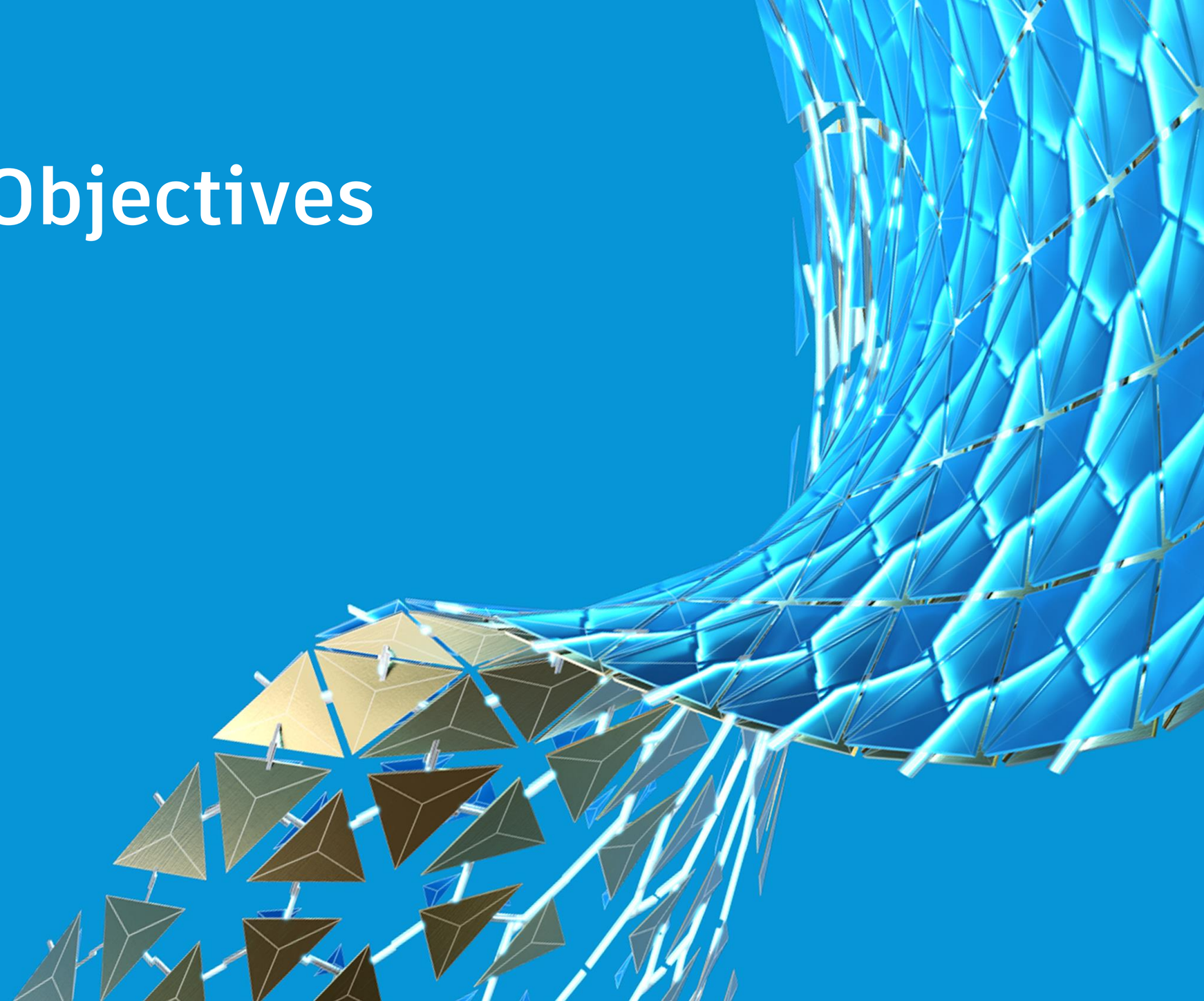
AUTODESK. UNIVERSITY

Bridge Design Workflow: Best Practices for Data Exchange

Michel Beaulieu, Patrick Siemek and Jae Kwon

SolidCAD Consultants | @SolidCAD

Topics and Objectives



Topics

1. INTRODUCTION

CURRENT WORKFLOWS

Overview of current workflows. New approaches centered on InfraWorks or Dynamo.

2. C3D & IW

EARLY STAGES OF DESIGN

GIS, base plans and road design with Civil 3D. Passing information between Civil 3D and InfraWorks.

3. INVENTOR

MODEL FOR DETAILING

Creating smart, custom bridge components in Inventor will simplify and increase efficiency for Revit Detailers.

4. REVIT

DETAILING BRIDGES

Using Revit Annotations, dimensions and Rebar tools to detail your bridge and your bridge components.

Objectives

INFRAWORKS

Explain the differences in working with IMX, FBX, and various other formats for transferring data in and out of InfraWorks

INVENTOR

Explain differences between Inventor parts or assemblies for importing bridge components into InfraWorks

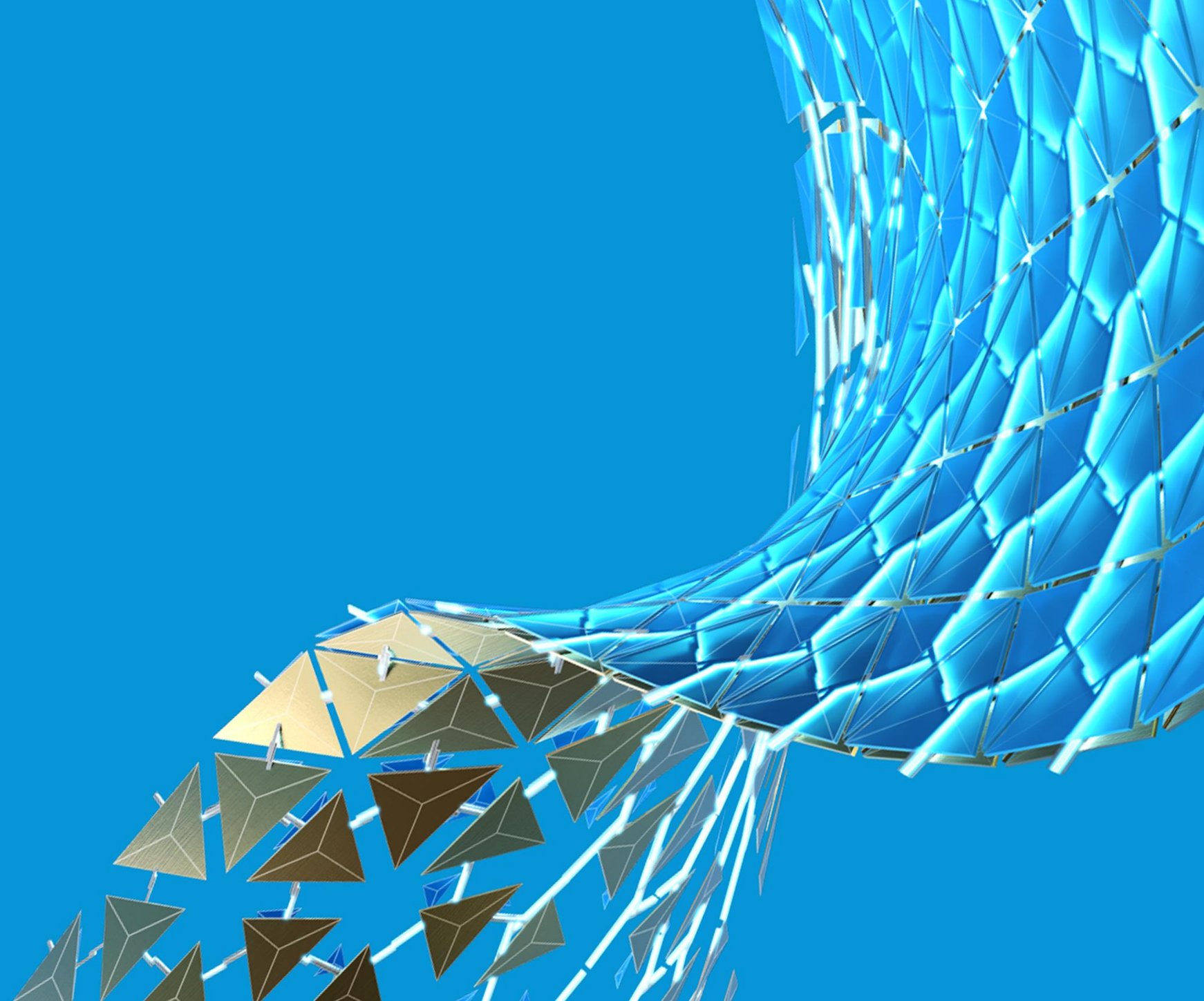
REVIT

Identify Revit detailing capabilities based on the InfraWorks component type and data format

TIPS

Explain tips for smooth coordination between Autodesk products in the InfraWorks accelerated bridge design process.

Presenters



About the speaker

Jae Kwon, Technical Consultant

- Autodesk Certified Professional (AutoCAD & Civil 3D)
- Provides teaching and support for Civil3D, AutoCAD, InfraWorks, Lumion and related products
- Primary areas of interest: Dynamo, visualization, BIM processes in civil engineering
- Jae.kwon@solidcad.ca

