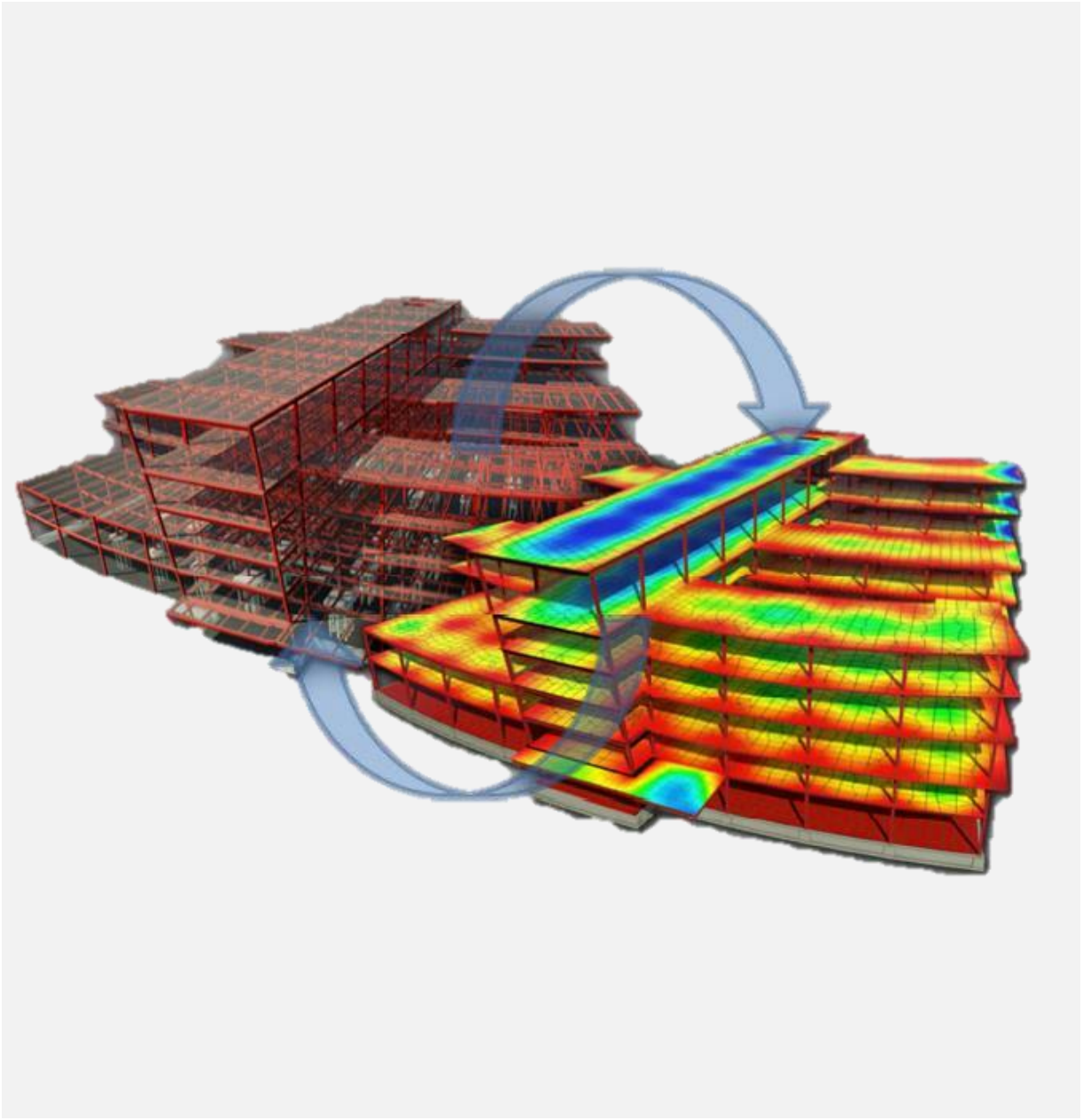

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BIM Interoperability for Structural Analysis

Shauna Hurley

16:04:2021

Introduction – Shauna Hurley

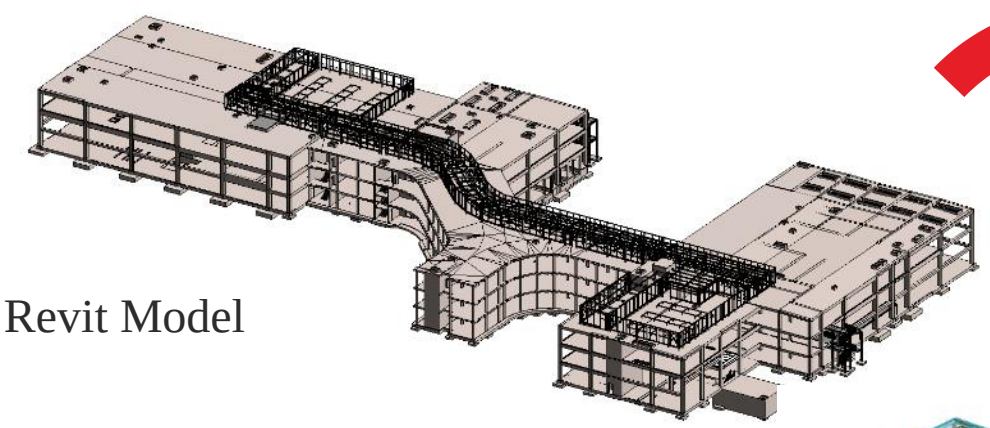
ARUP

Current Position:
Senior Engineer, Arup

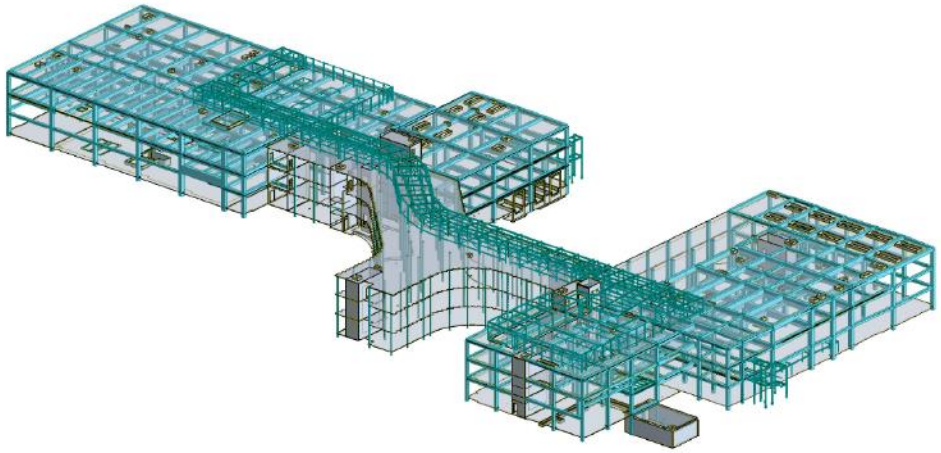
Qualifications:
BEng (Honours) in Structural Engineering, CIT
MEng in Structural Engineering, CIT
CEng MIEI

BIM Interoperability

ARUP



Autodesk Revit Model



Structural Analysis Model

Analysis Packages

ARUP

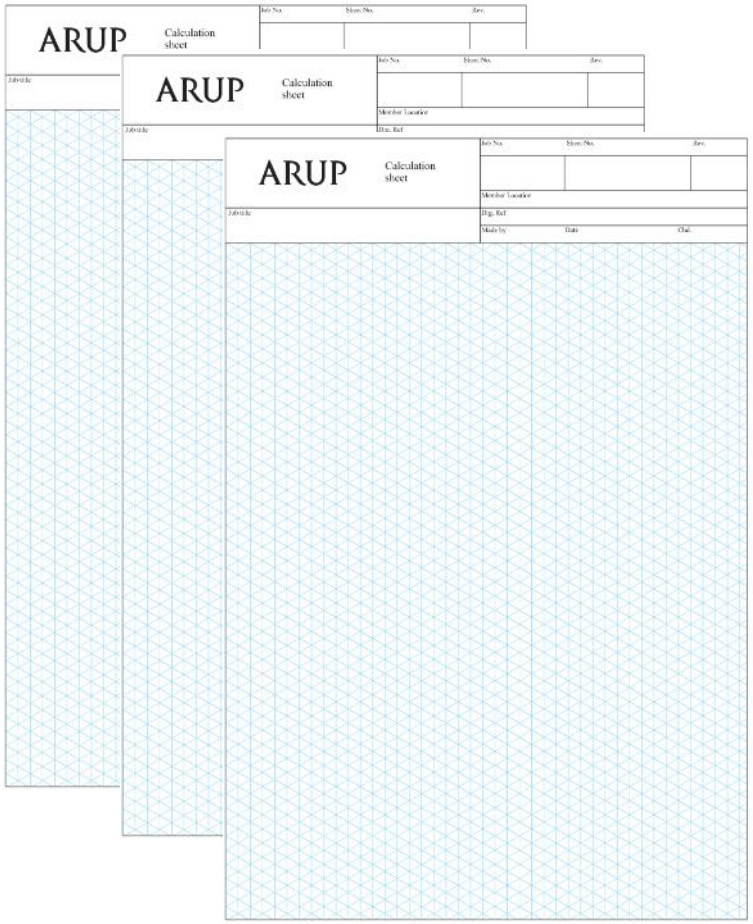
Autodesk Revit ⟷ Autodesk Robot Structural Analysis Professional

