ES17657-L: Integrating Structural Design, Analysis, and Detailing: Advance Steel and Robot

Aaron Vorwerk, AIA, EIT, LEED AP BD+C
Sr. Technical Sales Specialist, AEC, Autodesk
@AaronVorwerk

Stephen Bessette
Technical Sales Support, MEP & Fabrication, Autodesk

Class summary

- In this hands-on lab, we will explore the new interoperability between Advance Steel 2017 software and Robot Structural Analysis Professional 2017 software. We will begin by exploring a simple structural model in Advance Steel software. We will push that model into Robot Structural Analysis Professional software and perform a basic analysis and code group-based design. Once the design is correct, we will update the Advance Steel model geometry from Robot Structural Analysis Professional and continue the steel-detailing process.

Key learning objectives

At the end of this class, you will be able to:

- Create and manipulate model geometry in **Advance Steel**
- Send **Advance Steel** models to **Robot Structural Analysis Pro (RSA)** and back for analysis
- Perform code group-based design in **Robot Structural Analysis Pro**
- Add connections, number parts, and generate drawings in **Advance Steel**

Today's Agenda

Integrating Structural Design, Analysis, & Detailing

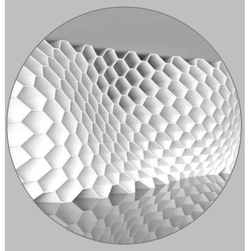
- **Tools and Workflows**
  - What, Where, and Why
- **Advance Steel**
  - E1: Modeling in Advance Steel
- **Robot Structural Analysis Pro (RSA)**
  - Key Features
  - E2: Analyzing the Model
- **Advance Steel**
  - E3: Detailing the Model

Tools by Phase

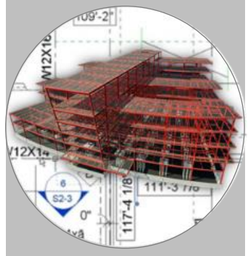
The Autodesk Structural Toolbox

Design

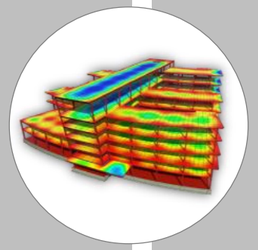
Conceptual Design



Structural Design



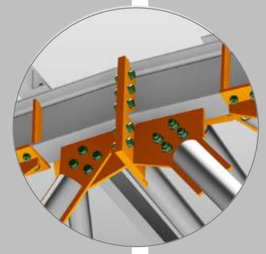
Coordination, Simulation



Code Checking

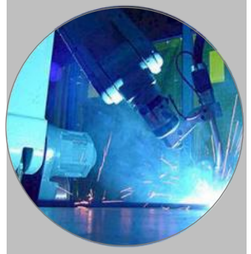
Fabrication

Fabrication Model



Shop Drawings

Prefabrication and Production



Construction

Installation

Structural Analysis for Revit

Robot Structural Analysis Professional

Dynamo

Partner Add-ins, e.g. SOFiSTiK

Revit

Advance Steel

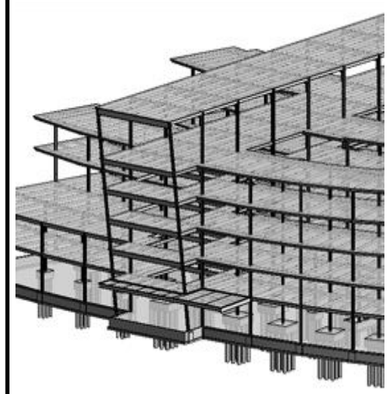
BIM 360 Team, BIM 360 Docs, Navisworks, BIM 360 Glue

BIM 360 Field, BIM 360 Plan

Steel Design and Detailing Workflow

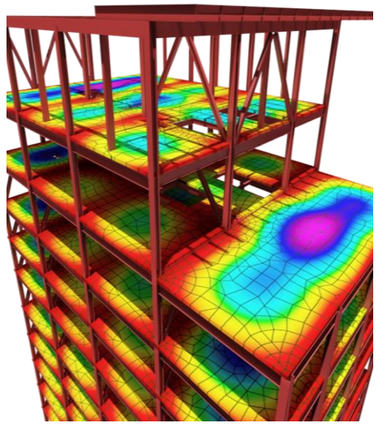
Autodesk Revit, Robot, and Advance Steel

Construct Model



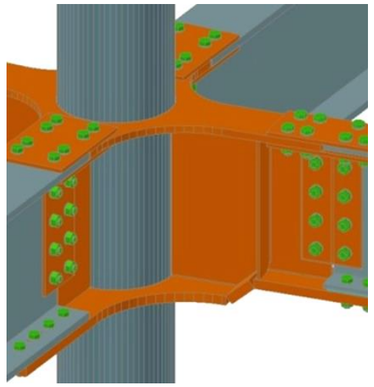
Advance Steel, Revit

Perform Analysis



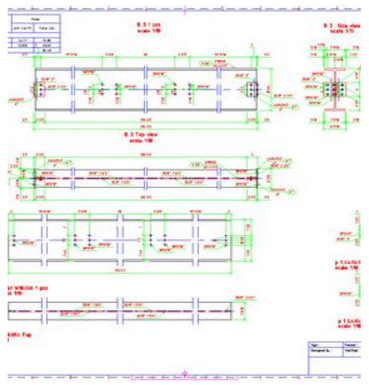
Robot Structural Analysis Pro

Detail Steel Connections



Advance Steel, Revit

Generate Shop Drawings

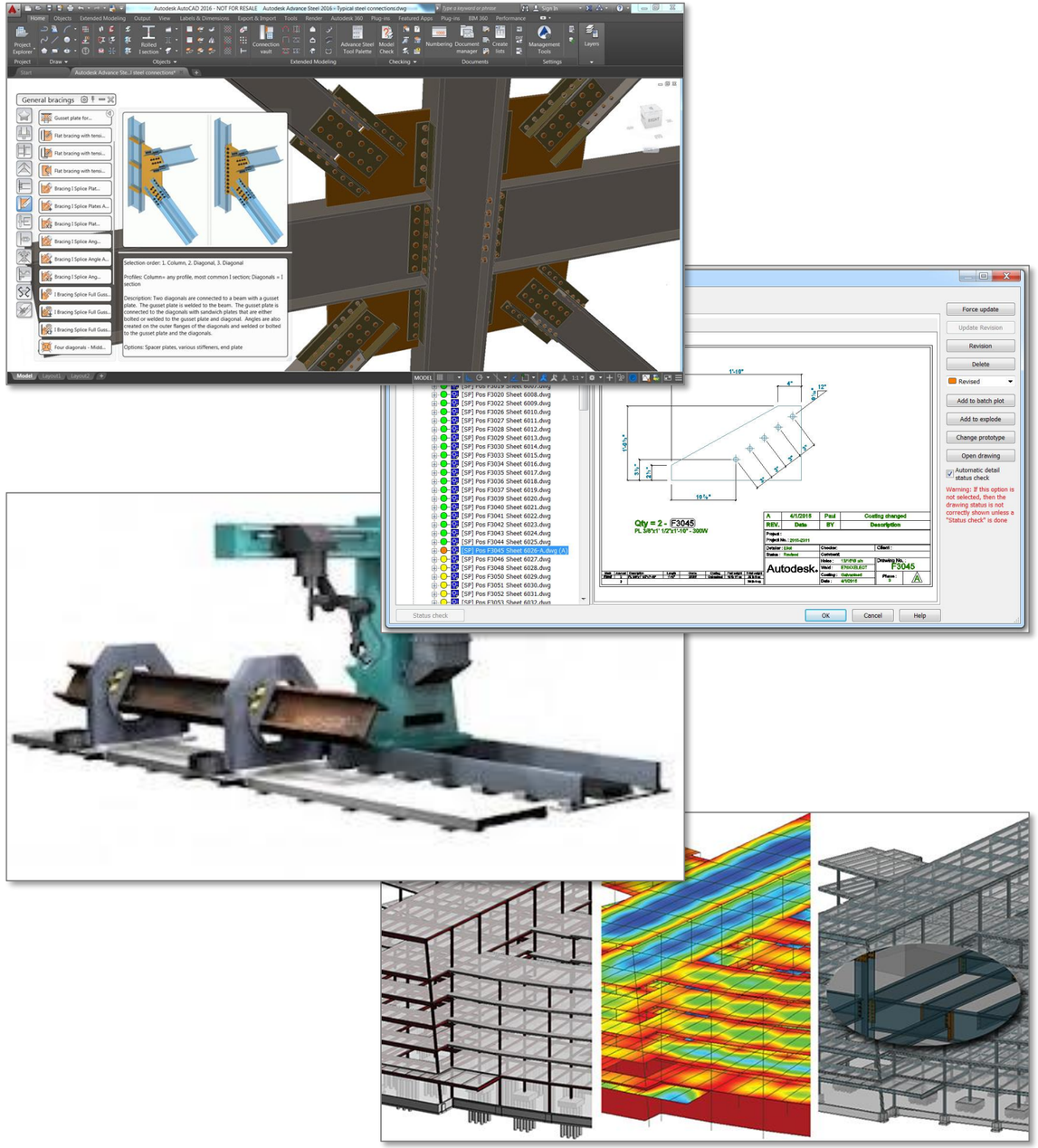


Advance Steel

Autodesk Advance Steel 2017

Key features
Advance Steel 2017

- Smooth workflow from design to fabrication
- Based on the familiar AutoCAD® technology
- Minimize errors and omissions with deliverables
- Direct interface with CNC machines
- Integration with other Autodesk design and analysis software

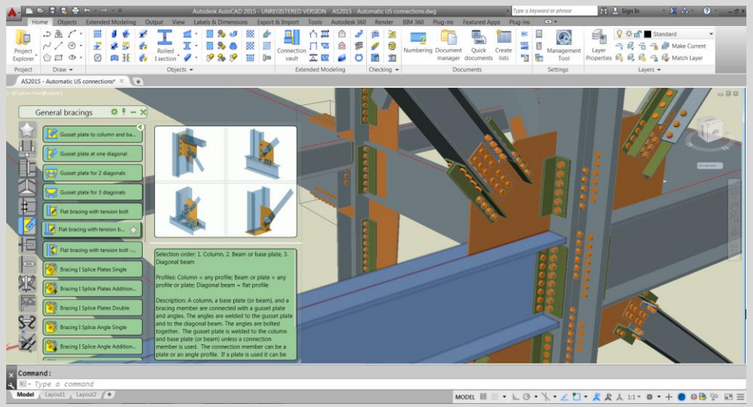


Tools for automating the 3D modeling phase

Advance Steel 2017

Steel Connection Design Engine

Comprehensive library of parametric steel connections; tools to create your own connections; built-in steel connection design engine



Miscellaneous Steel: Stairs, Railings, Cage Ladders

Macros for stairs, railings and cage ladders; large library of stair tread types

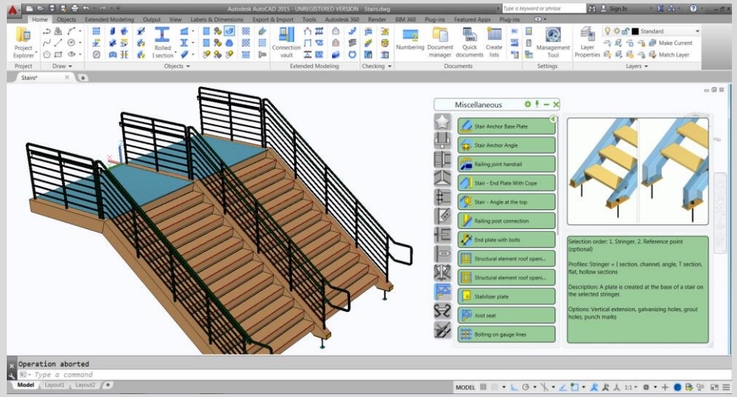
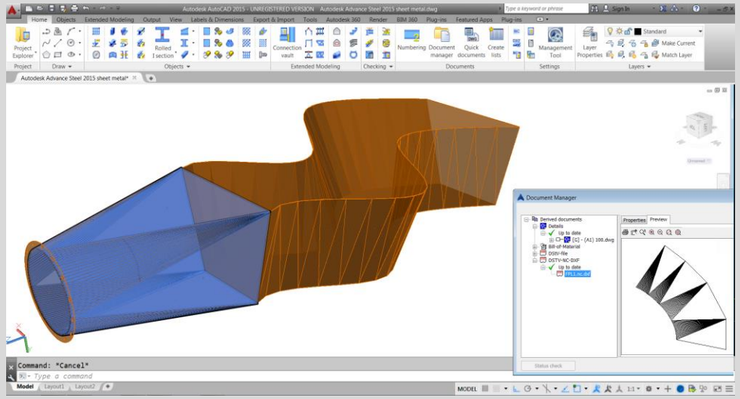


Plate Works: Folded Plates, Transitions, Unfolding

Folded plates of any shape; transitions such as round-square; automatic unfolding

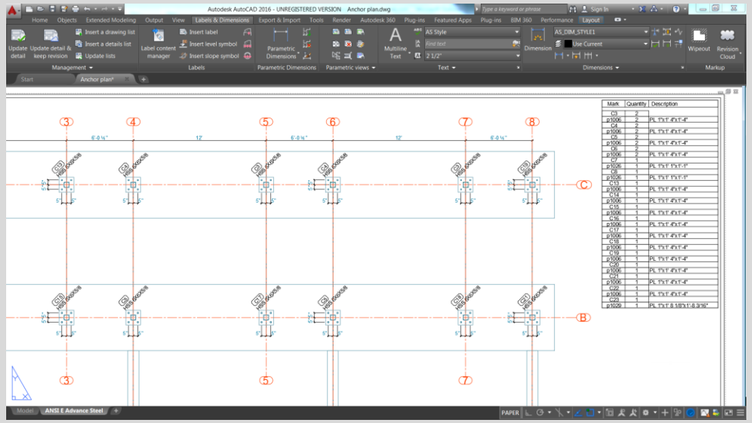


Tools to meet project documentation needs

Advance Steel 2017

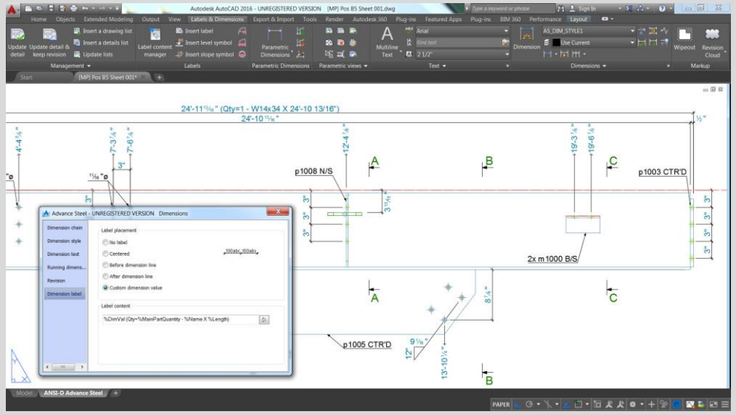
General Arrangement Drawings: Templates and Automation

Ready-to-use templates for elevation view, top view, anchor plan, isometric view; automatically labeled & dimensioned



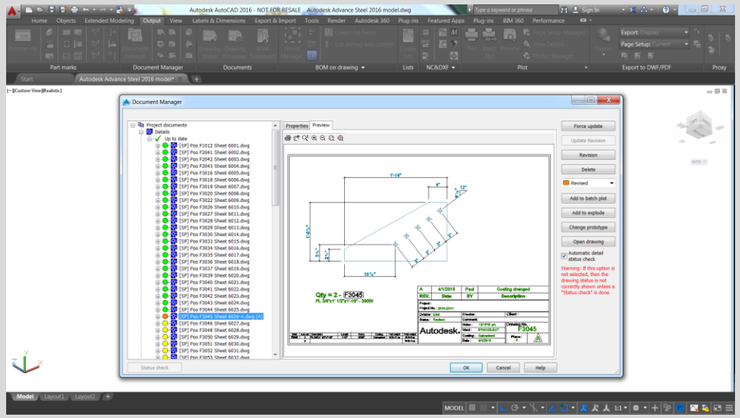
Fabrication Deliverables: Shop Drawings, BOMs, CNC Data

Single part and assembly drawings; bills of materials (BOMs); DSTV & DXF & KISS files



Document Manager: Automatic Updates, Revisions, Approvals

Automatic update of drawings, BOMs and CN data; revision clouds on drawings; drawing approval-based workflow



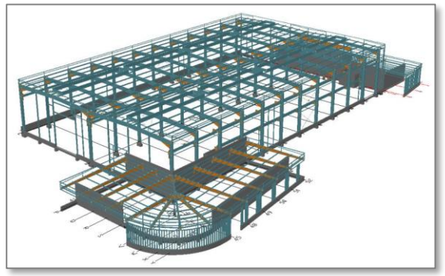
New and enhanced features

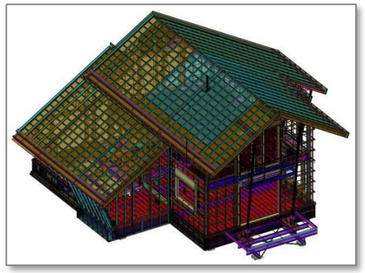
Advance Steel 2017 and 2017.1

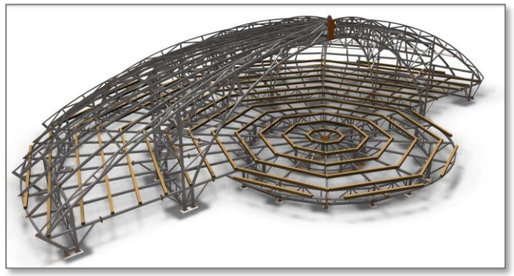
- Bridging connection for cold rolled elements
- Beam offset information in labels
- Structural member representation
- Custom clipping symbols
- Snap points on anchors
- Grid balloon placement control
- New templates for lists on drawings
- User-defined formulas in BOMs
- Enhancements to the BOM editor
- Enhanced drawing styles for the US market
- View native drawings in AutoCAD®
- IFC export enhancements

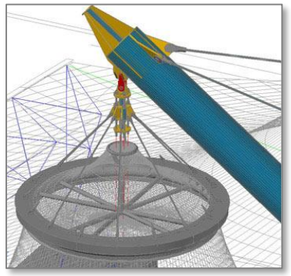
- Advance Steel 2017 Extension for Revit®
- Autodesk® Steel Connections for Revit®
- Dynamo Extension for Advance Steel
- Code checking steel connections with latest AISC codes
- Connection libraries with DASt values
- Simplified way to create drawings
- Background mask behind dimension & label texts
- Special parts visibility on drawings
- IFC 2x3 export enhancements
- Model information exported to FabTrol Pro
- Higher precision for angle values in NC-file

