InfraWorks Bridges the Gap for Structural Modeling

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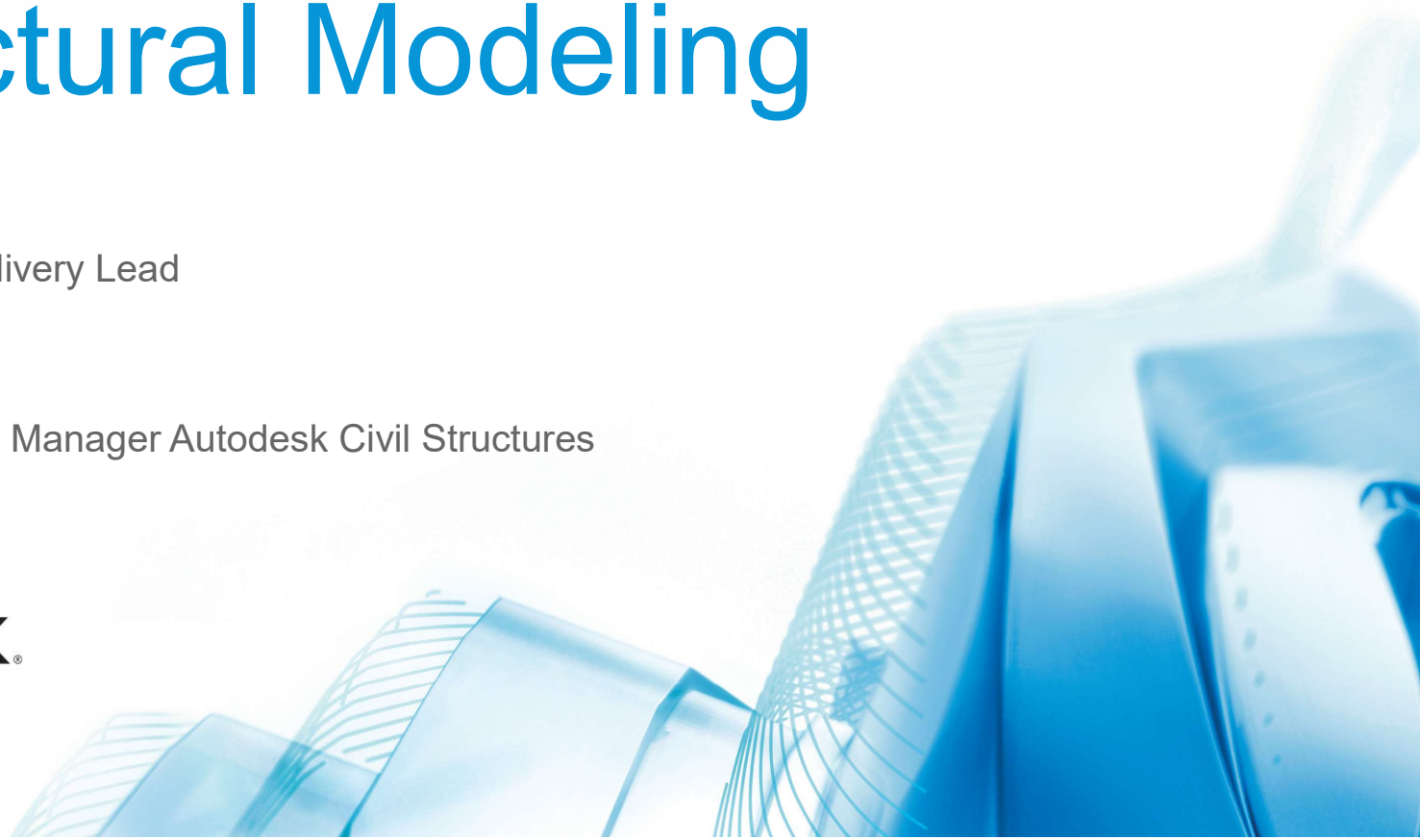
AUTODESK. UNIVERSITY



About the speaker

Mike McKeon - Jacobs

Mike has worked in the civil engineering industry for over 30 years. His primary focus has been on the design and delivery of major highways and infrastructure projects. At Jacobs, Mike sits as a Digital Delivery Lead, focusing on design automation, information management and the development of innovative workflows. Mike has had the privilege of attending several Inside the Factory events with the Autodesk Civil team.

About the speaker

Ara Ashikian – Autodesk

Ara Ashikian is the Senior Product Line Manager for the Autodesk Civil Structures product development teams. Prior to joining Autodesk in 2013, he had over 20 years of experience as a bridge engineer and a software developer, working on a large number of bridge projects, including preliminary, detailed and construction engineering design aspects for a wide range of bridge types. These projects included the detailed construction engineering of the EG LNG suspension bridge in Africa, as well as for the New Bay Bridge (self-anchored suspension bridge in California), the detailed engineering for the launching of the Kicking Horse Canyon in the Canadian Rockies as well as for the Coast Meridian.

Course Summary

This class will cover:

- the workflow for using InfraWorks, with Inventor and Revit, for bridge modeling.
- progress made with using this workflow on a test project
- Steps to you can take to started
- Some key differences between this workflow and Dynamo
- what you can do with the software today, as well as what will be available in the near future.

Why Look at InfraWorks for Bridge Modeling

Priority - advance all the disciplines within transportation and infrastructure to work in 3D, using BIM workflows.

- Efficiency
  - Change management with alignment and corridors updating frequently.
  - Parametric models adapt to change easier
  - Once the parts are created, similar bridges can be modelled rapidly
  - The ability to create quick visualizations, with minimal effort
- Clients and contractors are starting to ask/require 3D
- Moves the industry closer to automated plan production and paperless delivery
- Can minimize errors or emissions due to having more information in a comprehensive and immersive environment before construction.

Why Look at InfraWorks for Bridge Modeling

Key differences between InfraWorks and Dynamo workflows

- **InfraWorks led workflow is much more approachable to more staff**
- **Can be used very effectively in design pursuit and refined towards detailed design**
- Inventor allows for the parametric modeling of very complex components
- For most users, an understanding of bridge layouts is all that is required to use the workflow and consume custom components
- Workflow focuses on coordination between the project's road design efforts, bridge design and construction drawings
- Supports effective iterative design with intelligent change management
- InfraWorks allows teams to tackle large projects with many bridges and not just one bridge in isolation
- Allows for easy visualization and real time modeling
- Will soon have fully integrated advanced structural analysis for bridge superstructures

* Note – some of these are based upon future functionality being added to InfraWorks and Revit

Steps to get started

- Request to get added to the InfraWorks Rolling Sandbox beta site.
  https://feedback.autodesk.com/welcome/
- Start with showing this workflow to your marketing team and PM's.
- For presentation purposes, Inventor is often not needed.
- Find a good team that is interested and realizes the need to move out of the 2D world.
- Get access to the current version of Civil 3D and Inventor.
- Try this approach in parallel and setup a pilot or proof of concept

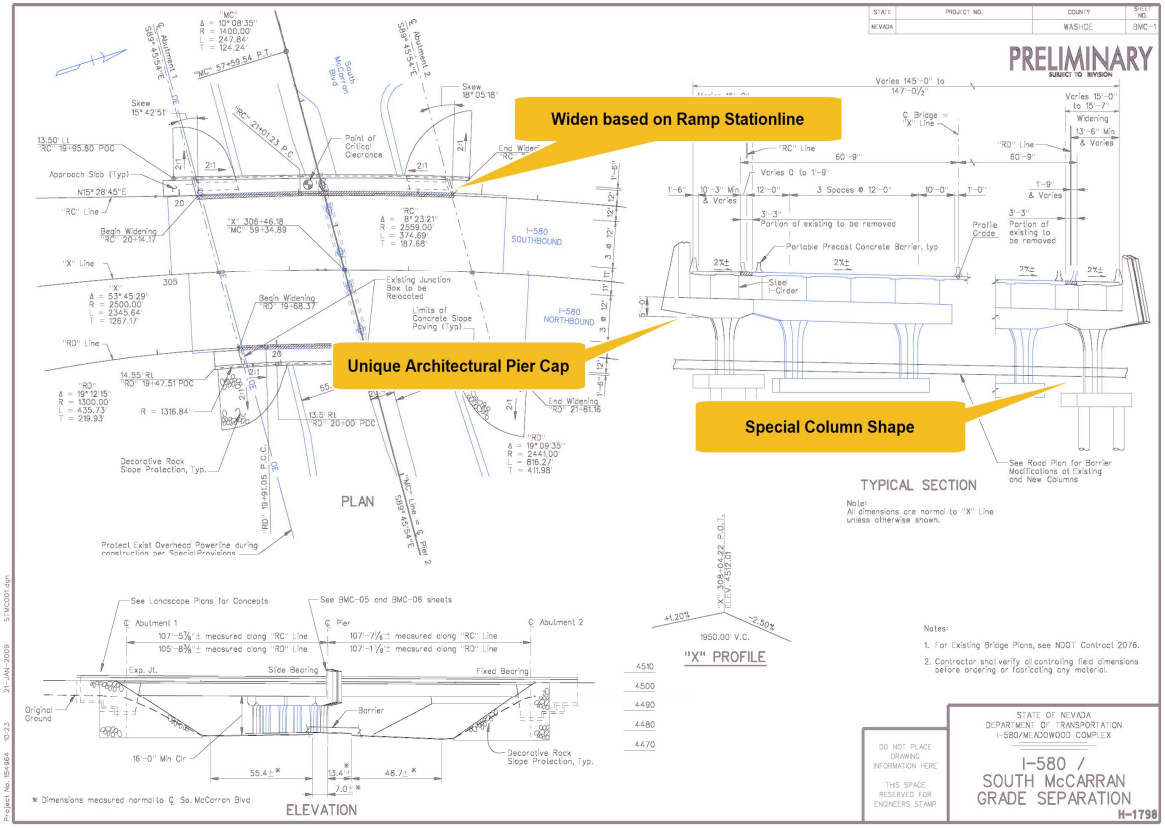
The Project

South McCarran bridge - I-580/Meadowood Complex project in Nevada

In selecting a project, we chose one that would challenge the workflow.

