

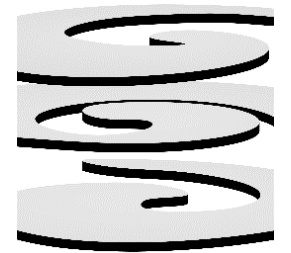


openBIM Project Solutions

3rd July 2024
Sydney



Jon Mirtschin
Geometry Gym
jonm@geometrygym.com





<https://geometrygym.wordpress.com/>

Geometry Gym

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Search

Interoperability Tools for BIM and Structural Analysis

Geometry Gym develops utilities and plugins for Rhino3d, Grasshopper, Revit, Tekla, Navisworks and a range of Structural Analysis programs that enable openBIM IFC(Industry Foundation Classes) generation and exchange.

[GET STARTED](#)

...




BIM and Industry Foundation Class (IFC)



[Learn about BIM and Industry Foundation Class tools and Features](#)

Free to Try



RhinoIFC


Rhino 6 and Newer

[Available from Rhino Package Manager](#)

[Technical](#) [Examples](#) [Blog](#)
[Updates](#)

[Learn about Rhino3d](#)

Free to Try



RevitIFC

Revit 2018 to 2024. Earlier versions available on request.

[ggRevit User v24.01.23](#) (24th Jan 2024)

[Technical](#) [Blog](#) [Updates](#)

[Learn about Revit](#)

Free to Try



NavisIFC

Navisworks Manage 2018 to 2024

[ggNavisIFC v23.11.17](#) (17/11/2023)

[Technical](#) [Blog](#)

[Learn about Navisworks](#)




openBIM Project Solutions (Disclosed)

- **Schema Compliance and Validation**
- **Inconsistent and Problematic Interpretations**
- **Efficiency vs Reliability (File Sizes)**
- **Model View Definitions**








Let us know what we're getting right and what we can improve at validate@buildingSMART.org

- Home
- Validation


Click or drop files here to upload for validation

UPLOAD & VALIDATE

- 1 Select the IFC file(s) you want to validate
- 2 Click on "Upload & Validate"
- 3 Check the detailed results by clicking on the icons

<input type="checkbox"/>	File Name	STEP Syntax [Ⓢ]	IFC Schema [Ⓢ]	Normative IFC Rules [Ⓢ]	Industry Practices [Ⓢ]	bSDD Compliance	Date	
<input type="checkbox"/>	IFC_Demo_Port_Fairy_Rail_Trail.ifc						4 days ago	Download file

validate v0.6.4



<https://www.buildingsmart.org/standards/bsi-standards/information-delivery-specification-ids/>

Information Delivery Specification (IDS)

Define your exchange requirements with IDS to build confidence, clarity and enhance interoperability

[Learn more](#)

[Documentation](#)






<https://www.iai.kit.edu/english/1649.php>

ifcCheckingTool_Lite x64 V 2.4

Developed at:



KIT
Karlsruhe Institute of Technology
Institute for Applied Science

IFC File Check

File:

Start Checking Show Report Save Report

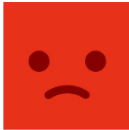
Terms of Use Info

Report

Checking Report

Filename: IFC_Demo_Port_Fairy_Rail_Trail.ifc

Check Option: IFC4X3_ADD2



- Show Object Statistic
- Show Full Statistic
- Show Header
- Show Messages

Results:

Total Number of Errors	7	Errors in PropertySets	1
Total Number of Warnings	1	Warnings in PropertySets	0
Total Number of Comments	1		

Message Code	Message Type	Amount
HEADER_03	WARNING	1
IFCPRESENTATIONLAYERWITHSTYLE.APPLICABLEONLYTOITEMS	ERROR	6
PSET_IFC4X3_ADD2_01	ERROR	1
PSET_IFC4X3_ADD2_10	COMMENT	1

Object Statistic:

Object Types	13
Object Instances	346

Object	Amount
IFCALIGNMENT	2
IFCALIGNMENTHORIZONTAL	1
IFCALIGNMENTSEGMENT	77
IFCALIGNMENTVERTICAL	1



Many viewers swallow / ignore issues and problems when importing/opening an IFC file.

Encourage vendors to provide a log file. Revit will generate a .log.html file when linking an IFC file that can be useful for troubleshooting on Autodesk software.



Warnings and Errors

General WARNING: Schema IFC4X3_ADD2 is not fully supported. Some elements may be missed or imported incorrectly.
#148: ERROR: Unhandled subtype of IfcProduct: IfcAlignment (This message will only appear once.)

Entities Processed

Entity Type	Count
IfcBuiltElement	32
IfcCartesianPoint	4
IfcDirection	2
IfcGeographicElement	2
IfcGeometricRepresentationContext	2
IfcGroup	2
IfcLocalPlacement	48
IfcMaterial	1
IfcPostalAddress	1
IfcProject	1
IfcPropertySet	240
IfcPropertySingleValue	239
IfcRailing	1
IfcRoad	1
IfcRoadPart	12
IfcSign	2
IfcSite	2
IfcSIUnit	5
Total	597

Elements Created

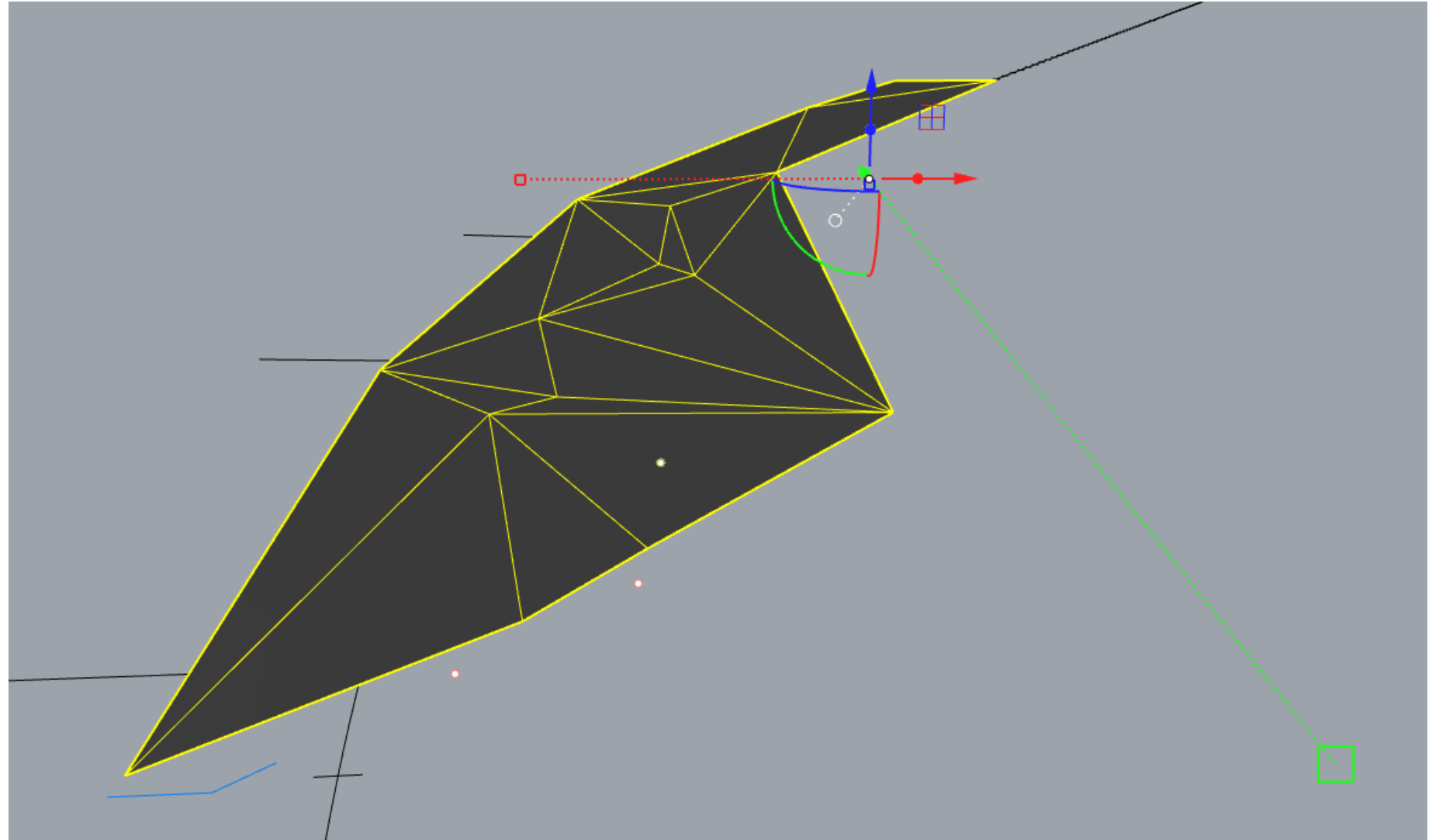
Element Type	Count
(Generic Models) DirectShape	34
(Railings) DirectShape	1