Autodesk Revit ⟷ Oasys GSA

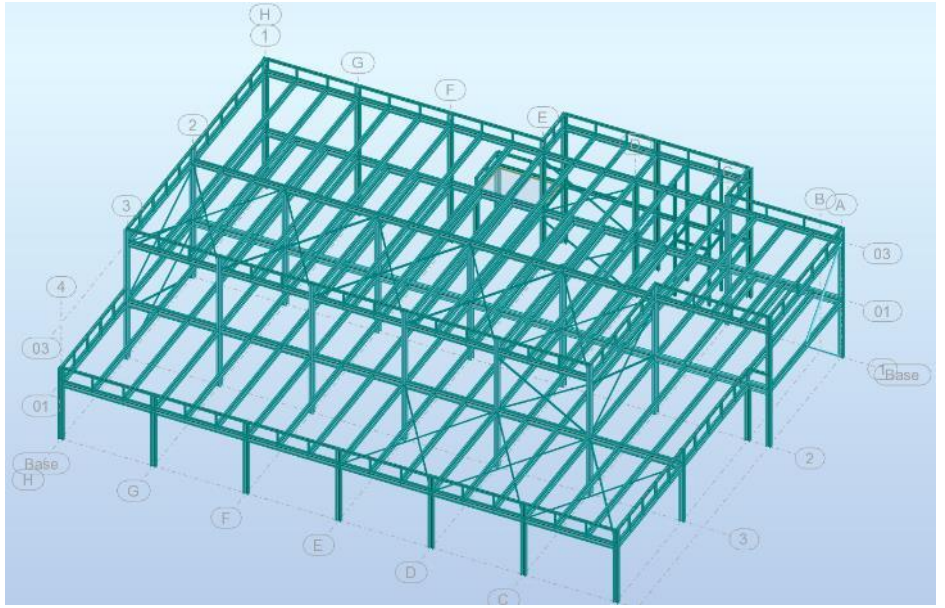
Autodesk Revit ⟷ Tekla Structures

Structural Design

ARUP



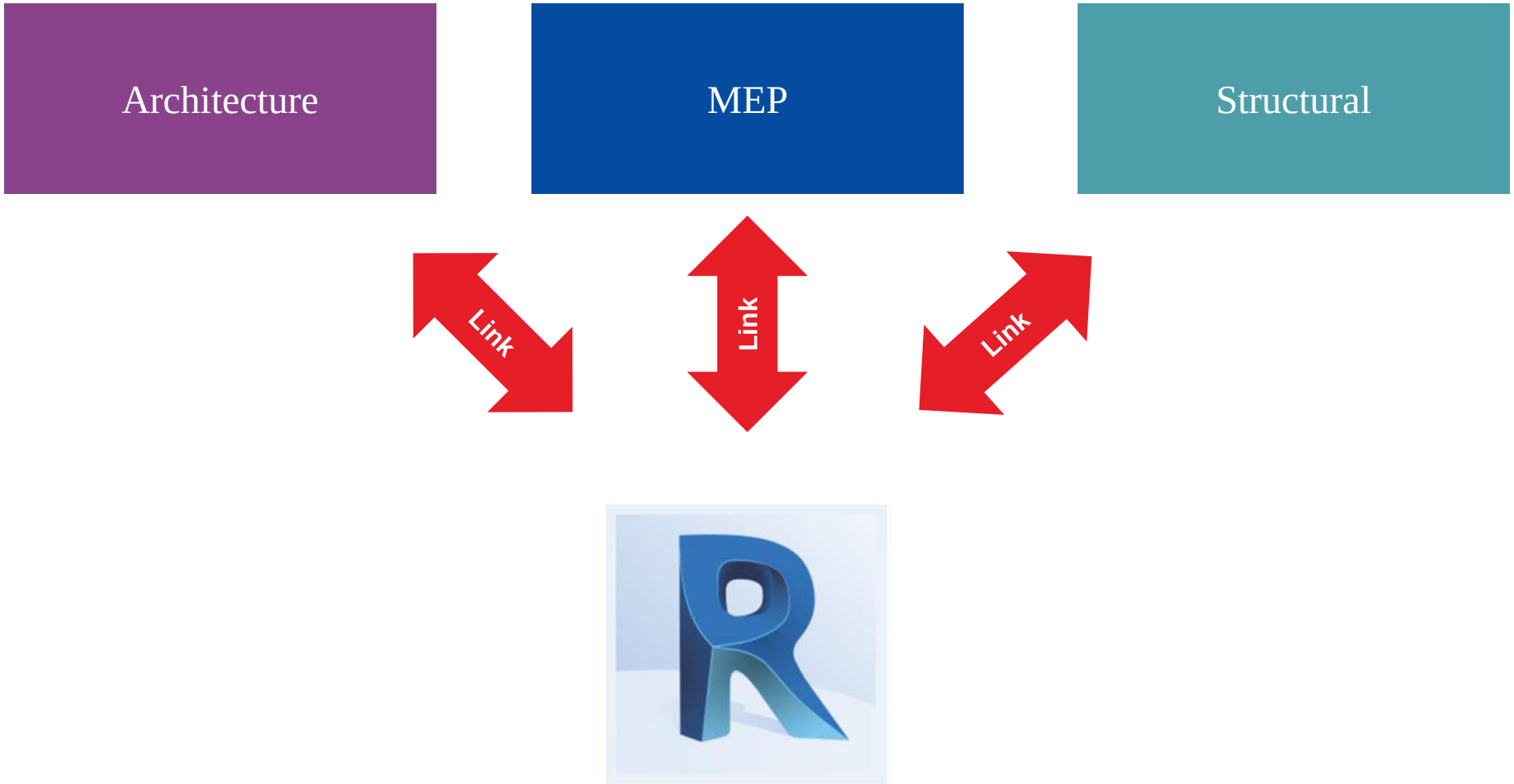
Hand Calculations



3D Modelling

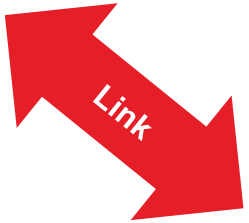
BIM

ARUP



BIM - Structural

ARUP

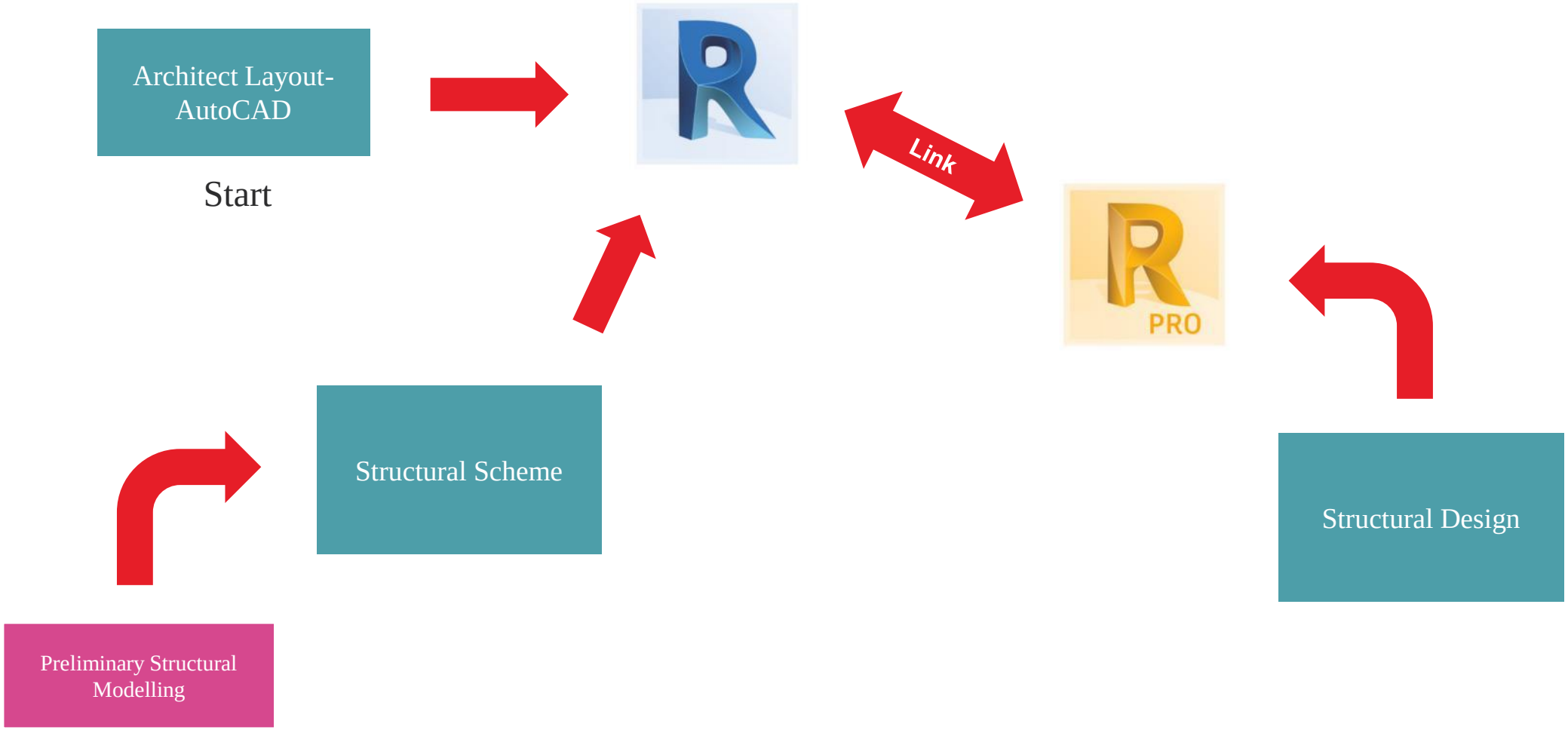


Structural Drawings

Structural Design

BIM - Structural

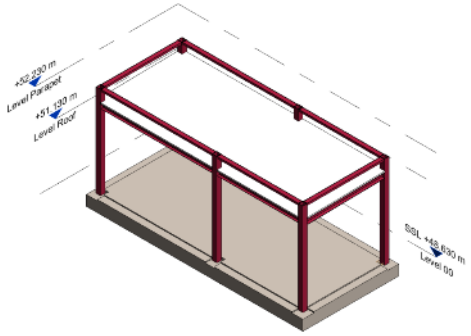
ARUP



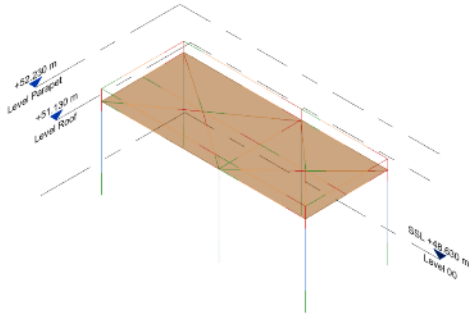
BIM – Structural Workflow

ARUP

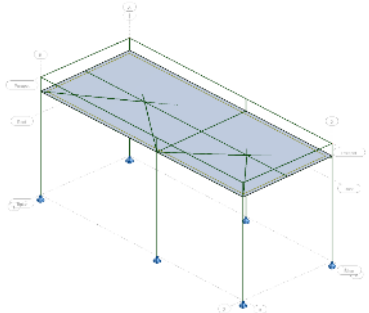
Design Focused



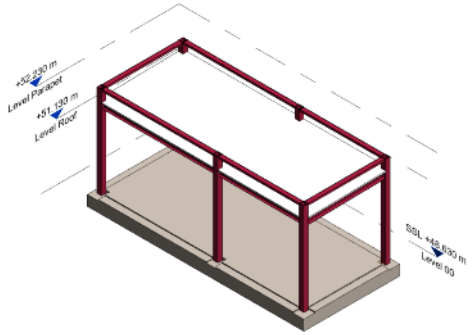
Physical Model



Analytical Model



Analysis Model

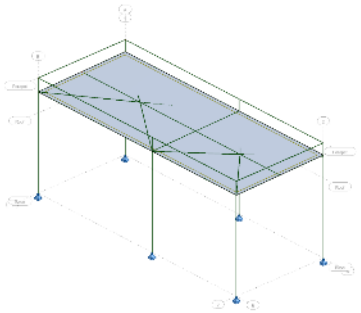


Final Model

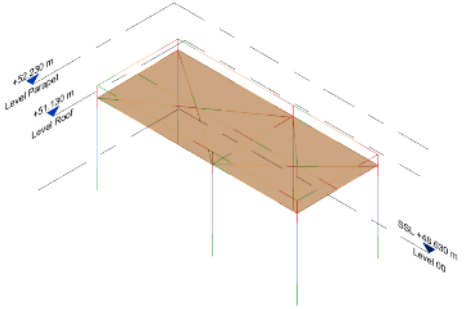
BIM – Structural Workflow

ARUP

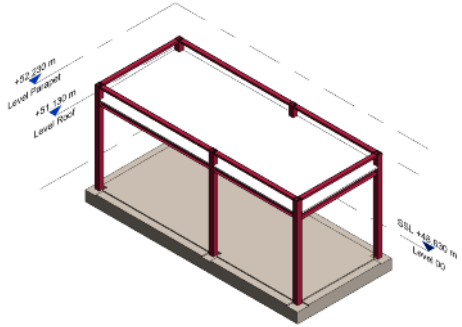
Analysis Focused



Analysis Model



Analytical Model



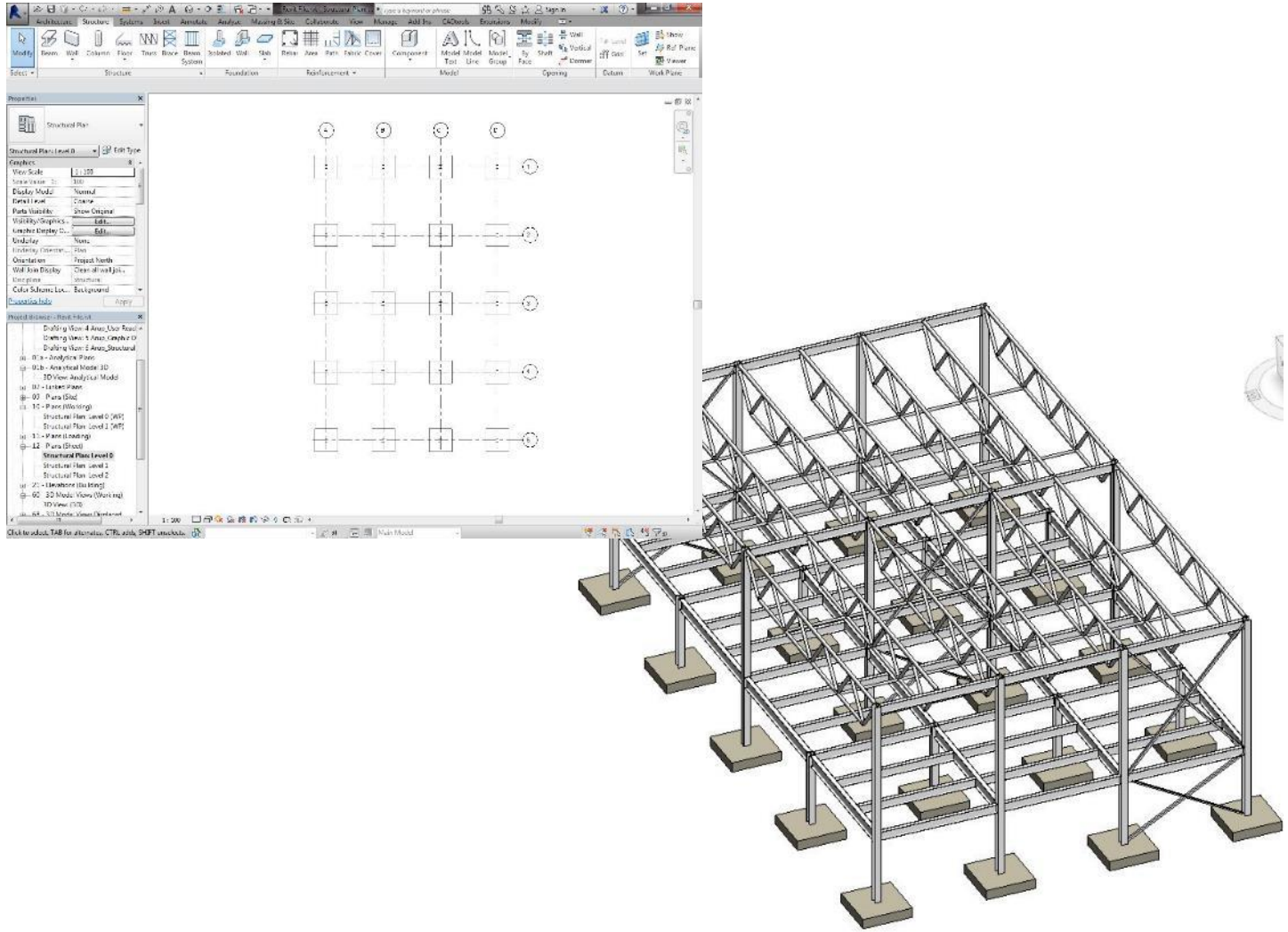
Physical Model

Revit Model

ARUP

Create Structural Scheme

- Architect's AutoCAD drawings.
- Project Setup
  - Grids,
  - Levels
- Modelling Members

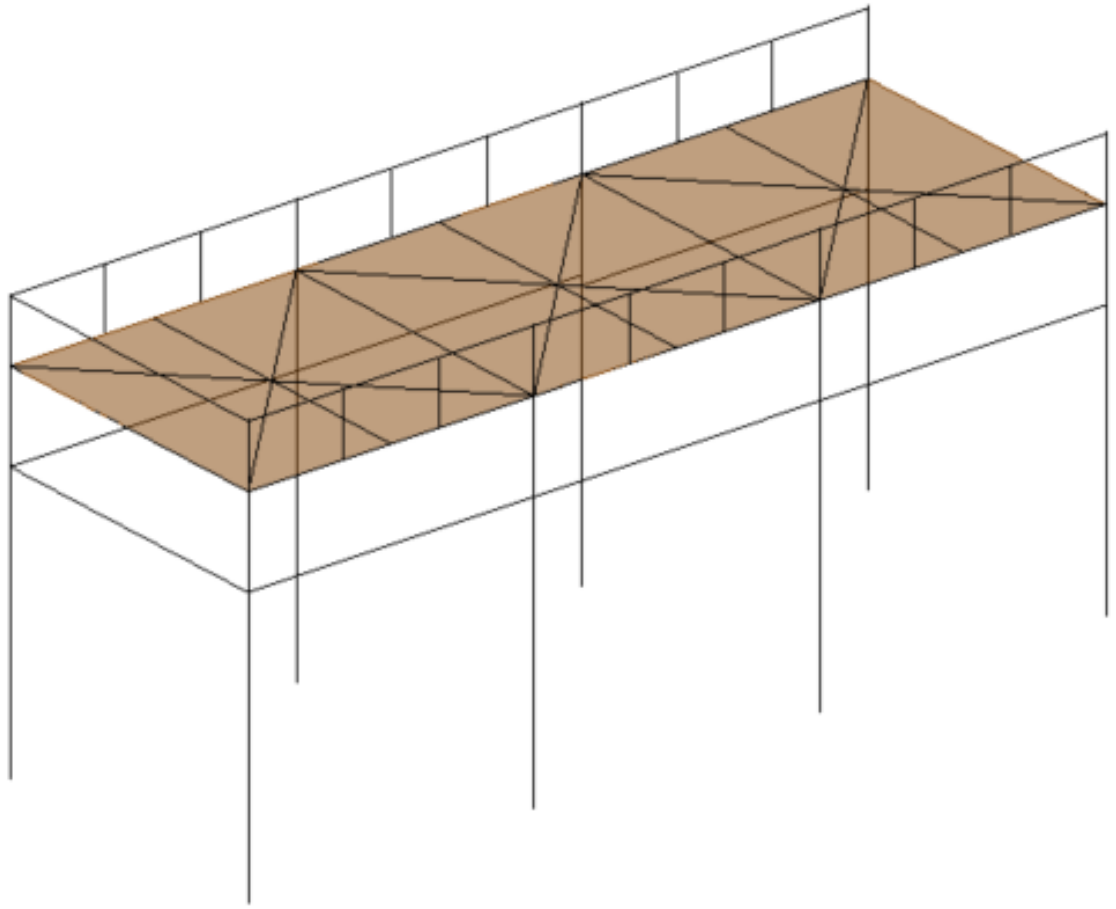


Analytical Modelling

ARUP

Viewing the Analytical Model

- Project Browser
- Shortcut – AA Analytical Adjust

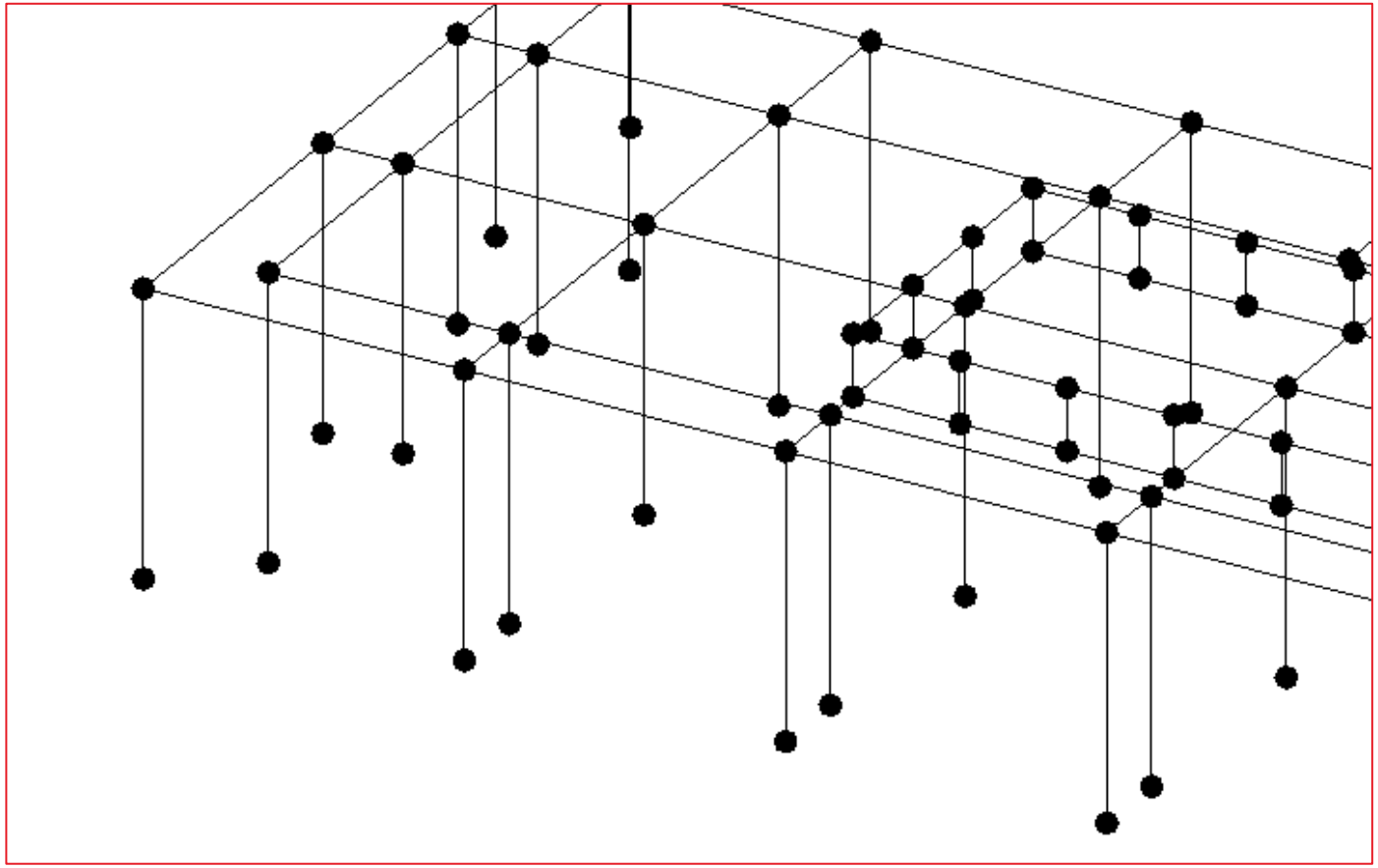


Analytical Modelling

ARUP

Viewing the Analytical Model

- Change colours to distinguish between beams, columns, and the start and end of both.