Some of the challenging aspects were:

- Widening of an existing structure
- Unique deck, columns and pier cap
- Was not solely built off the highway centerline



The Project

Disclaimer


DISCLAIMER:
NO STRUCTURAL ENGINEERS WERE HARMED
IN THE MAKING OF THIS COURSE

The Workflow

The Workflow

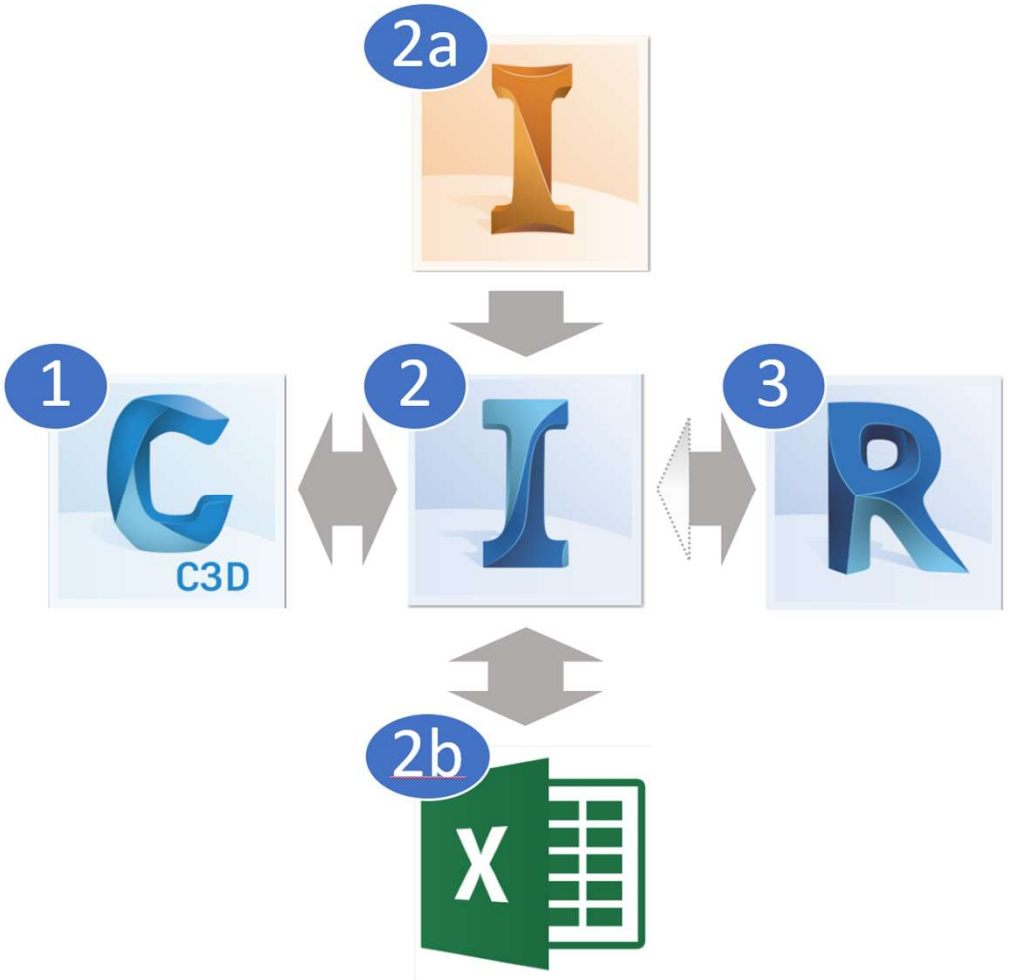
High-level workflow:

1. Civil 3D
   - Author roadway design content
2. InfraWorks
   - Bring in roadway design content and create bridge model

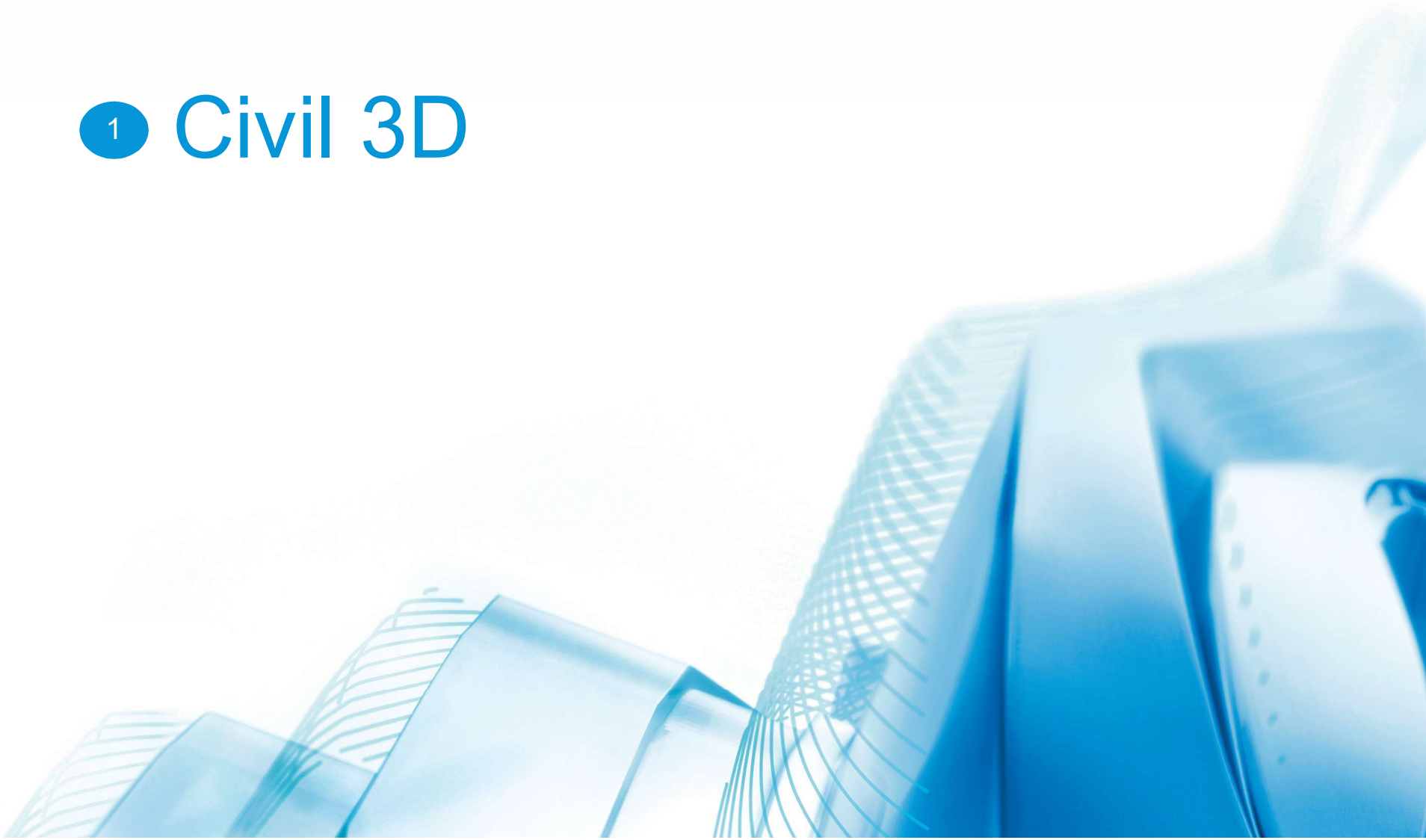
2a. Inventor
   - Create parametric bridge parts

