CES468769

Bridge Design Workflow: Best Practices for Data Exchange

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Learning Objectives

- Explain the differences between importing Inventor parts or assemblies into InfraWorks.
- Explain the differences in working with IMX, FBX, and other formats for data transfer between each application.
- Identify Revit detailing capabilities based on the InfraWorks component type and data format.
- Explain tips for smooth coordination between Autodesk products in the InfraWorks accelerated bridge design process

Description

In this session, we will teach you the best practices for exchanging data between Civil 3d, Infraworks, Inventor and Revit. We will get into the differences of the software interactions when using FBX or IMX or ADSK, as well as the differences between creating Inventor Parts (single body vs multi-body) vs Assemblies (with skeleton modeling and iLogic) and their advantages and disadvantages; and last, how this translates to Revit for detailing and what you need to watch out for in Revit.

Data Set

The data set used for this class presentation can be found here:
https://canselo365-my.sharepoint.com/:f:/g/personal/jae_kwon_solidcad_ca/Eqx2EWKaQ75Fhj-uHeuyNacBwCnkWdffOQGxN2Ao31efGw?e=lh5JpZ

Speaker(s)

Michel Beaulieu
SolidCAD, a Cansel Company Business Developer

Michel earned his Mechanical Engineering Technologist degree in New Brunswick, Canada and has worked in various MFG and AEC positions in English and French, beginning with McDonnell Douglas Aircraft in 1984. He has since gained experience in a wide range of projects including manufacturing, building, DOT infrastructure, and more. Combining his consulting, management and technical experience, he operated a successful technology consulting business from 2004 and joined SolidCAD in 2017.

He has Autodesk Professional Certifications in AutoCAD, Civil 3D, Inventor, as well as the Infrastructure Certified Implementation Expert designation. He developed workflows and software in dredging, document/data management, manufactured/log home design and standards/Revit2DWG standards converter for Department of National Defense of Canada.

Patrick Siemek
SolidCAD BIM Consultant

Patrick Siemek is a BIM/AEC Technical Consultant at SolidCAD Solutions. He graduated from George Brown College, in Architectural Technology. After completing the program, Patrick developed a strong interest in the field, and shortly after completed a Revit Architecture Professional Certificate course from Humber College.

Before working at SolidCAD Solutions, Patrick worked as an Architectural Technologist, where he earned valuable insight into the logical and critical thinking skills required to develop both an efficient and effective application of architectural technology for construction and building design. These skills helped Patrick translate them to working with SolidCAD.

Over the years Patrick has gained expertise using Revit from all disciplines Architecture, Structure and MEP along with many other tools that are used during a BIM project workflow. Patrick currently supports, teaches and builds workflows for the AEC industry using products like Revit, AutoCAD, ReCap and other related products.

Jae Kwon
SolidCAD Technical Consultant

Jae earned a certificate in civil engineering technology with a focus on highway and municipal projects in Moncton, New Brunswick, Canada. He has worked in the civil engineering industry as a designer and a CAD standards manager before joining SolidCAD as a technical consultant.

Jae currently teaches, provides support and develops workflows for Civil3D, AutoCAD, InfraWorks and related products. His primary areas of interest are automation via Dynamo for Civil 3D, promoting impactful narratives through real-time visualizations and investigating BIM practices in the civil engineering industry.

Introduction

Traditionally, bridges have been designed and documented on 2D drawings and spreadsheets. The main challenge with this approach was ensuring that all documents reflect the latest design through multiple design changes. This was a time intensive process fraught with potential for human error and liability risk. Two 3D model based BIM workflows have been developed to address these challenges: Dynamo based approach and InfraWorks based approach. Each have their strengths. The Dynamo workflow is highly customizable and powerful (e.g. able to leverage machine learning) but has a steeper learning curve. InfraWorks approach is easy to learn, relies on existing (and familiar) software for custimization, and is easy to communicate visually at all stages of design.

The InfraWorks approach relies on all of the big three design platforms for specialized tasks: Civil 3D, Inventor and Revit. With this much inter-platform collaboration, what task to perform in which software, and how to prepare the data to be consumed by the next become important questions. It is the goal of this class to address these questions. We will offer various tips on how to make this workflow work smoothly.

There are many scenarios of which software gets involved in what stage of the project. Much of this will be dictated by the nature of the project (new or reconstruction?) how many designers are involved, what their responsibilities are, and what their individual schedules are. What data is moved when will be dictated by the scenario for the specific project.

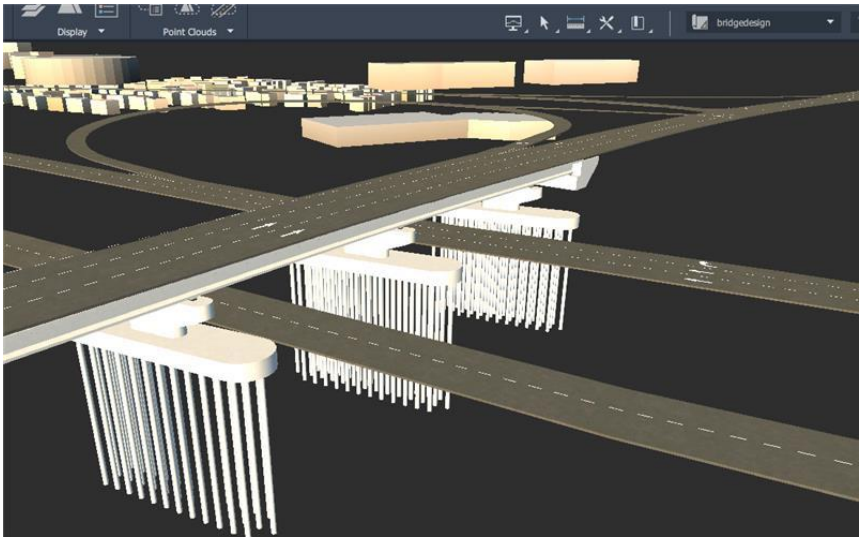
This class will mostly deal with one sample scenario. Data flow will be discussed in roughly the order of events from project start and completion. Note that this is not necessary the “correct” path for a bridge project; it is simple one possible path.

Data Transfer Between GIS, Civil3D and InfraWorks – Guide to Various Formats

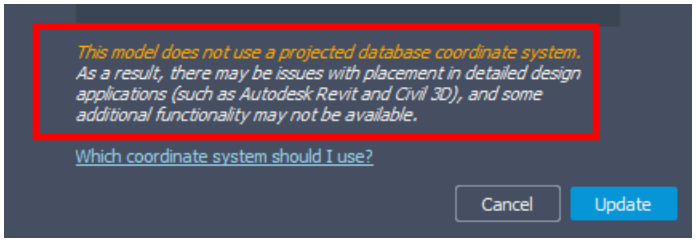
Initial Project Creation in InfraWorks: Model Builder or Manual?

Initial project setup can either begin with the model builder, or a blank new model. Model builder allows us to get some contextual data (aerial, terrain elevation, buildings, roads) very quickly and easily, and so this is how a project will often start in the earliest stages. However, if you already have more refined terrain, aerial, building and road data already available, you may want to create a blank new model.

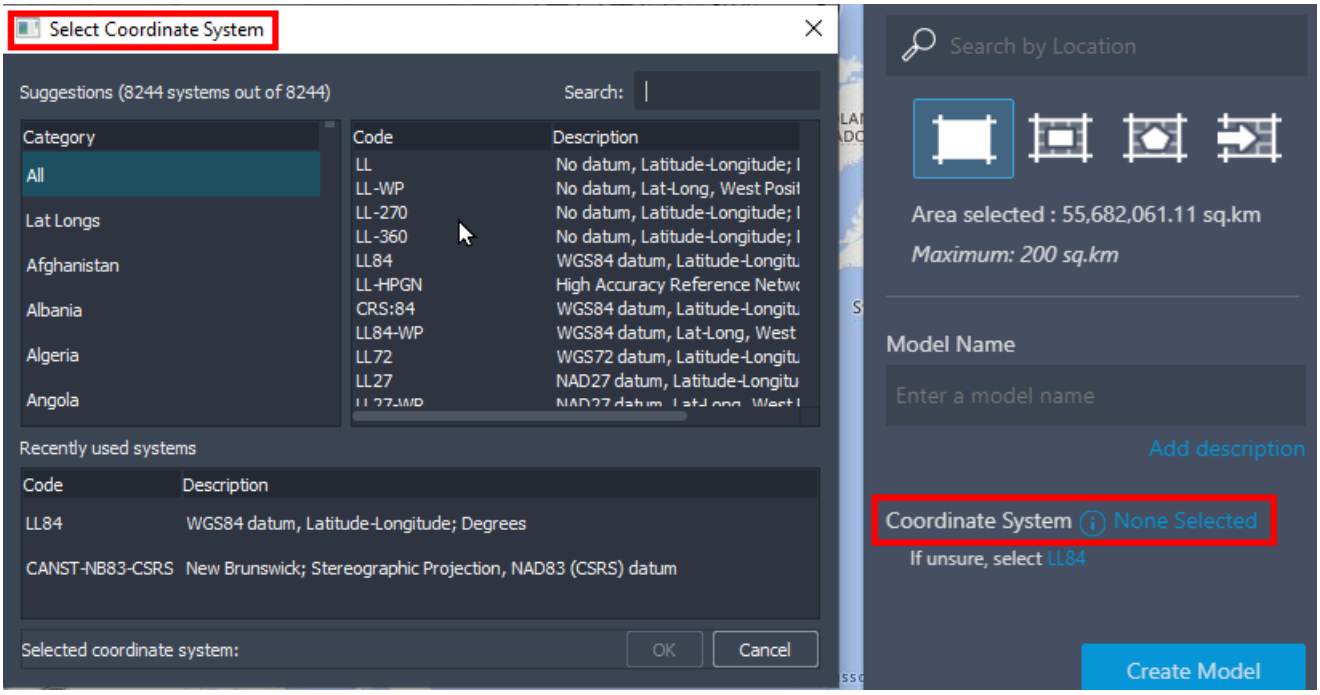
One important note is that before the 2020.1 update, there was a significant downside to models created with the model builder: the model was built with LL84 coordinate system (CS). You could change the display CS afterwards, but not the actual CS of the model. While we found that InfraWorks handled CS transformations well in virtually all of our projects, it rarely produced some unexpected errors. InfraWorks 2020.1 update solves this issue. We are now able to create model builder models using a projected coordinate system instead of LL84.



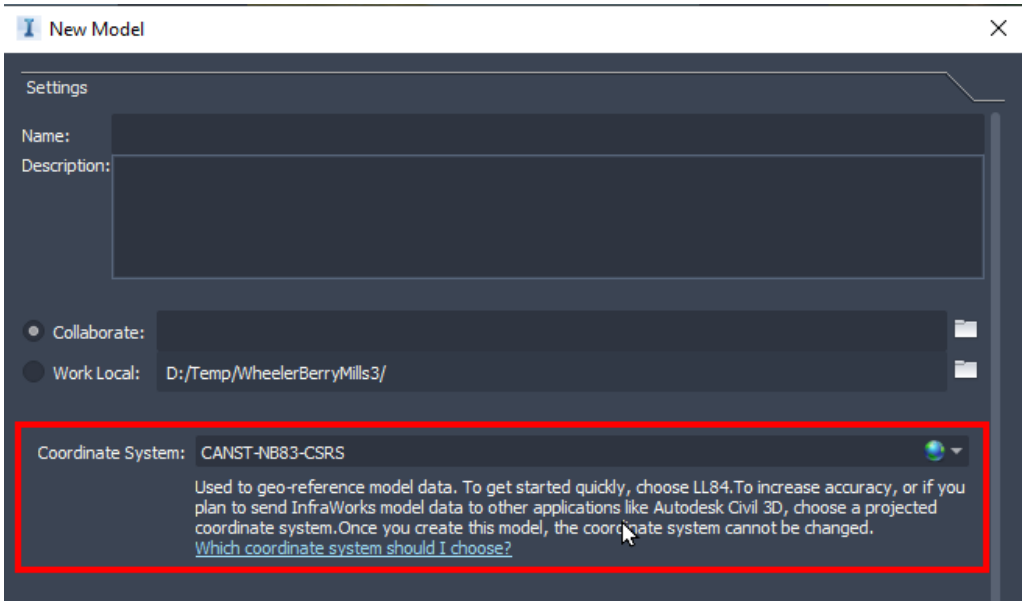
A POSSIBLE COORDINATE SYSTEM TRANSFORMATION ERROR RESULTING IN MISSING TERRAIN



A COORDINATE SYSTEM WARNING DURING AN UPDATE OF AN EXPORT



NEW 2021.1 FEATURE: MODEL BUILDER WITH PROJECTED COORDINATE SYSTEMS



COORDINATE SYSTEM SELECTION IN NEW MODEL

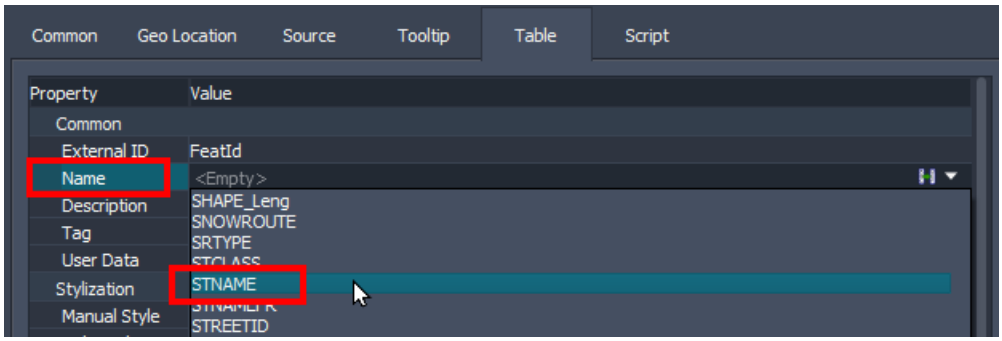
Setup Baseplans in InfraWorks

Once the model is created, we typically start adding additional baseplan data. This might include refined elevation data from LIDAR, high resolution aerial rasters, or GIS data. Before adding these types of data, however, it is often preferrable to inspect or prepare them using Civil 3D. Following are the tasks that we will cover:

1. Review GIS data
2. Prepare more accurate surfaces
3. Process surveyed data.
4. Prepare key alignments (or corridors)

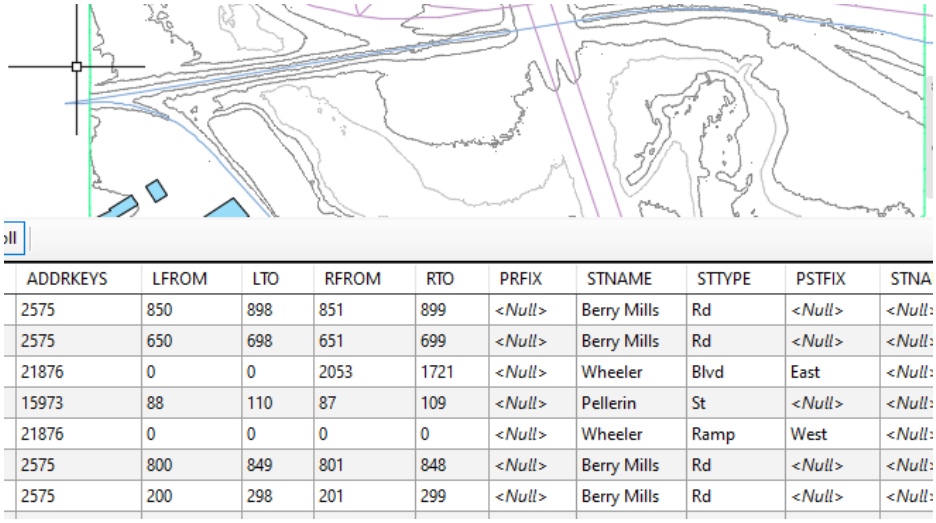
Review GIS Data

In InfraWorks, we cannot view what kinds of property set ("schema") that most GIS source data has directly (except those brought in via ArcGIS connector). Standard InfraWorks data types have their own schema; to access properties from a GIS data source, we need to assign source data properties to the InfraWorks properties ("schema mapping").



ASSIGNING A DATA SOURCE PROPERTY (STNAME) TO AN INFRAWORKS PROPERTY (NAME)

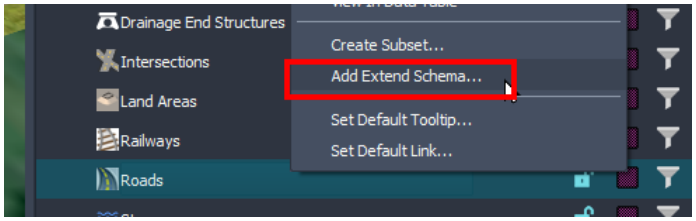
Hopefully InfraWorks will soon have automatic schema mapping for all GIS data sources like it does for ArcGIS Connector data. Until then, we need to use another program to review the source data properties, so that we know what properties will be useful and map them accordingly. Map3D, one of the underlying components of C3D, is well suited for reviewing GIS data.



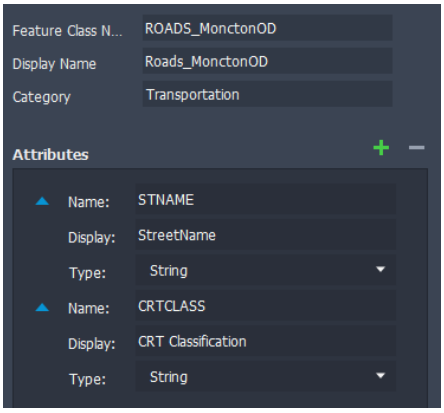
ADDRKEYS	LFROM	LTO	RFROM	RTO	PRFIX	STNAME	STTYPE	PSTFIX	STNA
2575	850	898	851	899	<Null>	Berry Mills	Rd	<Null>	<Null>
2575	650	698	651	699	<Null>	Berry Mills	Rd	<Null>	<Null>
21876	0	0	2053	1721	<Null>	Wheeler	Blvd	East	<Null>
15973	88	110	87	109	<Null>	Pellerin	St	<Null>	<Null>
21876	0	0	0	0	<Null>	Wheeler	Ramp	West	<Null>
2575	800	849	801	848	<Null>	Berry Mills	Rd	<Null>	<Null>
2575	200	298	201	299	<Null>	Berry Mills	Rd	<Null>	<Null>

GIS DATA TABLES IN CIVIL 3D

If none of the standard InfraWorks data properties is a good fit for a source property, we can always create a custom data type in InfraWorks that have an extended schema. This is done with the "Add Extend Schema…" contextual command in the Model Explorer palette.