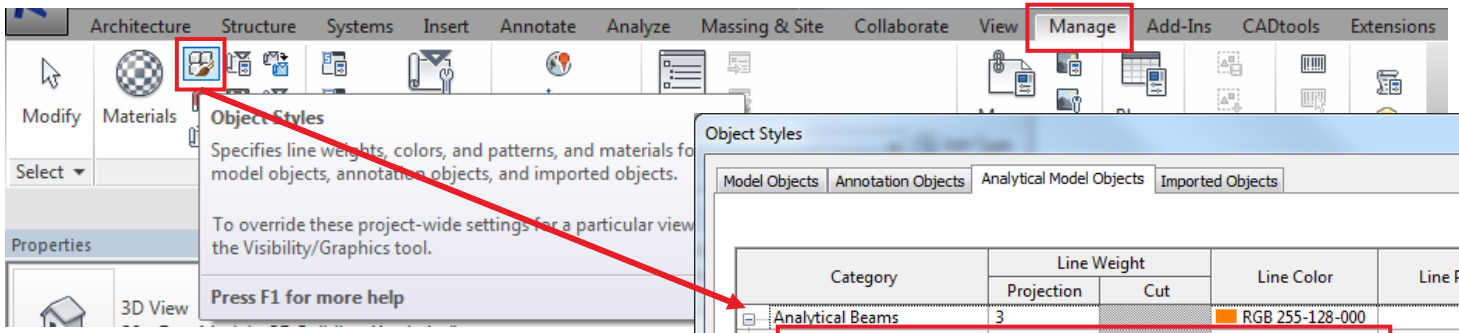
Analytical Modelling

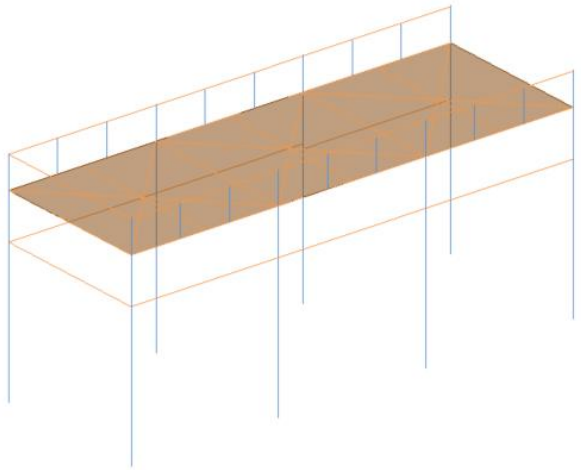
ARUP

Viewing the Analytical Model

- Change colours to distinguish between beams, columns, and the start and end of both.

Manage Tab





Object Styles

Model Objects | Annotation Objects | Analytical Model Objects | Imported Objects

Category	Line Weight Projection	Line Weight Cut	Line Color	Line Pattern	Material
Analytical Beams	3		RGB 255-128-000		
End Segment	3		Red		
Rigid Links	5		RGB 000-127-000		
Start Segment	3		RGB 000-128-000		
Analytical Braces	3		Black		
End Segment	3		Red		
Start Segment	3		RGB 000-128-000		
Analytical Columns	1		Blue		
Base Segment	1		RGB 000-128-000		
Top Segment	1		Red		
Analytical Floors	1		Black		
Analytical Foundation Slabs	3		Black		
Analytical Isolated Founda...	3		Black		
Analytical Links	5		RGB 000-127-000		
Analytical Nodes	3		Black	Solid	
Analytical Wall Foundations	3		Black		
Analytical Walls	1		Black		

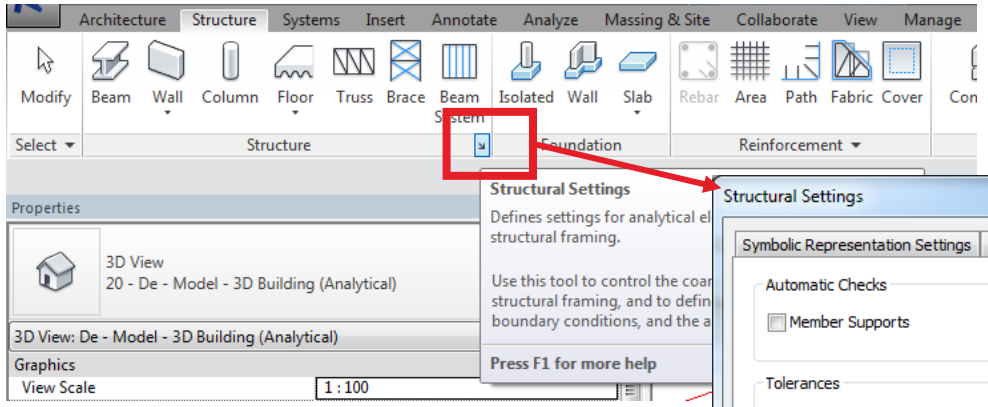
Select All | Select None | Invert

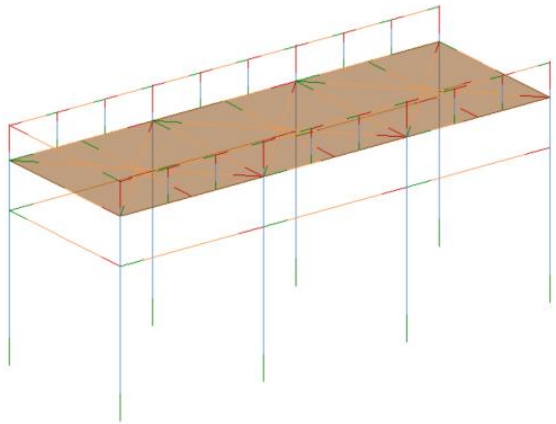
Modify Subcategories: New | Delete | Rename

