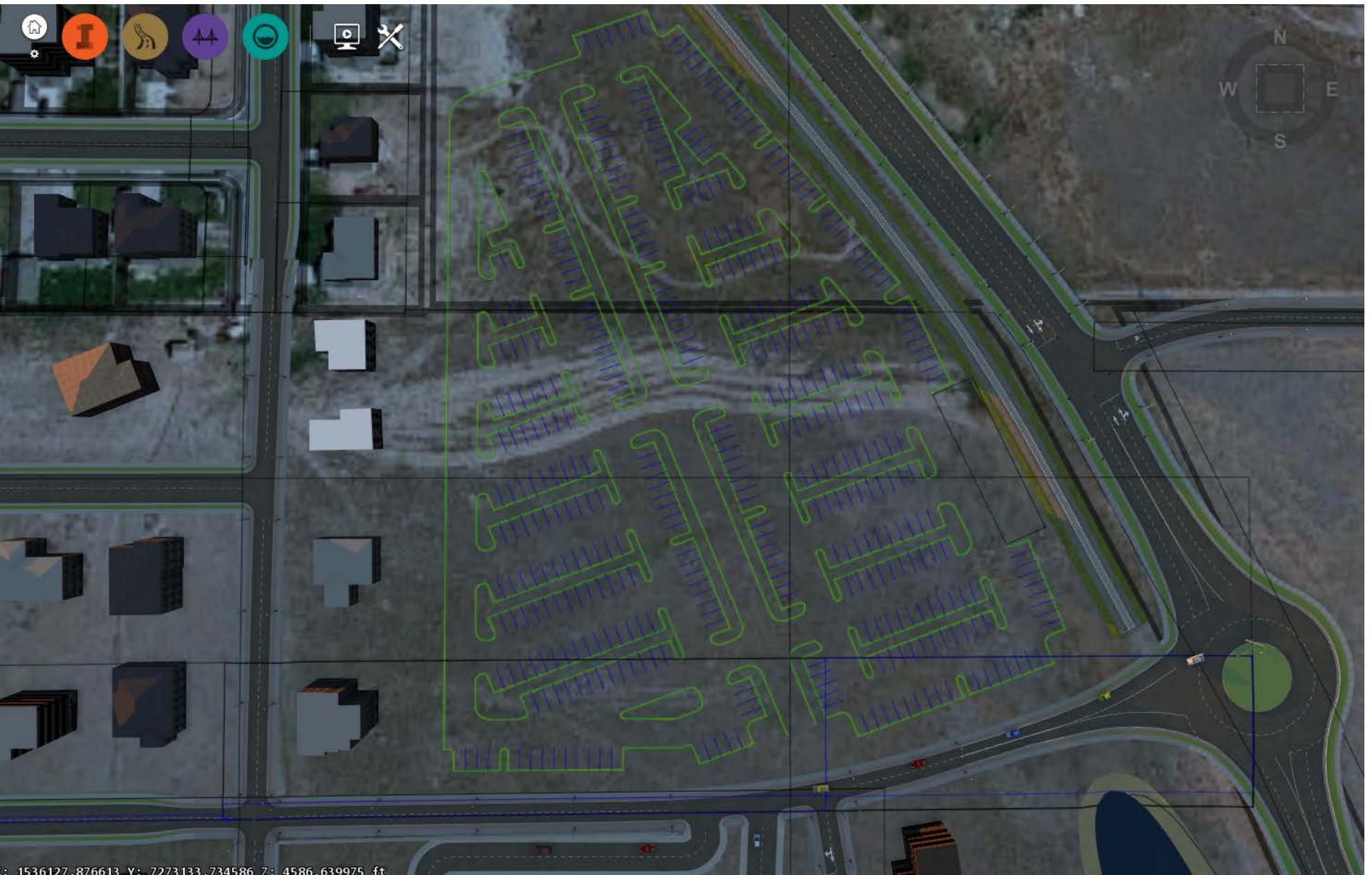
```
[0:00:00.000] INFO 10/27/2016 15:48:13
[0:00:13.620] INFO Autodesk Structural Bridge Design 2016 launched
[0:00:13.620] INFO Product Version: 2016.0.0.F
[0:00:13.620] INFO File Version: 7.0.0.43408
[0:00:13.745] INFO Data Version: 7.1006
[0:00:13.792] INFO Design Code: US
[0:00:13.870] INFO New project created
[0:00:13.870] INFO Report Page Type: A4
[0:00:13.870] INFO Material Properties creation
[0:00:13.870] INFO Strength: 34.4738MPa
[0:00:13.870] INFO MP1: C35 Es 29.6 created
[0:00:13.870] INFO Strength: 55.1581MPa
[0:00:13.870] INFO MP2: C56 Es 37.4 created
[0:00:13.870] INFO Strength: 41.3685MPa
[0:00:13.870] INFO MP3: C42 Es 32.4 created
[0:00:13.870] INFO Strength: 1861.58MPa
[0:00:13.870] INFO Initial Prestress Force: 75
[0:00:13.870] INFO MP4: Grade 1862 E 197.0 created
[0:00:13.870] INFO MP5: Grade 420 E 200.0 created
[0:00:13.886] INFO Design beam creation: SB1
[0:00:13.886] INFO Slab thickness: 0.3m
[0:00:13.886] INFO Roadway width: 20.3206m
[0:00:13.886] INFO Number of beams: 11
[0:00:13.886] INFO Skew angle: 0deg
[0:00:13.886] INFO Diaphragms or cross frames present: true
[0:00:13.886] INFO Table A.6.2.2.1-1 type: K
[0:00:13.886] INFO Roadway overhang: 1.13477m
[0:00:13.886] INFO Beam spacing: 1.8051m
[0:00:13.886] INFO Transverse distribution factor parameters assigned
[0:00:13.886] INFO Span length: 23.1136m
[0:00:13.886] INFO Surface thickness: 0.06096m
```

