BrisBIMx

Technology Innovation in the Built Environment

OpenBIM – The Shape of Things to Come

Jon Mirtschin – Geometry Gym

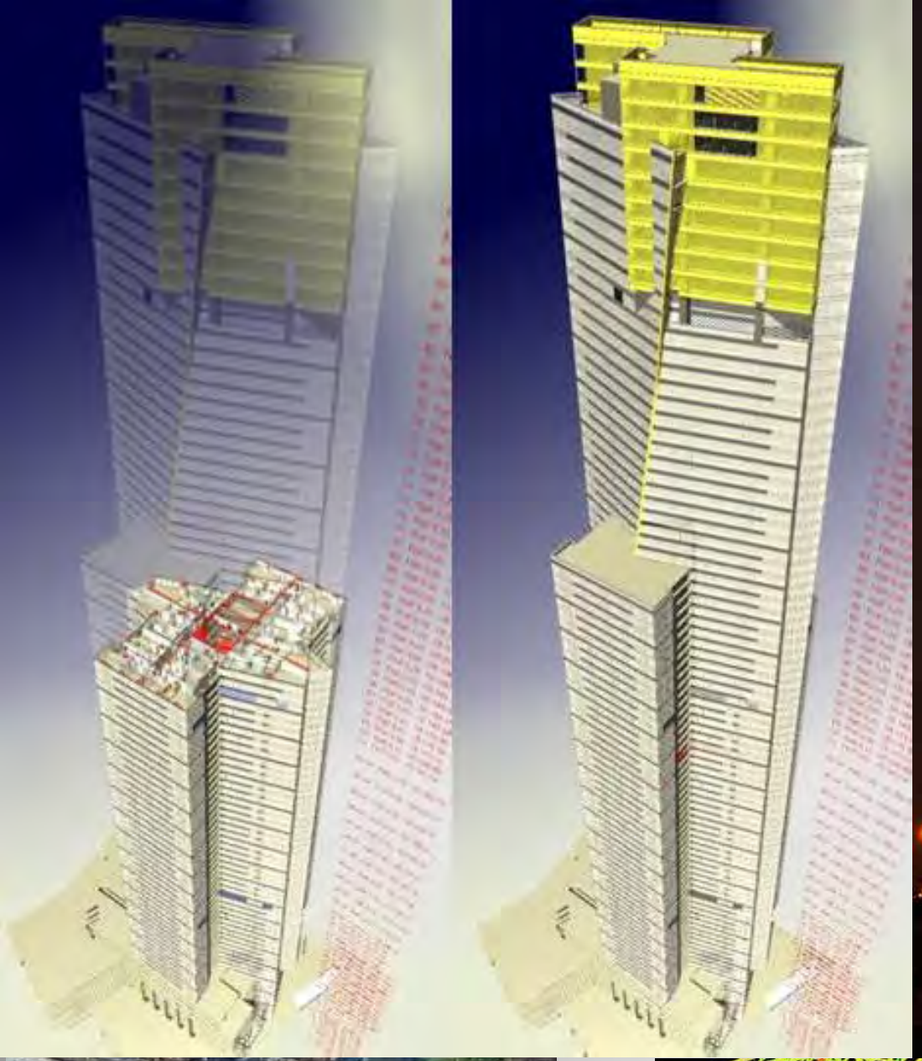
Jon Mirtschin

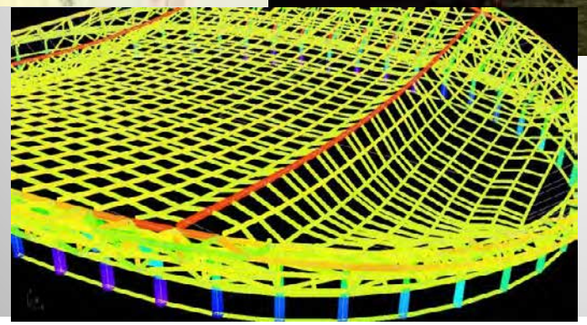
B.Eng (Civil) / B.Sci (Computer Science) University of Melbourne

2001 to 2005 - Connell Wagner (Melbourne) - Eureka Tower, MCG Northern Stand, Wembley Stadium Roof and Arch

2005 to 2009 - Expedition Engineering (London) – Infinity Bridge, 55 Baker Street Redevelopment, Chiswick Park Footbridge, 2012 Velodrome, Instesa Sanpaolo Headquarters

2009 to Present – Geometry Gym – Specialist software tool development and consultancy for Structural Analysis and BIM data exchange






©Getty Images

Geometry Gym –

www.geometrygym.com www.geometrygym.blogspot.com

Primarily developing plugins for Rhino3d, Grasshopper, Revit, Tekla and Navisworks to enable model exchange.

OpenBIM framework IFC (Industry Foundation Classes) central to these workflows.

Project Information Exchange

How can we provide information (the key aspect of BIM) to others that need it?

Demonstration of technical process

Many other aspects to consider including contractual, legal and financial.

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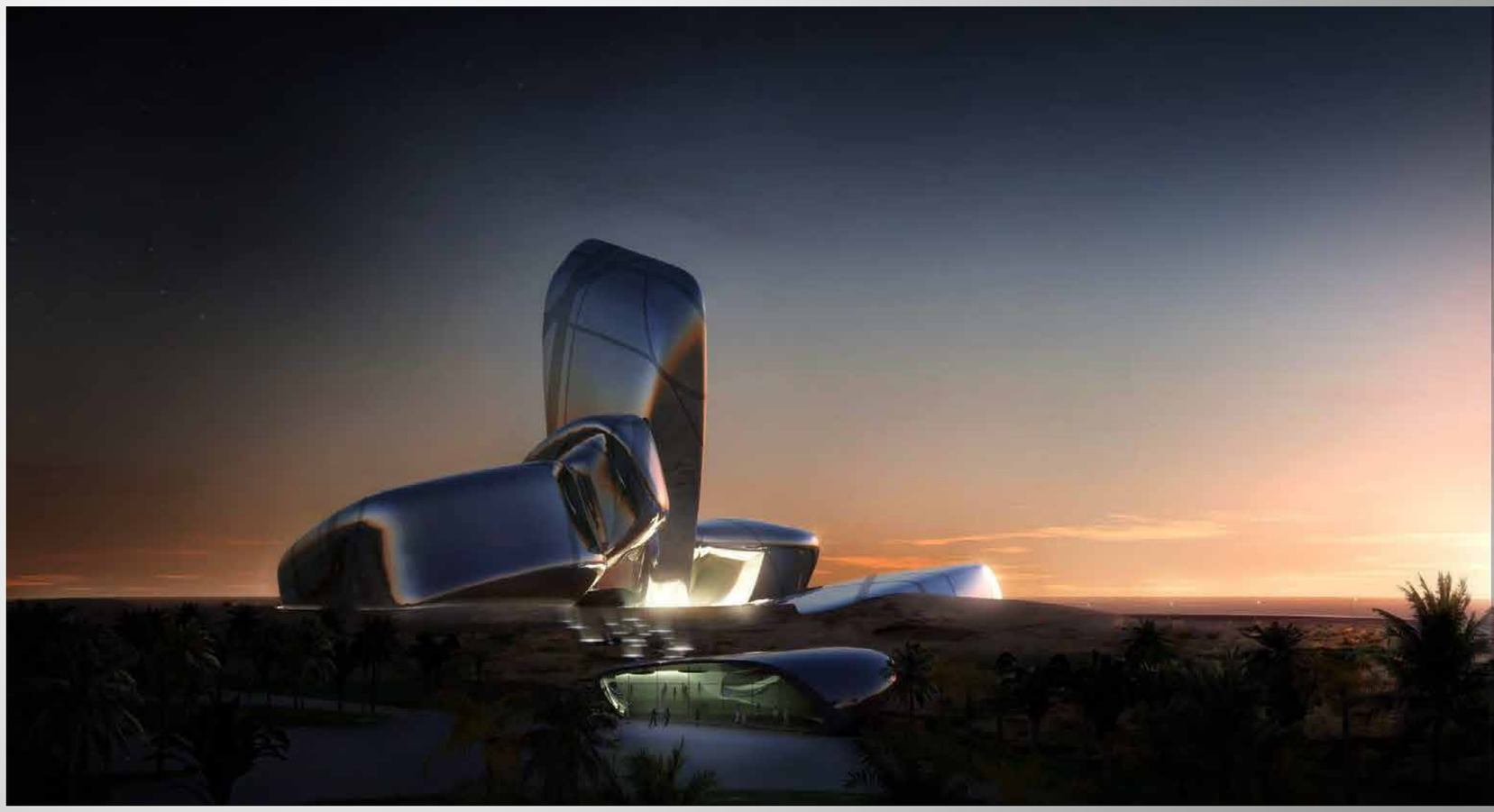
Location – Dhahran, Saudi Arabia

Client - Saudi Aramco

Architect – Snohetta

Size – 100,000 m2



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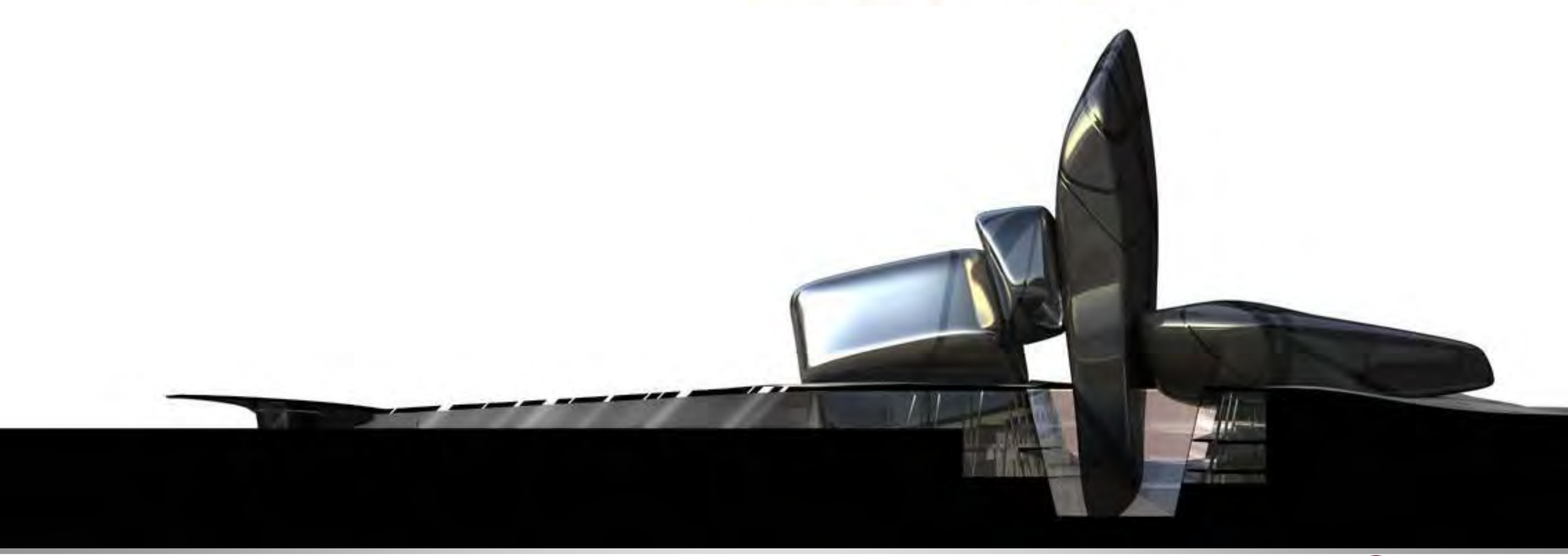
INOCLAD
„ALL YOU NEED FOR FACADE CONSTRUCTION"

nurol
GULF W.L.L.

SPT



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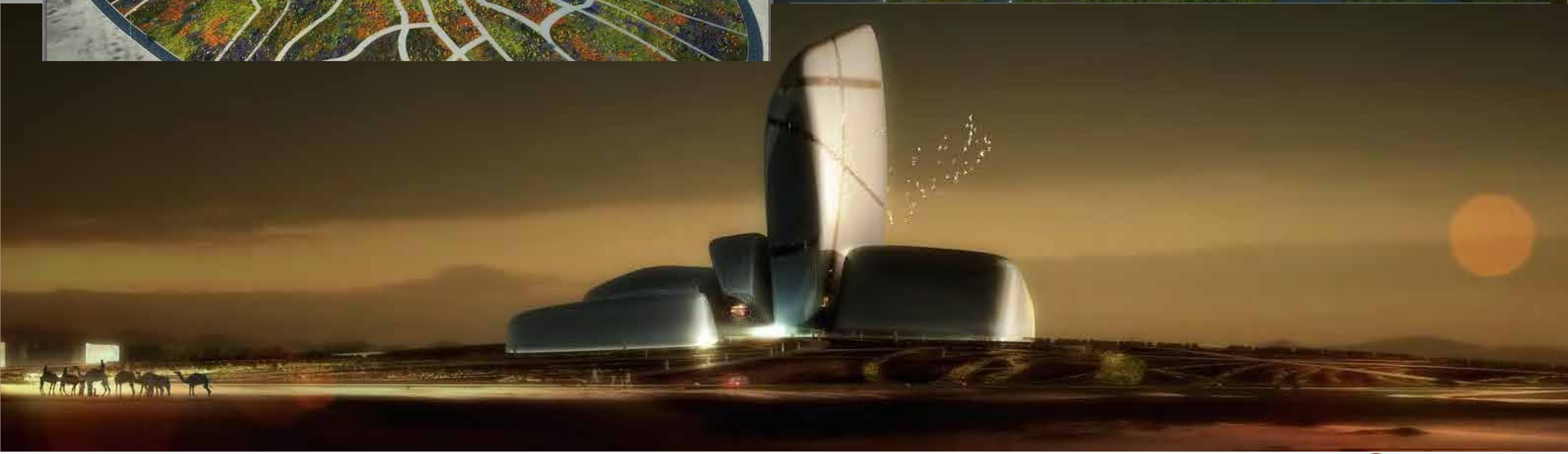

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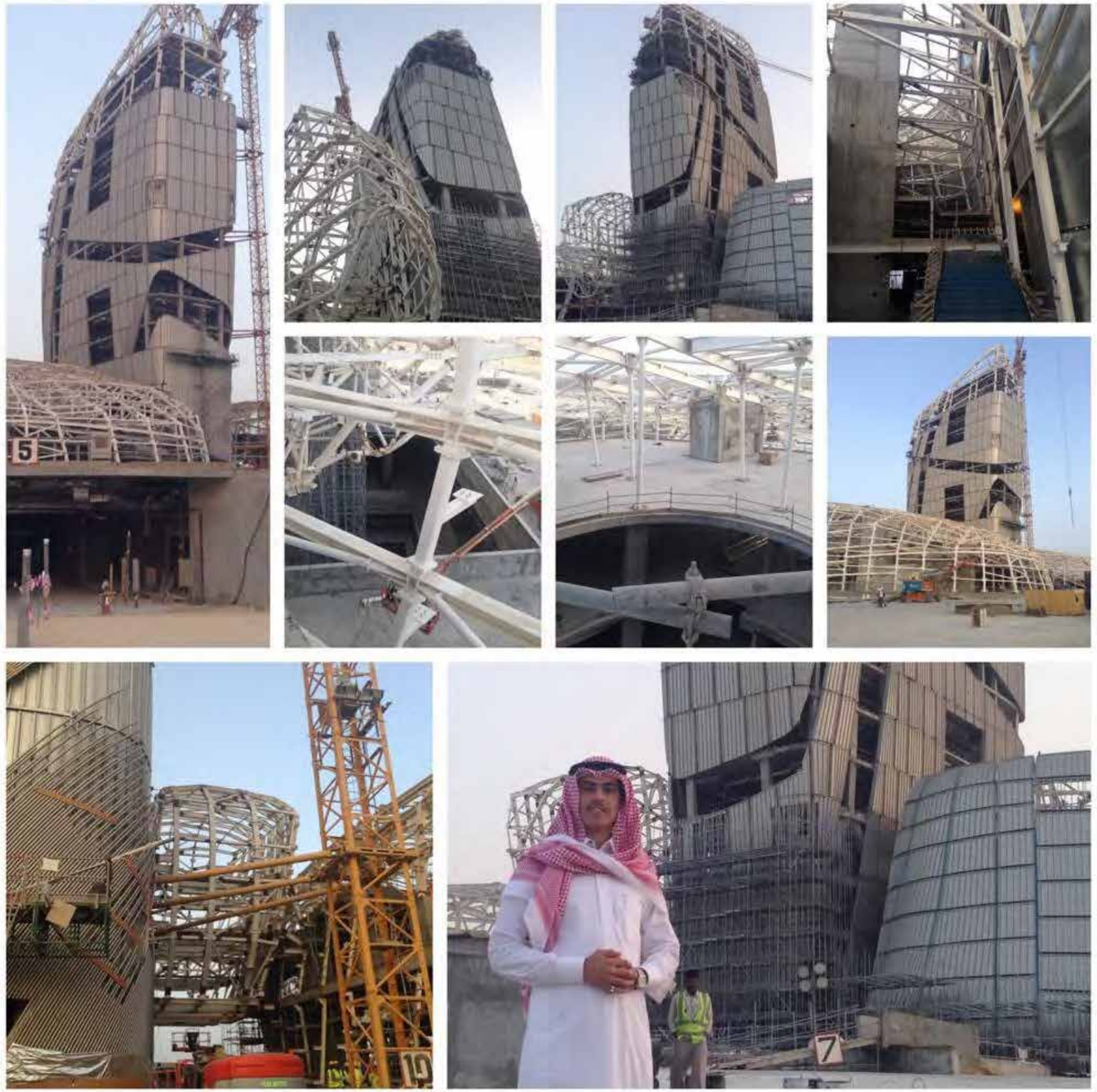
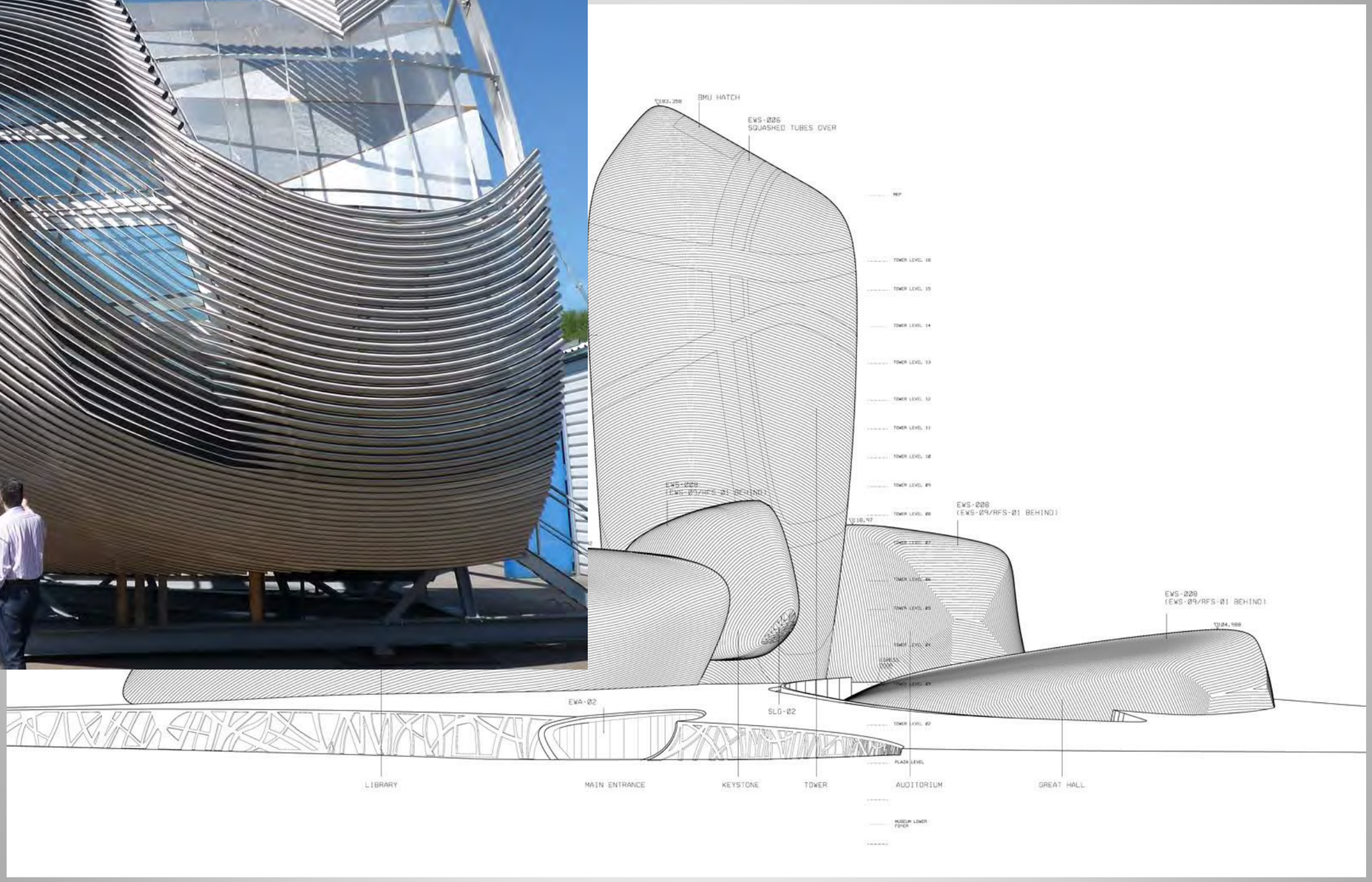
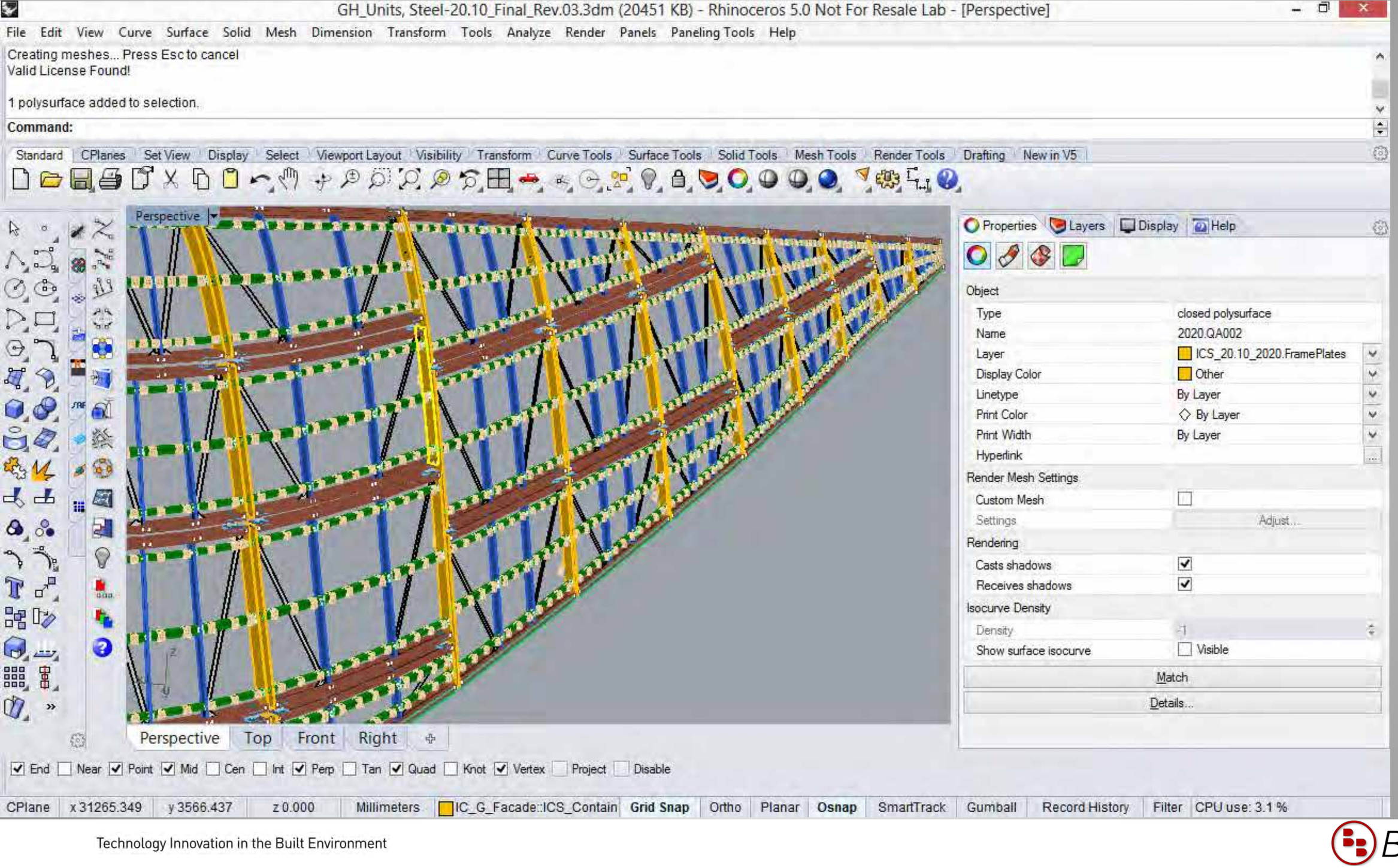