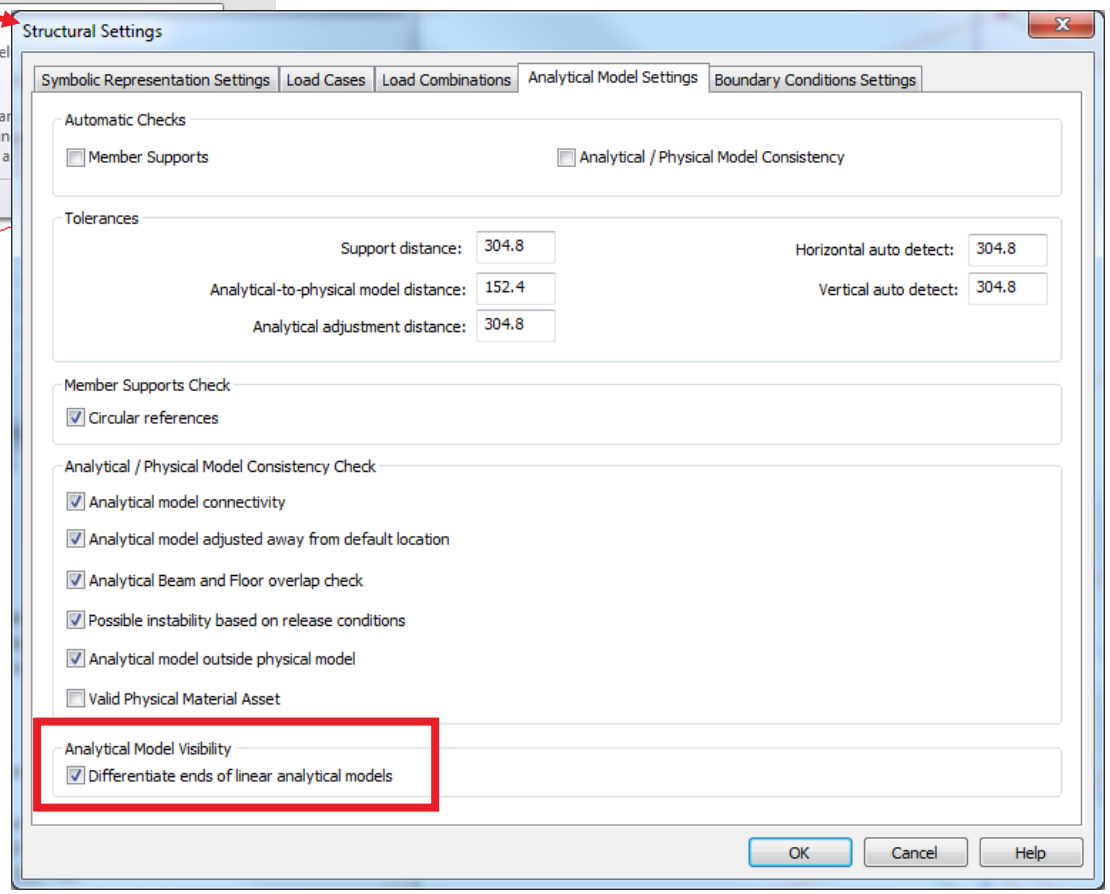
OK | Cancel | Apply | Help

Analytical Modelling

ARUP

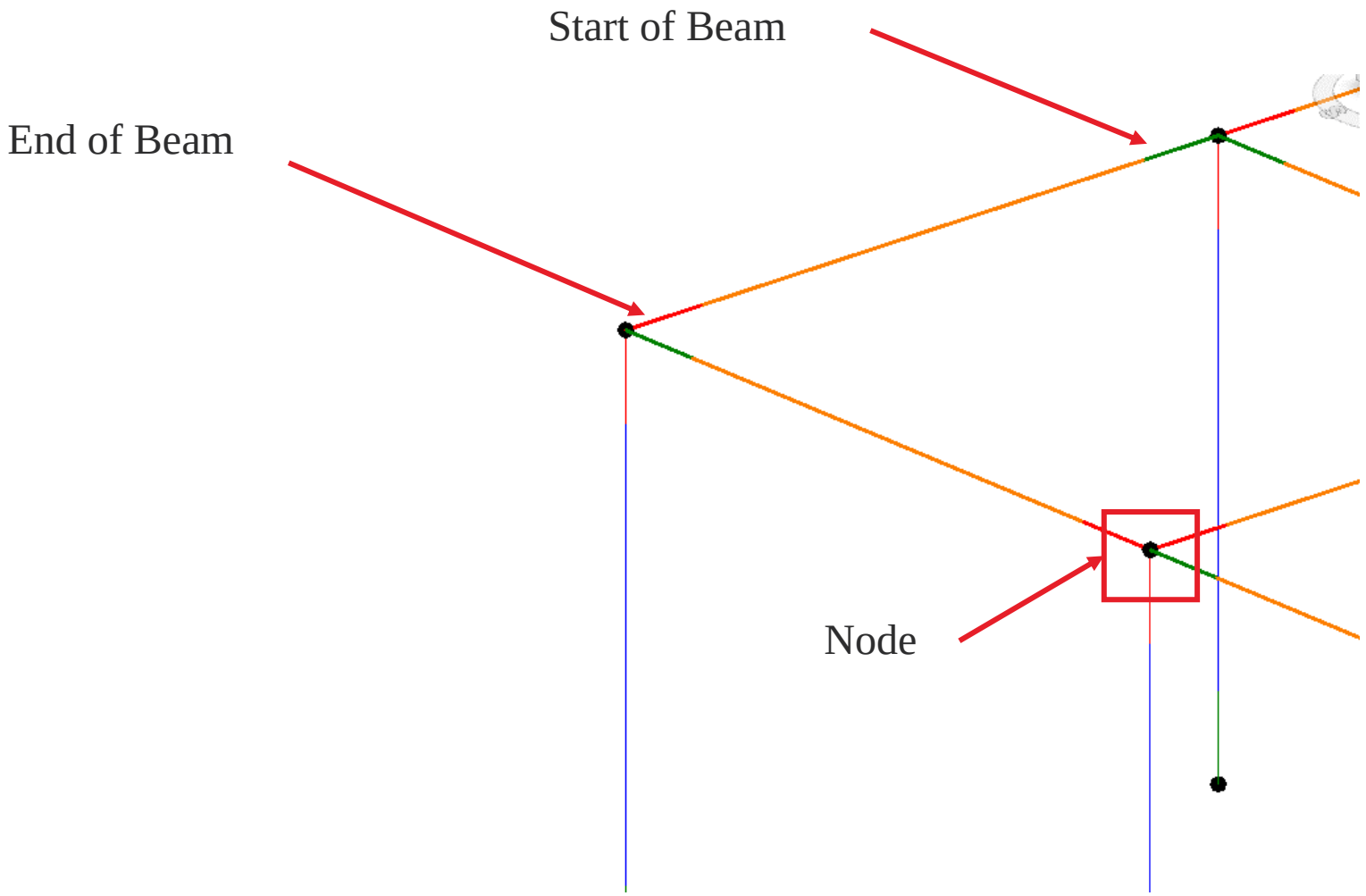






Analytical Modelling

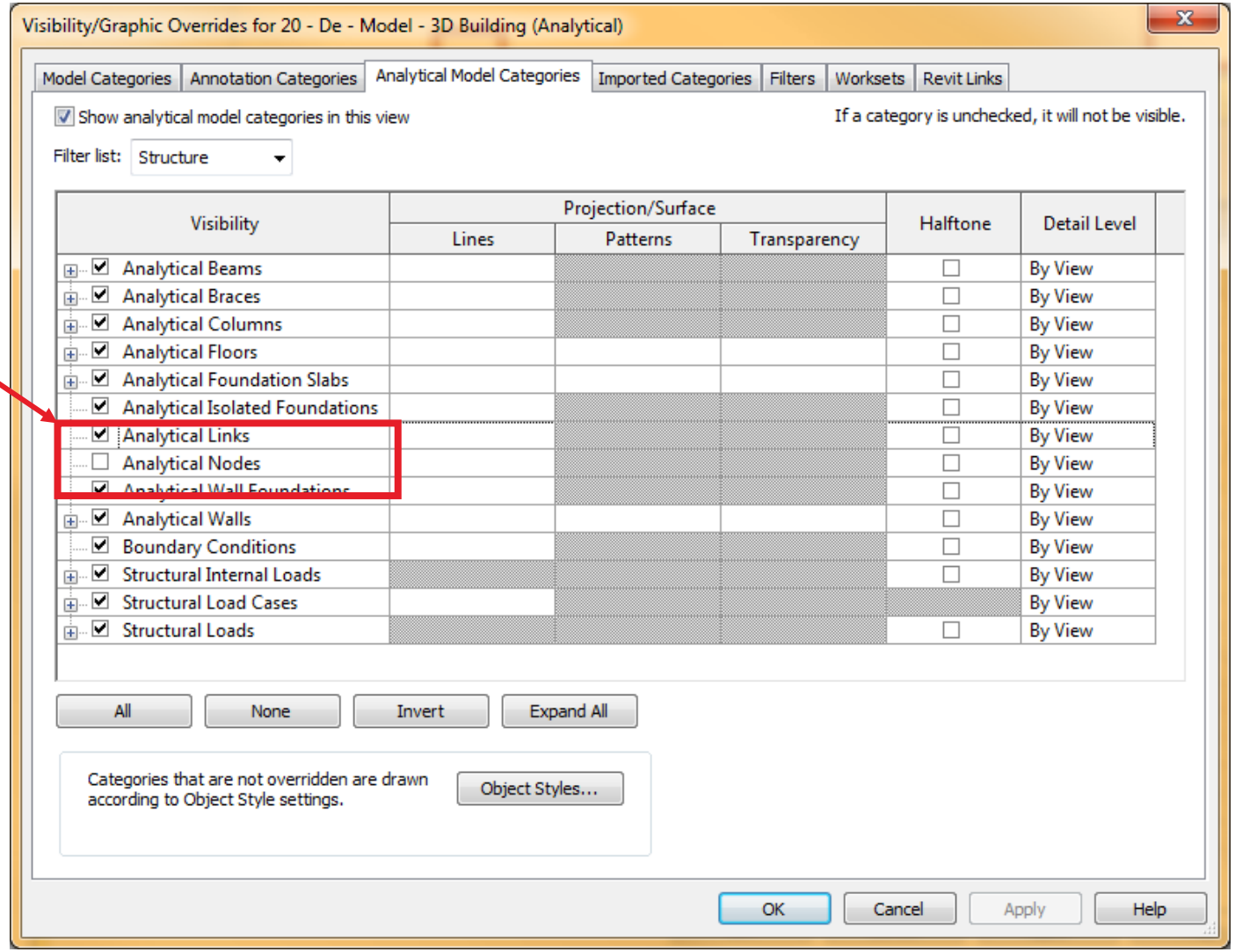
ARUP



Analytical Modelling

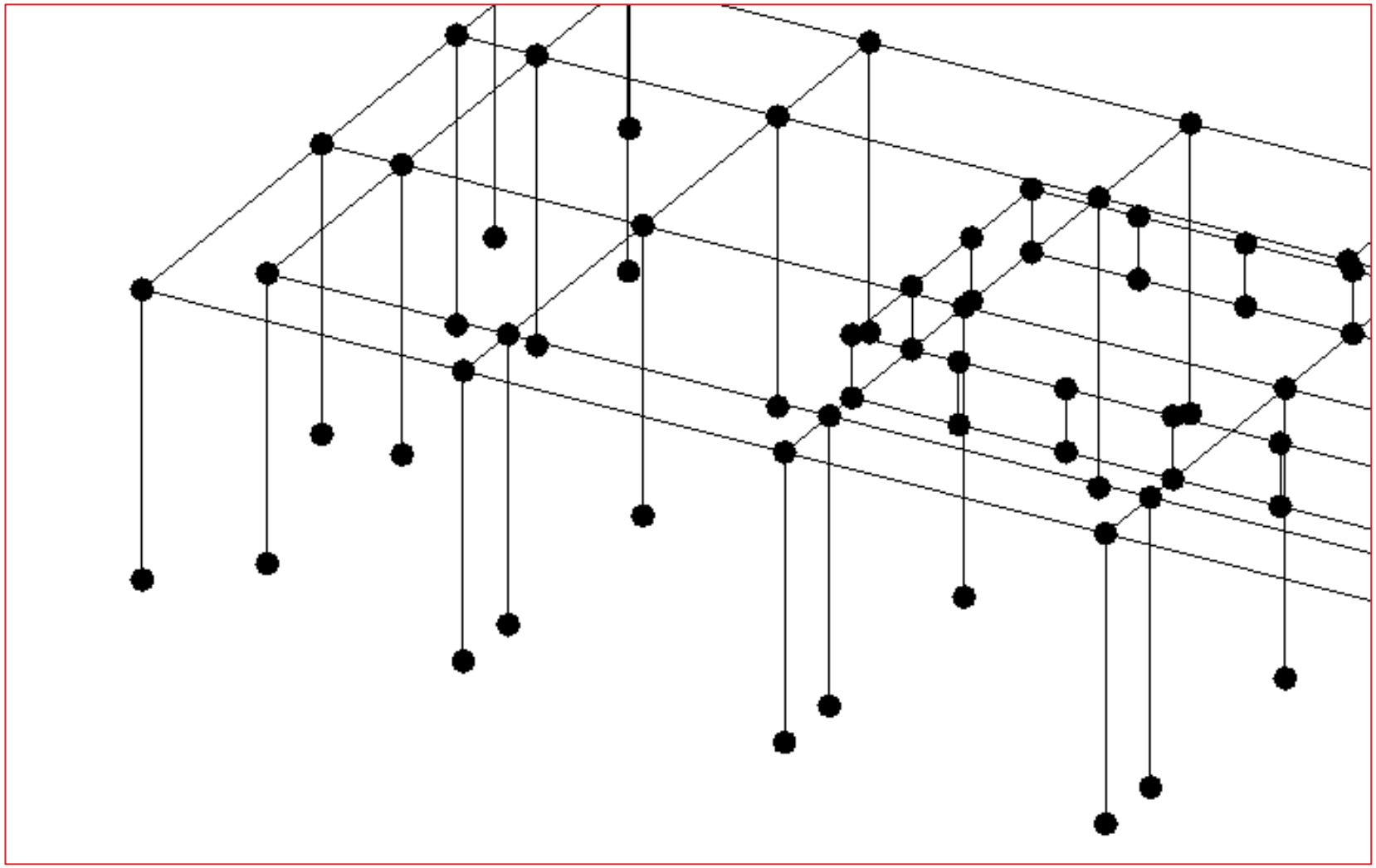
ARUP

Turn on
Analytical Nodes



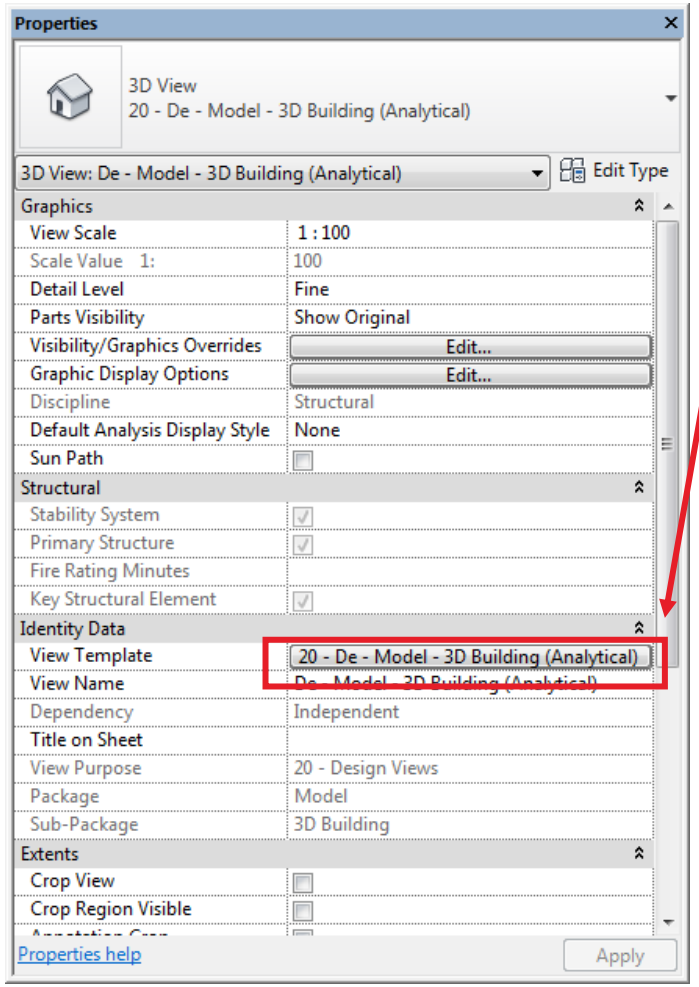
Analytical Modelling

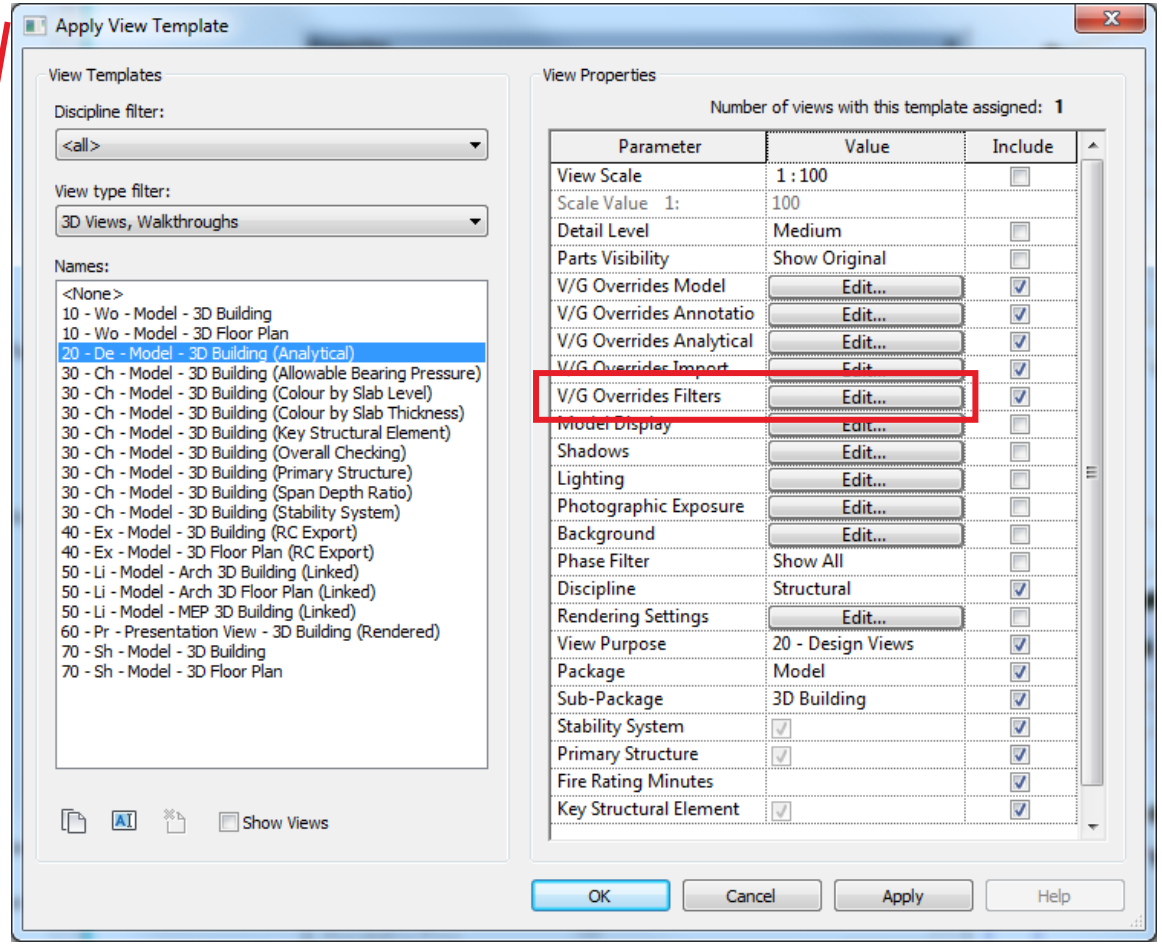
ARUP



Analytical Nodes

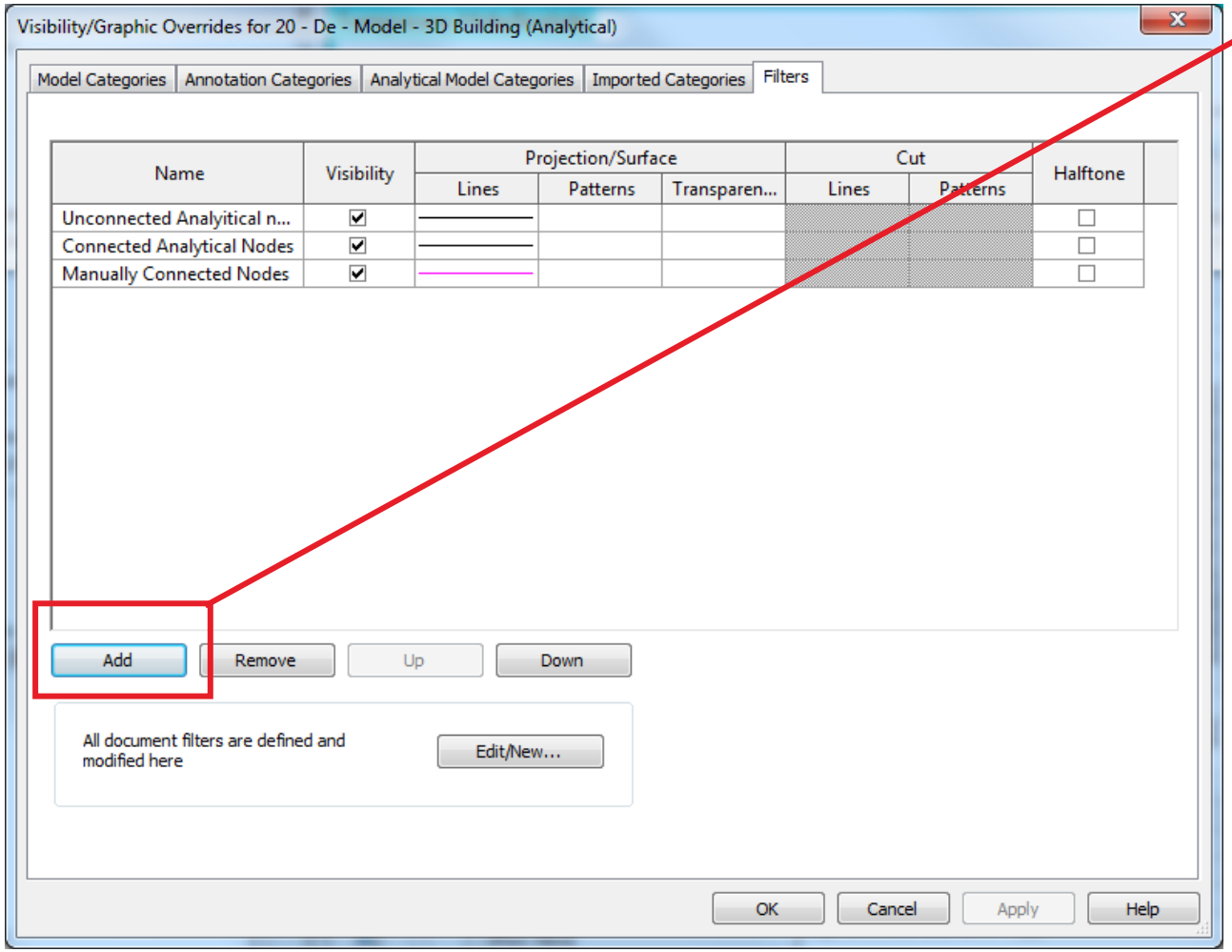
Identify connected and unconnected nodes