2b. Excel
   - Make bulk previsions to bridge parameters

3. Revit
   - Create plans an deliverables



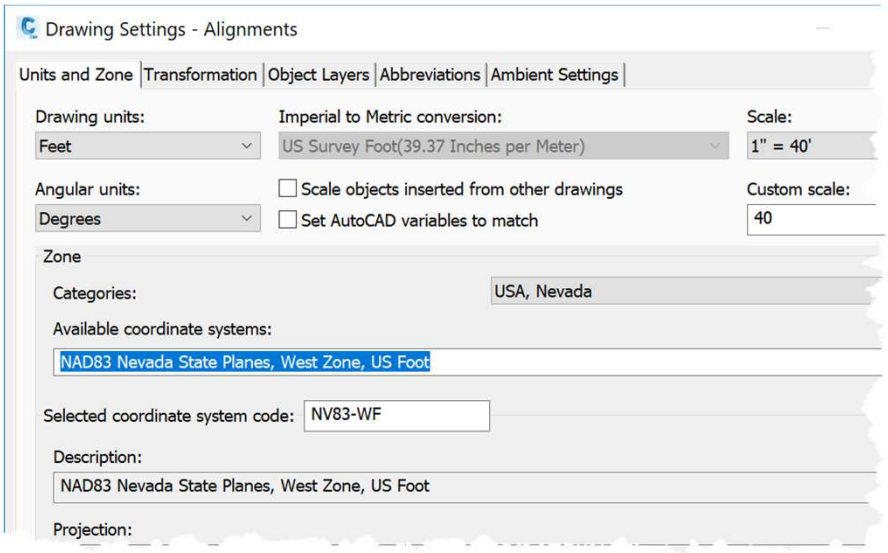
1 Civil 3D



Civil 3D – Prepare Your DWG

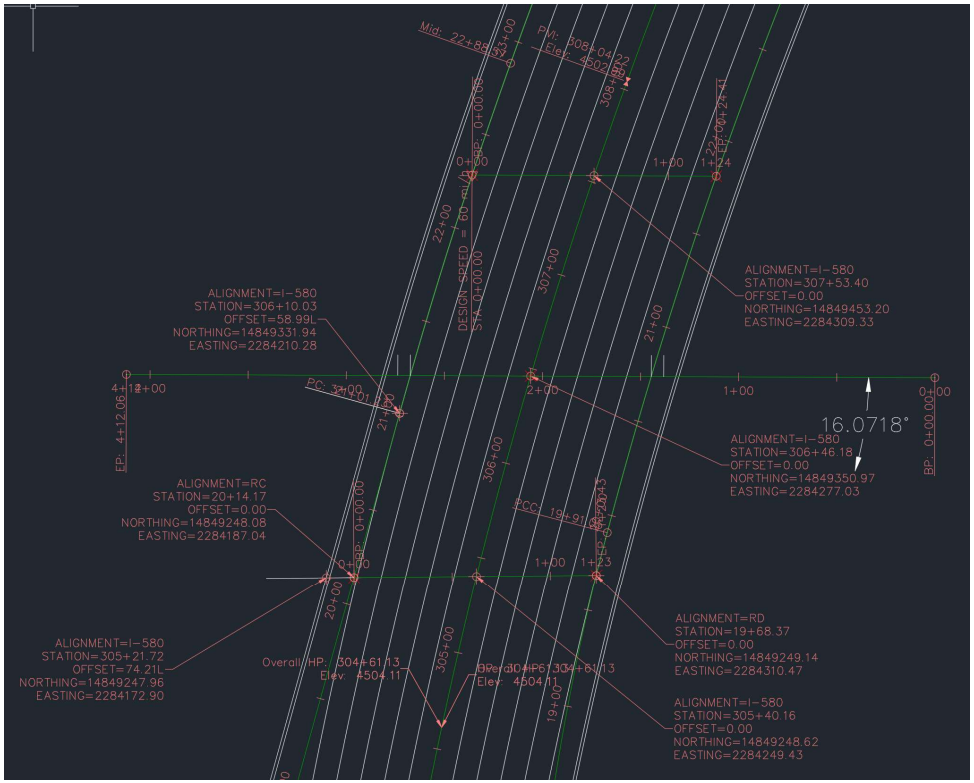
Prepare your Civil 3D drawing so that you can use it in InfraWorks, this includes:

- Set the project's coordinate system
  - The coordinate system must match between Civil 3D and InfraWorks
- Create alignments, profiles and superelevation
- Acquire Existing ground surface
- Design finished ground surface



Civil 3D – Prepare Your DWG

Tip: Layout the bridge in Civil 3D. Add labels for BB, EB, bents, lane transitions, skew angles…



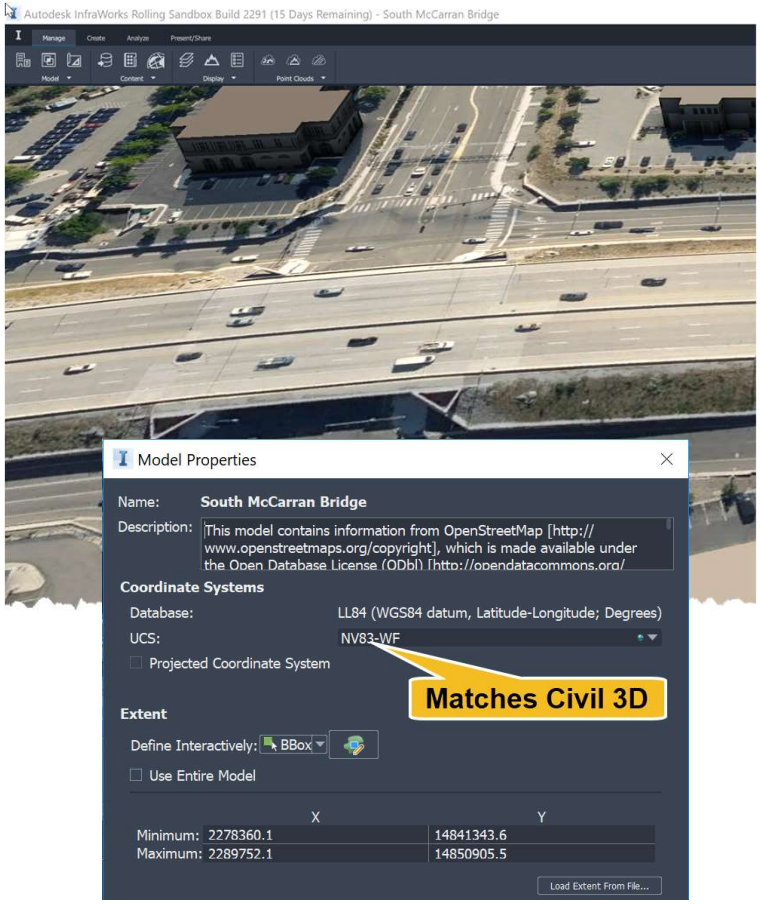
2 InfraWorks

InfraWorks

The next step is to prepare your InfraWorks model

- Create the InfraWorks model
  - Model Builder (automatic)
  - Manual

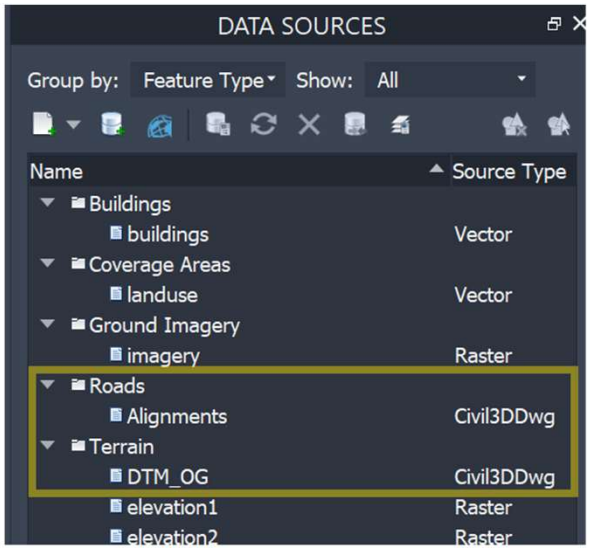
- Set the model properties
  - Set the project's coordinate system
  - Set the design standards if desired

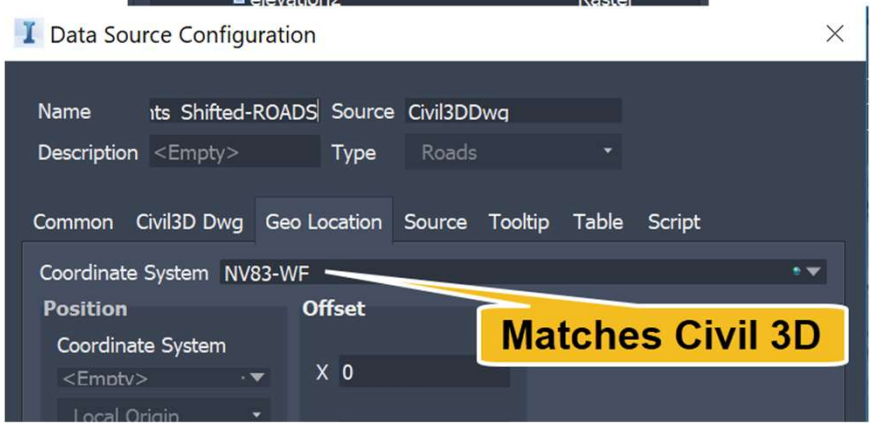


InfraWorks

Adding your project's data

- Add Civil 3D drawings as a data source
  - Alignments and profiles
  - Surfaces, existing and proposed
  - Verify that the InfraWorks and Civil 3D data lineup



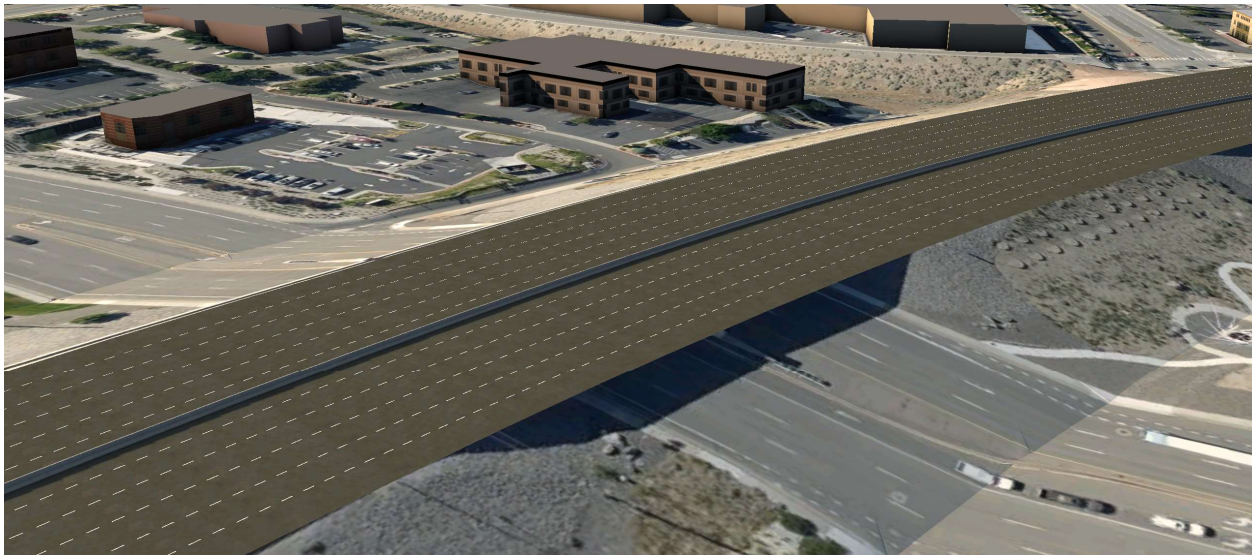


InfraWorks

Create component roads

- Currently, InfraWorks does not understand Civil 3D corridors so you must create roads using InfraWorks components *
- Check superelevation against Civil 3D *

