Extended workflows with Autodesk Advance Steel

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Class summary

In this class, we will explore extended workflows that lead to enhanced fabrication details with Autodesk Advance Steel. We will see the advantages of an integrated approach with Autodesk Revit, Autodesk Robot Structural Analysis Professional and ultimately Autodesk Navisworks. We will also be introducing how we can link to general connection design through an Autodesk Structural Partnering solution. Finally, in this class we will explore the use of Dynamo with Autodesk Advance Steel through discussion and worked examples. This session features Autodesk Advance Steel, Autodesk Revit and Autodesk Robot Structural Analysis Professional. AIA Approved

Key learning objectives

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

- Understand the Autodesk structural offerings
- Understand the integrated workflow with Autodesk Advance Steel
- Know some of the recent enhancements to the portfolio
- Learn where Dynamo can assist your design process

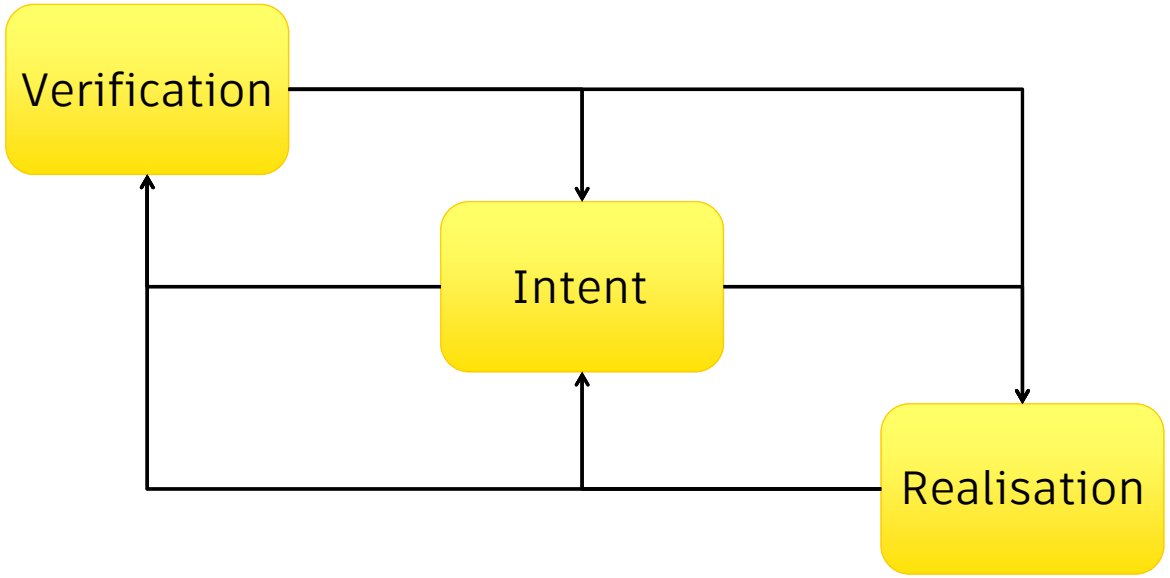
What is Structural Engineering?

Structural Engineering

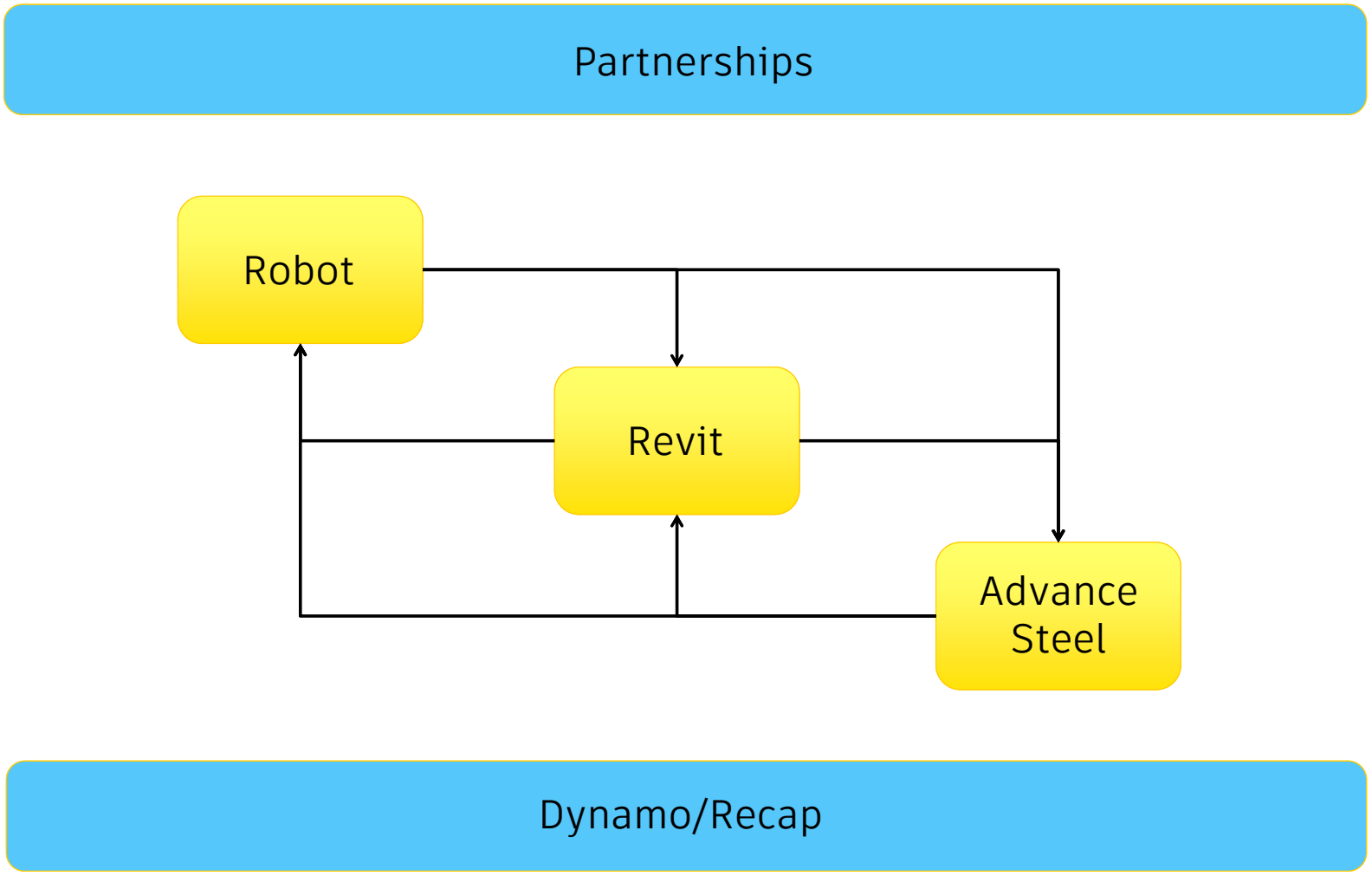
"Engineering is the art of modelling materials we do not wholly understand, into shapes we cannot precisely analyse so as to withstand forces we cannot properly assess, in such a way that the public has no reason to the suspect the extent of out ignorance." Dr A R Dykes

Why an integrated workflow?