About the speaker

Michel Beaulieu, Business Developer SolidCAD

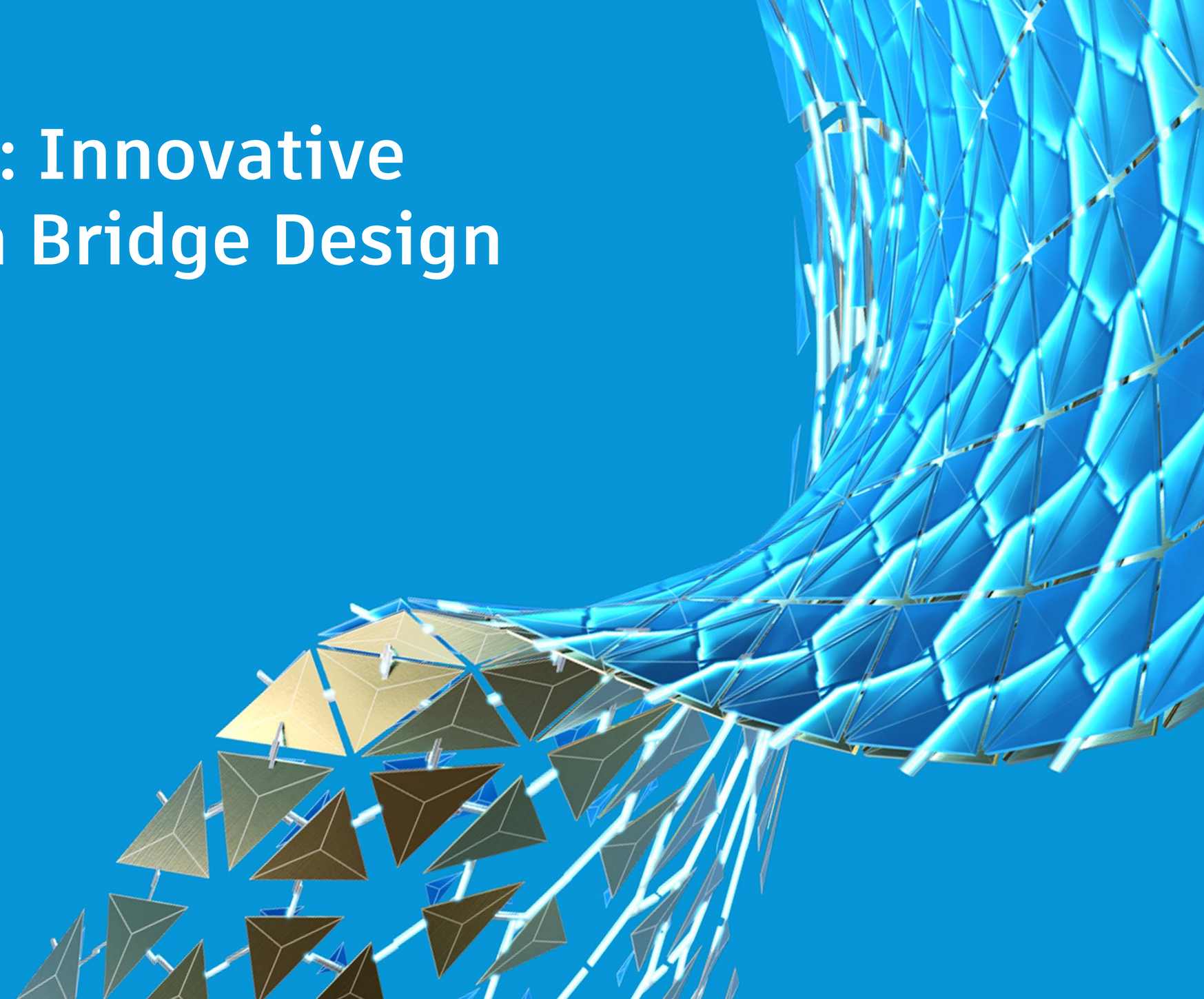
- Certified Mechanical Technologist
- Autodesk Certified Professional (AutoCAD, Civil 3d & Inventor)
- Focus on developing new markets for Manufacturing and Infrastructure
- Provides training and technical support
- Michel.beaulieu@solidcad.ca

About the speaker

Patrick Siemek, BIM Consultant

- Autodesk Certified Professional (Revit)
- Provides training and technical support for Revit, ReCap and other AEC related products
- Drives to develop concrete BIM/AEC workflows
- Patrick.siemek@solidcad.ca

Introduction: Innovative Workflows in Bridge Design



Bridge Design Workflows

AUTOCAD®

2D Plans

Challenge of ensuring latest design in all documents

Dynamo

Visual Scripting

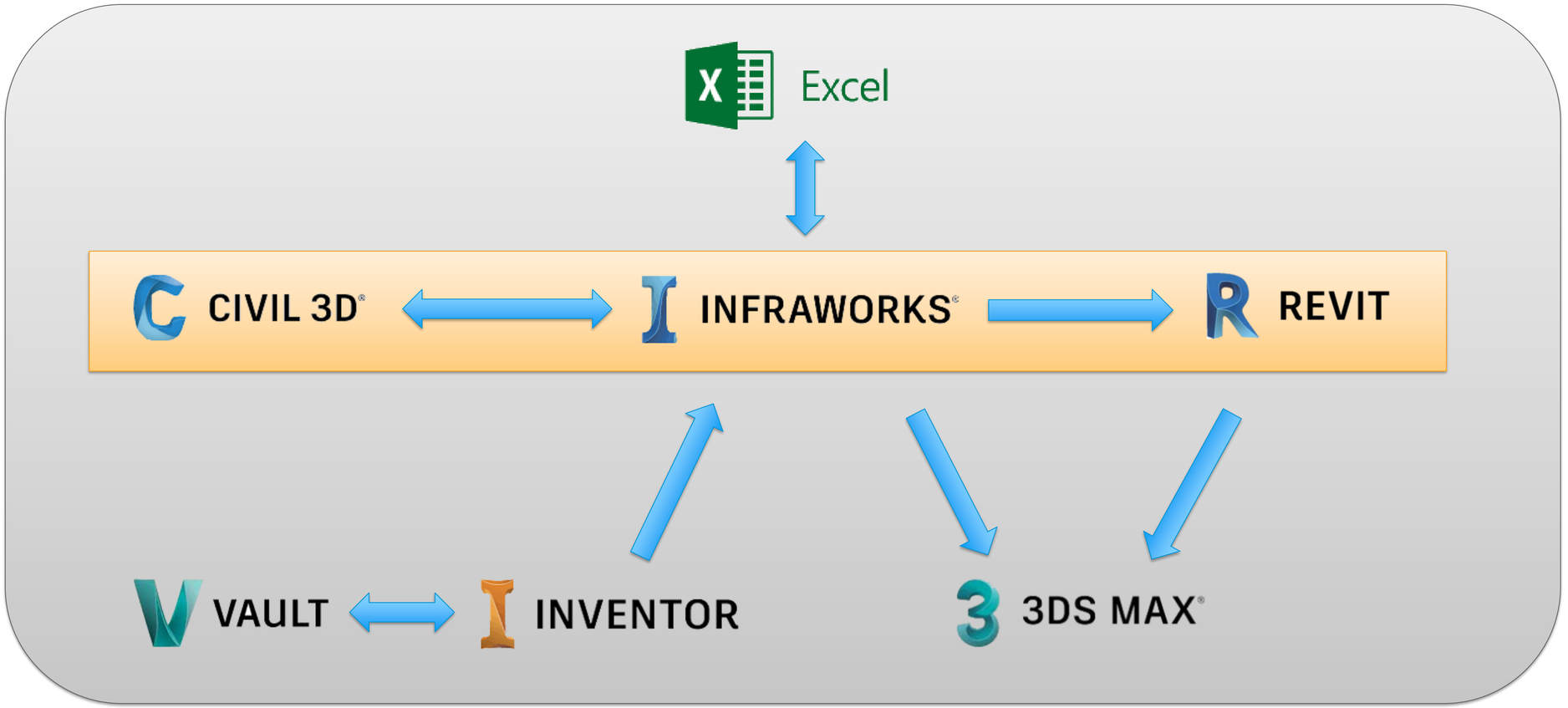
Extremely flexible, moderate/steep learning curve.

INFRAWORKS®

3D Modeling Engine

Easy learning curve, relies on familiar tools, easy to visually communicate.

InfraWorks Bridge Design Workflow

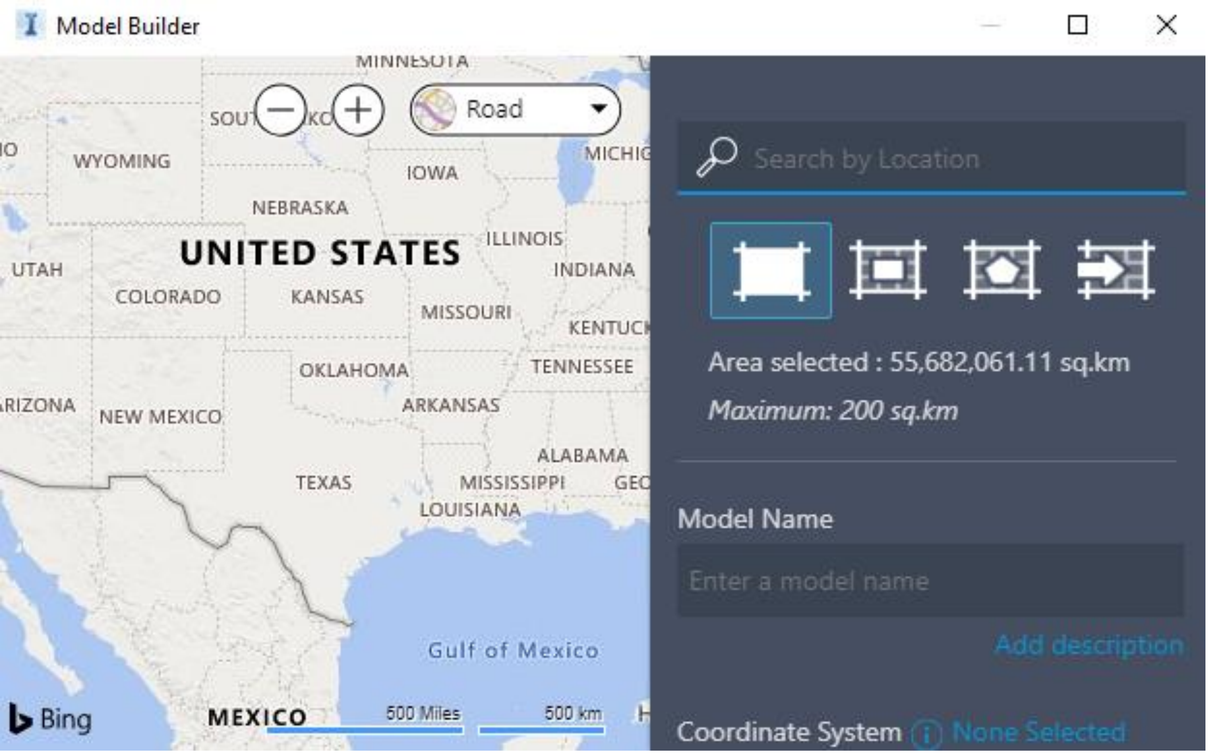


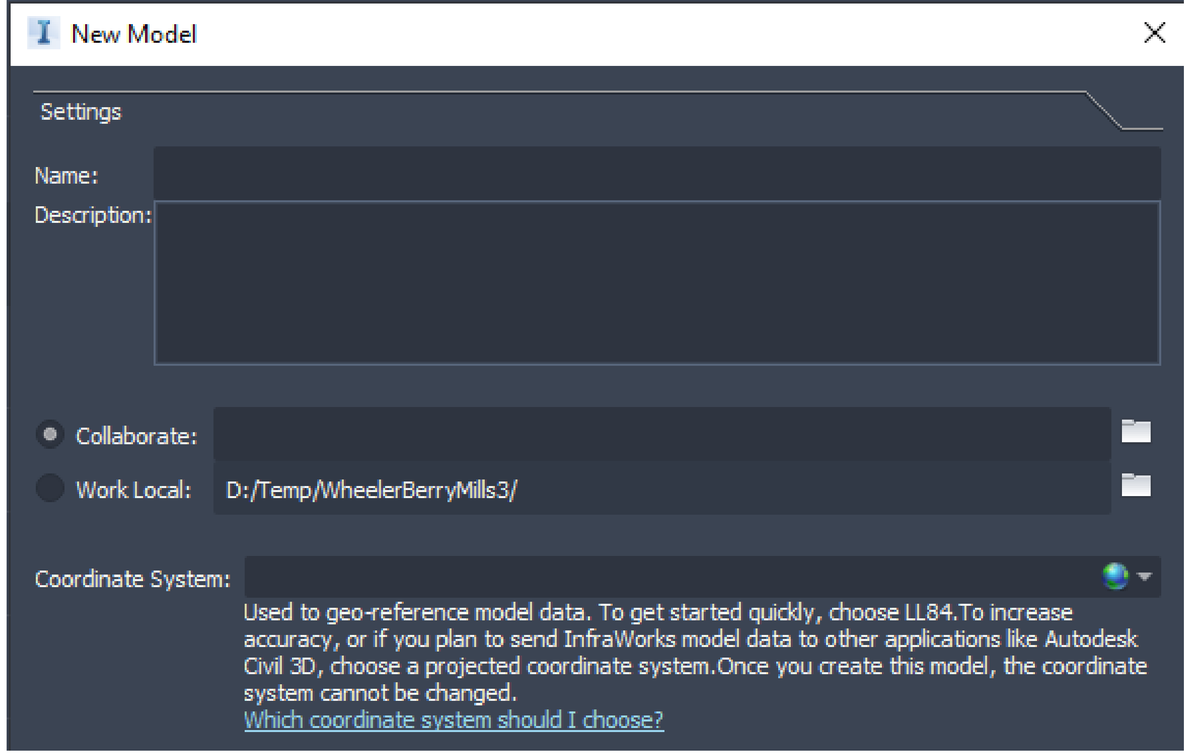
- What to do when with which software
- Best way to export/import