GIG
FASSADEN


BMU HATCH
EWS-Ø26
SQUASHED TUBES OVER
EWS-Ø09
(EWS-Ø9/RFS-Ø1 BEHIND)
EWS-Ø09
(EWS-Ø9/RFS-Ø1 BEHIND)
EWS-Ø09
(EWS-Ø9/RFS-Ø1 BEHIND)
EWA-Ø2
SLO-Ø2
LIBRARY
MAIN ENTRANCE
KEYSTONE
TOWER
AUDITORIUM
GREAT HALL


a strong team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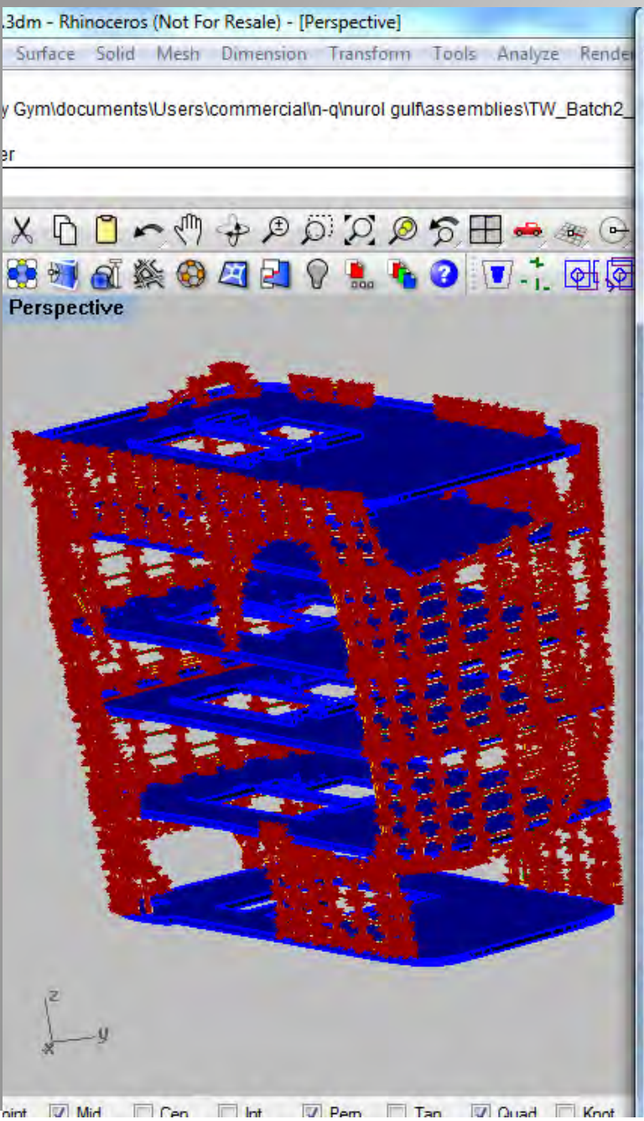
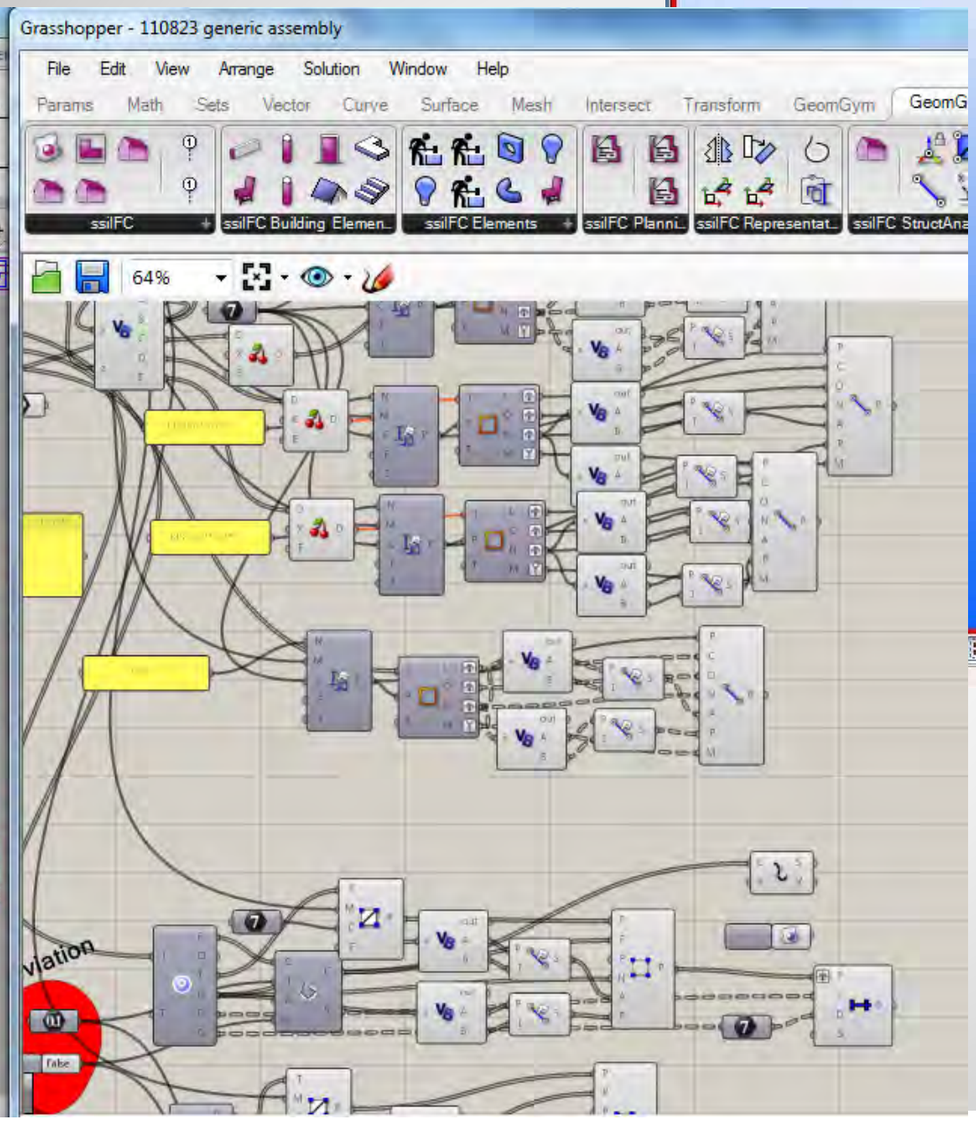
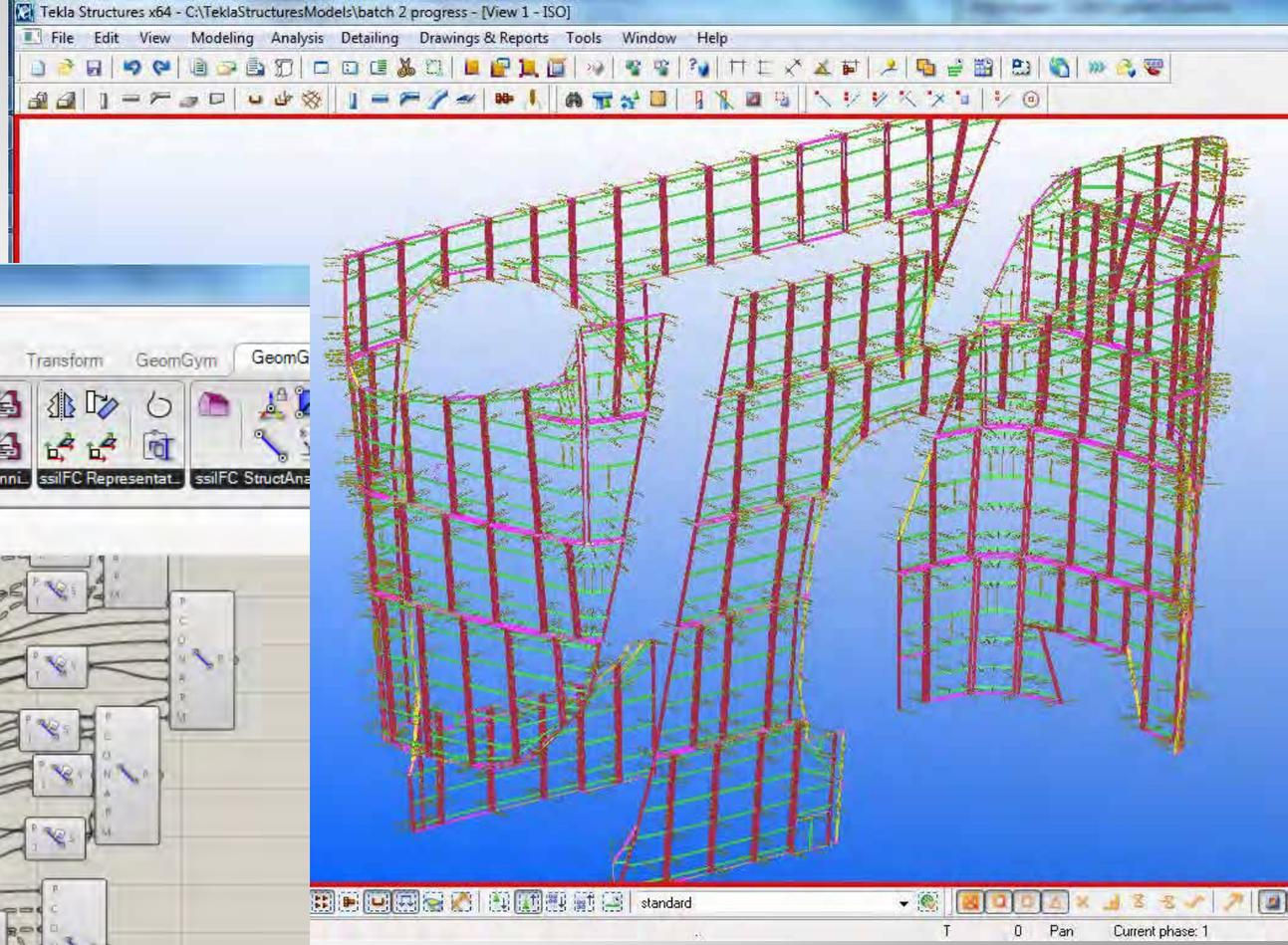
File Edit View Curve Surface Solid Mesh Dimension Transform Tools Analyze Render Panels Paneling Tools Help
Creating meshes... Press Esc to cancel
Valid License Found!
1 polysurface added to selection.
Command:
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform Curve Tools Surface Tools Solid Tools Mesh Tools Render Tools Drafting New in V5
Perspective
Properties Layers Display Help
Object
Type closed polysurface
Name 2020.QA002
Layer ICS_20.10_2020.FramePlates
Display Color Other
Linetype By Layer
Print Color By Layer
Print Width By Layer
Hyperlink
Render Mesh Settings
Custom Mesh
Settings Adjust...
Rendering
Casts shadows
Receives shadows
Isocurve Density
Density -1
Show surface isocurve Visible
Match
Details...
Perspective Top Front Right
End Near Point Mid Cen Int Perp Tan Quad Knot Vertex Project Disable
CPlane x 31265.349 y 3566.437 z 0.000 Millimeters IC_G_Facade::ICS_Contain Grid Snap Ortho Planar Osnap SmartTrack Gumball Record History Filter CPU use: 3.1 %

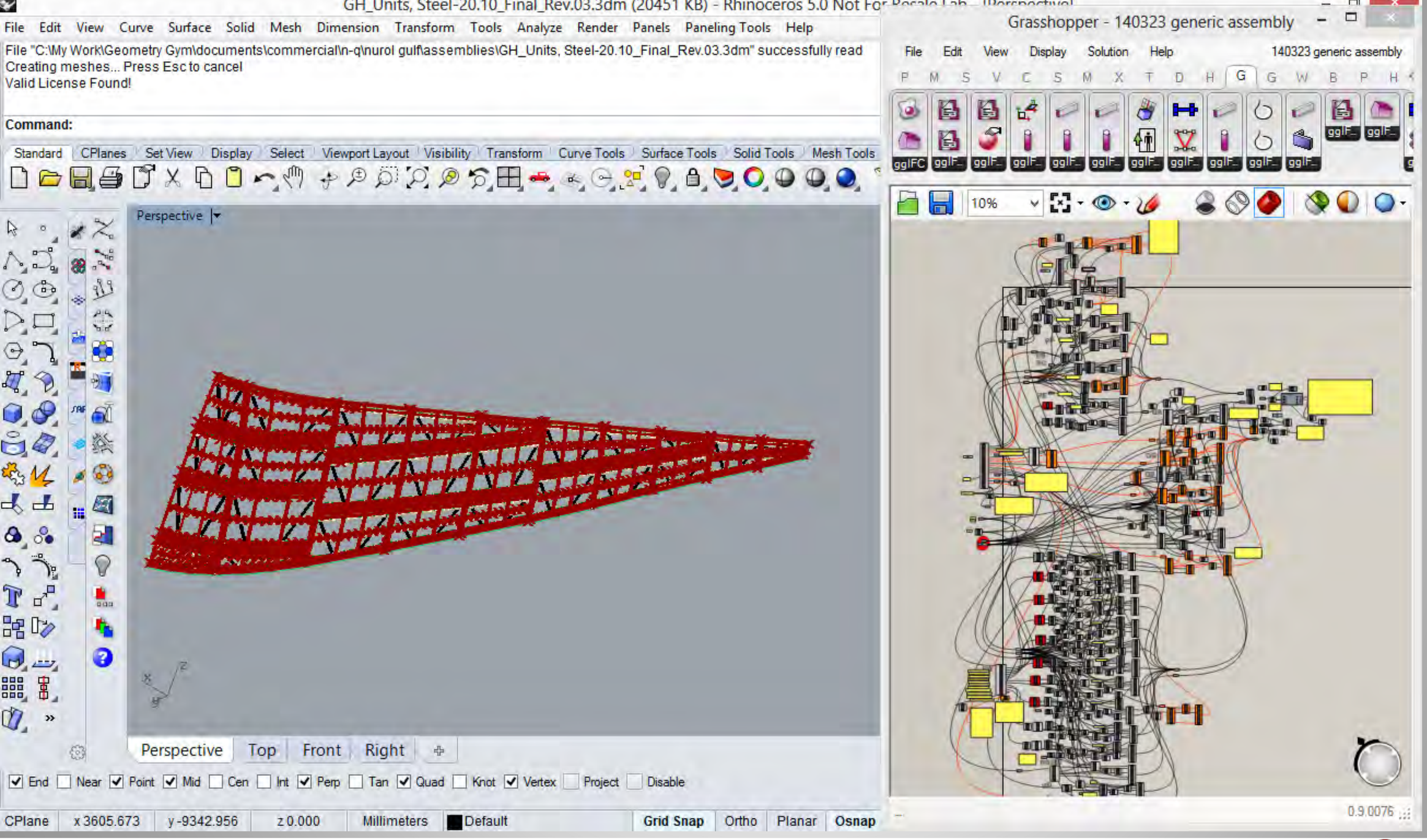
King Abdulaziz Centre for World Culture







nurol GULF W.L.L.