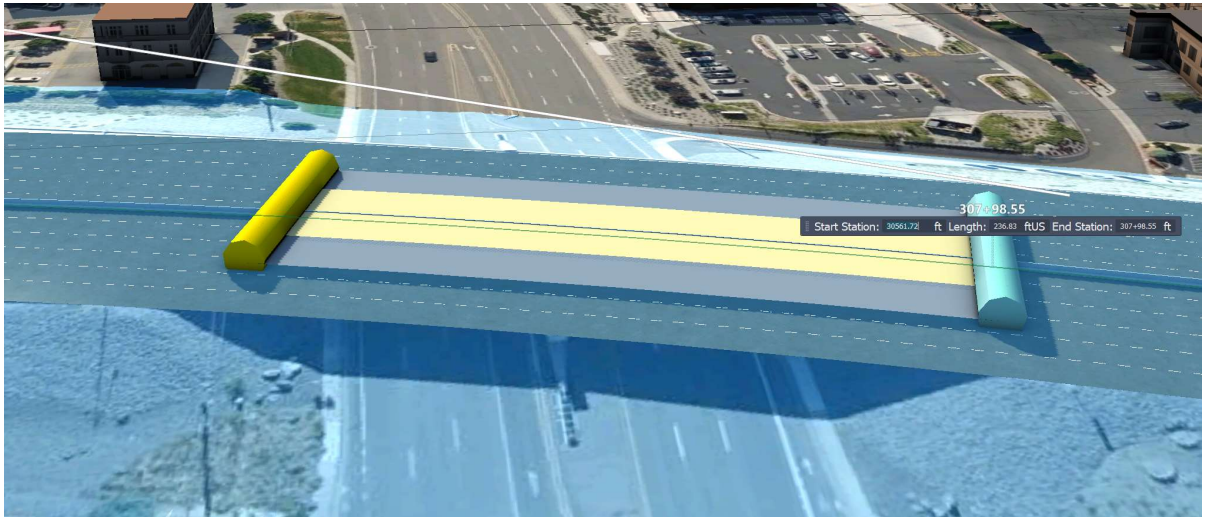
* Future feature – InfraWorks will understand Civil 3D corridors and bridge decks will automatically adapt



InfraWorks

Adding the bridge

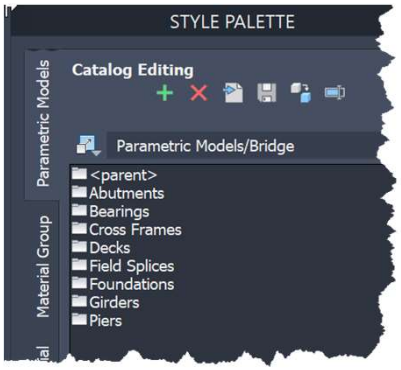
- Place the bridge on the road.
  - You can sketch it, you will be able to adjust it later

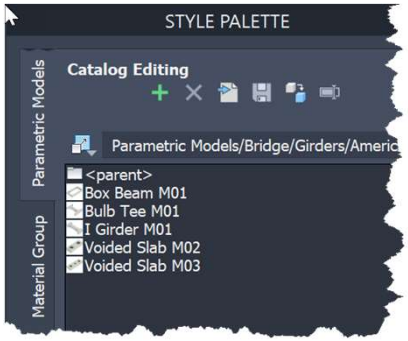


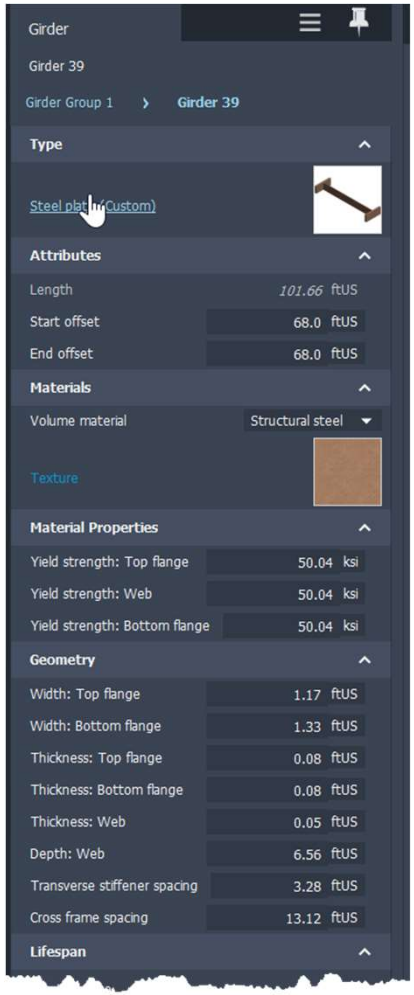
InfraWorks

Evaluate stock InfraWorks bridge parts

- InfraWorks ships with quite a few parametric bridge parts. Evaluate if these meet the project's needs
- Parts are flexible and can fit many needs
- If they do not, use Inventor to create ones that do







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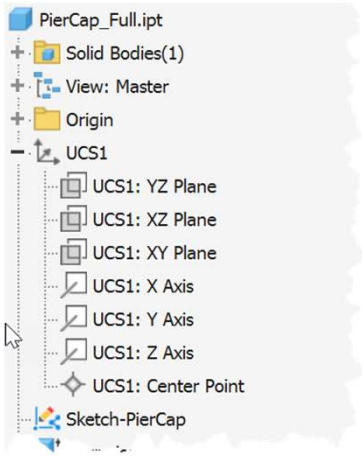
2a

Inventor

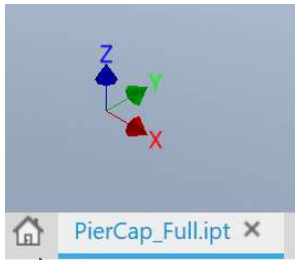
Inventor – Getting Started

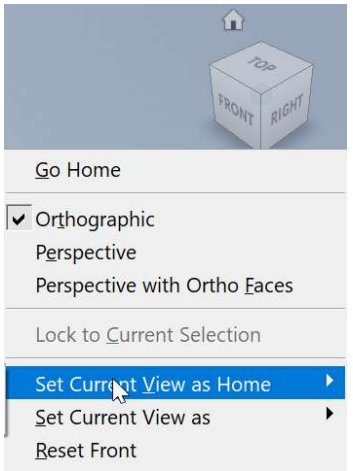
Create an Inventor template for bridges - Optional

- Create a UCS
  - The UCS will represent the part origin
  - Less issues when the part is placed offset from the origin



- Set the default views
  - “Home” – Default view when you click on the Home button of the view cube
  - “Top” – Default view when you select Top on the view cube
  - Setting these makes it easier to move around in Inventor