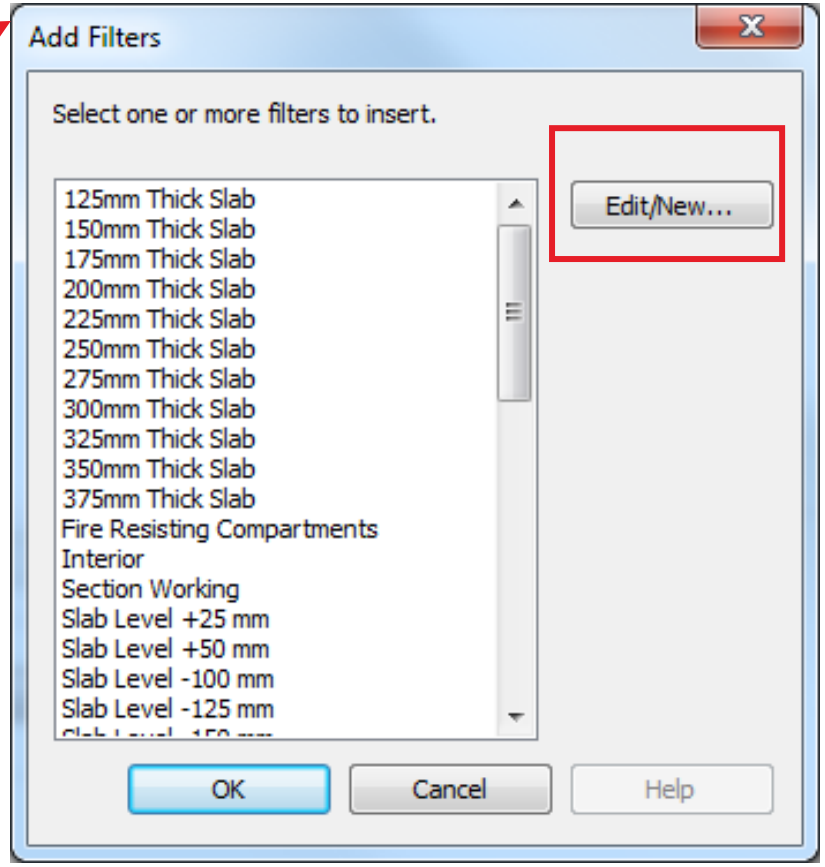




Analytical Modelling

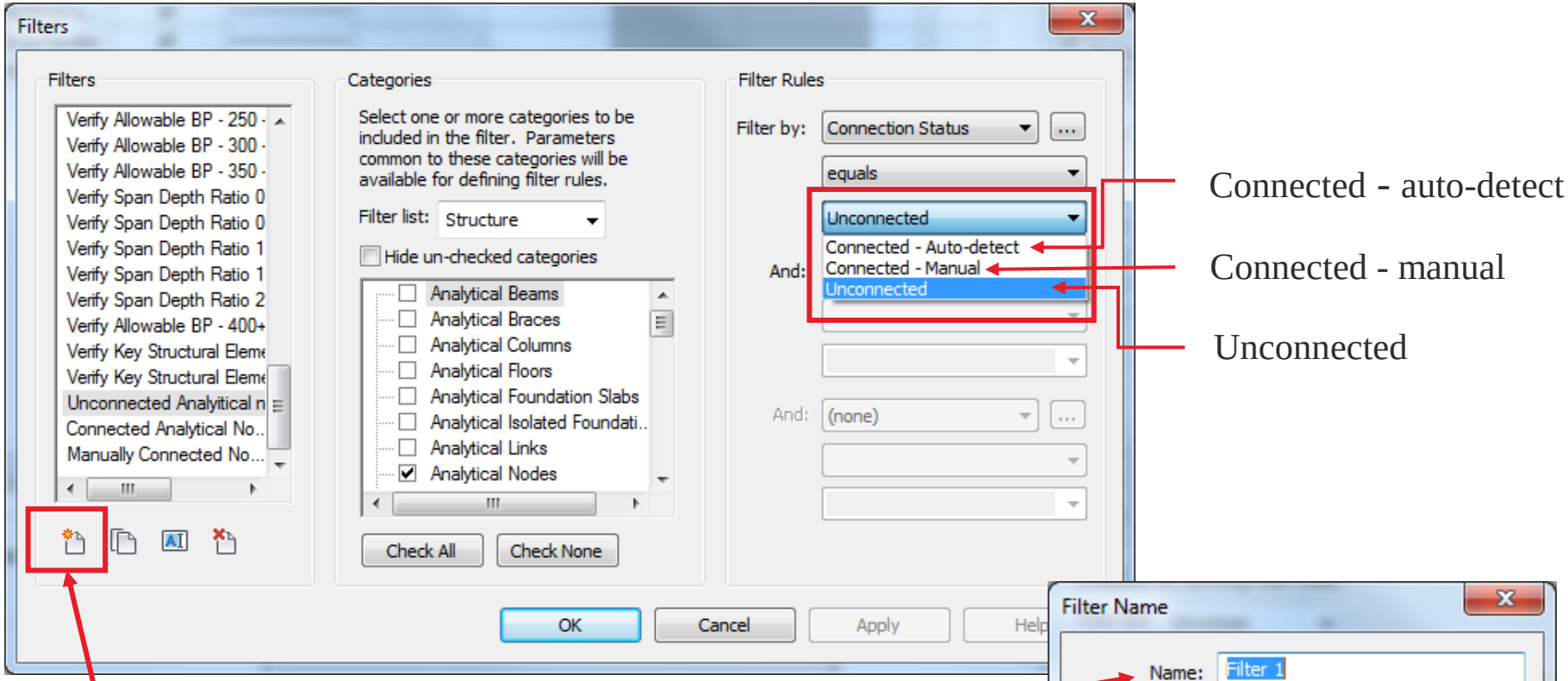
ARUP





Analytical Modelling

ARUP



Connected - auto-detect

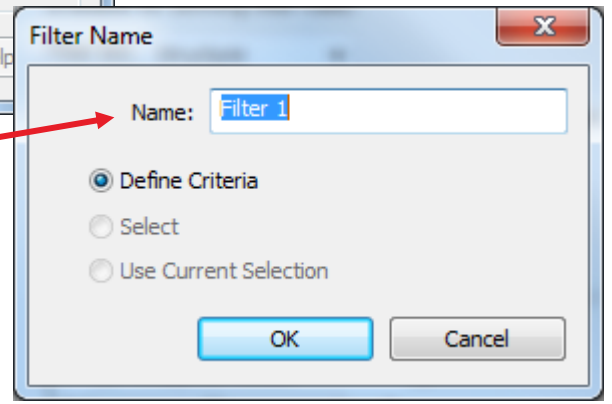
Connected - manual

Unconnected

Create new filter

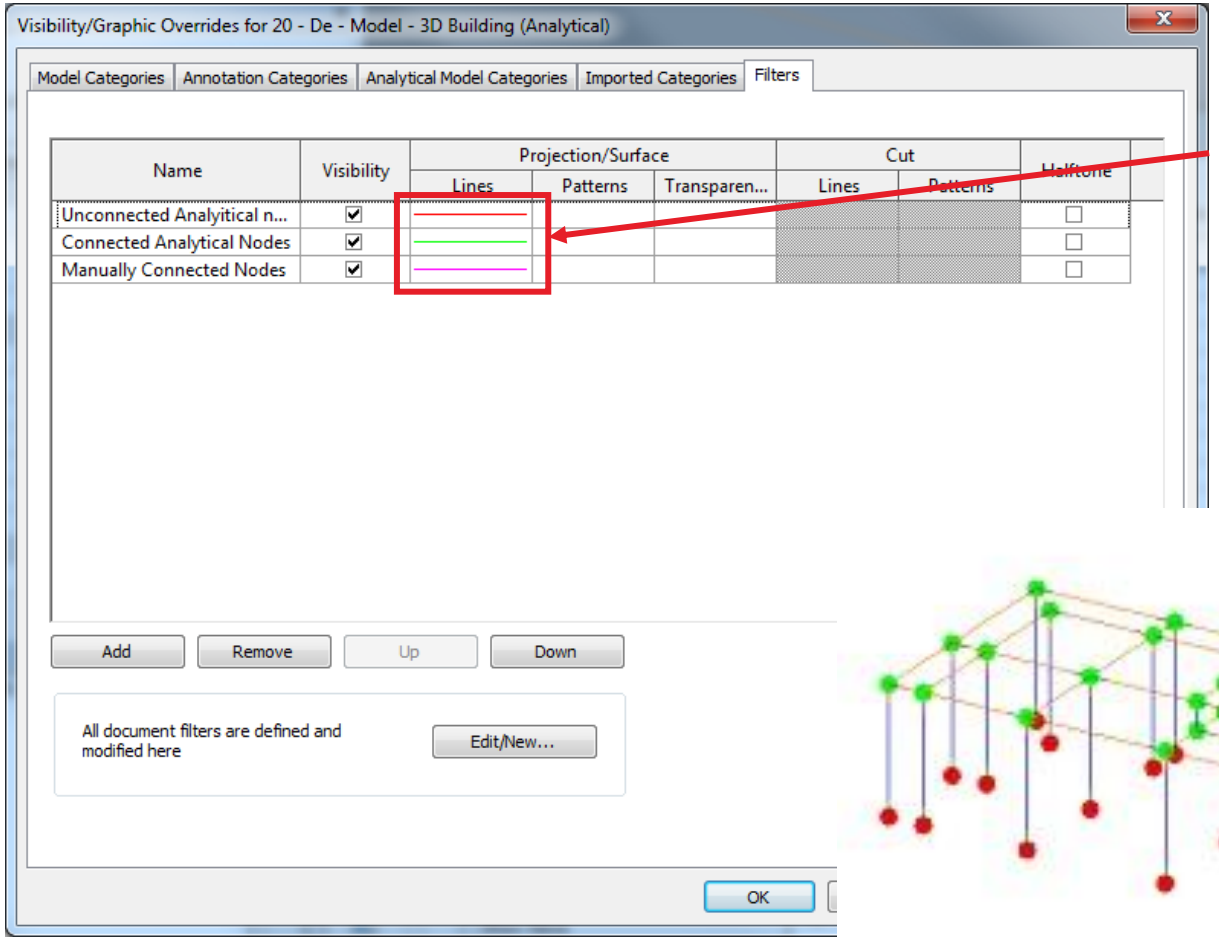
Name the new filter

- Unconnected Nodes
- Connected Nodes
- Manually Connected Nodes



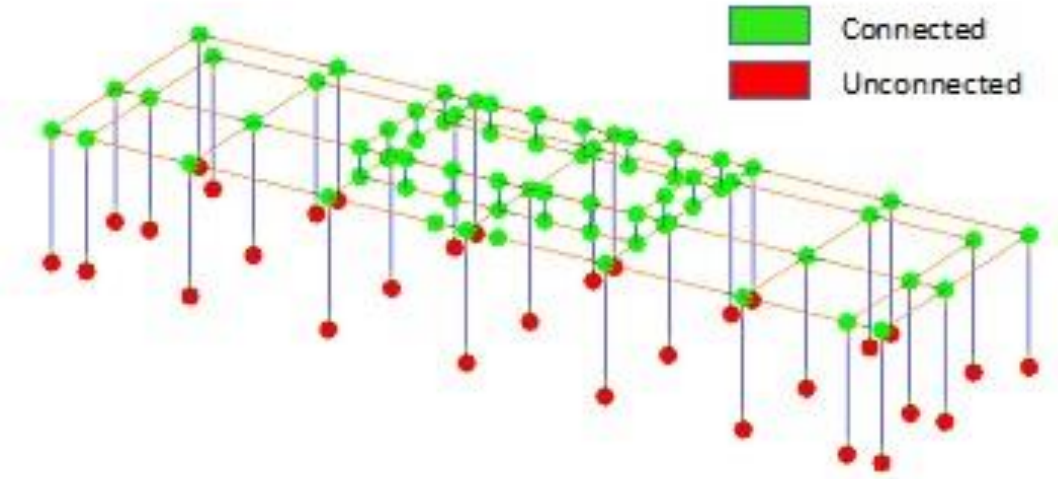
Analytical Nodes

ARUP



Change colours of nodes

- Green = connected
- Red = unconnected
- Purple = manually connected

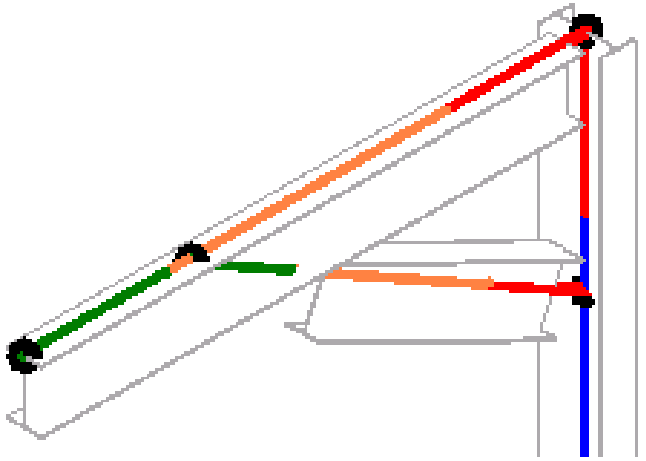


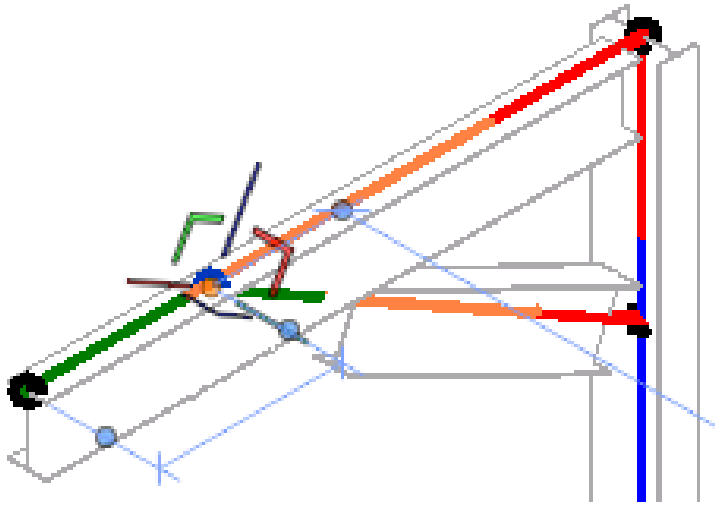
Analytical Nodes

ARUP

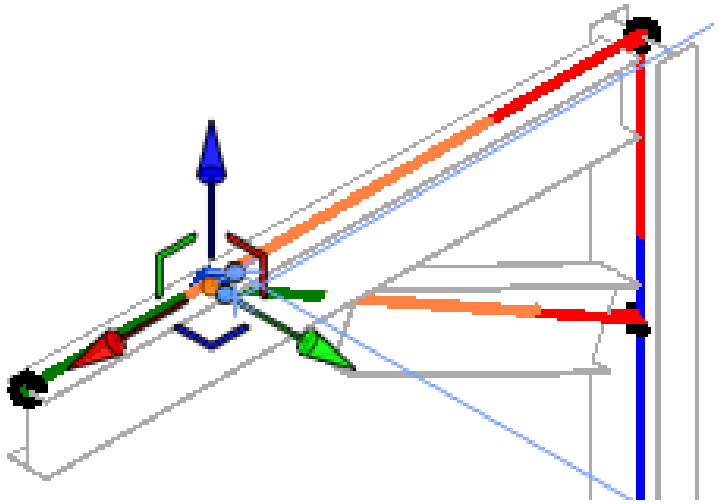
Coordinate System of Nodes

- Local coordinates
- Global coordinates





Control the
Local Coordinates



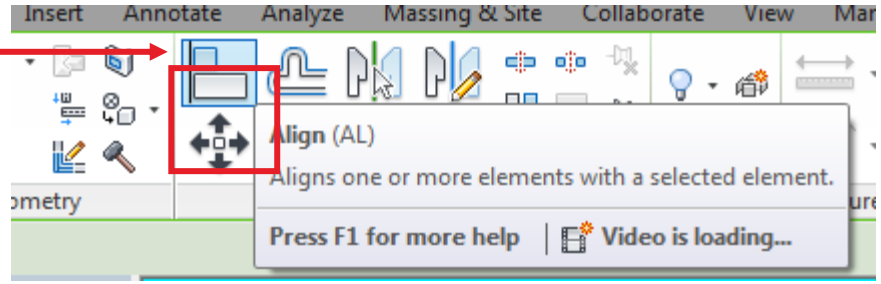
Control the
Global Coordinates

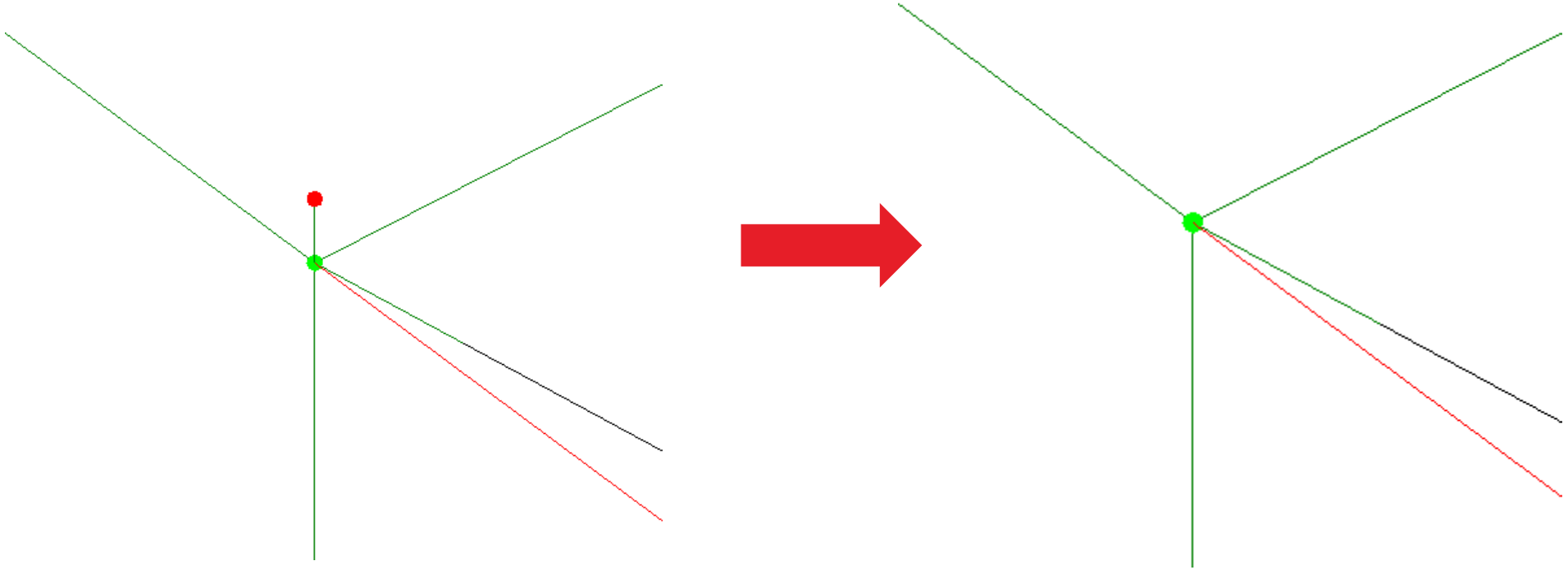
Analytical Nodes

ARUP

Align Tool

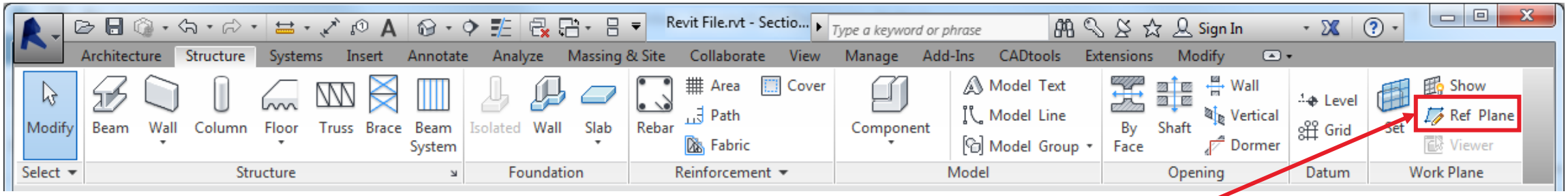
- Select connected node
- Select node to be moved