REQUIRED

BIM 360

Civil 3D, GIS and InfraWorks: Early Stages of Design





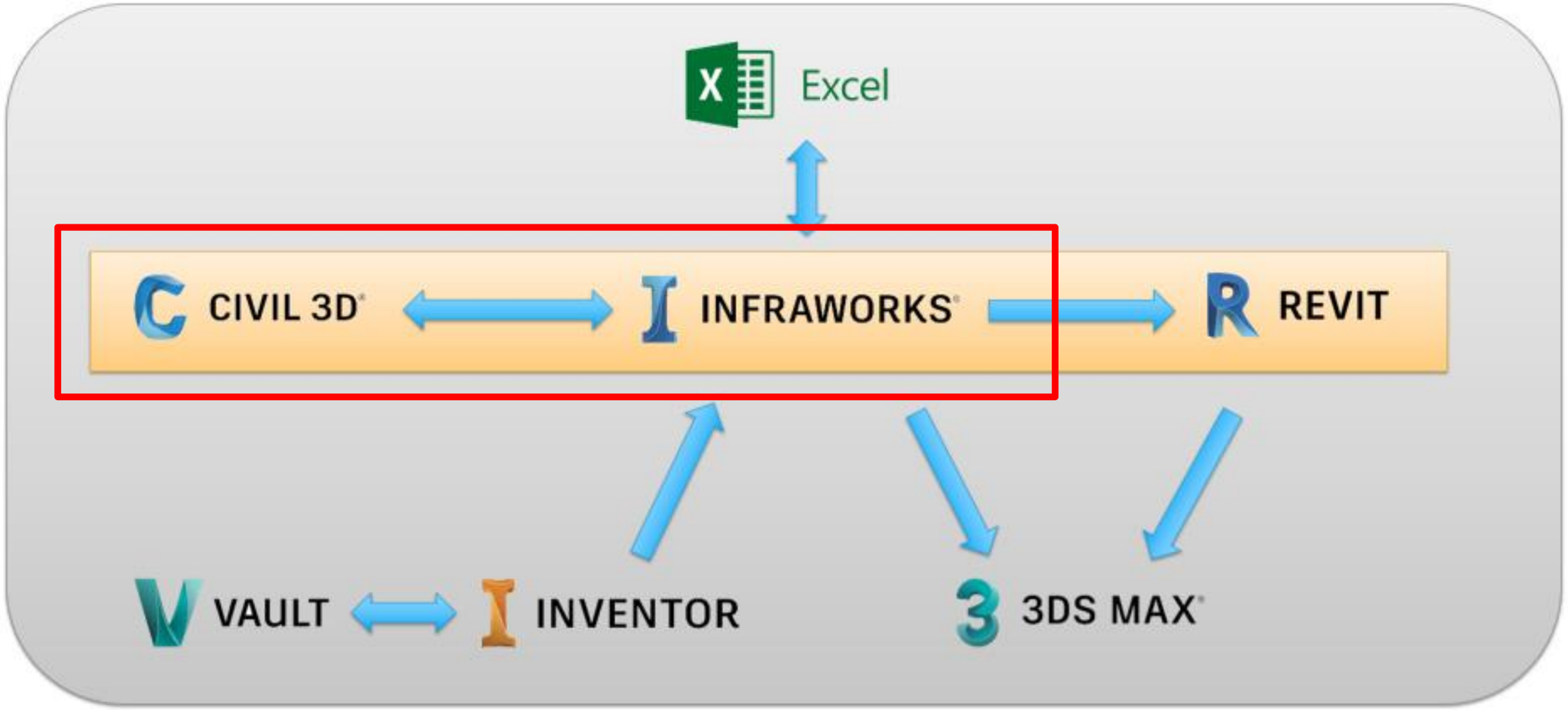
Model Builder

Obtain initial contextual data quickly

- Aerial
- Terrain
- Buildings
- Roads
- Water

New Model

- Already have more refined contextual data?
- Less cleanup; no need to create proposal w/ MB context deleted
- Preferred for 2021.0 and earlier

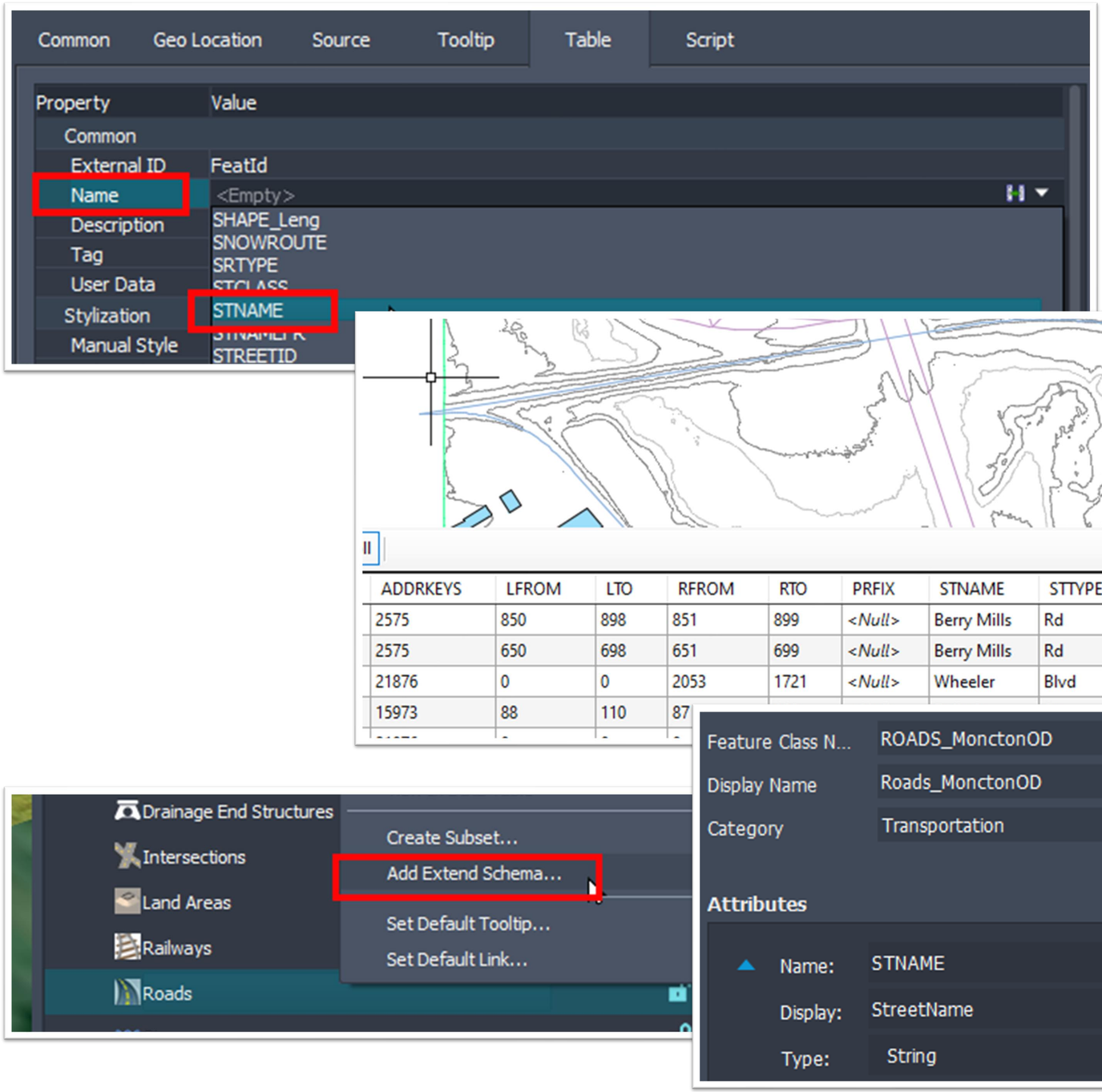


Civil 3D: Refine Base Plans and Design Roads

1. Review GIS DATA
2. Convert survey data to GIS/surface
3. Prepare TOPO surface
4. Design road alignment/corrido

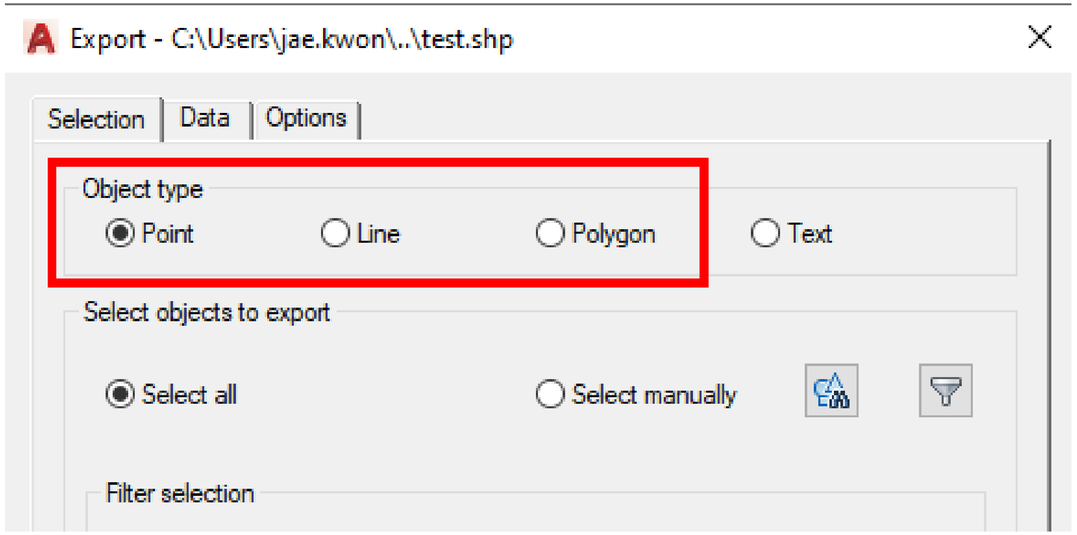
Review GIS Data

- How IW handles GIS data
- View source data in C3D
- Map schema, extending schema as needed.
- ArcGIS connector