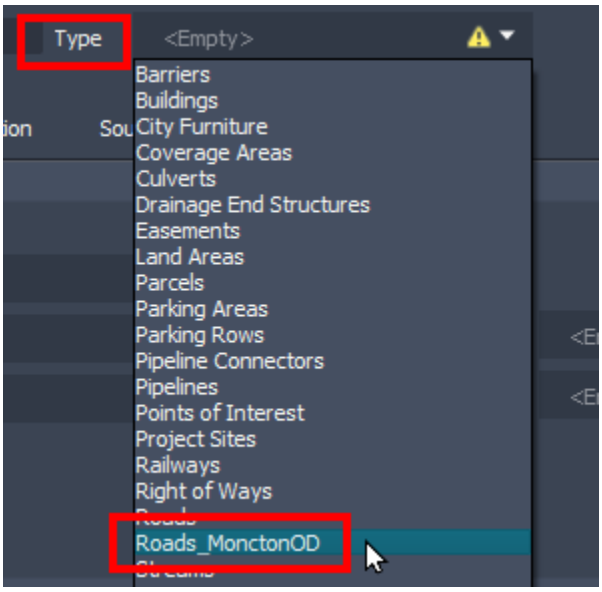


CREATING CUSTOM GIS PROPERTIES FOR A DATA SOURCE IN INFRAWORKS

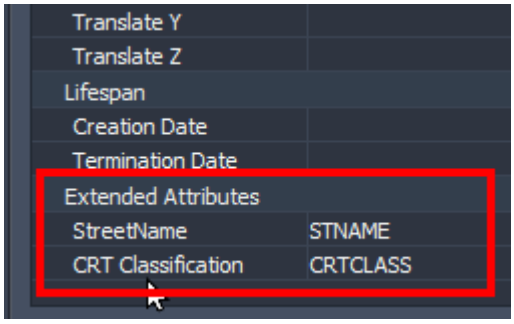


A CUSTOM DATA TYPE WITH ADDITIONAL PROPERTIES

Once a custom data type is created, it can be used when bringing in GIS data into InfraWorks. This custom data type will have an extended schema that has additional custom properties that we created for mapping to the source properties.



ASSIGNING A CUSTOM ROAD DATA TYPE



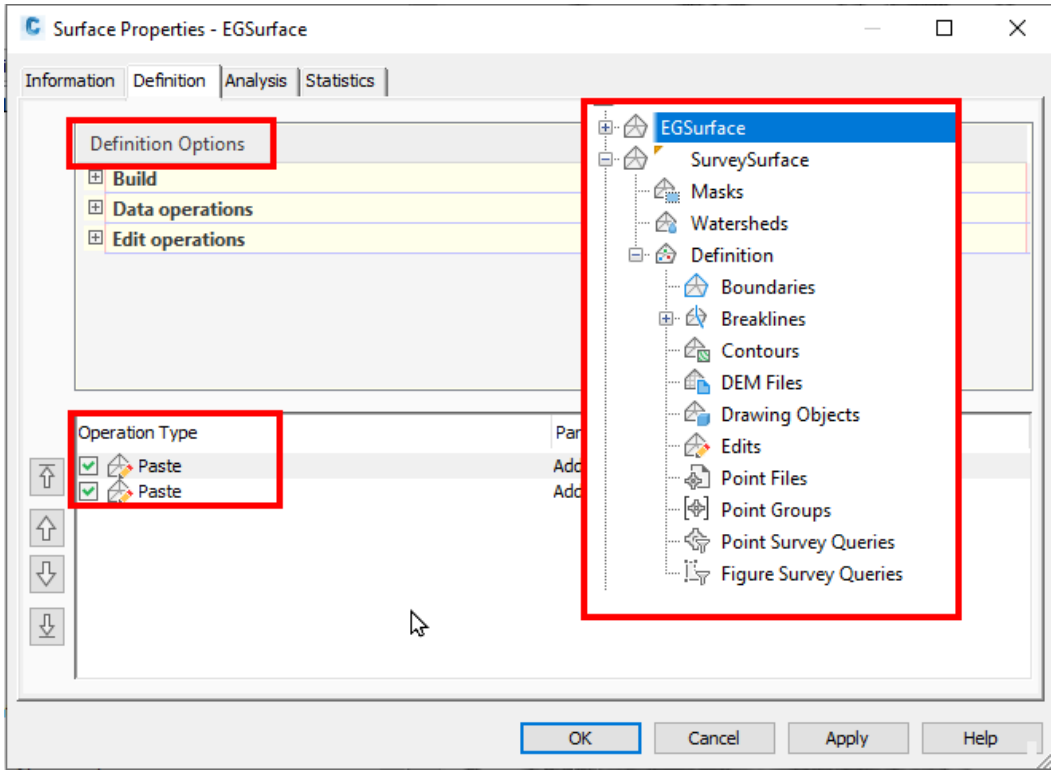
SOURCE DATA MAPPED TO CUSTOM PROPERTIES

The following are some sample GIS review and schema mapping tasks:

- Connect to the building SHP, review zoning/usage of buildings. Map data accordingly in IW, and setup a feature theme.
- Connect to road SHP, review number of lanes, and map data accordingly in IW, and have roads drawn with correct number of lanes.

Prepare a Surface in Civil3D

Elevations from model builder gets us going quickly but should be replaced with a more accurate surface. Even before a field survey is completed, a good surface can usually be prepared from various data types (e.g. DEM, contours, Lidar, photogrammetry point cloud). Some of these surface types can be brought directly into InfraWorks, but Civil 3D is typically a better tool to organize and combine various data sources.



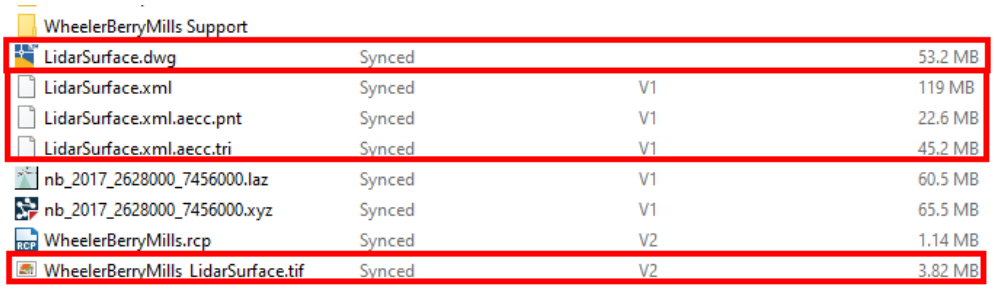
POWER OF SURFACE CONSTRUCTION IN CIVIL 3D

For this project, a LIDAR surface was prepared in the following steps:

1. Unzip the LAZ lidar file to LAS, and extract only the terrain points to an XYZ file.
2. Create a point cloud file (RCP) with Recap
3. Attach the point cloud in a Civil 3D DWG.
4. Generate surface from point cloud (decimated by average distance between points, with no filtering options)
5. Select surface and generate a GeoTIFF dem from it.
6. Import TIF into InfraWorks, move it from unclassified to terrain and turn off old terrain elevation.

Tip: The surface can be directly imported from the DWG in InfraWorks. In this case GeoTIFF was used to reduce file size and improve performance.

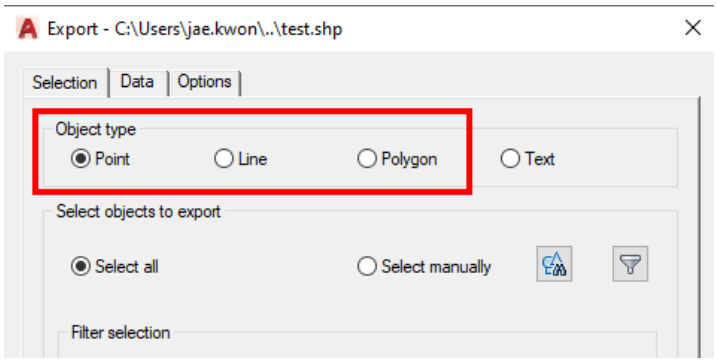
Tip: The surface can also be exported as a LandXML but this format can take significantly longer to import and can have more potential coordinate system issues.



COMPARATIVE FILE SIZES OF SOME SURFACE DATA FORMATS

Import and integrate survey data

C3D also excels at bringing in surveys as points and figures. This can be used to create features for importing into InfraWorks, or to refine the surface that is being imported into InfraWorks. Tip: Typically, the best way to bring point and linear features from surveys into InfraWorks is to import the survey into Civil 3D then exporting it has shape files for consumption by InfraWorks.

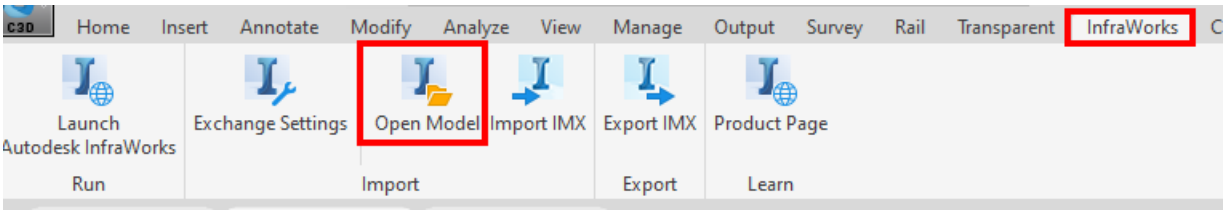


MAPEXPORT: THE BEST METHOD TO EXPORT POINT, LINE AND AREA OBJECTS TO INFRAWORKS

Refine Road Alignment in Civil3D

Often, roads from GIS data are disconnected, have inaccurate geometries, and are generally unsuitable for use in design. While IW has alignment/profile design capabilities, C3D has a mature toolset that more road designers are familiar with. If a GIS Map3D/Civil3D DWG is already prepared and includes road data, use that as reference. If not, an import of the InfraWorks model builder data can be used as reference. The import workflow depends on the model location.

1. Local model: In C3D, open InfraWorks model (file type = sqlite). Default InfraWorks model location is \Documents\Autodesk InfraWorks Models\Autodesk 360. “Open model” has advantage over the “Import IMX” in that object settings and selection set can be refined.
   - Tip: While “opening model”, the InfraWorks model should be closed in IW to avoid coordinate system errors.
   - Tip: Selection set: while selection can be refined, keep in mind that you can’t filter by proposals. If there are several versions of existing coditions available in different proposals, it may be better to just export/import an IMX instead.



REFERENCING MODEL BUILDER DATA IN CIVIL 3D

2. BIM 360 model: BIM 360 models use the IWM format and is not compatible with the "Open Model" command. In this case, it is best to export to IMX.

Use the imported alignment geometries as a guide to draw proper alignments with sound geometries to replace the old ones. Construction lines, snapping, offsetting and so on can be very useful here. Once the refined alignments (and optionally, profiles) are drawn, you will want to isolate them before bringing them back into IW, as you do not want to re-import duplicates.

The best way to do this is to data shortcut the refined roads. Create a new drawing with only those roads, from data shortcuts. If the original design is altered, simply sync the data shortcut drawing and reimport into IW. Another option is a simple save-as, but it loses some dynamic linking which is not preferable.

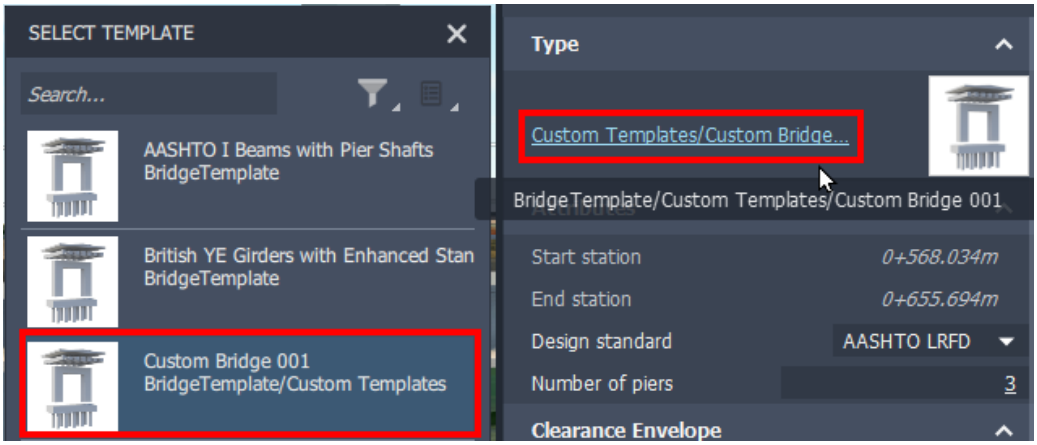
Construct Corridors in Civil 3D

At any point during the project, alignments in Civil 3D can be fully developed into detailed corridors and imported into InfraWorks. This feature has been further improved in 2021.1 update to allow for additional flexibility after being imported into InfraWorks.

Begin Designing Bridge in Infraworks

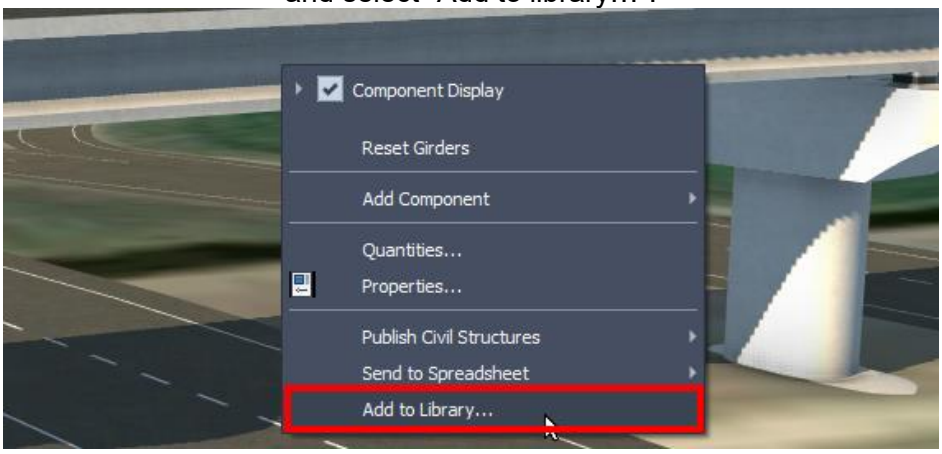
Initial Bridge Design and Edit

Once a bridge is created, the bridge design process can be further accelerated by reusing configurations from past projects, or leveraging Excel in adjusting parameters. There are two levels at which settings can be saved and reused: at the level of parts (e.g. pier, girder, deck, footing) or all at once (bridge assembly). To import all settings of the entire bridge assembly at once, simply select the bridge and click on the assembly icon on the properties palette.



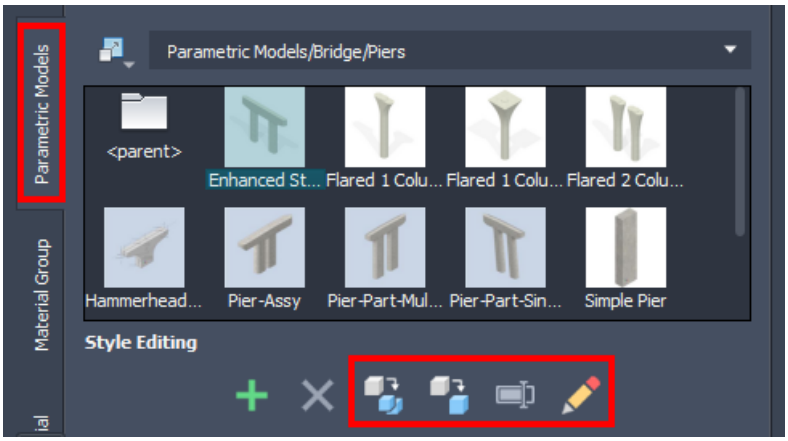
LOADING AN EXISTING BRIDGE ASSEMBLY

To save an existing bridge configuration to the library, simply select the bridge, right click and select “Add to library…”.



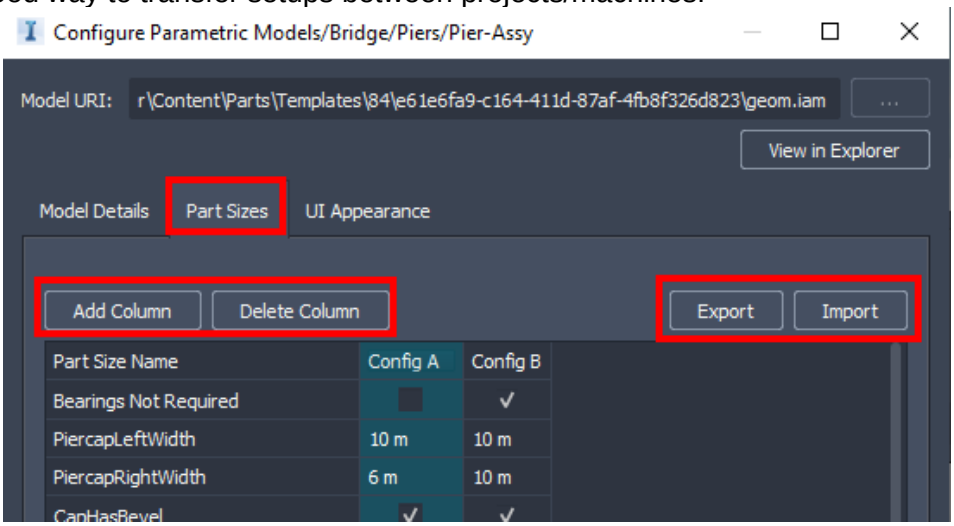
ADDING A COMPLETE BRIDGE CONFIGURATION TO THE LIBRARY

Saving or loading part configurations are done through the style palette. Existing styles can be edited with the edit button. Note that stock styles will need to be duplicated first, as the original can't be edited.