GH_Units, Steel-20.10_Final_Rev.03.3dm (20451 KB) - Rhinoceros 5.0 Not For Resale Lab - [Perspective]
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File "C:\My Work\Geometry Gym\documents\commercial\n-q\nurol gulf\assemblies\GH_Units, Steel-20.10_Final_Rev.03.3dm" successfully read
Creating meshes... Press Esc to cancel
Valid License Found!
Command:
Standard CPlanes Set View Display Select Viewport Layout Visibility Transform Curve Tools Surface Tools Solid Tools Mesh Tools
Perspective
Perspective Top Front Right
End Near Point Mid Cen Int Perp Tan Quad Knot Vertex Project Disable
CPlane x 3605.673 y -9342.956 z 0.000 Millimeters Default Grid Snap Ortho Planar Osnap
Grasshopper - 140323 generic assembly
File Edit View Display Solution Help 140323 generic assembly
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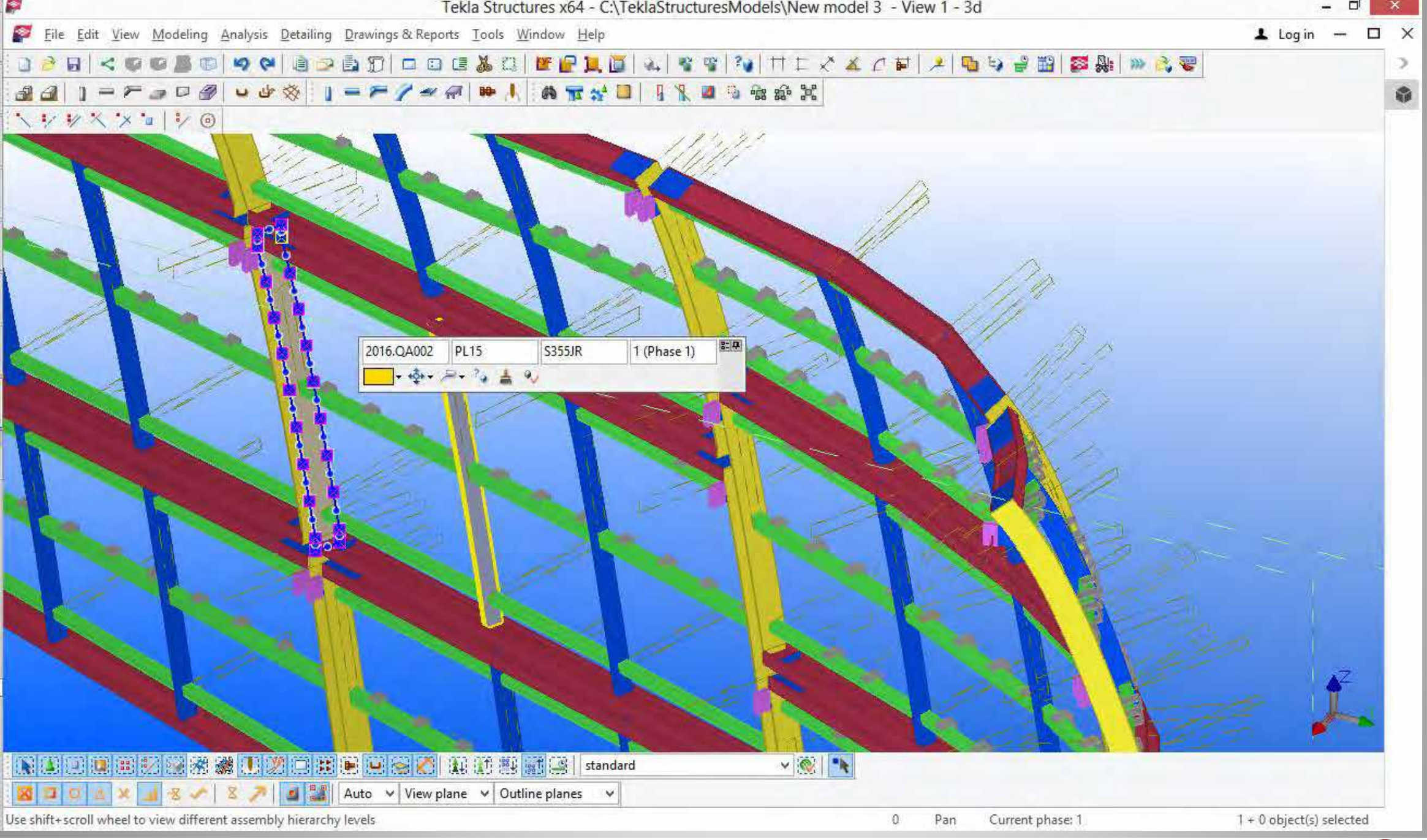
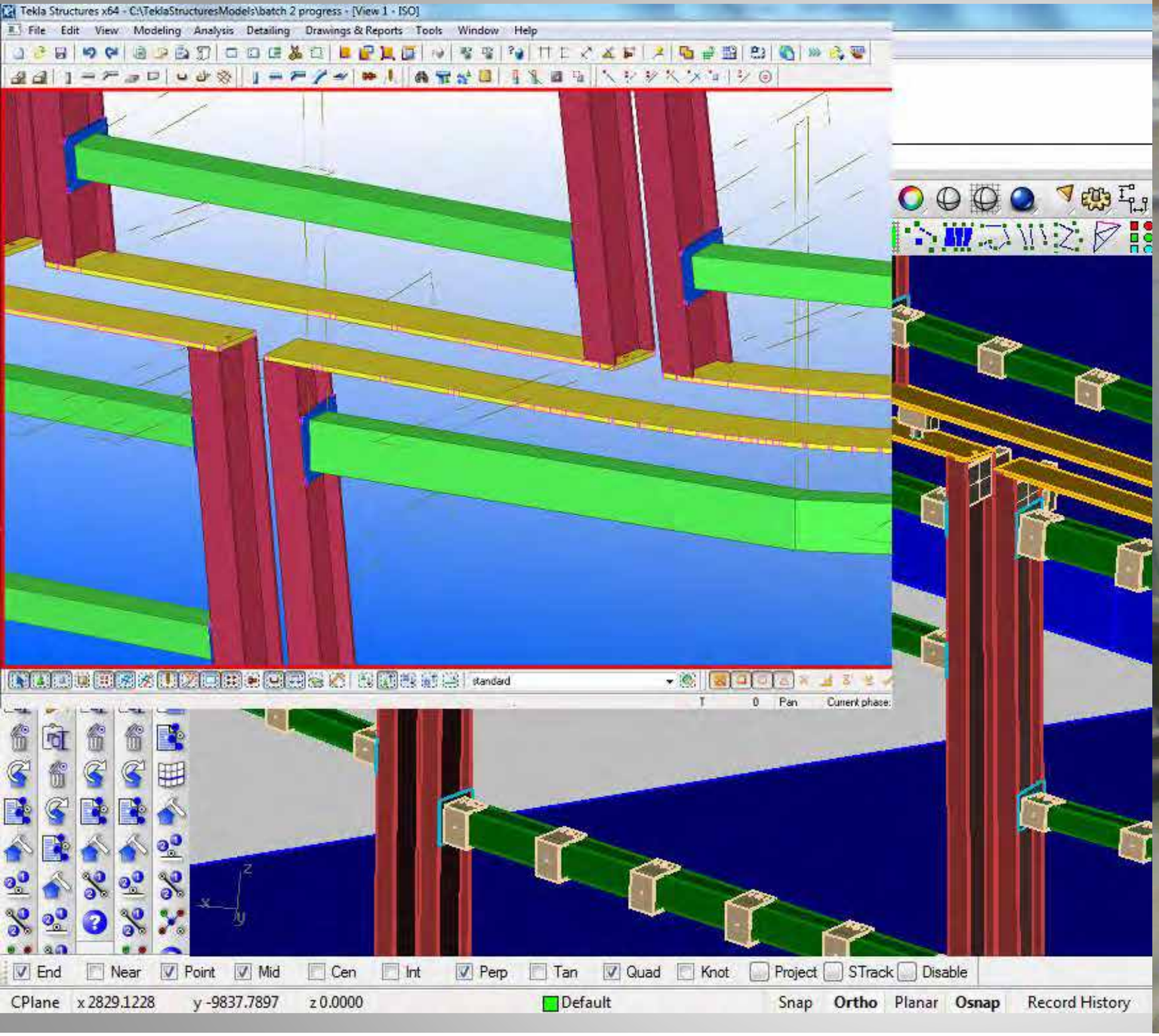
0.9.0076


Tekla Structures x64 - C:\TeklaStructuresModels\New model 3 - View 1 - 3d
File Edit View Modeling Analysis Detailing Drawings & Reports Tools Window Help
Log in
2016.QA002
PL15
S355JR
1 (Phase 1)
standard
Auto
View plane
Outline planes
Use shift+scroll wheel to view different assembly hierarchy levels
0
Pan
Current phase: 1
1 + 0 object(s) selected



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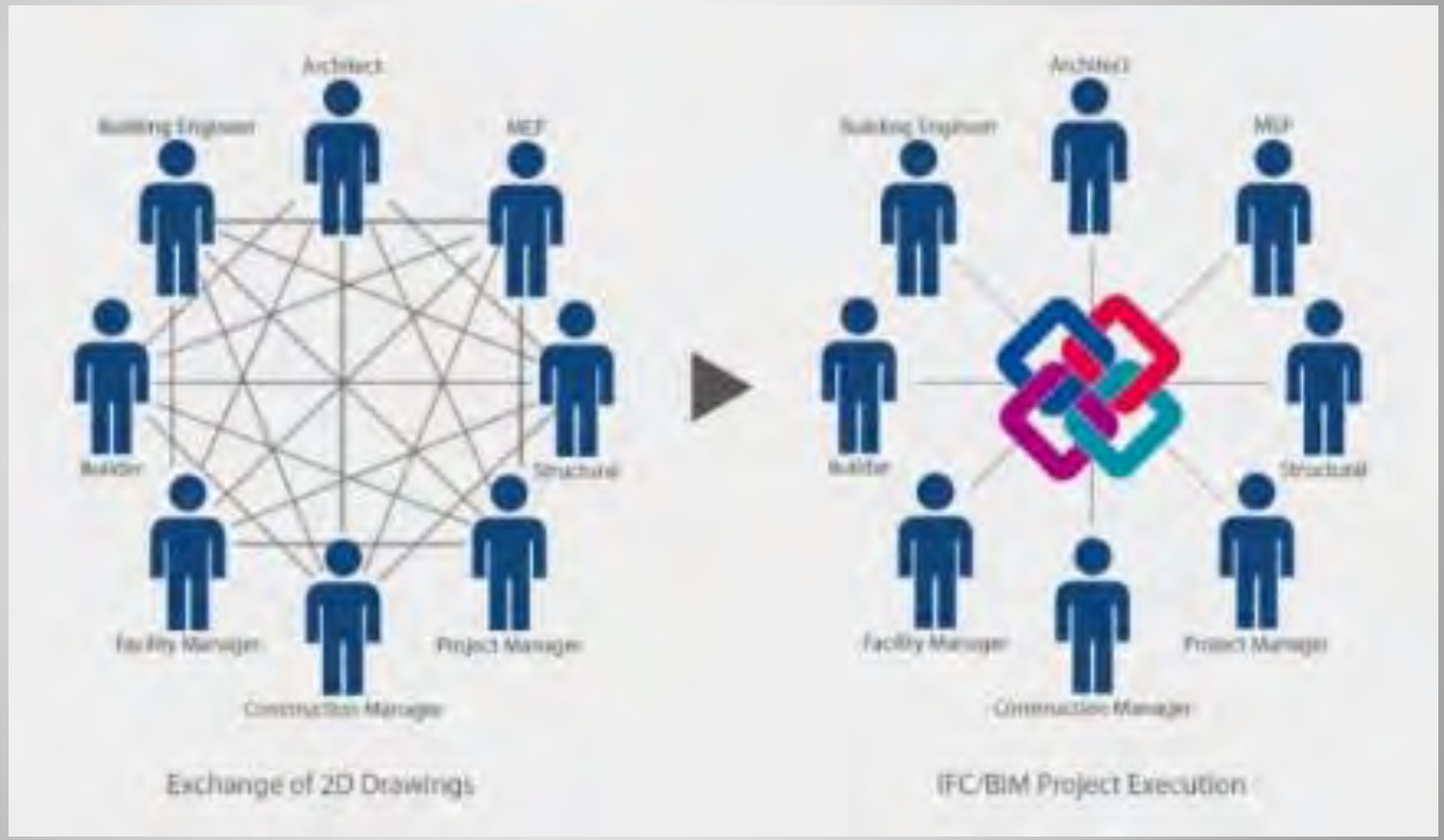
OpenBIM – Industry Foundation Classes



IC_L_Roof_BS_Base00_Rev00_IFC00.ifc - IfcQuickBrowser

File Edit View ?

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#123= IFCPLATE('1PVICSK6bDfeRnMSWNGMwT',#6,'AE18_B01','40.0mm Plate',$,#144,#143,'AE18_B01');
  #6= IFCOWNERHISTORY(#3,#1,$,.ADDED.,1383659750,$,$,1383659750);
  #144= IFCLOCALPLACEMENT($,#145);
  #143= IFCPRODUCTDEFINITIONSHAPE('AE18_B01','AE18_B01',(#142));
    #142= IFCSHAPEREPRESENTATION(#19,'Body','SweptSolid',(#141));
      #19= IFCGEOMETRICREPRESENTATIONSUBCONTEXT('Body','Model',*,*,*,*,#14,$,.MODEL_VIEW.,$);
      #141= IFCEXTRUDEDAREASOLID(#131,#11,#10,0.0400000000000305);
        #131= IFCARBITRARYCLOSEDPROFILEDEF(.AREA.,'AE18_B01',#130);
          #130= IFCPOLYLINE((#125,#126,#127,#128,#129));
            #125= IFCCARTESIANPOINT((-0.535000006690495,-0.159999999999986));
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        #11= IFCAXIS2PLACEMENT3D(#7,#10,#8);
        #10= IFCDIRECTION((0.0,0.0,1.0));
#124= IFCRELAGGREGATES('0ixfSdFU1F5B_WK6liMKCQ',#6,'ELEMENTASSEMBLY Container','ELEMENTASSEMBLY Container for Elements',#81,(#123,#292,#411,#596,#815,#842,#1149,#1162,#1319,#1402));
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```

```
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  #101= IFCPLATETYPE('0cXqCRSz9FS8qM4GUBJDtd',#6,'40.0mm Plate',$,$,$,$,$,$,.SHEET.);
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#140= IFCRELASSOCIATESMATERIAL('3MMu3XmEjBExtzY5mvQ7kJ',#6,'MatAssoc','Material Associates',(#123),#139);
  #6= IFCOWNERHISTORY(#3,#1,$,.ADDED.,1383659750,$,$,1383659750);
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  #139= IFCMATERIALLAYERSETUSAGE(#99,.AXIS3.,.NEGATIVE.,0.0);
    #99= IFCMATERIALLAYERSET((#87),'40.0mm Plate');
      #87= IFCMATERIALLAYER(#67,0.0400000000000305,.F.);
        #67= IFCMATERIAL('S355JR');
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  #292= IFCMECHANICALFASTENER('1hSRJZzZX8IQ6Fx4CIowTQ',#6,$,$,$,#286,#293,$,0.02,0.0400000000000305);
#598= IFCRELCONNECTSELEMENTS('1g5Nk49HT7Uh7ATxh5py4O',#6,$,$,$,#123,#596);
```

Ready

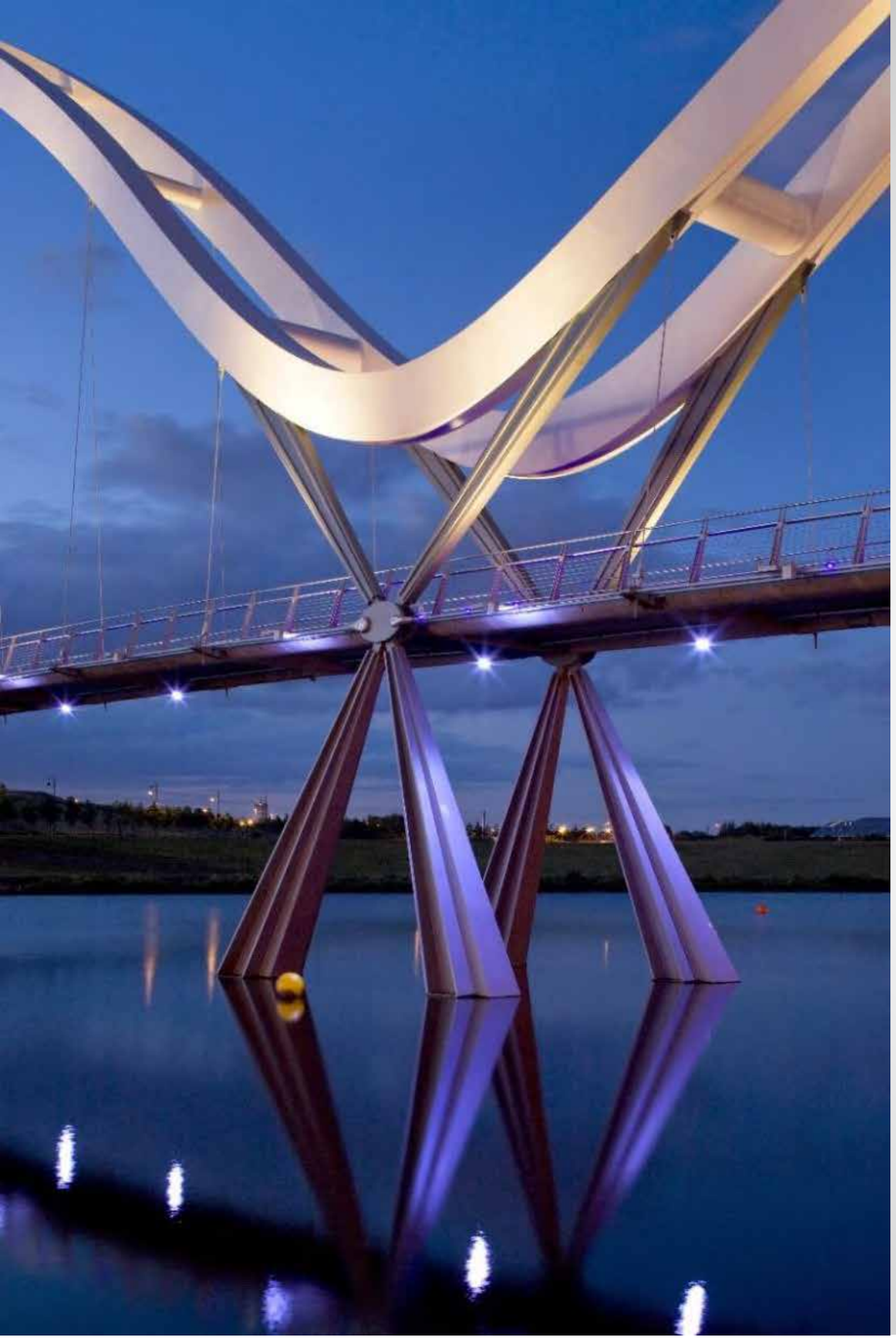
OpenBIM

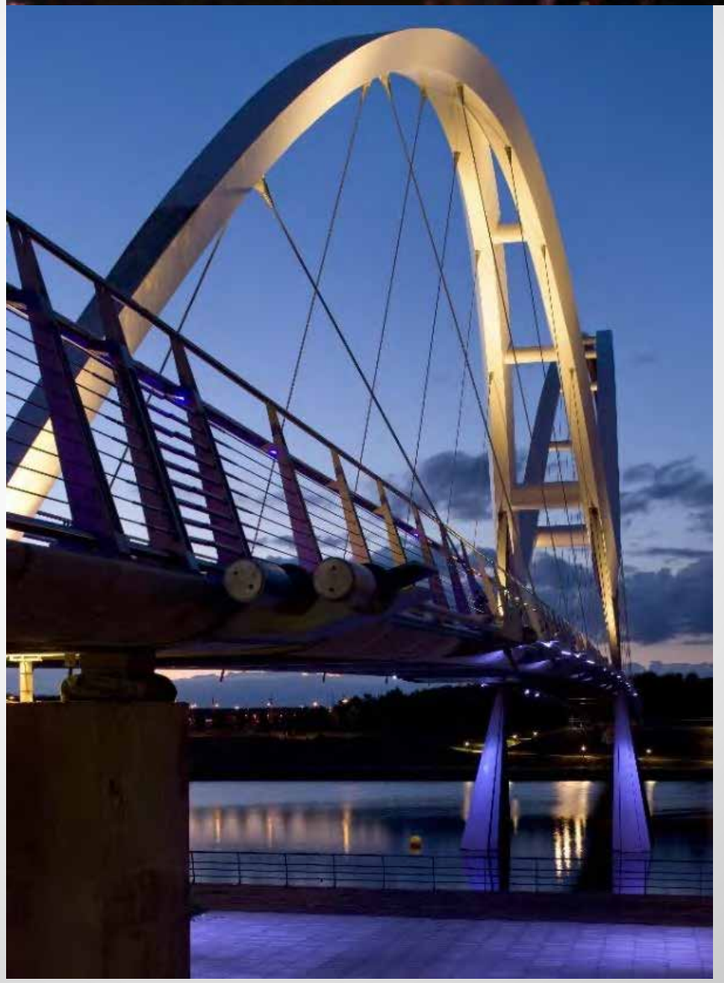
Industry Foundation Classes (IFC)