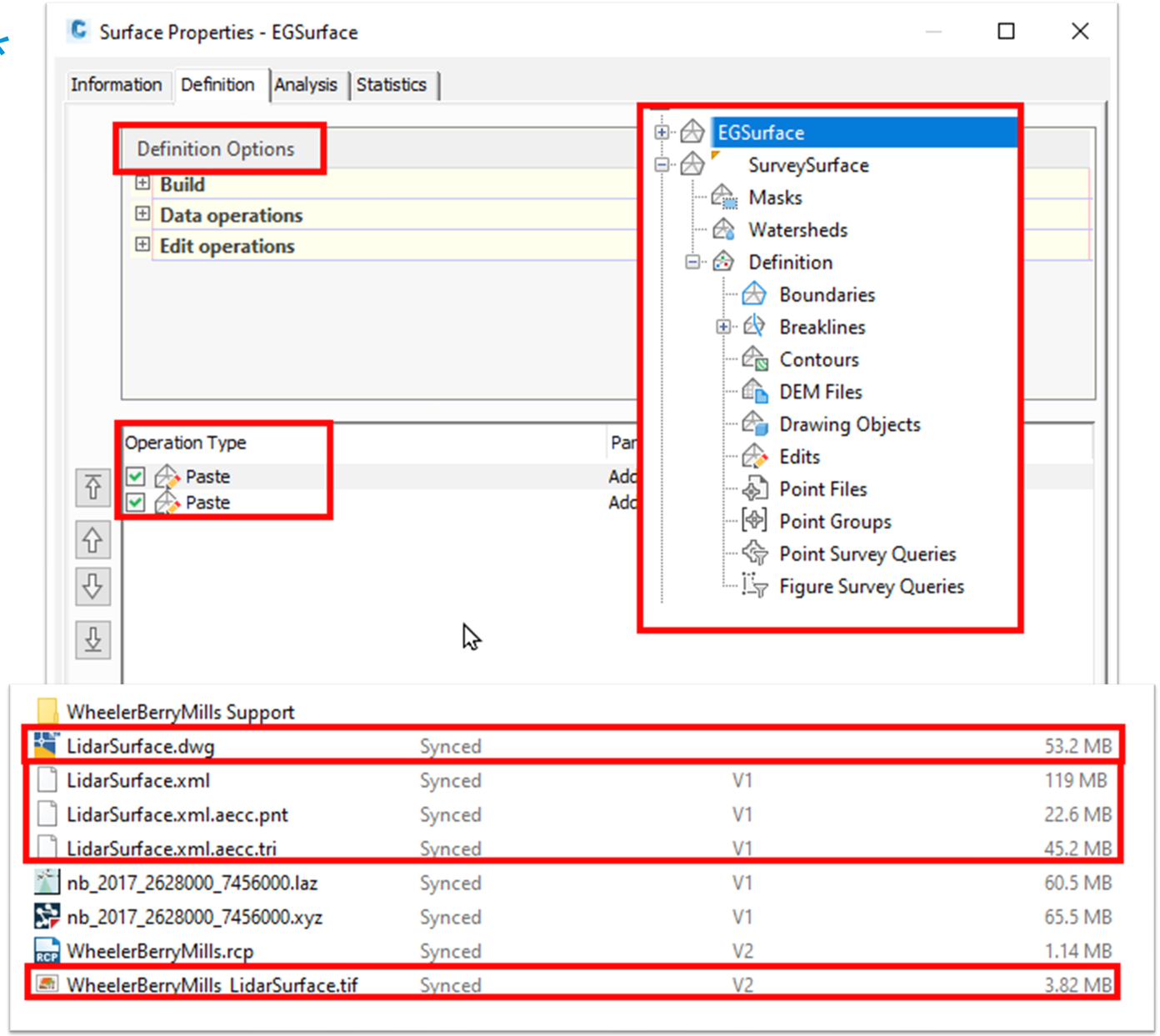
Process Survey Data

- **Import points**
- **Create survey topo surface**
- **Generate line work**
  - Add lines as breaklines to EG surface
  - Export point and line objects required as SHP files*
- **Why SHP files instead of overlay**

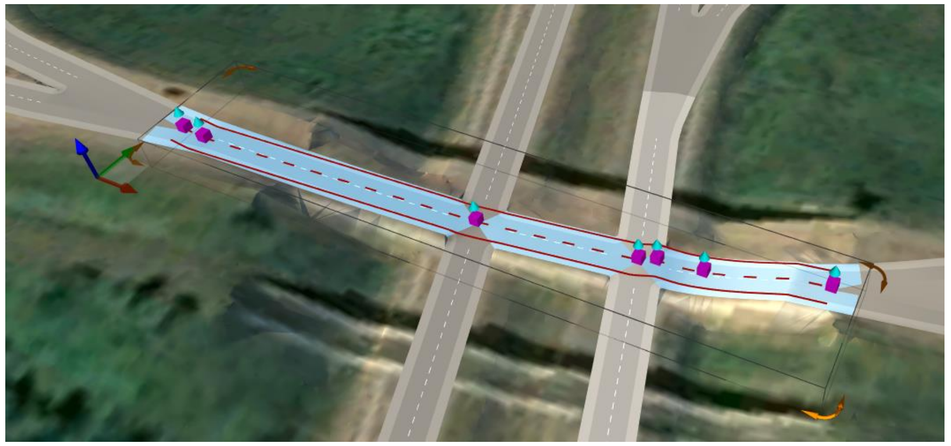


Prepare Topo Surfaces*

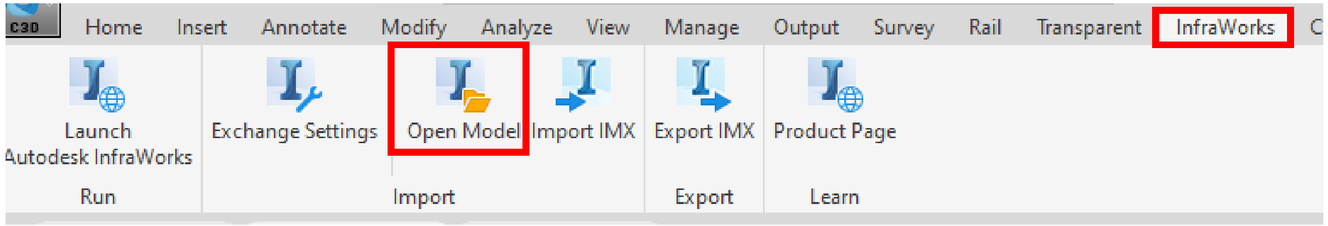
- **C3D surface definition options, operation order**
- **Export composite surface**
  - DWG
  - LandXML
  - GeoTIFF (preferred for large surfaces)

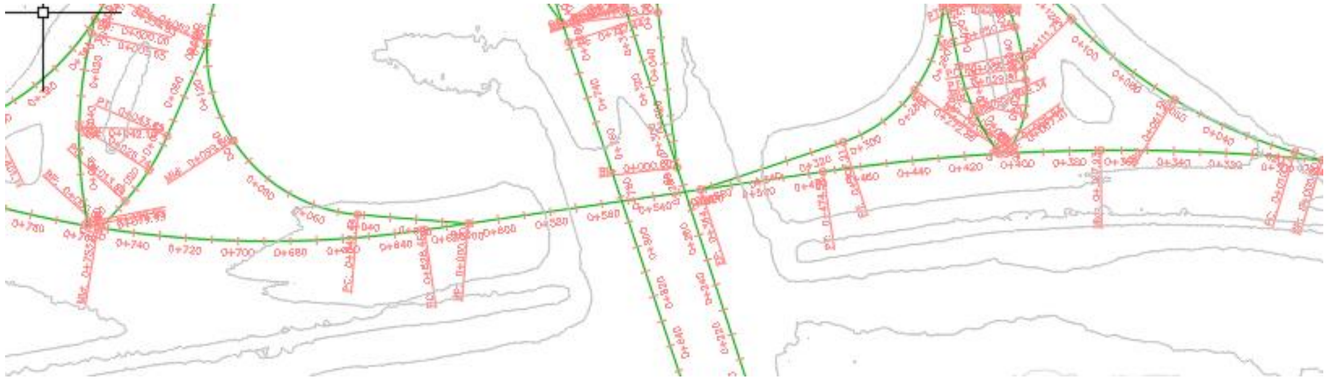


Design Alignments and Corridors



- C3D vs GIS centerline data or IW component
- IW as reference: open model*
- Alignment/Corridor design in C3D*
- Open DWG vs export IMX