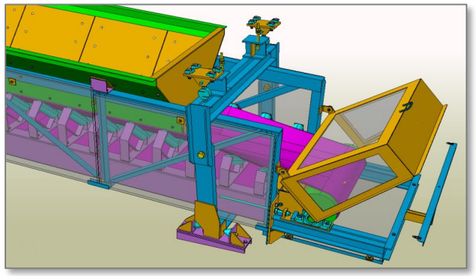
Customer Projects

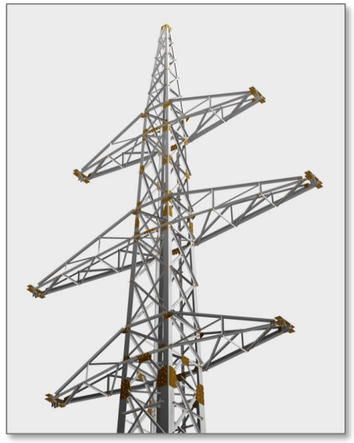


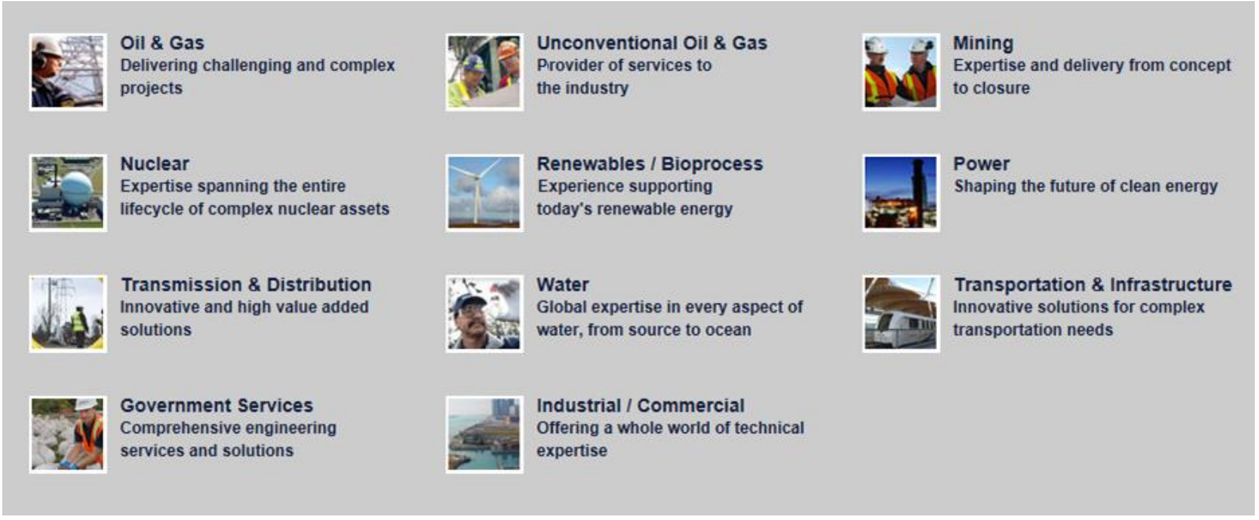












Oil & Gas
Delivering challenging and complex projects

Unconventional Oil & Gas
Provider of services to the industry

Mining
Expertise and delivery from concept to closure

Nuclear
Expertise spanning the entire lifecycle of complex nuclear assets

Renewables / Bioprocess
Experience supporting today's renewable energy

Power
Shaping the future of clean energy

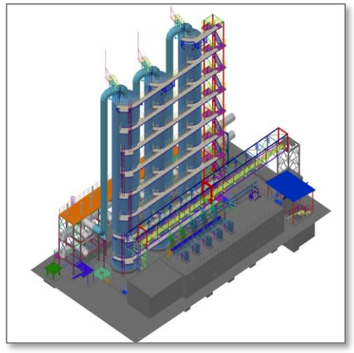
Transmission & Distribution
Innovative and high value added solutions

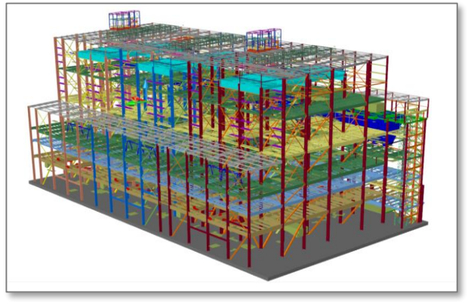
Water
Global expertise in every aspect of water, from source to ocean

Transportation & Infrastructure
Innovative solutions for complex transportation needs

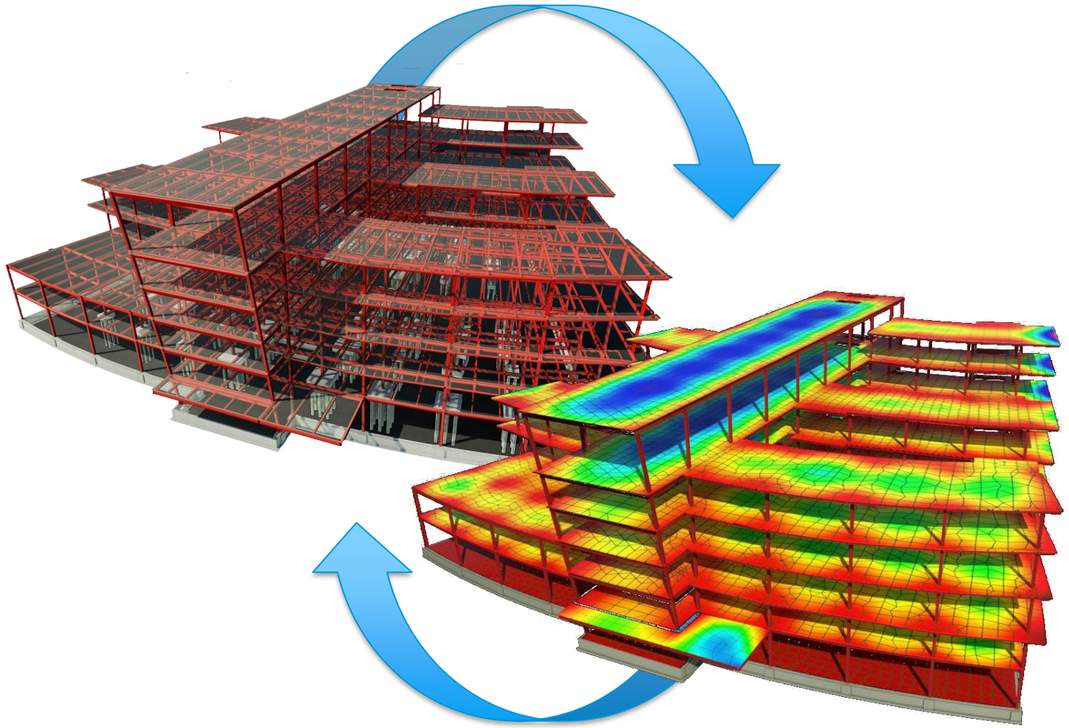
Government Services
Comprehensive engineering services and solutions

Industrial / Commercial
Offering a whole world of technical expertise





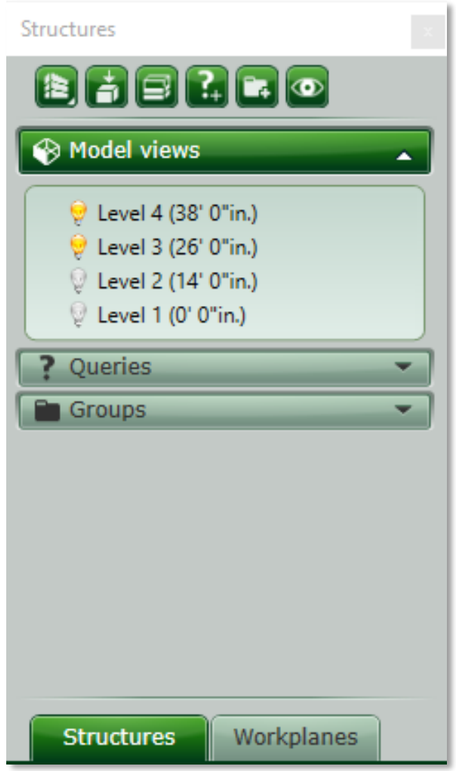
Ex 1: Modeling

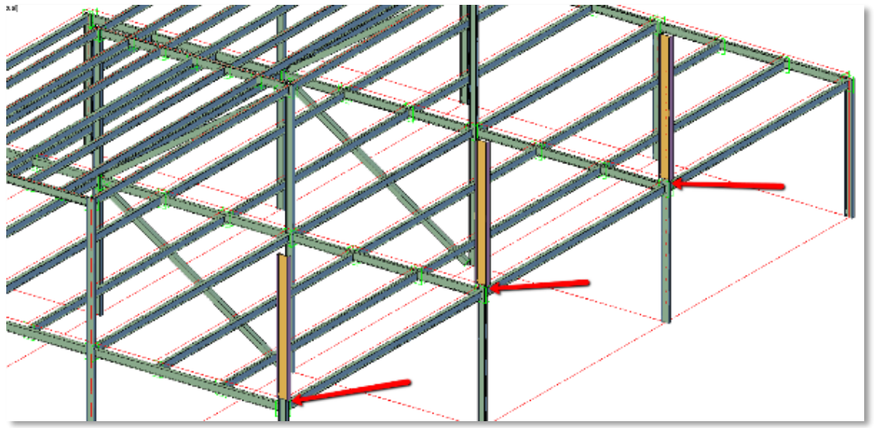


Exercise 1

Modeling Beams and Columns

1. Start Advance Steel 2017.
2. Select **File** > **Open**.
3. Choose **01 – AS Model 1.dwg**.
4. In the **Home** ribbon, choose **Project** > **Project Explorer**.
5. In the Project Explorer, turn off **Level 1**, **Level 2**.
6. In the **Home** ribbon, select **Objects** > **Column** and create 3 columns.

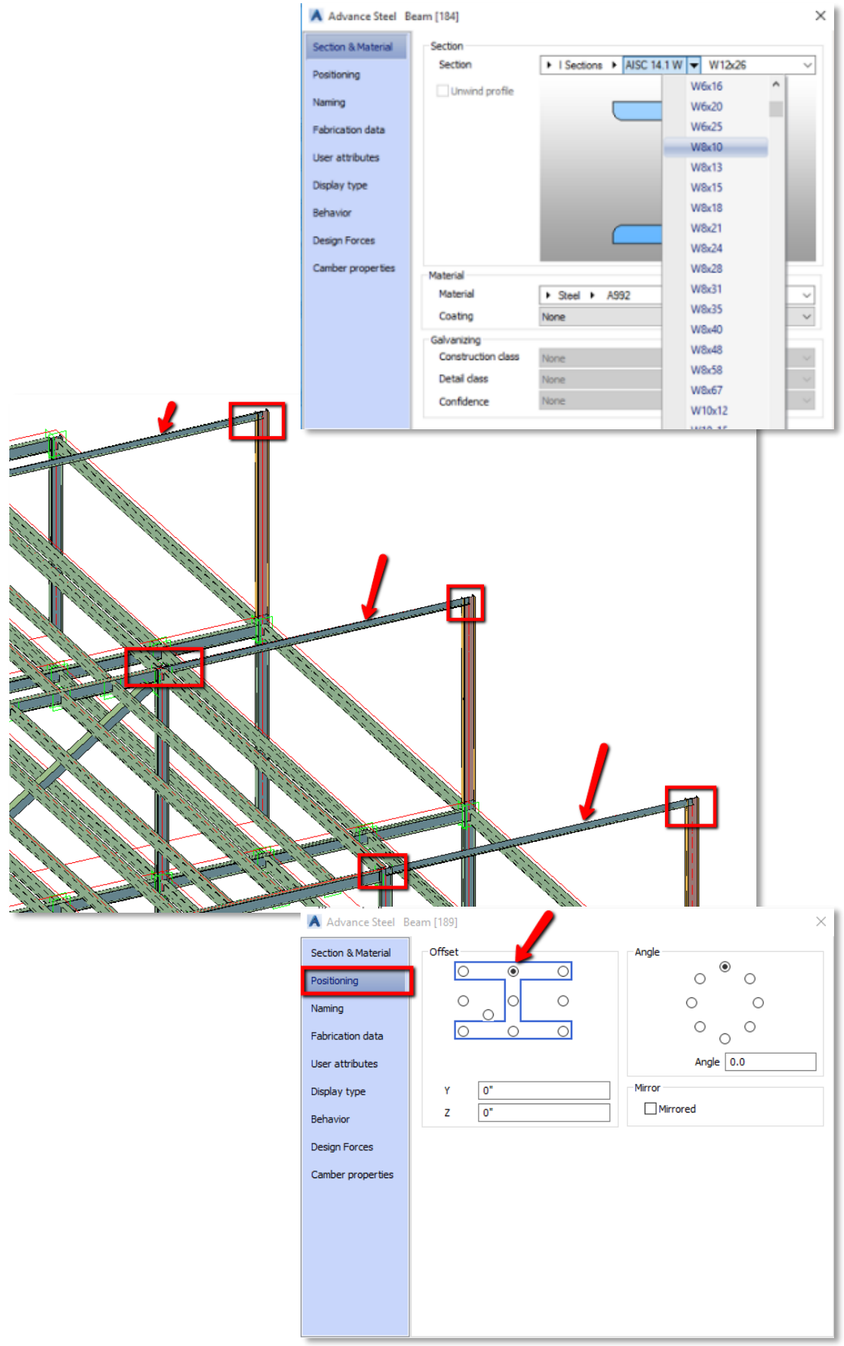




Exercise 1

Modeling Beams and Columns

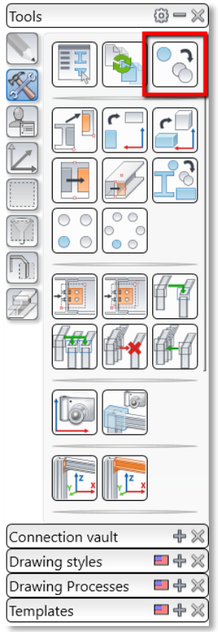
7. In the **Advance Properties** dialog box, change the column size to **W8x10**.
8. In the **Home** ribbon, select **Objects** > **Rolled I section** to draw the main beams. Connect these from node to node at the top of the columns.
9. In the **Advance Properties** dialog box, change the beam positioning to **top flange**.
10. In the **Home** ribbon, select **Project** > **Project Explorer** and turn off **Level 3**.

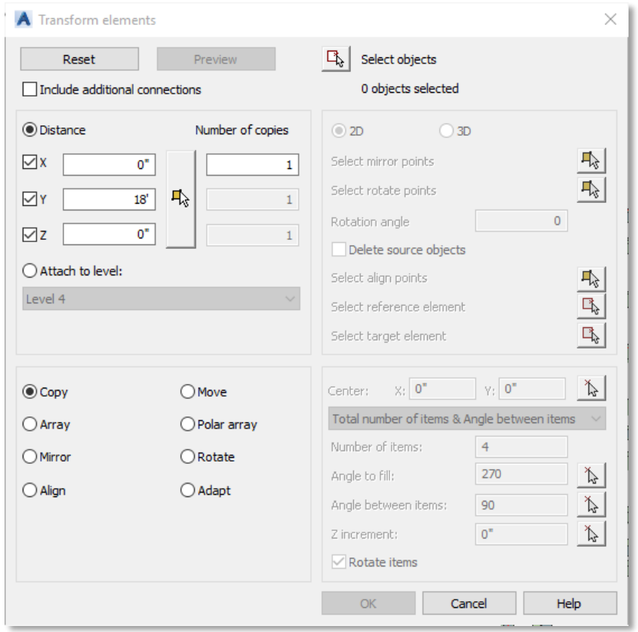


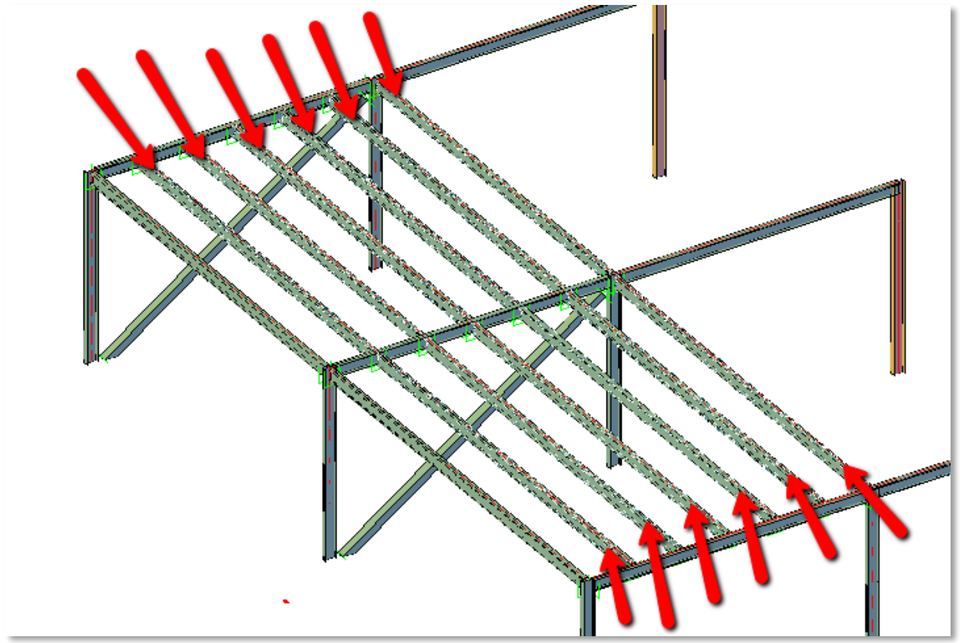
Exercise 1

Modeling Beams and Columns

11. In the **Advance Steel Tool Palette** > **Tools** Menu > select **Advance Copy**.
12. In the **Transform Elements** dialog box, enter **18’** for the **Y** component and click **Select Objects**.
13. Select the existing beams (see image).

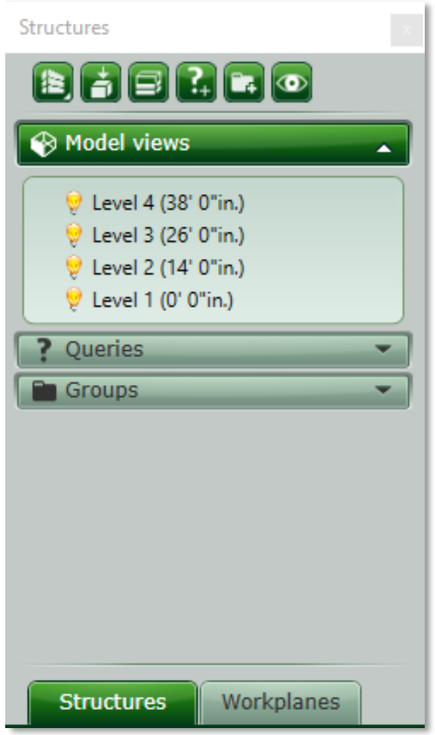


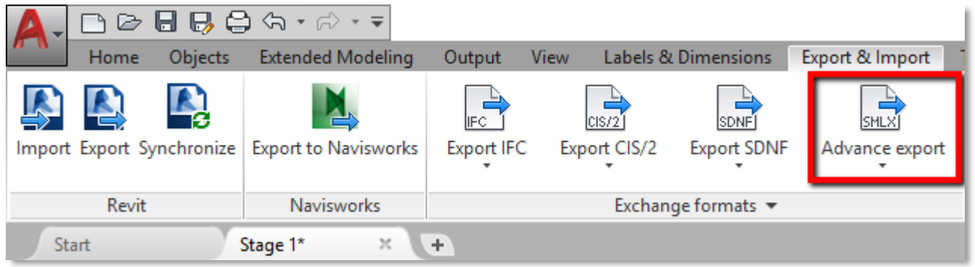




Exercise 1
Modeling Beams and Columns

14. In the **Home** ribbon, select **Project** > **Project Explorer** and turn on all of the levels.
15. Save the Model.
16. In the **Export & Import** ribbon, select **Exchange Formats** > **Advance Export** to export the model to the .SMLX file format (**01 – AS Model 1.smlx**).