Third party plug-ins/API Programming

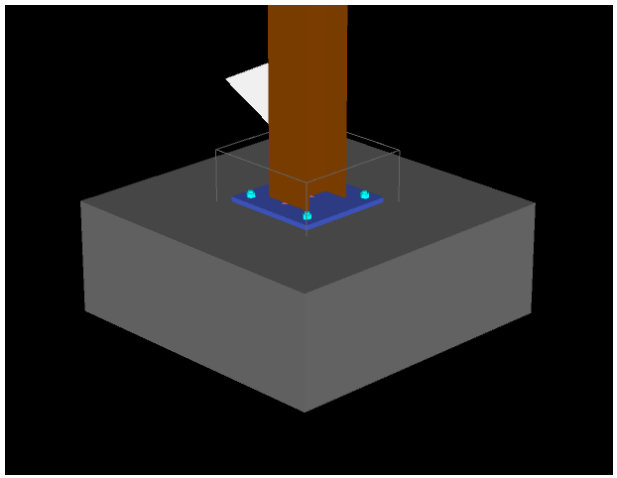


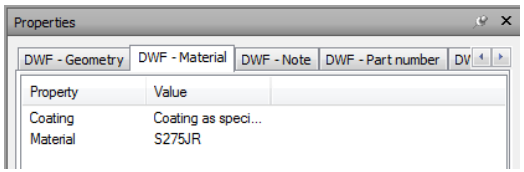
Visual programming/laser scanning


Partnerships
Robot
Revit
Advance Steel
Dynamo/Recap

Integraton with Autodesk Navisworks

- Leverages Autodesk Navisworks functionality
  - File formats
  - Coordination
  - Information

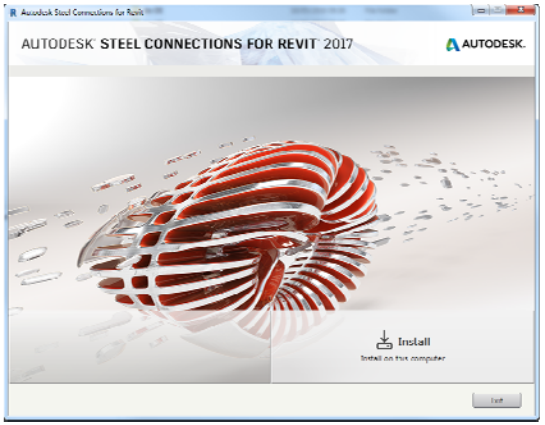


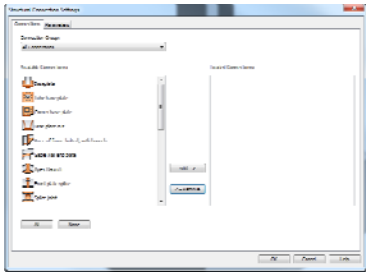


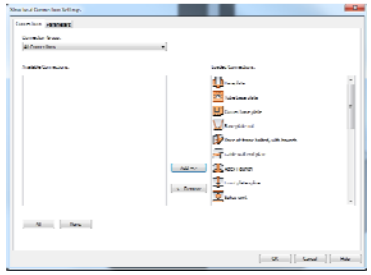
- Direct from Autodesk Advance Steel

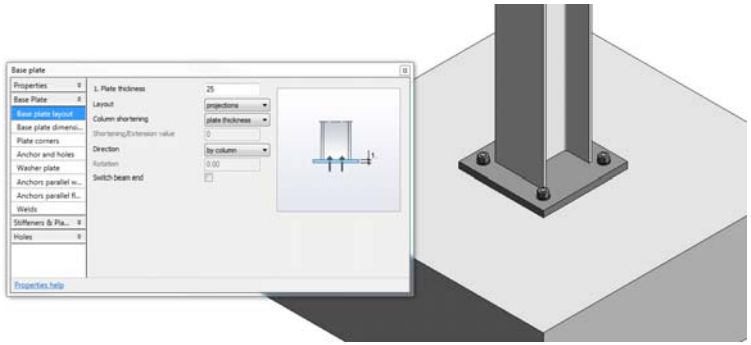
Connections in Autodesk Revit

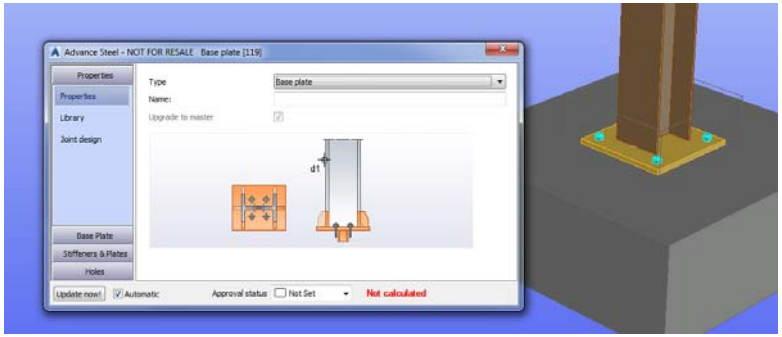
- New for 2017





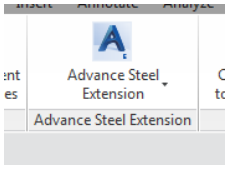


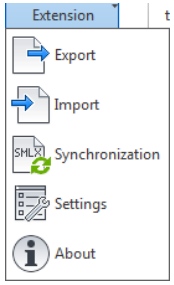




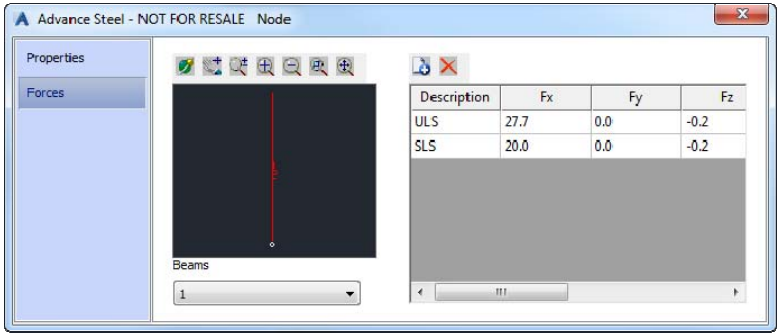
Autodesk Advance Steel add-in for Autodesk Revit