A 3D rendering of a modern city skyline with a bridge over a river in the foreground. The bridge is a multi-lane highway with a green and yellow striped barrier. The city skyline features several skyscrapers of varying heights and colors, including a prominent yellow one. The river is a dark blue color, and there are green parks and trees along the banks. The sky is clear and blue.

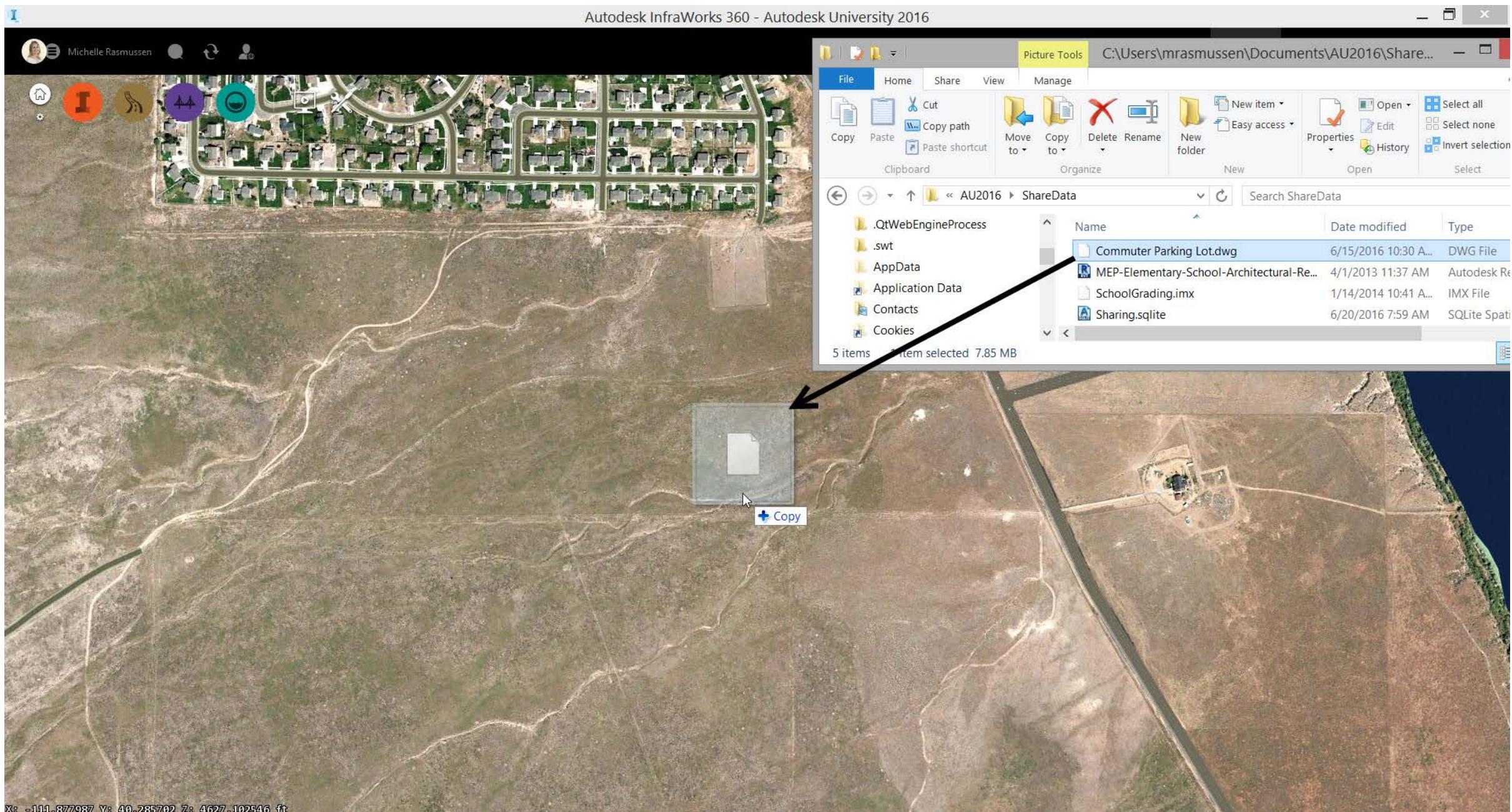
**Incorporate design changes from
AutoCAD Civil 3D**