Autodesk Robot Structural Analysis Pro 2017

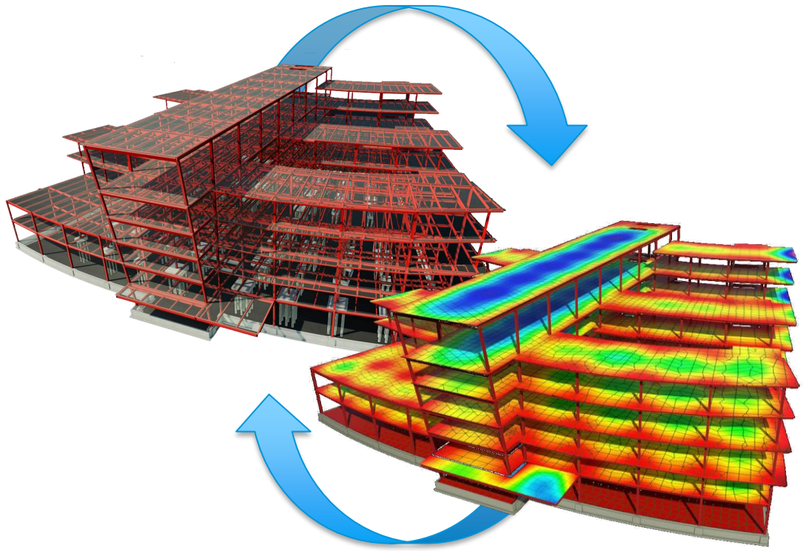
(aka Robot, RSA)

Top features

Robot Structural Analysis Professional 2017

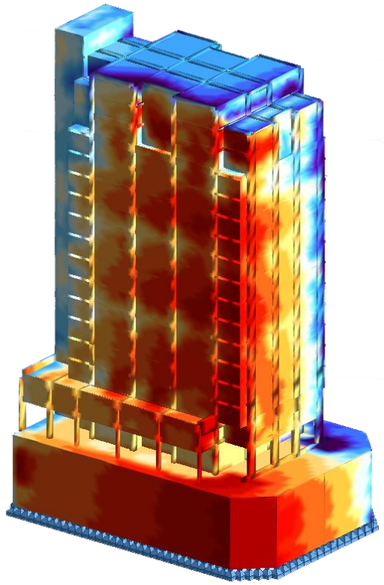
Collaboration

- Supports efficient BIM workflows
- Interoperability with Advance Steel, Revit, etc.



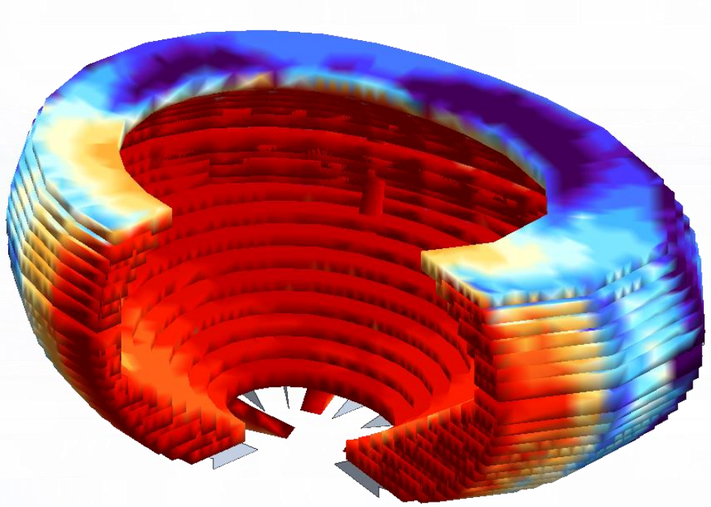
Speed

- Auto-meshing (FEA)
- Robust nonlinear and dynamic algorithms
- Over 70 design codes



Versatility

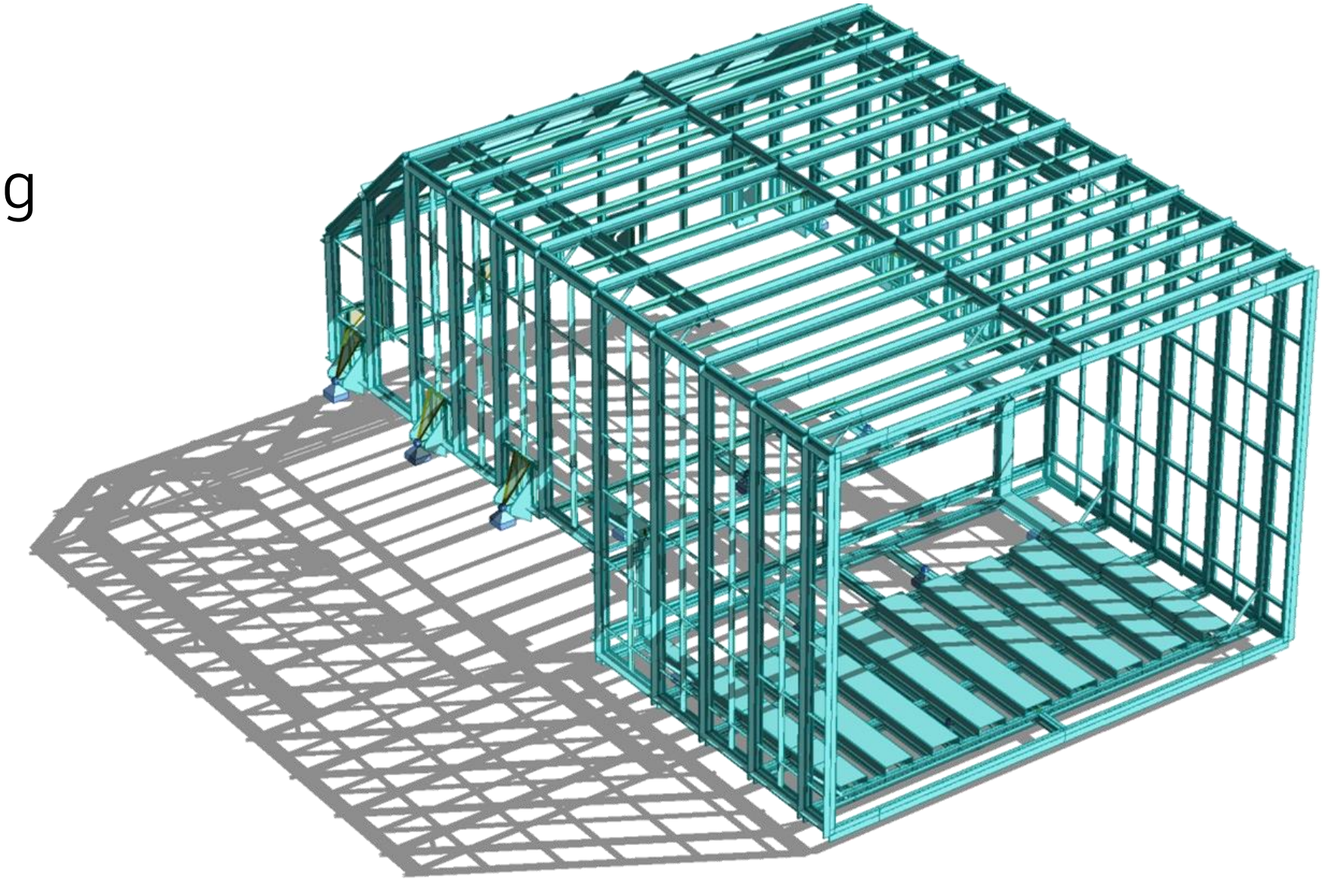
- Flexible, open API
- Covers a broad range of structures
- Localized for global markets



Typical customers

Robot Structural Analysis Professional 2017

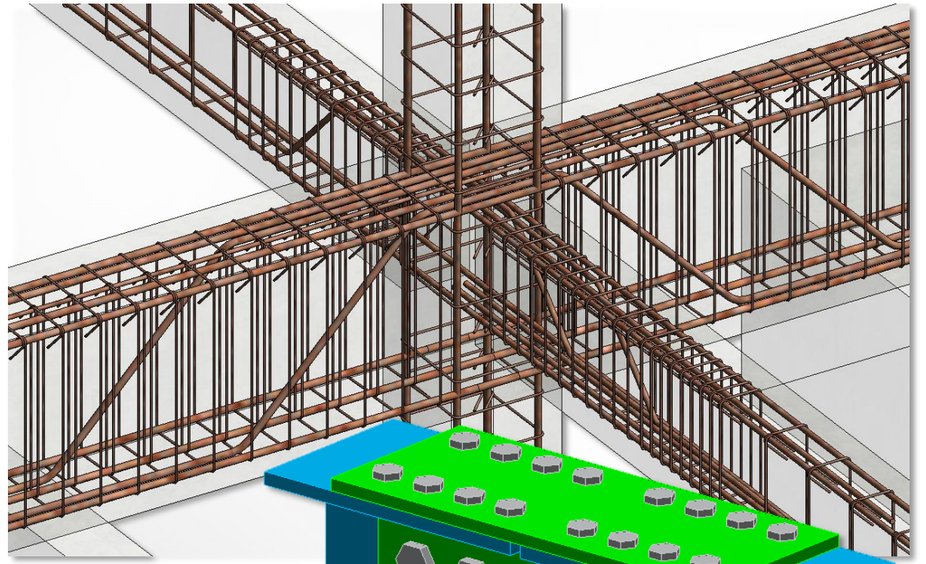
- **Spans multiple industries**
  - Structural Engineers
  - Multidisciplinary Engineering Teams
  - Building Product Manufacturers and Fabricators
  - Large Industrial Machinery Providers
  - Oil and Gas / Mining Firms

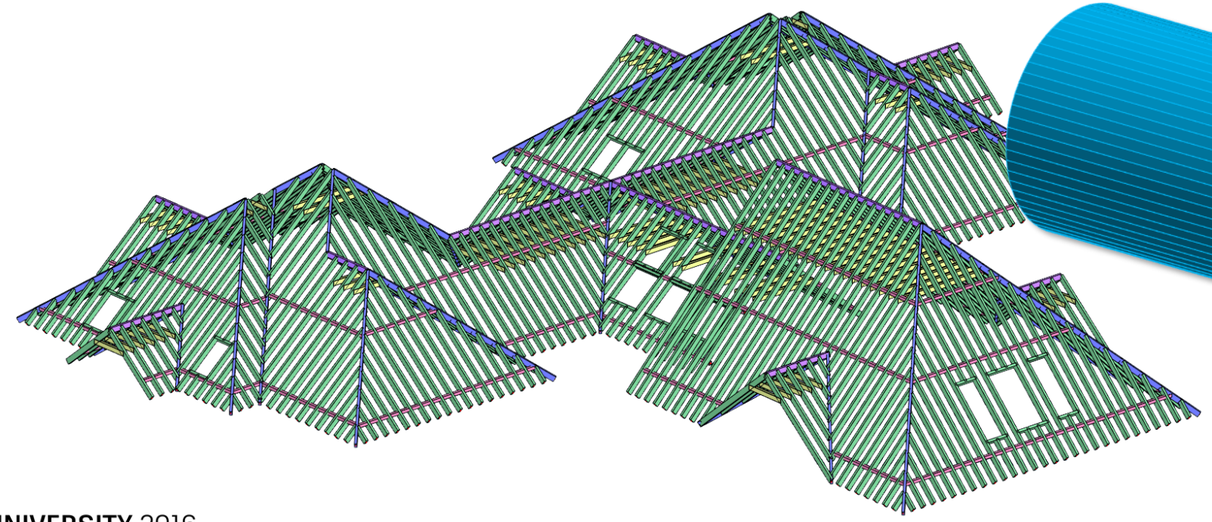


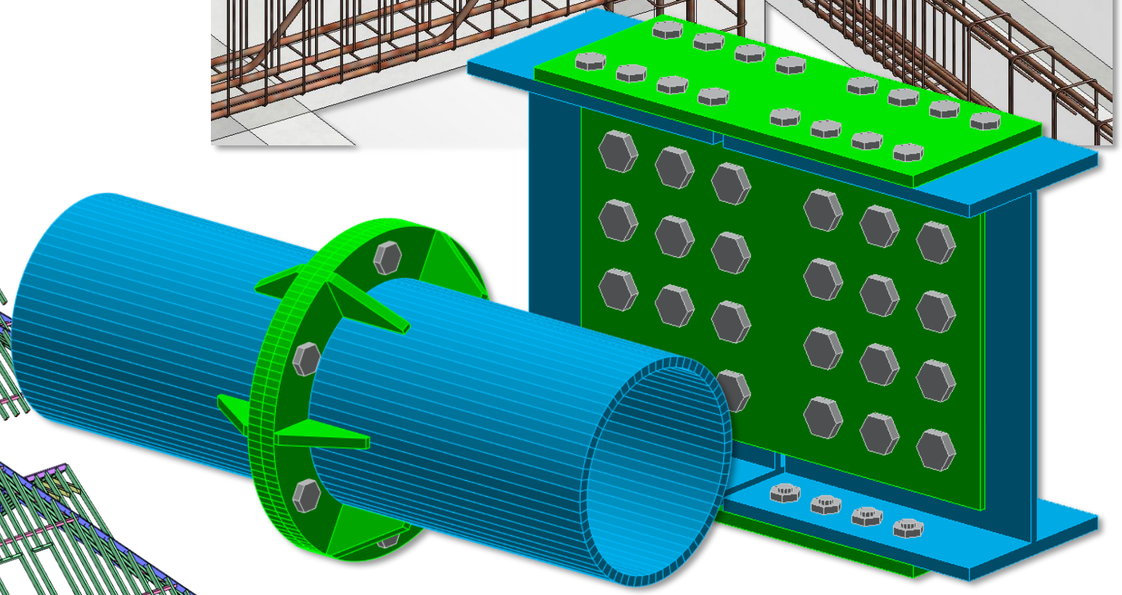
Analysis of concrete, steel, and timber designs

Robot Structural Analysis Professional 2017

- **Design versatility**
  - Reinforced concrete design module
  - Steel design module
  - Timber design module



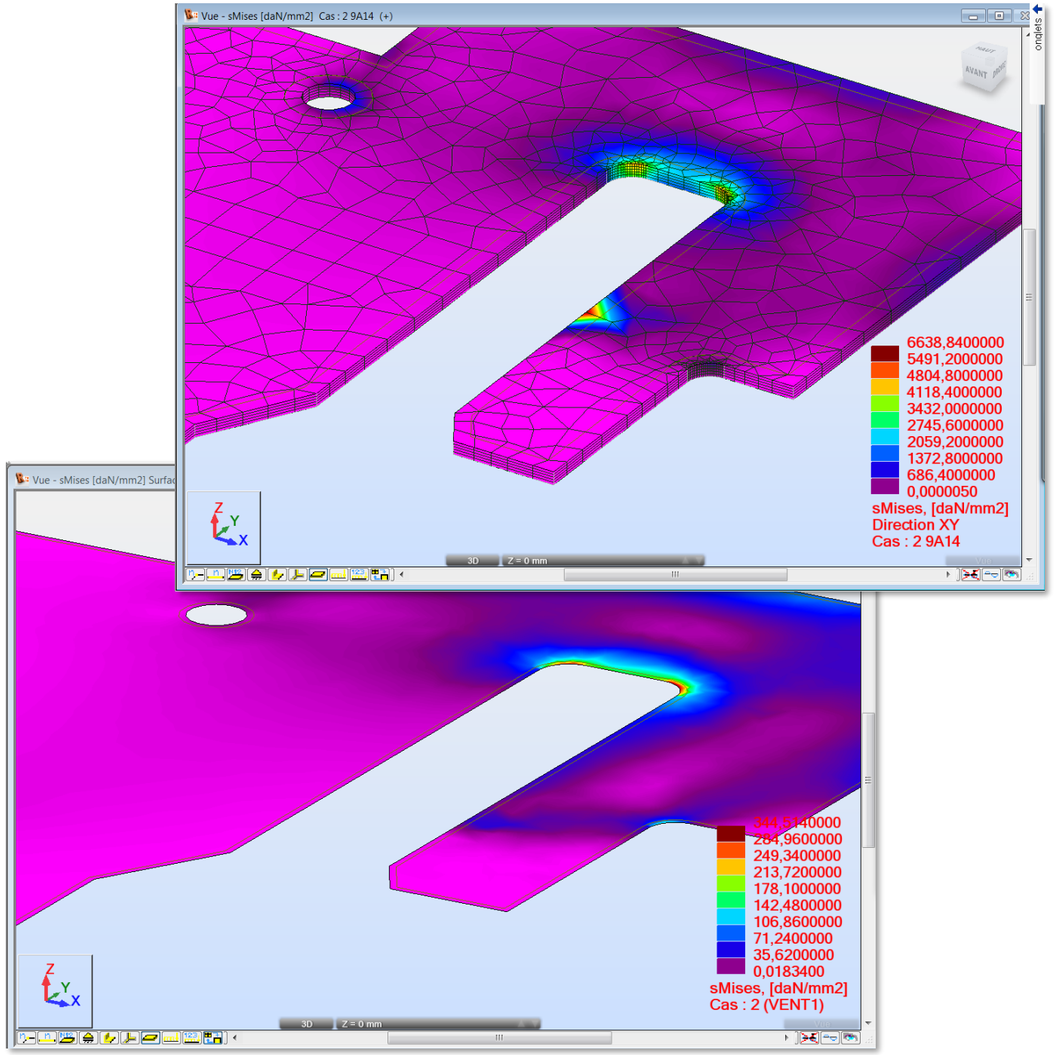




Modeling flexibility

Robot Structural Analysis Professional 2017

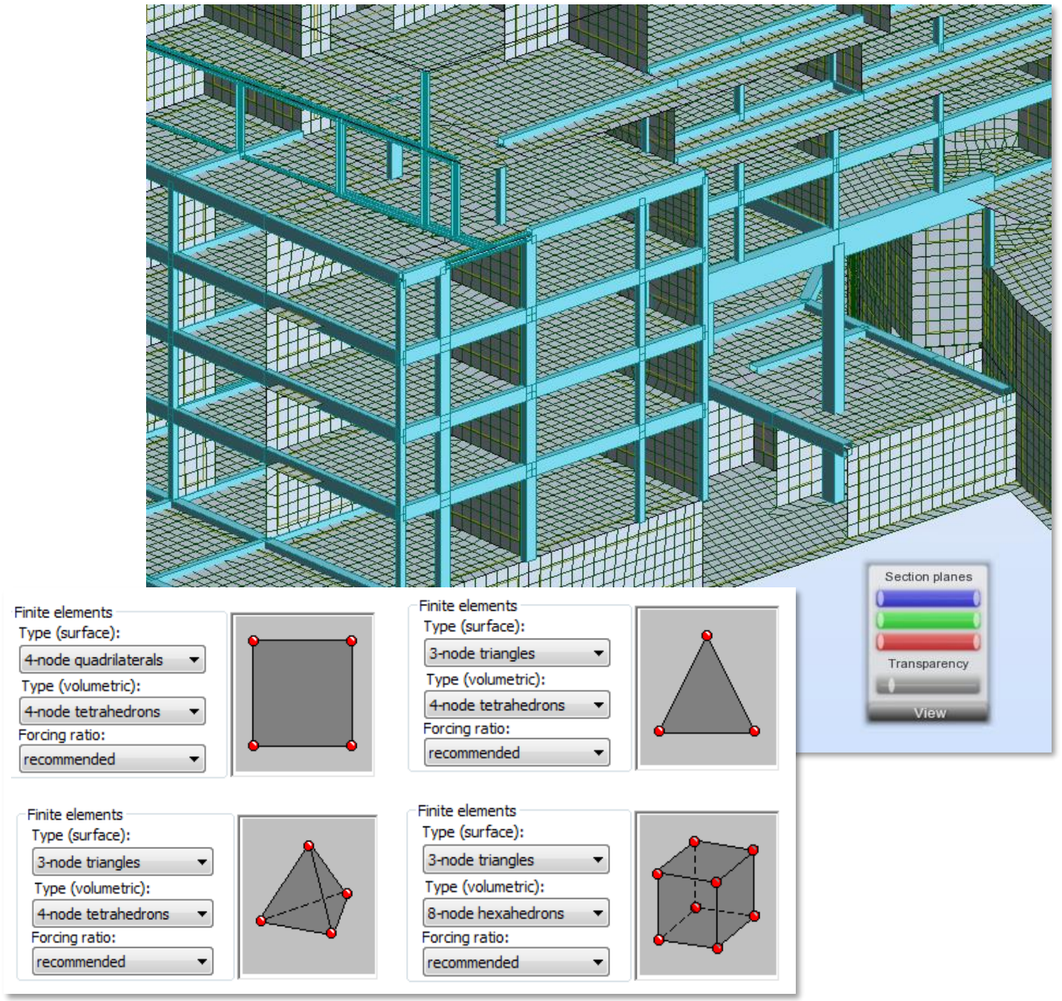
- **Shells, solids, and more**
  - 2D and 3D frames and trusses
  - Plates
  - Shells
  - Grillages
  - Plane stress structures
  - Plane deformation structures
  - Axisymmetric structures
  - Volumetric structures
  - Composite beams