InfraWorks Bridge Design Overview

- Create
- Edit
- Reuse
- Analyze
- Visually communicate

InfraWorks Bridge Design Overview – Tasks Demo'd

CREATE

1. Create a bridge by station

EDIT

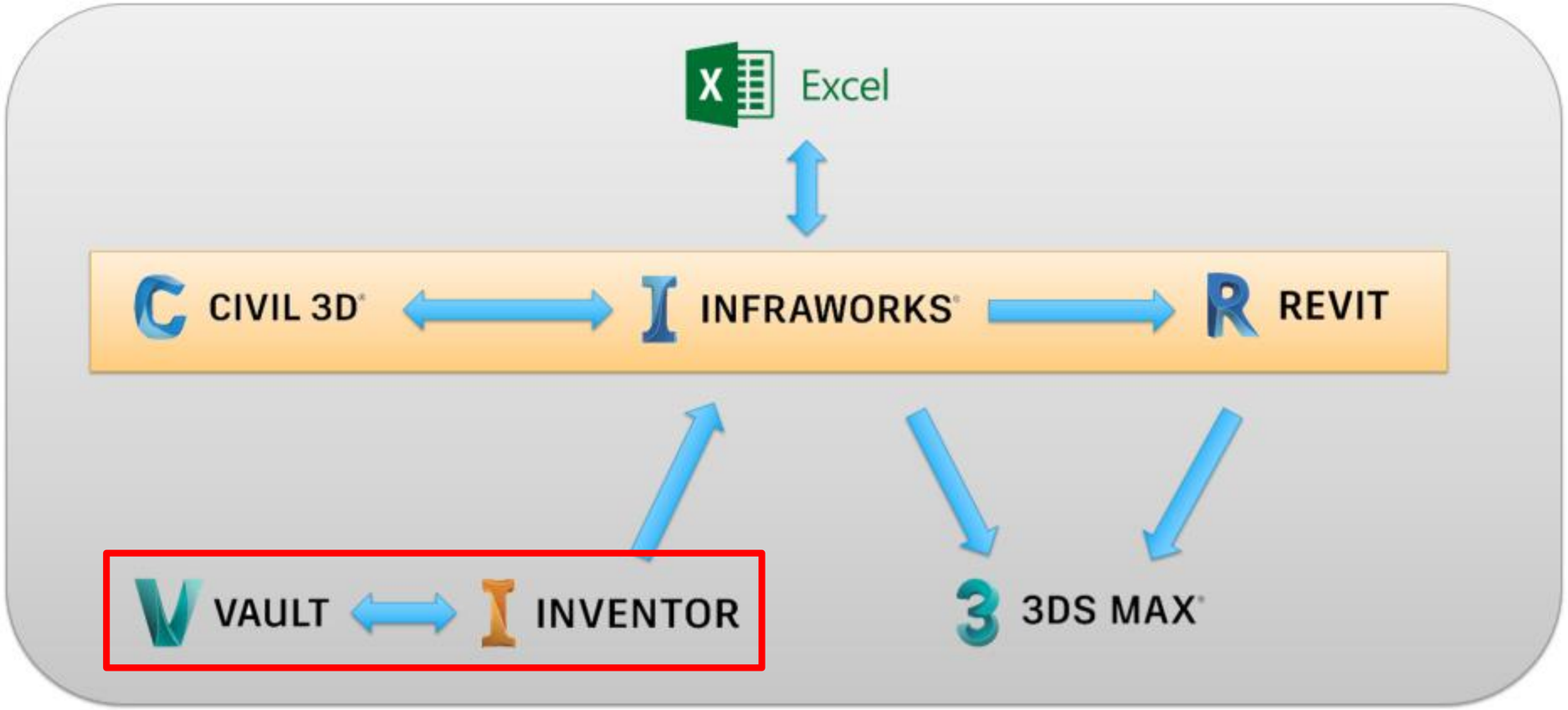
1. Select bridge template
2. Change number of piers
3. Reposition piers and set skew
4. Inspect other parameters
5. Change girder type
6. Apply change to other girders in group
7. Create section plane for girder and adjust parameter
8. Create a duplicate girder style
9. Add a new part size column
10. Export/import settings to/from json
11. Set girder to newly created size
12. Send bridge parameters to Excel
13. Update Excel and update bridge
14. Create a new bridge template

ANALYZE

1. Run line girder analysis
2. Run refined analysis

SHARE

1. Create snapshot
2. Export a video of a storyboard
3. Create and mark up a shared view
4. Export FBX for rendering
5. Publish/update model for consumption by Revit



Custom Bridge Components: Inventor

- When stock components are not enough
- Design custom bridge components in Inventor

Customizing Bridge components, using Autodesk Inventor

Custom Components – Where to Start?

You have choices…. Both items listed below assume you are familiar with Inventor.

- Option #1; Start from scratch: You can start with a simple, basic part, create the “required parameters”, do some extrusions and see where things go.

- Option #2; Reverse engineer: Copy and Edit existing bridge component

- ** Either way, you will need to be aware of the “Required Parameters” by Infraworks **

Custom Component – Required Parameters

PIERS

PierHeight

PiercapRightWidth

PiercapLeftWidth

BEARINGS

BearingAssemblyHeight

ExtraHeight

GirderSoffitLongiSlope

GirderSoffitTransSlope

PiercapLongiSlope

PiercapTransSlope

ESSENTIALS (PIERS)

PierCapTopLeftSlopeInPercentage

PierCapTopRightSlopeInPercentage

StepHeight

(and more)

ABUTMENTS

CLBearingToBBW

LeftWidth

SeatDepth

SeatOffset

SeatWidth

DECKS

LeftWidth

RightWidth

NOTE: This is only a partial list of required parameter. See Infraworks Help Files for further info.

Custom Components – Reverse Engineering

COPY INFRAWORKS STYLE

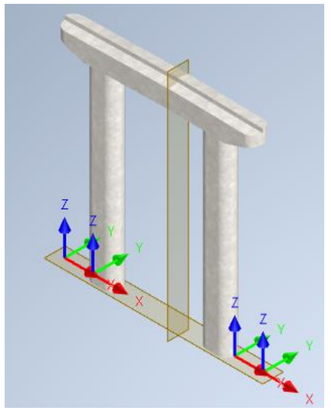
Use the Duplicate Icon in Infraworks Style Manager to Copy an existing Style

EDIT STYLE

Use the Edit icon to change and reveal the path to the existing model

SAVEAS IN INVENTOR

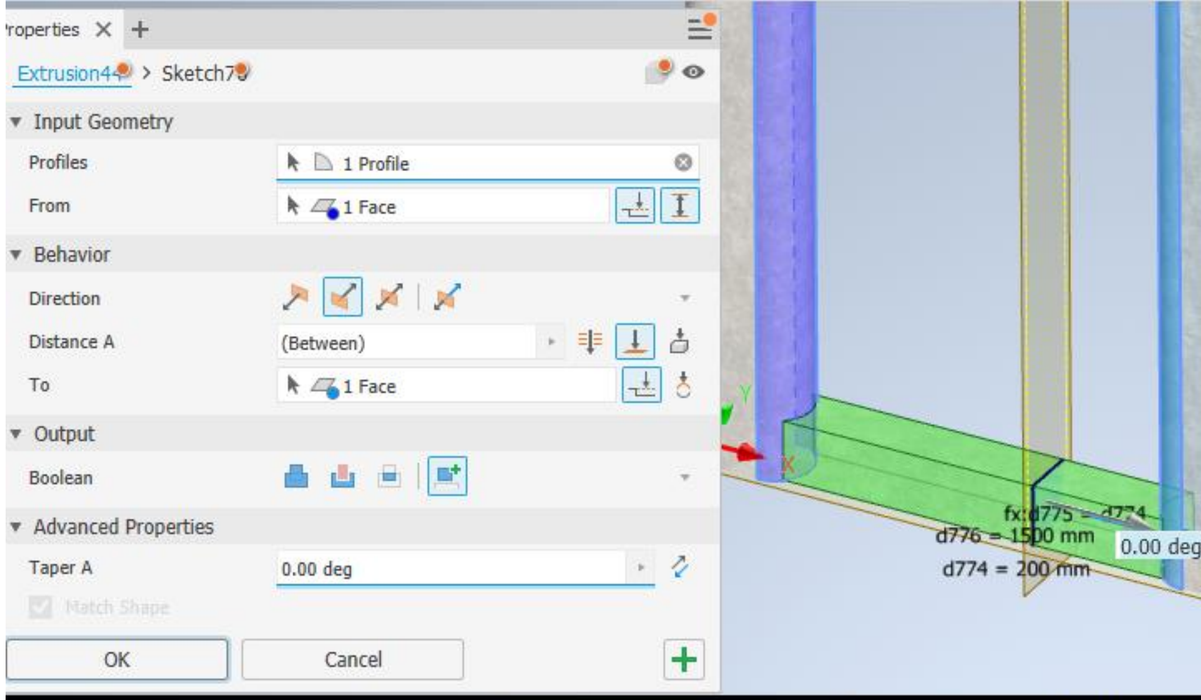
Open the File from Browser and once in Inventor, do a SaveAs and save the file in your Project workspace.

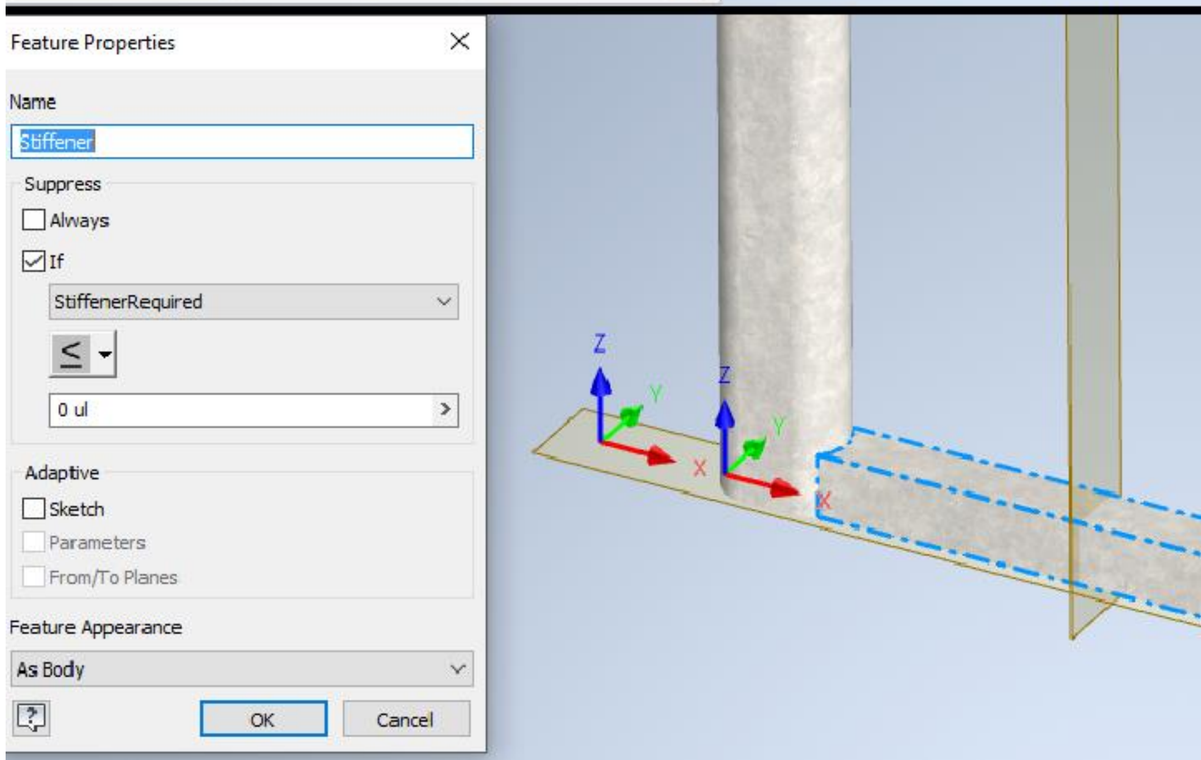


Custom Components – Reverse Engineering

Use Inventors intuitive interface along with its full 2d and 3d parametric modeling to creating simple and flexible models.