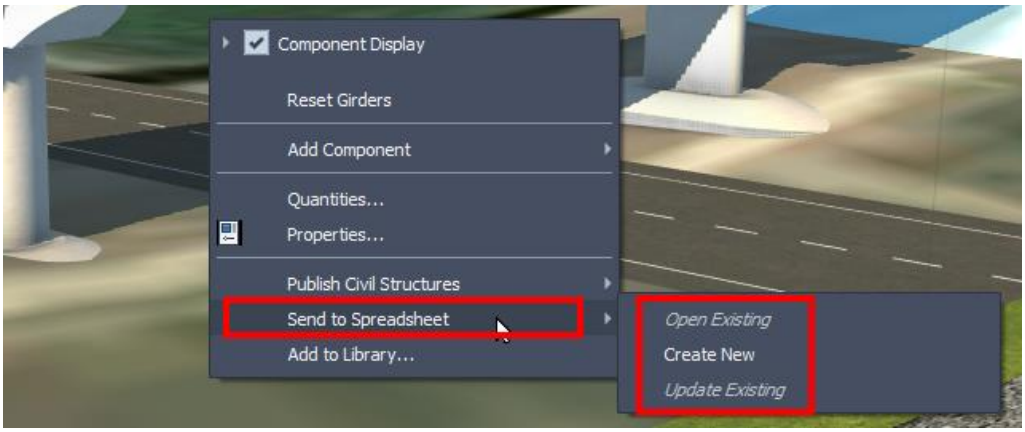
DUPLICATE, RENAME AND EDIT PARAMETRIC BRIDGE COMPONENTS

Under the “Part Sizes” column, edit individual parameters. To setup multiple sets of values that you can switch to easily, you can use the “Add Column” button.
Once the values (or columns of values) are adjusted to your liking, you can export all columns to a json file with the export button. Exporting to and importing from json files is a good way to transfer setups between projects/machines.



CONFIGURING, IMPORTING AND EXPORTING SETS OF BRIDGE COMPONENT VALUES

Bridge assemblies and json files are a good way to load part and bridge templates. But what about editing the current bridge? There is a powerful way to do that as well via Excel.



EXPORTING, UPDATING AND RE-IMPORTING BRIDGE INPUT PARAMETERS TO/FROM EXCEL

To export the existing bridge input parameters to Excel: select the bridge, right click, and select “Send to spreadsheet”\”Create New”.
Once exported, you have the full power of Excel’s formulas, scripts, and other analytical/calculation tools at your disposal.

31	PierCapTopRightSlopeInPer	PierCapTopRightSlopeInPer		3
32	PierCount	PierCount		1
33	PierDepth	PierDepth	m	1
34	PierHasFillets	PierHasFillets		1
35	PierHeight	PierHeight	m	4.816
36	PierIsRound	PierIsRound		0
37	PierSpacing	PierSpacing	m	5.5
38	PierWidth	PierWidth	m	3

Bridge | Deck | Piers SingleBody-Pier | Piers Assy-Pier | Piers MultiBody-Pier | Foundations MB-GroundRaised | Foundations A

BRIDGE COMPONENT PARAMETERS IN EXCEL SPREADSHEET

To make changes and update the previously exported spreadsheet: select the bridge, right click and select “Send to spreadsheet”\”Update existing”. To update the bridge design from the spreadsheet values: select the bridge, right click and select “Send to spreadsheet”\”Open existing”.

Communicating Design

InfraWorks designs can easily be communicated via shared views, photos and videos using the built-in tools.

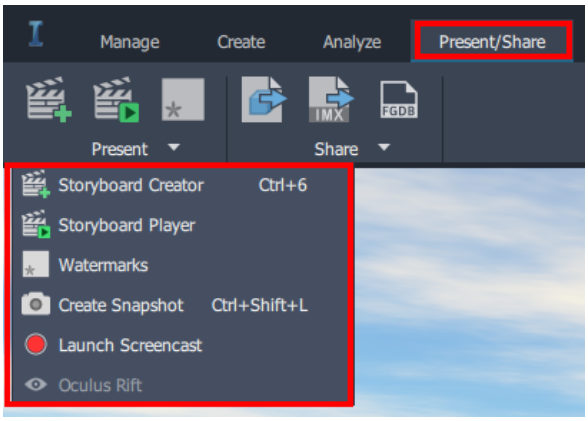
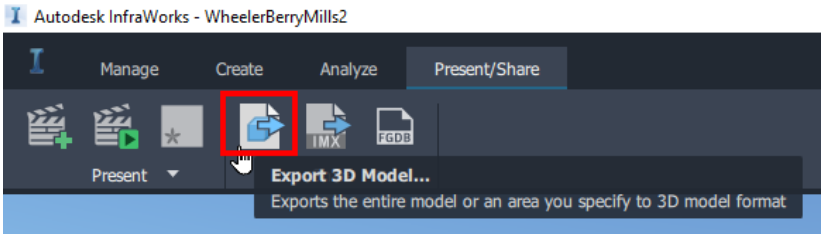


PHOTO AND VIDEO CREATION OPTIONS IN INFRAWORKS

What if, however, you want to create more sophisticated visualizations using, for example, 3DS Max or a real-time visualization enging? This is when you want to export the model as an FBX.



EXPORTING A PROPOSAL AS AN FBX FOR ADVANCED RENDERING

A SAMPLE REAL-TIME RENDERING USING AN EXPORTED FBX

Customizing Bridge components, using Autodesk Inventor

You may be able to create your initial bridge design using the built-in Bridge components of Infraworks, such as the Abutments, Bearings, Cross Frames, Decks, Field Splices, Foundations, Girders or Piers. However, in some situations, these standard components will not suffice and you may need to customize an existing component or even create a new component from scratch. This is accomplished by using Autodesk Inventor.

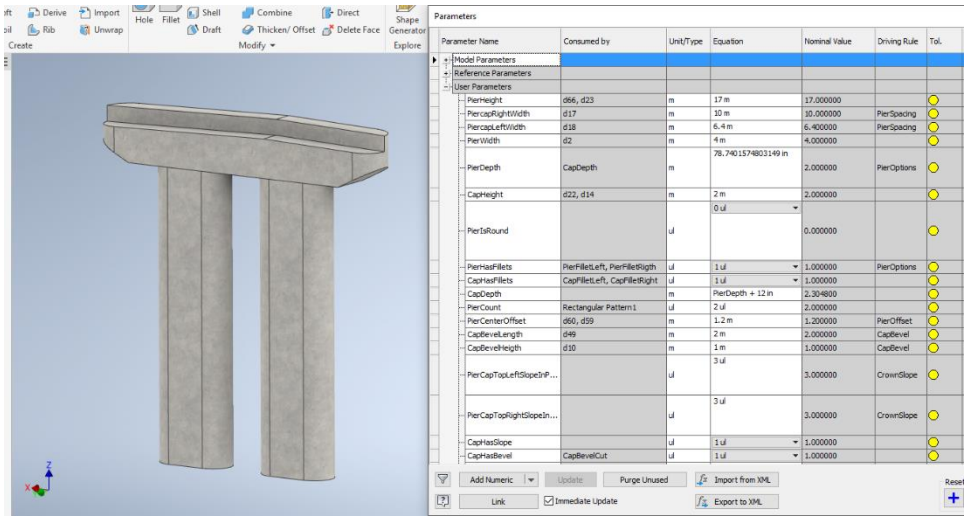
Autodesk Inventor is a powerful 3d modeling software because it has a robust 3d parametric modeling engine and has a simple to learn and use interface. It is however extremely powerful because it is a full design/manufacturing package that support parts with single bodies, parts with multiple bodies and assemblies and sub-assemblies as well. On top of all that, it also has a very simple sketching interface with strong sketch relationships (constraints) and also a built-in scripting language based on VBA called iLogic – which allows you to add automation and/or intelligence to your design, which is very important in the case of using Assemblies

Note: This class is not going to teach you how to use Inventor or do detailed assemblies or iLogic. For this class, we assume users only have basic knowledge of Inventor.

The following image shows a custom Pier and its parameters in Infraworks

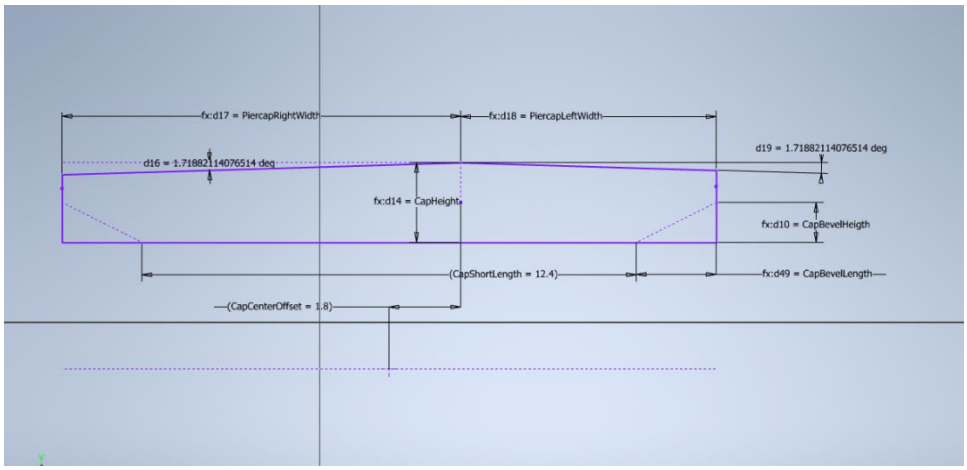
Pier in Infraworks

The following image shows the same pier (from previous image) and the same parameters inside of Autodesk Inventor.



Original Pier model in Inventor

While the following image shows the Sketch and associated parameters inside Autodesk Inventor

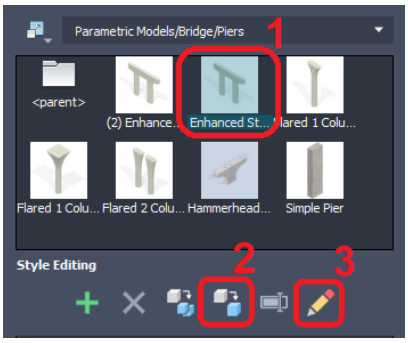


Pier Cap Sketch in Inventor

Customizing an existing Pier

The best place to start with custom components is to see/find if an existing component will do 90 or 95% of what you need and then customize that component – instead of starting from scratch.

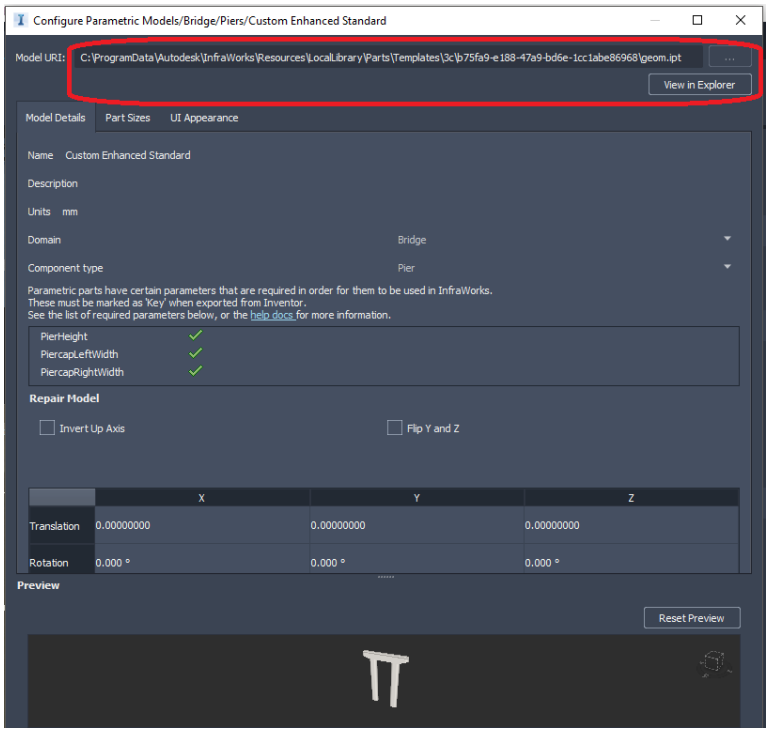
1. Open the Styles Palette in Infraworks.
2. Using the tabs on the left, pick the Parametric Models tab.
3. In the Parametric Tab, go to the Bridge heading. Here you find all the parametric bridge components.
4. For this example, go into the Piers
5. Select the Enhance Standard Pier (1) and then click on the Duplicate Icon (2) give the new Pier a new/different name. Once done, Pick the Edit button (3).



Copy and Edit in Infraworks

6. This will give you the location of the Inventor part.

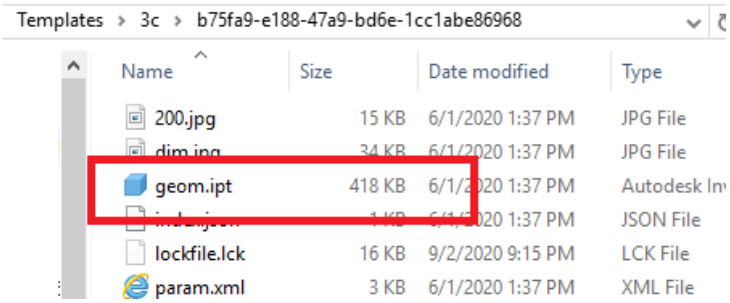
7. Use the View in Explorer button to see the location and name of the files and associated files required.



Edit dialog in Infraworks

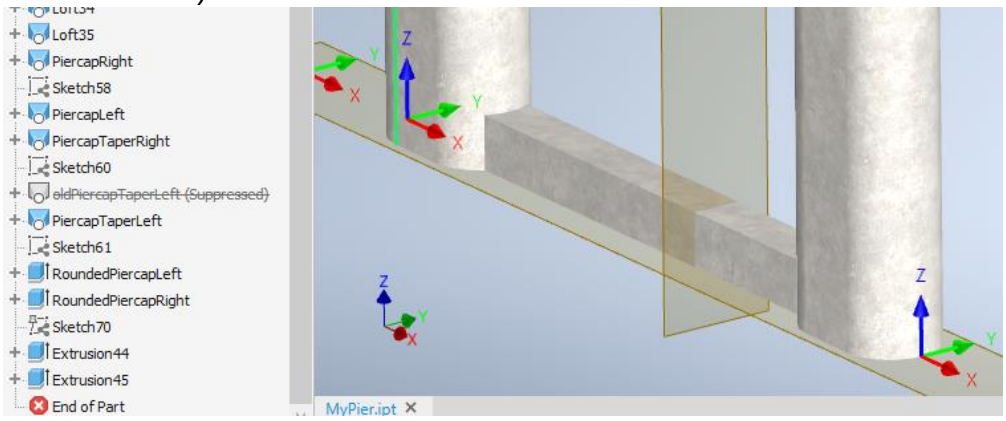
8. Now, because Infraworks stores its parametric files in a unique numbering scheme, you probably won't be able to remember where this particular file is next time. We suggest you open the file in Inventor and Save a Copy of this file in a folder that you will be able to get to easily later on, when you need to make additional changes...

   Note you won't need the other files as Inventor's Infrastructure plugin will create these from scratch for you.



Name of File to Open in Inventor

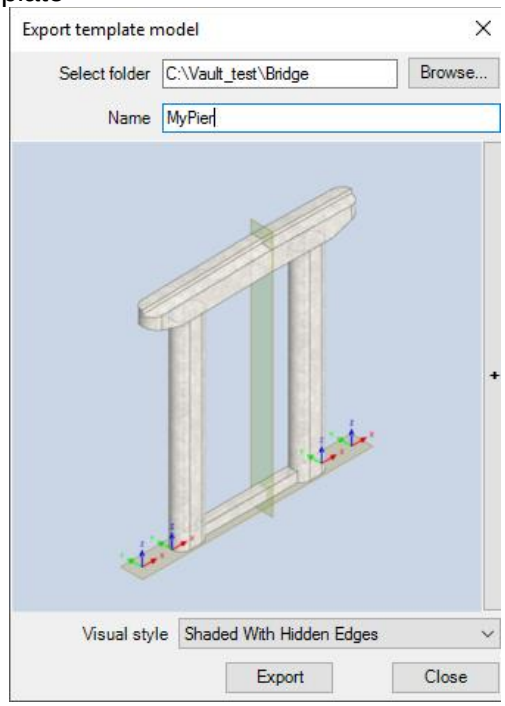
9. Now that the file is saved, we will create a new sketch on the work plane between the two columns; draw a rectangle and then extrude between the required bodies (more stable than faces)



Part File in Inventor, after modifications are done

10. Save the file.

11. Export the model to Infraworks.
    -Click on Environment
    -Click on Infrastructure Part Shape Utilities
    -Click on Export Template

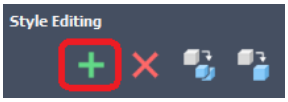


Export Infraworks dialog in Inventor

-Browse to a Folder that you will be able to find again easily, maybe a project or library folder.
-Enter the name of the File you want to create/export.
-Click on Export, then close, then Finish (on the ribbon).