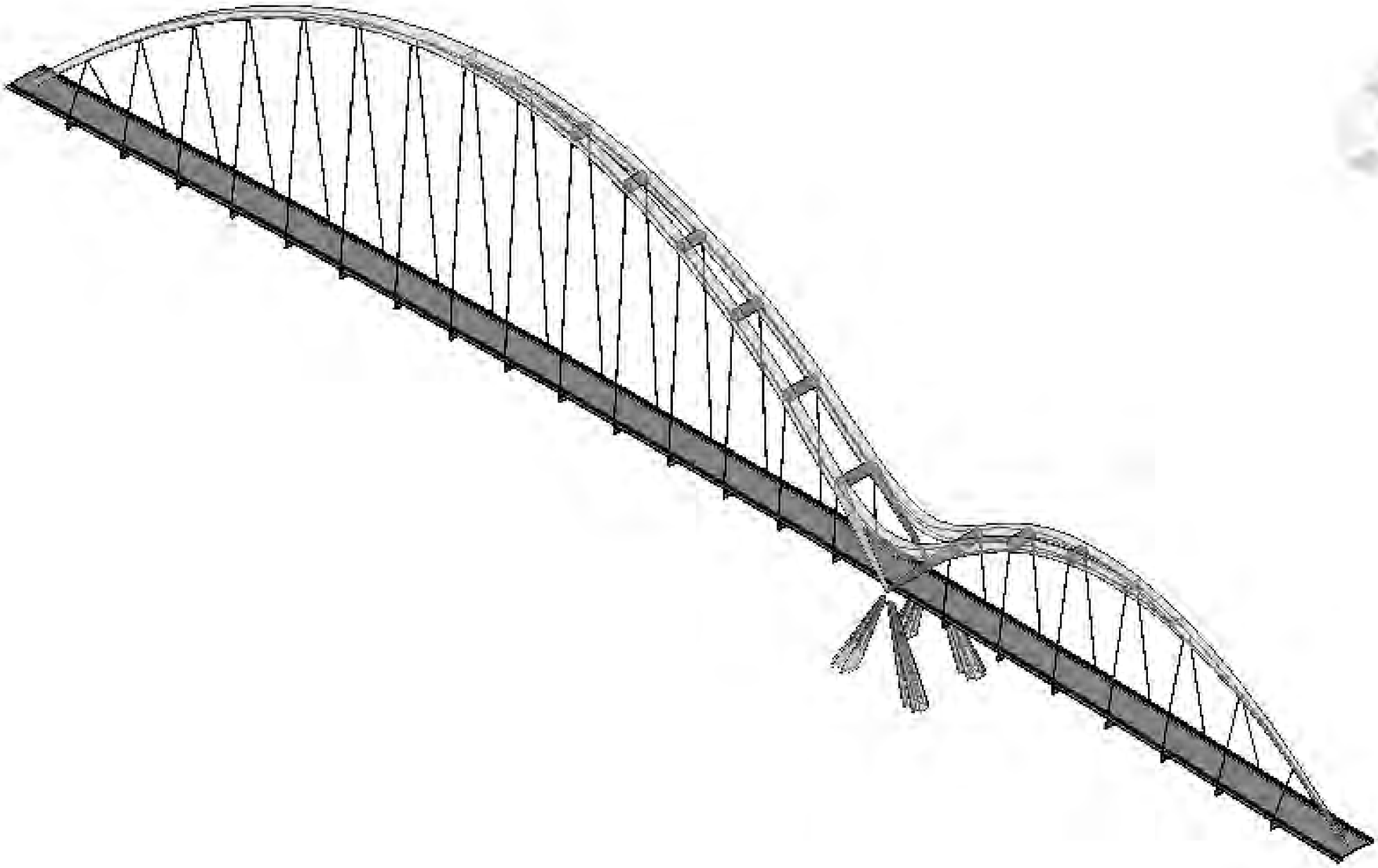
Revit, Archicad, Navisworks, Tekla, Solibri, Digital Project, Bentley, ……

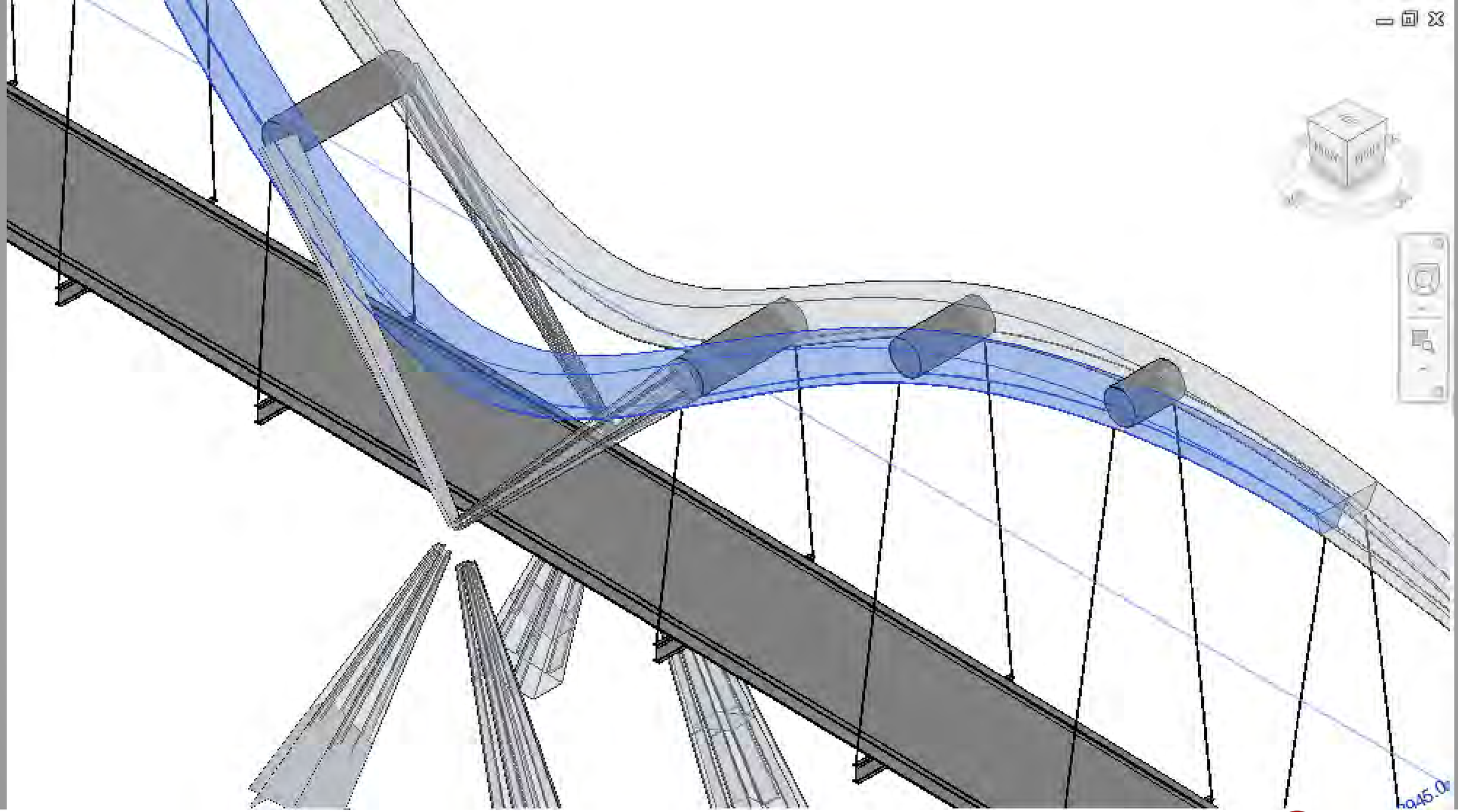
- IFC4 (Released March 2013)
- IFC2x3

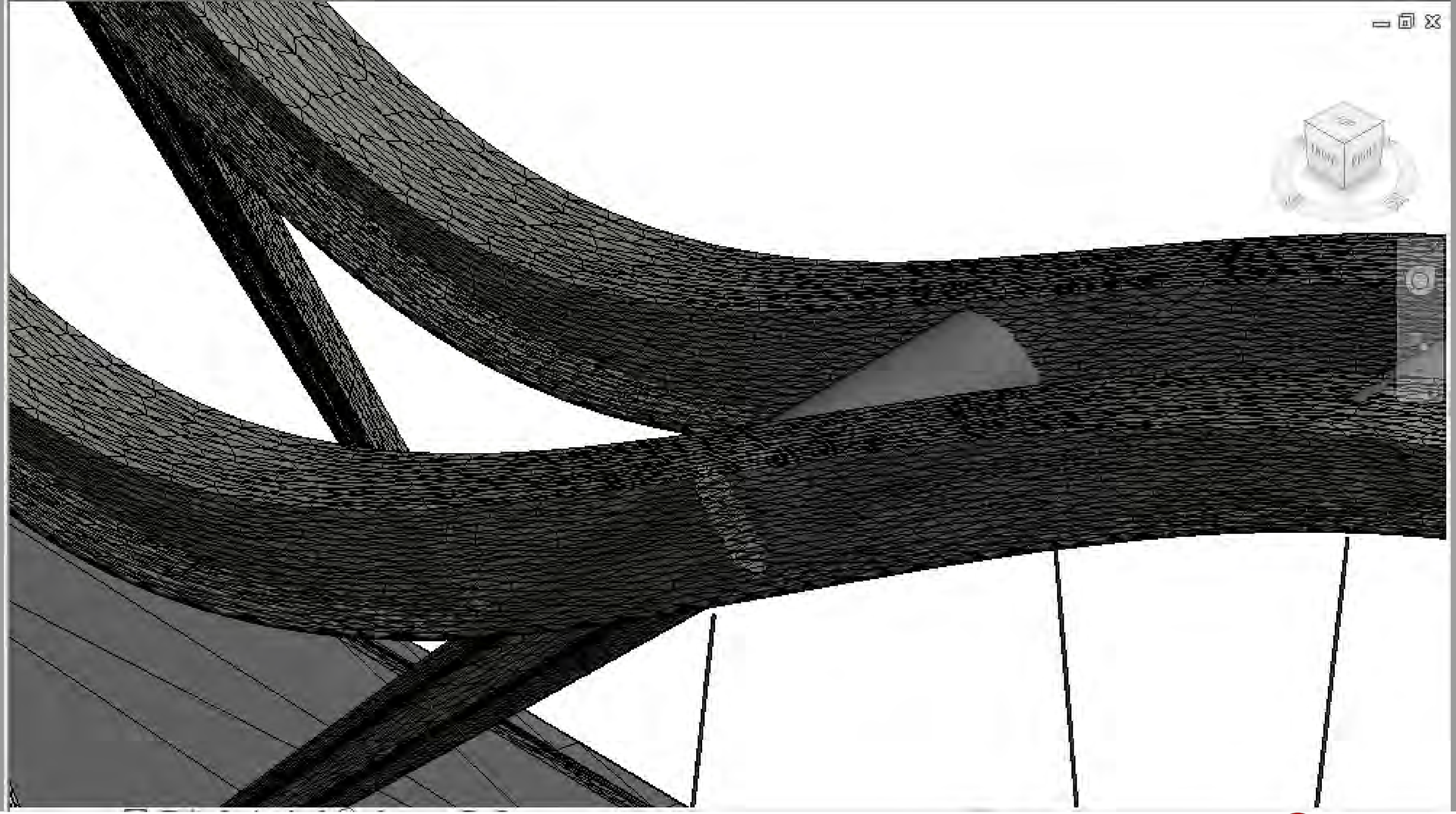

expedition



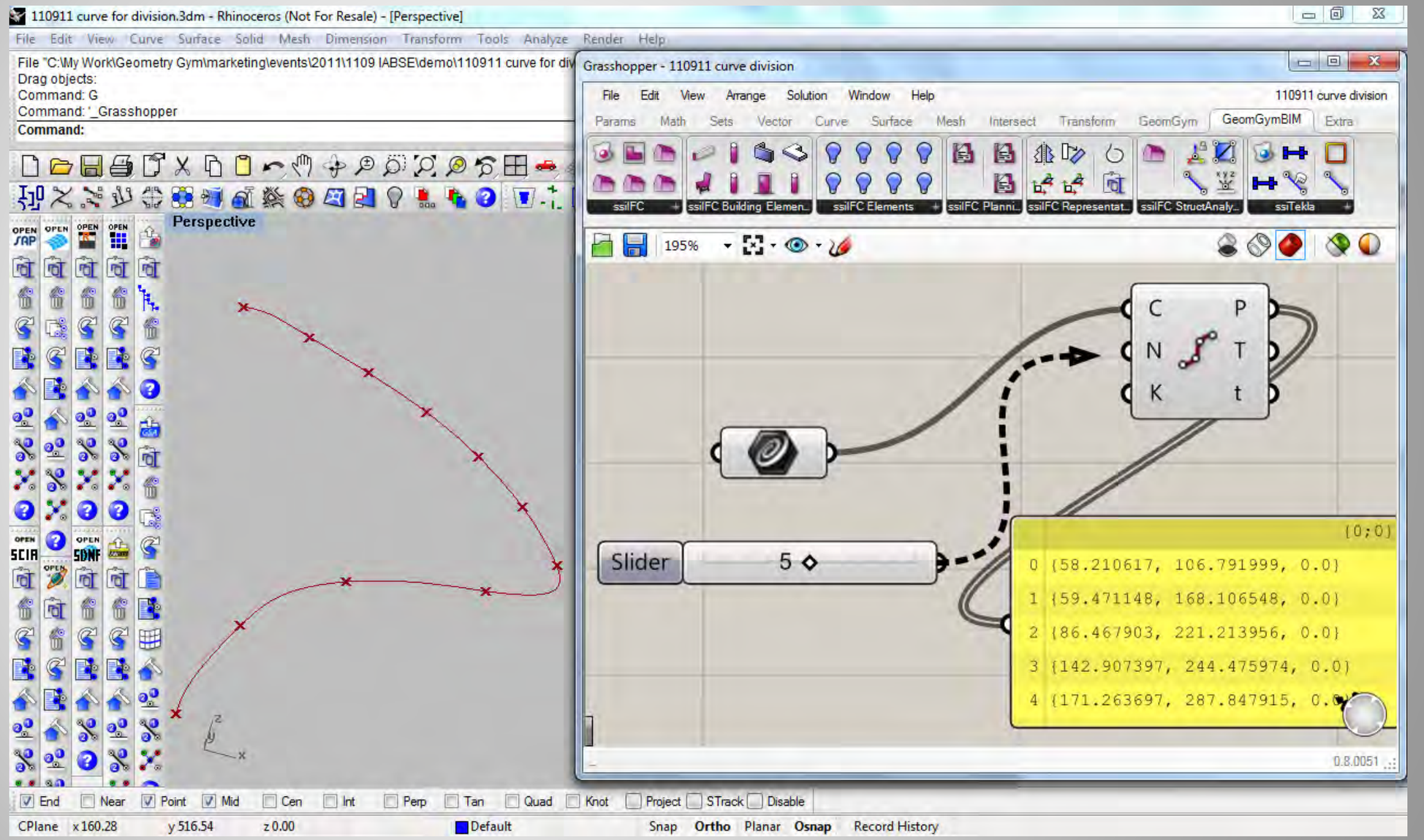


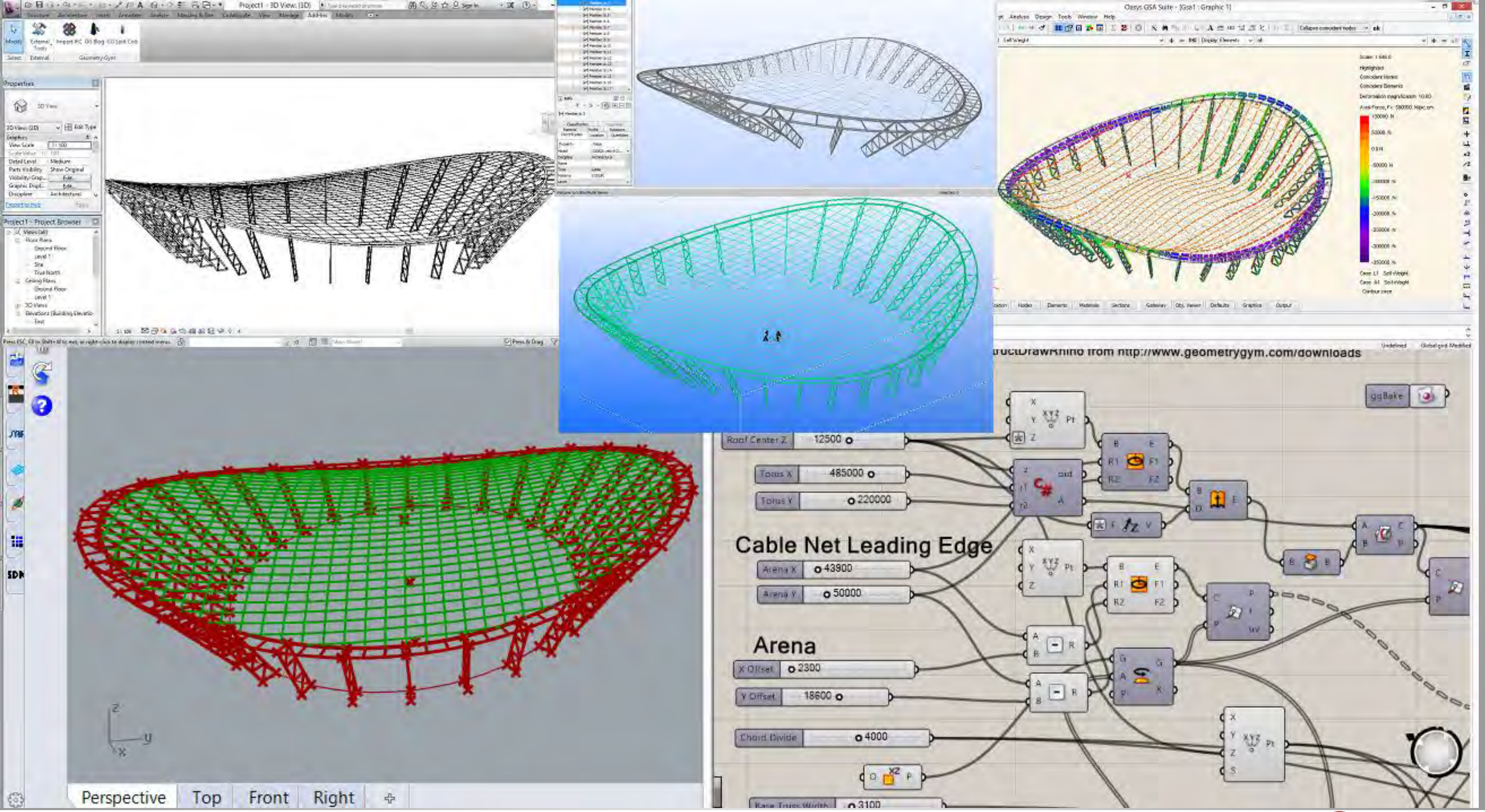






Generative BIM

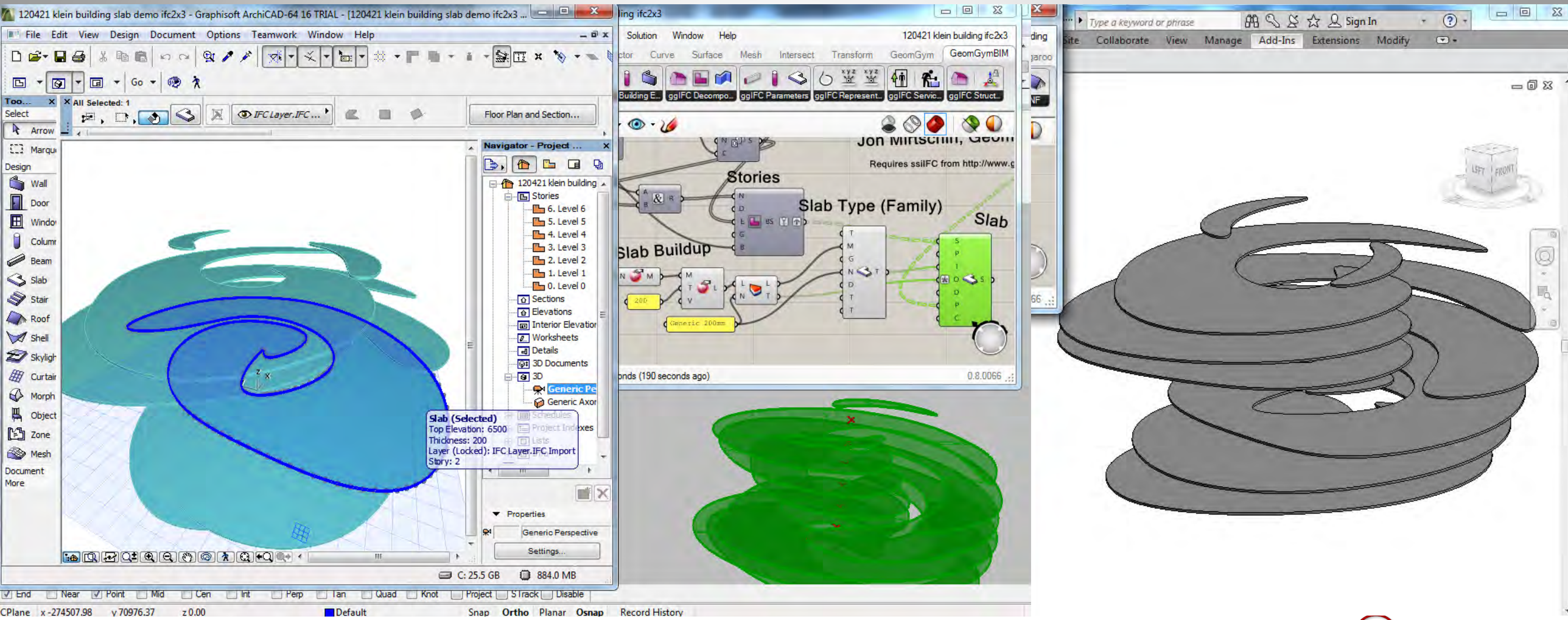



Cable Net Leading Edge
Roof Center Z
12500
Torus X
485000
Torus Y
220000
Arena X
43900
Arena Y
50000
Arena
X Offset
2300
Y Offset
18600
Chord Divide
4000
ggBake
Perspective
Top
Front
Right