Errors and problems



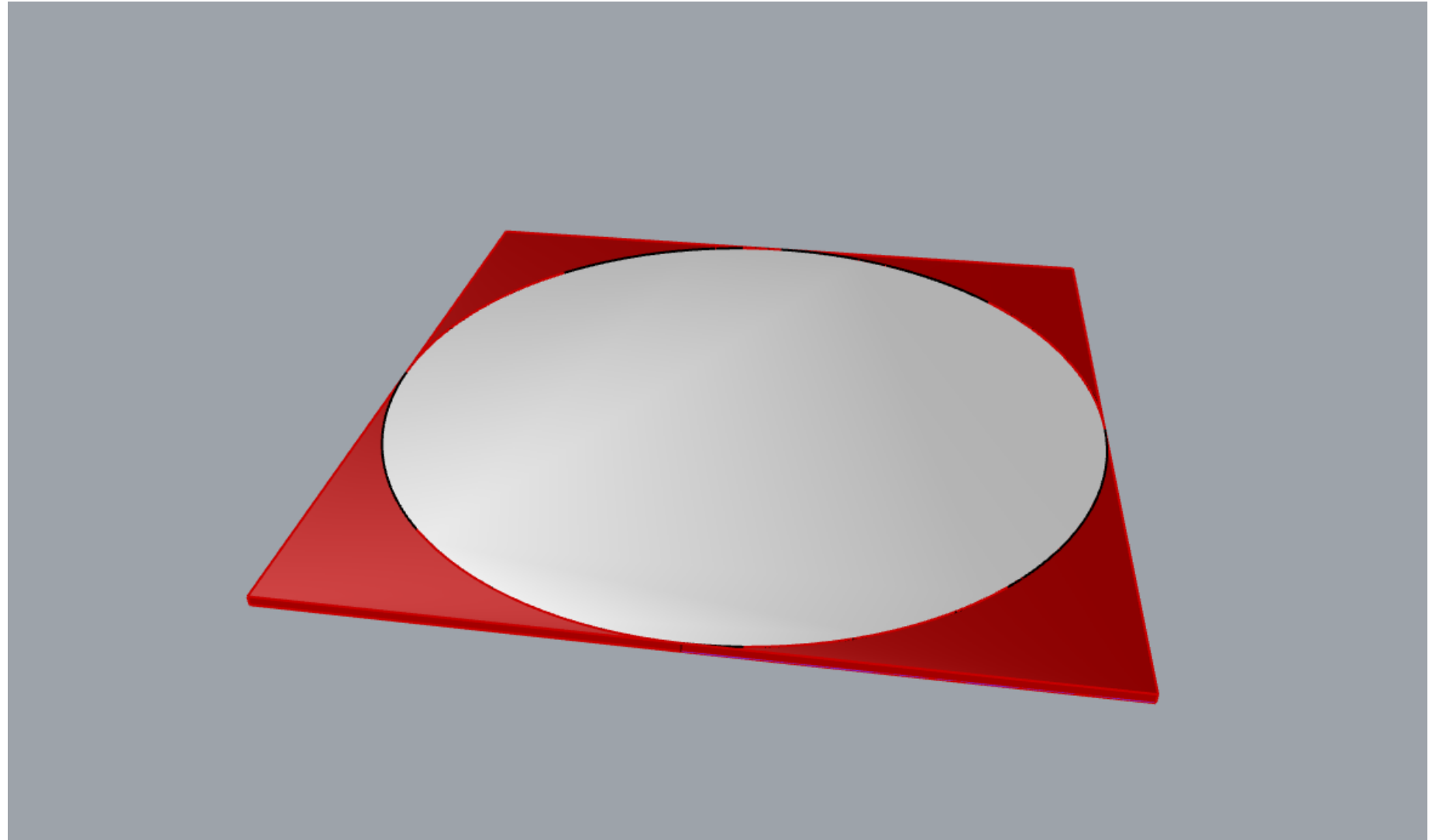
```
Axis : #28= IFCDIRECTION((0.0,0.0,1.0));
RefDirection : #29= IFCDIRECTION((1.0,0.0,0.0));
- IsDecomposedBy : #35= IFCBUILDING('9dadaa6d-49f3-530a-bc4b-93543b74f559',#5,'AUXILIARY EQ
+ Placement : #30= IFCLOCALPLACEMENT(#25,#31);
- IsDecomposedBy(736)
+ #73= IFCBUILDINGELEMENTPART('00000000-0000-0000-f64a-fb8a00000000',$,'AUXILIARY EQ
+ #171= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #242= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #313= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #384= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #455= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #526= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #597= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #668= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #739= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #810= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #881= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #952= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDING
+ #1023= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1094= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1165= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1236= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1307= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1378= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1449= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1520= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1591= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
+ #1662= IFCBUILDINGELEMENTPART('00000000-0000-0000-0a0b-ebf000000000',$,'IFCBUILDIN
```

Triangulated Geometry



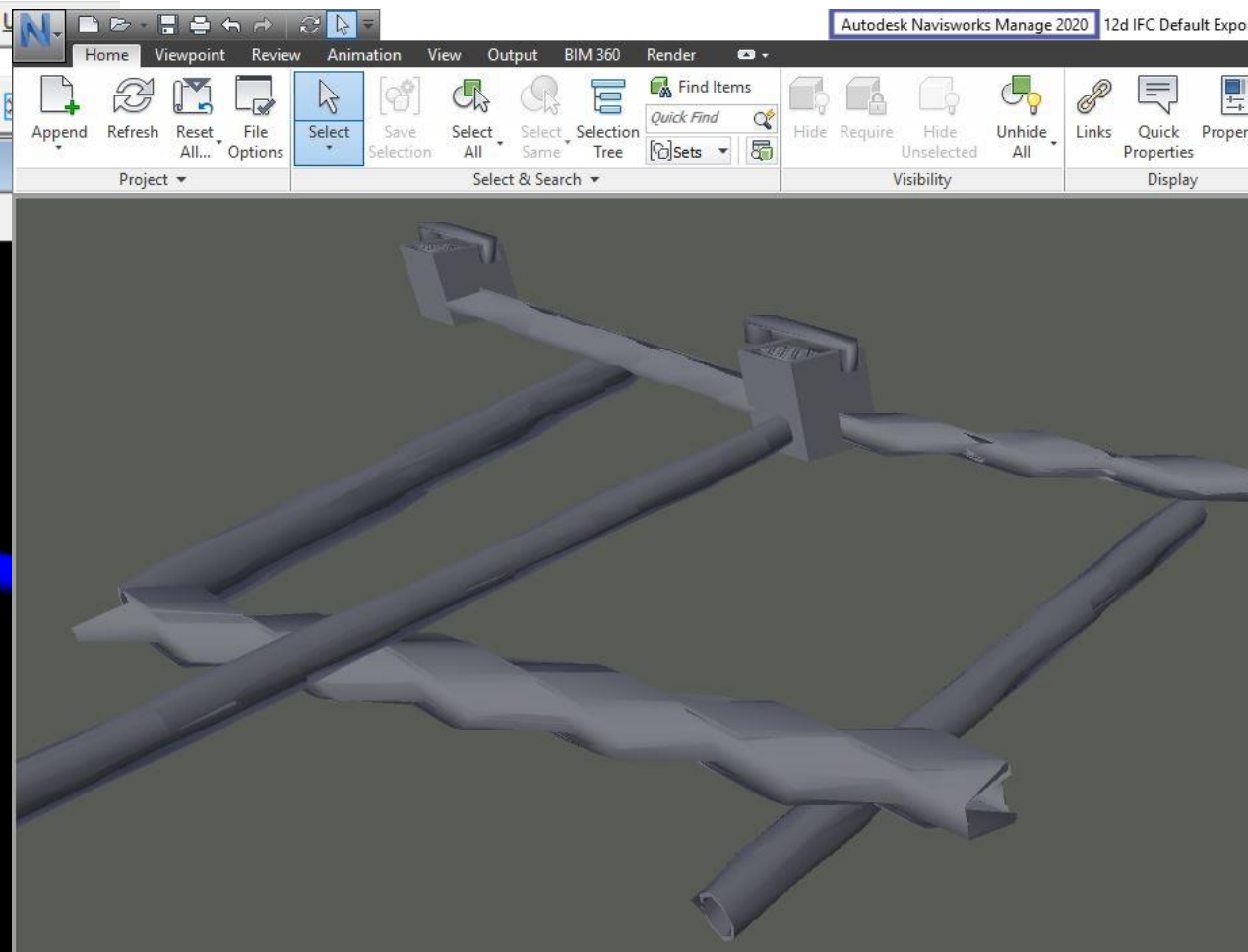
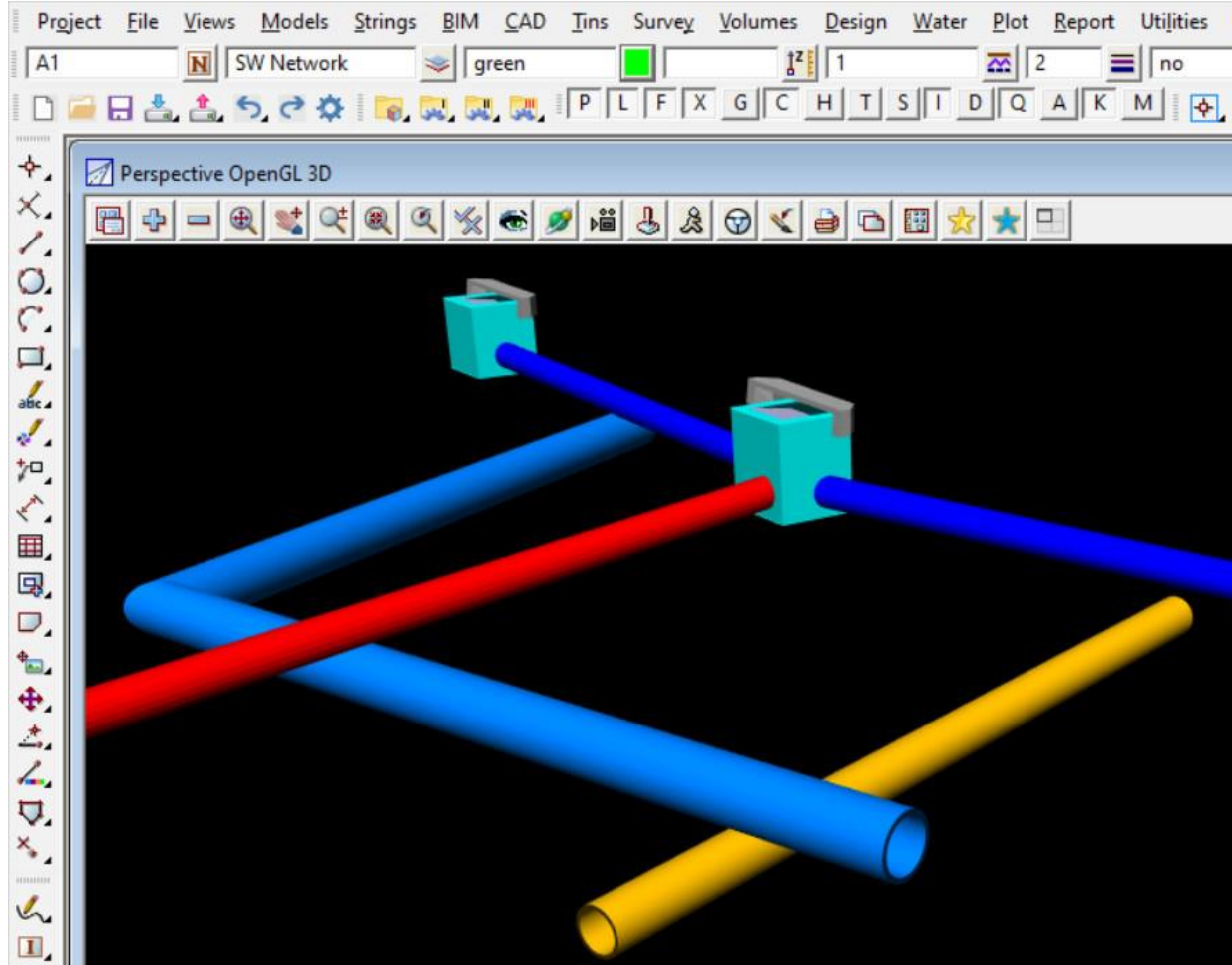