Advanced analytical capabilities

Robot Structural Analysis Professional 2017

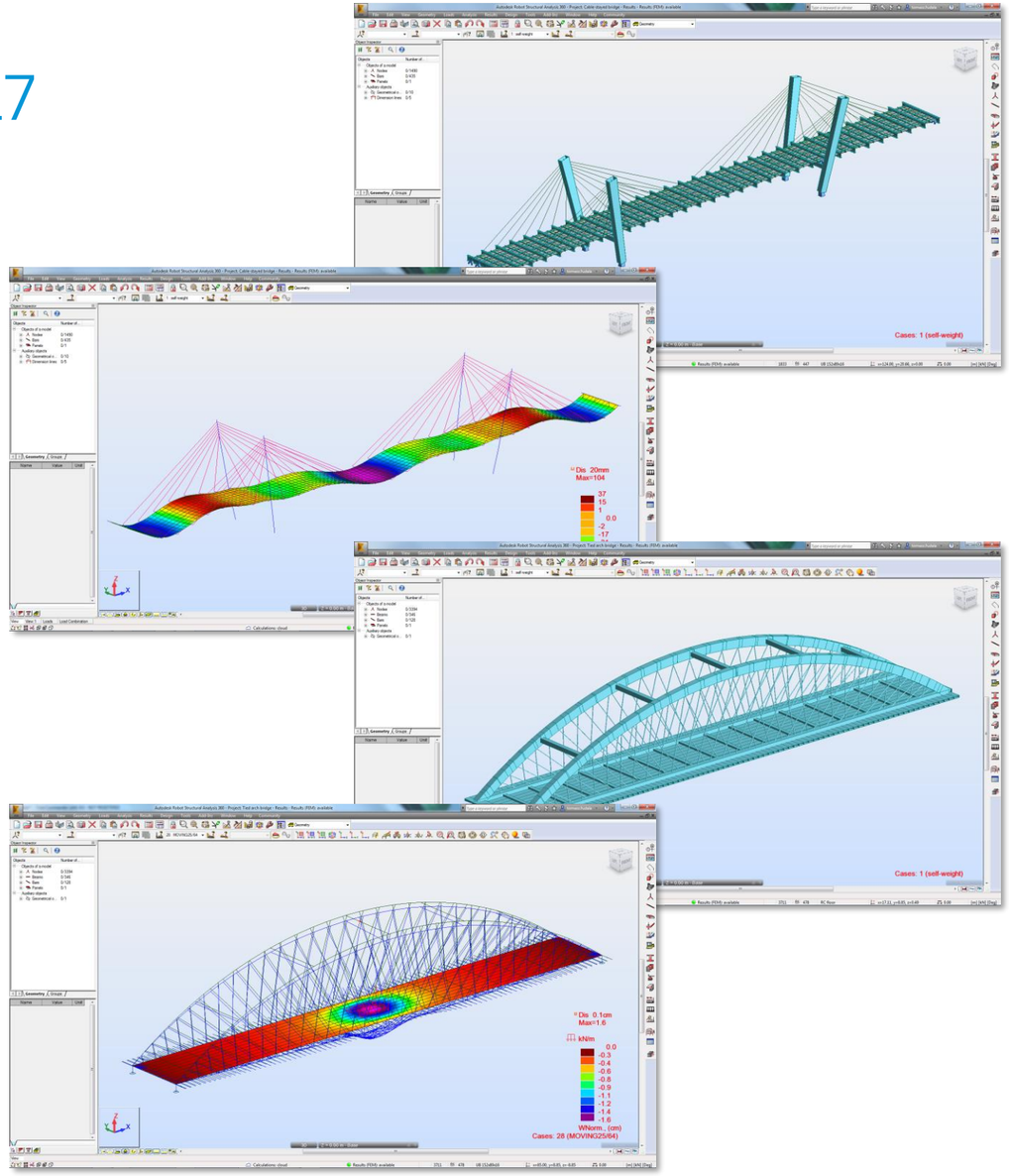
- **Flexibility to meet your needs**
  - Advanced finite element auto-meshing
  - Wide range of analysis capabilities
  - Powerful analysis solvers



Advanced analytical capabilities

Robot Structural Analysis Professional 2017

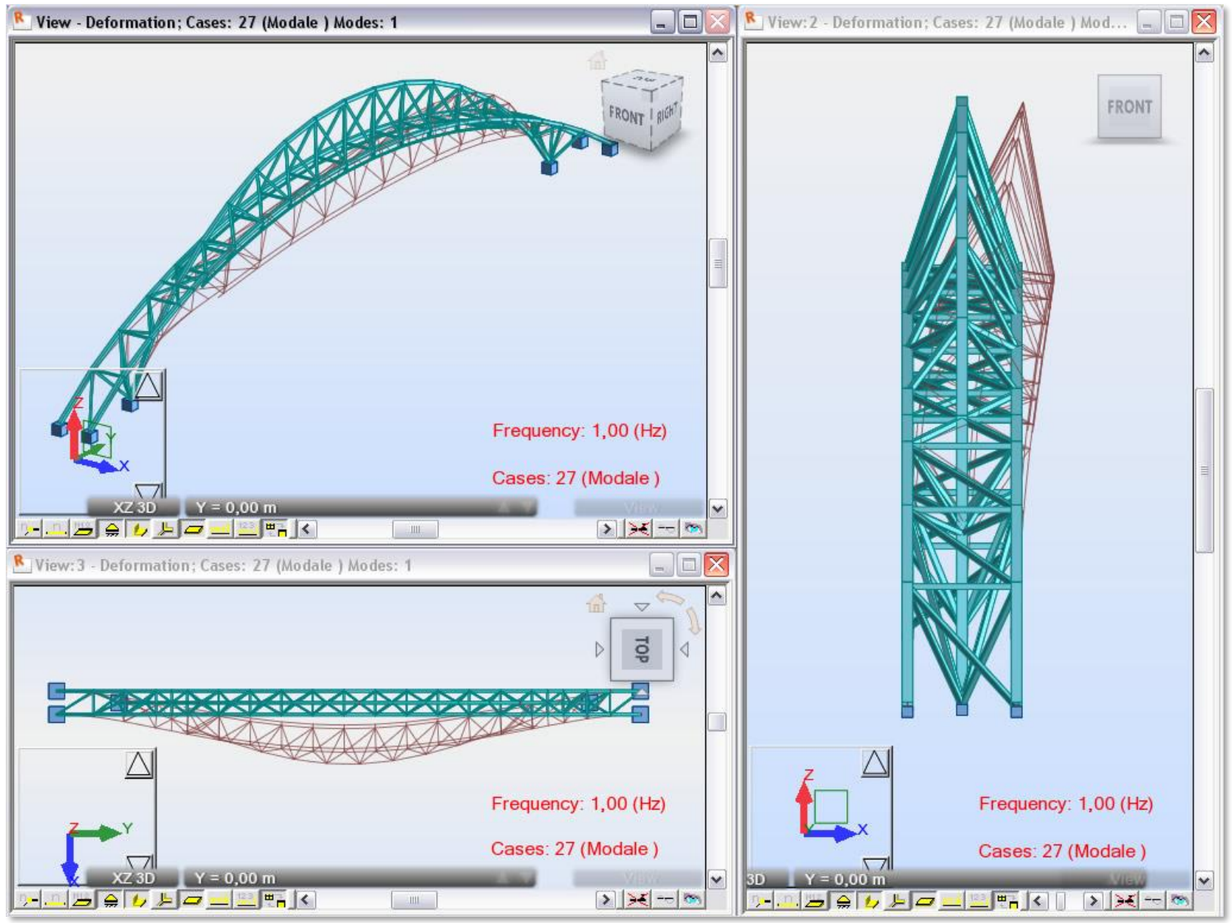
- **Linear and non-linear analysis**
  - Compression / tension elements
  - Cable elements
  - Non-linear constraints
  - Material plasticity
  - Non-linear hinges
  - 2nd-order effects (non-linear)
  - 3rd-order effects (P-delta)



Advanced analytical capabilities

Robot Structural Analysis Professional 2017

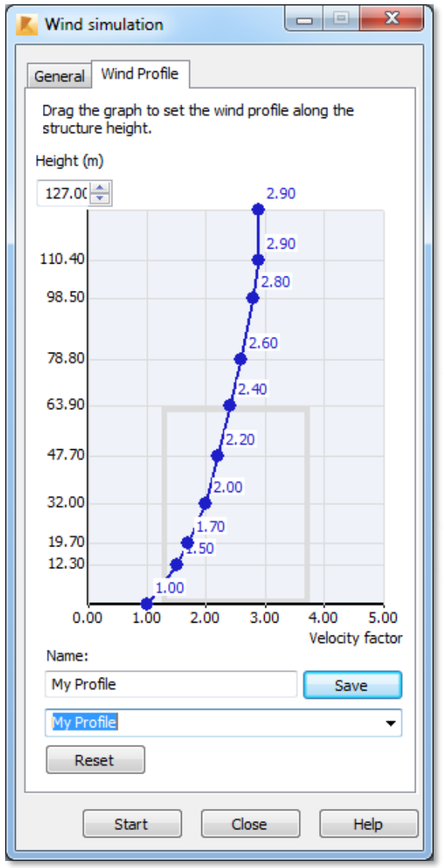
- **Dynamic analysis**
  - Modal
  - Seismic
  - Spectral
  - Harmonic and FRF
  - Time history (linear and non-linear)
  - Elasto-plastic
  - Pushover
  - Footfall

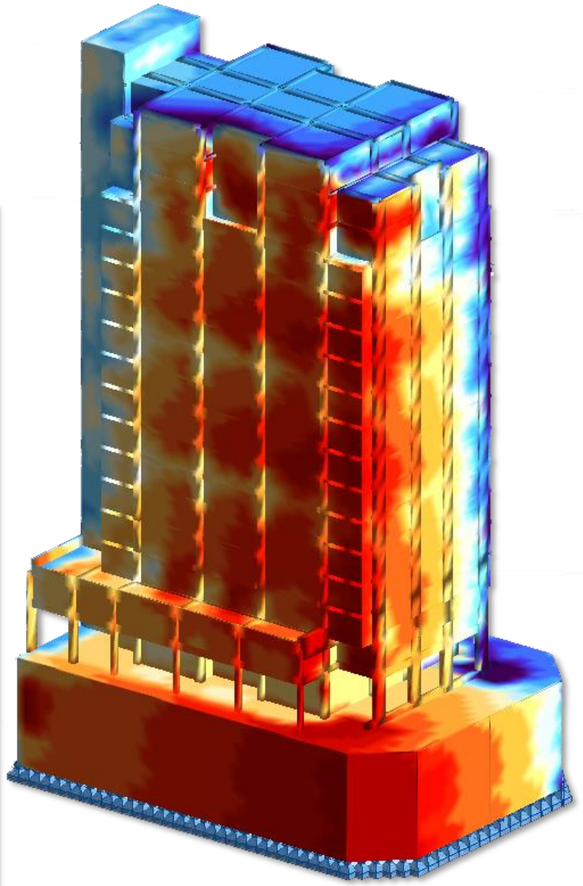


Advanced analytical capabilities

Robot Structural Analysis Professional 2017

- **Wind load simulation**
  - Simulates the wind flow around a structure
  - Generates wind loads on all surfaces automatically
  - Adjustable wind profile and velocity factor
  - Graphic representation of the virtual wind tunnel

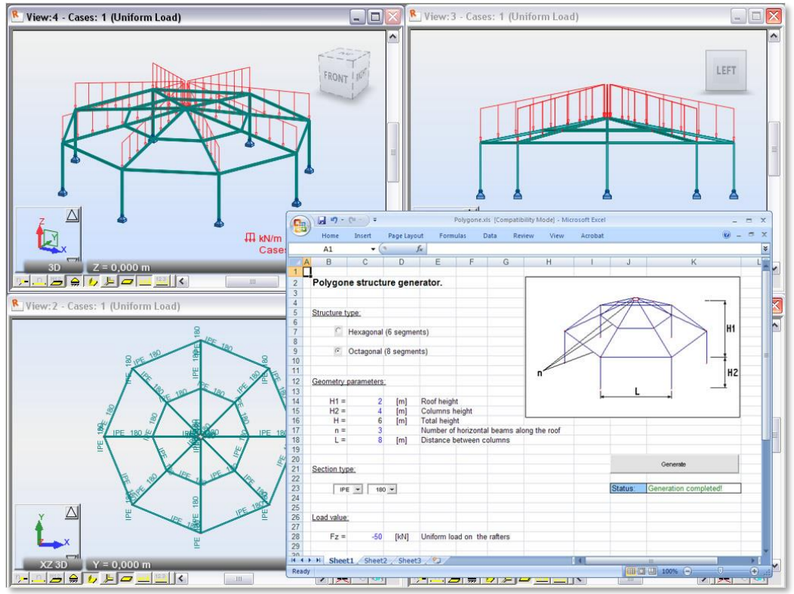


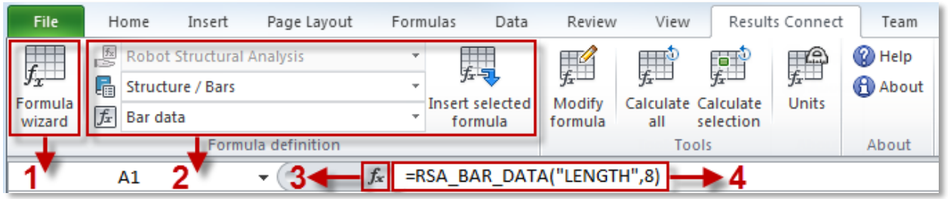


Extensibility

Robot Structural Analysis Professional 2017

- **Open, flexible API**
  - Custom macros creation
  - Extraction of analysis results
  - Parametric structure creation
- **Results Connect**
  - Seamlessly access RSA data and results using Microsoft Excel, even without API knowledge
- **Dynamo**
  - Access the API with powerful visual programming tools





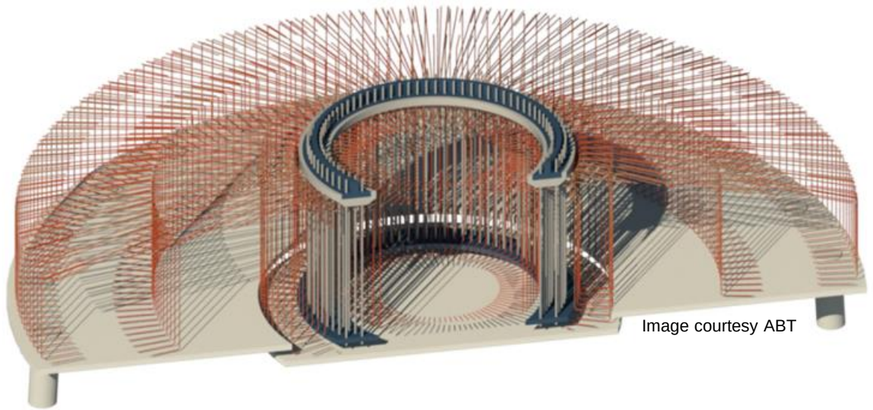
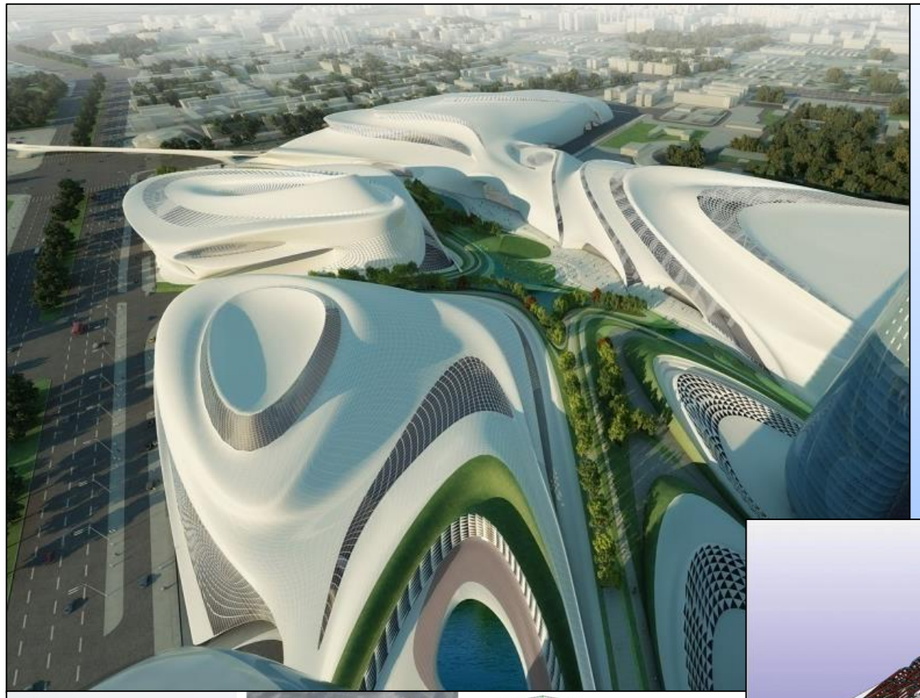
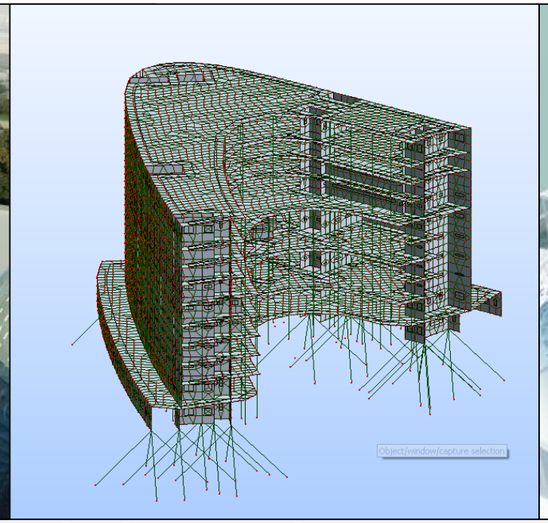