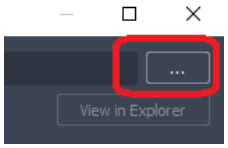
NOTE: Inventor closes your original file and left you with the “export” model file, ready for Infraworks. Save and close this file. Any time you need to modify the model, modify the original (the one you did a SaveAs) and publish to your project or library…

12. Importing the model into Infraworks. (Start Infraworks and open your model, if not already done)
13. In the Style Palette, navigate to the Bridge/Pier components again (if not already there)
14. Click on Add New Style



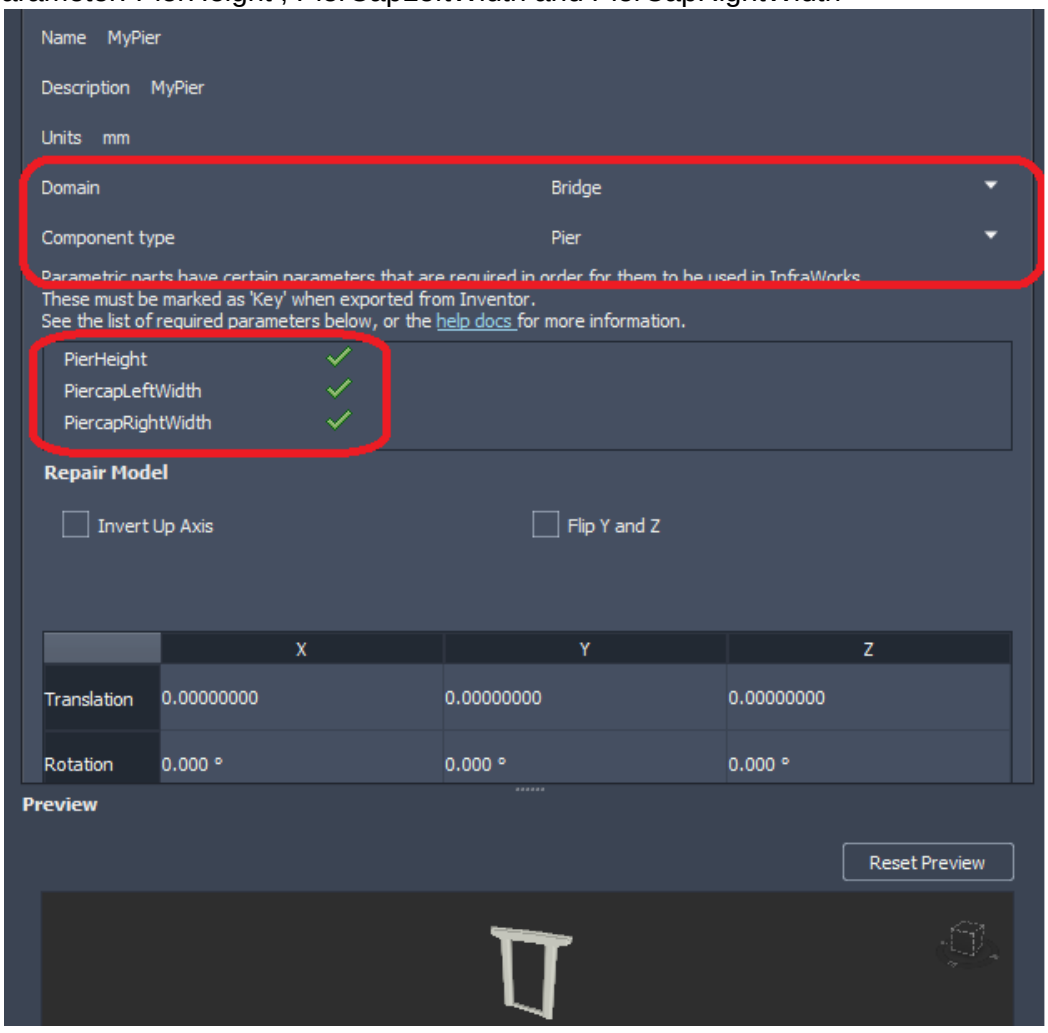
Add New Style button in Infraworks Styles Palette

15. Pick the Browse button in the Top Right.



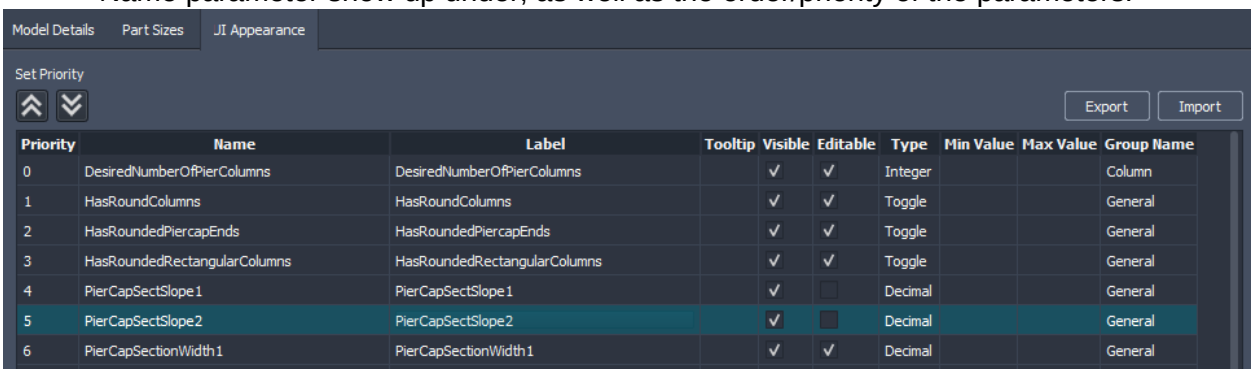
Browse button in Infraworks Add Style

16. Browse to and select the “exported” model from Inventor. (saved in your project or library)
17. You should now see a preview of the updated model you created. You should also see the Name and Description of your Pier, as well as the Domain and Component type as required by Infraworks… And last but not least, you should also see the 3 required parameter: PierHeight , PierCapLeftWidth and PierCapRightWidth



Model Details Tab in Infraworks Add Style window

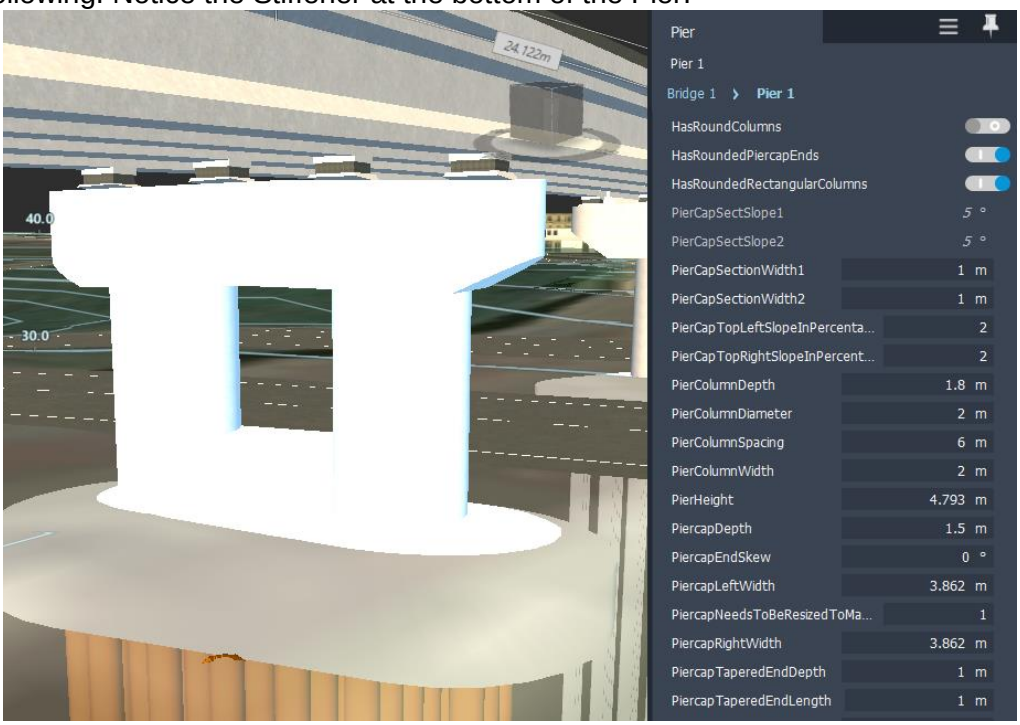
18. If everything looks good, then the next step is to review the UI Settings, click the UI Appearance TAB.
19. You can control the label, visibility, type/toggle, Min/Max values as well as the Group Name parameter show up under, as well as the order/priority of the parameters.



Priority	Name	Label	Tooltip	Visible	Editable	Type	Min Value	Max Value	Group Name
0	DesiredNumberOfPierColumns	DesiredNumberOfPierColumns		✓	✓	Integer			Column
1	HasRoundColumns	HasRoundColumns		✓	✓	Toggle			General
2	HasRoundedPiercapEnds	HasRoundedPiercapEnds		✓	✓	Toggle			General
3	HasRoundedRectangularColumns	HasRoundedRectangularColumns		✓	✓	Toggle			General
4	PierCapSectSlope1	PierCapSectSlope1		✓		Decimal			General
5	PierCapSectSlope2	PierCapSectSlope2		✓		Decimal			General
6	PierCapSectionWidth1	PierCapSectionWidth1		✓	✓	Decimal			General

UI Appearance Tab in Infraworks Add Style window

20. Once done, click on OK and your new Pier will be imported into the Style Palette and you can apply it to any of your piers.
21. Depending on your circumstances, the following input would show/result in a pier like the following. Notice the Stiffener at the bottom of the Pier.



New Peir as applied in Infraworks

22. With the Bridge Design complete, you can now “export” an IMX file to be detailed into Revit. Select the Bridge, right-click and pick “Publish Civil Structures” , either “Create New” or “Update Existing”.

Couple of tips on creating new Bridge Components

Now that you are familiar with the process of customizing and publishing a pier, you can create other component types by using the same method. If you plan on starting from scratch, with a fresh, blank Inventor file, then here are a few simple rules that will simplify your life.

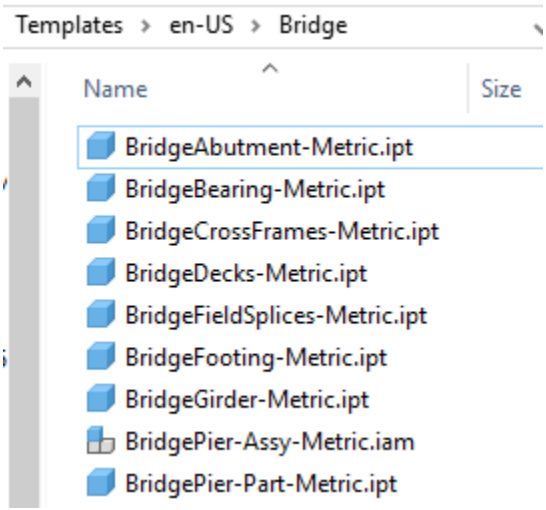
1. Start a new part in Inventor using the Metric Template, set the units to Meter (or feet, depending on your units)

2. Change the orientation of your ViewCube so XY plan matches the Civil 3d/Infraworks view. (in other words, XY should be a view from the Top down….

3. Create User Defined Parameters ahead of time and try to organize them, in the order you might want to edit their values in Infraworks, before you start.

4. Once you believe you have all the changes and settings that you need, save this as an Inventor Template. (You could create a pre-defined template for each component type and have the majority of everything you need done ahead of time. The only steps left after is the actual modeling)

   The image below shows a series of Inventor Template created specifically for Bridge Components.



Sample List of Inventor Bridge Templates

The following image shows an example of the above BridgePier-Part-Metric.ipt template with the pre-defined parameters.

Model Parameters				
User Parameters				
PierHeight		m	6 m	
PiercapRightWidth		m	5 m	
PiercapLeftWidth		m	5 m	
PierWidth		m	2.5 m	
PierDepth	CapDepth	m	1 m	Pier Depth can't be more than Pier Width
CapHeight		m	1 m	
PierIsRound		ul	0 ul	0=Square or Rectangular, 1 means Round
PierHasFillets		ul	1 ul	
CapHasFillets		ul	1	
CapDepth		m	PierDepth + 300 mm	
PierCount		ul	1 ul	Number of Columns
PierCenterOffset		m	1.0 m	Math to recenter pier when array of 1 column vs 2 vs 3
CapBevelLength		m	1.0 m	
CapBevelHeigth		m	1.0 m	
PierCapTopLeftSlopeInPercentage		ul	3 ul	As a percentage, usualy a Positive Number
PierCapTopRightSlopeInPercentage		ul	3 ul	As a percentage, usualy a Positive Number
CapHasSlope		ul	1 ul	0=No, 1=Yes
CapHasBevel		ul	1 ul	0=No, 1=Yes
PierSpacing		m	5 m	Center to Center Spacing
PierOffsetDirection		deg	180 deg	Controls Direction of Column Offset
StepHeight		m	1.0 m	Cap Step Height
PierCapSectSlope1		ul	0 ul	PierCap Front Slope in Percentage
PierCapSectSlope2		ul	0 ul	PierCap Back Slope in Percentage
TopOfCapVerticalOffset		m	0 m	Cap Vertical Offset
IsIntegralPierThatDoesNotRequireBearings		ul	0 ul	Required to Toggle Bearings On or Off

Sample of Pier Parameters in Pier Template for Inventor

NOTE: Pay attention to the Units that are set, the multi-pick values and even the Comment, which show up as Tool Tips in Infraworks.

Creating Bridge Components as Single Body vs Multi-Body parts or as Assemblies in Autodesk Inventor

As per the customizing of the existing Pier above, the pier in question was a single body part. Think of it as if you did a concrete pour in a single shot and filled the entire columns and cap in 1 shot (pretty difficult and my not represent the real world details and components). This may affect downstream capabilities inside of Revit, for detailing purposes. In this section of the class, we are going to review the differences between single body, multi-body and Assemblies and how it might affect Revit Detailing.

The first question people normally ask is: How can you tell if you are working with a Single Body or Multi-Body part, and how does that look or behave differently than an Assembly.

The image below show the Single Body Pier from the initial/above class steps.

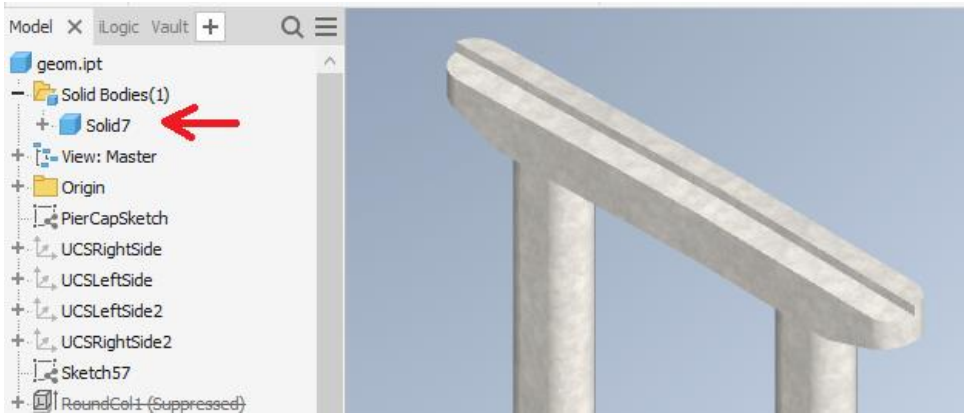


Image of a Pier as an Inventor Single Body Pier

While the following image shows the same design as a Multi-Body part

Image of a Pier as an Inventor Multi-Body Pier

The following image shows a slightly different Pier model, but done as an Assembly.

Image of a Pier as an Inventor Assembly

Creating a Single Body Part

By default, when you create a new part in Inventor and you use all the default tools, the software creates a single-body part by default. So, you actually have nothing to do/change while modeling and you automatically get single-body parts.

Creating a Multi-Body Part

A Multi-Body part is created pretty much in the same fashion as a single-body part. However, when you are creating a new feature (such as an extrude, revolve or other), look for the option called “New Solid”. If you don’t toggle on the “New Solid”, then you are creating a single-body part.