Reference Planes

ARUP

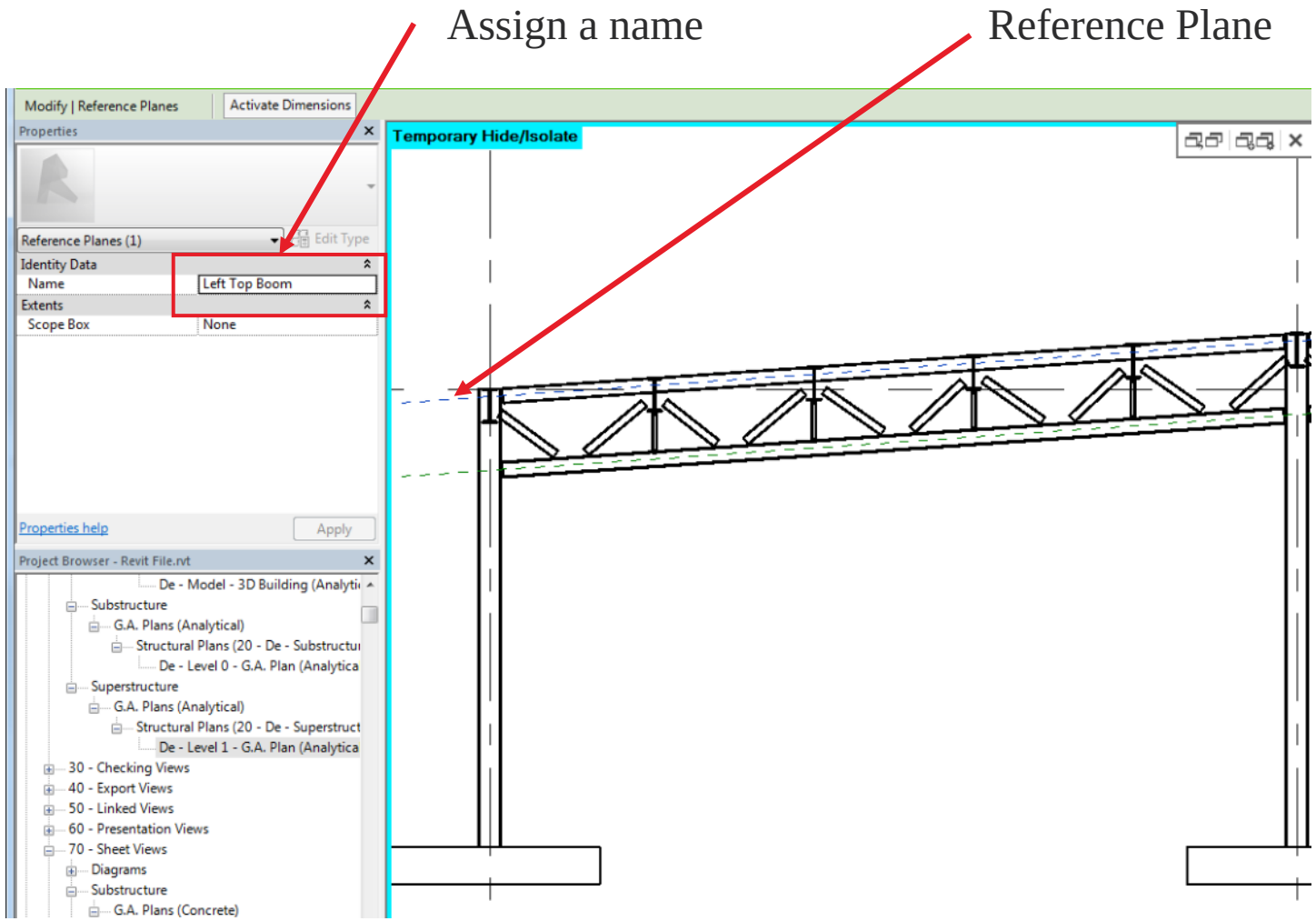


Reference Plane

- Complex Geometry e.g. Trusses
- Use reference planes to align element to a certain level/slope

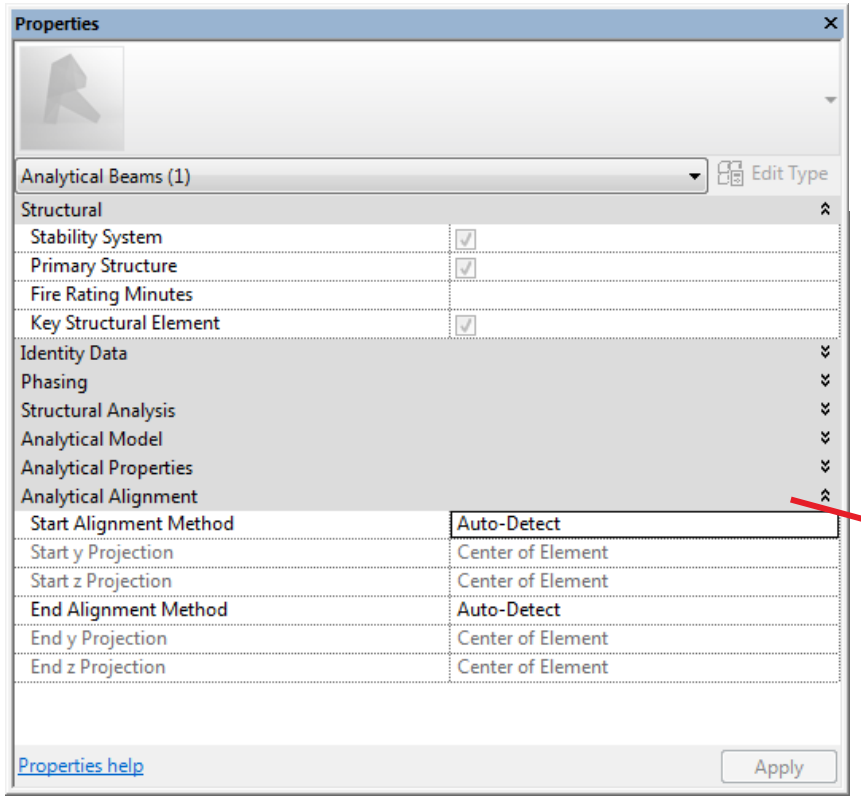
Reference Planes

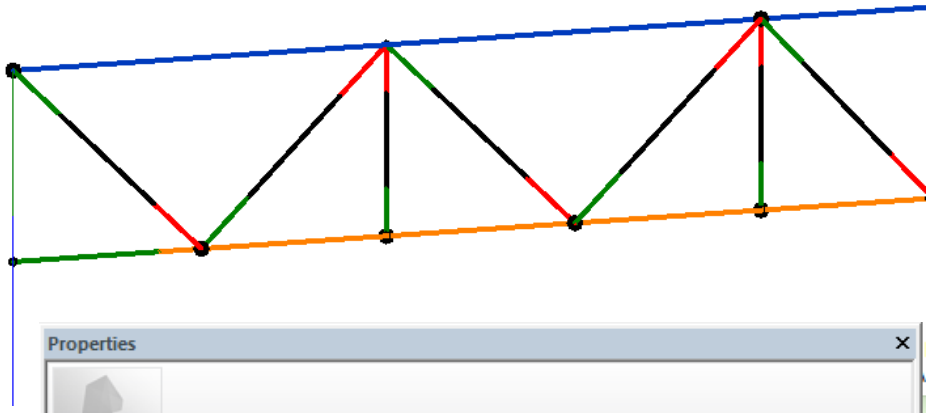
ARUP

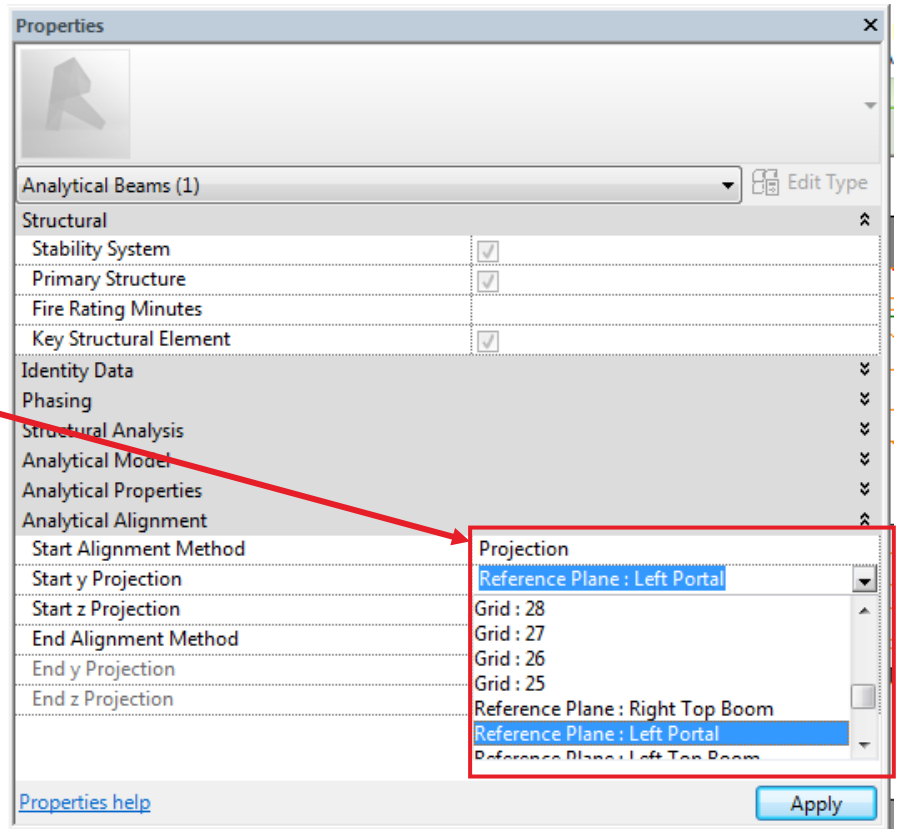


Reference Planes

ARUP



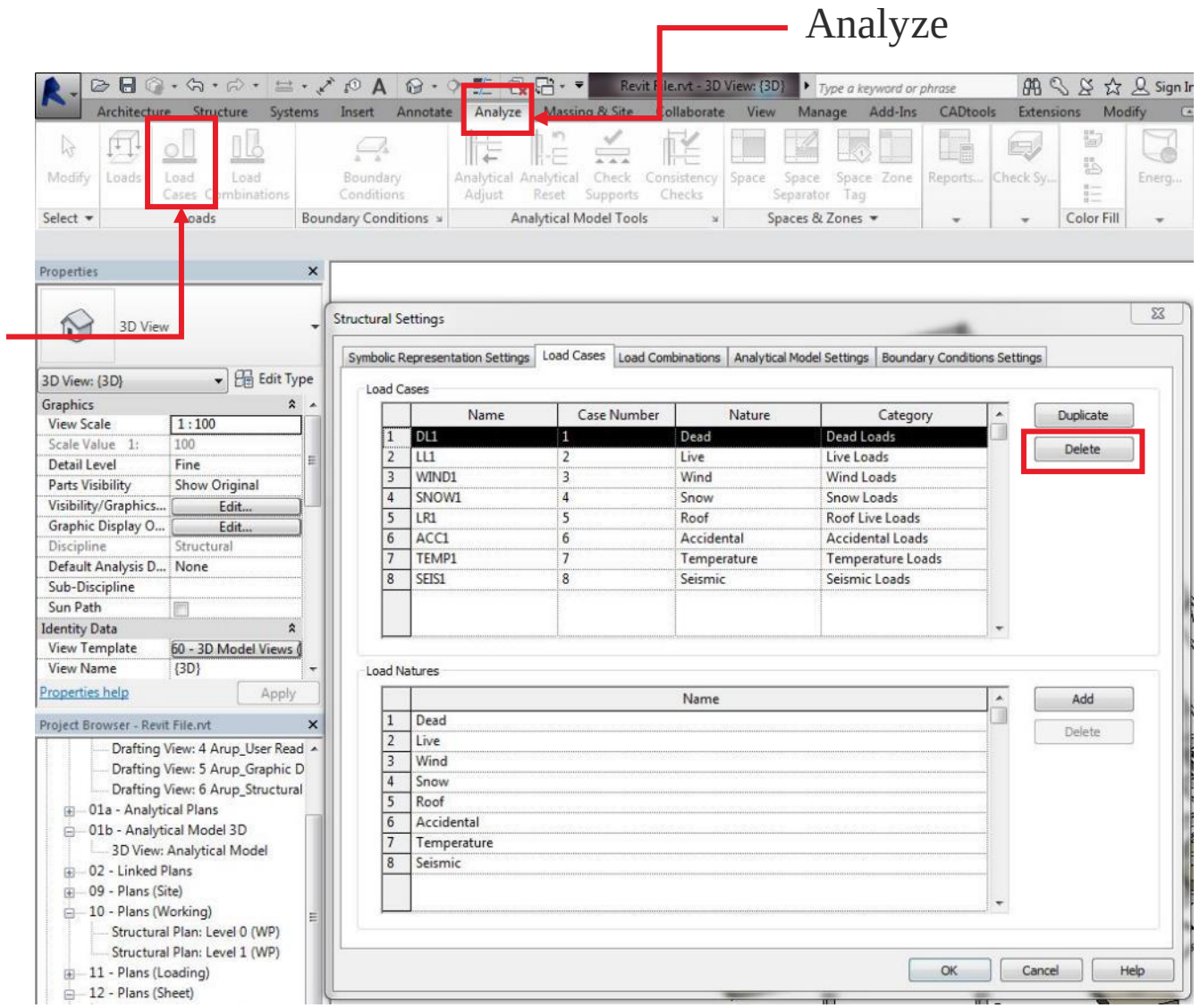




Revit Model Transfer to Robot

ARUP

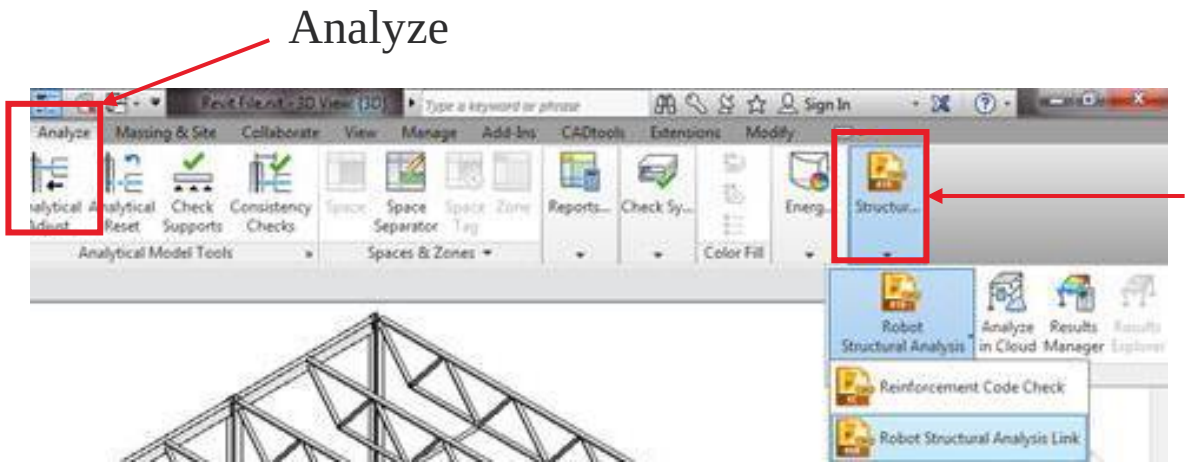
- Revit Load Cases
- Preference to add all load cases and combinations here or create them in Robot