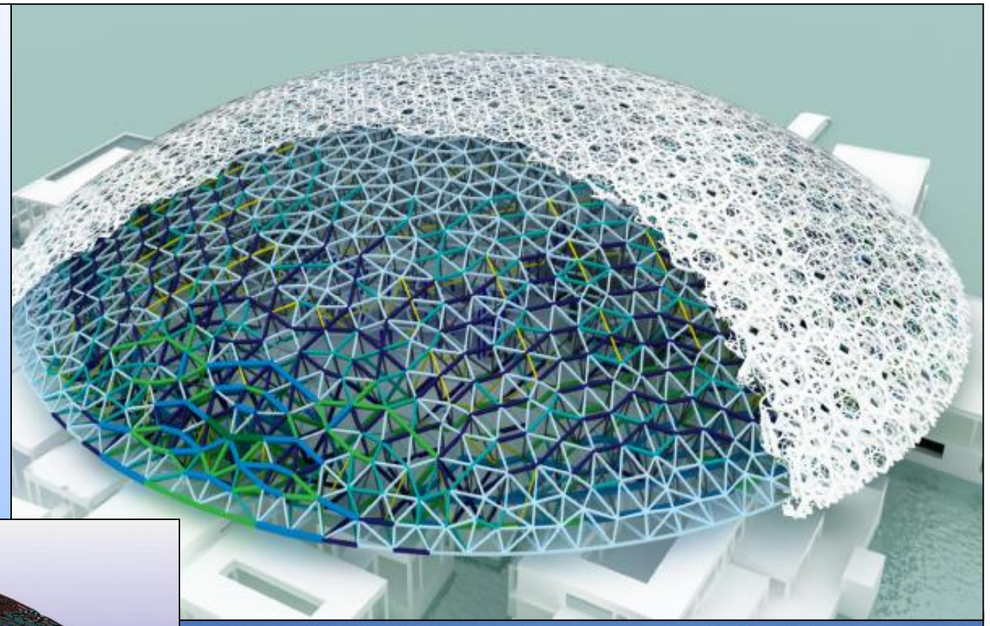
Image courtesy ABT

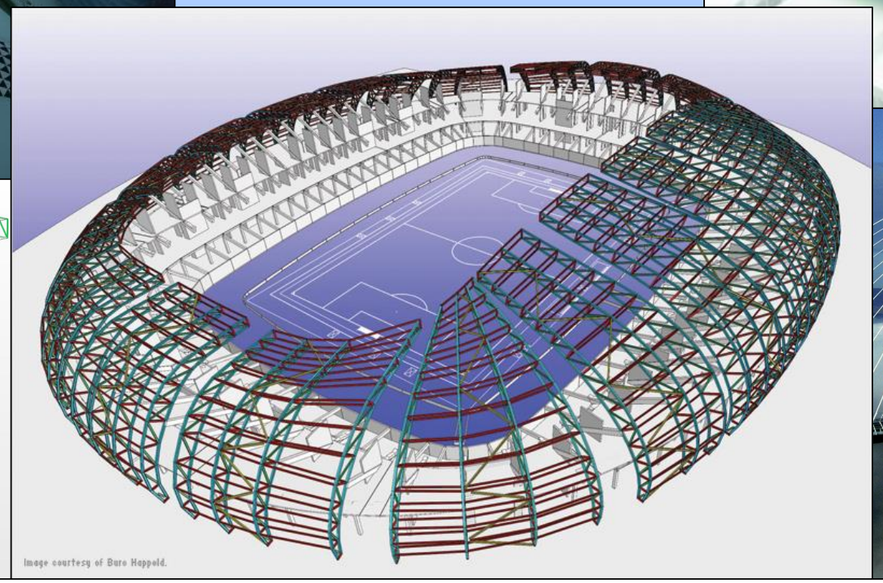
Customer Examples

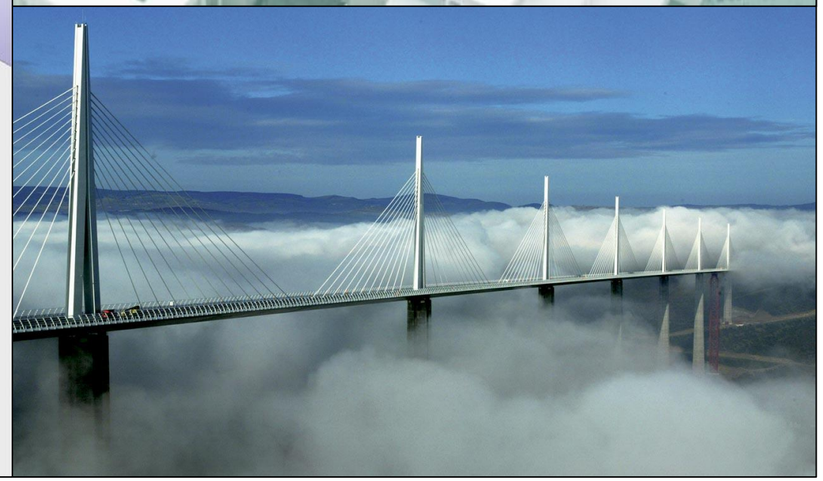
Robot Structural Analysis Professional 2017



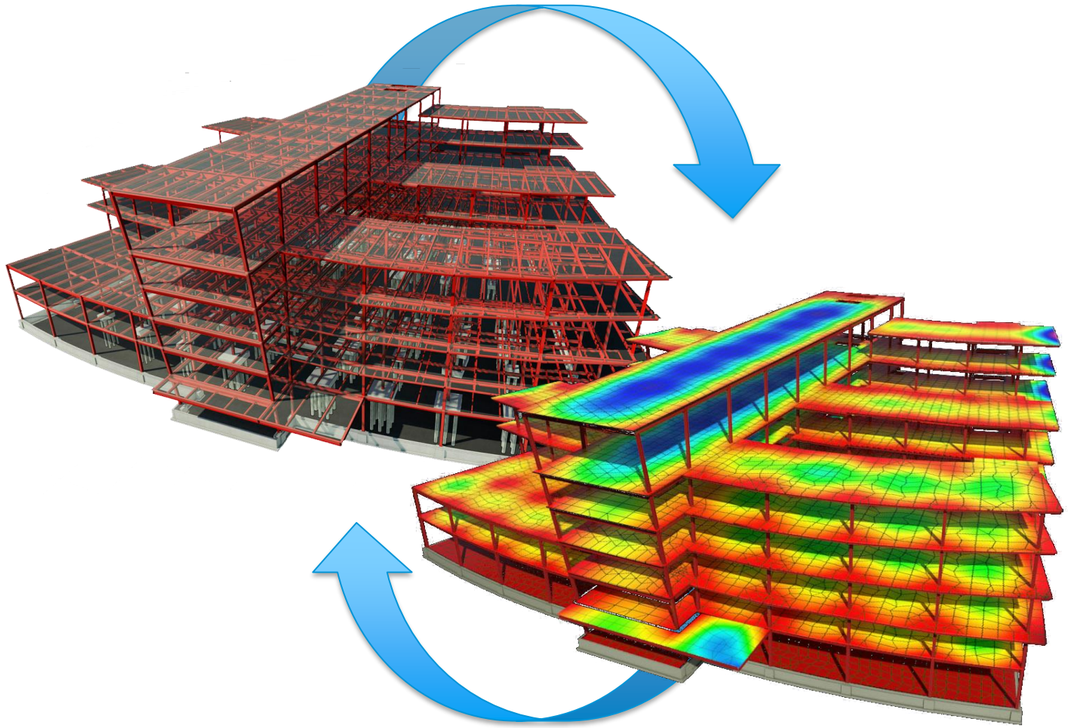








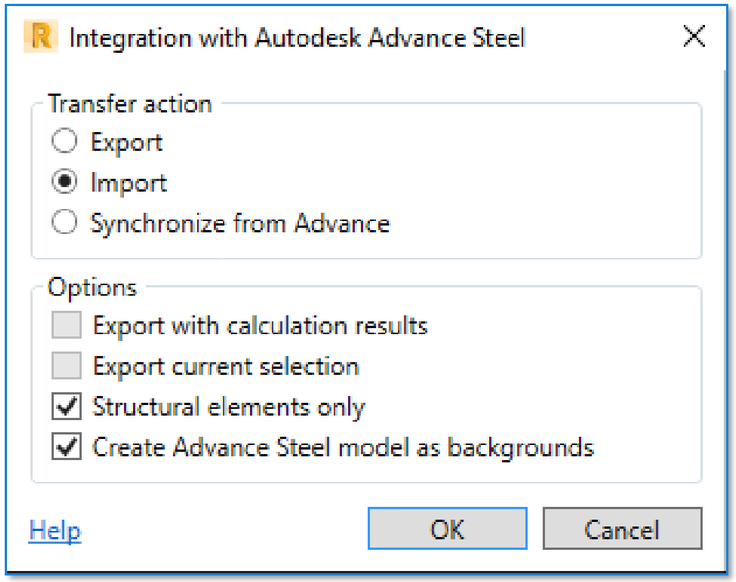
Ex 2: Analysis



Exercise 2

Import Advance Steel into RSA

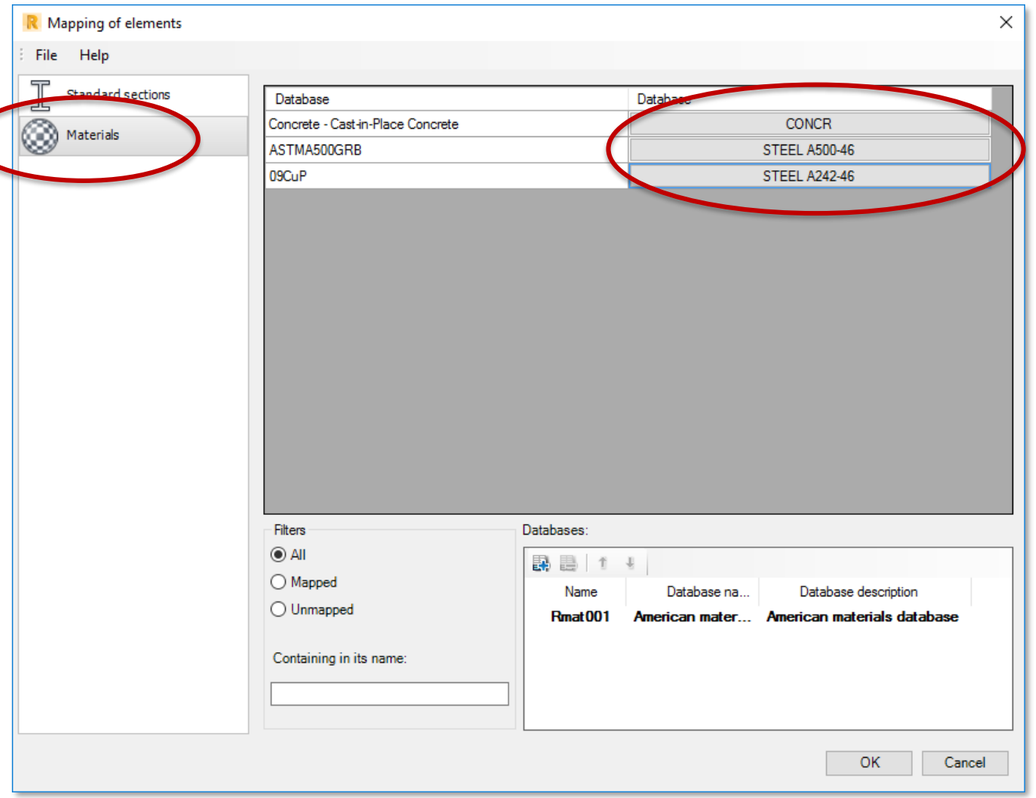
1. Open **RSA** and start a new Building Design project.
2. Select **Add-ins** tab > **Integration** > **Autodesk Advance Steel**.
3. Select **Import** and then **OK**.
4. Select **02 – AS Export.smlx** and then **Open**.
5. RSA will open and begin importing the Advance Steel model data.

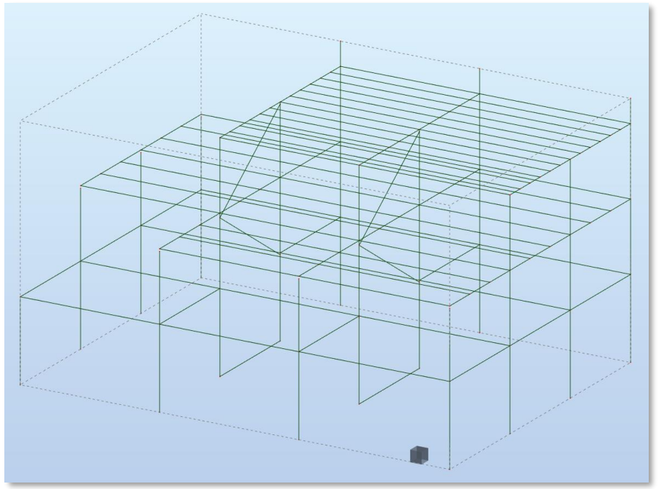


Exercise 2

Map Sections and Materials

6. In this example, a few materials need to be mapped.
7. In the **Mapping of elements** dialog, Select **Materials** at left, then click the buttons to the right of each material and set to the values shown.
8. Click **OK** when finished to view the imported geometry.

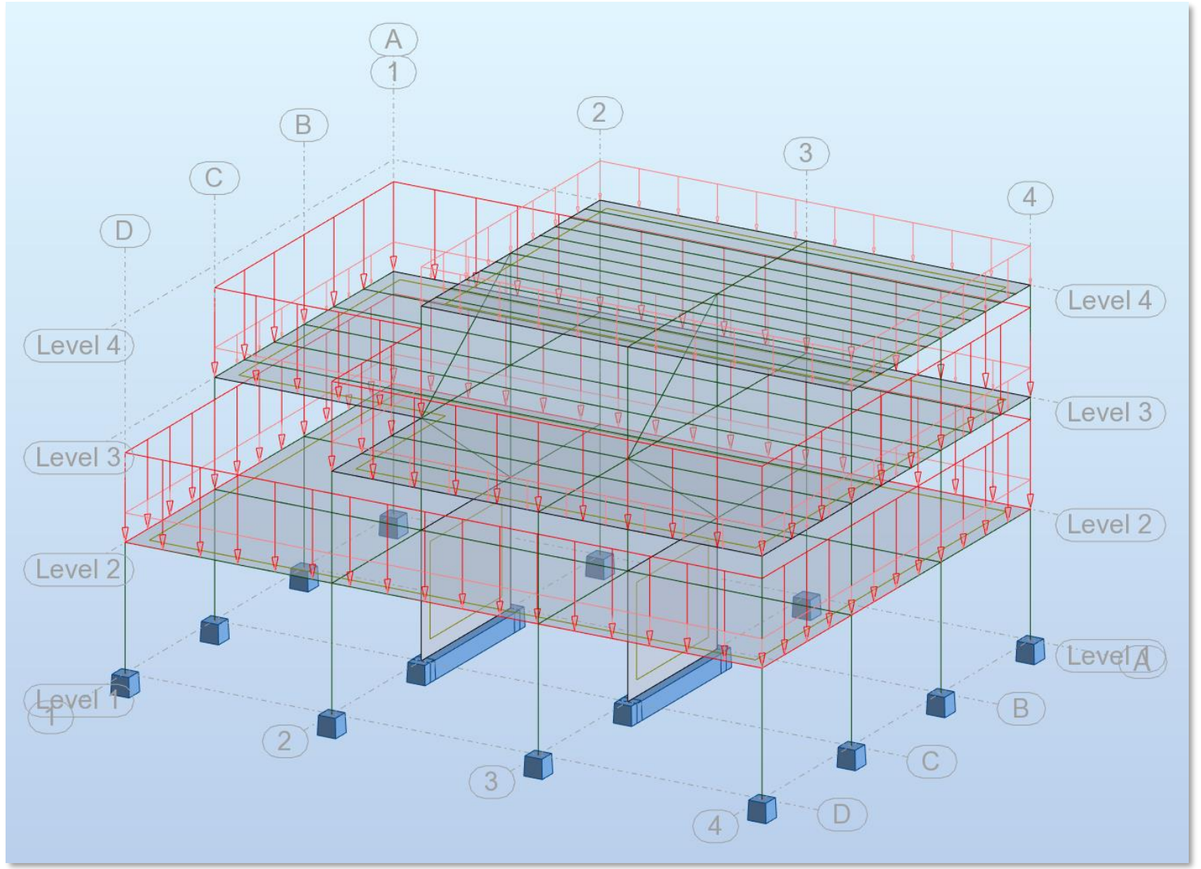




Exercise 2

Add Supports, Panels, and Loads

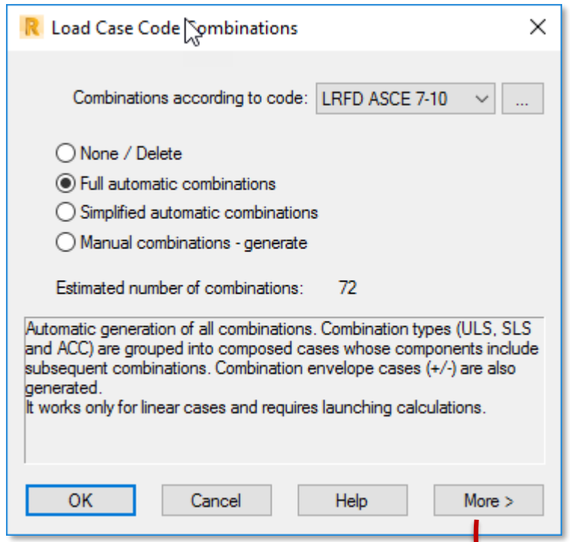
9. Open **04 – Analysis Start.rtd**. To save time, much of the prep work on the imported model has been completed for you.
10. Note that grids, levels, supports, panels (i.e. slabs and walls), and loads are visible in this model.

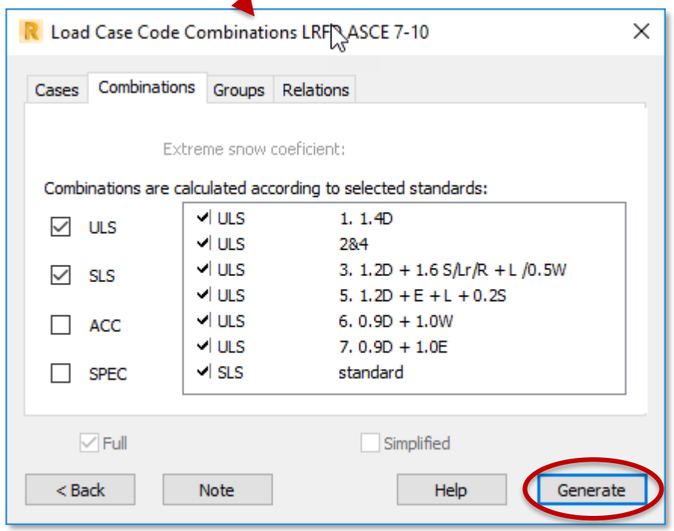


Exercise 2

Generate Load Case Combinations

11. Select **Loads** tab > **Automatic Combinations** to open the Load Case Code Combinations dialog.
12. Select **Full automatic combinations**, then click **More** to view the combinations in more detail.
13. Select **Generate** to build out the load combinations list.