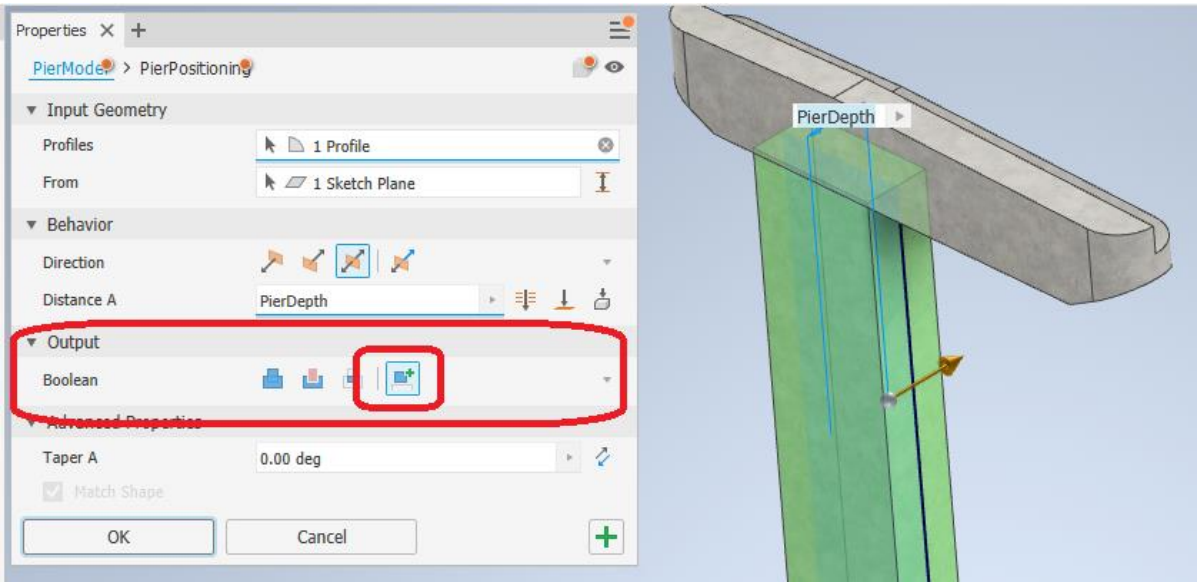
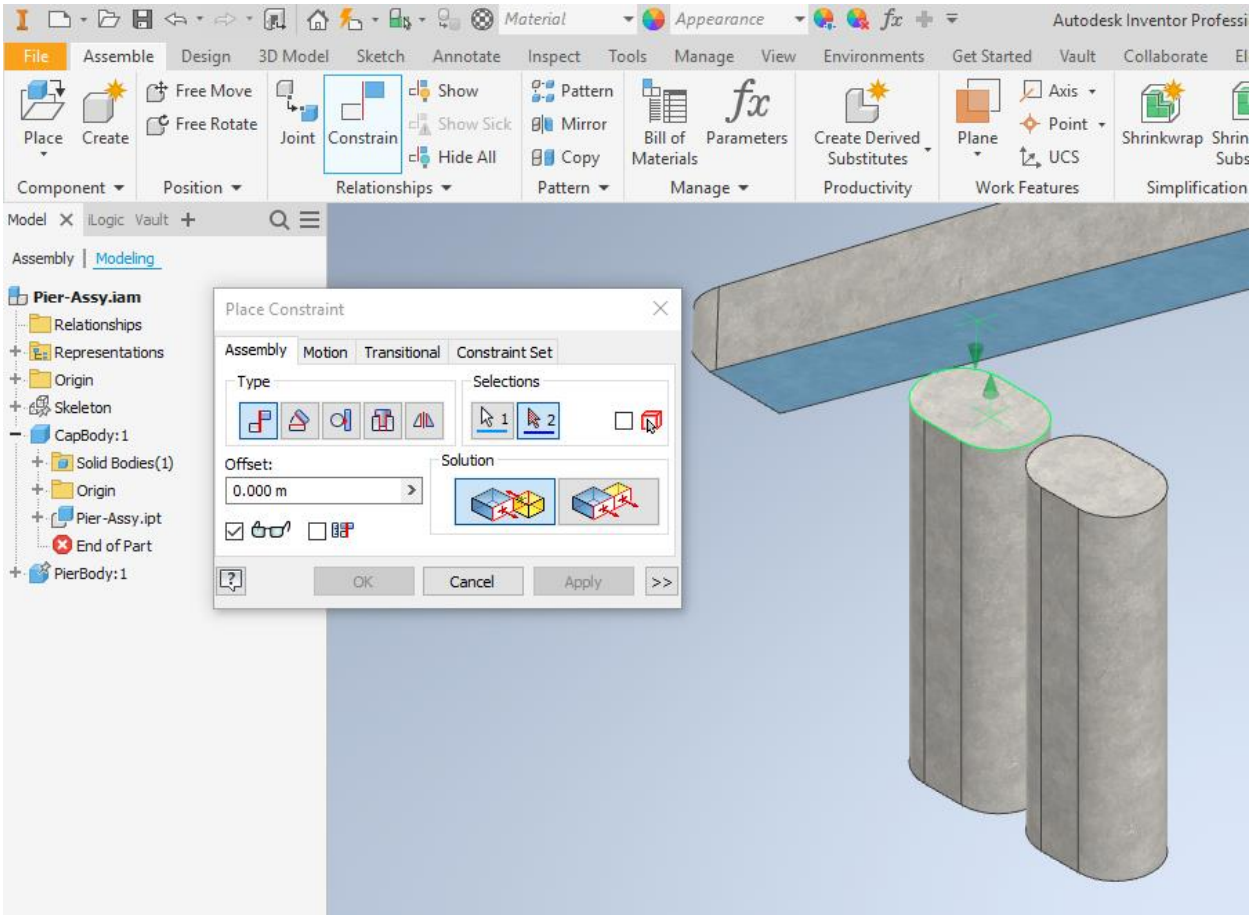


Image of a Pier as an Inventor Assembly

Creating an Assembly

Assemblies are created from bringing multiple parts (either single-body or multi-body) together and constraining them together. To constrain means to establish a relationship between the parts.

In Figure 7, you can see the Pier Cap that was brought in and is being “constrained” as a Mate to the top of a Pier Column.



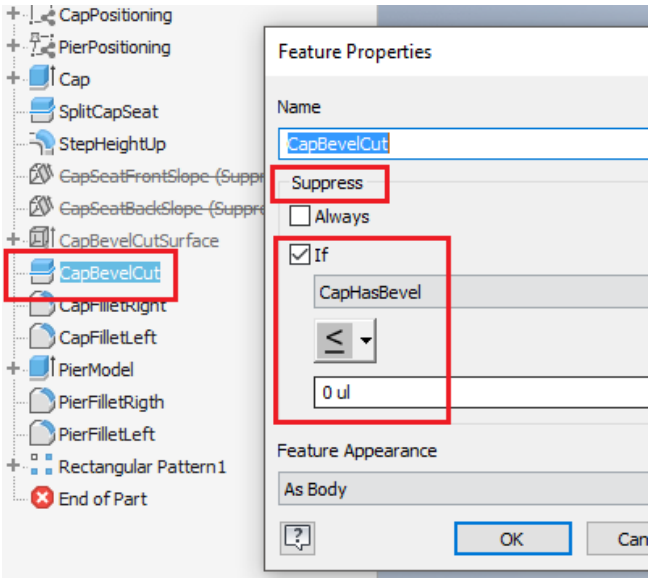
Assembly Constraints during Pier creation

Advantages vs Disadvantages

What are the advantages or disadvantages of one vs the other?? It depends what you are trying to get done and how complicated your model might be. Add on top of that, as you export to Revit, you might have different capabilities (either now or in the future).

Let's look at some of the typical topics in Inventor that a user might want to use, to create and manipulate a model.

- Ability to Toggle on/off Features in the model, based on a Parameter Value. This means you can control the view & modeling of features without programming. Note however that this only applies to an on/off scenario.



Feature Properties in Inventor

Single-Body: Yes. You can use the right-click properties on a Feature and tell it which parameter controls its suppression.

Multi-Body: Yes. You can use the right-click properties on a Feature and tell it which parameter controls its suppression.

Assembly: No. You will need to use iLogic to turn the visibility and activation of a part on or off. (NOTE: iLogic is pretty simple to use however. For the majority of the tasks, It does not require any knowledge of programing)

- Ability to apply different materials/textures to different parts of the model easily.

Single-Body: Yes/No, the entire body can only have 1 material. To change the look, you then have to apply a different texture to different faces or features.

Multi-Body: Yes/No, the entire body can only have 1 material. To change the look, you then have to apply a different texture to different faces or features or bodies.

Assembly: Yes, each part has its own material and each face, feature or body within the parts can have different textures.

- Ability to move features, bodies or parts around easily.

  Single-Body: No/Yes. Features are created based on the location of the sketch. You either have to be able to move the sketch around or you have to apply a move/rotate/scale feature to the solid or you have to build your model via a UCS and then move the UCS around. (Typically done via iLogic)

  Multi-Body: No/Yes. Features are created based on the location of the sketch. You either have to be able to move the sketch around or you have to apply a move/rotate/scale feature to the solid or you have to build your model via a UCS and then move the UCS around. (Typically done via iLogic)

  Assemblies: Yes. Parts are constrained into location. Using ilogic you simply need to change the value of the constraint (Offset value) to move the parts further or closer.

- Ability to select or separate objects, such as the Pier Cap from the Pier Column for detailing in Revit.

  Single-Body: No. Because it is a single body, the cap and pier column are a single object and can't be separated.

  Multi-Body: No. Because the multi-body is made as a part (even if it has two bodies), the cap and the pier are a single object.

  Assembly: Yes. Because each part within the assembly is "a separate part ", each part can be selected individually inside of Revit.

- Ability to control entire model from a single source file of parameters (in Inventor)

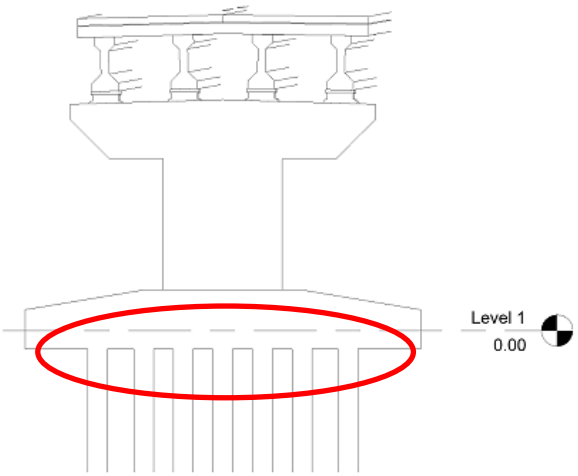
  Single-Body: Yes. Since the single-body part file is only 1 file, all parameters are defined within and control the entire model.

  Multi-Body: Yes. Since the Multi-body part file is only 1 file, all parameters are defined within and control the entire model.

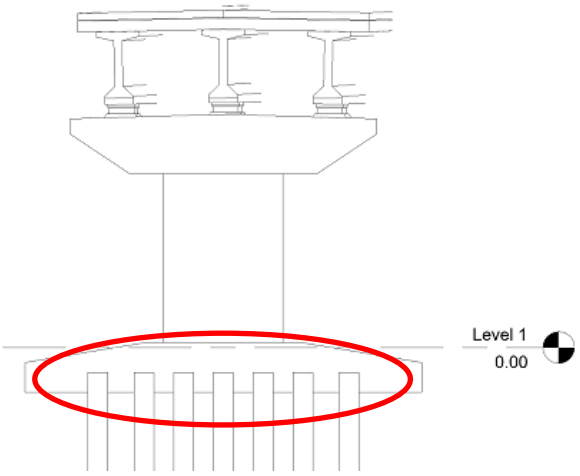
  Assembly: Yes. Using a skeletal modeling methodology, all parameters can be stores/placed into a single file. That file is then referenced into the individual parts and used for modeling. The skeleton can also be used to constrain the parts together at the assembly level. Making a change to a value in the skeleton file updates all the parts.

- Ability to control line work display properly (as created in the real world) in Revit.

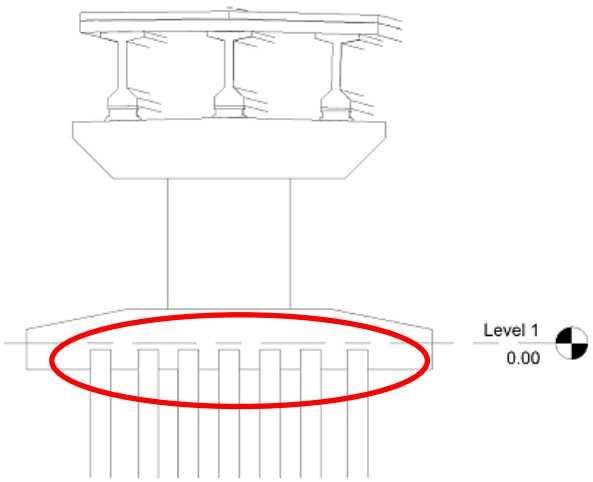
Single-Body: No. Since the model is a single body, cutting a section through the middle of a Pier & Cap won't reveal the joint line.



Multi-Body: Yes. Since the model is made of multiple bodies, each a proper and unique envelope, cutting a section through the middle of a Pier & Cap will reveal the joint line.



Assembly: Yes. Since the model is made of multiple files, each a proper and unique envelope, cutting a section through the middle of a Pier & Cap will reveal the joint line.



- Ability to swap out parts for different parts.

  Single-Body: Yes/No. Everything must be modeled into the single-body part and then features must be turned on or off. If you are not careful, features can merge together and disappear.

  Multi-Body: Yes. Everything must be modeled into the single file. Different looking parts of the model must be modeled as different bodies. In the end, all bodies must exist in the file (making a large file) and bodies have to be turned on/off as required.

  Assembly: Yes. Parts can be replaced/swapped out for different parts within the assembly.

In short: As per the table below, modeling Infraworks bridge components in Inventor using assemblies as benefits, even if it means a bit more work upfront.

Description of Feature of Capability	SB	MB	ASSY
Ability to Toggle on/off Features in the model, based on a Parameter Value	●	●	◉ iLogic
Ability to apply different materials/textures to different parts of the model easily.	◉	◉	●
Ability to move features, bodies or parts around easily.	◉ iLogic	◉ iLogic	●
Ability to select or separate objects, such as the cap from the pier for detailing in Revit.	○	○	●
Ability to control entire model from a single source file of parameters (in Inventor)	●	●	◉ iLogic
Ability to control line work display properly (as created in the real world) in Revit.	○	●	●
Ability to swap out parts for different parts	○	◉ iLogic	● iLogic

SB=Single-Body, MB=Multi-Body, ASSY=Assembly

● = YES , ○ = NO ◉=Difficult

Detailing Exported Data from Infraworks to Revit

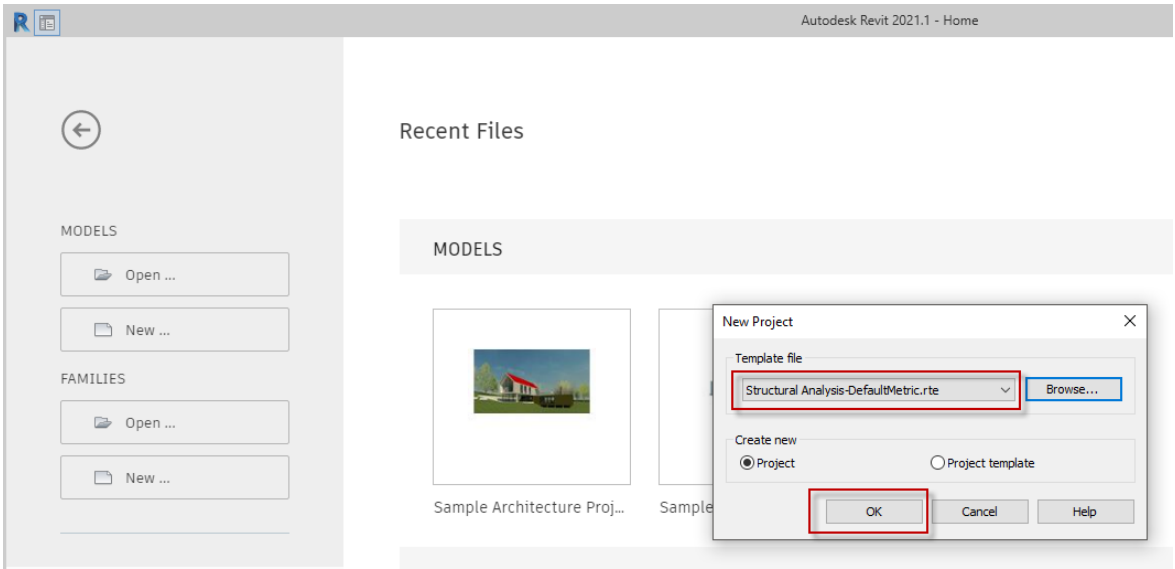
Previous workflow vs new workflow.*****

- New categories to better support bridge design in Revit have been added.
- This feature supports the Civil Structures Workflow with Autodesk InfraWorks and Revit.
- This update includes a new filter for the infrastructure category, making it easier to find and use infrastructure-related categories.
- In addition to the filter, 26 model categories and 20 annotation categories have been added.
- These categories support visibility/graphics overrides, object styles, schedules, and tags.
- Previous workflows of bridge design from Infraworks to Revit have changed.
- Older workflows consisted of “Send to Revit” options in Infraworks to import/export files to Revit.
- Elements from Infraworks would come in as families to Revit and can be modified within the Revit enviroenment.
- The new worfklows, you export the Infraworks models and import from Revit.
- Any changes to the bridge design are done within Infraworks and updated in Revit

Importing Infraworks Data into Revit

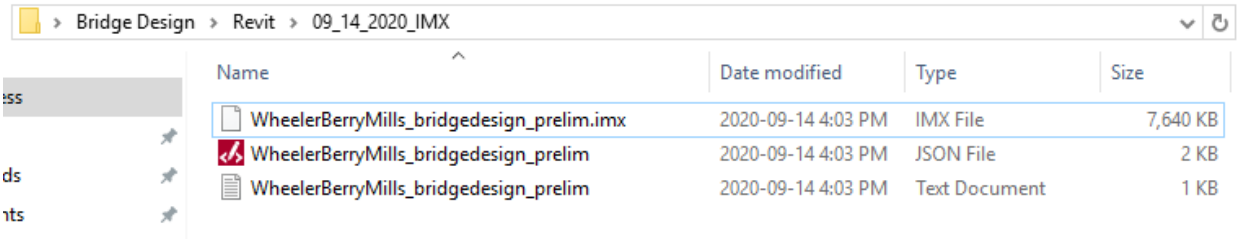
Within Revit, there is no native tool that will allow you to import the exported bridge design IMX and JSON files from Infraworks. The “Civil Structures” add-in will be needed in order to import the bridge design files.

- Start a new Revit project with your desired “Revit Template”.



Start New Revit Project.

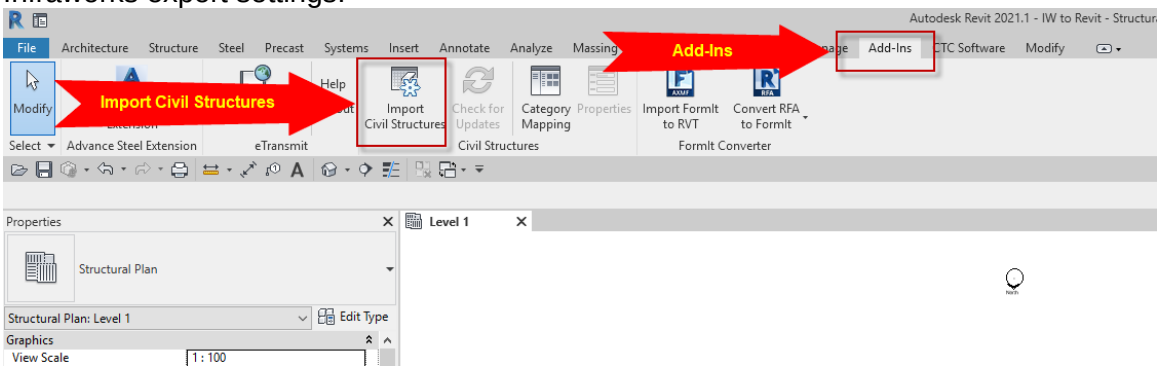
- Once the Project has been saved, you can begin to start the import process of the Infraworks bridge model design into Revit.
- Within Revit, there is no native tool that will allow you to import the exported bridge design model from Infraworks to Revit.
- The “Civil Structures” add-in will be needed in order to import the bridge design files.
- Once installed, you can use the Revit “Import Civil Structures” add-in found under the “Add-ins” tab.
- The exported bridge design files from Infraworks should be in a folder consisting of the IMX, JSON and Text files from Infraworks.