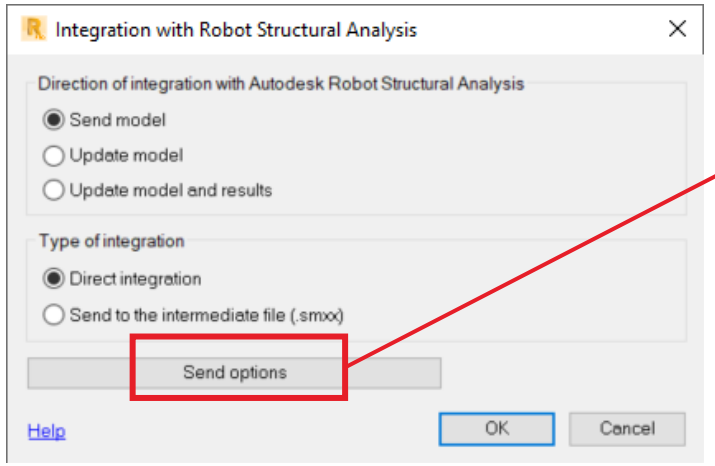


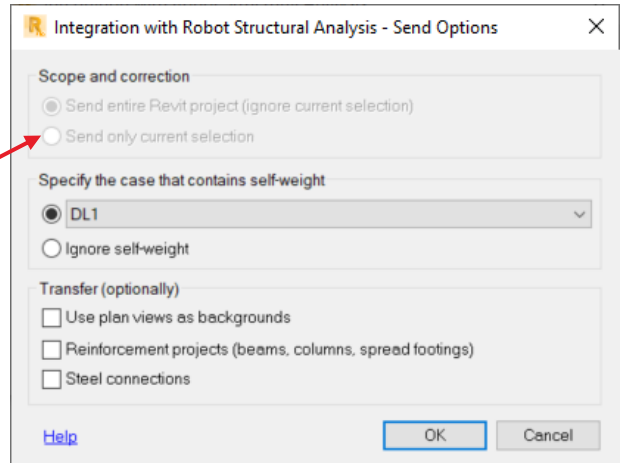
Revit Model Transfer to Robot

ARUP

- Revit-Robot Link
- Send (Revit-Robot)
- Update (Robot-Revit)
- Send Options



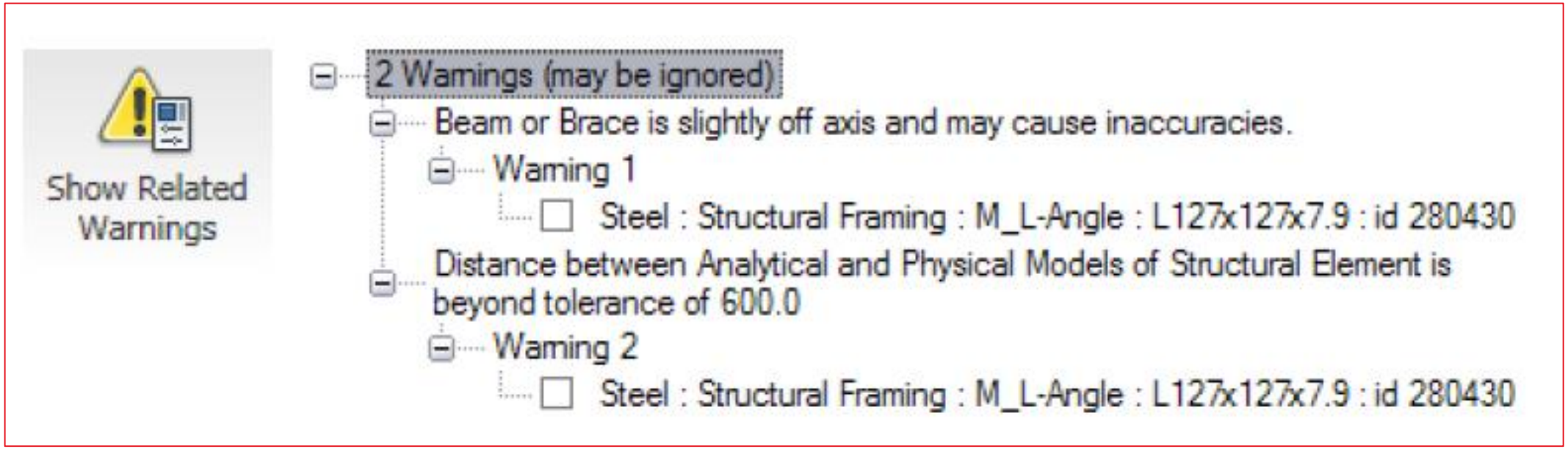




Only one Robot and one Revit open when transferring

Limitations and Errors

ARUP



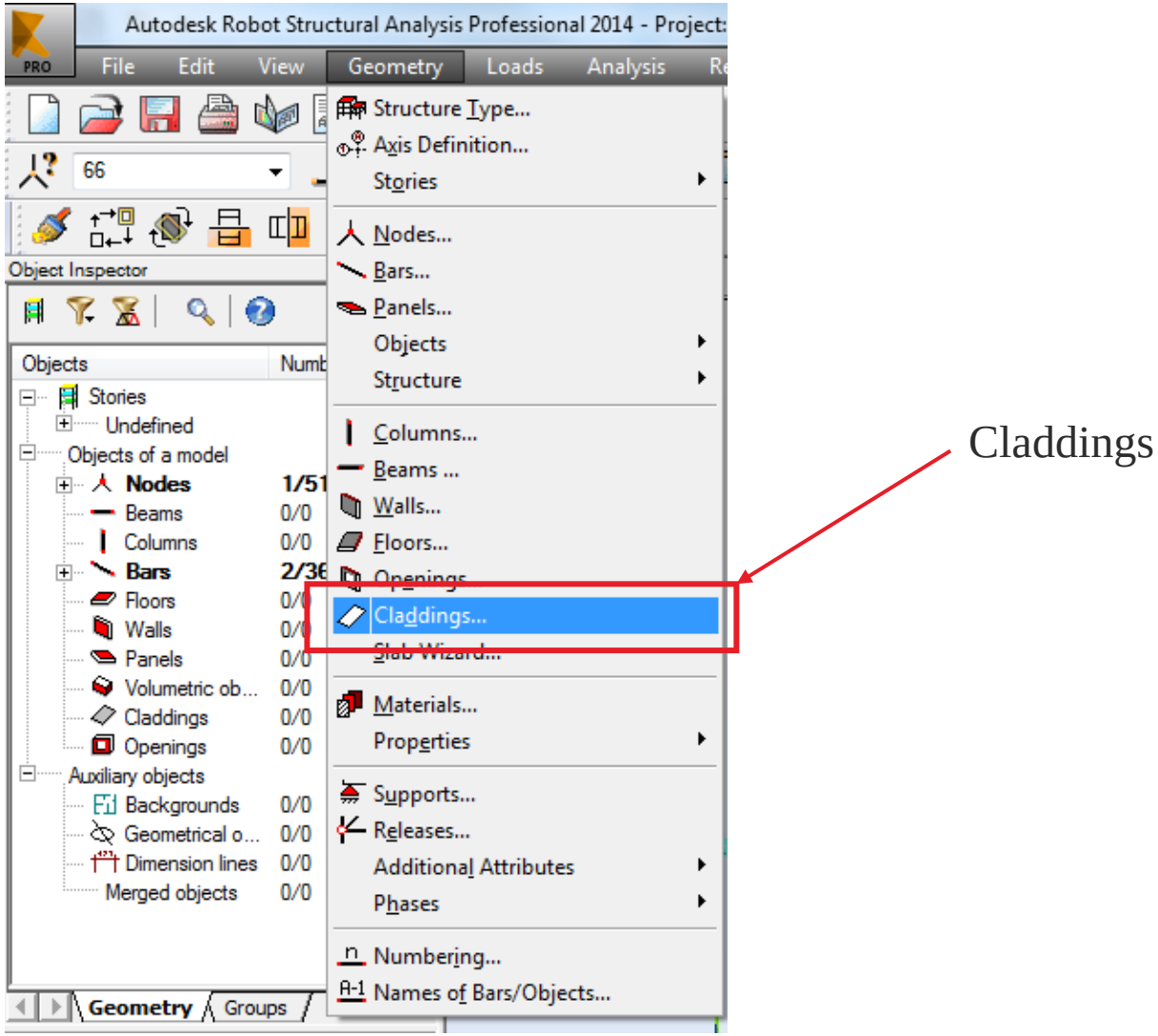
- Error messages when updating or sending model
- Loadings may not transfer from Robot to Revit
- Modifying an element in Robot may lead to changes in Revit
  - Stick to workflow methodology

Limitations and Errors

ARUP

Claddings

- Used to apply loading
- Disappear in Revit but are remembered when resending model to Robot



Limitations and Errors

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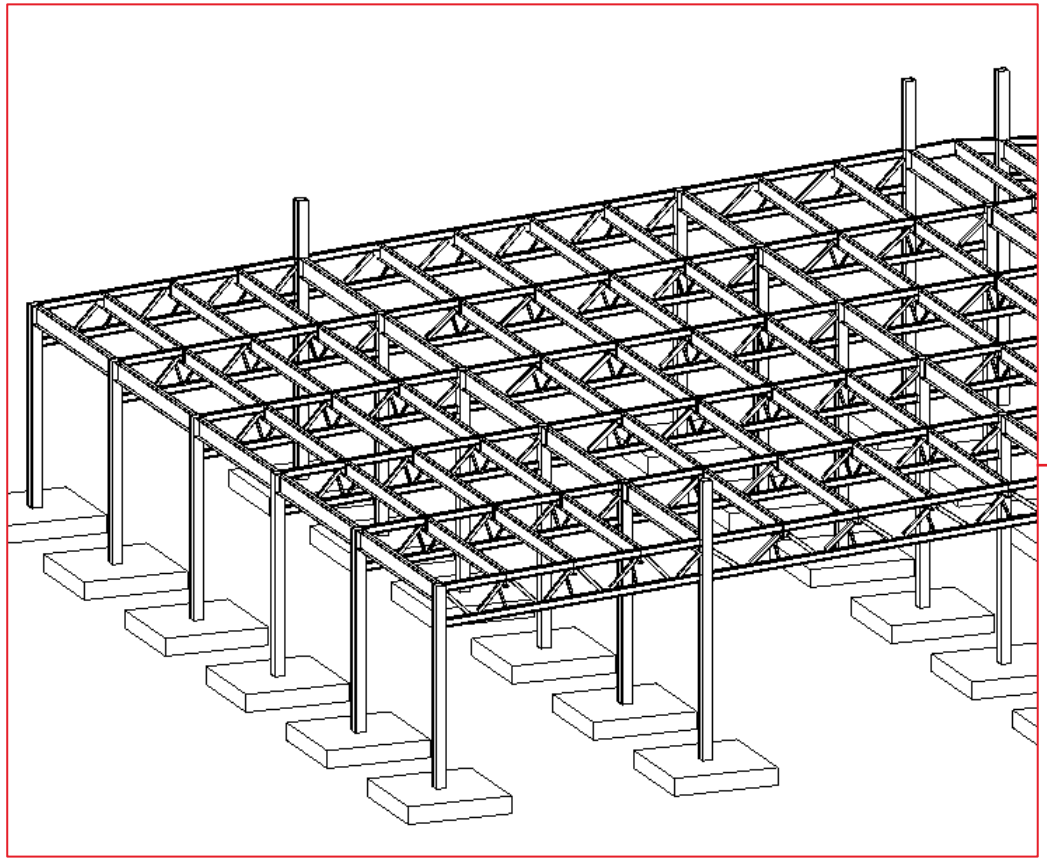

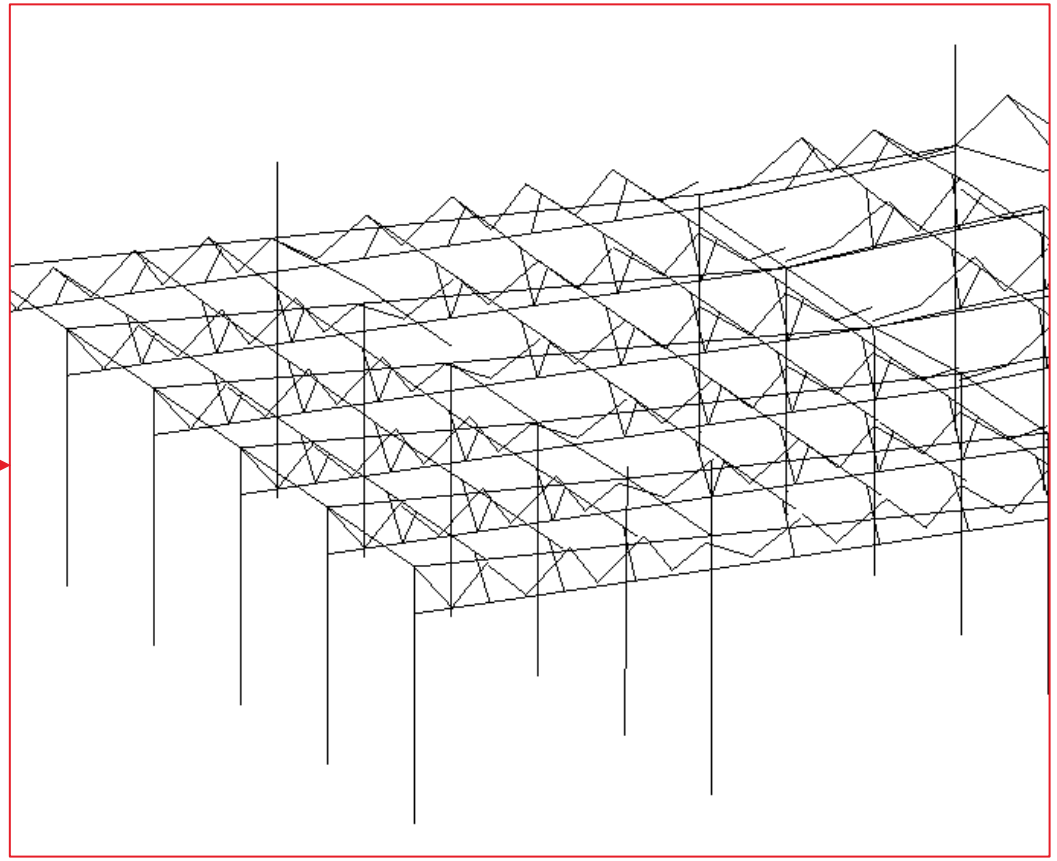

Workflows

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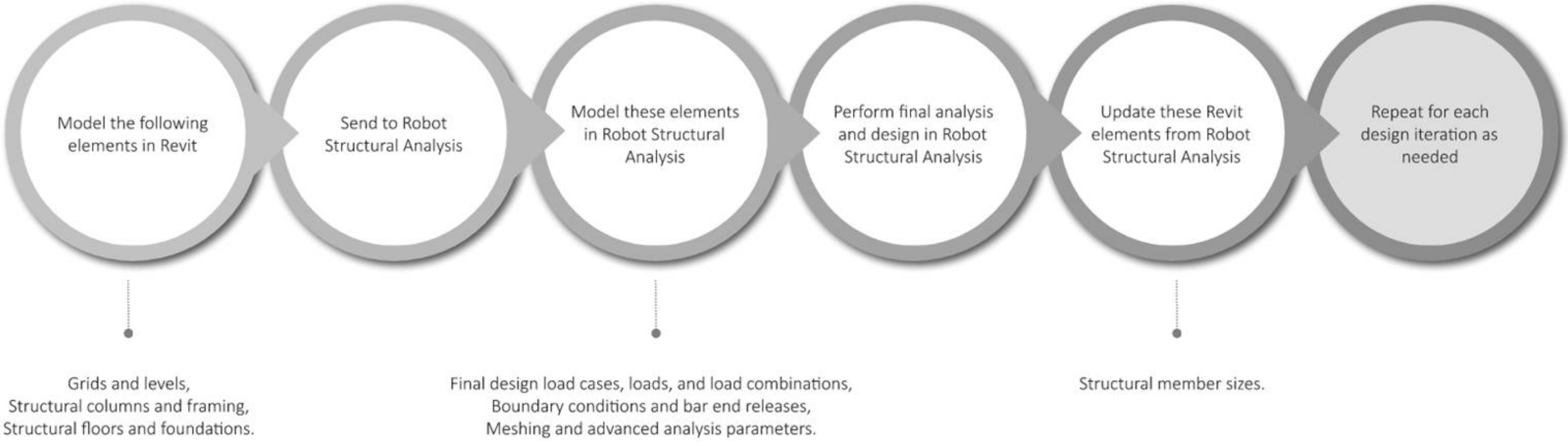
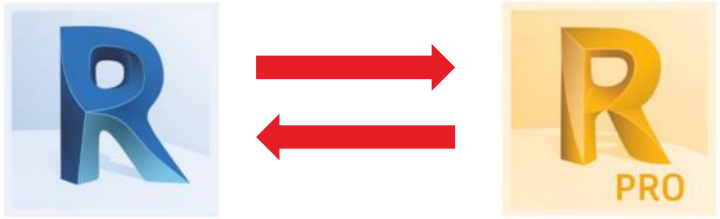


- Revit-Robot Link - Easy to use
- Some degree of interoperability is verified
- Time advantage for Engineer to Modeller



West Pharmaceuticals, Waterford

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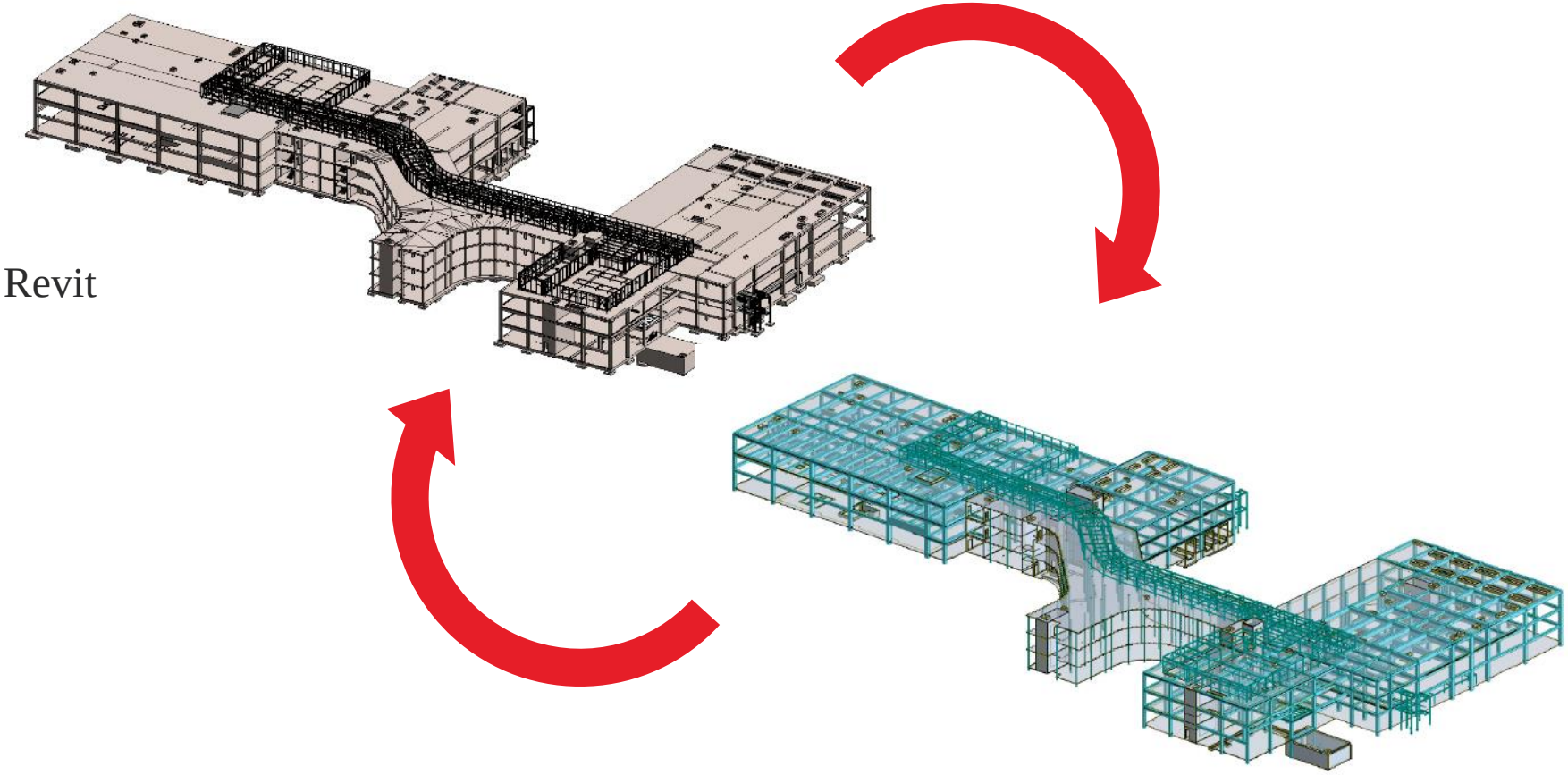
Autodesk Revit