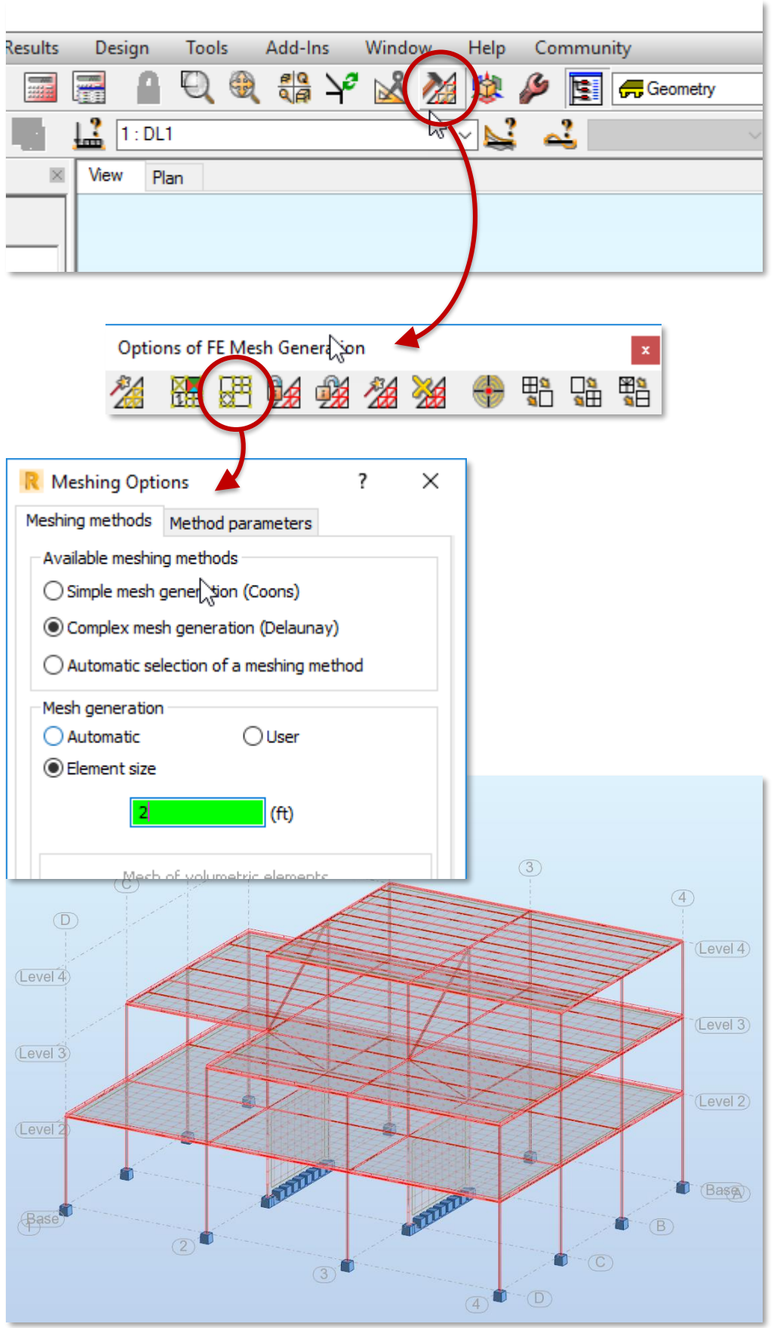




Exercise 2

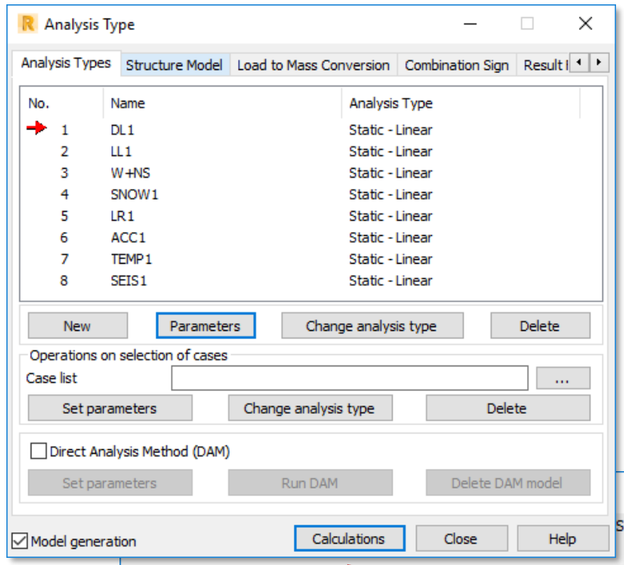
Create Finite Element Mesh

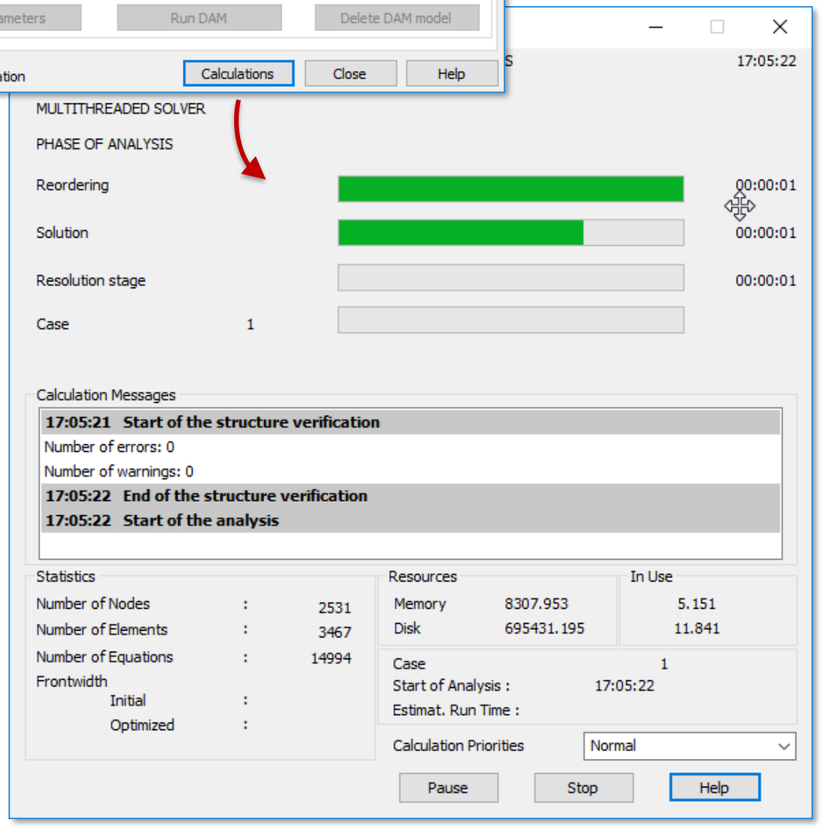
14. Click the **Options of FE Mesh Generation** icon to open this toolbar, then choose **Meshing Options** (select **Yes** to the pop-up message).
15. Select **Complex mesh generation (Delaunay)** and set the **Element size** to 2 feet. Select **OK**.
16. Select **Generation of calculation model** to create the FE mesh.
17. Select **Mesh Freeze** to store this mesh; then close the toolbar.



Exercise 2
Perform Analysis

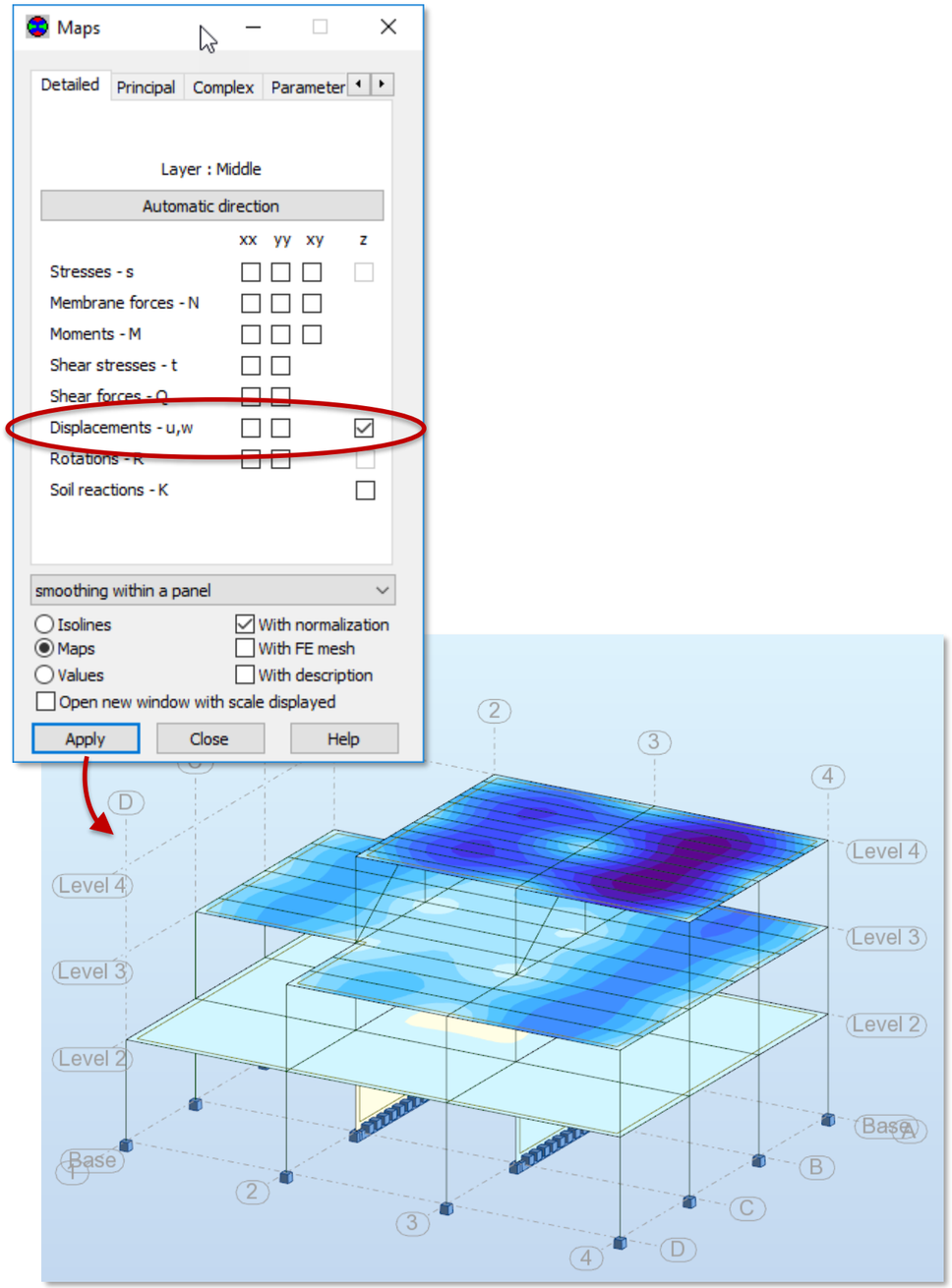
18. Time for analysis! If you're behind, open **05 – Analysis Ready.rtd** to catch up.
19. Go to **Analysis** tab > **Analysis Types** to open this menu. Observe additional capabilities under the **New** and **Parameters** buttons.
20. Select **Calculations** to run the analysis. A green light at the bottom of the screen indicates that current results are available.





Exercise 2
View Results

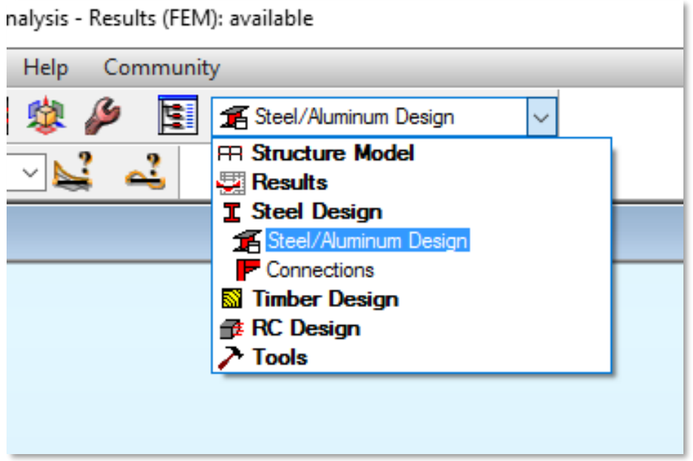
21. Select **Results** tab > **Maps** to open this dialog.
22. Select the **z** direction for **Displacements – u,w** and select **Apply**.
23. Note the color mapping in RSA is similar to the results previously explored in Revit.
24. Deselect the **z** checkbox and select **Apply** again to remove the map.

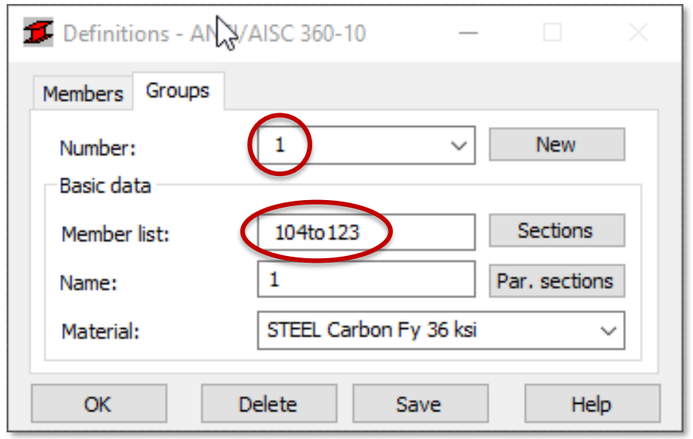


Exercise 2

Configure Code Group for Design

25. For this step, let's change our RSA layout. Locate the **Layouts** toolbar and change from **Geometry** to **Steel/Aluminum Design**.
26. Proceed to the **Groups** tab of the **Definitions** dialog. Click **New** to create a new code group and enter members **104 to 123** in the **Member list**.
27. Select **Save.**

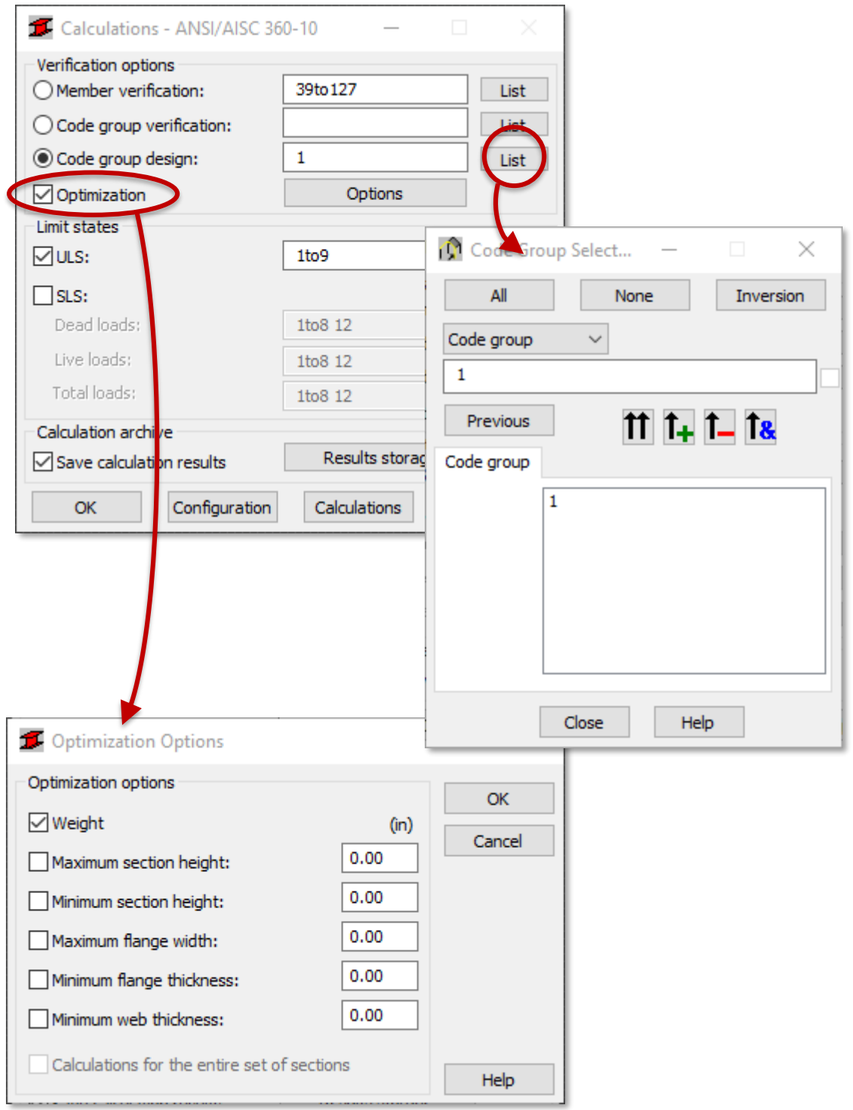




Exercise 2

Perform Code Group Design with Optimization

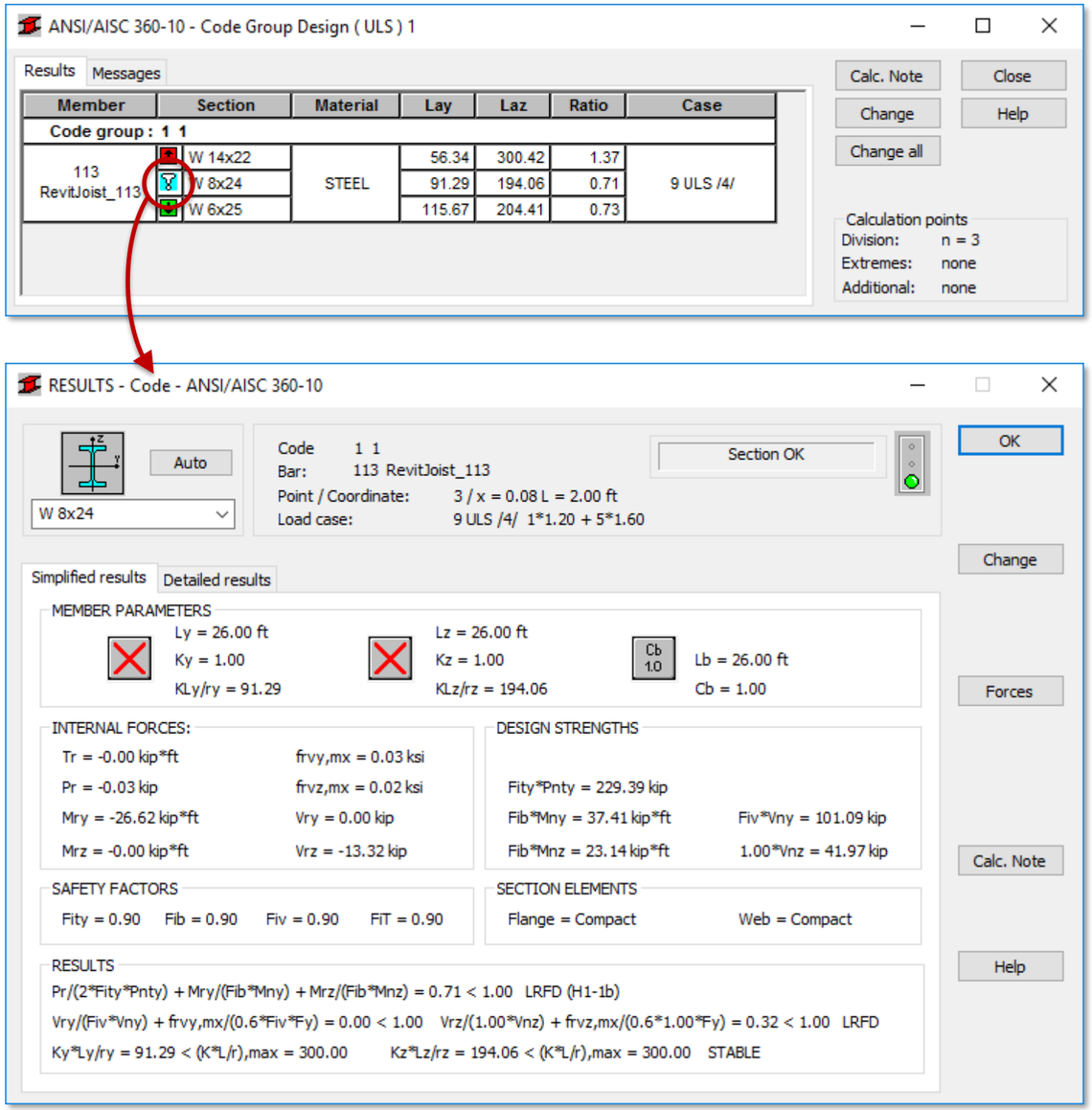
28. Proceed to the **Calculations** dialog and select the **Code group design** option. Enter **1** or use the **List** button to find and select group 1.
29. Select **Optimization** and check the **Weight** option. Select OK to close this dialog. If you're behind, open **06 – Design.rtd** to catch up.
30. Select **Calculations** to perform code group design for the selected settings.