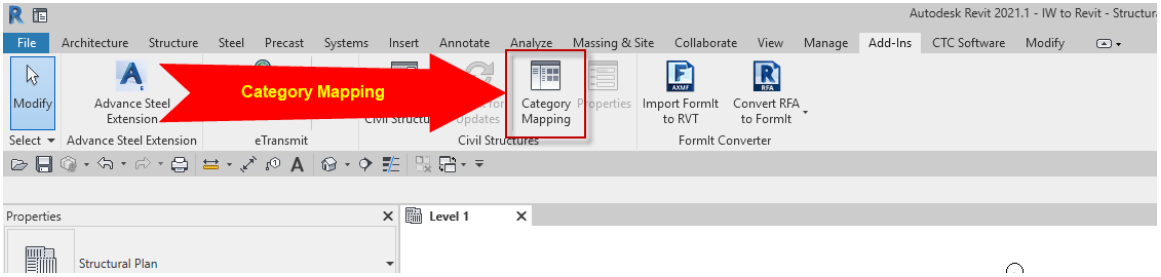
IMX, JSON, Text Files

Map Revit Categories

Prior to importing the bridge design files, you can “Map Revit Categories” based on the Infraworks export settings.

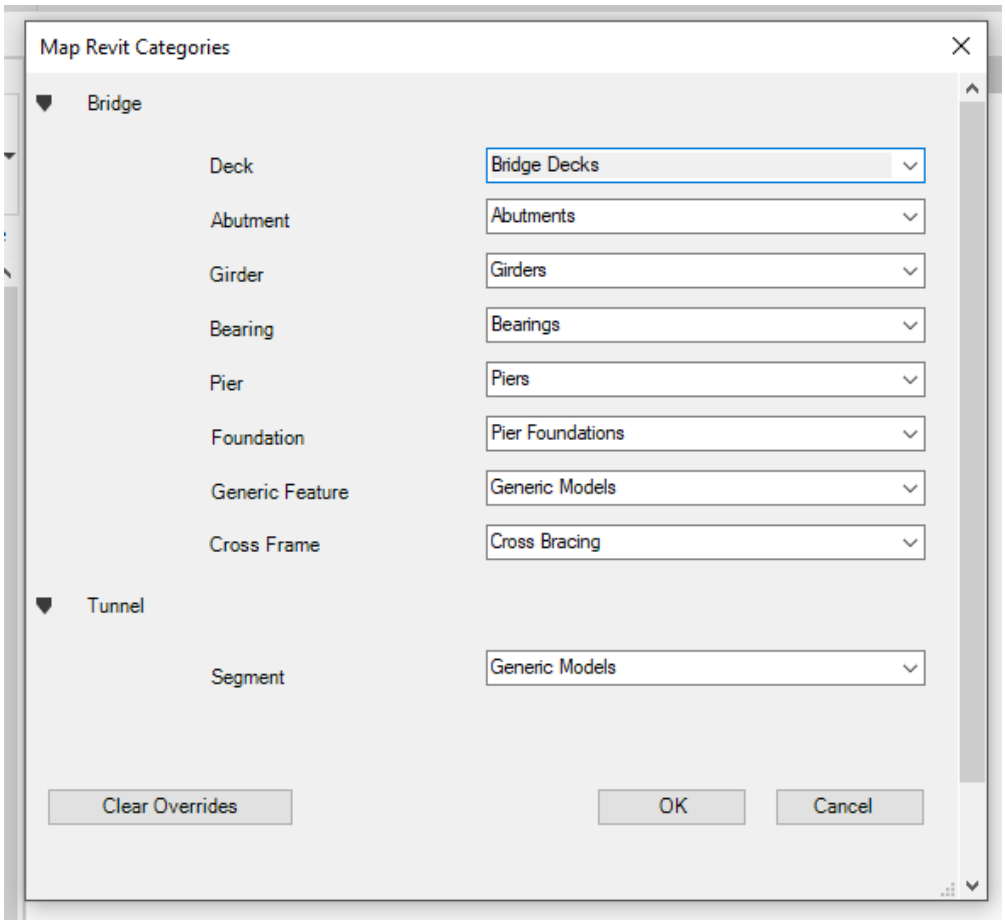


Import Civil Structures Add-in



Category Mapping

- New categories to better support bridge design in Revit have been added.
- This update includes a new filter for the infrastructure category, making it easier to find and use infrastructure-related categories.
- These categories support visibility/graphics overrides, object styles, schedules, and tags.

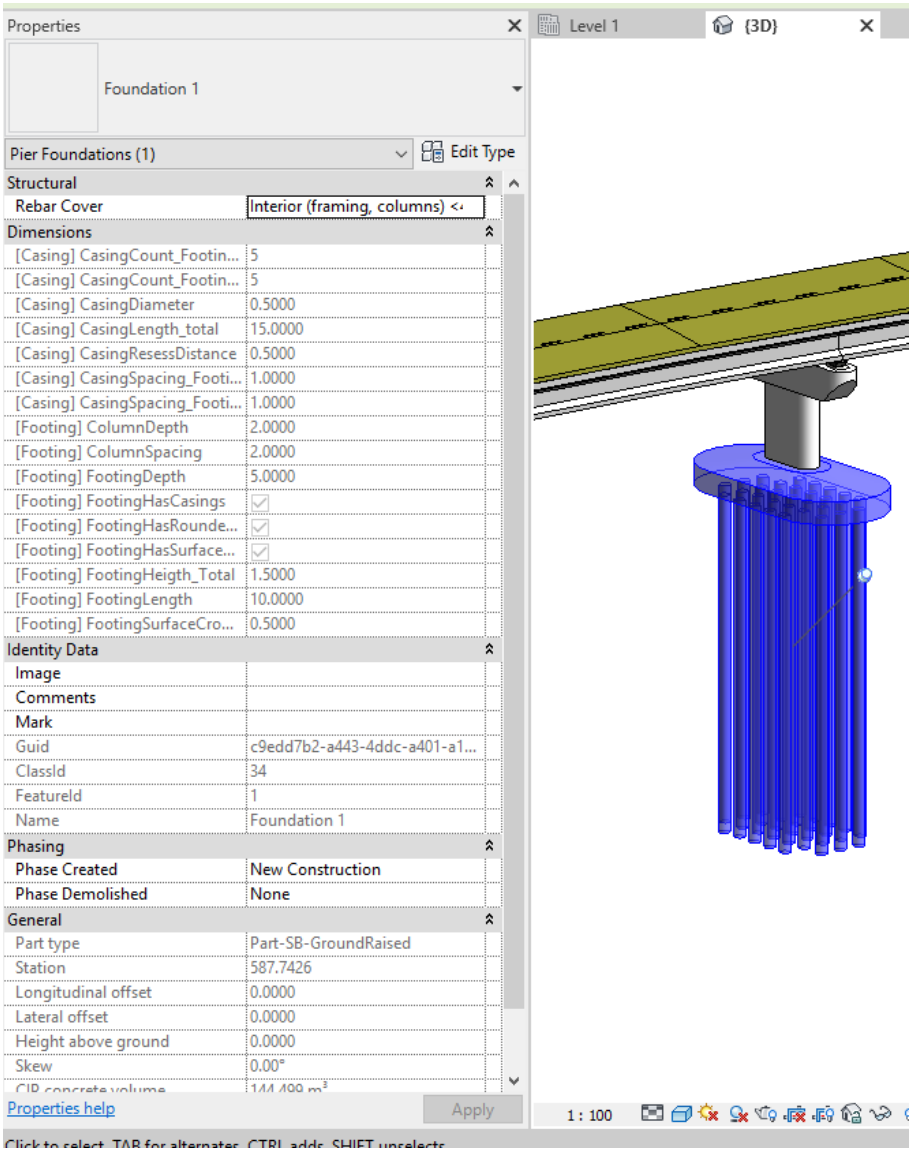


Categories

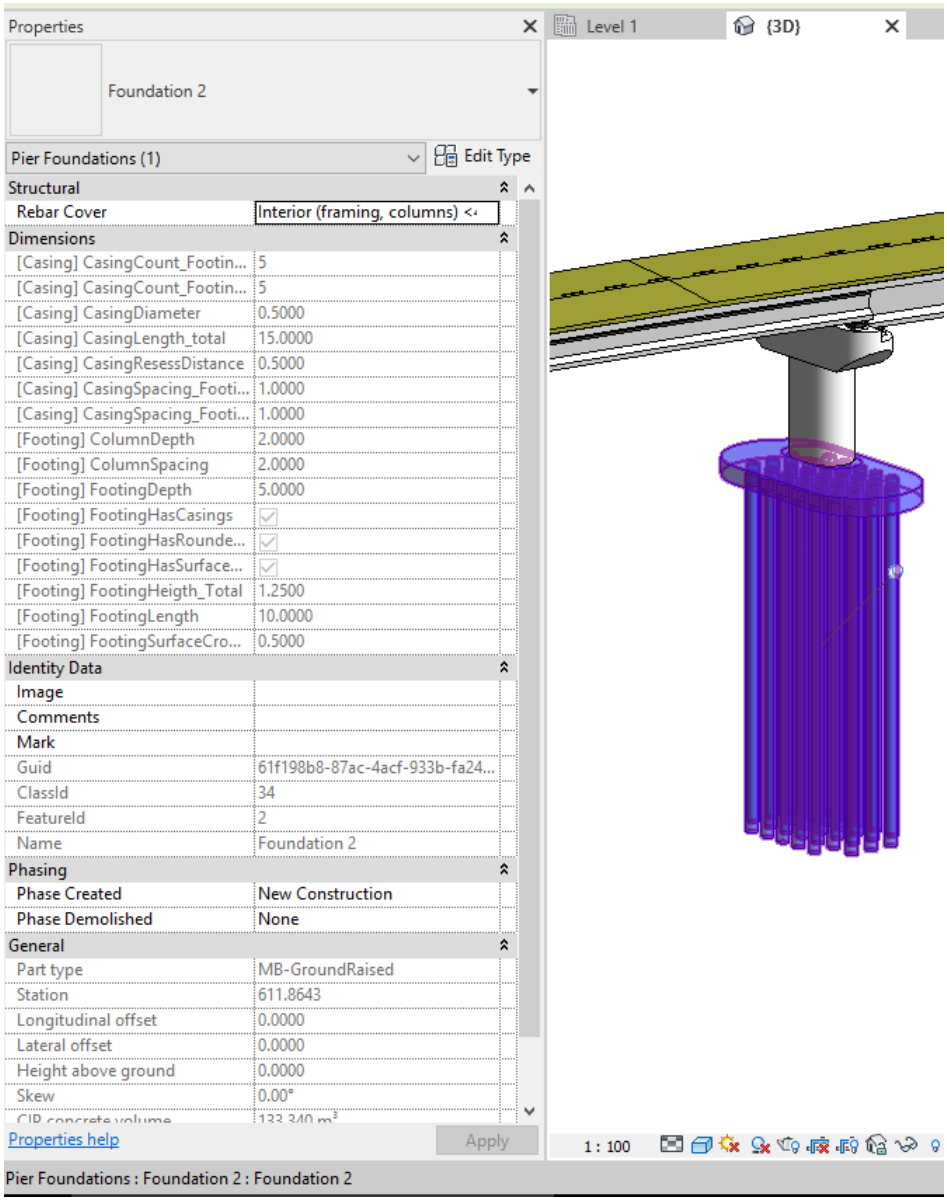
Verify the Data

Once the bridge design has been imported, we can verify the data closer by selecting the elements that have been imported.

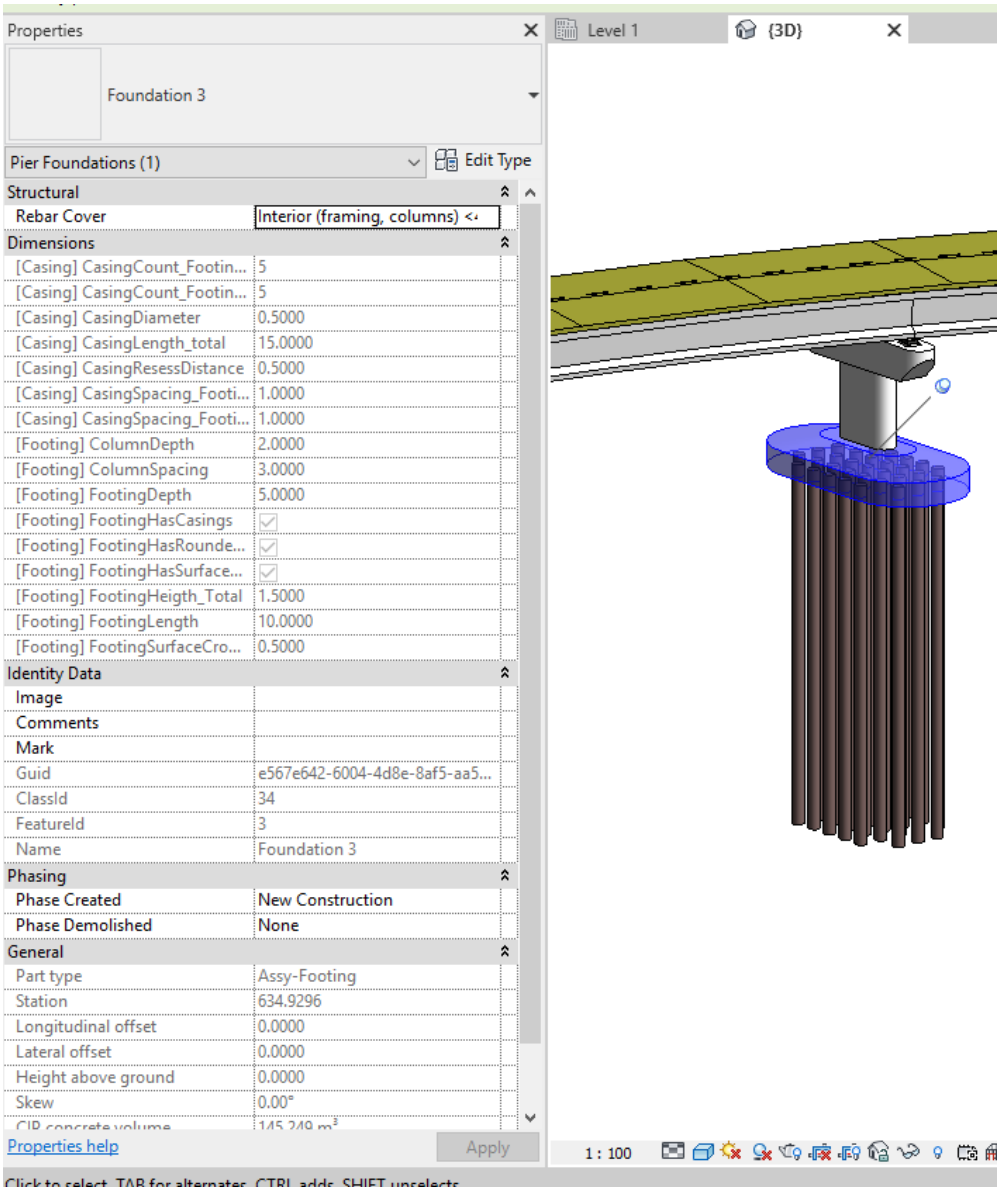
- Parametric data from Infraworks will be present inside the Revit environment.
- The way elements are created within Infraworks will be designated by a part type parameter in Revit.
- Single body vs Multi-body vs Assembly, do import in a different way.
- An “Assembly” part type is the recommended option as you gain more control of individual elements to add additional detailing.
- “Assembly” part types have true graphical properties of the categories that have been imported.