Autodesk Robot Structural Analysis Professional

West Pharmaceuticals, Waterford

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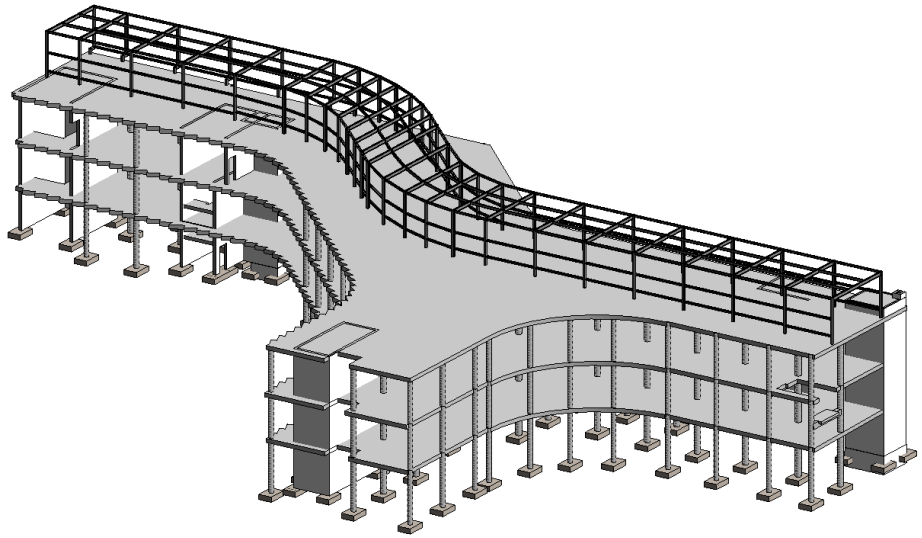
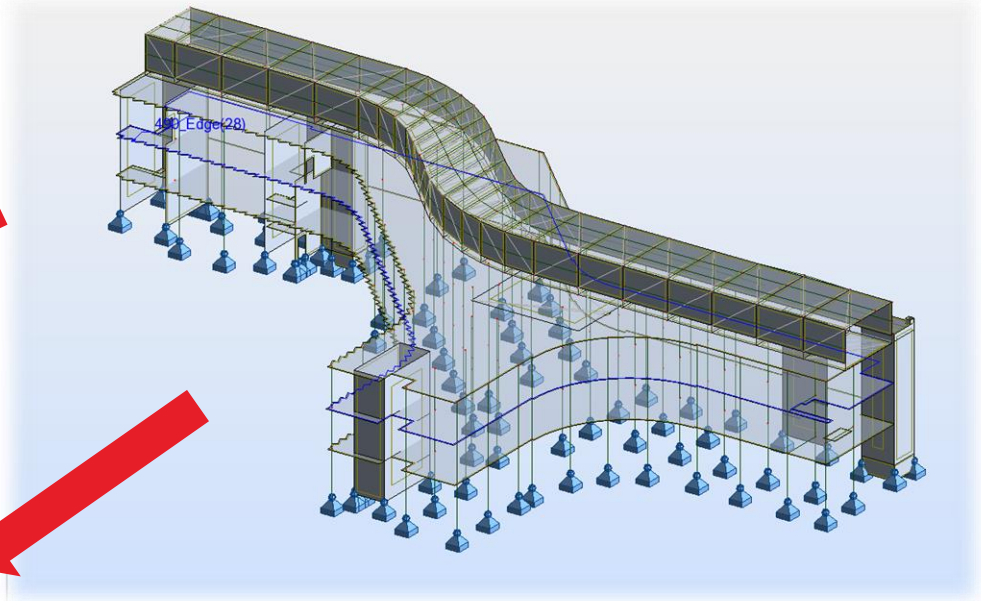
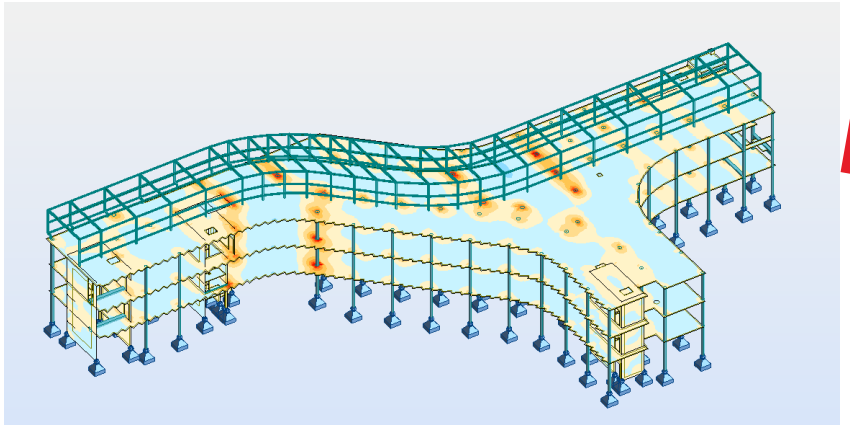


Autodesk Revit





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The Future

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Automation & Scripting Software

The Future

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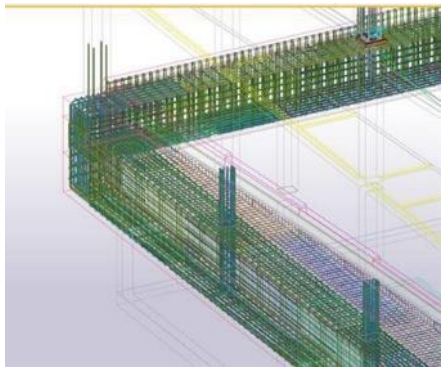
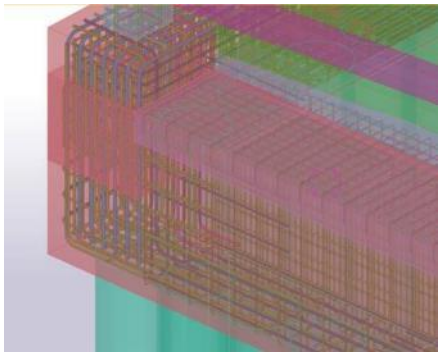
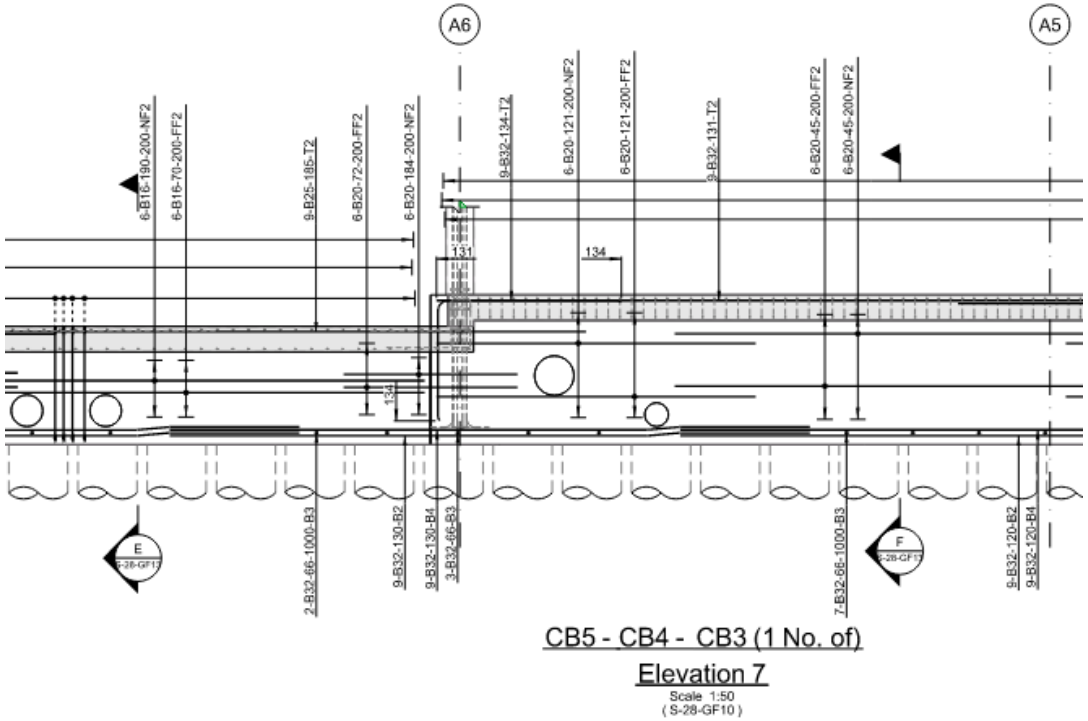
Rebar Modelling Automation

- 3D RC detailing using Tekla Structures and Grasshopper (UK and Australia Arup teams)







The Future

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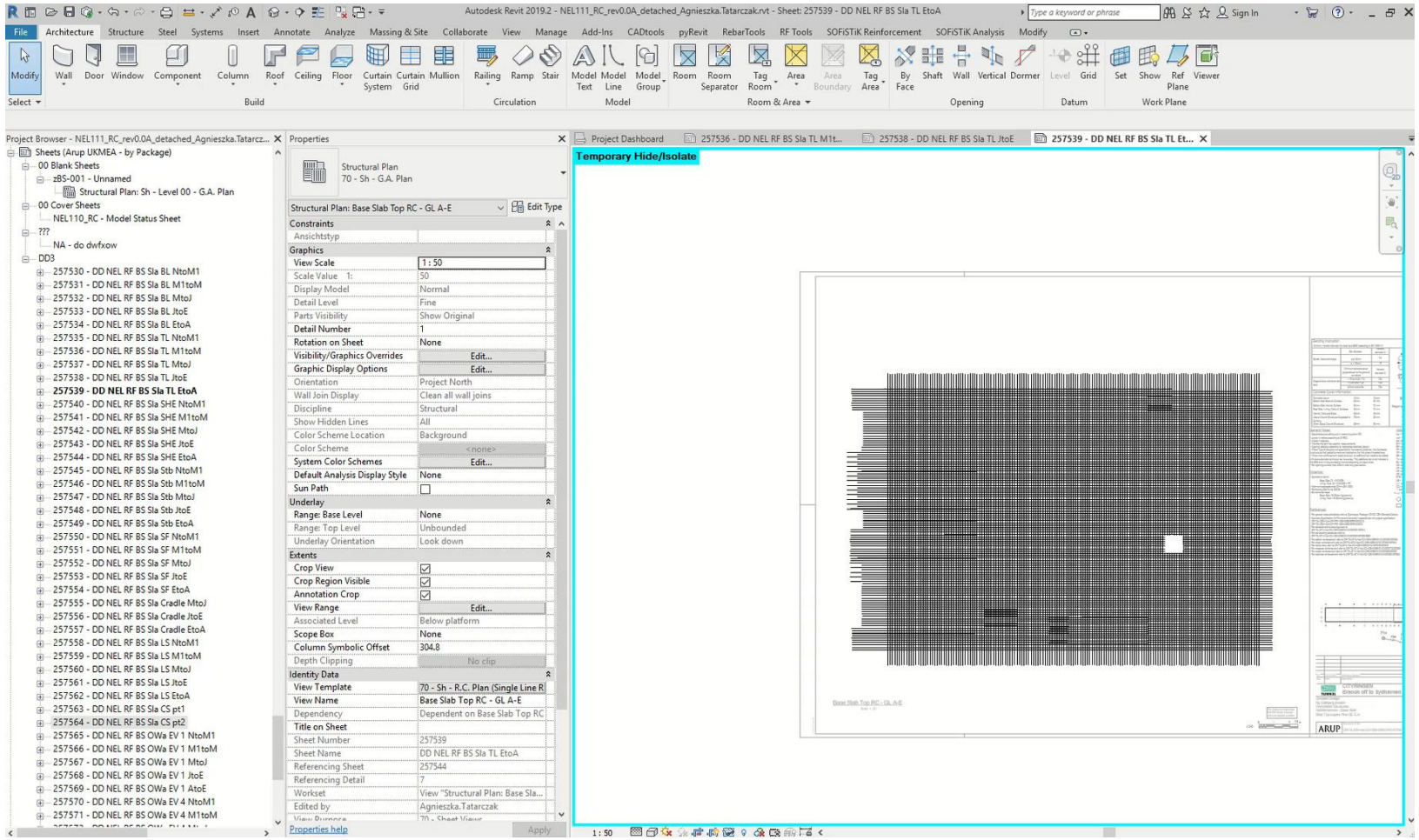
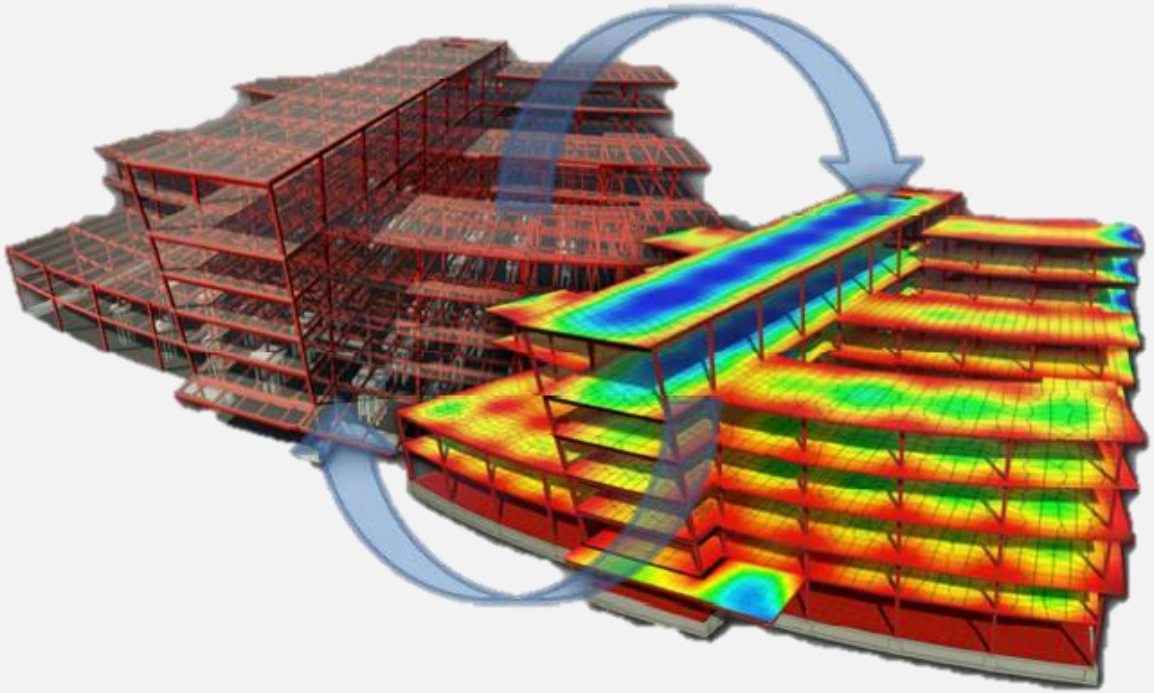
Rebar Modelling Automation

- 3D RC detailing using Revit and Python
- (Europe Arup offices)





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Thank you

Any Questions?

Shauna Hurley

16:04:2021

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