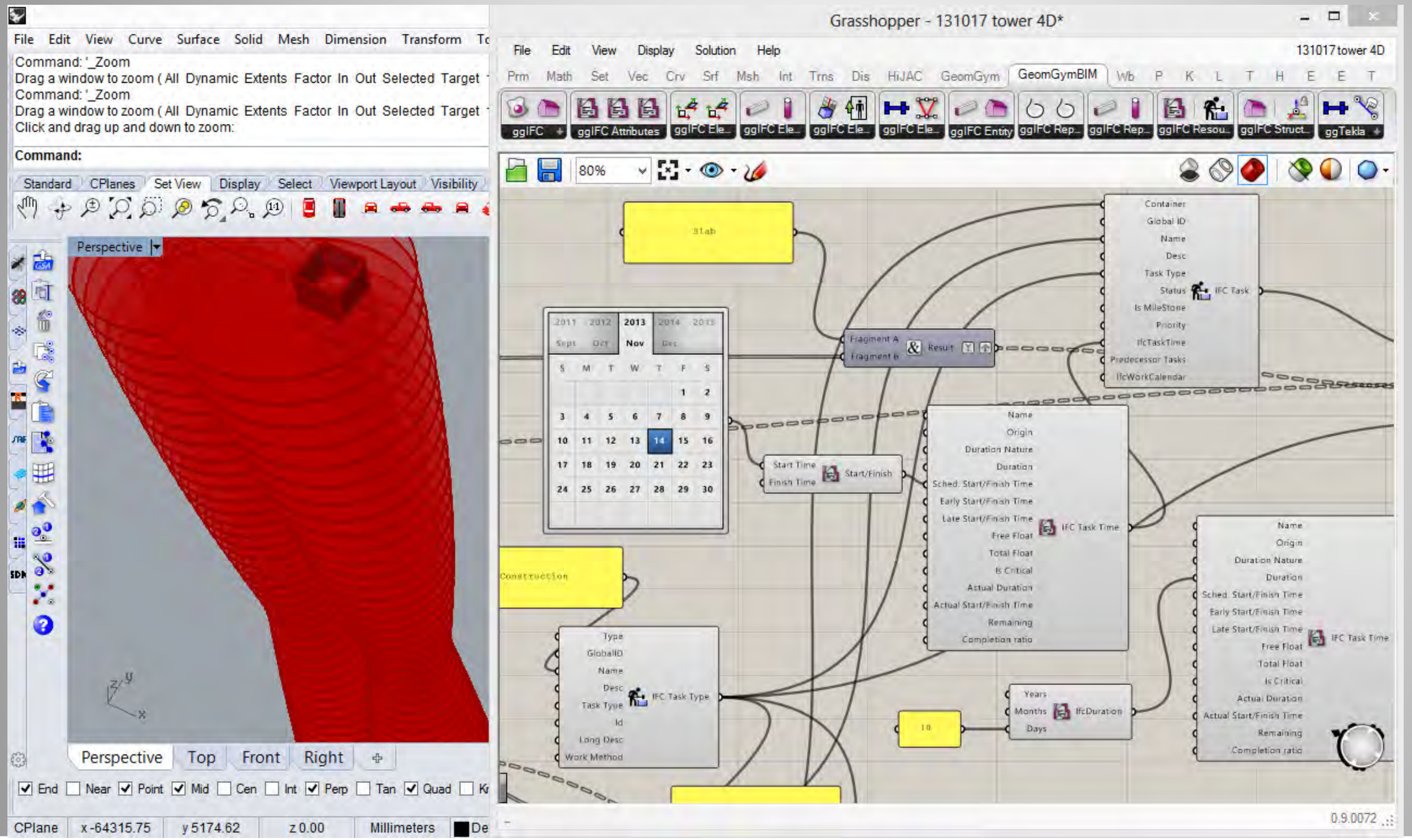
Geometry Gym IFC Tools

- Rhino3d (Comprehensive Import and primitive Export)
- Grasshopper (Comprehensive Export, Import and Modify)
- Revit (Advanced Import, Structural Analysis Export and adding more)
- Navisworks (Import enhancing extraction of timeline data, color/visualization styling and links)
- Tekla (Advanced Import including welds, bolts, assembly and cut part information, Export)
- Structural Analysis Software – Oasys GSA, CSI ETABS, CSI SAP2000, Autodesk Robot, SpaceGASS, SCIA

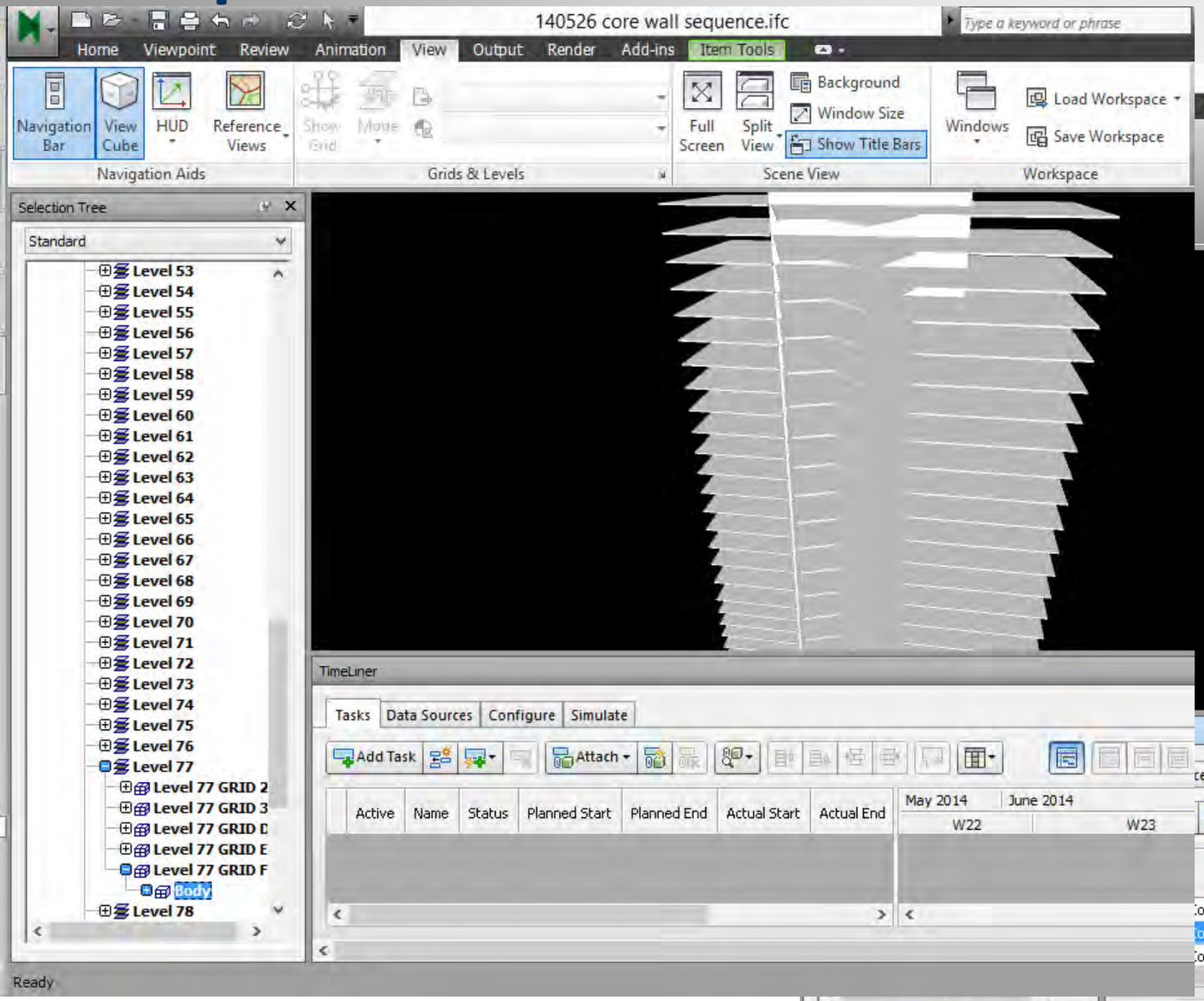
OpenBIM – Grasshopper to Archicad & Revit

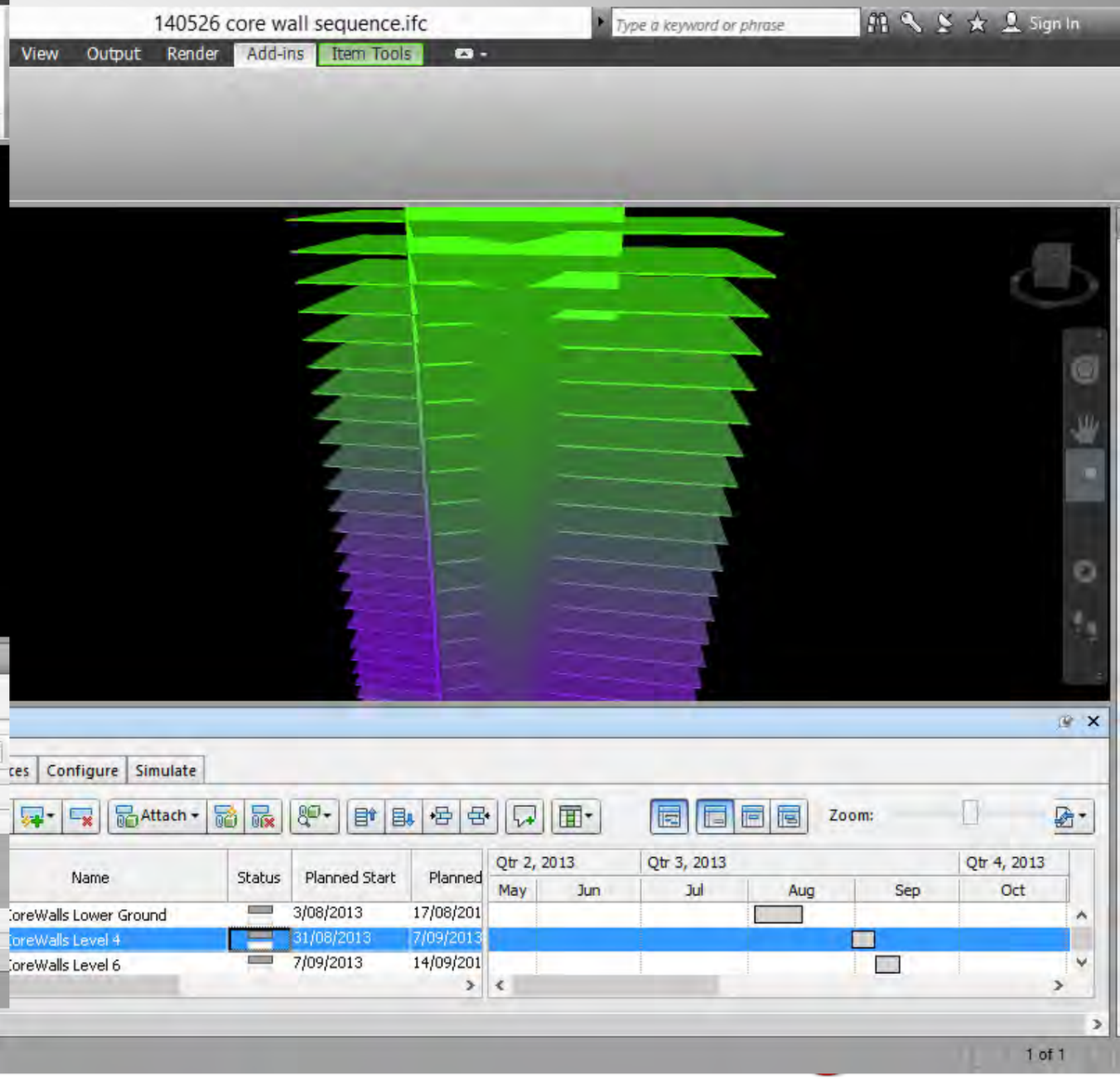


OpenBIM – IFC 4D Construction Sequence

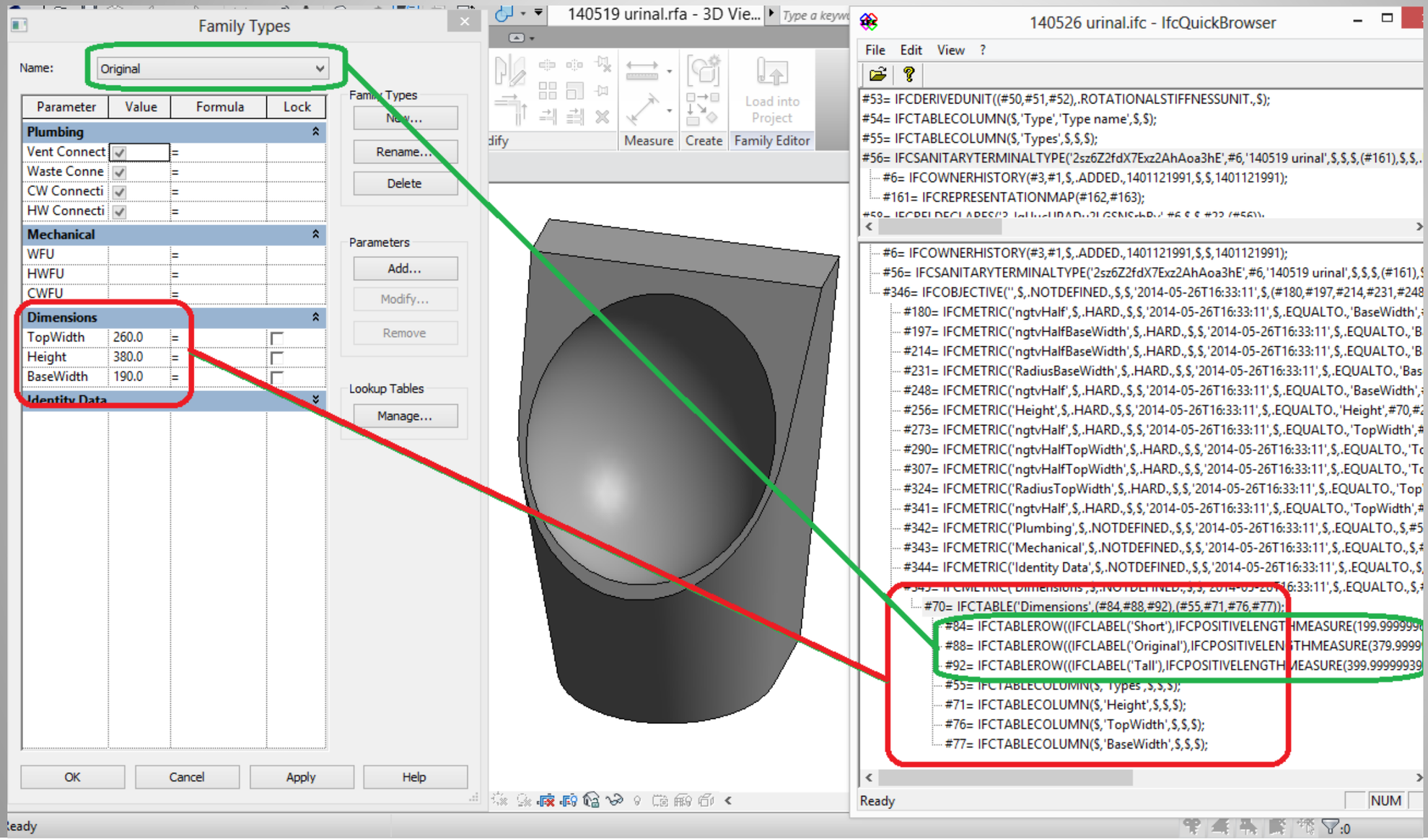


OpenBIM – Enhance Navisworks IFC





IFC4 – Parametrics and Constraints

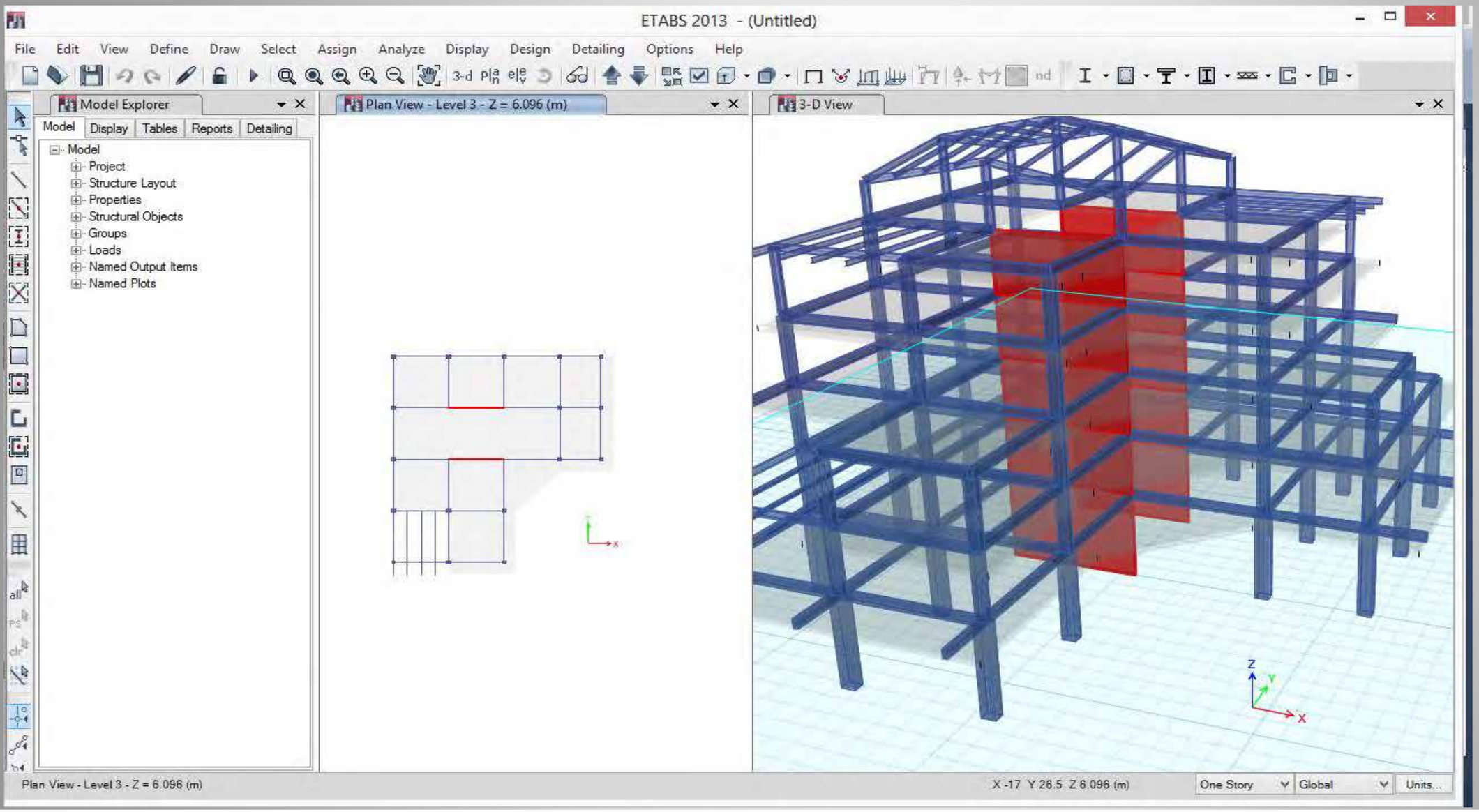


IFC4 Parametric and Constraints

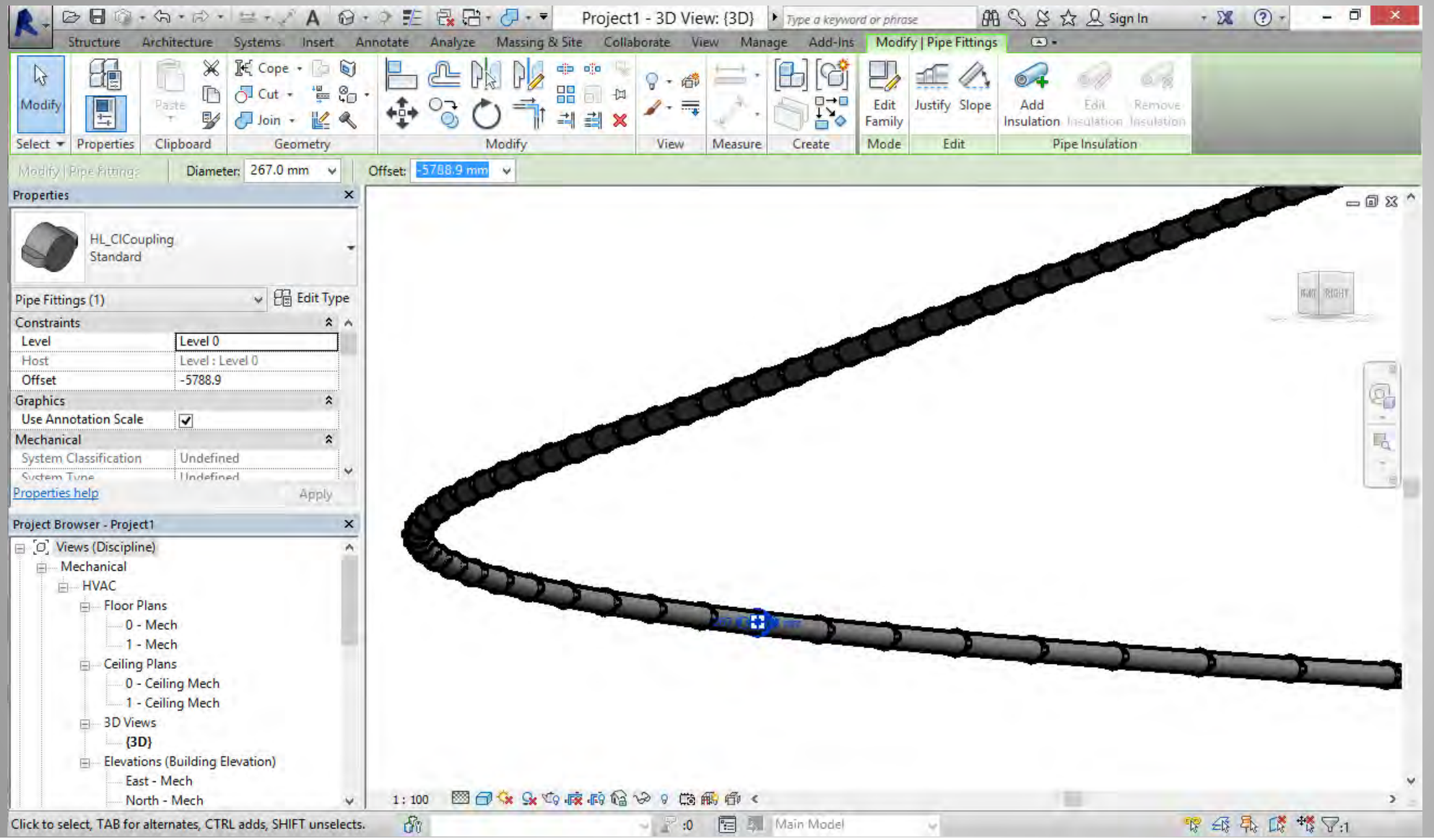
Potential Use

- Content authored in Revit converted to intelligent definitions in software such as Archicad or AECOSIM
- Content authored in software such as Archicad or AECOSIM converted to intelligent definitions into Revit
- Downgrading Revit families from one Version to earlier
- Changing hosted families to non-hosted and vice versa