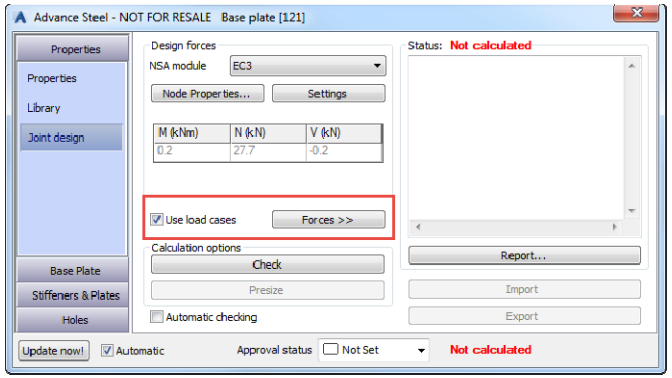
- Bi-directional integration via SMLX





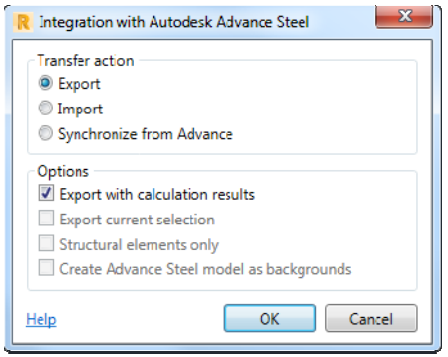
- Reactions re-used for connection design



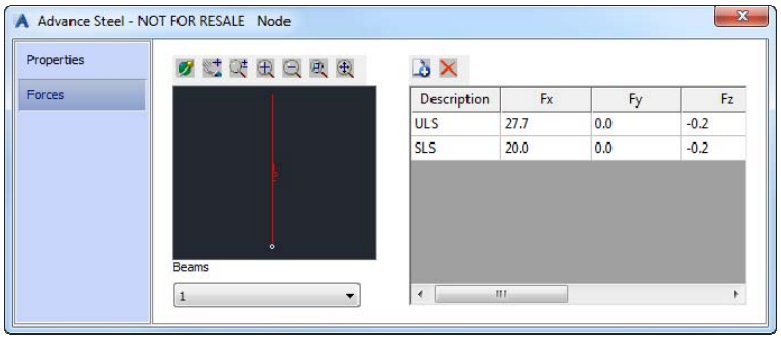


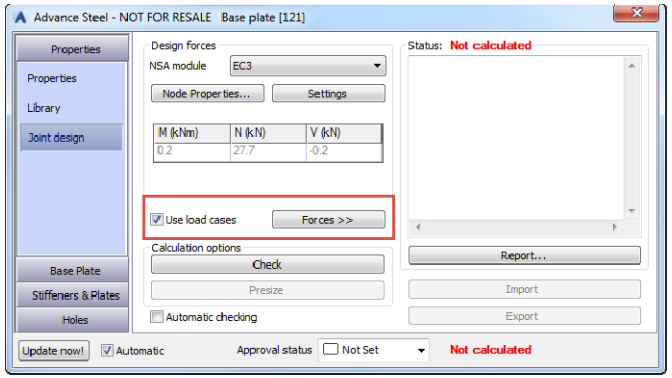
Autodesk Advance Steel add-in for Autodesk Robot Structural Analysis Professional