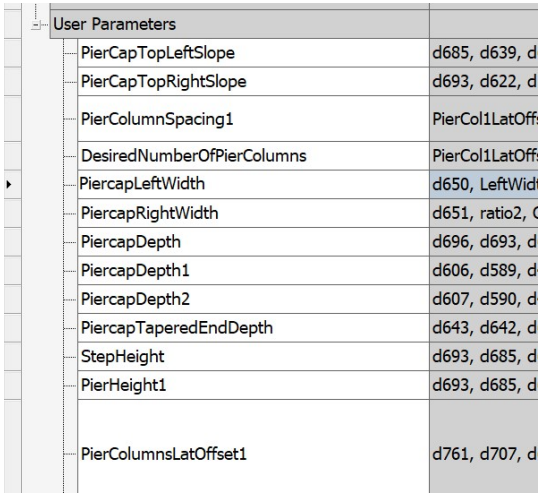




Inventor – Getting Started

Create an Inventor template for bridges continued - Optional

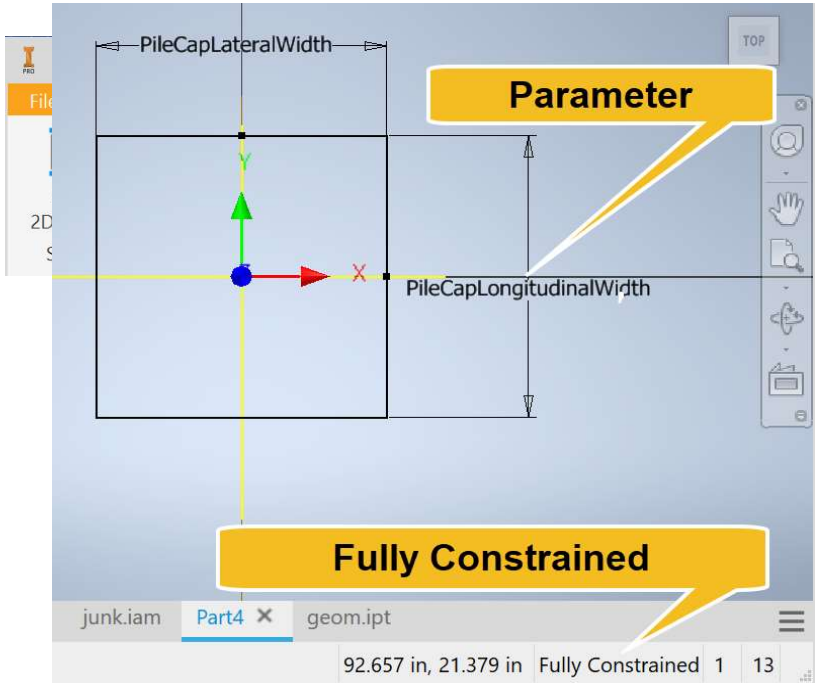
- Create frequently used Parameters
  - Promotes consistency between projects
  - Focus on ones that will be used regularly as well as the standard ones that InfraWorks expects
    - "Required parameters for each bridge part:
      - **Piers**
        - PierHeight
        - PiercapRightWidth
        - PiercapLeftWidth
      - **Abutments**
        - CLBearingToBBW
        - LeftWidth
        - SeatDepth
        - SeatOffset
        - SeatWidth
      - **Bearings**
        - BearingAssemblyHeight
        - ExtraHeight
        - GirderSoffitLongiSlope
        - GirderSoffitTransSlope
        - PiercapLongiSlope
        - PiercapTransSlope
      - **Decks**
        - LeftWidth
        - RightWidth



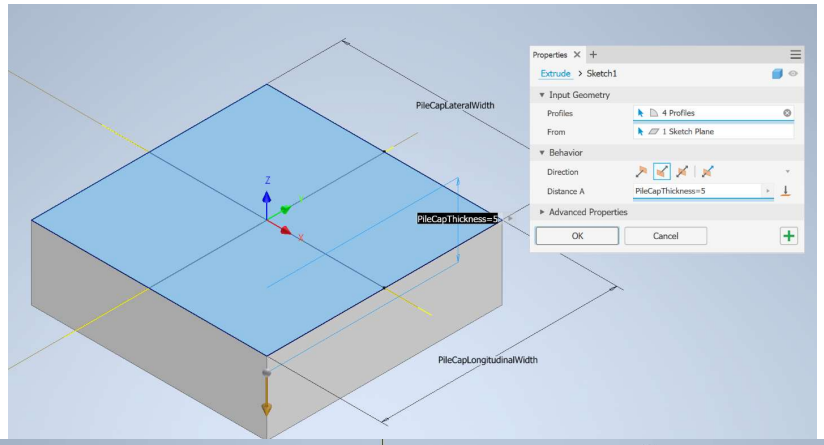
Inventor

Create an Inventor part or assembly

- Create 2D Sketch
  - Define parameters
    - Parameters let you “flex” the part in InfraWorks
  - Recommended to fully constrain the part. This minimizes issues when the part is flexed, or adjusted

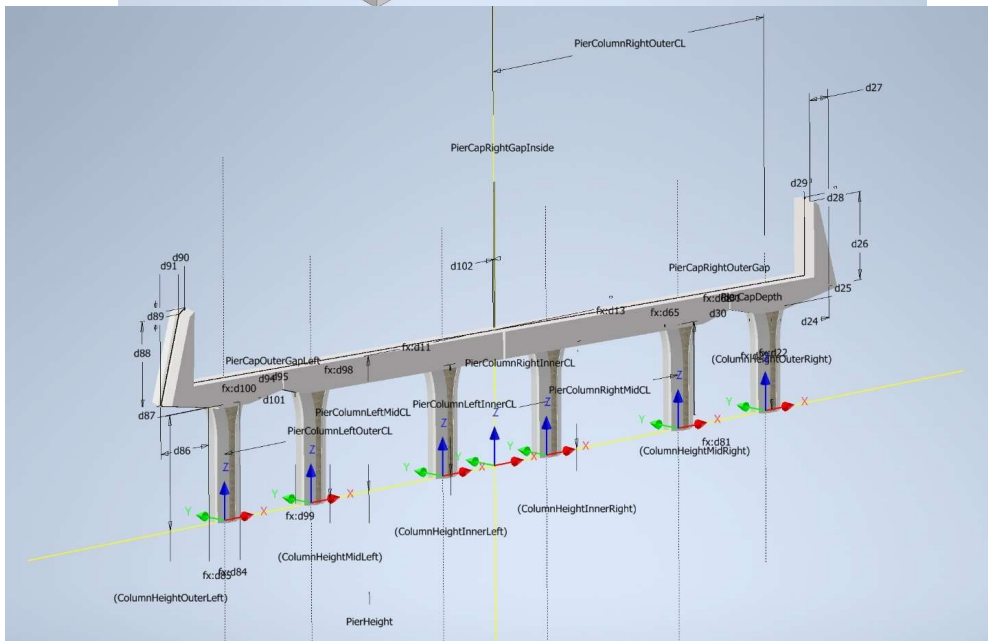


Inventor



Create an Inventor part or assembly

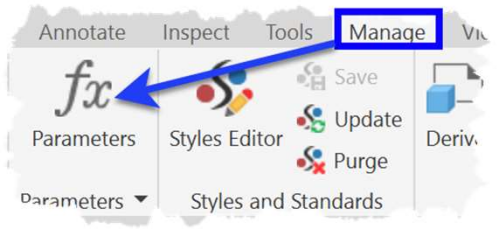
- Create 3D solids from sketches
  - Extrude, loft, revolve, sweep…
- Two paths:
  - Part – collection of geometrically and dimensionally related features that represent a physical object
    - simple and quick
  - Assembly – a collection of parts and subassemblies that function as a single unit
    - more complex and flexible/reusable
    - Easier to reuse individual parts for other assemblies

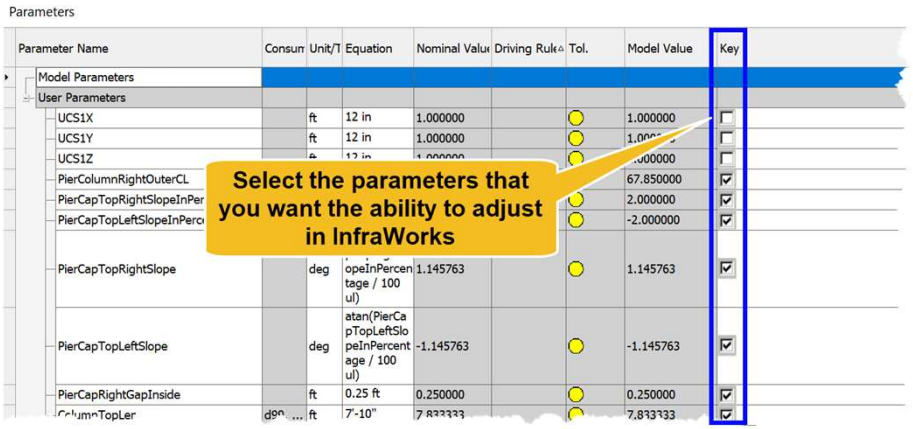


Inventor

Export part or assembly for use in InfraWorks

- **Before exporting the part**, you must select the parameters that you want to pass to InfraWorks
  - **Manage > Parameters**
  - In the **Key column**, select the parameters to export with the part

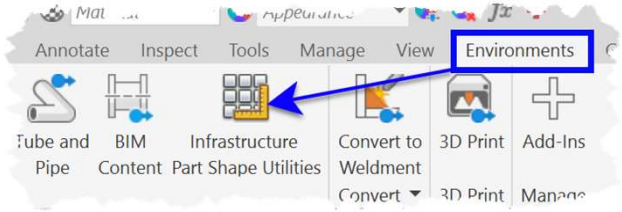


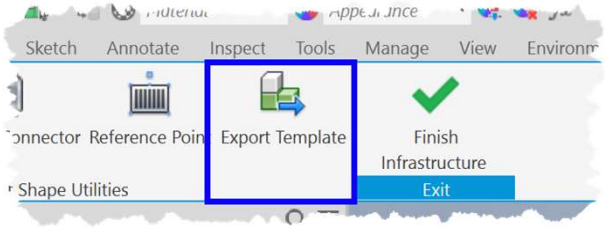


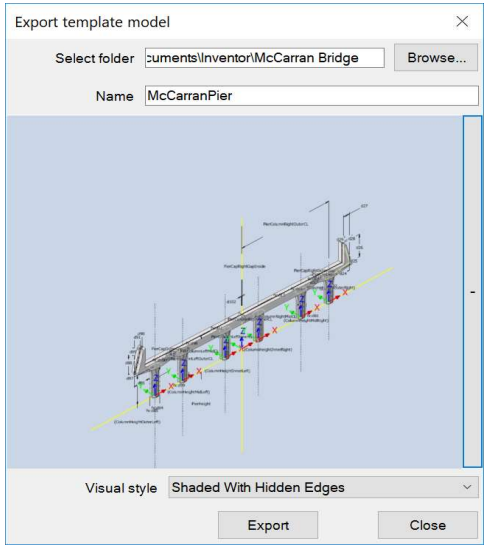
Inventor

Export part or assembly for use in InfraWorks

- To export the part
  - Navigate to **Environments > Infrastructure Parts Shape Utilities**
    - Requires *Inventor Infrastructure Modeler Plugin*
  - Select **Export template**
    - Select the location you want to store the part and give it a name
    - select **Export**