Constructive Solid Geometry





Distorted Geometry



IFC 4.3 – Georeferencing (Model Setout)



Coordinate System – Assign

Currently Assigned

Code: MGA/20C-54

Description: Map Grid of Australia Zone 54, GDA2020 Conformal Grid

How

Status: Up to date Code type: Autodesk Category: No filter selected Unit: No filter selected

Search

Language

Status	Code	Description	Definition type	Referenced to	Categories	EPSG code	Unit
✓	MGA/20-46	Map Grid of Australia Zone 46, G...	P	GDA2020-7F	Australia	7846	Meter
✓	MGA/20-47	Map Grid of Australia Zone 47, G...	P	GDA2020-7F	Australia	7847	Meter
✓	MGA/20-48	Map Grid of Australia Zone 48, G...	P	GDA2020-7F	Australia	7848	Meter
✓	MGA/20-49	Map Grid of Australia Zone 49, G...	P	GDA2020-7F	Australia	7849	Meter
✓	MGA/20-50	Map Grid of Australia Zone 50, G...	P	GDA2020-7F	Australia	7850	Meter
✓	MGA/20-51	Map Grid of Australia Zone 51, G...	P	GDA2020-7F	Australia	7851	Meter
✓	MGA/20-52	Map Grid of Australia Zone 52, G...	P	GDA2020-7F	Australia	7852	Meter
✓	MGA/20-53	Map Grid of Australia Zone 53, G...	P	GDA2020-7F	Australia	7853	Meter
✓	MGA/20-54	Map Grid of Australia Zone 54, G...	P	GDA2020-7F	Australia	7854	Meter
✓	MGA/20-55	Map Grid of Australia Zone 55, G...	P	GDA2020-7F	Australia	7855	Meter
✓	MGA/20-56	Map Grid of Australia Zone 56, G...	P	GDA2020-7F	Australia	7856	Meter
✓	MGA/20-57	Map Grid of Australia Zone 57, G...	P	GDA2020-7F	Australia	7857	Meter
✓	MGA/20-58	Map Grid of Australia Zone 58, G...	P	GDA2020-7F	Australia	7858	Meter
✓	MGA/20-59	Map Grid of Australia Zone 59, G...	P	GDA2020-7F	Australia	7859	Meter
✓	MGA/20C-46	Map Grid of Australia Zone 46, G...	P	GDA2020-C	Australia	7846	Meter

Assign View Close Help

Draw Modify Layers Clipboard

Object Selection Settings

Selected: 1

Survey Point

PREVIEW AND POSITIONING

SURVEY POINT SETTINGS

Geo Referencing Map...

Name: EPSG:28356

Description: BILT Developments Setout

Geodetic Datum: GDA94

Vertical Datum: AHD

Map Projection: EPSG:28356

Map Zone: 56

Eastings: 333780622

Northings: 6246775891

Orthogonal Height: 97457

X Axis Abscissa: 0.99

X Axis Ordinate: -0.14

Scale: 1.00



Geometry challenges

- Coincident vertex or points
- Short Edge lengths
- Constructive Solid Geometry
- Sweeps



IFC is a comprehensive data model that has evolved over 20+ years.

Vendors do find it challenging to implement and support.

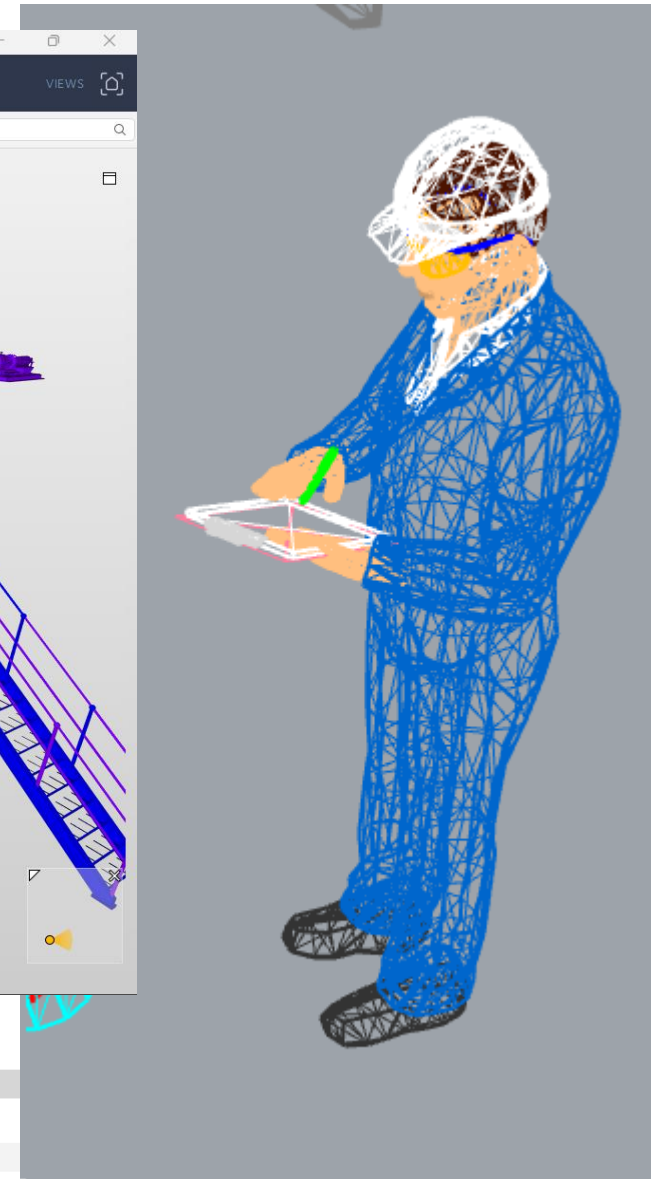
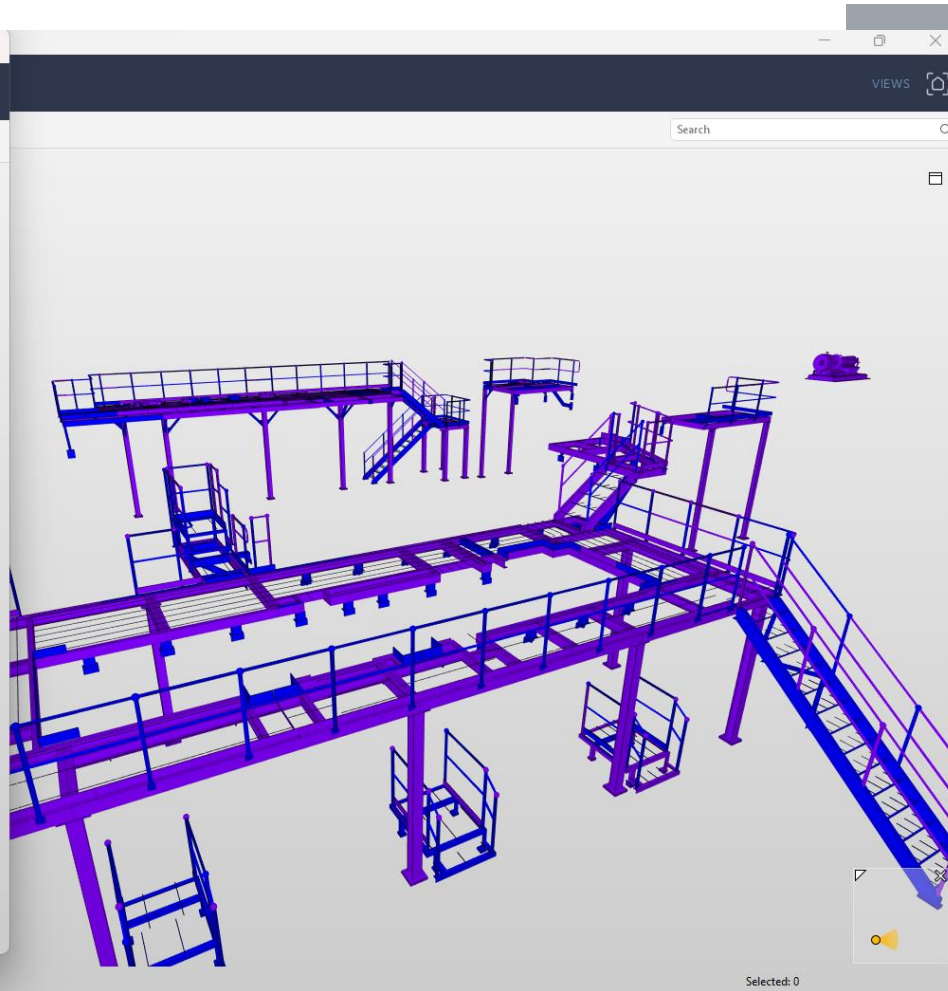
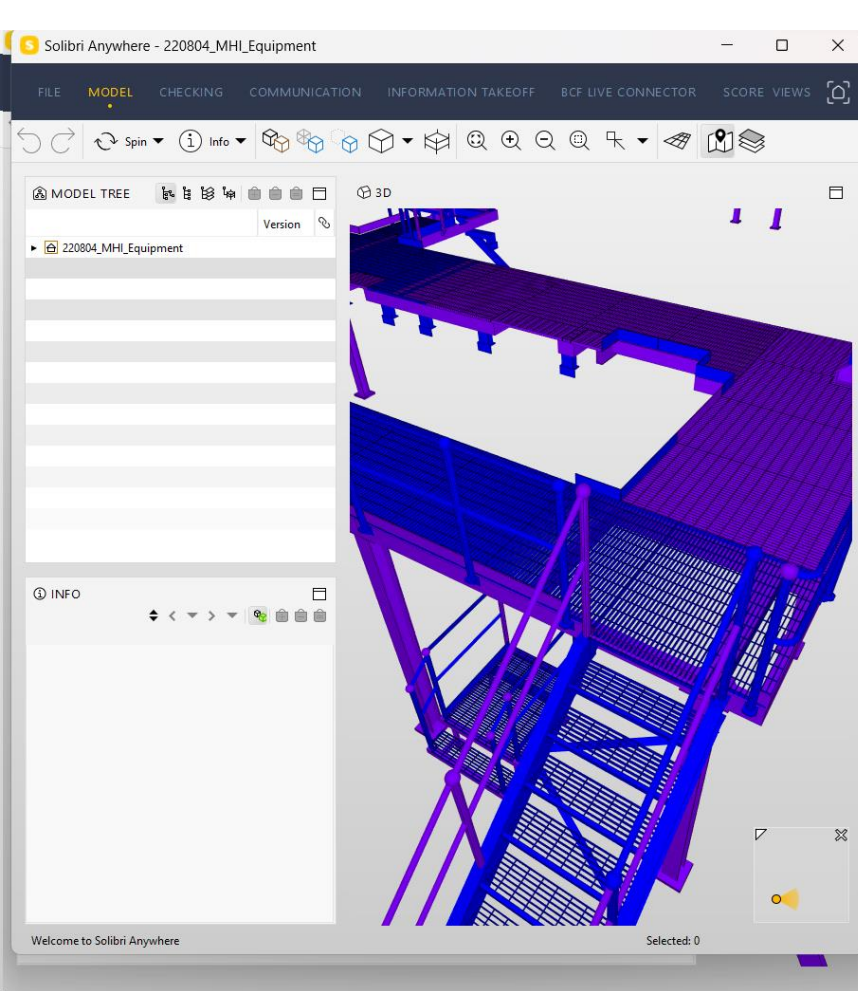
Data model does have some duplication (ie number of ways to color an object).