- Bi-directional integration via SMLX



- Reactions re-used for connection design



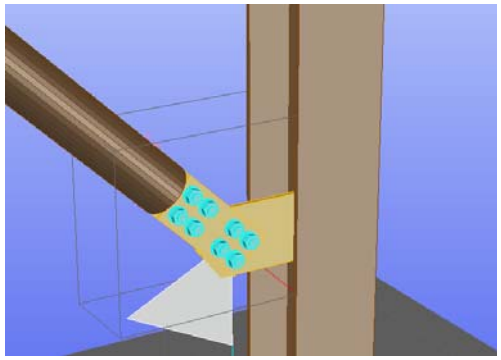


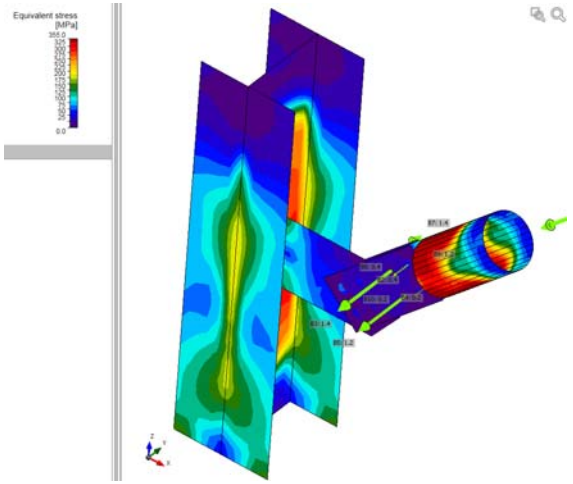
Complex Connections

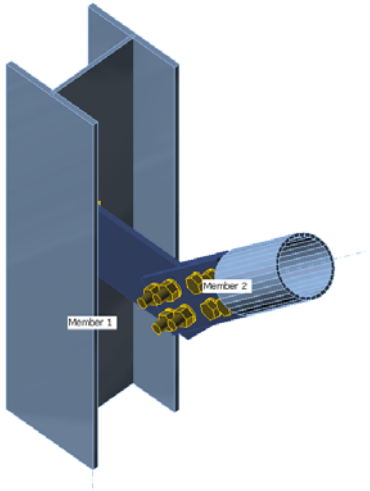
- Idea Statica
  - CBFEM

Overview of all checks for extreme load effect

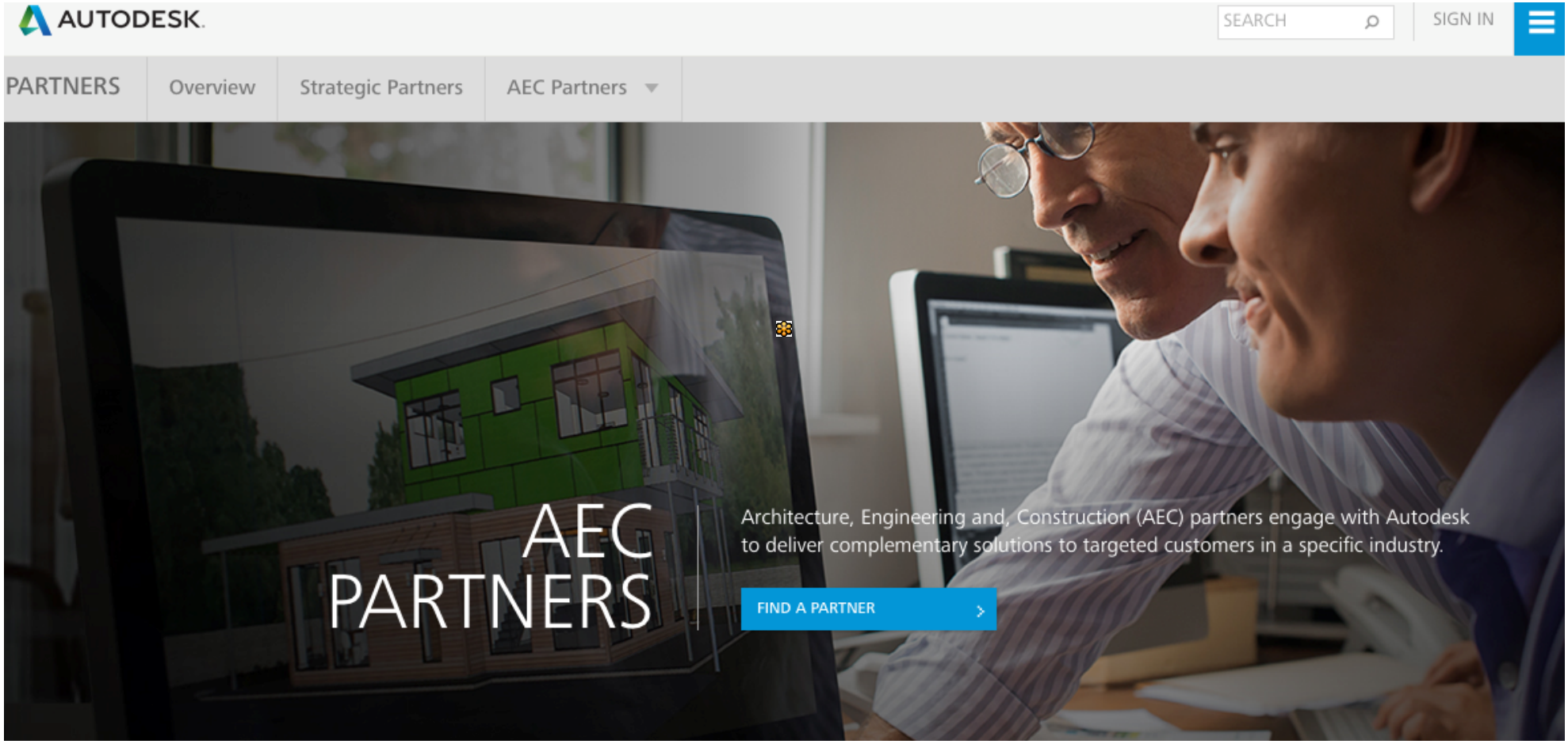
	Check item	Value	Status
	Analysis	Applied loads : 100.0%	✓
>	Plates	142.7 > 5%	✗
	Bolts	8.8 < 100%	✓
	Welds	120.9 > 100%	✗



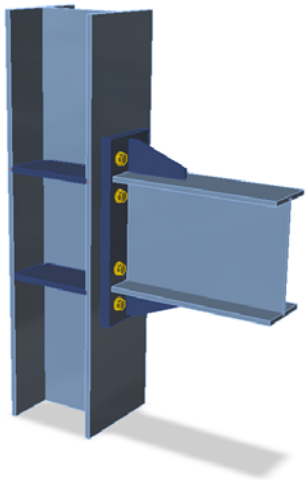


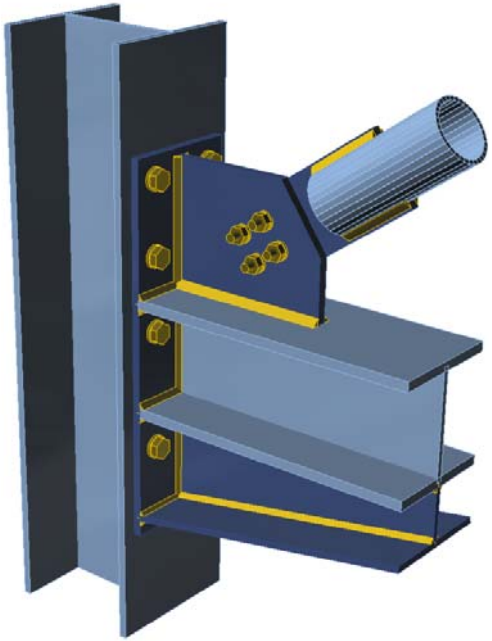


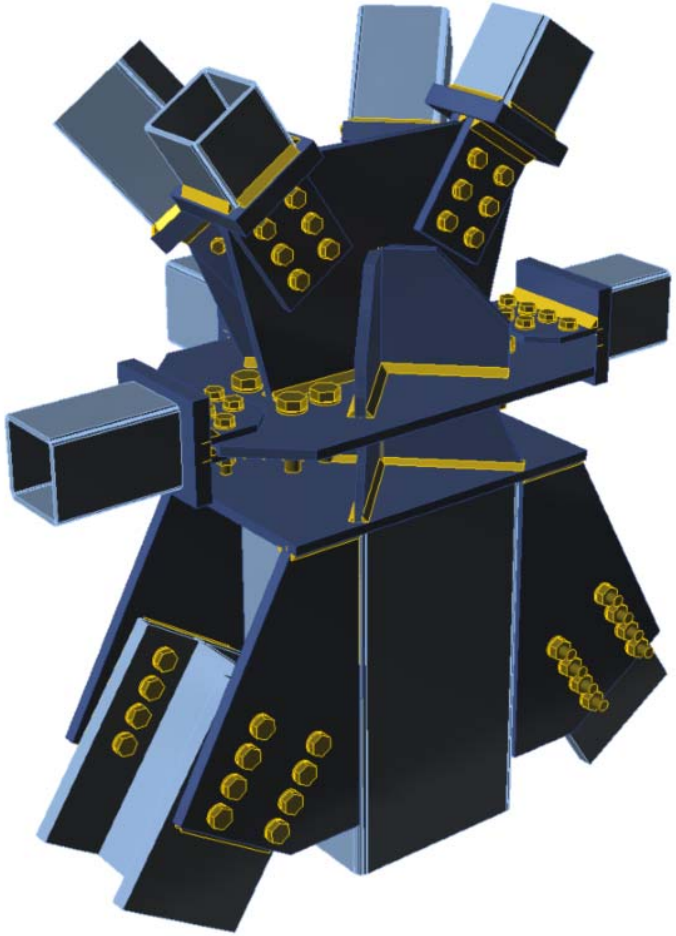
IDEA StatiCa is a solution associate of Autodesk