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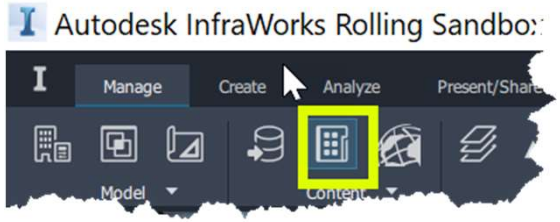
2 InfraWorks

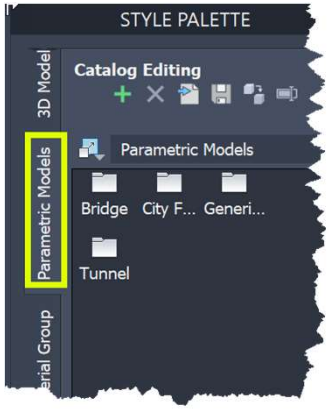
InfraWorks

Import the Inventor part

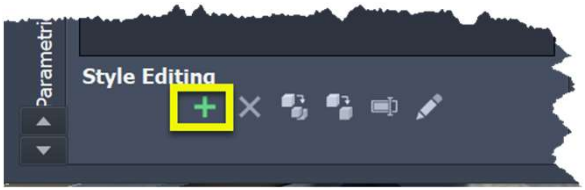
- To import the part to InfraWorks you must create a new Style
  - Select **Manage > Style Palette**



  - Select the **Parametric Models** tab of the Style Palette dialog
  - Select the **Bridge** folder, then select the folder that represents the category that you want to import (Pier, Foundation, Abutment…)



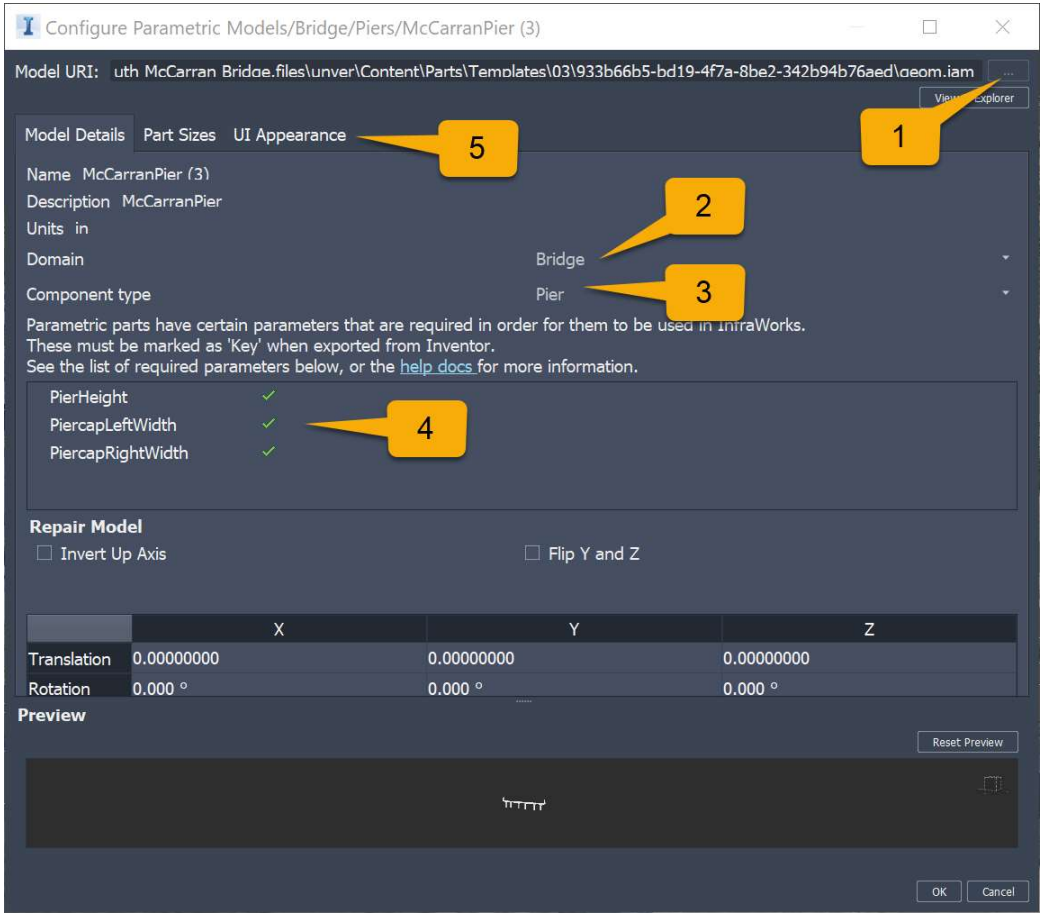
  - At the bottom of the Style Palette dialog, select the **"+",** which is the **Add new style** tool



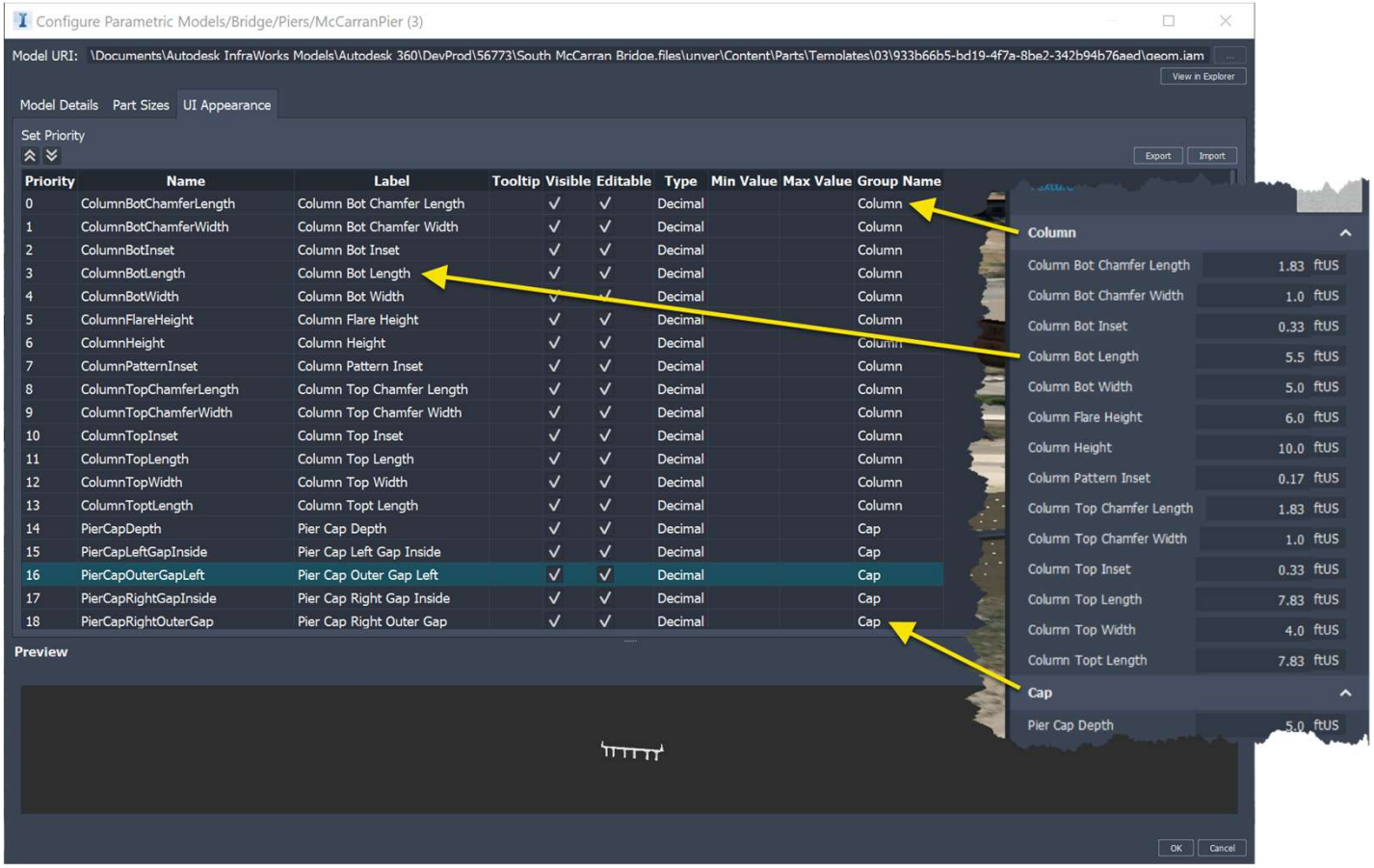
InfraWorks

Import the Inventor part

1. Browse to the Inventor Part
2. Select Domain Type
3. Select Component Type
4. Check the “required parameters
5. Switch to the UI Appearance tab