IFC Efficiency – Duplicated Data

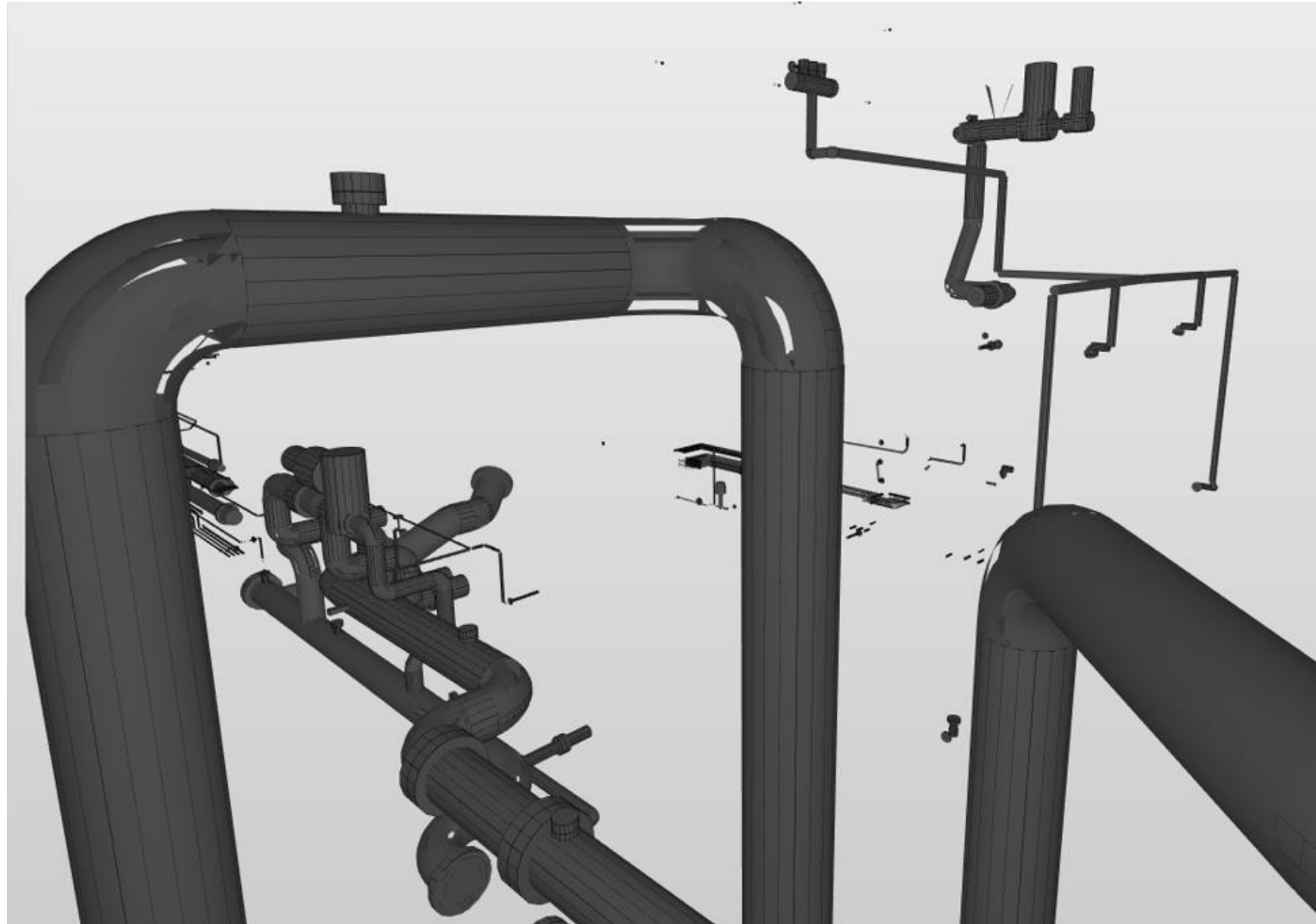


```
#2110=IFCMATERIAL('S235JR');
#2120=IFCPROPERTYSSINGLEVALUE('Reference',$,IFCIDENTIFIER('Reference'));
#2130=IFCPROPERTYSSINGLEVALUE('Span',$,IFCPOSITIVELENGTHMEASURE(0.));
#2140=IFCPROPERTYSSINGLEVALUE('Slope',$,IFCPLANEANGLEMEASURE(0.));
#2150=IFCPROPERTYSSINGLEVALUE('IsExternal',$,IFCBOOLEAN(.F.));
#2160=IFCPROPERTYSSINGLEVALUE('LoadBearing',$,IFCBOOLEAN(.F.));
#2170=IFCPROPERTYSSINGLEVALUE('FireRating',$,IFCLABEL(''));
#2180=IFCPROPERTYSET('177rmsZJ5FXwlMT8DXet0k',#150,'Pset_Column');
#2190=IFCRELDEFINESBYPROPERTIES('3814gjcRj1zWzUcZjjoc',#150,'Pset_Column');
#2200=IFCPROPERTYSSINGLEVALUE('SectionFamily',$,IFCIDENTIFIER('RO42.4X4'));
#2210=IFCPROPERTYSSINGLEVALUE('Section',$,IFCIDENTIFIER('RO42.4X4'));
#2220=IFCPROPERTYSET('3GgsCQTin5wPCPOeM6PHHO',#150,'Pset_Column');
#2230=IFCRELDEFINESBYPROPERTIES('3hw6AhyYX3wultAK2zmu',#150,'Pset_Column');
#2240=IFCBOOLEANCLIPPINGRESULT(.DIFFERENCE.,#2250,#2300);
#2250=IFCEXTRUDEDAREASOLID(#2270,#2300,#2260,1129.981327522);
#2260=IFCDIRECTION((0.,0.,-1.));
#2270=IFCCIRCLEHOLLOWPROFILEDEF(.AREA.,'RO42.4X4',#2250);
#2280=IFCAXIS2PLACEMENT2D(#2290,$);
#2290=IFCCARTESIANPOINT((0.,0.));
#2300=IFCAXIS2PLACEMENT3D(#2310,$,$);
#2310=IFCCARTESIANPOINT((0.,0.,0.));
#2320=IFCHALFSPACESOLID(#2330,.T.);
#2330=IFCPLANE(#2340);
#2340=IFCAXIS2PLACEMENT3D(#2370,#2350,#2360);
#2350=IFCDIRECTION((0.,0.,-1.));
#2360=IFCDIRECTION((1.,0.,0.));
#2370=IFCCARTESIANPOINT((31299.965789789,1.,-46.182327522));
#2590=IFCDIRECTION((0.,0.,1.));
#2600=IFCDIRECTION((-1.,0.,0.));
#2610=IFCCARTESIANPOINT((31299.965789789,1.,7229.981327522));
#2620=IFCPRODUCTDEFINITIONSHAPE($,$,(#2630));
#2630=IFCSHAPEREPRESENTATION(#20,'Body','Clipping',(#2240));
#2640=IFCMATERIAL('S235JRG2');
#2650=IFCPROPERTYSSINGLEVALUE('Reference',$,IFCIDENTIFIER('Not a reference'));
#2660=IFCPROPERTYSSINGLEVALUE('Slope',$,IFCPLANEANGLEMEASURE(0.));
#2670=IFCPROPERTYSSINGLEVALUE('IsExternal',$,IFCBOOLEAN(.F.));
#2680=IFCPROPERTYSSINGLEVALUE('LoadBearing',$,IFCBOOLEAN(.F.));
#2690=IFCPROPERTYSSINGLEVALUE('FireRating',$,IFCLABEL(''));
#2700=IFCPROPERTYSET('1kXiBfRO5BHuquqYPbtaVq',#150,'Pset_Column');
#2710=IFCRELDEFINESBYPROPERTIES('1TX9lmoOj7m9NACWZEnJcr',#150,'Pset_Column');
#2720=IFCPROPERTYSSINGLEVALUE('SectionFamily',$,IFCIDENTIFIER('RO42.4X4'));
#2730=IFCPROPERTYSSINGLEVALUE('Section',$,IFCIDENTIFIER('RO42.4X4'));
#2740=IFCPROPERTYSET('36xbcUqJlAAA1$9Gq5g6_b',#150,'ProfileProperties');
#2750=IFCRELDEFINESBYPROPERTIES('0eTx2IT2195vSjlZwvvlU4',#150,'ProfileProperties');
#2760=IFCBOOLEANCLIPPINGRESULT(.DIFFERENCE.,#2770,#2810);
#2770=IFCEXTRUDEDAREASOLID(#2270,#2790,#2780,1129.981327522);
#2780=IFCDIRECTION((0.,0.,-1.));
#2790=IFCAXIS2PLACEMENT3D(#2800,$,$);
#2800=IFCCARTESIANPOINT((0.,0.,0.));
#2810=IFCHALFSPACESOLID(#2820,.T.);
#2820=IFCPLANE(#2830);
#2830=IFCAXIS2PLACEMENT3D(#2860,#2840,#2850);
#2840=IFCDIRECTION((0.,0.,-1.));
#2850=IFCDIRECTION((1.,0.,0.));
#2860=IFCCARTESIANPOINT((30364.253947661,1.,-46.182327522));
#2870=IFCOPENINGELEMENT('0eb0s9Nfn6cfC9FN_Sb0FH',#150,$,$,'Opening');
#2880=IFCLOCALPLACEMENT3D(#2860,#2880);
```