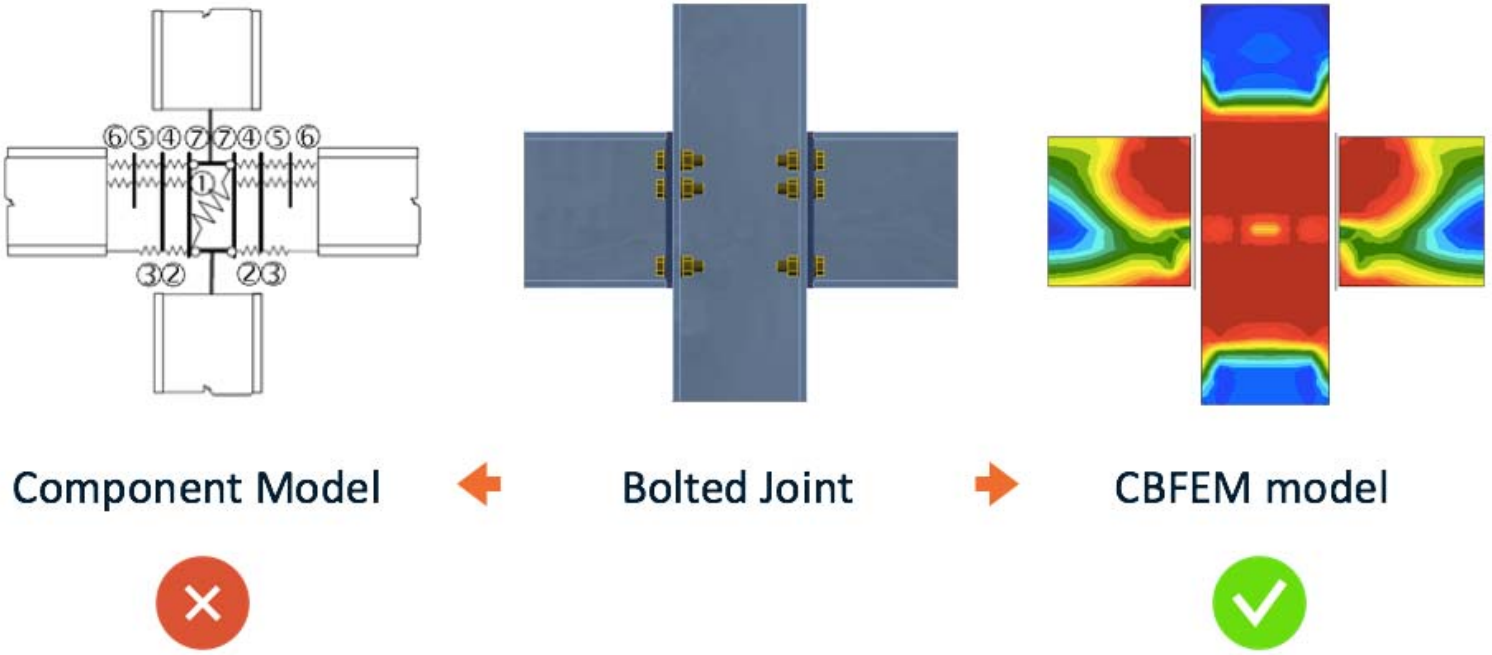
What does any topology mean





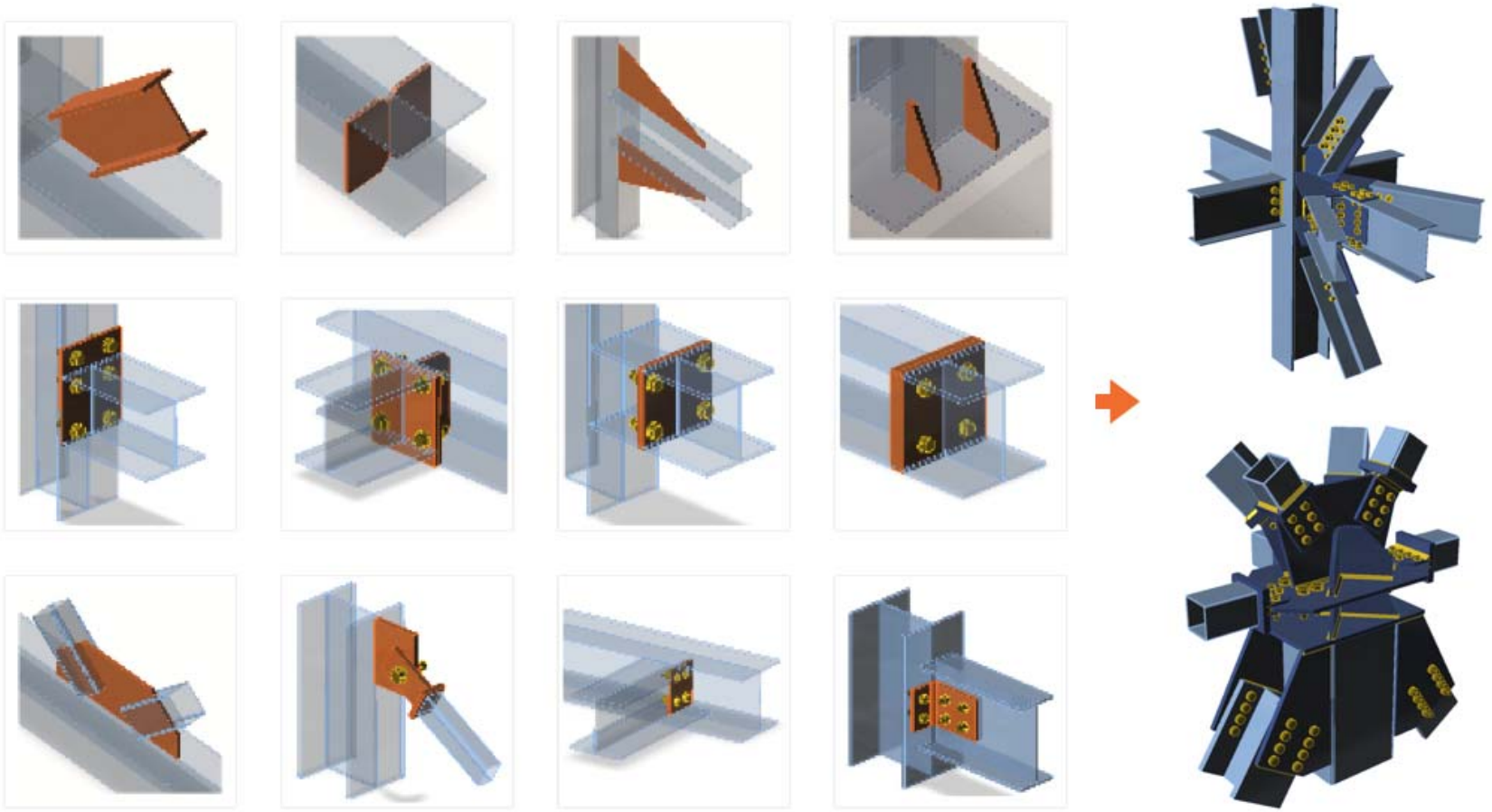


Component based finite element model (CBFEM)