InfraWorks


Configure Parametric Models/Bridge/Piers/McCarranPier (3)
Model URI: \Documents\Autodesk InfraWorks Models\Autodesk 360\DevProd\56773\South McCarran Bridge.files\unver\Content\Parts\Templates\03\933b66b5-bd19-4f7a-8be2-342b94b76aed\geom.iam
View in Explorer
Model Details
Part Sizes
UI Appearance
Set Priority
Export
Import
Priority | Name | Label | Tooltip | Visible | Editable | Type | Min Value | Max Value | Group Name
0 | ColumnBotChamferLength | Column Bot Chamfer Length | | ✓ | ✓ | Decimal | | | Column
1 | ColumnBotChamferWidth | Column Bot Chamfer Width | | ✓ | ✓ | Decimal | | | Column
2 | ColumnBotInset | Column Bot Inset | | ✓ | ✓ | Decimal | | | Column
3 | ColumnBotLength | Column Bot Length | | ✓ | ✓ | Decimal | | | Column
4 | ColumnBotWidth | Column Bot Width | | ✓ | ✓ | Decimal | | | Column
5 | ColumnFlareHeight | Column Flare Height | | ✓ | ✓ | Decimal | | | Column
6 | ColumnHeight | Column Height | | ✓ | ✓ | Decimal | | | Column
7 | ColumnPatternInset | Column Pattern Inset | | ✓ | ✓ | Decimal | | | Column
8 | ColumnTopChamferLength | Column Top Chamfer Length | | ✓ | ✓ | Decimal | | | Column
9 | ColumnTopChamferWidth | Column Top Chamfer Width | | ✓ | ✓ | Decimal | | | Column
10 | ColumnTopInset | Column Top Inset | | ✓ | ✓ | Decimal | | | Column
11 | ColumnTopLength | Column Top Length | | ✓ | ✓ | Decimal | | | Column
12 | ColumnTopWidth | Column Top Width | | ✓ | ✓ | Decimal | | | Column
13 | ColumnToptLength | Column Topt Length | | ✓ | ✓ | Decimal | | | Column
14 | PierCapDepth | Pier Cap Depth | | ✓ | ✓ | Decimal | | | Cap
15 | PierCapLeftGapInside | Pier Cap Left Gap Inside | | ✓ | ✓ | Decimal | | | Cap
16 | PierCapOuterGapLeft | Pier Cap Outer Gap Left | | ✓ | ✓ | Decimal | | | Cap
17 | PierCapRightGapInside | Pier Cap Right Gap Inside | | ✓ | ✓ | Decimal | | | Cap
18 | PierCapRightOuterGap | Pier Cap Right Outer Gap | | ✓ | ✓ | Decimal | | | Cap
Preview
OK
Cancel
Column
Column Bot Chamfer Length 1.83 ftUS
Column Bot Chamfer Width 1.0 ftUS
Column Bot Inset 0.33 ftUS
Column Bot Length 5.5 ftUS
Column Bot Width 5.0 ftUS
Column Flare Height 6.0 ftUS
Column Height 10.0 ftUS
Column Pattern Inset 0.17 ftUS
Column Top Chamfer Length 1.83 ftUS
Column Top Chamfer Width 1.0 ftUS
Column Top Inset 0.33 ftUS
Column Top Length 7.83 ftUS
Column Top Width 4.0 ftUS
Column Topt Length 7.83 ftUS
Cap
Pier Cap Depth 5.0 ftUS

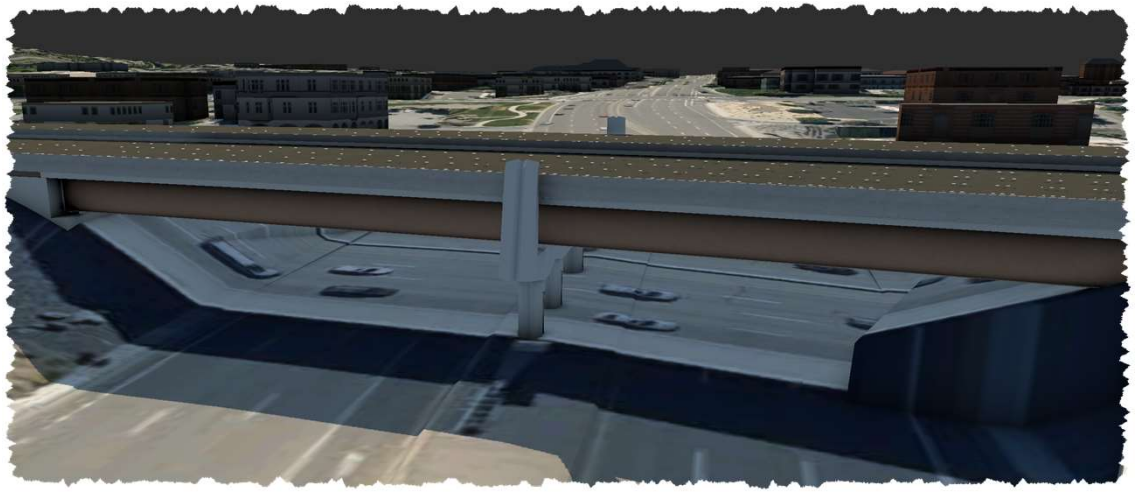
InfraWorks

Update the model

- Now that the part in imported, you can apply it to the bridge in InfraWorks

- Once you have all the correct parts applied to your bridge, change all of the parameters to meet the design requirements

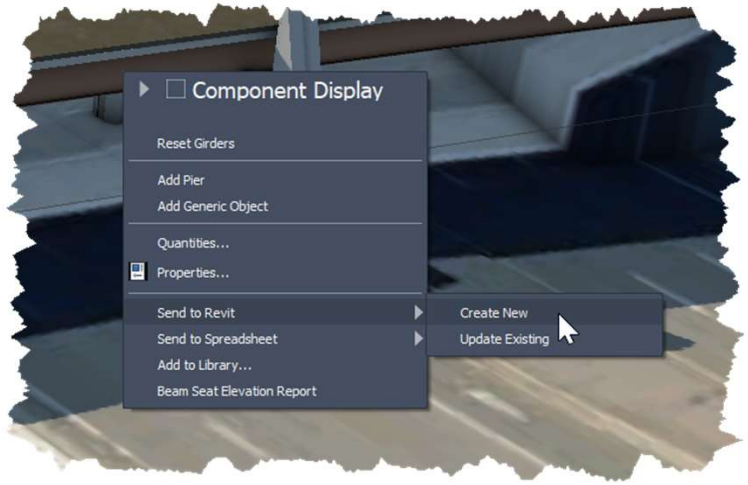
- You can make bulk changes by exporting to a spreadsheet. These changes can be reimported



InfraWorks

Export the Revit

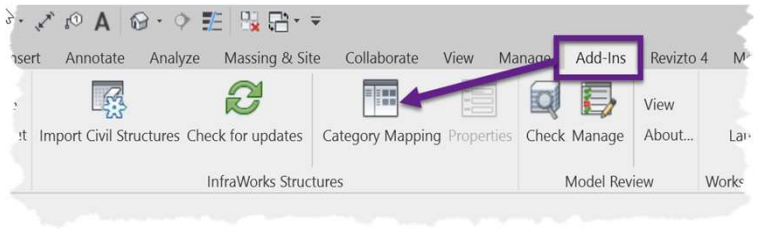
- Once you finalize your bridge, export it to Revit
- Currently this is a one direction process. You cannot make changes in Revit and update the InfraWorks model.



DEMO

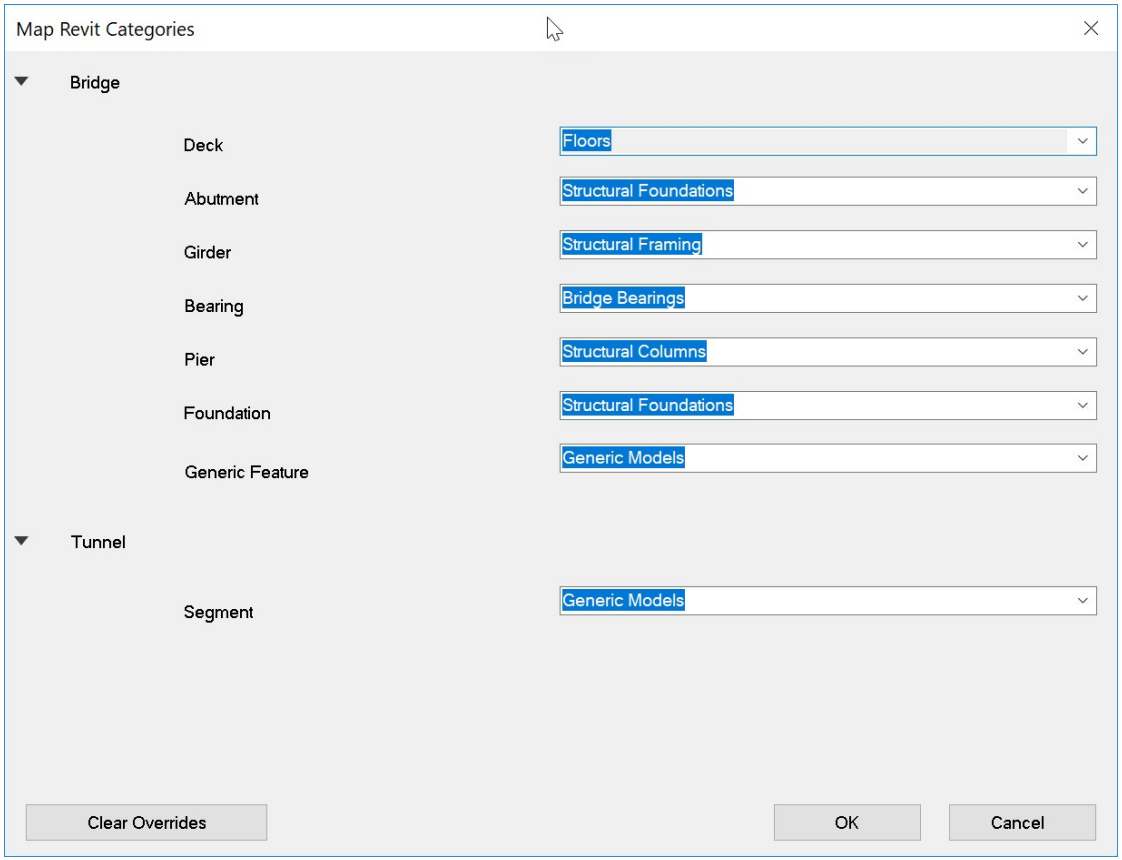
3 Revit

Revit



Import the InfraWorks model

- Create a new Structural Revit model from a template
- Navigate to the **Add-Ins** tab of the ribbon
  - This is only available if you have ***Revit InfraWorks Updater*** installed
- Select **Category Mapping** and select OK
  - Verify the categories are mapped properly and select **OK**
- Infrastructure discipline and bridge specific categories are being added to Revit *