- Create 2d Sketches on flat faces or work planes.
- Use Extrude, Revolve or other to turn your sketch into a 3d feature.
- Use Parameters to create “what if” scenarios

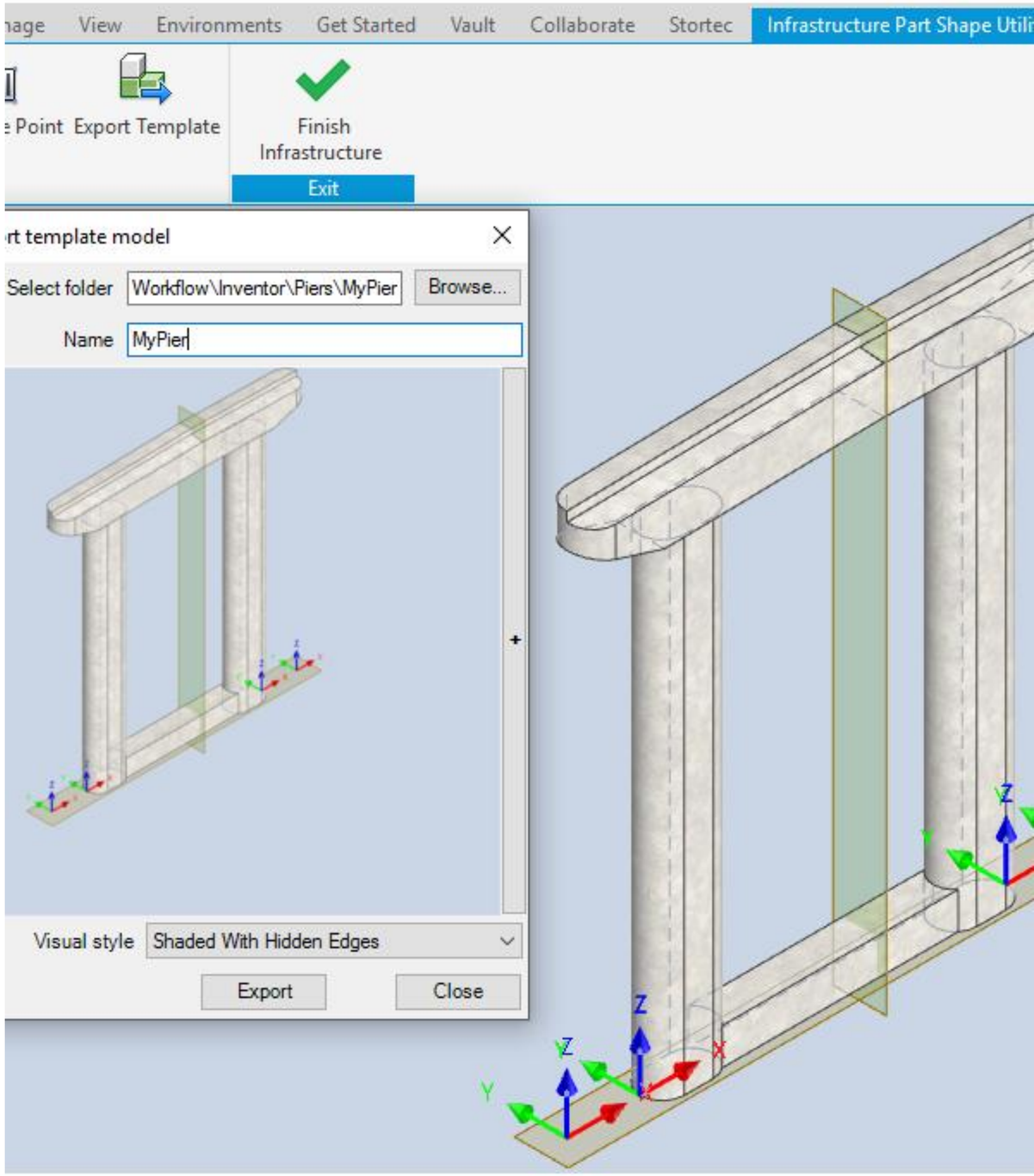




Custom Components – Reverse Engineering

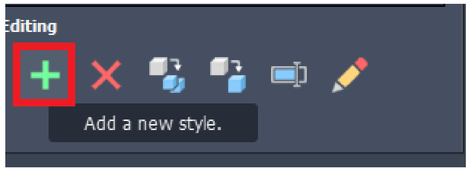
Autodesk created a special plug-in for Inventor, called the Infrastructure Part Shape Utilities.

- Download from Autodesk account
- Found on Environments Tab once installed
- Allows for Publishing of many different types of Infrastructure parts.
- Publish in a different folder than original model



Custom Components – Reverse Engineering

You can import an Inventor published file by using the Infraworks Style Palette.



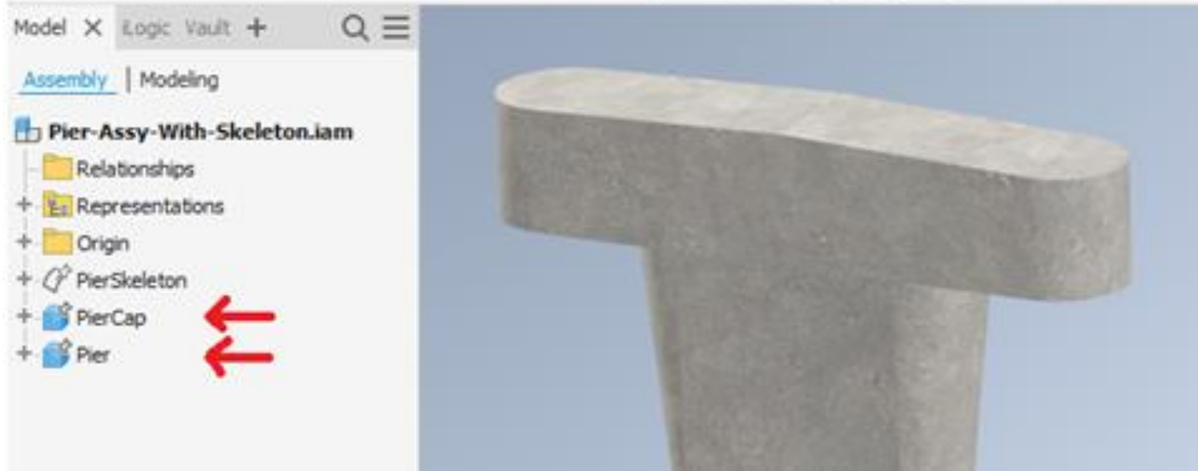
- Add a Style making sure to pick the correct Inventor Model
- Confirm Required Parameters
- Confirm Domain and Component Type
- Make changes to UI Appearance (for best user experience)

Priority	Name	Label	Tooltip
1	PierHeight	Pier height	Height of pier based on vertical profile of road
2	TopOfPierCapVertOffset	Vertical offset	Vertical space between the top of the pier cap and the bottom c
3	PiercapLeftWidth	Width: Left	
4	PiercapRightWidth	Width: Right	
5	PierCapSectionWidth1	Width: Front	
6	PierCapSectionWidth2	Width: Back	
7	PiercapDepth	Depth	
8	HasRoundedPiercapEnds	Has rounded ends	
9	PiercapTaperedEndLength	Tapered end: Length	
10	PiercapTaperedEndDepth	Tapered end: Depth	
11	PierCapTopLeftSlopeInPercentage	Slope: Left	Percent slope of the pier cap to the left of center line.
12	PierCapTopRightSlopeInPercentage	Slope: Right	Percent slope of the pier cap to the right of center line

Custom Components – Differences in Modeling

Not all models are create alike. Inventor has the ability of creating single body parts or multi-body parts as well as assemblies (collection of parts)

- Single Body parts only have 1 solid found within, regardless of the number of Features used.
- Multi Body parts are the same as single body, however each feature could be a separate solid body.
- Assemblies on the other hand can use either single body parts and/or multi body parts to bring (and hold) parts together.

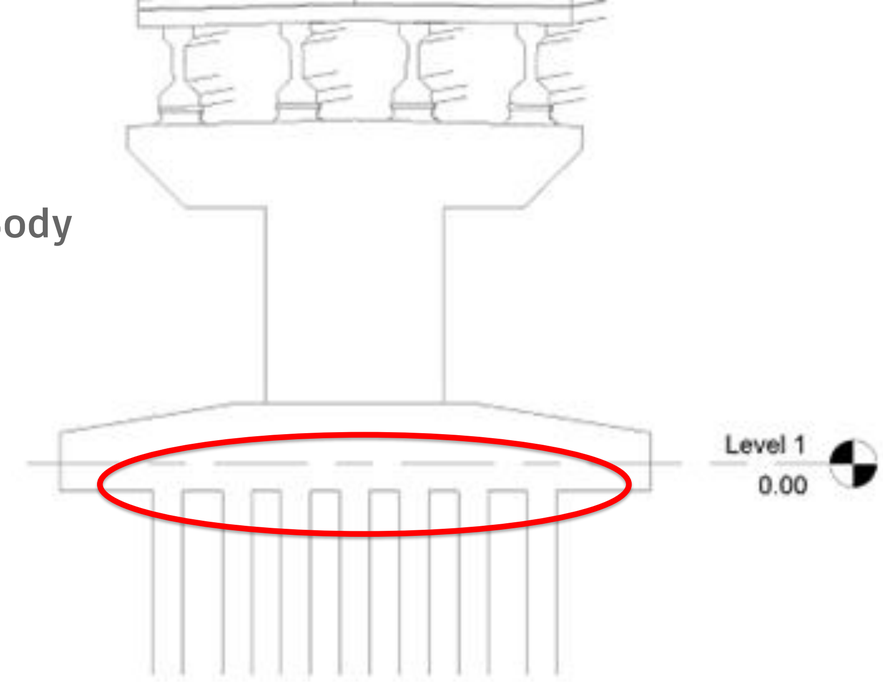


Custom Components – Differences in Modeling

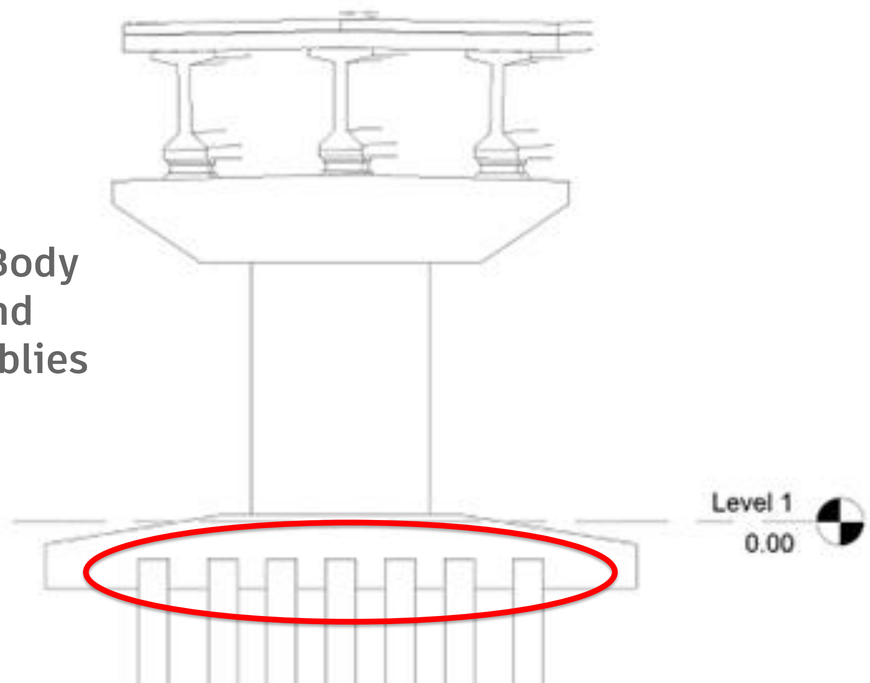
Not all models are create alike. Detailing or the ease of detailing is very important in a proper bridge modeling workflow.