Overlay or Import

- Import
 - Corridors
 - Surfaces
 - Pipes
 - Pipe Networks
- Overlay
 - Linework



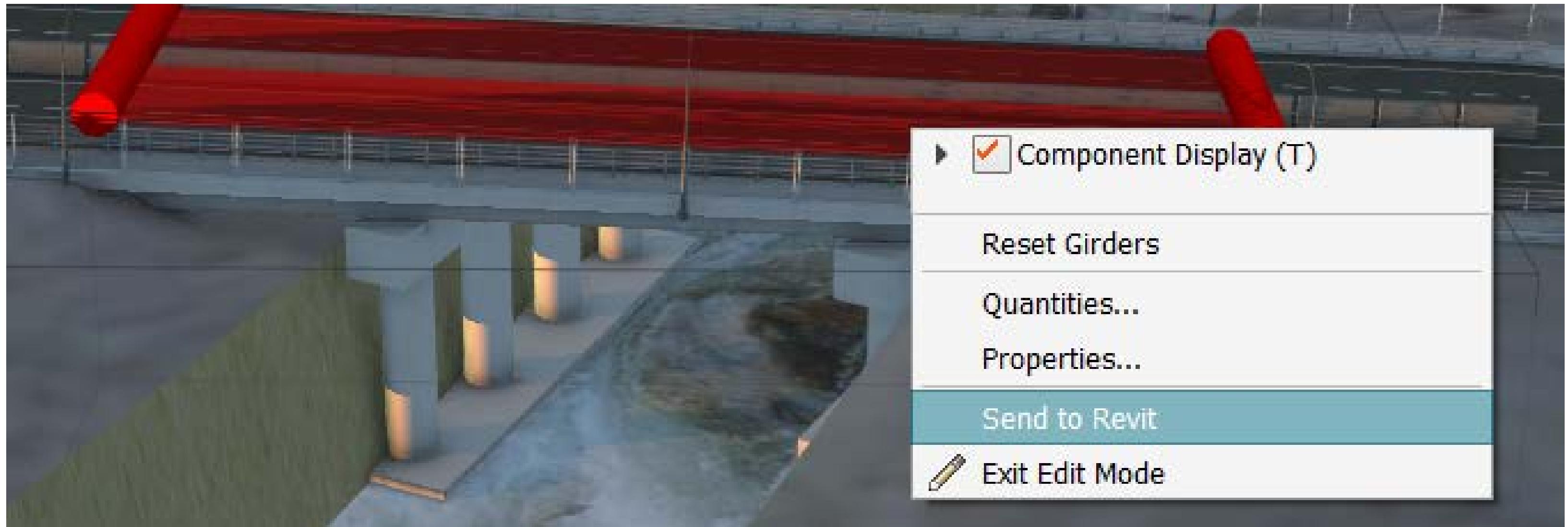
See it in Action



Bonus Material



Take the Bridge into Revit



See it in Action

Take the Design into Navisworks

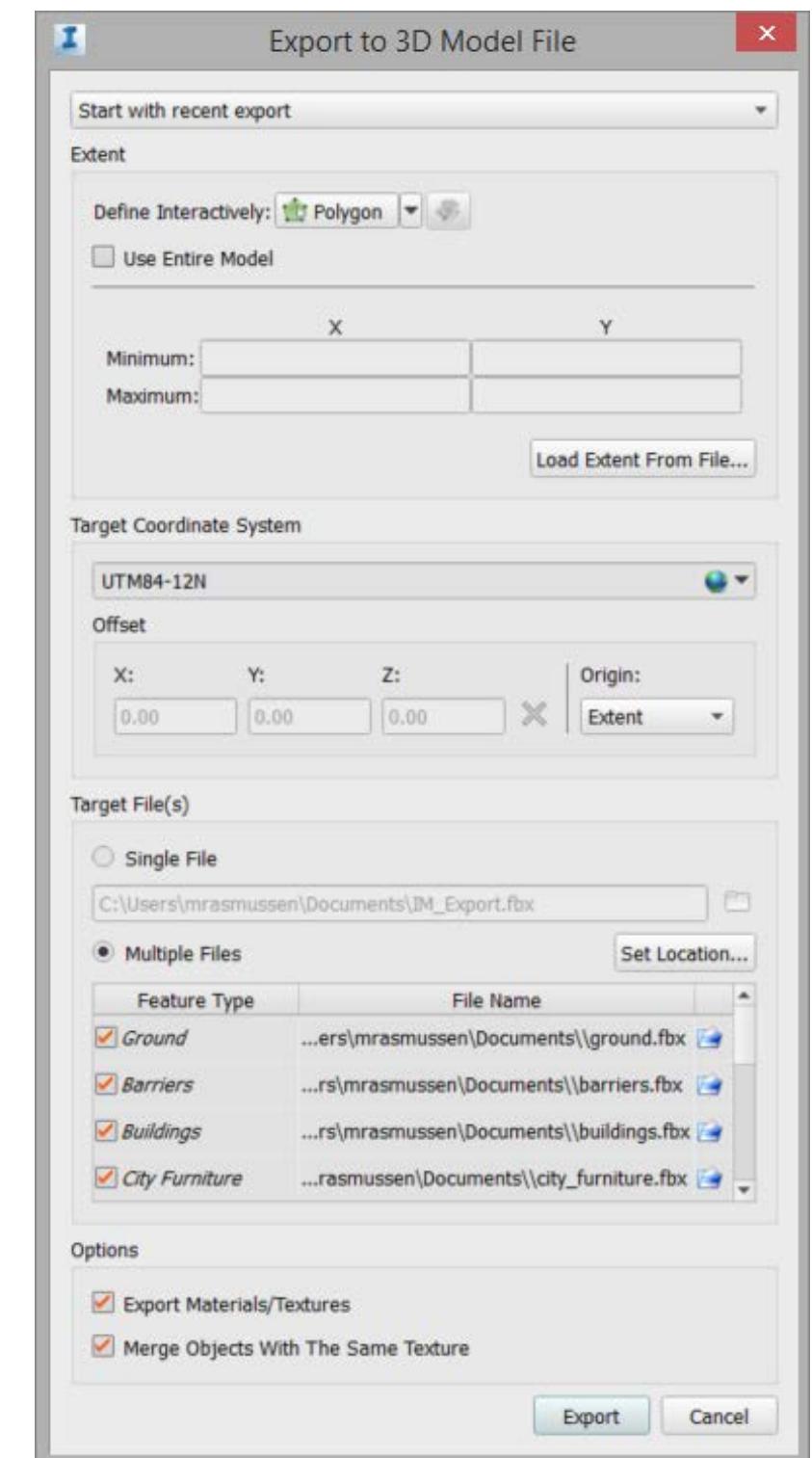
- Two options:
 - First, take it into AutoCAD Civil 3D.
 - Export a 3D Model which you can append to the Navisworks file.

Screencast

Export the Autodesk InfraWorks 360 Model to Navisworks

Export an FBX file

- Define the area to export
- Set the Target Coordinate System
- Determine if you want one file or many
- Click Export.



See it in Action

How did I do?

At the beginning of this class, I said you will be able to do the following:

- Create engineered roads of the proposed design.
- Add bridges to design roads using Bridge Design for InfraWorks 360.
- Verify the structural strength of the bridge girders.
- Incorporate design changes from AutoCAD Civil 3D

Bonus Material:

- Take the Bridge into Revit
- Take the Design into Navisworks

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- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**



Workout With Me and Pinky & Proppy

- When: Today at 6:00
- Where: Canyon Ranch Spa
- Cost: \$25 which goes to charity

- Party Bus: 9:00 pm
- Cost: \$75





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