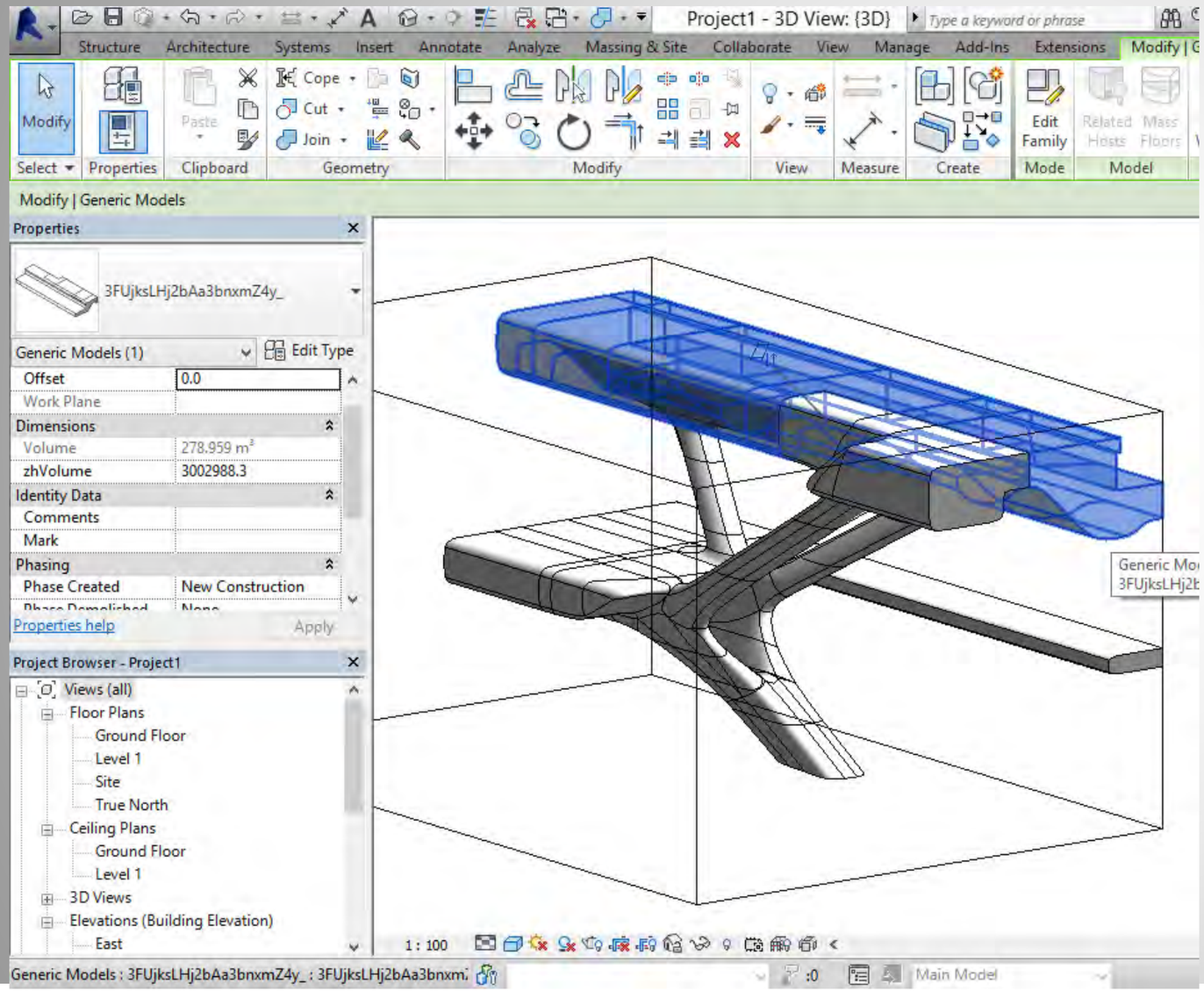
IFC4 Structural Analysis



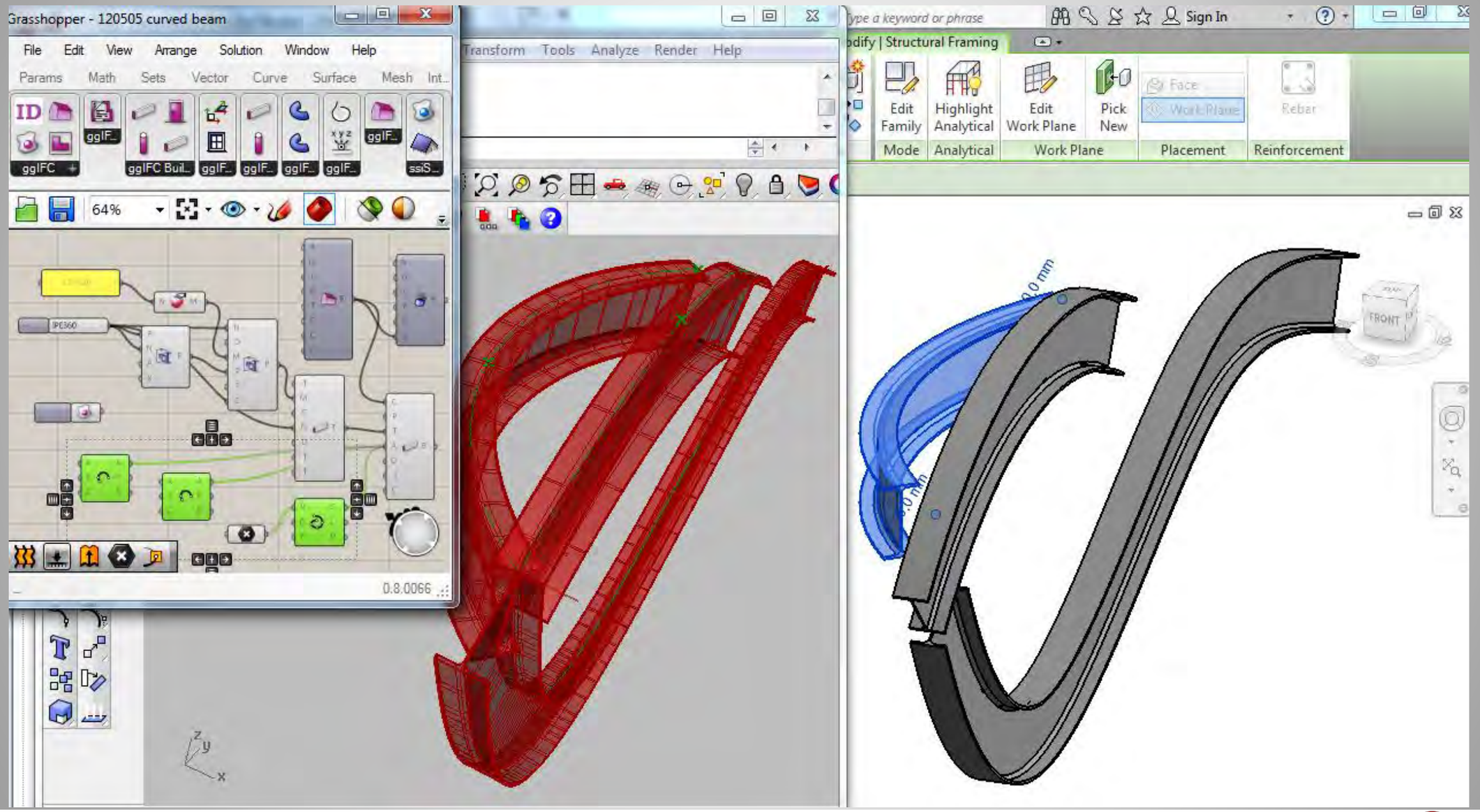
IFC4 - MEP


Project1 - 3D View: {3D}
Type a keyword or phrase
Sign In
Structure
Architecture
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify | Pipe Fittings
Modify
Select
Properties
Paste
Clipboard
Cope
Cut
Join
Geometry
Modify
View
Measure
Create
Edit Family
Mode
Justify
Slope
Edit
Add Insulation
Edit Insulation
Remove Insulation
Pipe Insulation
Modify | Pipe Fittings
Diameter: 267.0 mm
Offset: -5788.9 mm
Properties
HL_CICoupling
Standard
Pipe Fittings (1)
Edit Type
Constraints
Level
Level 0
Host
Level : Level 0
Offset
-5788.9
Graphics
Use Annotation Scale
Mechanical
System Classification
Undefined
Properties help
Apply
Project Browser - Project1
Views (Discipline)
Mechanical
HVAC
Floor Plans
0 - Mech
1 - Mech
Ceiling Plans
0 - Ceiling Mech
1 - Ceiling Mech
3D Views
{3D}
Elevations (Building Elevation)
East - Mech
North - Mech
1 : 100
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.
Main Model

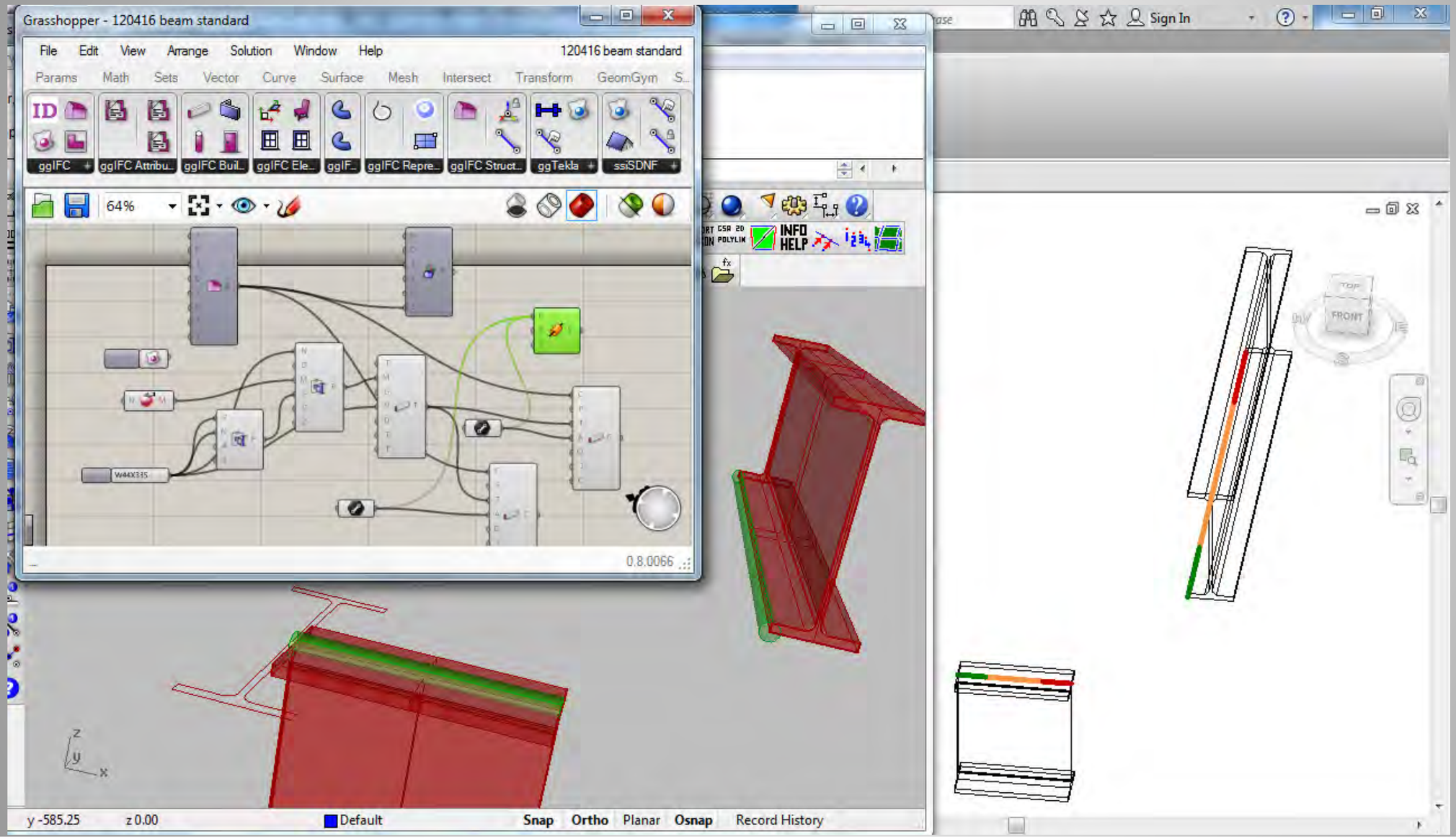
IFC4 - NURBS


Project1 - 3D View: {3D}
Type a keyword or phrase
Structure
Architecture
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Extensions
Modify | G
Modify
Select
Properties
Paste
Clipboard
Cope
Cut
Join
Geometry
Modify
View
Measure
Create
Edit Family
Mode
Related Hosts
Mass Floors
Model
Modify | Generic Models
Properties
3FUjksLHj2bAa3bnxmZ4y_
Generic Models (1)
Edit Type
Offset
0.0
Work Plane
Dimensions
Volume
278.959 m³
zhVolume
3002988.3
Identity Data
Comments
Mark
Phasing
Phase Created
New Construction
Properties help
Apply
Project Browser - Project1
Views (all)
Floor Plans
Ground Floor
Level 1
Site
True North
Ceiling Plans
Ground Floor
Level 1
3D Views
Elevations (Building Elevation)
East
1 : 100
Generic Models : 3FUjksLHj2bAa3bnxmZ4y_ : 3FUjksLHj2bAa3bnxm
:0
Main Model

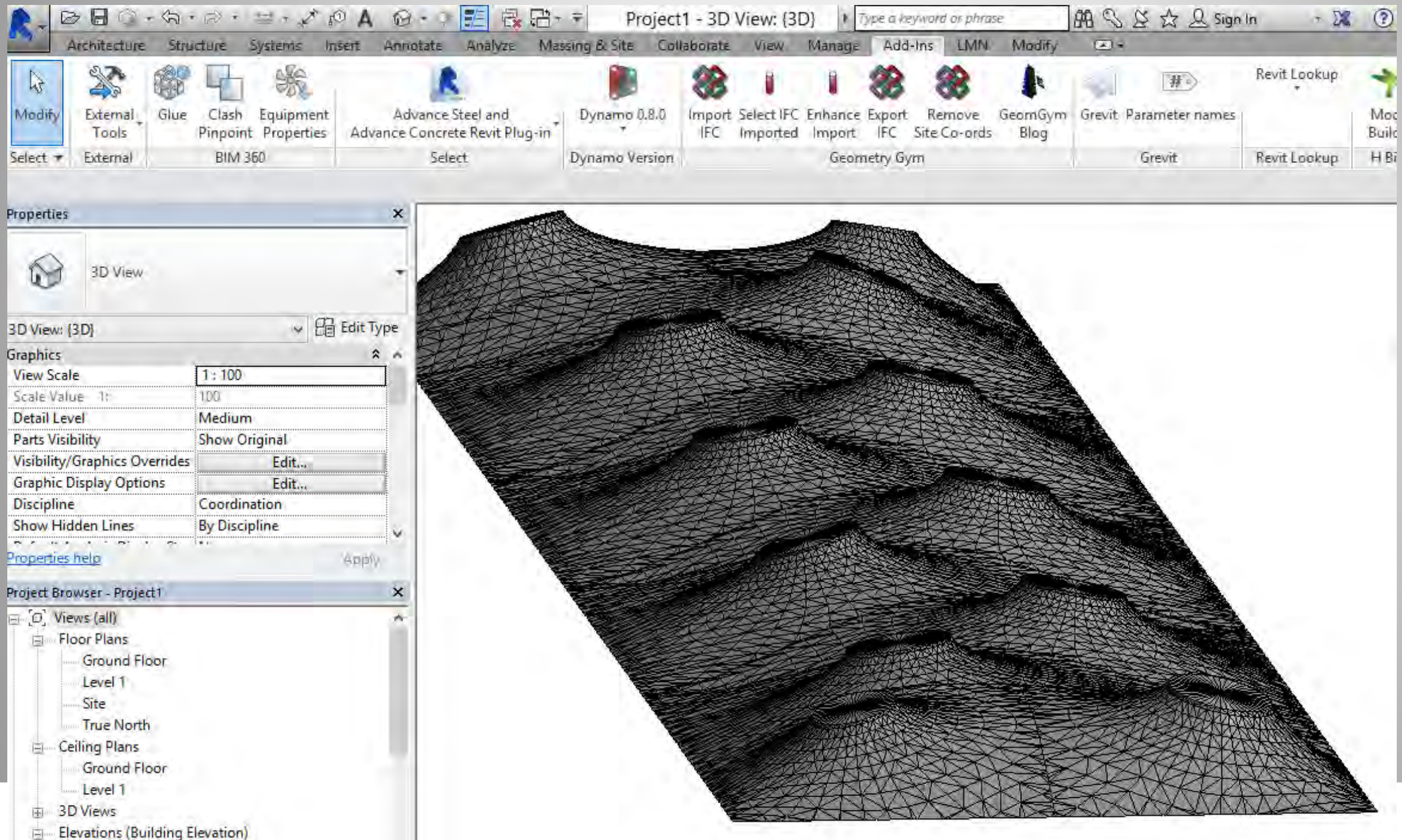
IFC4 - NURBS


Grasshopper - 120505 curved beam
File Edit View Arrange Solution Window Help
Params Math Sets Vector Curve Surface Mesh
ggIFC
64%
0.8.0066
Transform Tools Analyze Render Help
Edit Family
Highlight Analytical
Edit Work Plane
Pick New
Mode
Analytical
Work Plane
Placement
Reinforcement
Sign In
FRONT