- Single Body parts can have a visual issue when detailing takes place. Because there is only 1 solid, when a section is done, all parts are blended together. This causes further work for the Revit Detailing. (Foundation and Casing example)
- Multi Body parts and Assemblies on the other hand create a separation between the different parts as this is the way they were intended to be. This can reduce the effort required for detailing in Revit.

Single Body Part



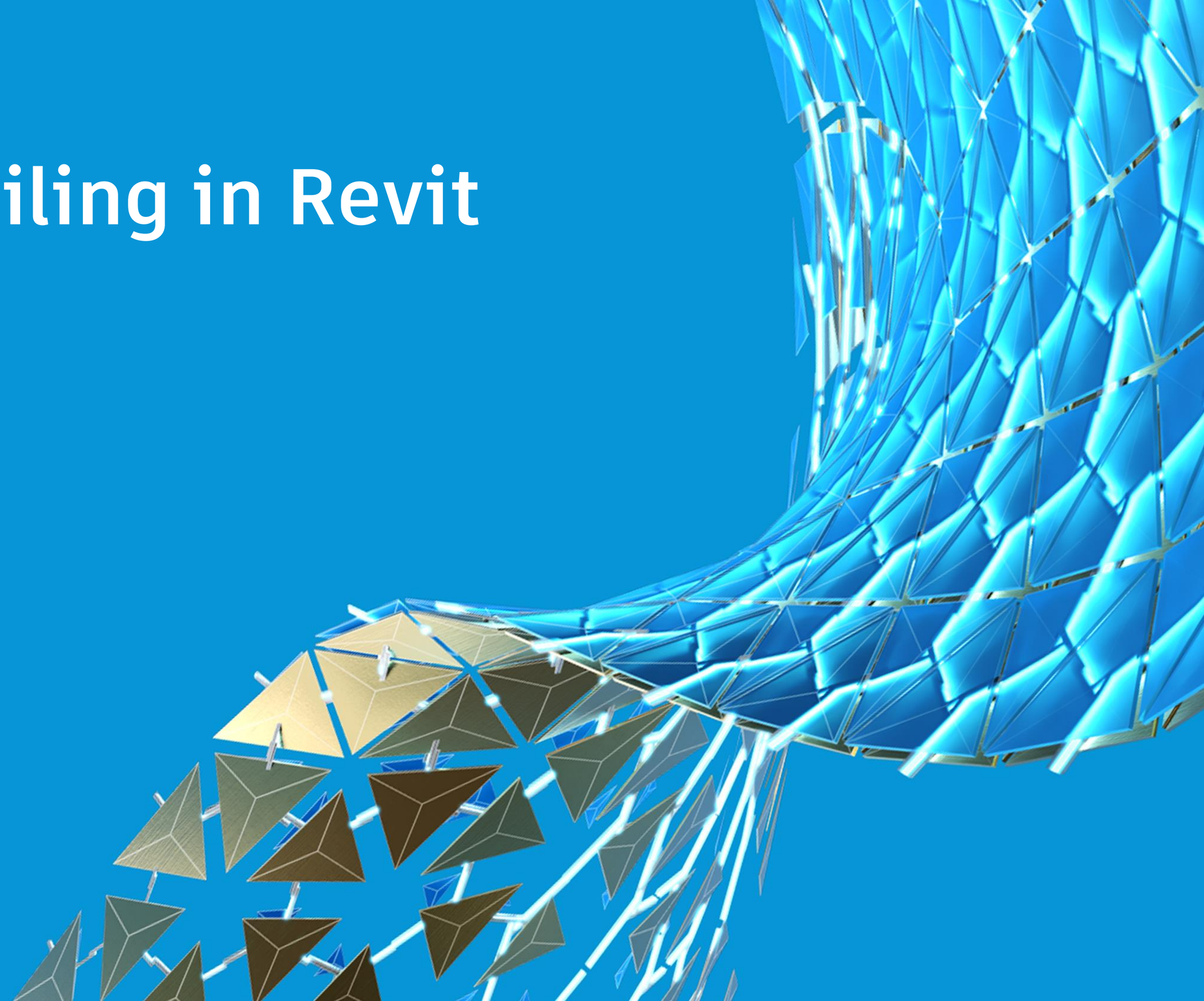
Multi Body Part and Assemblies



Custom Components – Reverse Engineering

DEMO

Bridge Detailing in Revit



Importing Infraworks Data into Revit

Previous workflows of importing data from Infraworks to Revit and modifying design have changed.

Old workflow

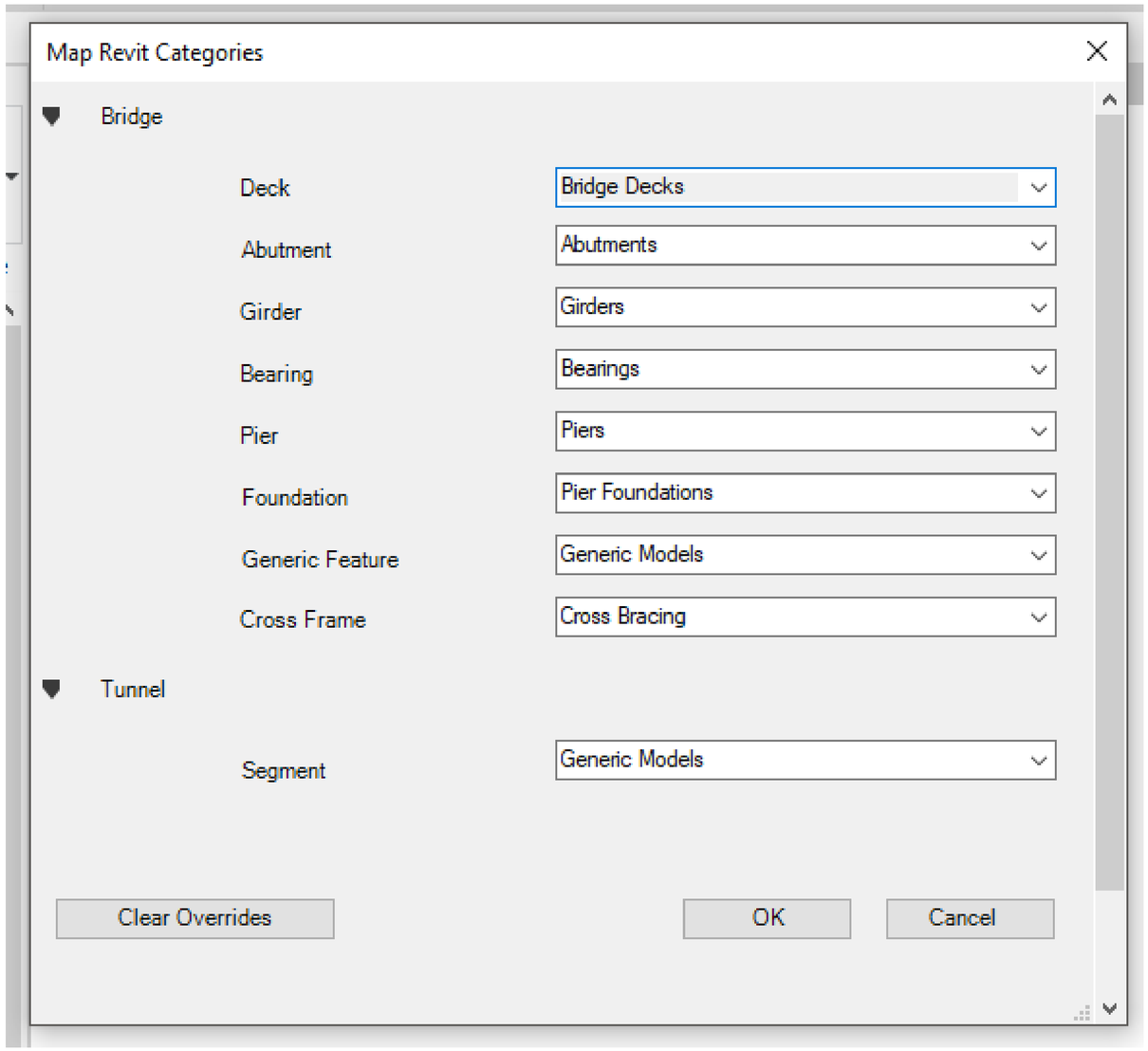
- Design in Infraworks
- Export data directly to Revit
- Modify design and detail within Revit

New Workflow

- Design in Infraworks
- Export data and import within Revit
- Modify design in Infraworks and re-export data back to Revit
- Add additional detailing (annotations, rebar etc.)