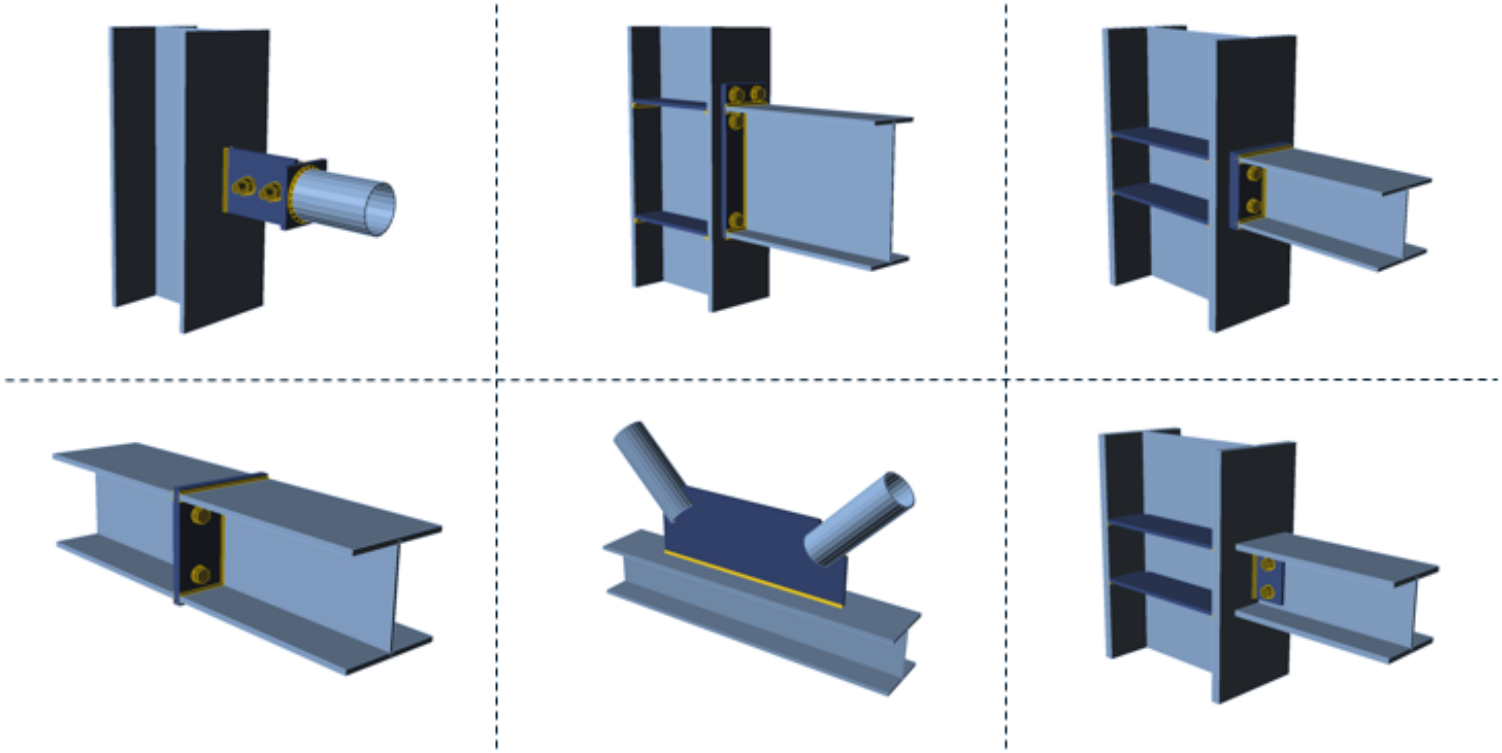


The weak point of standard Component method Design guides is that the topology is limited.