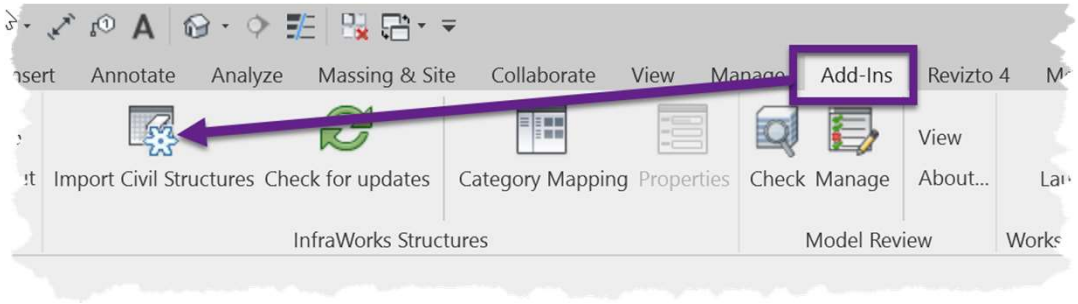


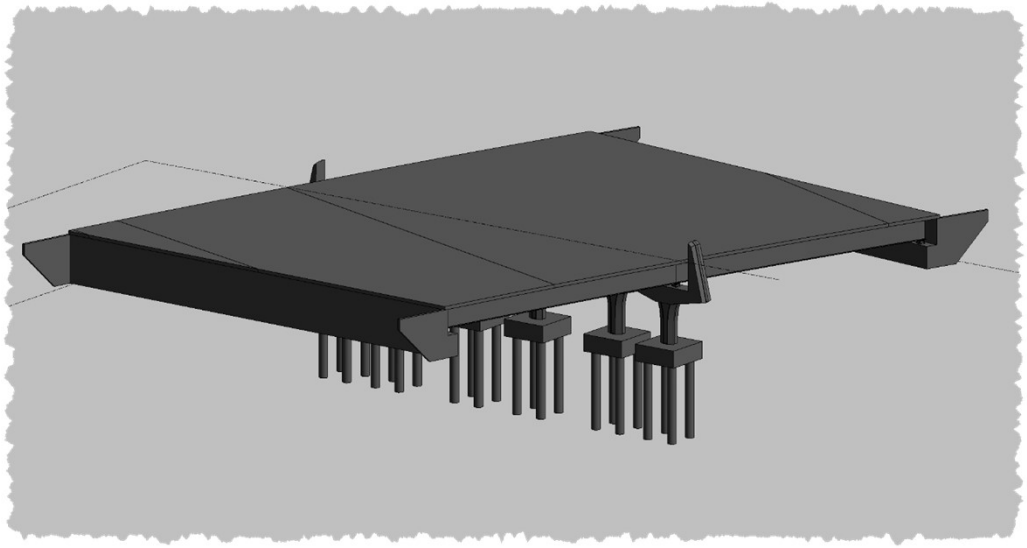
* Future feature

Revit

Import the InfraWorks model

- Select **Import Civil Structures**

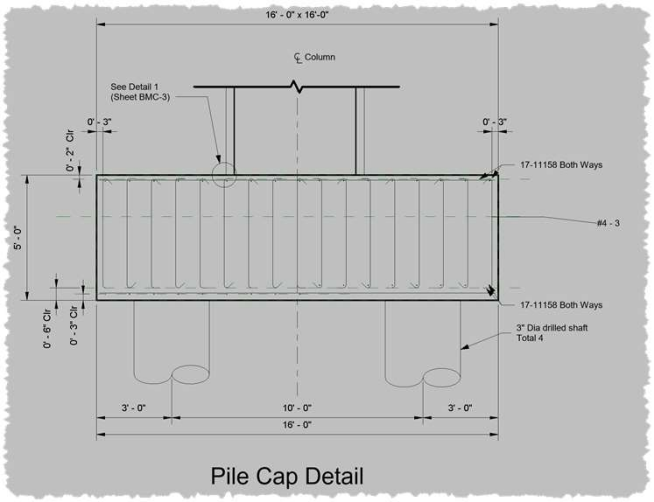




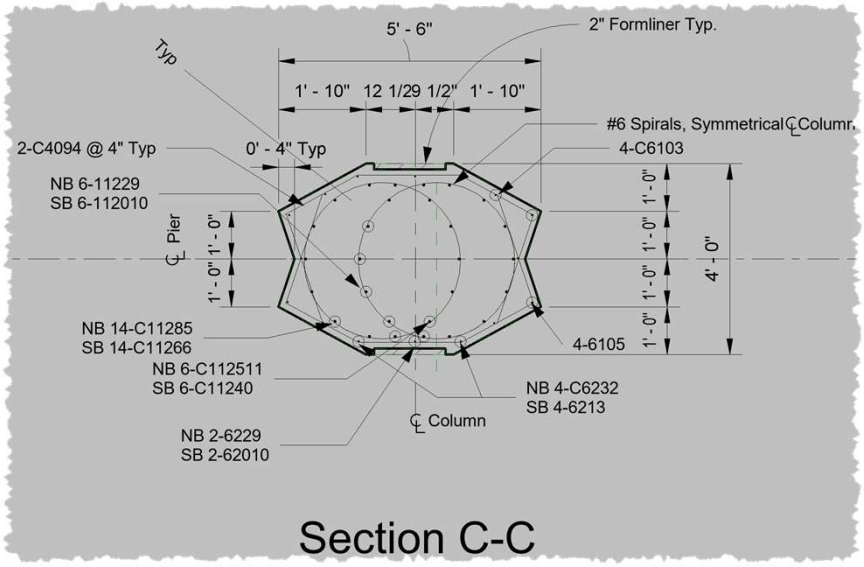
Revit

Import the InfraWorks model

- Use Revit to produce your deliverable plans
- It is important to note that the components that are imported from InfraWorks do not come in as Revit families (yet), so there are limitations to what you can do with them.
  - Some issues with controlling the display of individual lines or elements
  - Limitations with tagging elements
  - Some issues with placing rebar properly
  - These limitations should be short lived, pending updates to InfraWorks and Revit



Pile Cap Detail



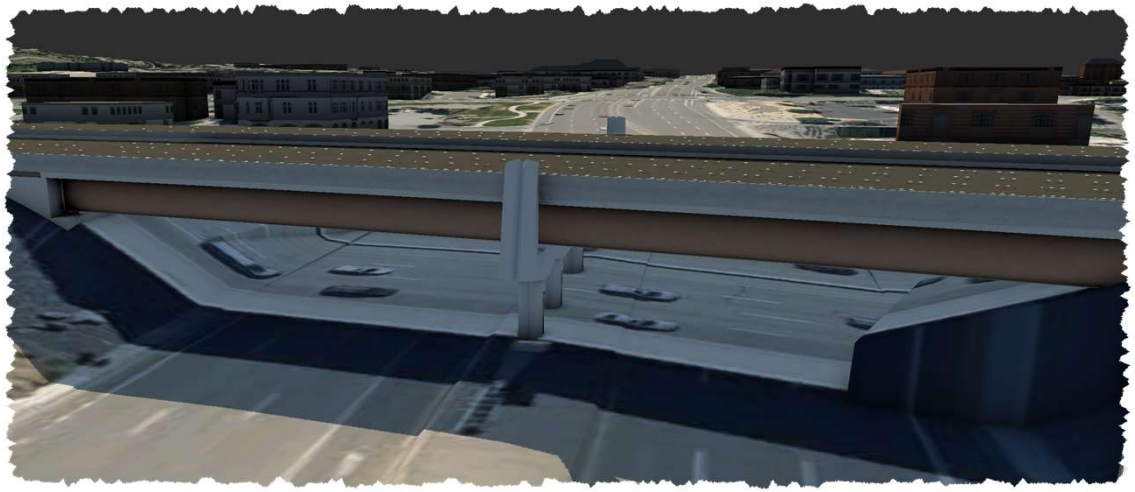
Section C-C

Recent Updates and Future Enhancements

Recent Enhancements to the Workflow

Update the model

- Dynamic C3D alignments into IW (alignments can be modified in C3D and the IW model roads and bridges can be automatically updated
- Passing all the bridge component parameters to the Revit model
- Increased level of detail of bridges with parametric bearings in IW 2020.2



Upcoming Enhancements to the Workflow

Update the model

- Support for C3D corridors
- Passing bridges will all their properties to C3D and reacting to updates from InfraWorks
- Using C3D for showing curved in plan bridges in C3D, with key annotations
- Increased LOD of steel bridges in IW: cross frames, field splices
- Extending the Line Girder Analysis capabilities by supporting grillage and finite element analysis workflows in InfraWorks with ASBD cloud services

Questions

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