Level of Detail (and asset breakdown)



Should not be a 2GB IFC File





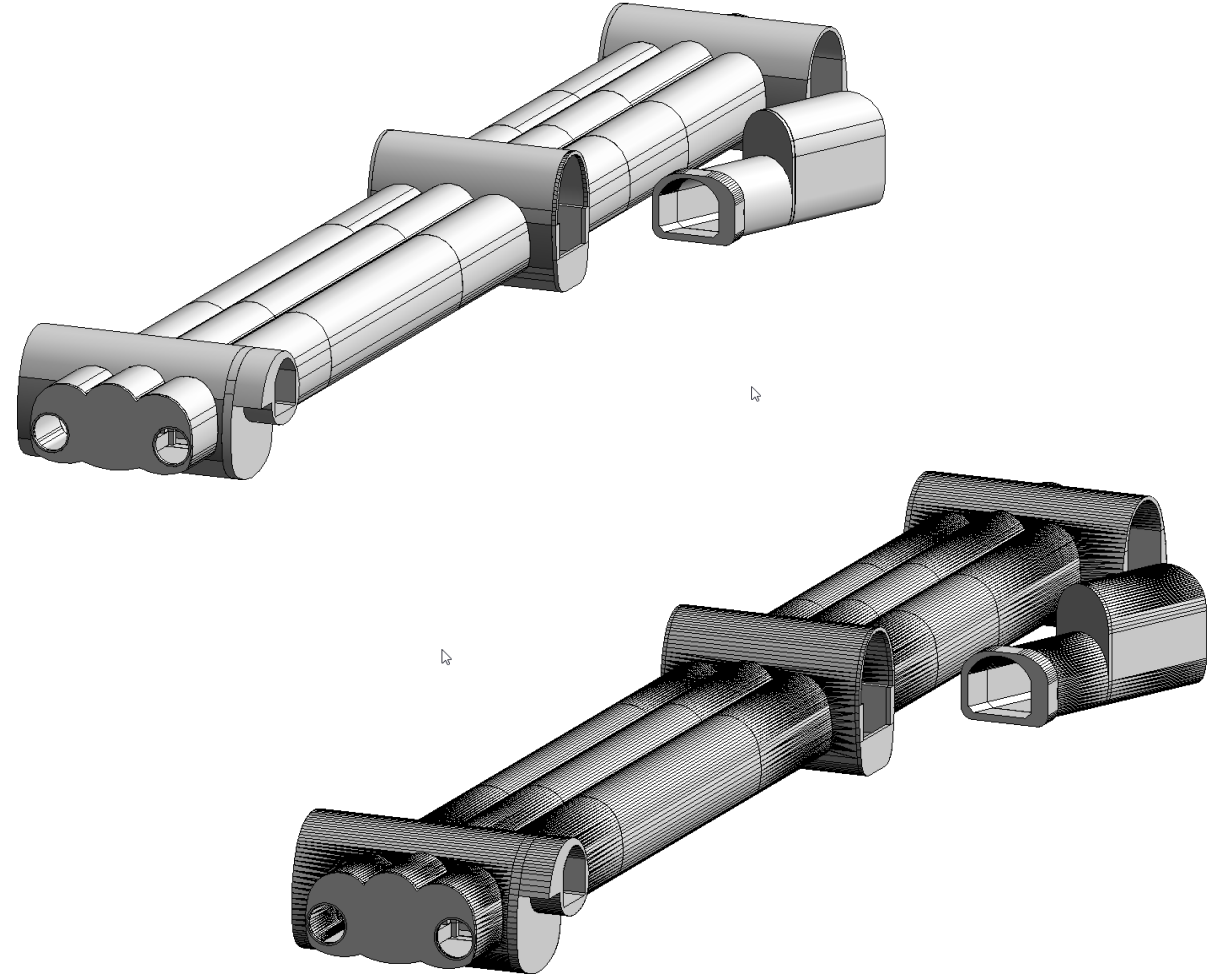
Solibri Model Optimizer seems to have been withdrawn

BlenderBIM has developed open source functionality

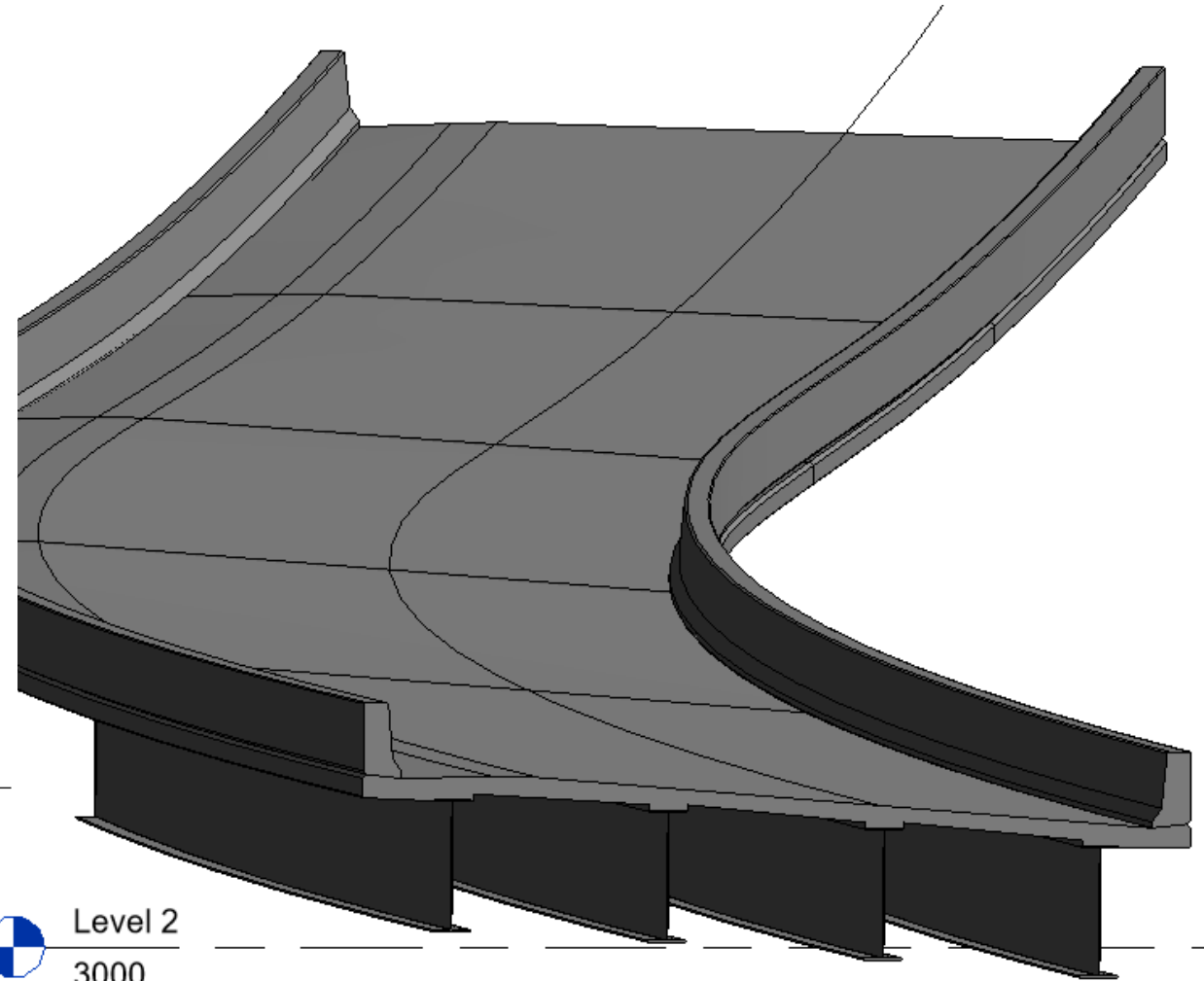
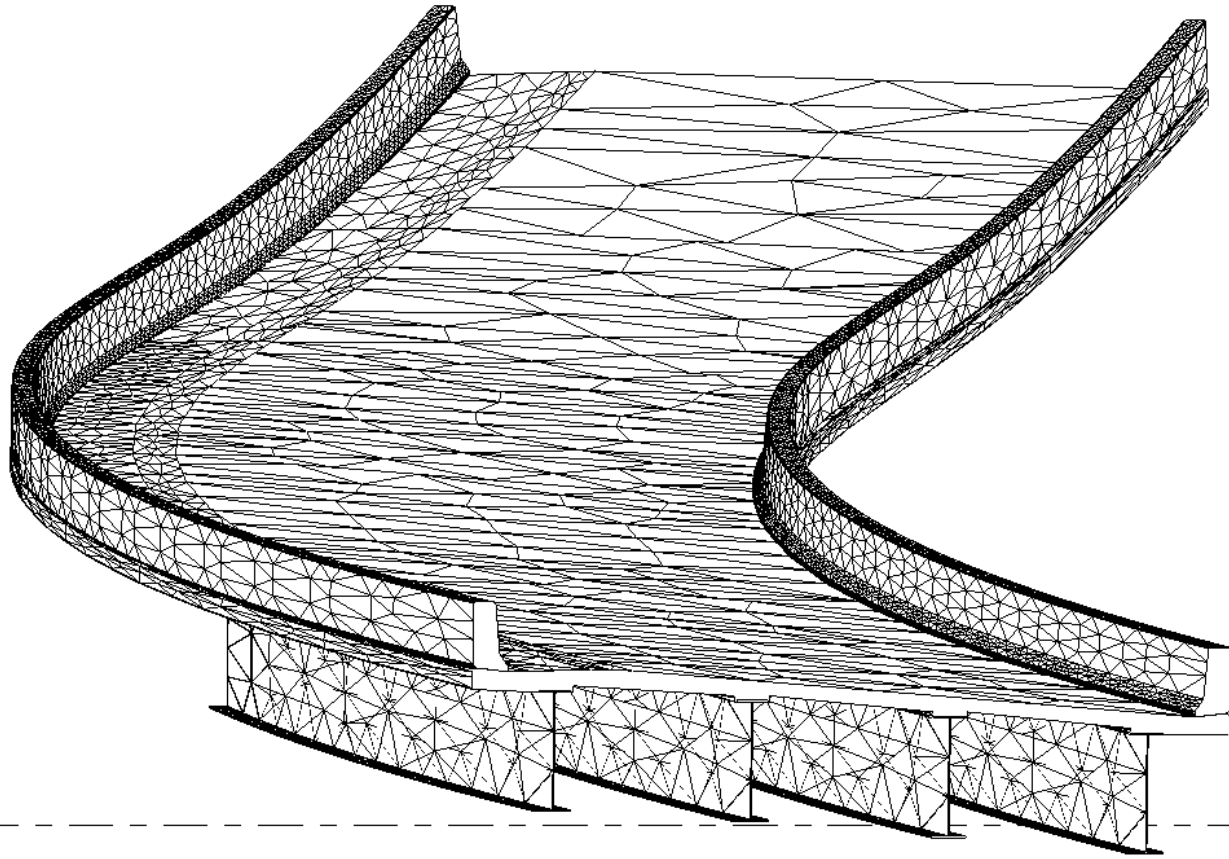
Geometry Gym also develops functions to optimize and decimate IFC