Real-life manufacturing operations

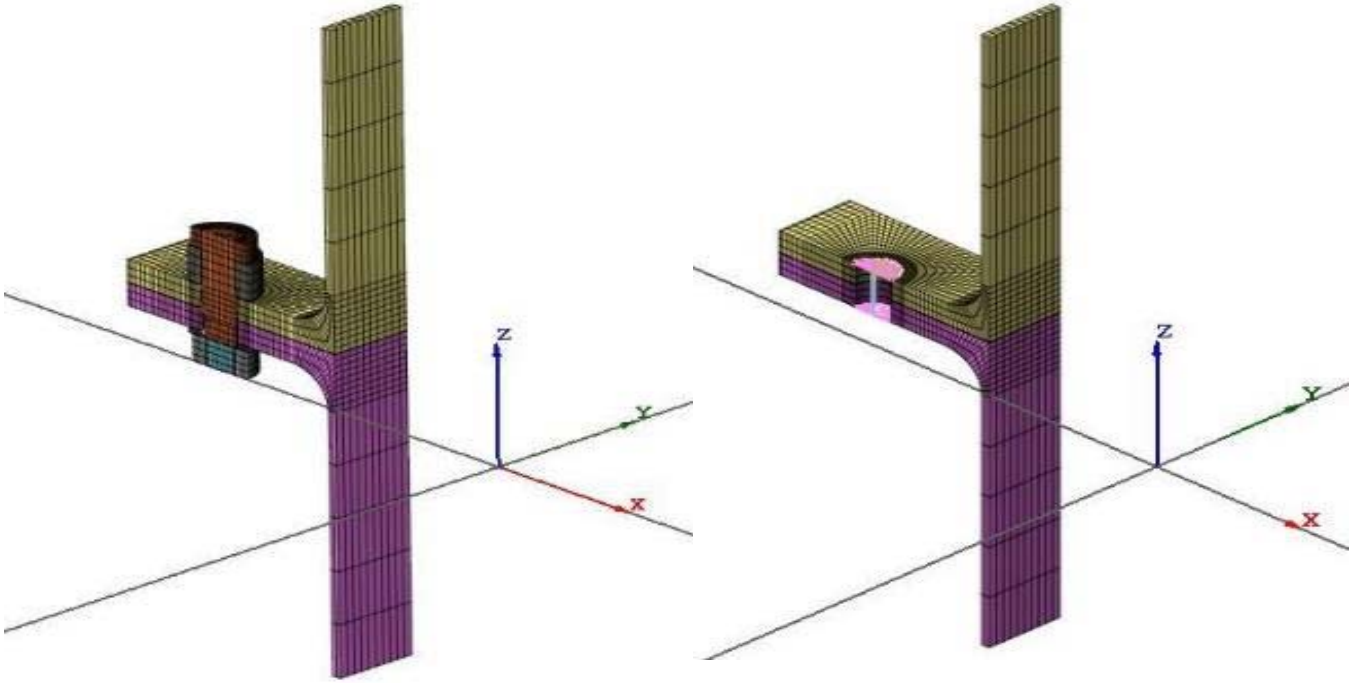


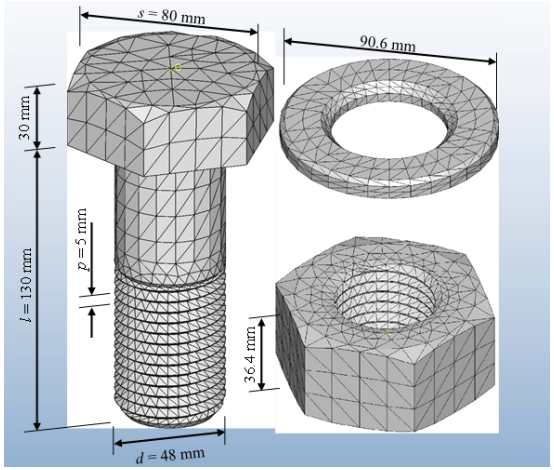
Verification and validation – level 1

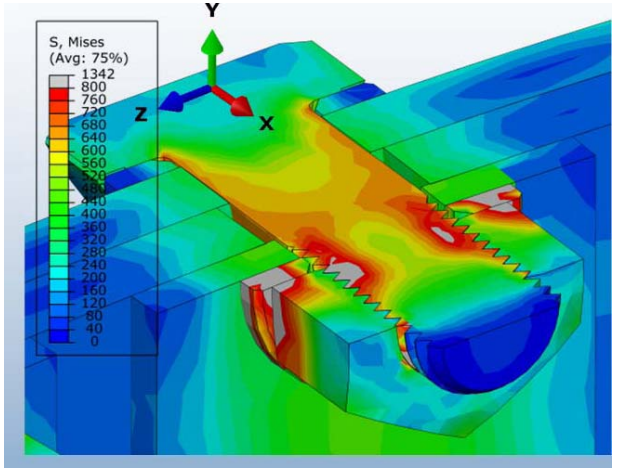


All standard connections from Eurocode / AISC design guides, calculated with the same results.

Level 2 – analytical models







Level 3 – live tests

VERIFICATION – COMPLEX TOPOLOGIES

Tailor-made design models created in various software.

Live testing.

All studies published.

Two university teams spent over 3 years on this.

Everything is published

COOPERATION WITH UNIVERSITIES
= VERIFIED SOLUTION

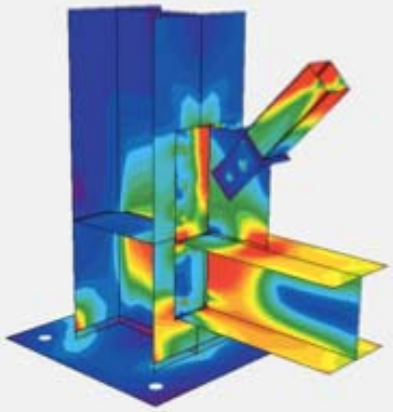
Workflow with Advance Steel

Workflow demonstration

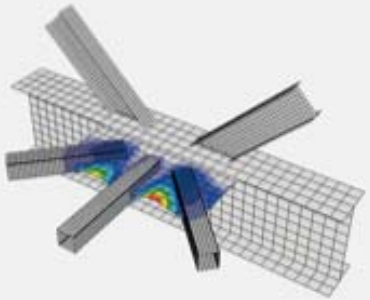
Real-life projects

What had to be taken into account

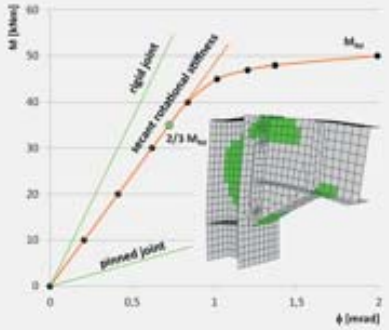
Stress-strain



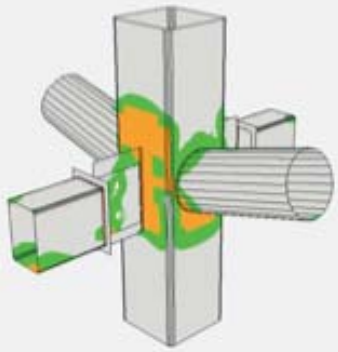
Buckling Analysis



Stiffness Analysis



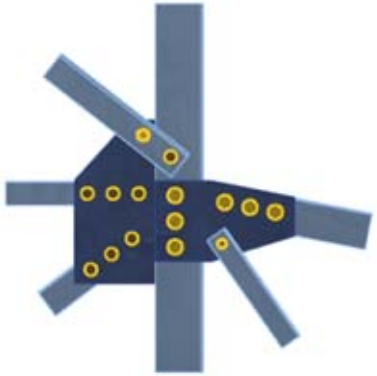
Overall Check

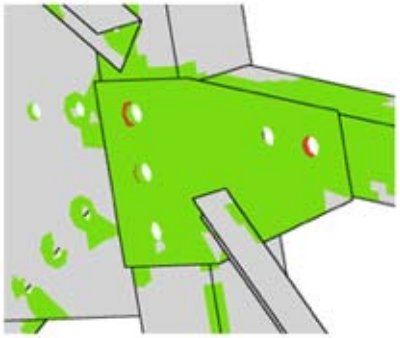


Stress-strain | Buckling analysis | Stiffness analysis | Overall check

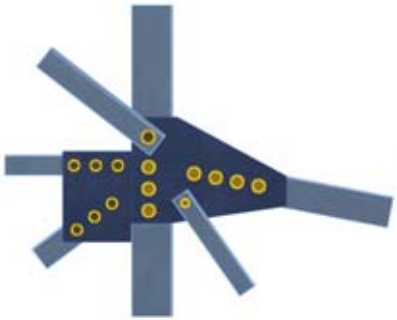
ELECTRICITY TOWER MAST – POLAND

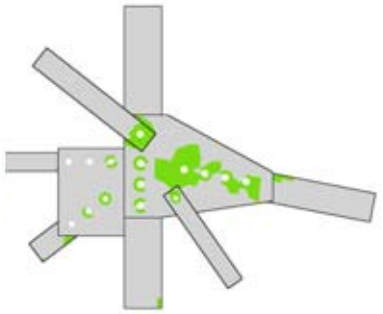
Huge normal force loads the group of bolts eccentrically. Bolts cannot take this.