IFC4 – Cardinal Points



IFC4 Triangulated FaceSet



BrisBIMx

IFC4 – Other Improvements

- Simplified ifcXML
- Documentation and Guidance
- Point Clouds

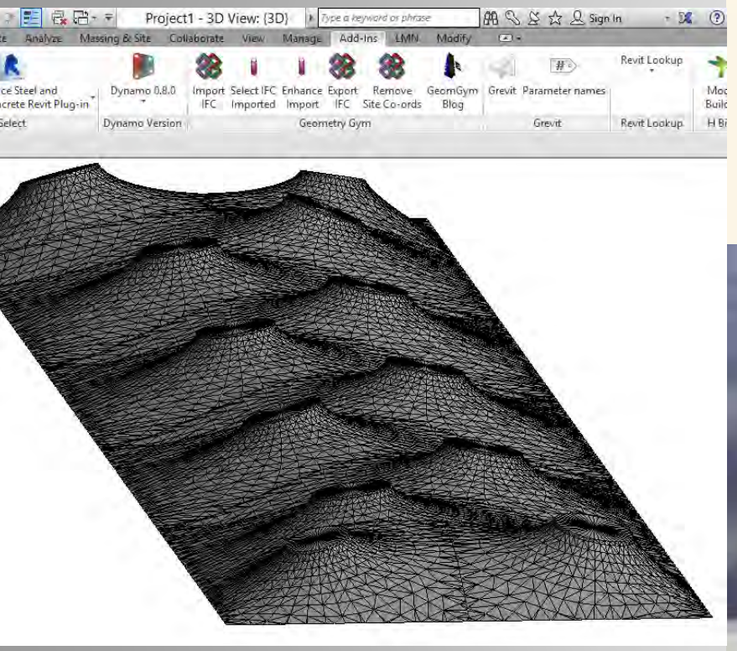
IFC4 – Model View Definitions

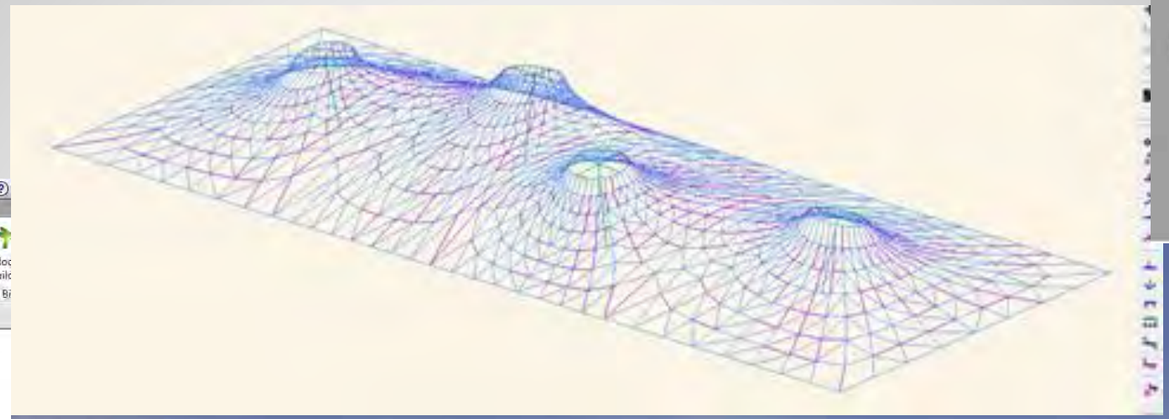
- IFC4 Reference View
- IFC4 Design Transfer View

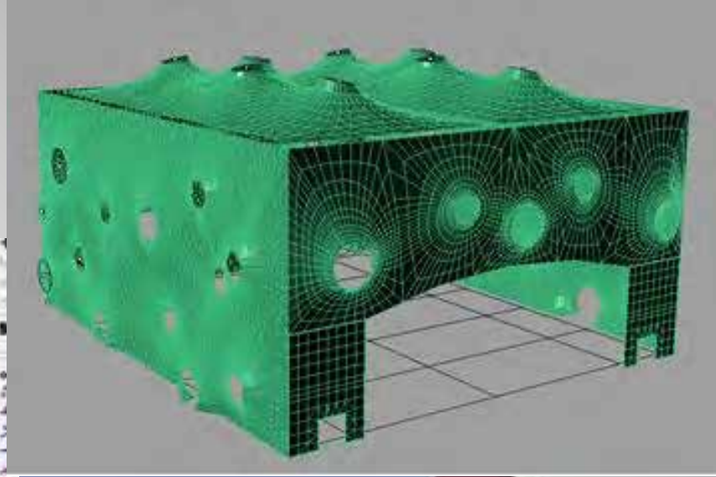
IFC5 - Infrastructure

- Bridges
- Alignment
- Terrain
- Ground Strata
- Road
- Rail
- Waterways
- Tunnels
- Public Utilities

BIM and Bullets







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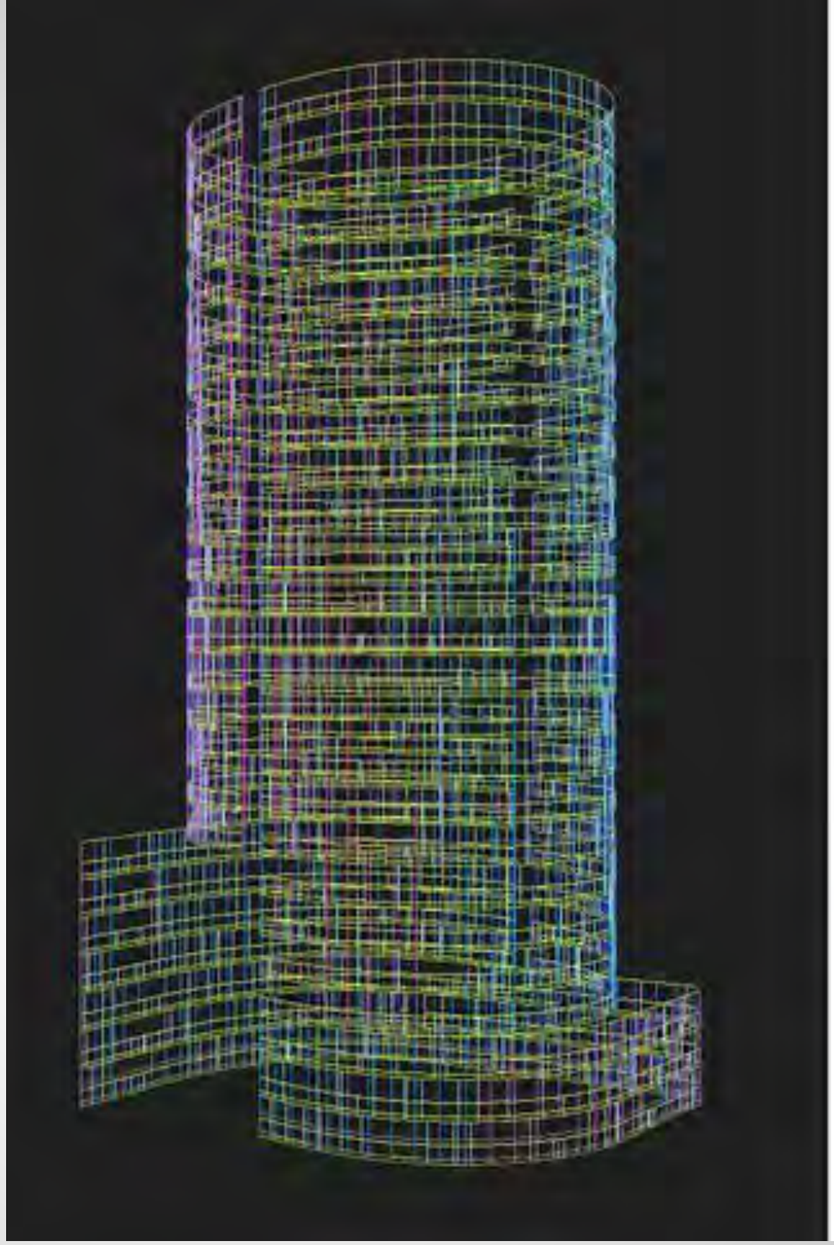
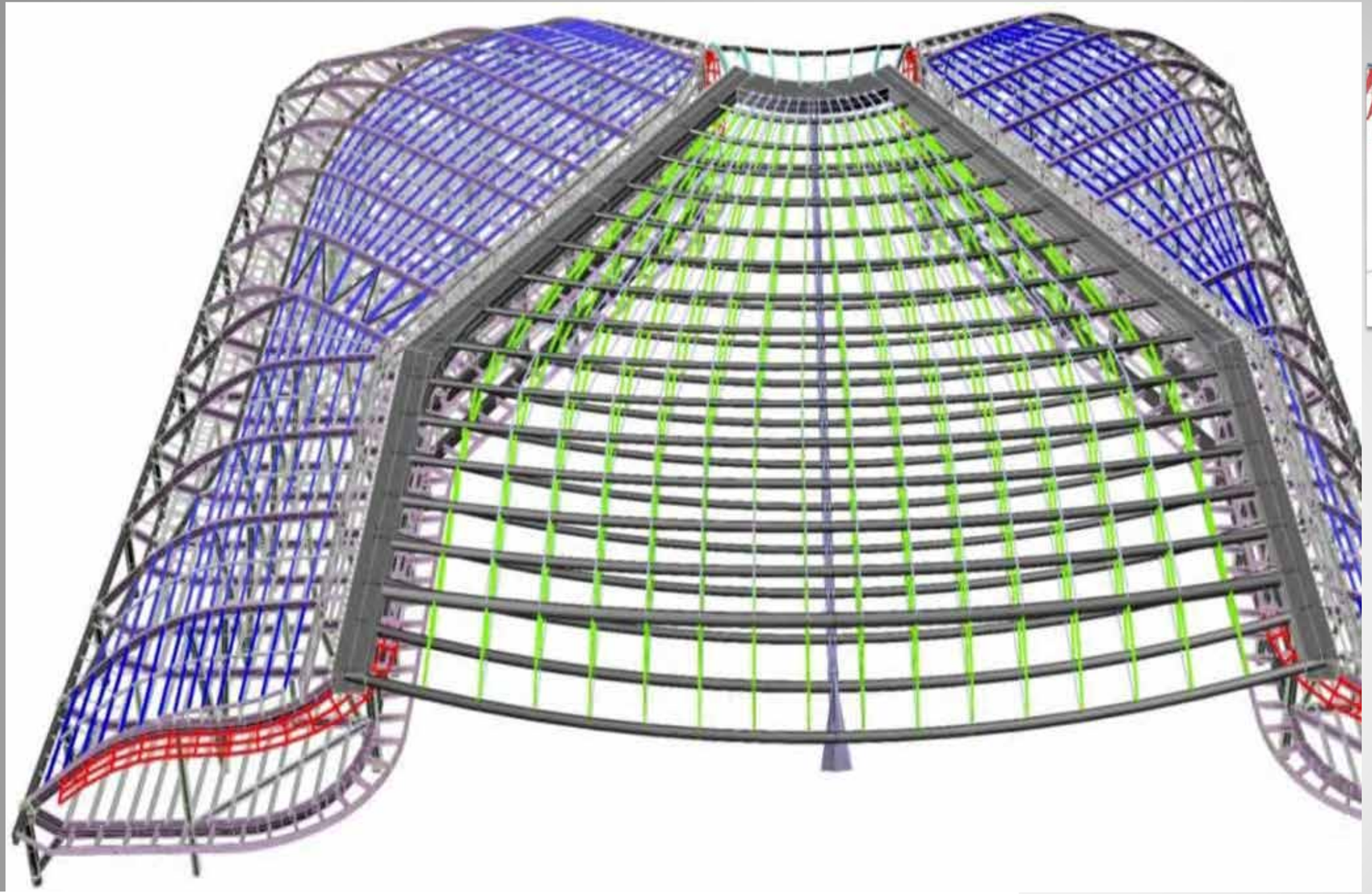
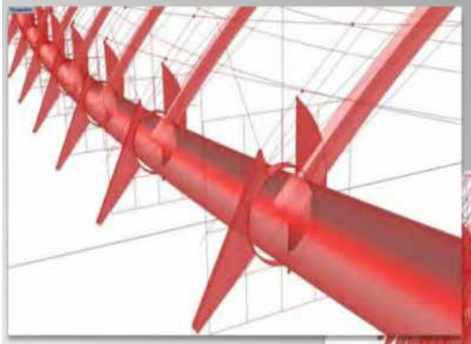
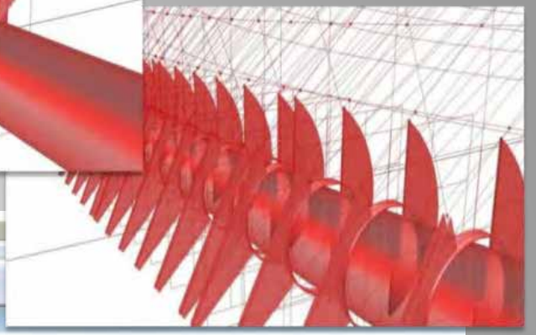
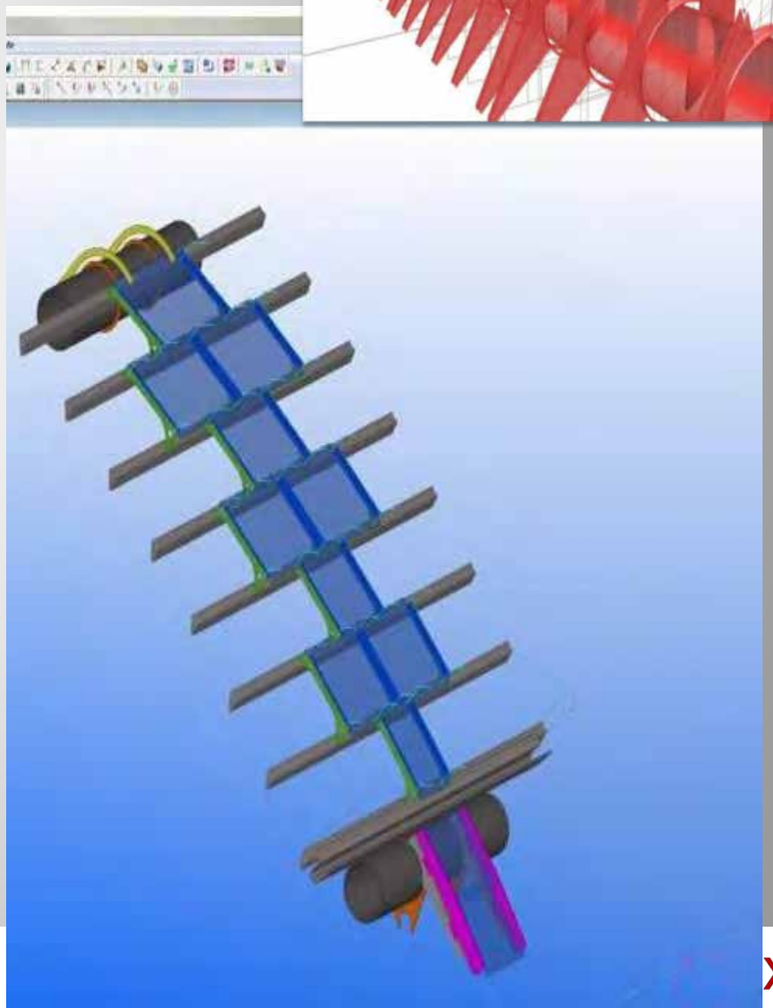
FJMT
Curtain Panels