Exercise 2

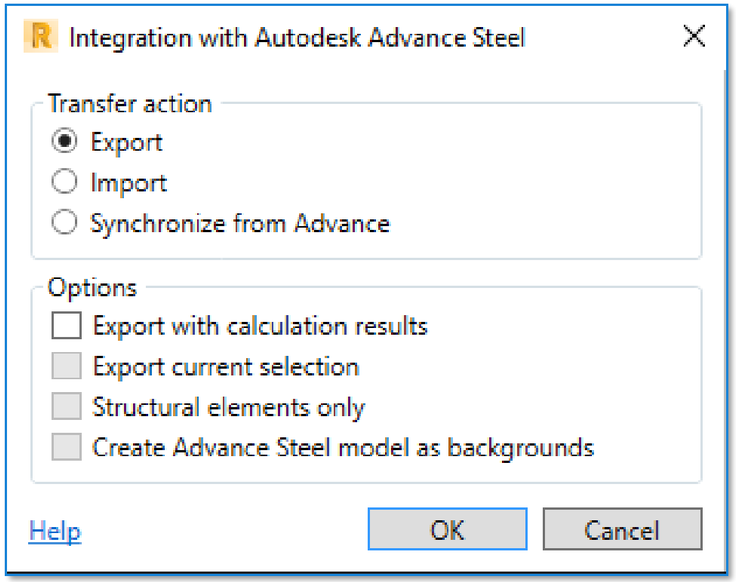
Select Optimal Sections

31. The **Code Group Design** module highlights the optimal section for the group (W 8x24 here). Click on the icon next to this section to view results; select **OK** to return.
32. In the **Code Group Design** dialog, select **Change all** to resize the sections. **Close** the dialog and **Cancel** saving the calculation results.

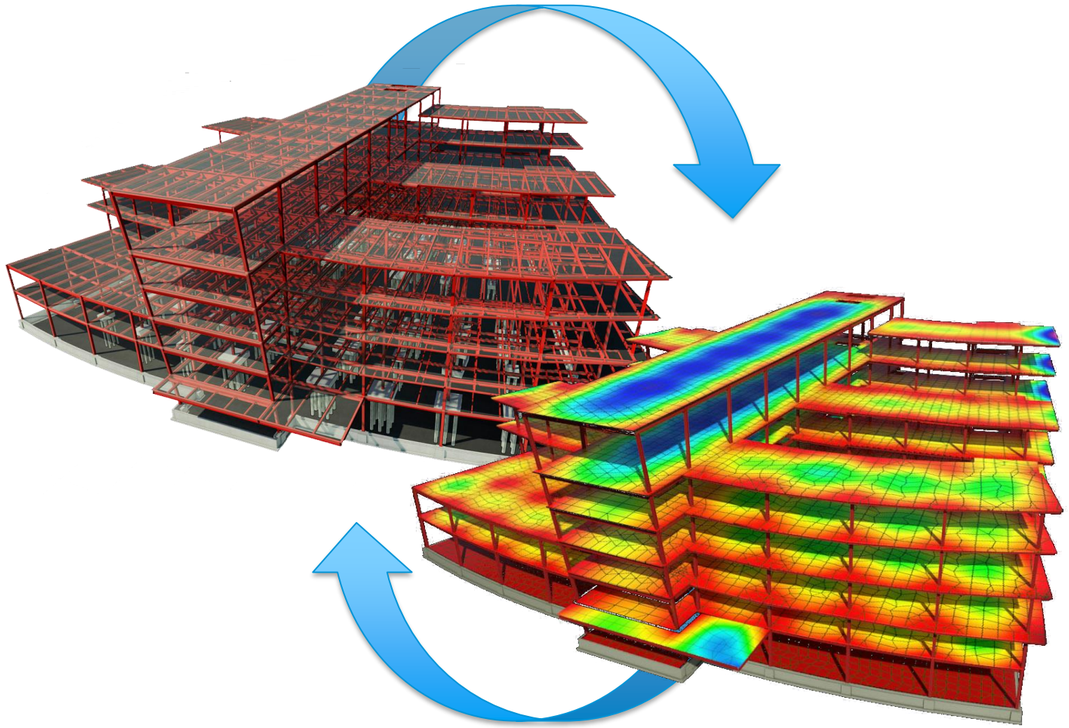


Exercise 2
Export Updated Geometry

33. Return to **Add-ins** tab > **Integration** > **Autodesk Advance Steel**.
34. Select **Export** and click **OK**.
35. Save the file as **07 – RSA Export.smlx**.



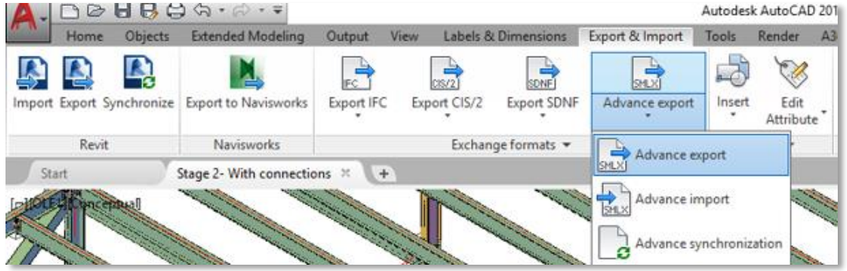
Ex 3: Syncing

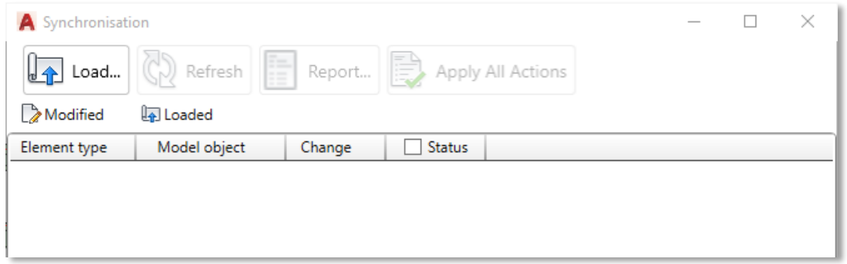


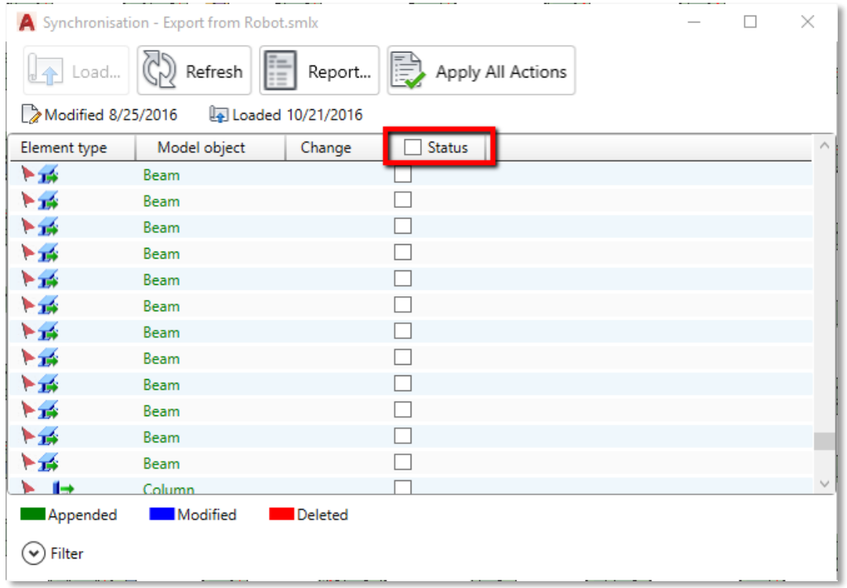
Exercise 3

Synchronize Model Changes

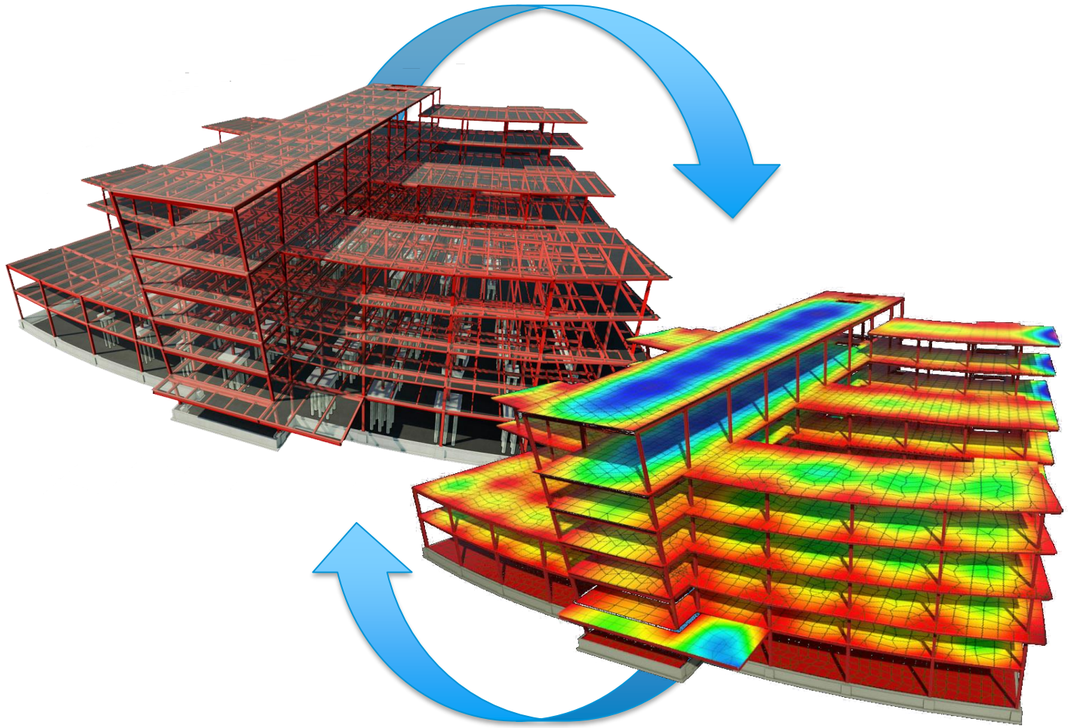
1. In **Advance Steel 2017**, on the **Export & Import** ribbon, select **Exchange Formats** > **Advance Export** pulldown > **Advance Synchronization**.
2. In the **Synchronization** dialog box, click **Load** and select the SMLX file exported from Robot.
3. In the **Synchronization** dialog box, click the box next to **Status** and select **Apply All Actions**.







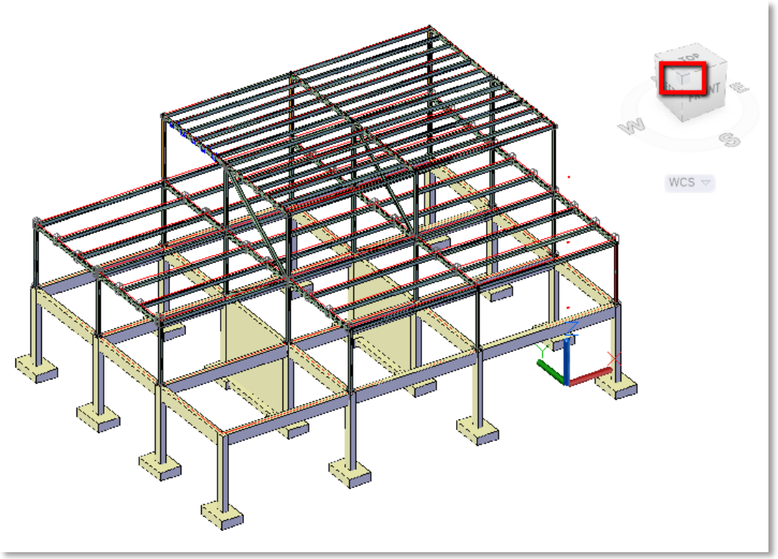
Ex 4: Connections

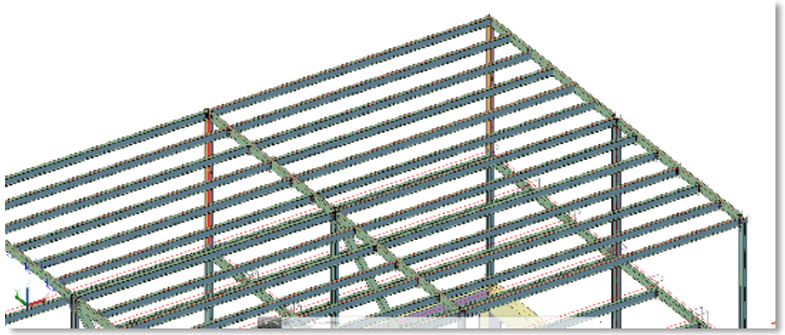


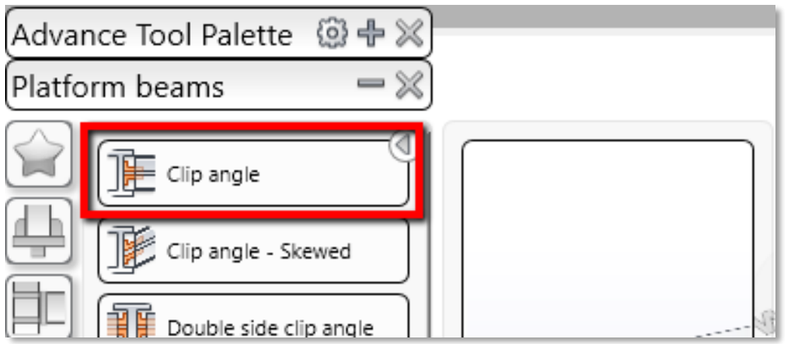
Exercise 4

Add Connections to the Model

1. Open **03 – AS Model2.dwg**.
2. Set the view to **Southwest Isometric** using the View Cube.
3. Zoom into the northeast corner of the top floor.
4. In the Connection Vault Tool Palette (**Home** > **Extended Modeling** > **Connection Vault**), **Platform Beams** menu, select **Clip Angle**.



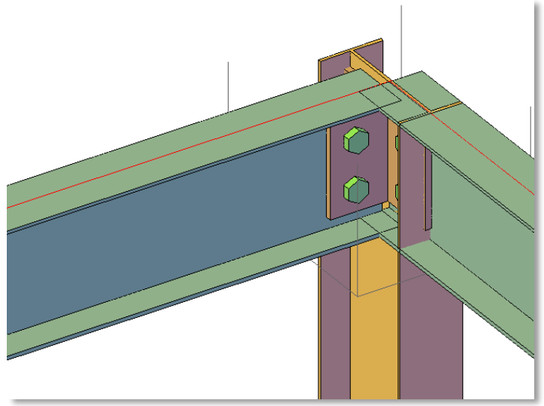


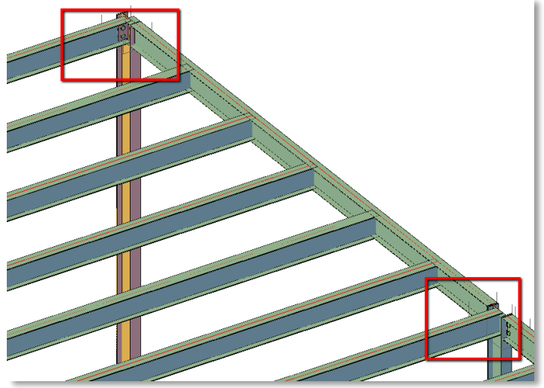


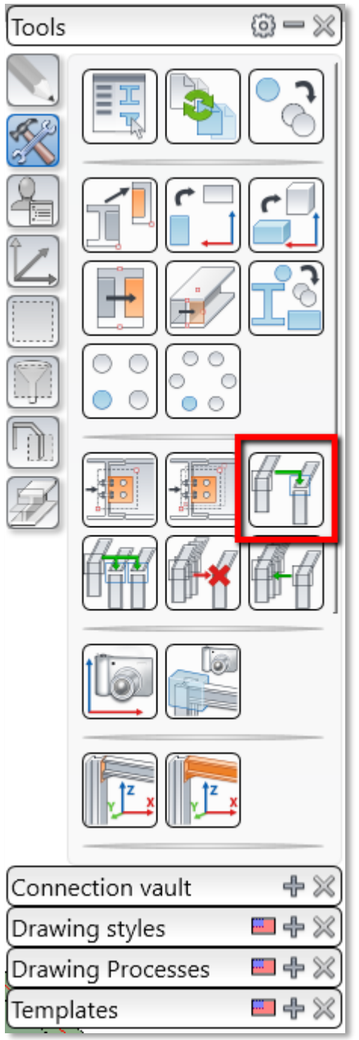
Exercise 4

Add Connections to the Model

5. Select the column and press **Enter**. Then select the exterior beam intersecting the web and press **Enter**.
6. Zoom out to see the next column beam intersection.
7. In the **Advance Tool Palette**, **Tools** menu, select **Create Joint in Joint Group**.
8. Select any portion of the clip angle connection previously created (e.g. bolts) and press **Enter**.