Efficiency

- Typically a trade off between efficiency and reliability
- Short Edge lengths
- Constructive Solid Geometry
- Extrusions / Sweeps
- IFC4 (and newer) vs IFC2x3

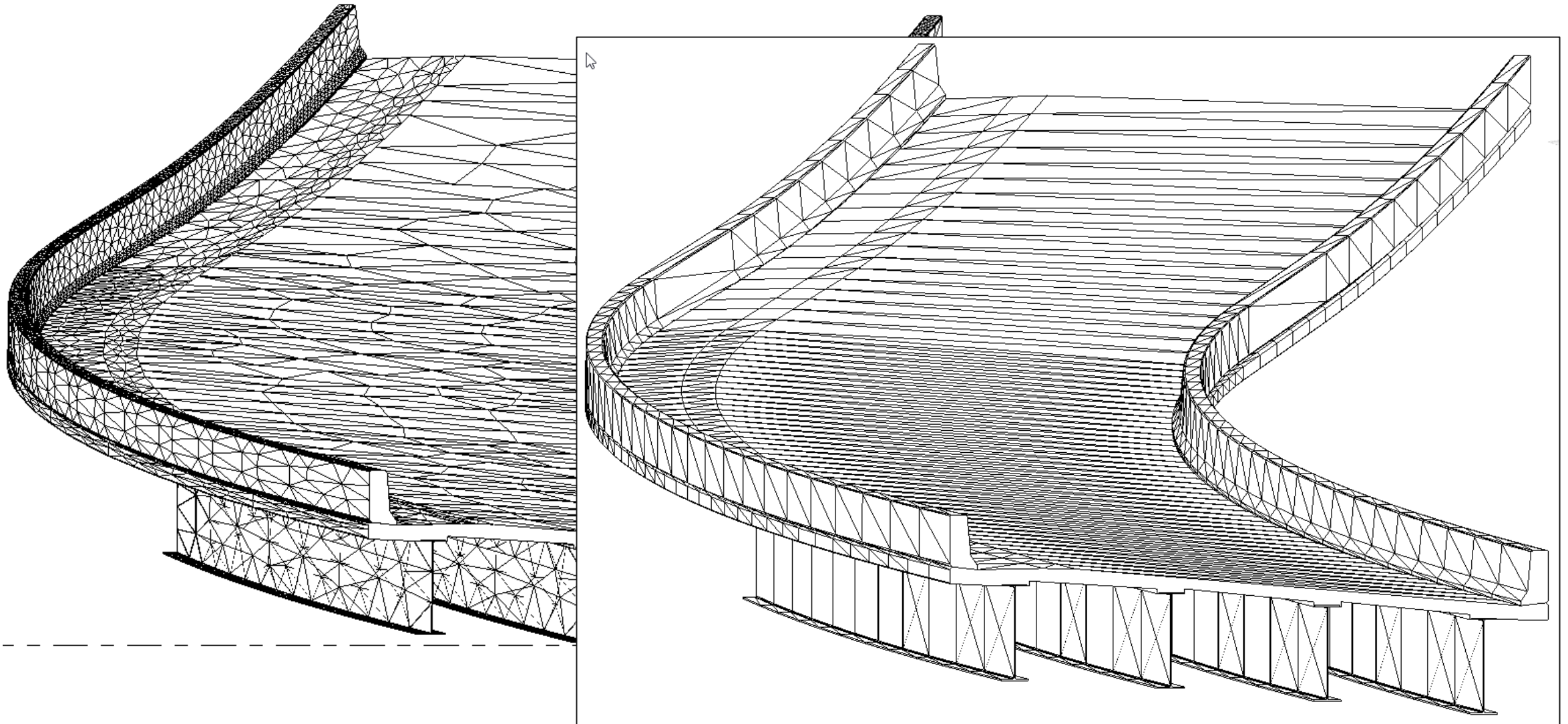