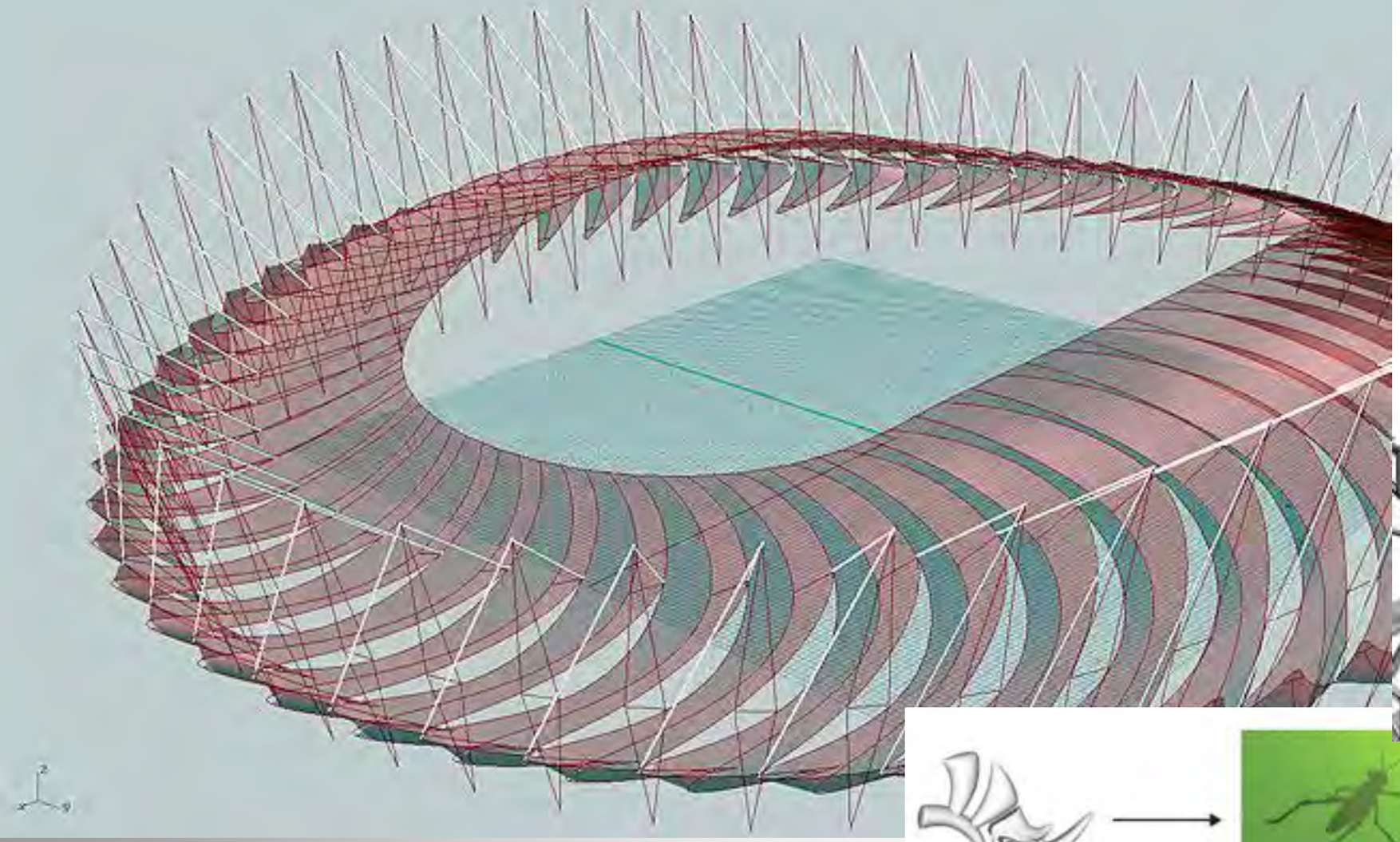


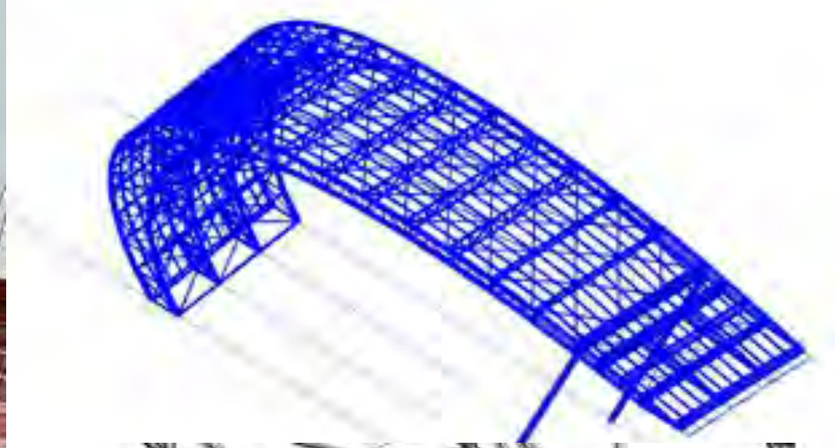


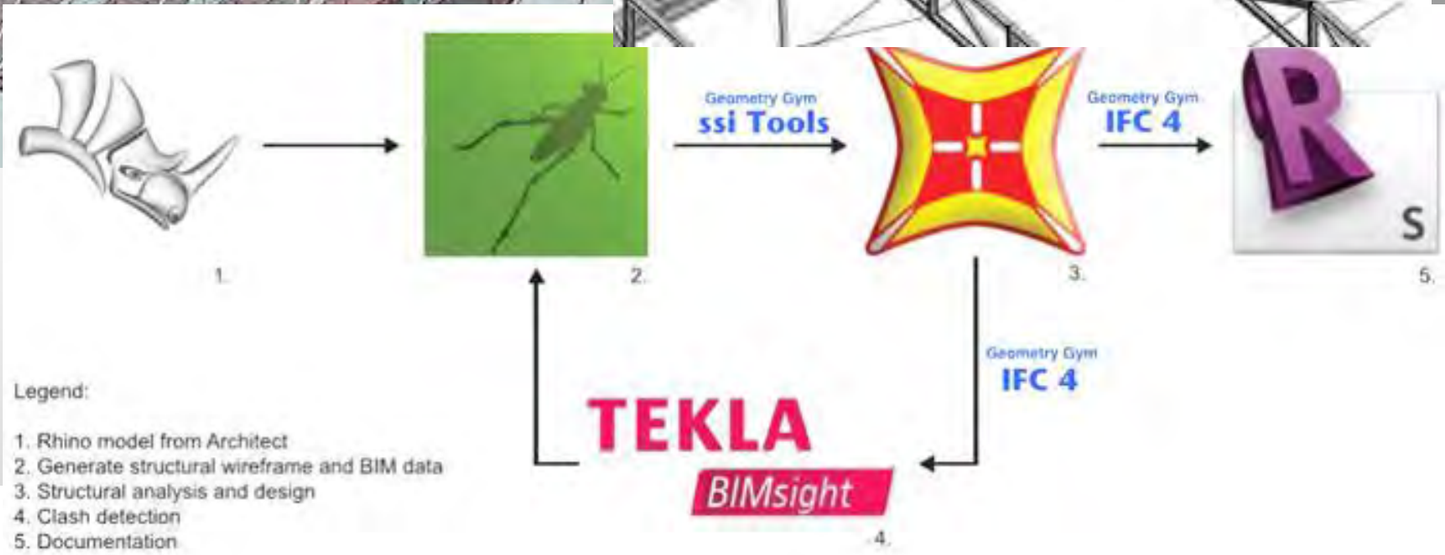




DEVELOPMENT COMPLEX DESIGN



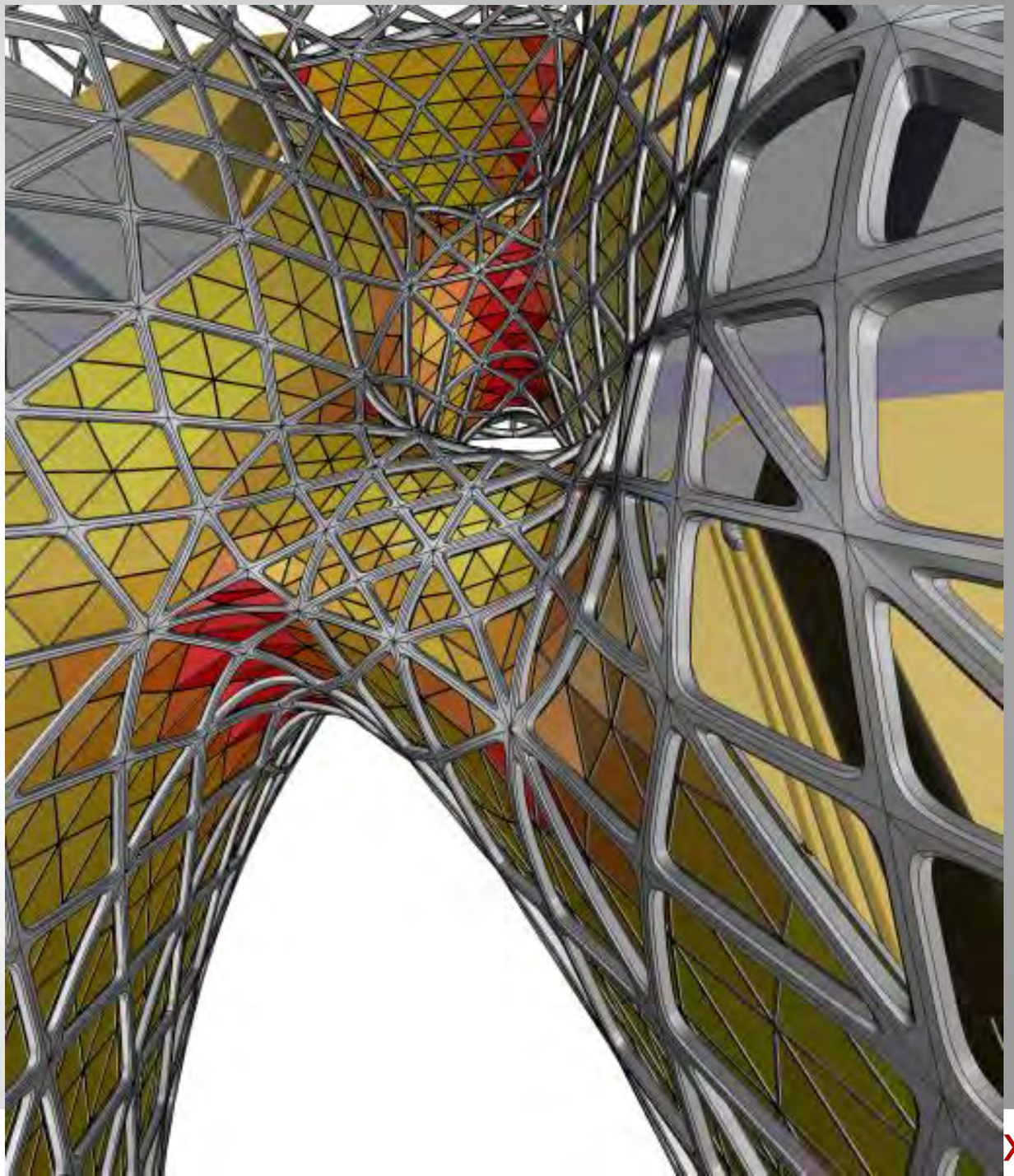


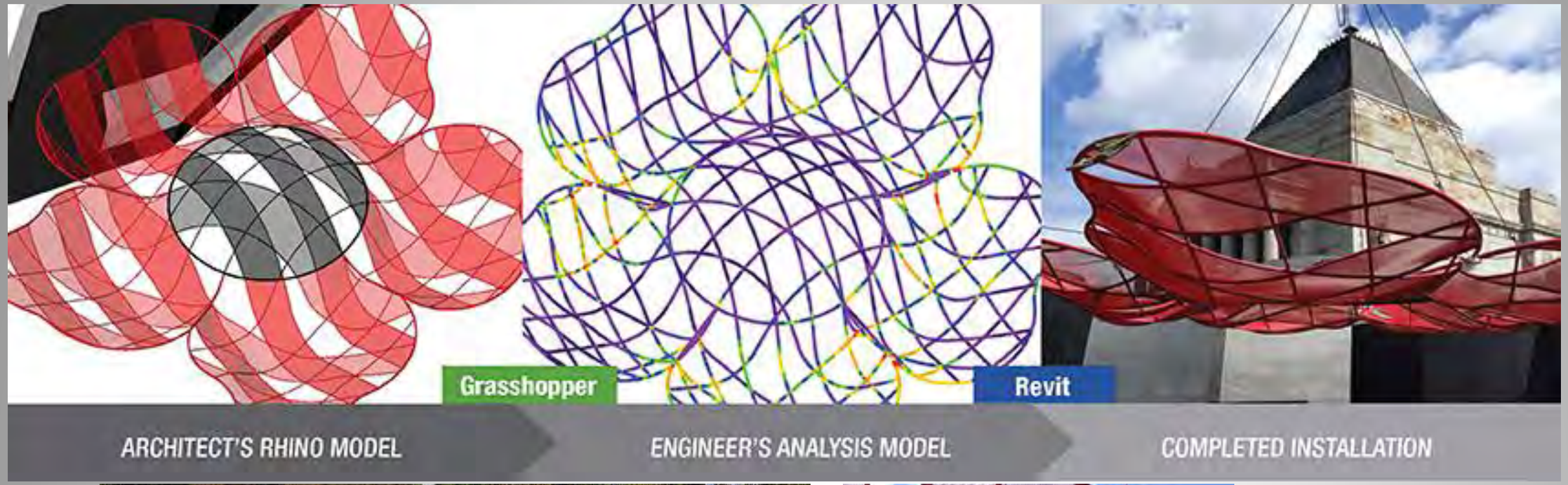


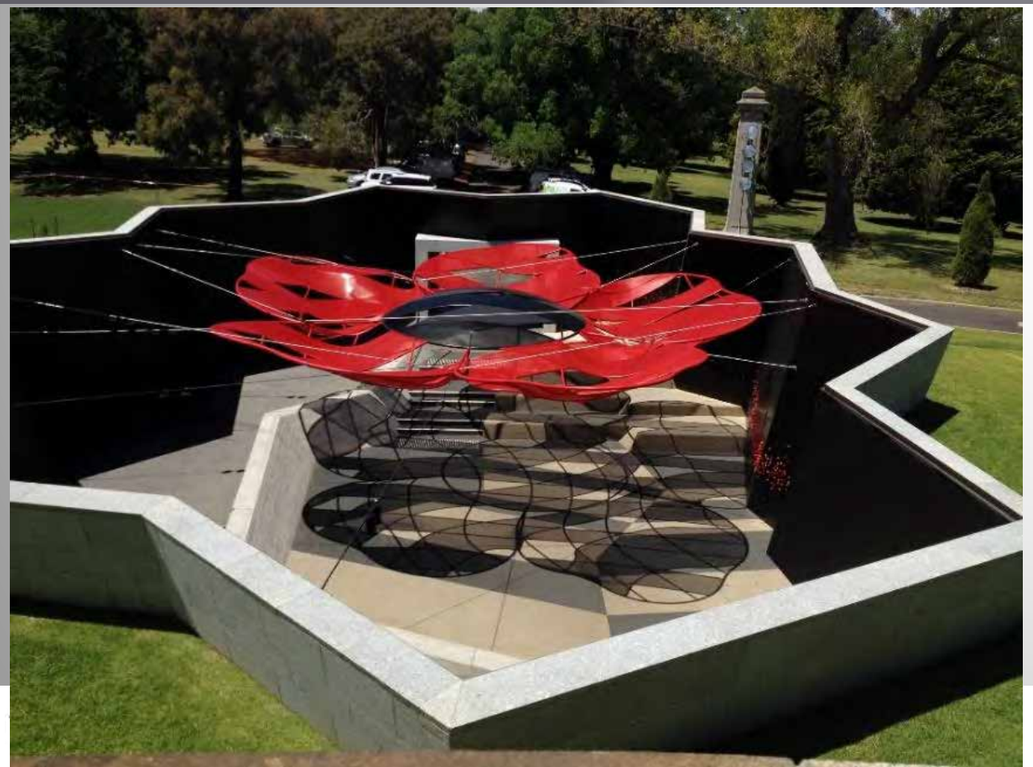
Thornton Tomasetti

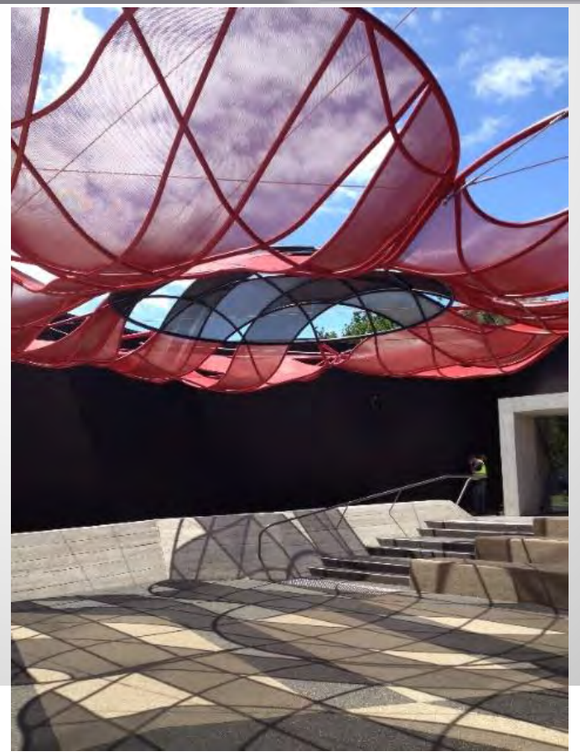
Legend:

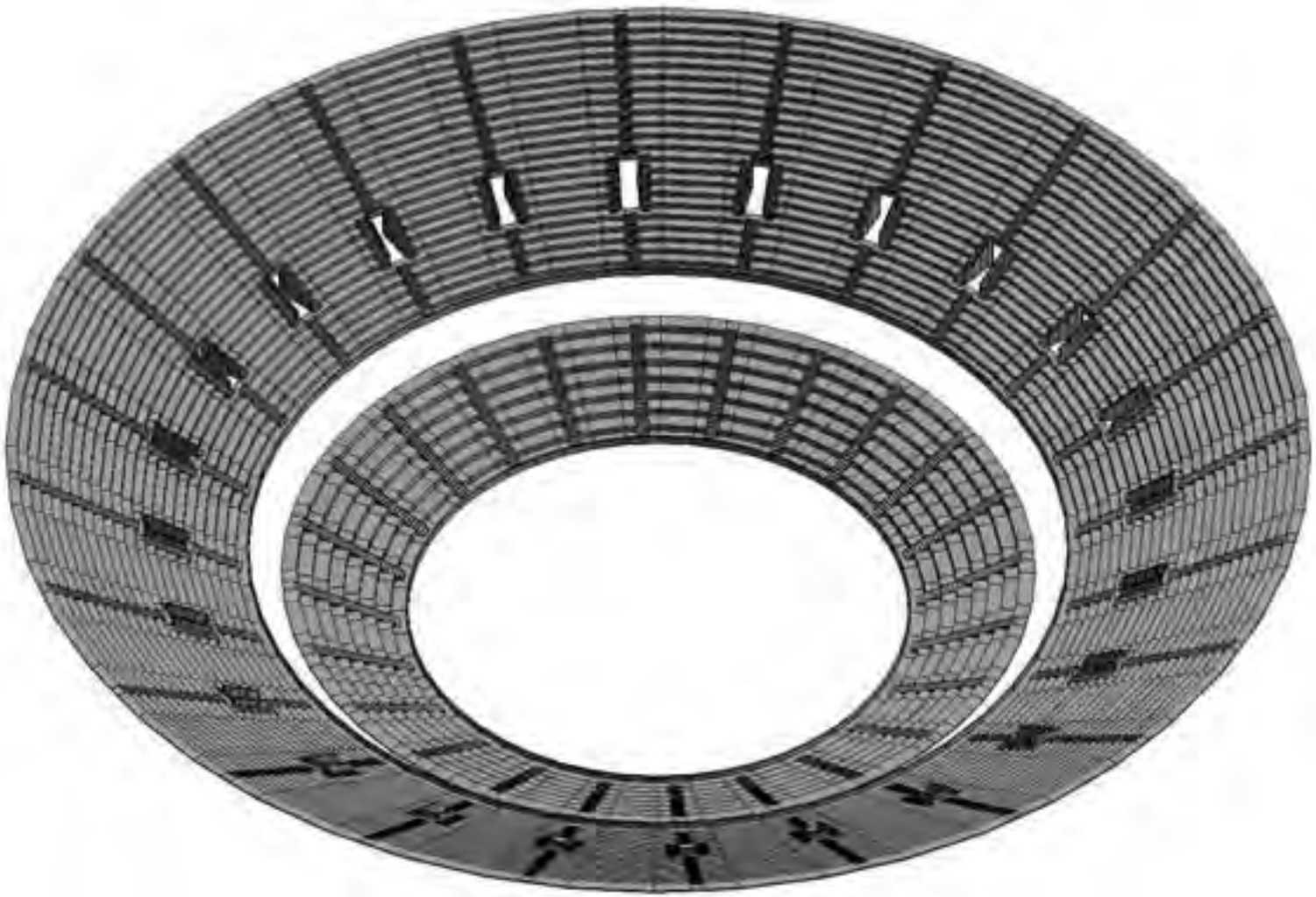
1. Rhino model from Architect
2. Generate structural wireframe and BIM data
3. Structural analysis and design
4. Clash detection
5. Documentation

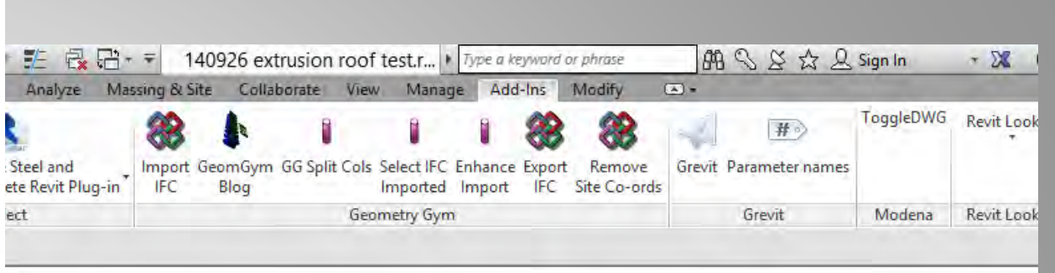



Grasshopper
Revit
ARCHITECT'S RHINO MODEL
ENGINEER'S ANALYSIS MODEL
COMPLETED INSTALLATION





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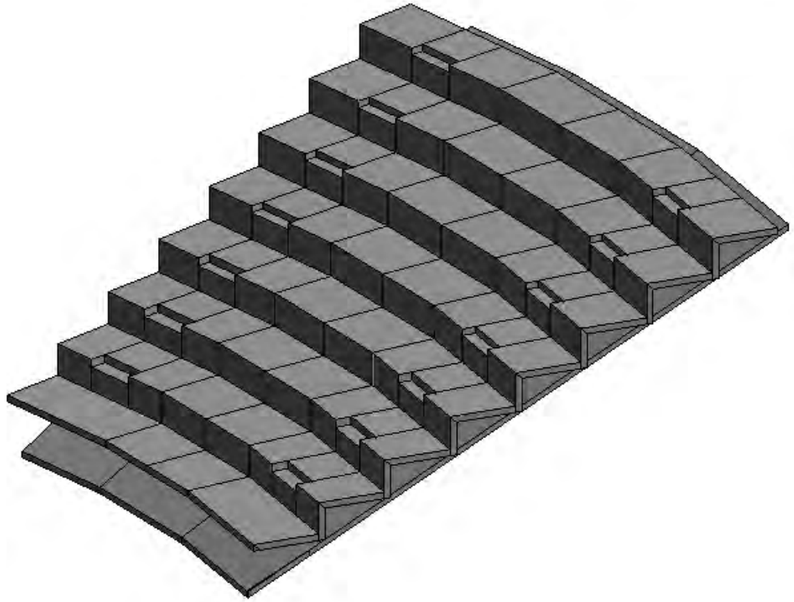

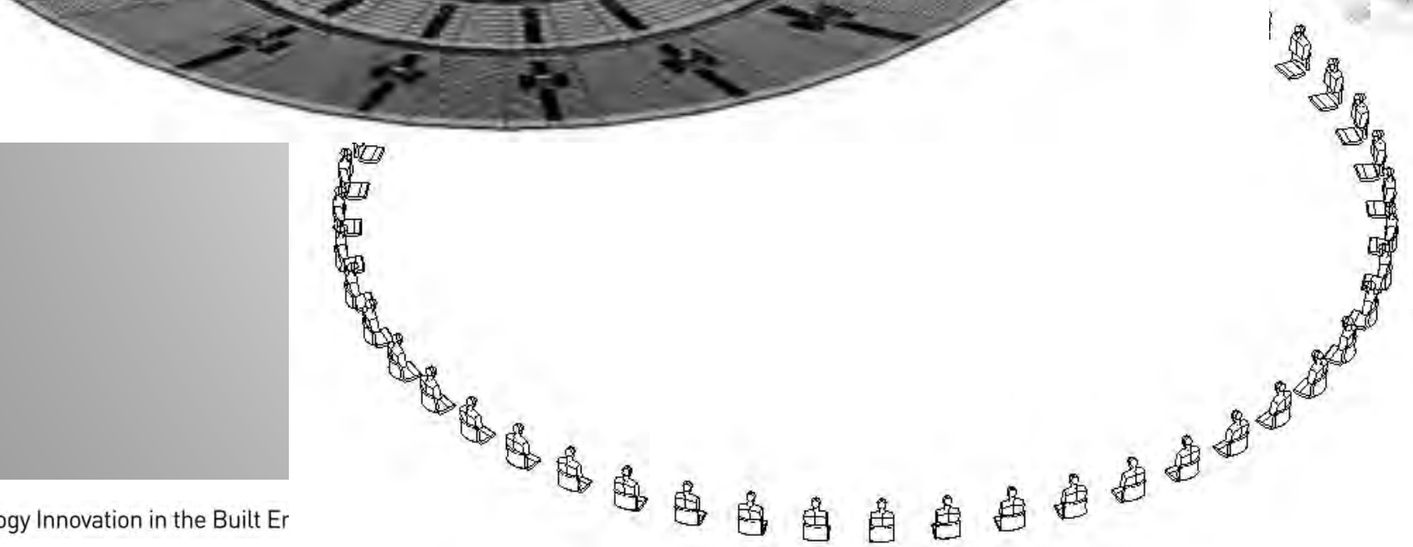

OpenBIM

If using IFC has been frustrating or problematic, nothing is going to change unless users demand their software developers do better.

jonm@geometrygym.com @geometrygym

www.geometrygym.com www.geometrygym.blogspot.com

BrisBIMx

Technology Innovation in the Built Environment