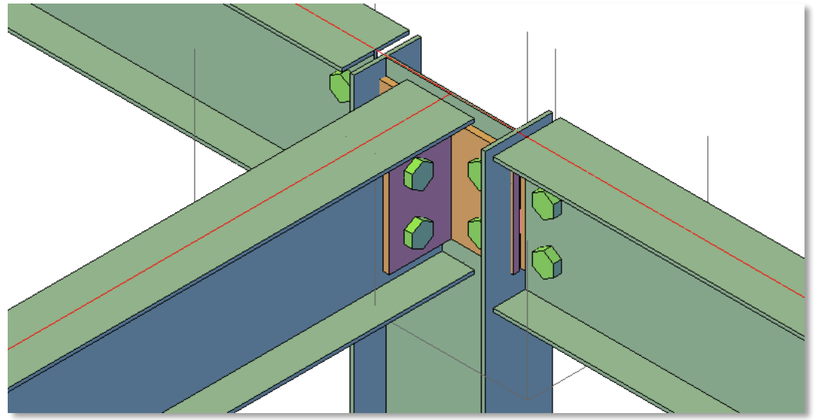


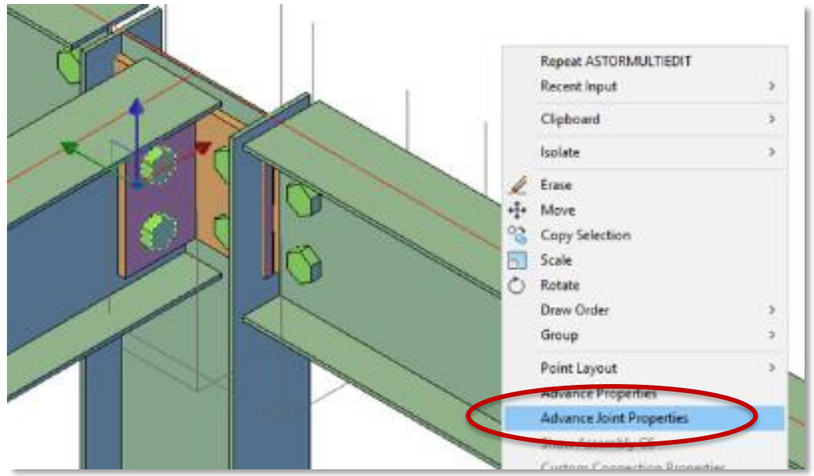


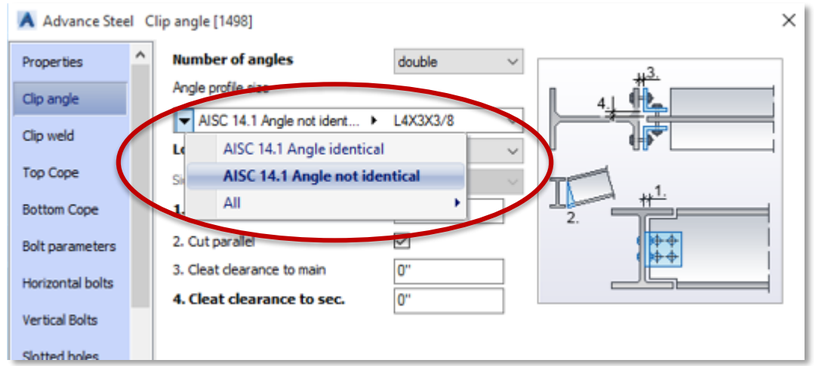
Exercise 4

Add Connections to the Model

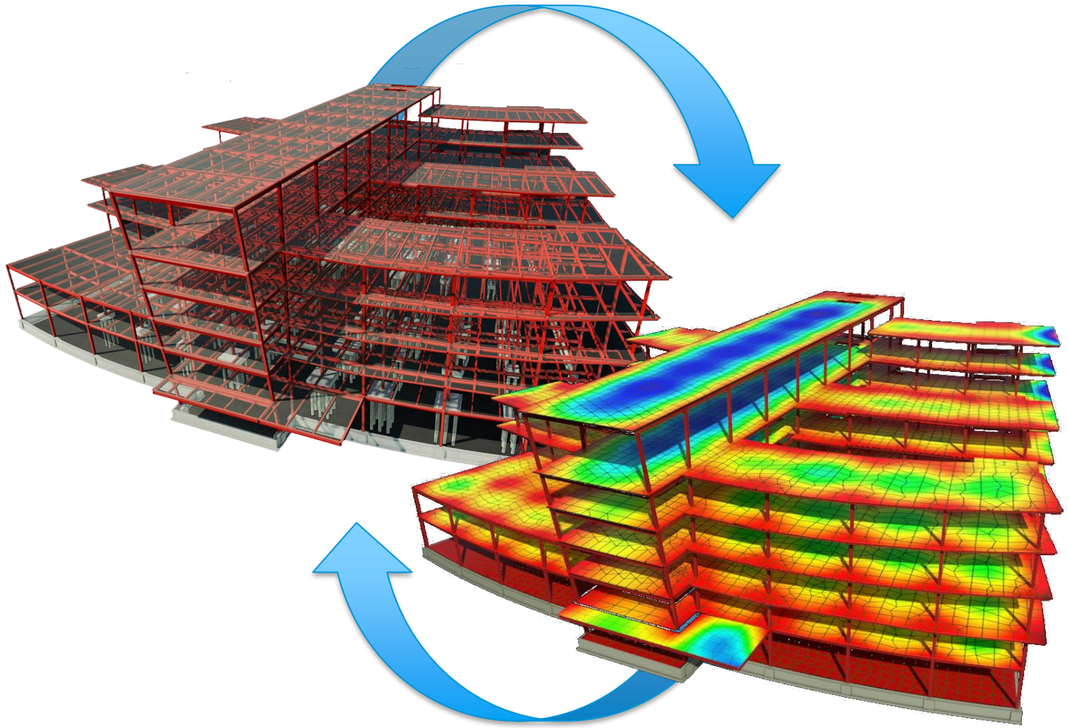
9. Select the column and press **Enter**. Then select the beam intersecting the column web and press **Enter**.
10. Select any portion of the joint created (e.g. bolts), right-click and select **Advance Joint Properties**.
11. In the dialog box, check **Upgrade to master**.
12. Select the clip angle header and change the profile size to **AISC 14.1 Angle Not Identical L 4x3x3/8**.





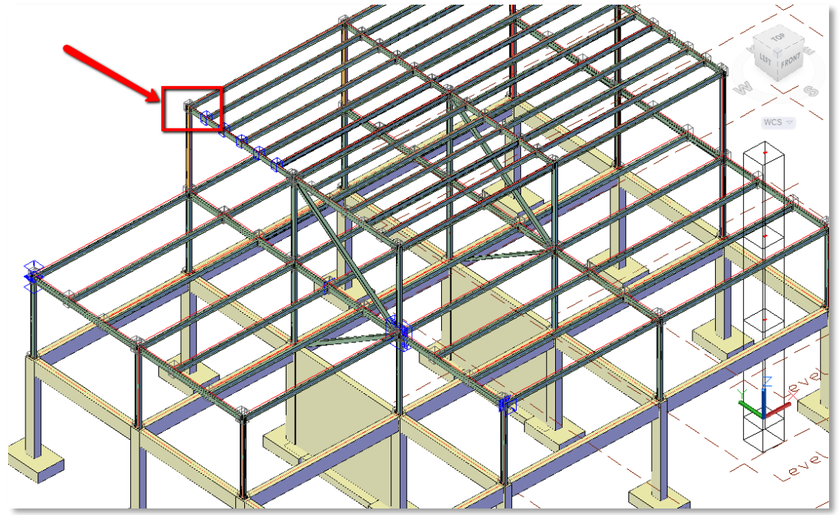


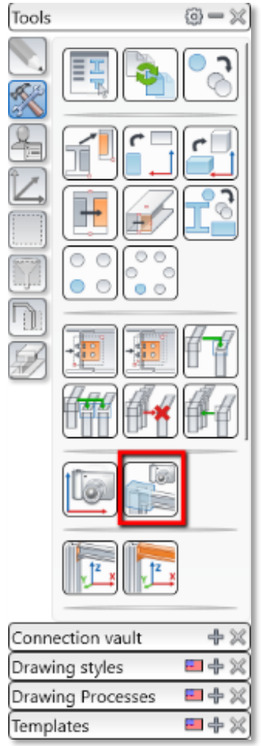
Ex 5: Detailing

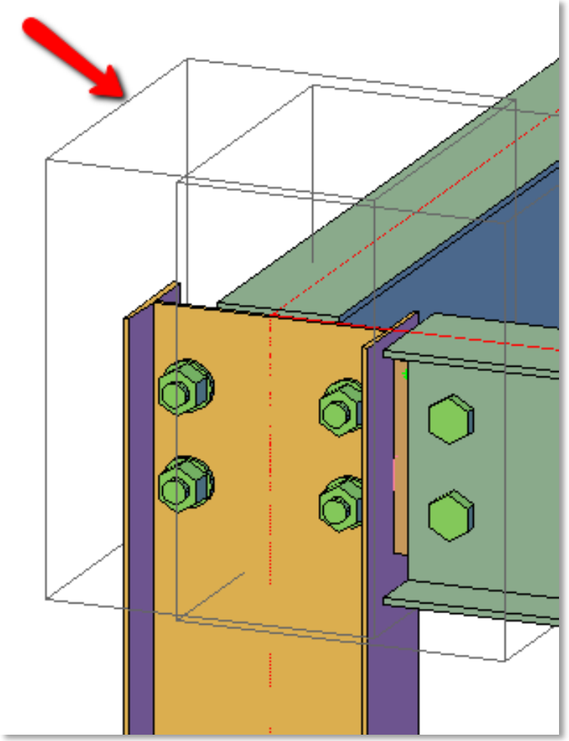


Exercise 5
Detailing the Model

1. In Advance Steel, open **08 – AS Model 3.dwg**.
2. Zoom into the northwest corner of the top level in the model.
3. In the **Advance Tool Palette** > **Tools**, select **Camera(s) at Node**.
4. Select the bounding box for the clip angle connections.

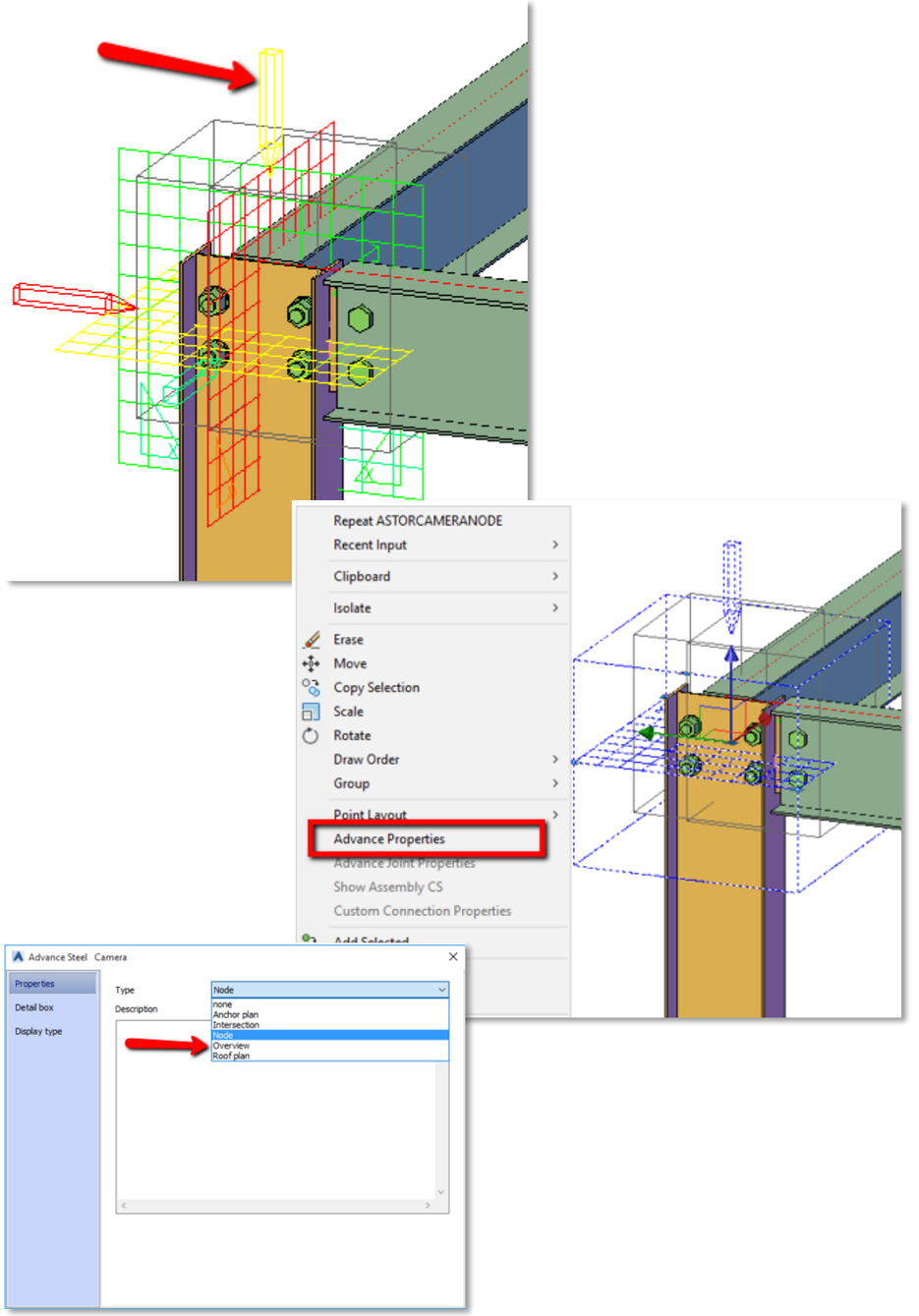






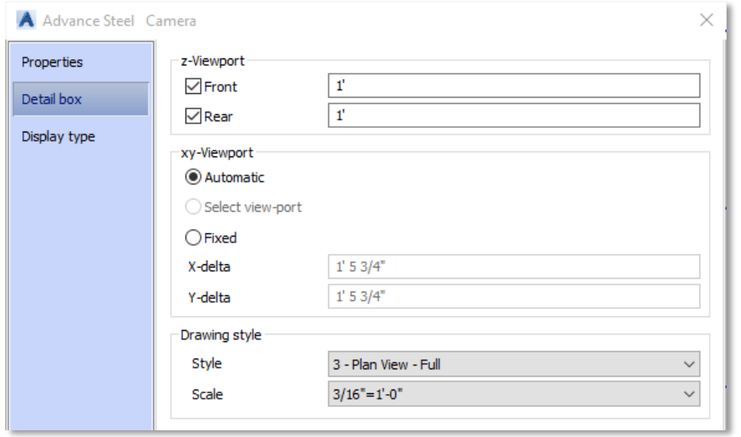
Exercise 5
Detailing the Model

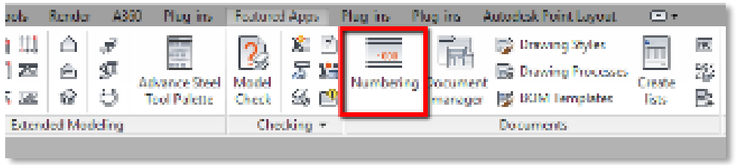
5. Select the top plane and press **Enter**.
6. Select the camera, right-click and select **Advance Properties**.
7. In the **Properties** menu, change **Type** to **Overview**, and type “**Roof Framing Plan**” under the **Description**.

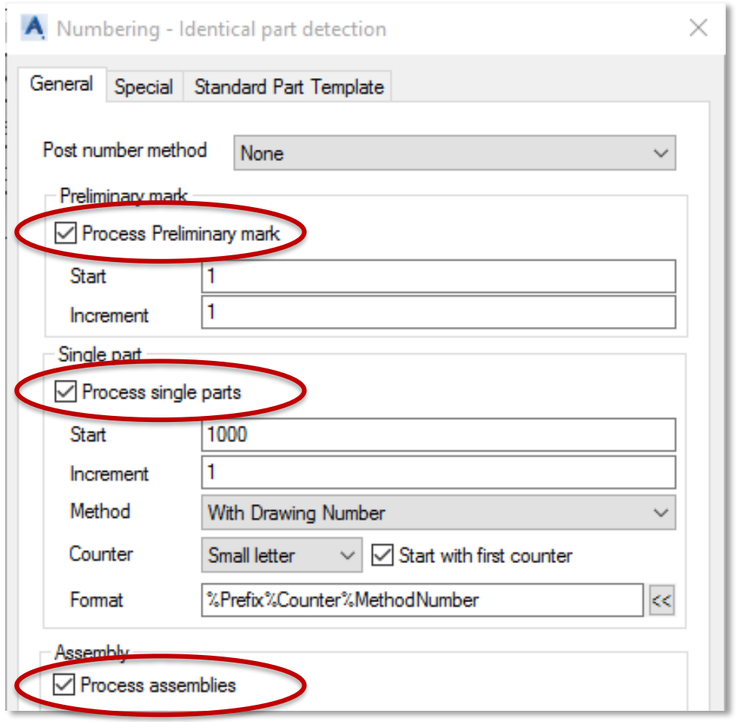


Exercise 5
Detailing the Model

8. In the **Detail Box** menu, change the following:
   a. z-Viewport to 1’ (Front and Rear)
   b. xy-Viewport to Automatic
   c. Style: 3 – Plan View – Full
   d. Scale: 3/16” = 1’ – 0”
9. In the **Home** ribbon > **Documents** panel > Select **Numbering**.
10. In the **Numbering** dialog box, select the boxes next to **Process Preliminary mark**, **Process single parts**, and **Process assemblies** then press **OK**.

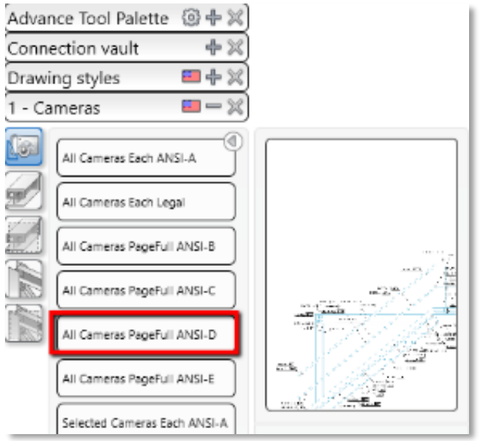


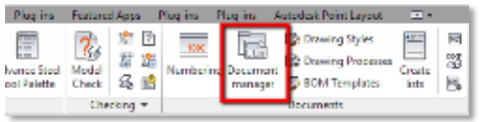


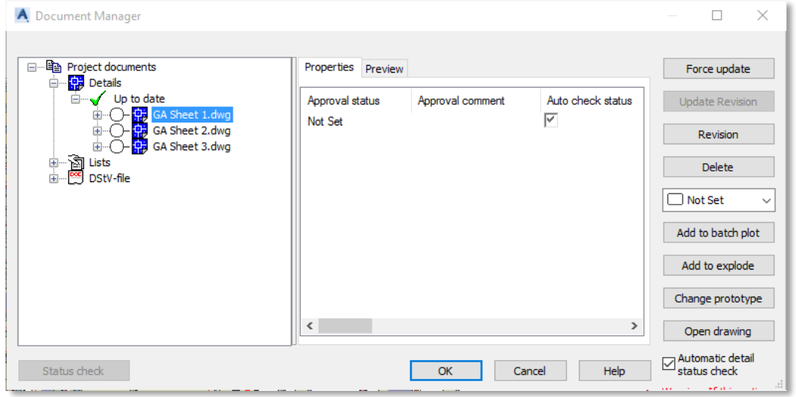


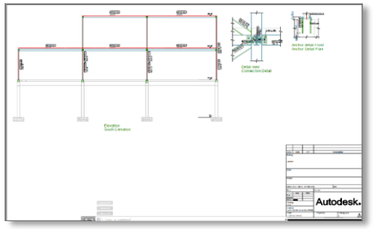
Exercise 5
Detailing the Model

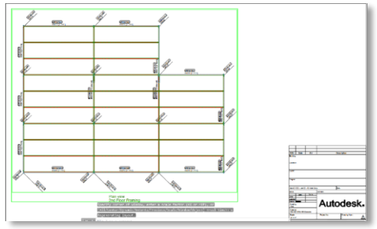
11. In the **Drawing Process Tool Palette**, select **Cameras** > **All Cameras PageFull ANSI-D**.
12. In the **Process Properties** dialog box, select **OK**.
13. On the **Home** ribbon, in the **Documents** panel, select **Document Manager**.
14. In the **Document Manager**, double-click any detail drawing to open it.











You did it!

Q&A

ES17657-L: Integrating Structural Design, Analysis, and Detailing: Advance Steel and Robot

Aaron Vorwerk, AIA, EIT, LEED AP BD+C
Sr. Technical Sales Specialist, AEC, Autodesk
@AaronVorwerk

Stephen Bessette
Technical Sales Support, MEP & Fabrication, Autodesk