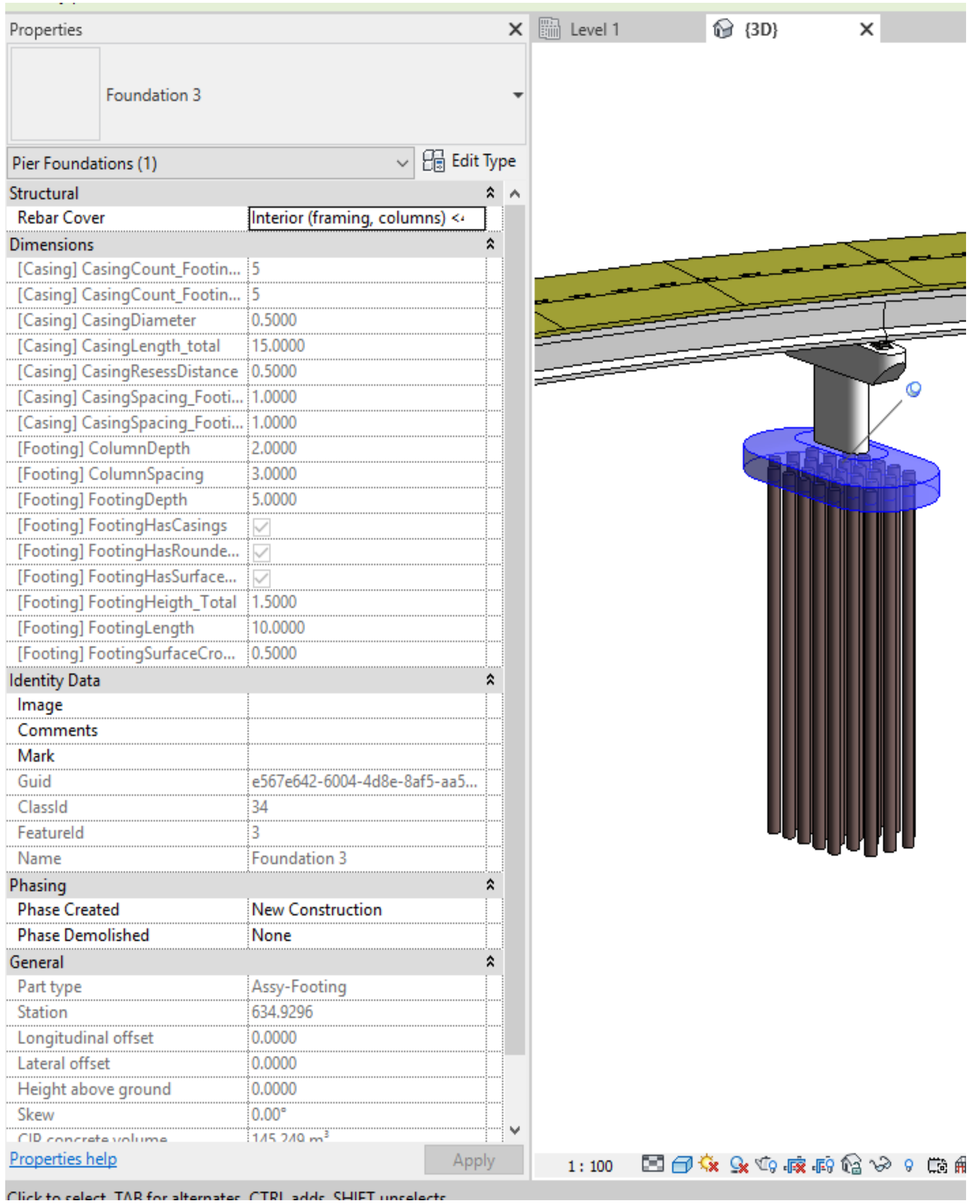
Map Revit Categories

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



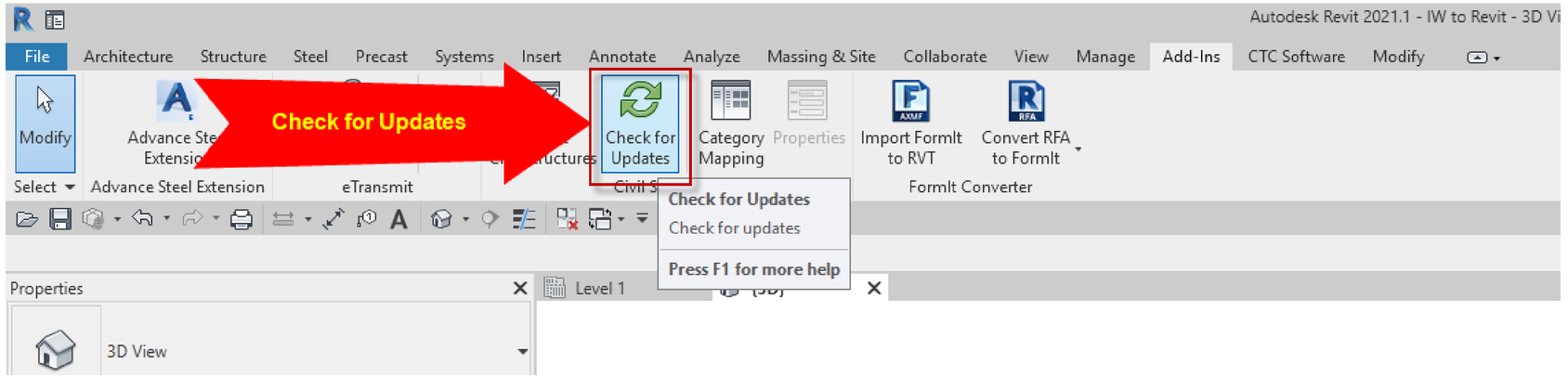
Verify the Data

- Once the bridge design has been imported, we can verify the data closer by selecting the elements.
- 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 differently within Revit.
- An “Assembly” part type is the recommended option as you gain more control of individual elements to add additional detailing.



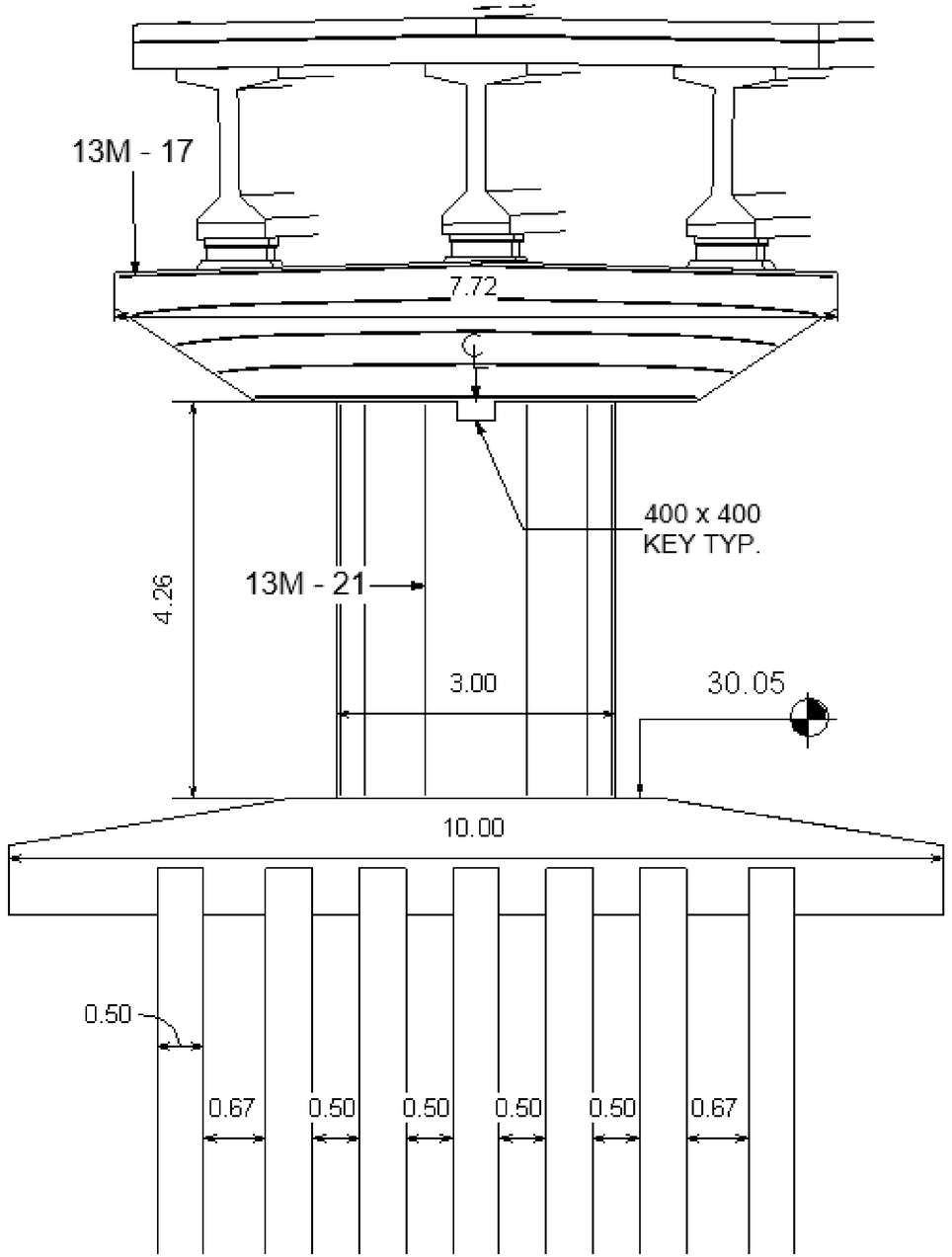
Modifying the Design

- To modify the design, this will be done in infraworks.
- Parametric data is modified within Infraworks and exported out.
- The link between the Infraworks data and Revit data will “Check for Updates”.



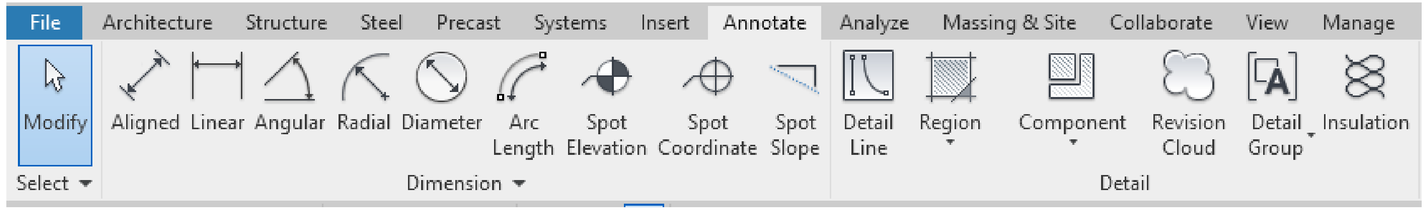
Reinforcement and Detailing

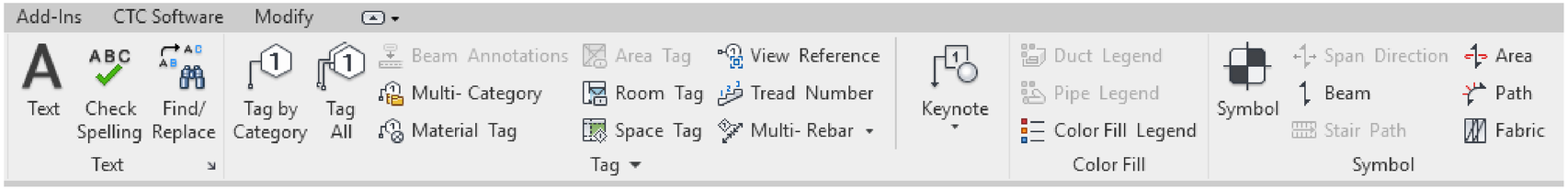
- Once the data has be updated, additional reinforcement and detailing can be done within Revit.
- 3D views, sections etc. are created.
- From these views, annotations and rebar reinforcement can be added.



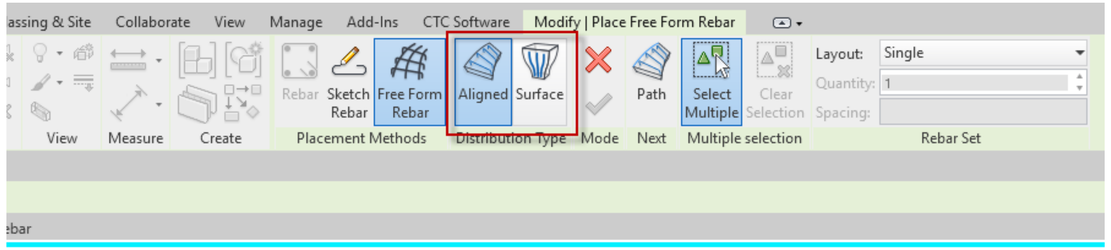
Revit Annotations

- Using the “annotations” tab, dimensions can be added to the views.
- In addition to dimensions, detail lines, regions and components can be applied to the model for further detailing.





Revit Reinforcement



- Rebar Reinforcement elements (rebar, hooks etc.) are also applied to the model for detail.
- The typical approach is to use the native Revit reinforcement tools.
- Free form rebar is a great way to add rebar to very unique shapes that come from the Bridge Design.