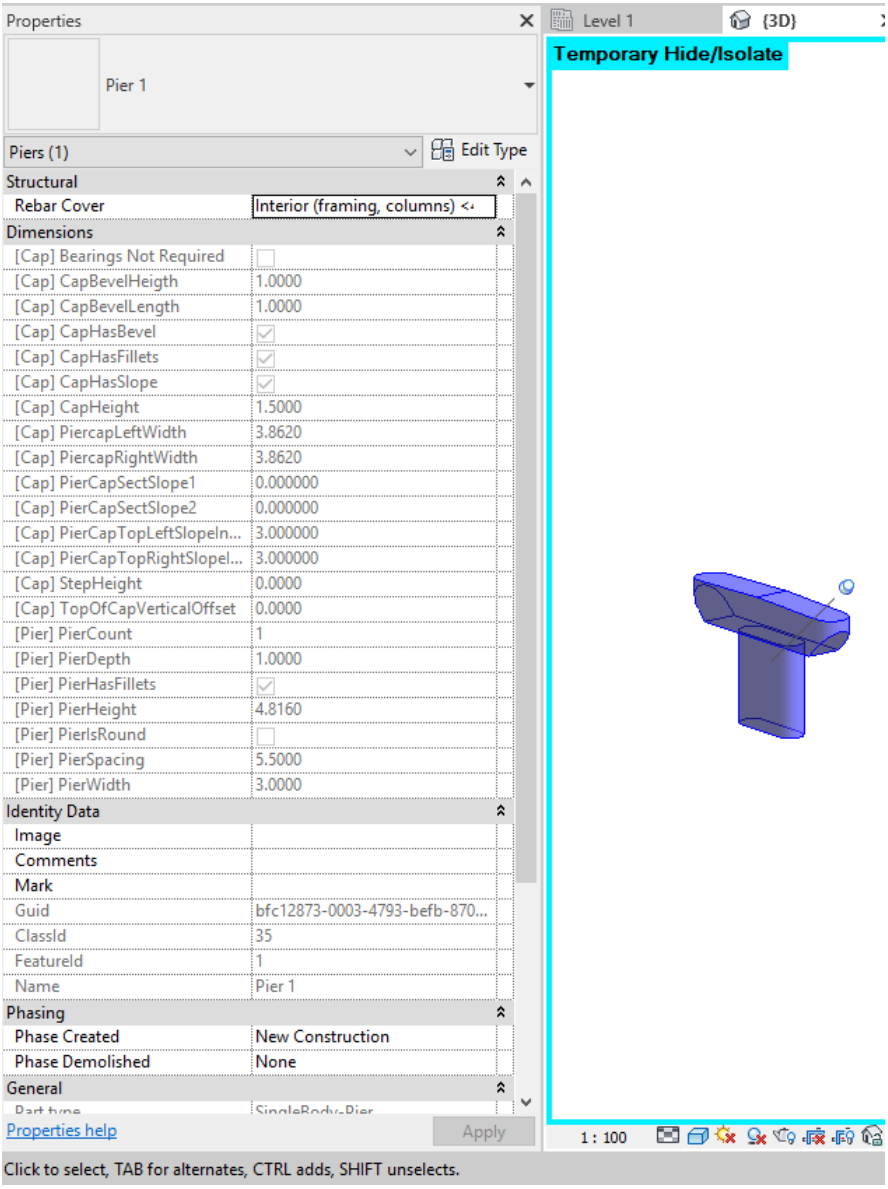
Single Body – Foundation 1



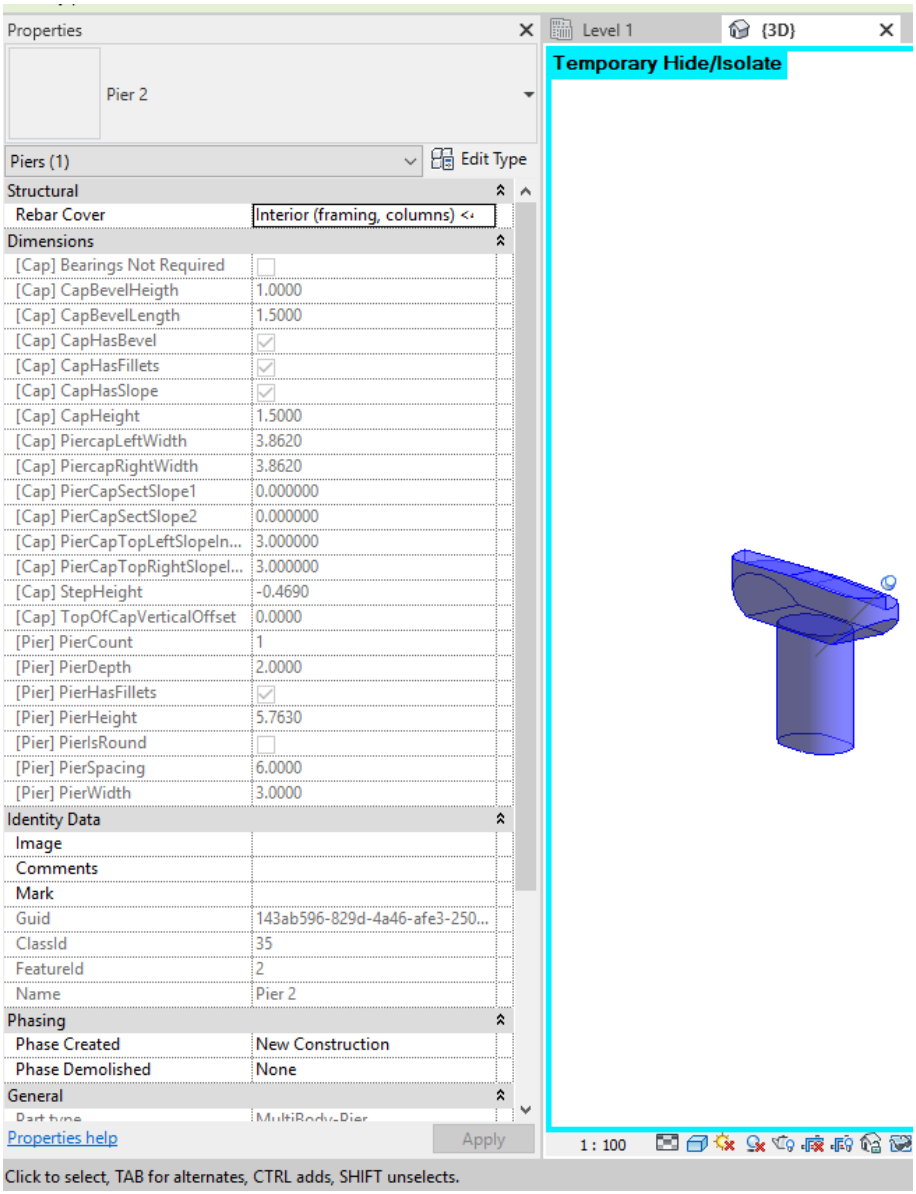
Multi-Body – Foundation 2



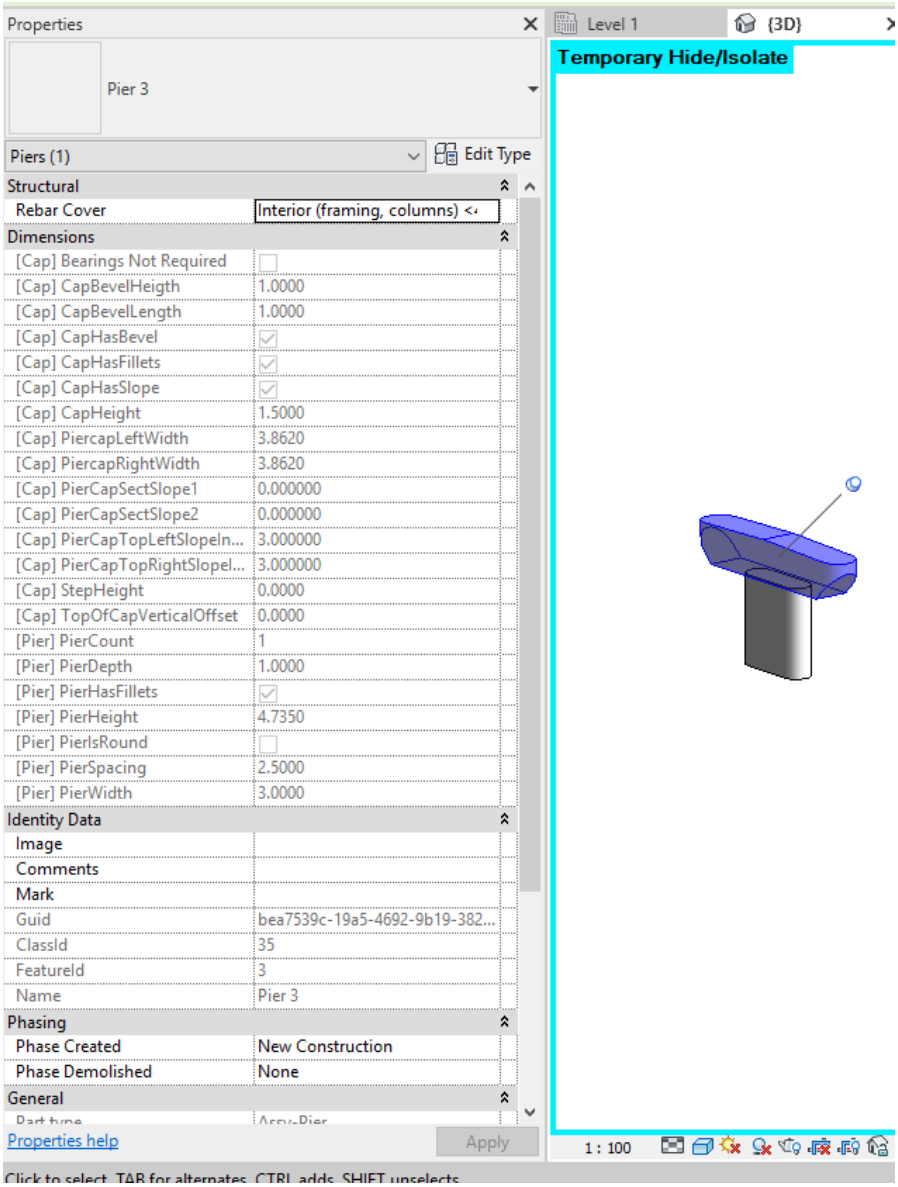
Assembly – Foundation 3



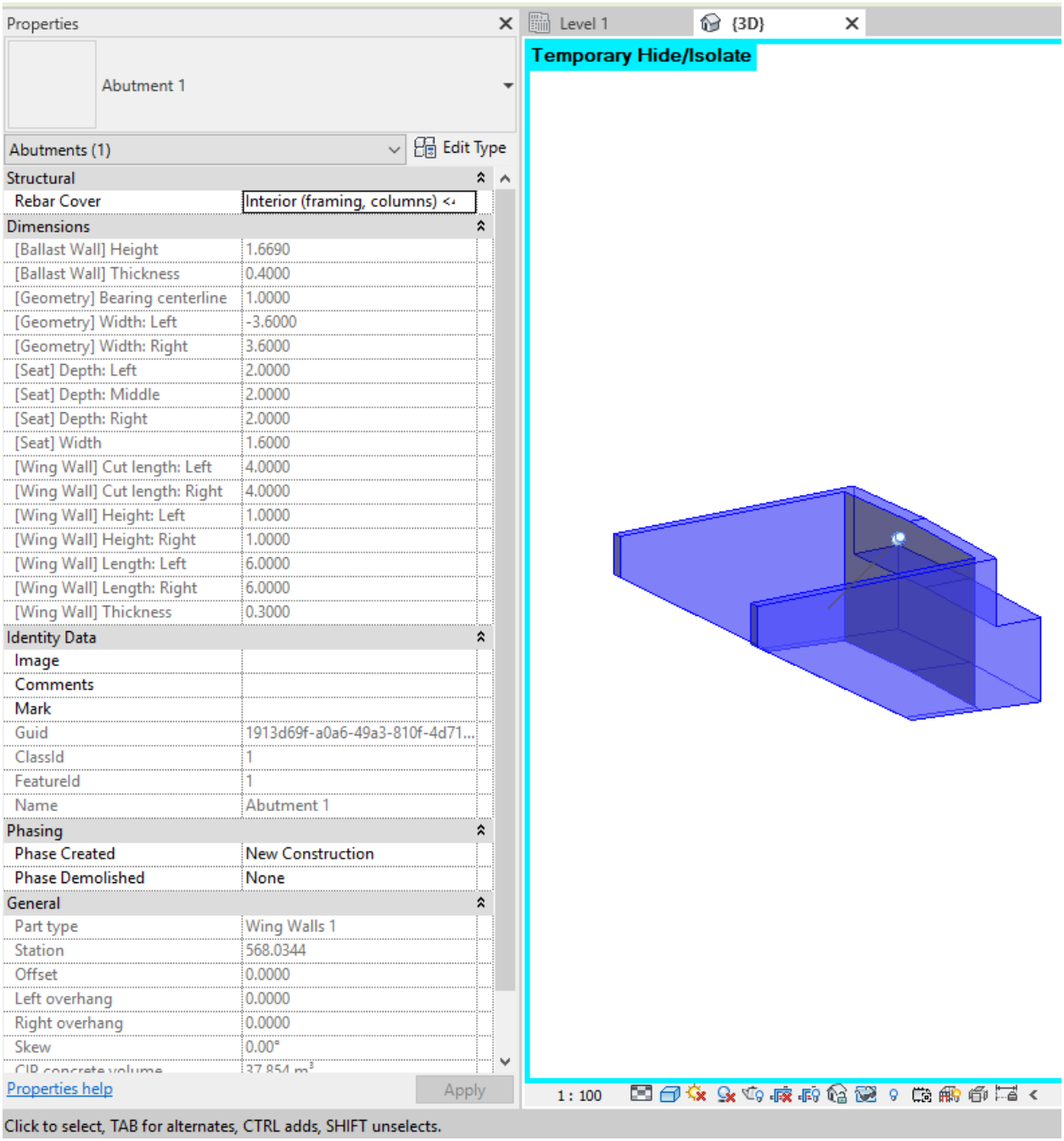
Single Body – Pier 1



Multi Body – Pier 2



Assembly – Pier 3


Properties
Abutment 1
Abutments (1)
Edit Type
Structural
Rebar Cover
Interior (framing, columns) <
Dimensions
[Ballast Wall] Height 1.6690
[Ballast Wall] Thickness 0.4000
[Geometry] Bearing centerline 1.0000
[Geometry] Width: Left -3.6000
[Geometry] Width: Right 3.6000
[Seat] Depth: Left 2.0000
[Seat] Depth: Middle 2.0000
[Seat] Depth: Right 2.0000
[Seat] Width 1.6000
[Wing Wall] Cut length: Left 4.0000
[Wing Wall] Cut length: Right 4.0000
[Wing Wall] Height: Left 1.0000
[Wing Wall] Height: Right 1.0000
[Wing Wall] Length: Left 6.0000
[Wing Wall] Length: Right 6.0000
[Wing Wall] Thickness 0.3000
Identity Data
Image
Comments
Mark
Guid 1913d69f-a0a6-49a3-810f-4d71...
ClassId 1
FeatureId 1
Name Abutment 1
Phasing
Phase Created New Construction
Phase Demolished None
General
Part type Wing Walls 1
Station 568.0344
Offset 0.0000
Left overhang 0.0000
Right overhang 0.0000
Skew 0.00°
Properties help
Apply
Level 1
{3D}
Temporary Hide/Isolate
1 : 100
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.

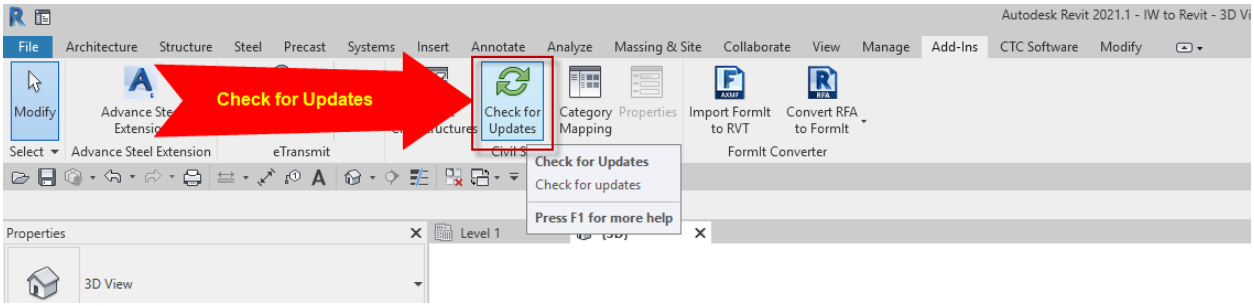
Abutment 1

Modifying the Design

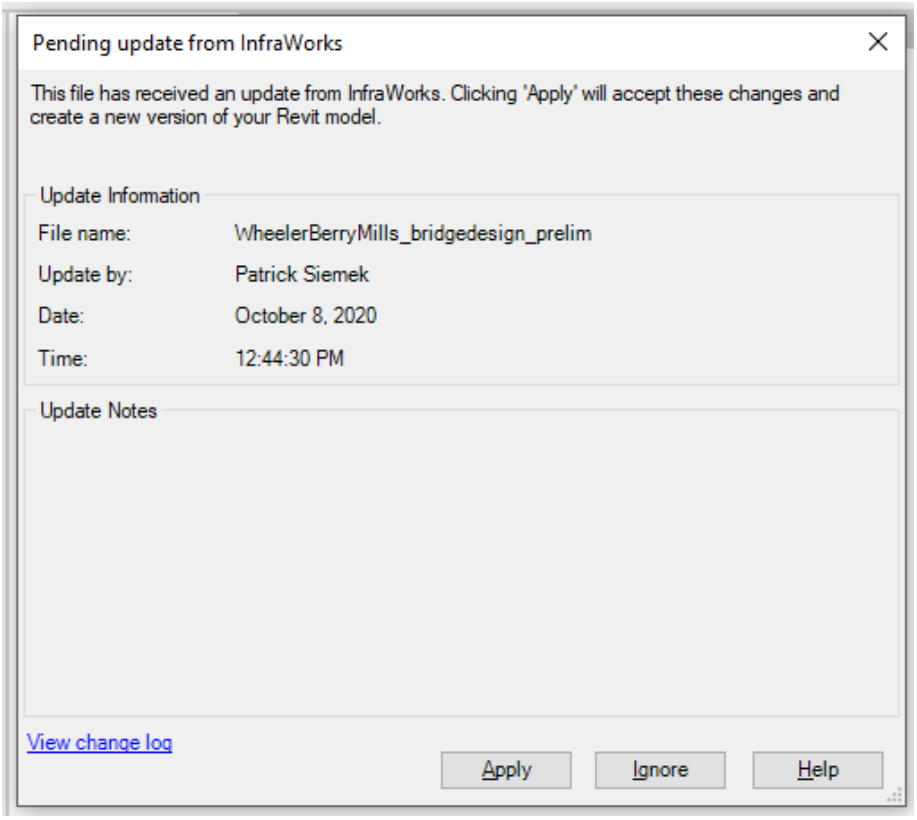
Modifying the bridge design will be done within Infraworks.

Modify Design

- Parametric data is modified within Infraworks and exported out back to Revit.
- The link between the Infraworks data and Revit data will automatically prompt an update when modifications are made and exported.
- If you do not want a live update, you can later manually update the data by using the “Check for Updates” command in the “Add-ins” tab.