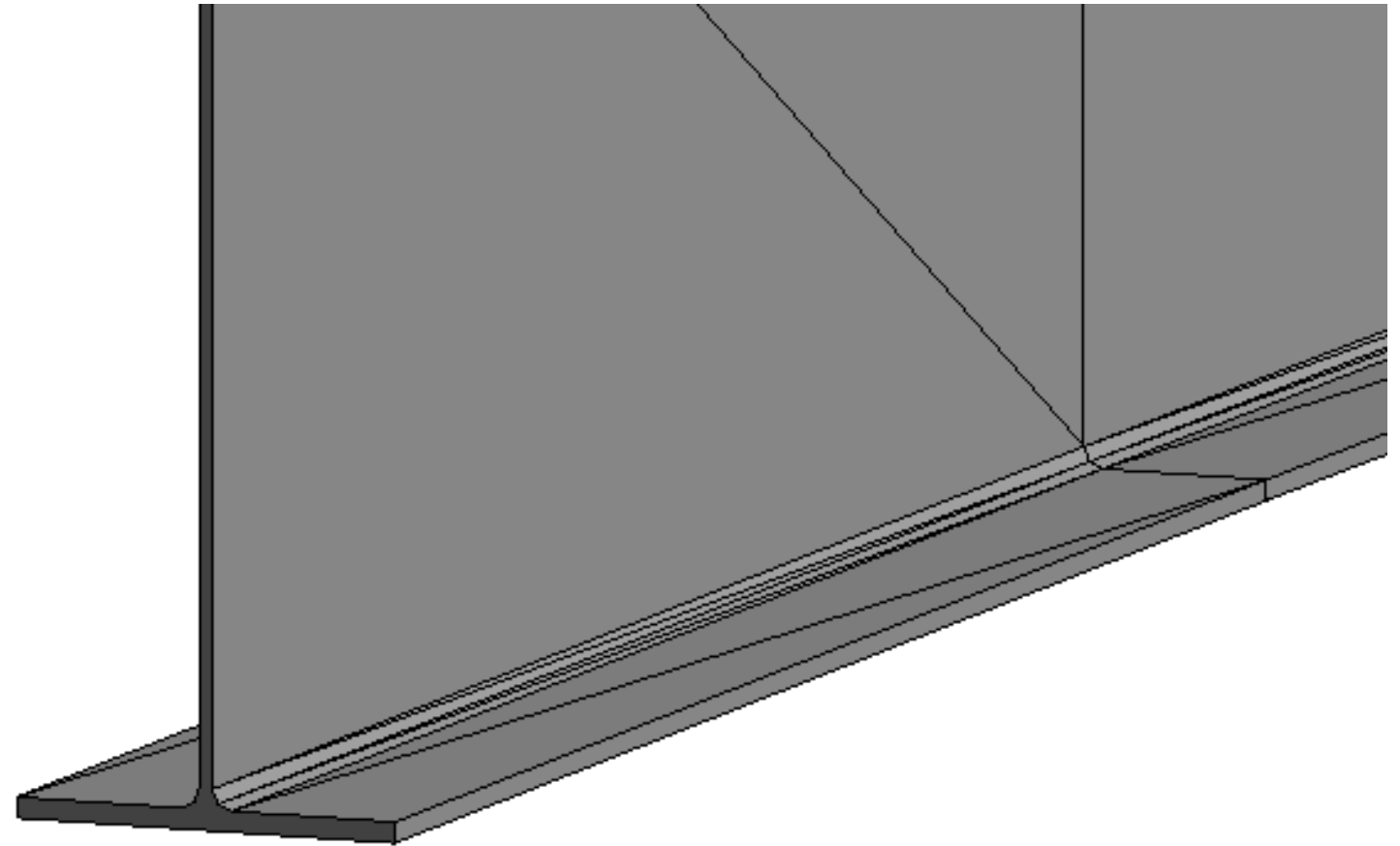
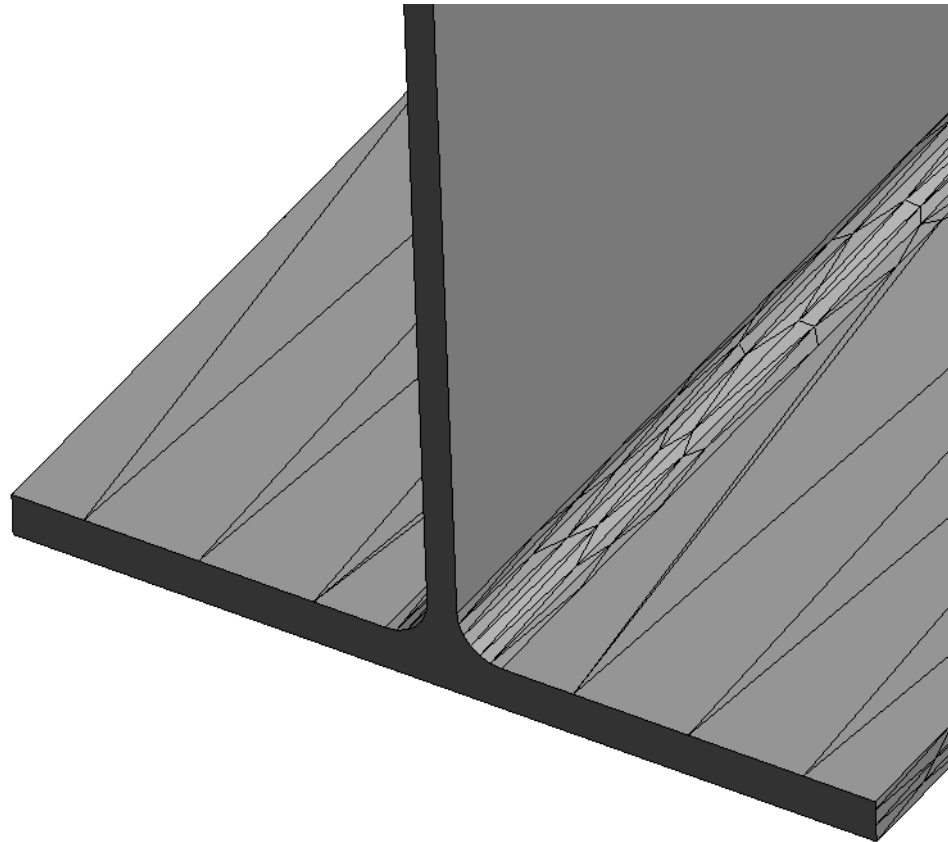
Efficiency



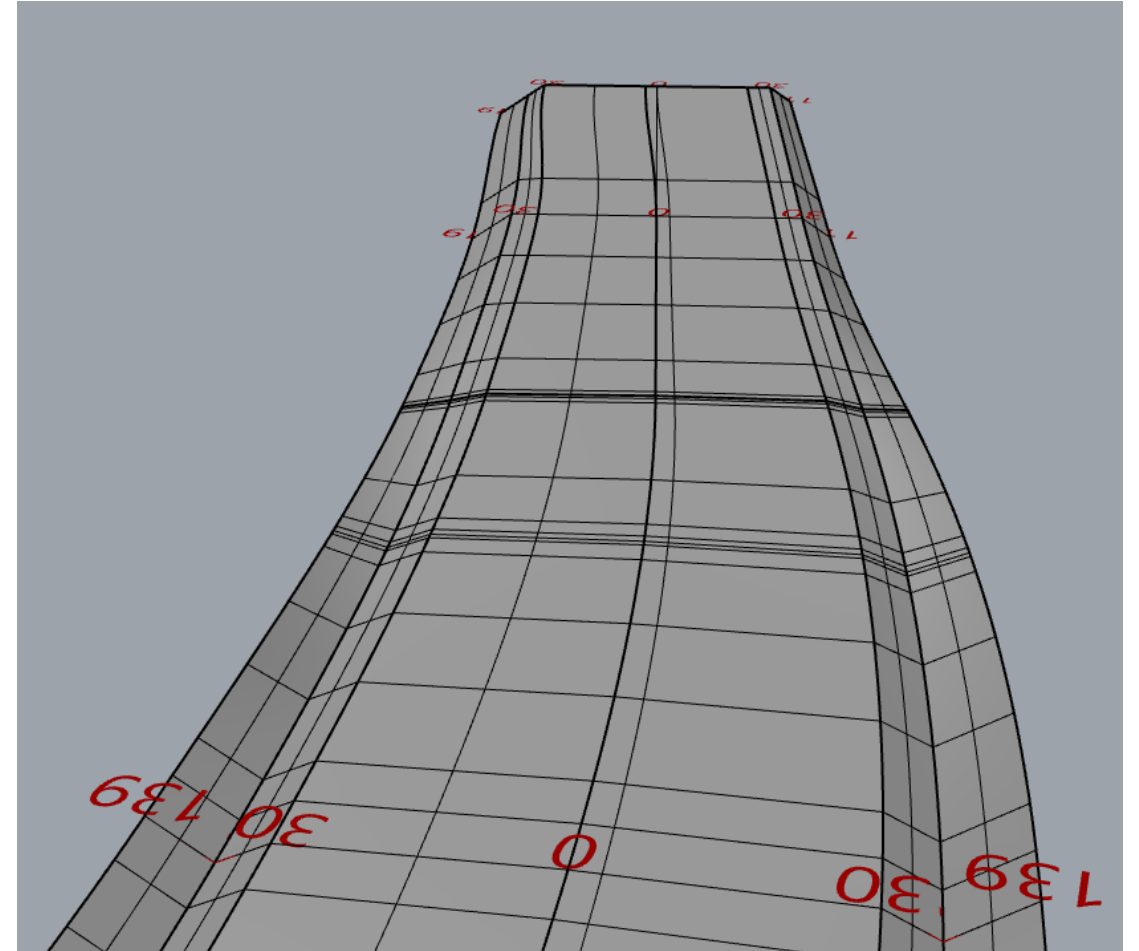
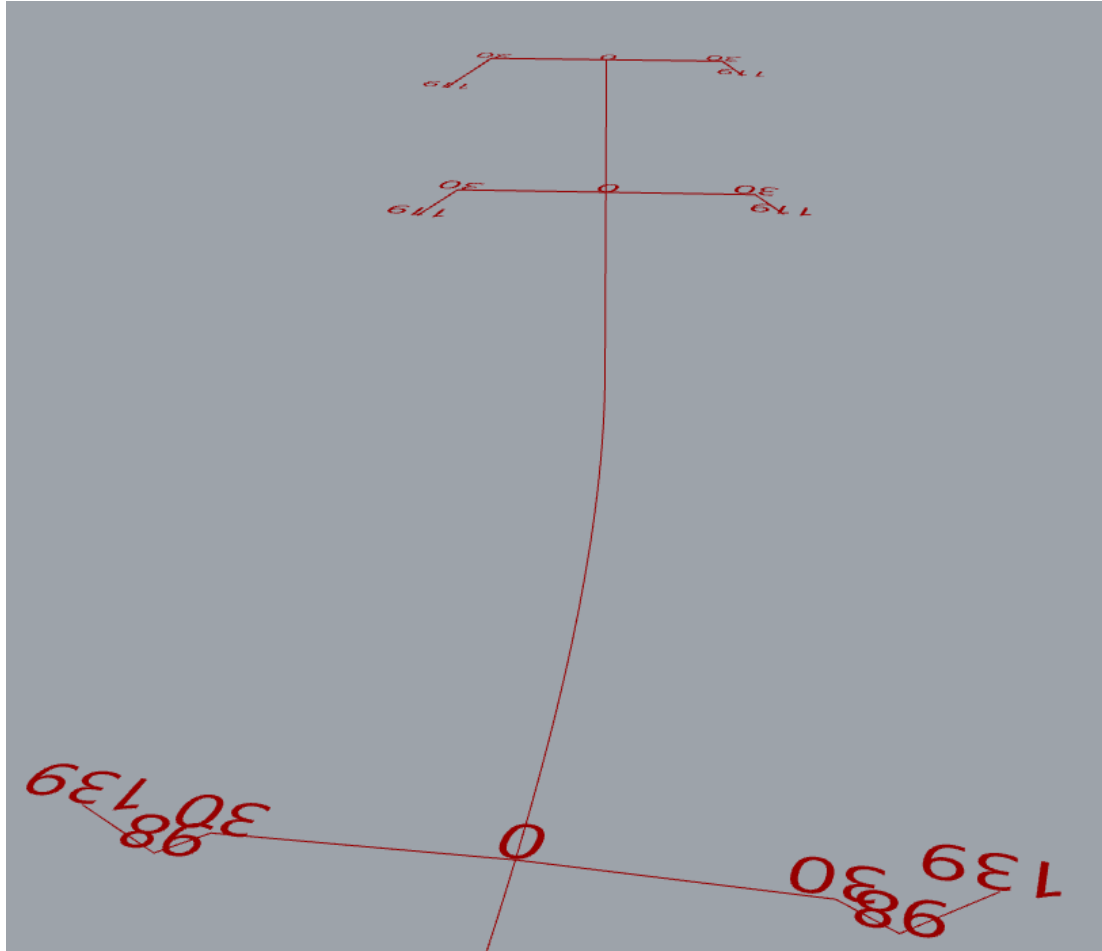
Level 2
3000