Check for Updates



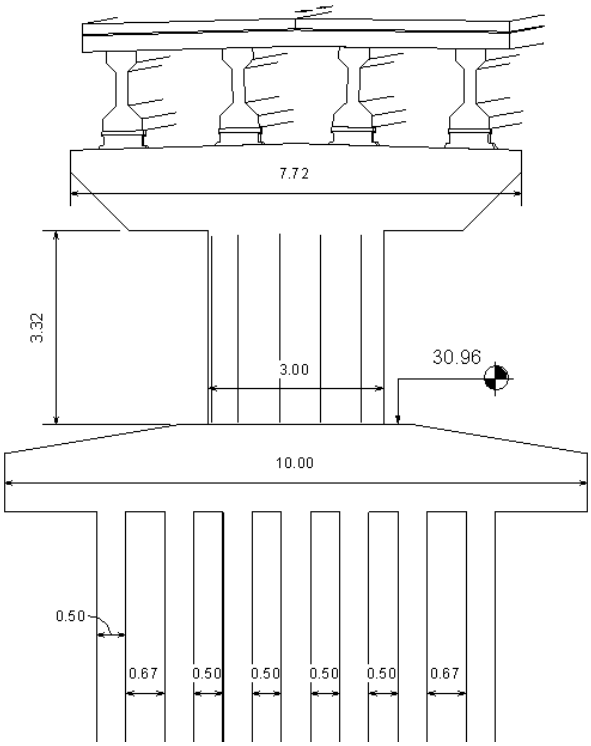
Changes Pending to Apply or Ignore

Revit Reinforcement and Detailing

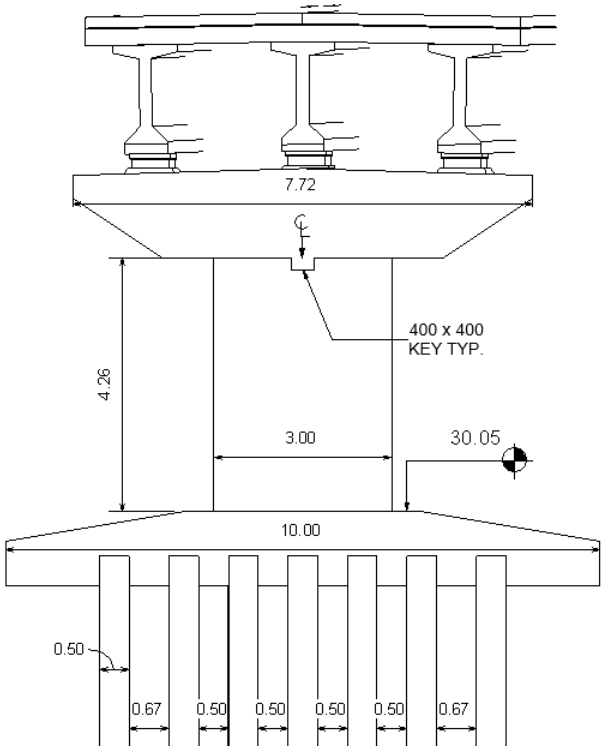
Once the data has be updated, additional reinforcement and detailing can be done within Revit. 3D views, sections etc. are created. From these views, details (dimensions, symbols etc.) and rebar reinforcement can be added.

Revit Annotations

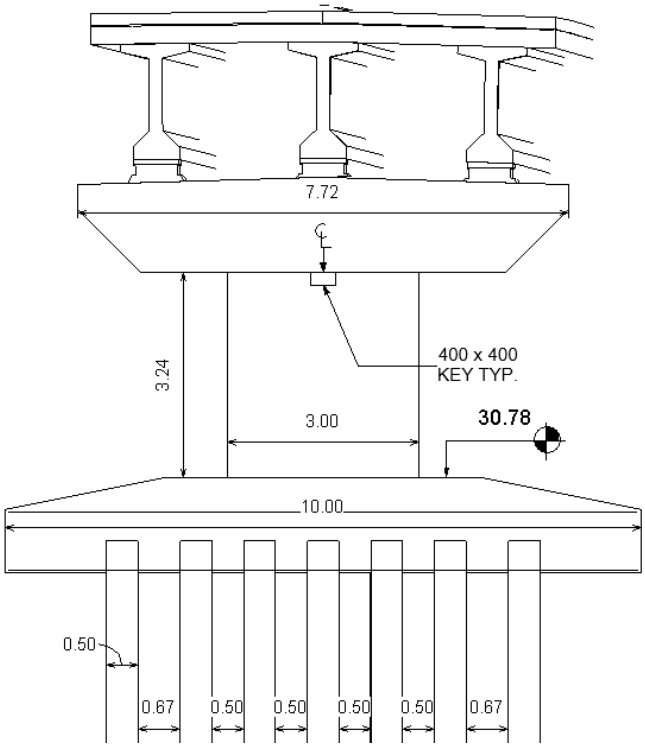
- Using the “annotations” tab, dimensions can be added to the views.
- “Spot Elevations” can also be added which is a key part to bridge design to get the proper elevation data.
- In addition to dimensions, detail lines, regions and components can be applied to the model for further detailing.
- As previously mentioned, a Single body vs Multi-body vs Assembly, do import differently within Revit.
- A “Assembly” is the recommended element as correct details are being transferred over when imported along with more control over single parts of the “Assembly”.
- An example is the pier with the details lines not showing correctly as a “Single Body”.
- An “Assembly” has the correct line work .



Single Body – Annotations



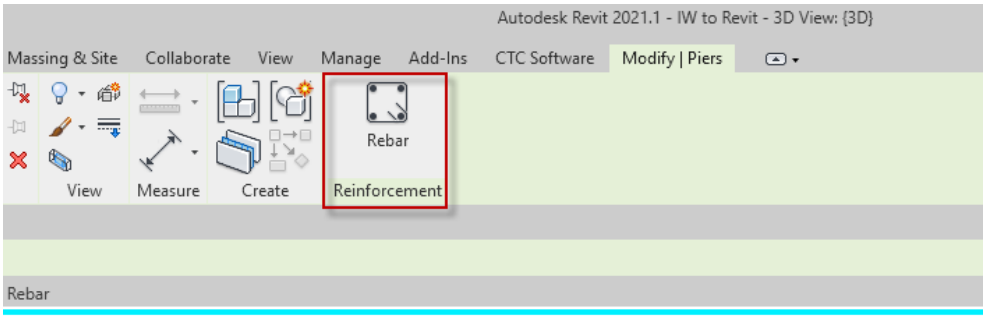
Multi Body – Annotations

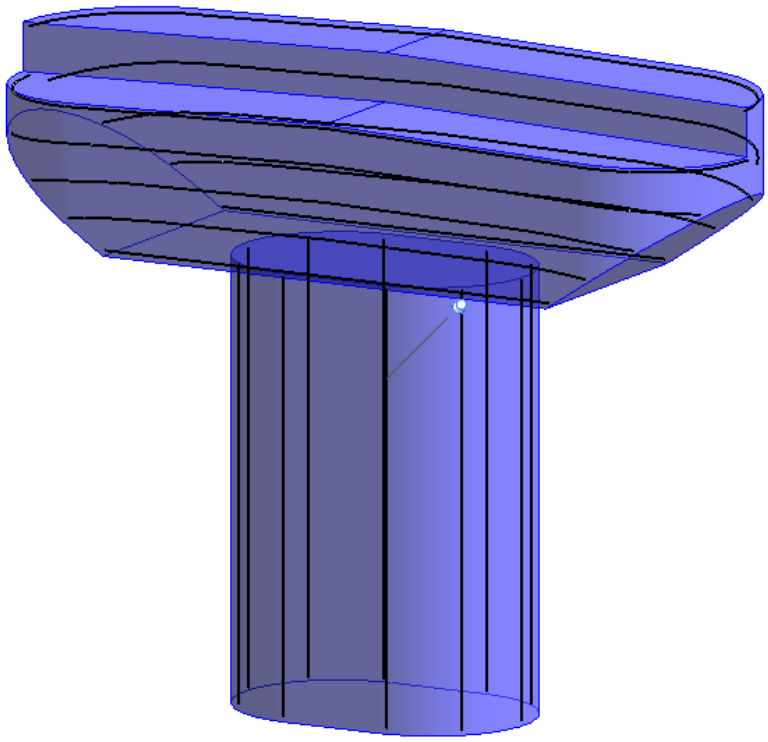


Assembly– Annotations

Revit Reinforcement

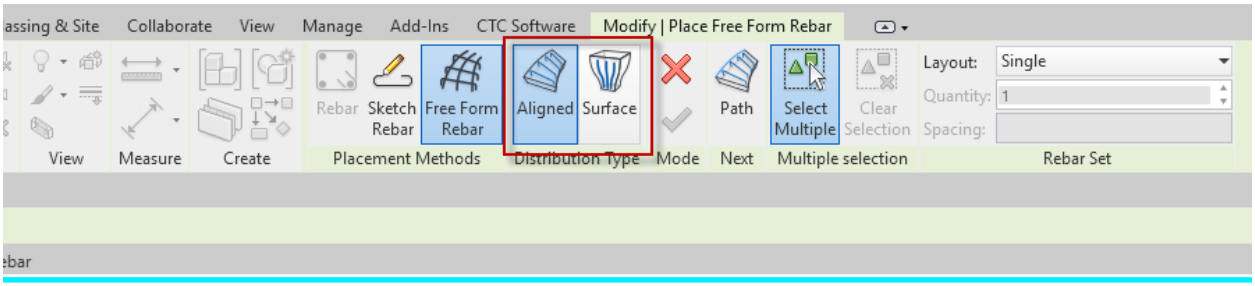
- Along with annotative details, Rebar Reinformcement can be added to the bridge design to further the design.
- The typical approach is to use the native Revit reinforcement tools.
- Free form rebar is a great way to add rebar reinforcement to very unique shapes that come with bridge design.

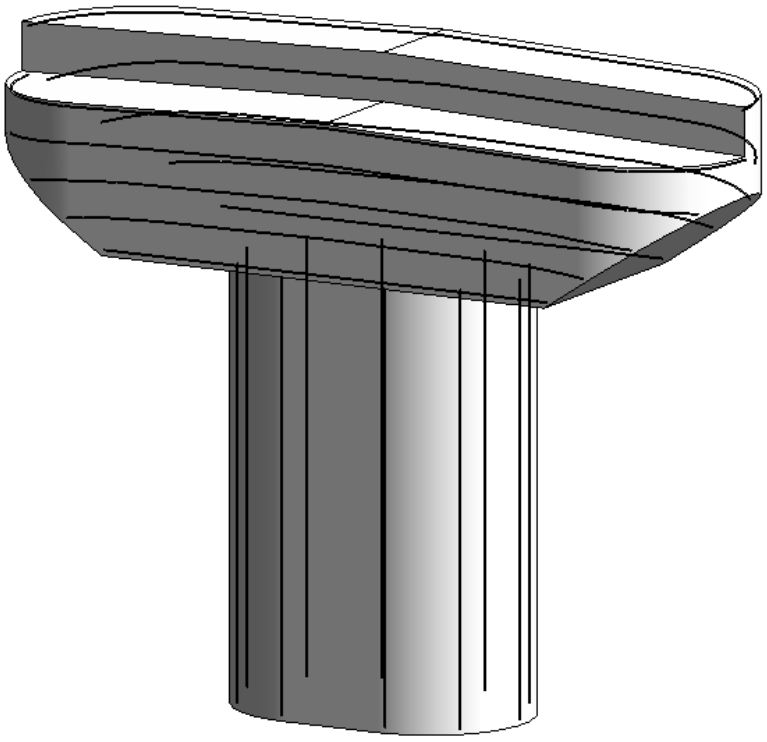




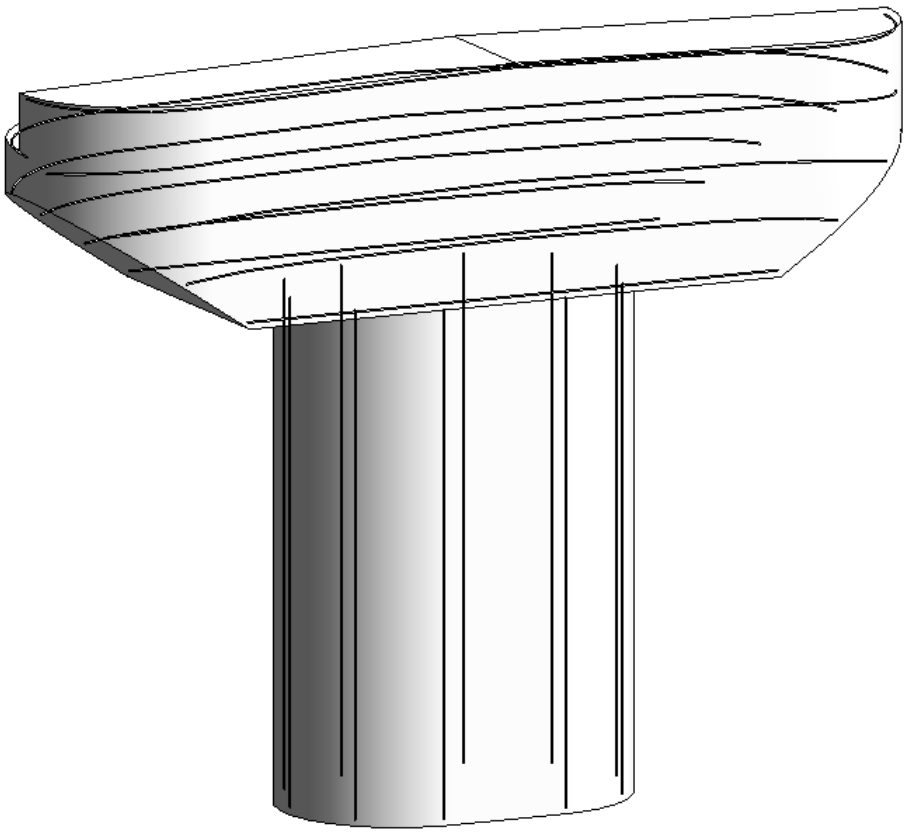
Rebar Reinformcent

- 2 distribution types are available with Free Form Rebar
- “Aligned” and “Surface”
- Aligned – Free form rebar aligned distribution populates the surfaces of irregularly shaped hosts with variable planar distribution.
- Surface - Free form rebar surface distribution populates the surfaces of irregularly shaped hosts with variable non-planar distribution.



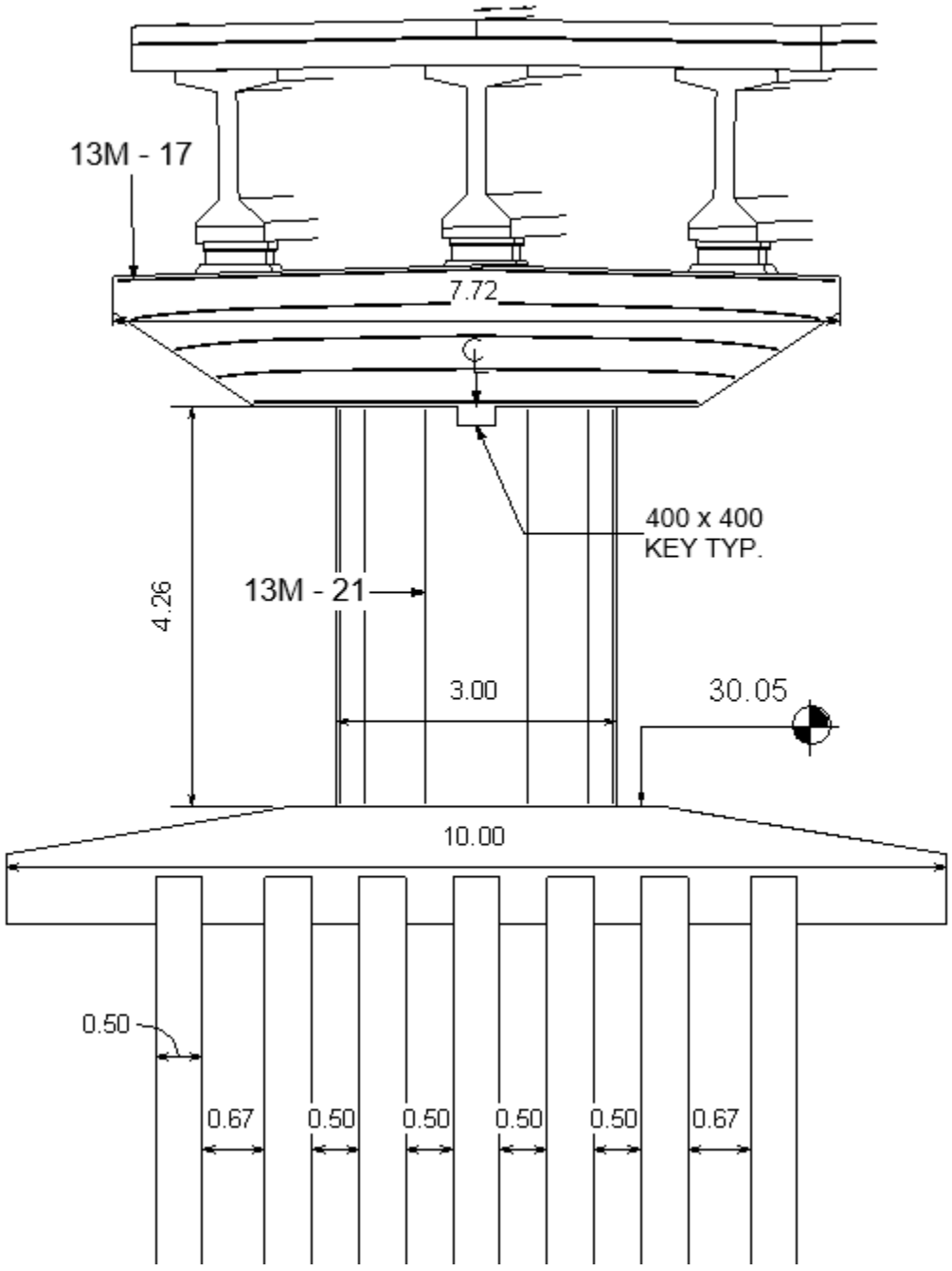


Free Form Rebar



Pier with Rebar

- Once the rebar has been added to your model, additional annotations can be added.



Complete Section – Annotations