Efficiency

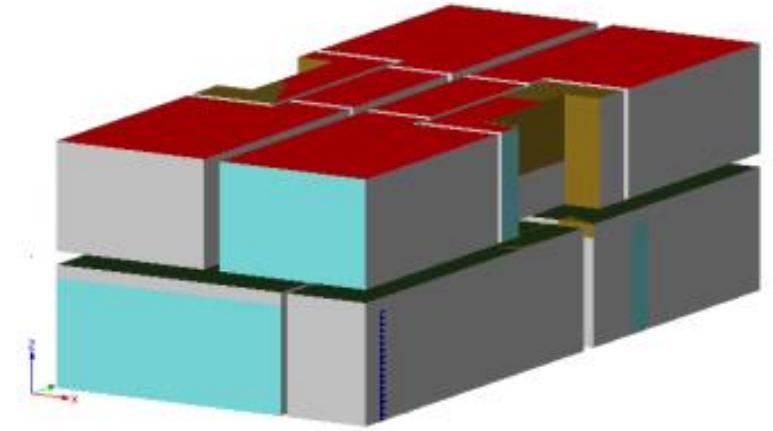
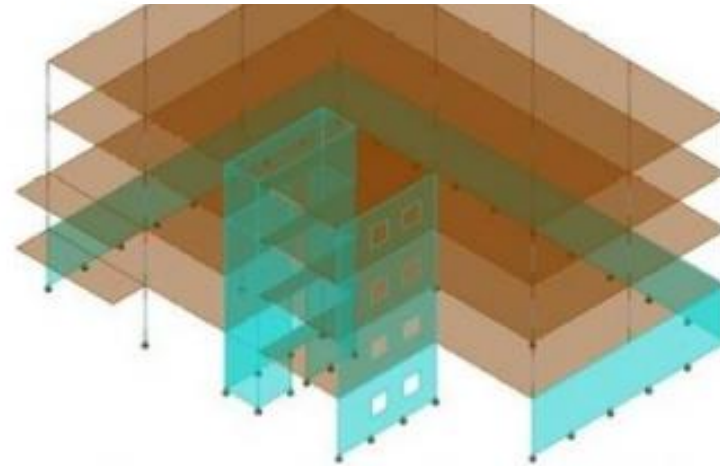
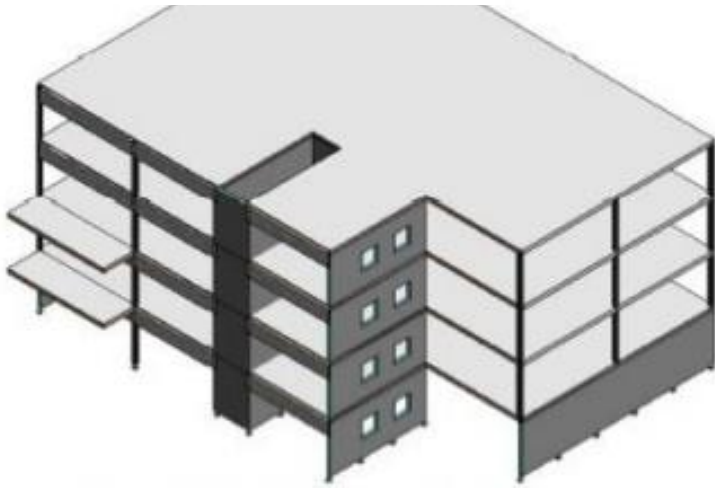
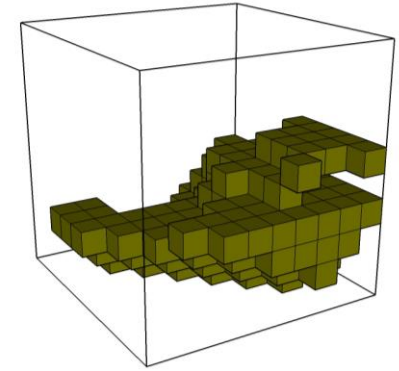
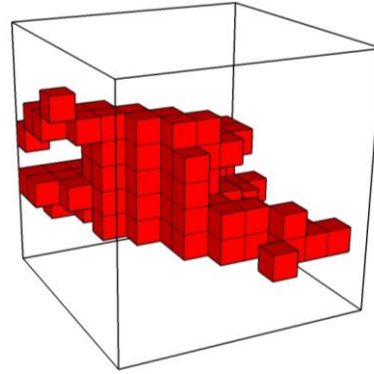
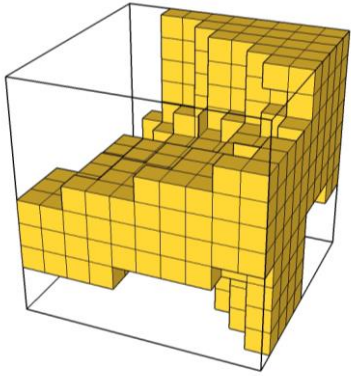




IFC 4.3 – Sectioned Shapes (Solids and surfaces)



Model View Definitions



IFC Coordination View

IFC Structural Analysis View

IFC Thermal Analysis View



IFC2x3 Coordination Model View

IFC4 Reference View

IFC4x3 Alignment Based Reference View

Other Model View Definitions

Not Official

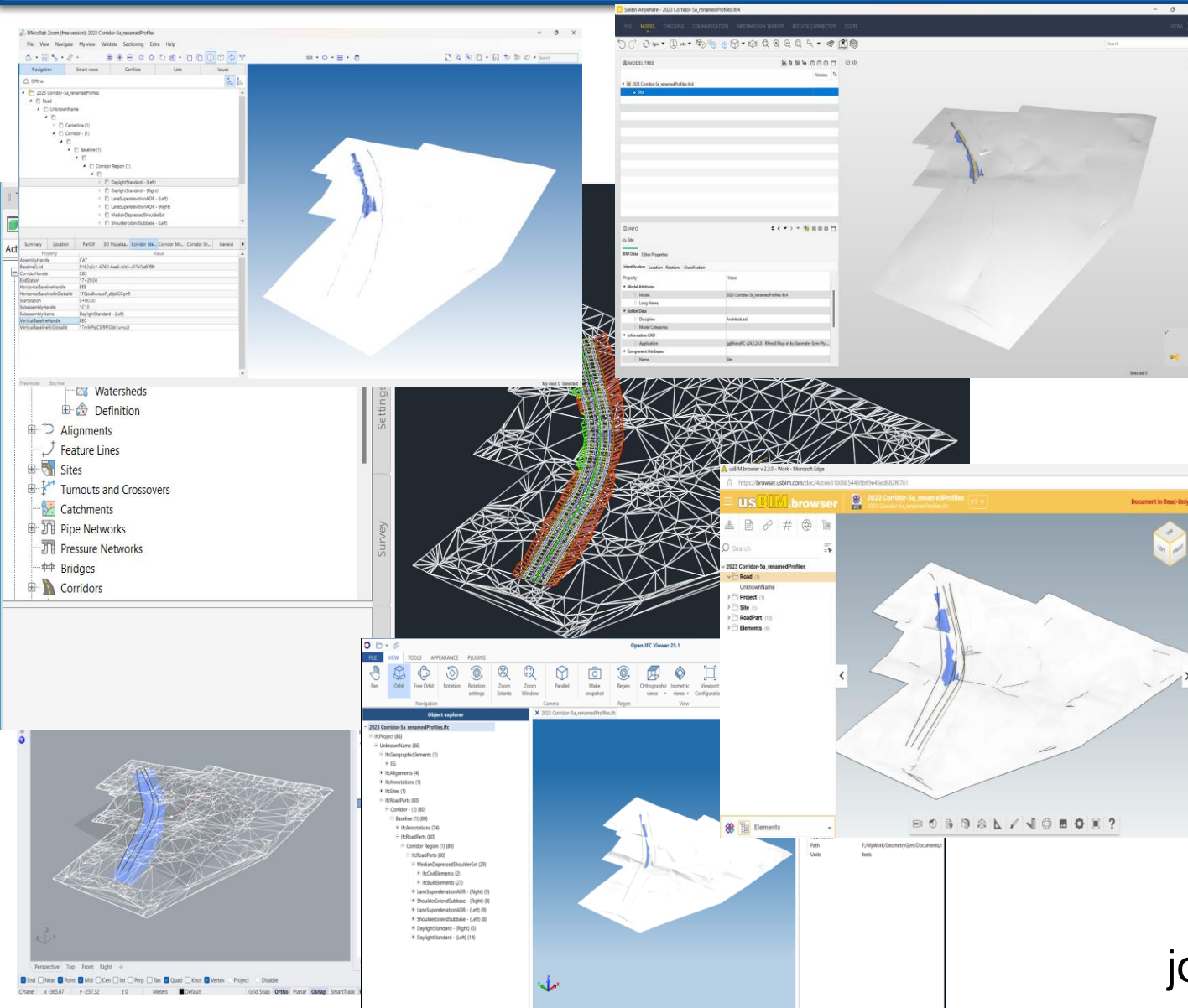
IFC4x3 Design Transfer



BIM should no longer be a trust request.

Party requesting IFC deliverable should specify Model View Definition and the contents of the IFC using IDS.

If frustrated with problems generating or receiving IFC, discuss with your software vendor.



UTS Sydney
3rd July 2024

Thankyou

Any questions

Jon Mirtschin
Geometry Gym
jonm@geometrygym.com