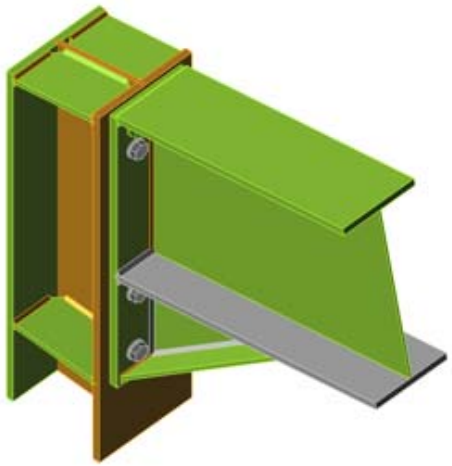
Rearranging of bolts solved the problem.



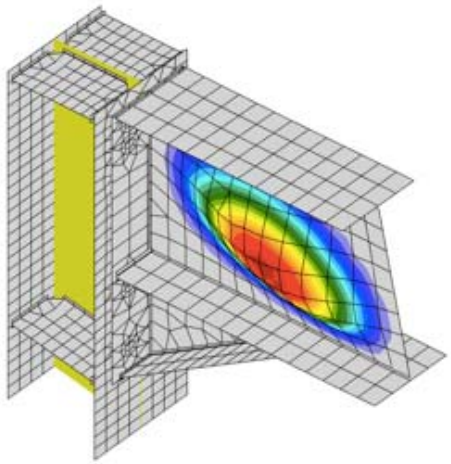


Stress-strain | **Buckling analysis** | Stiffness analysis | Overall check

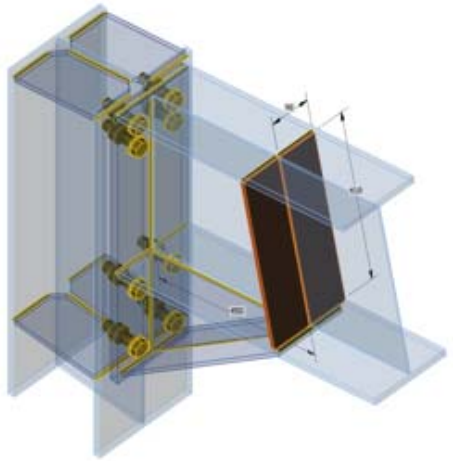
STEEL WAREHOUSE – GERMANY



Connection fully satisfies all stress/strain checks



But the web of the beam can collapse because of local buckling

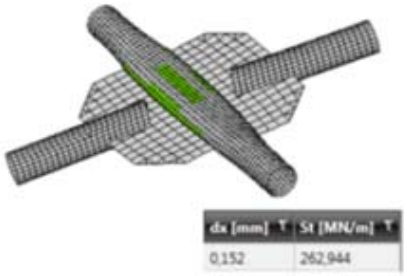


Additional stiffener resolved this problem

Stress-strain | Buckling analysis | **Stiffness analysis** | Overall check

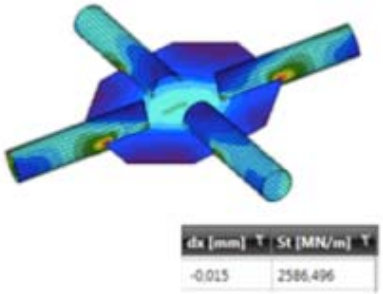
POWER PLANT – CZECH REPUBLIC

Ovalization of CHS. Stiffness perpendicular to CHS is weaker.



dx [mm]	St [MN/m]
0.152	262.944

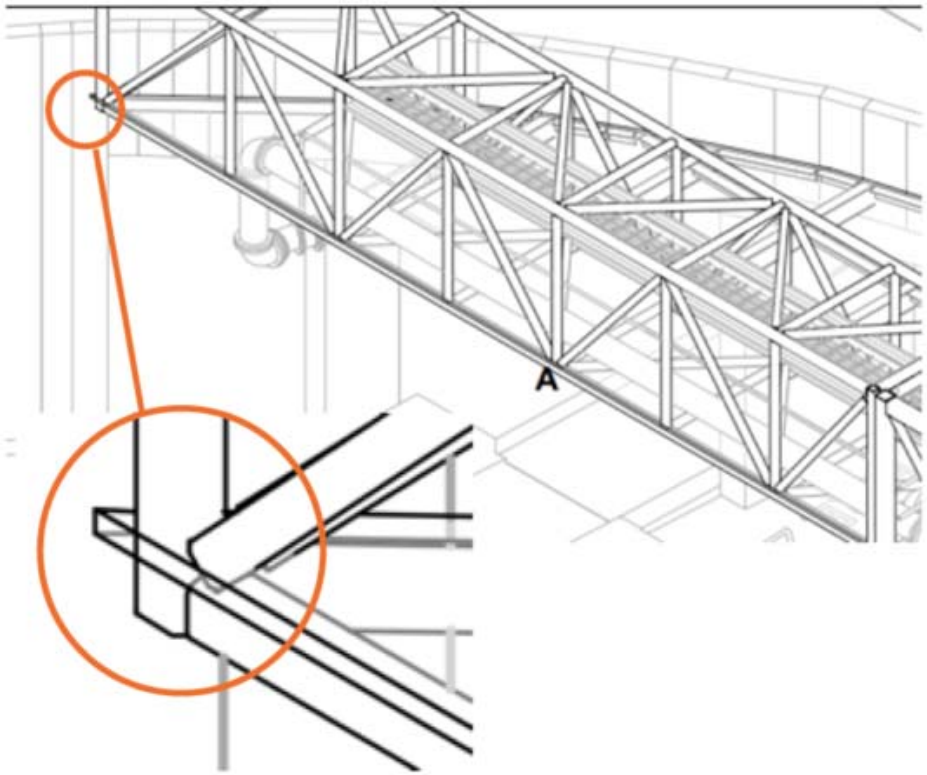
All CHS are welded to one plate. Stiffness is 10x higher.



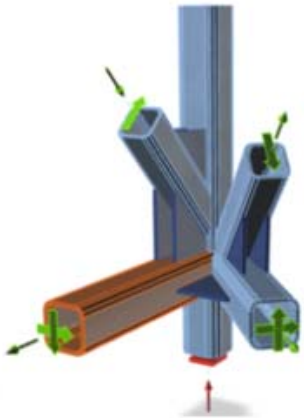
dx [mm]	St [MN/m]
-0.015	2586.496

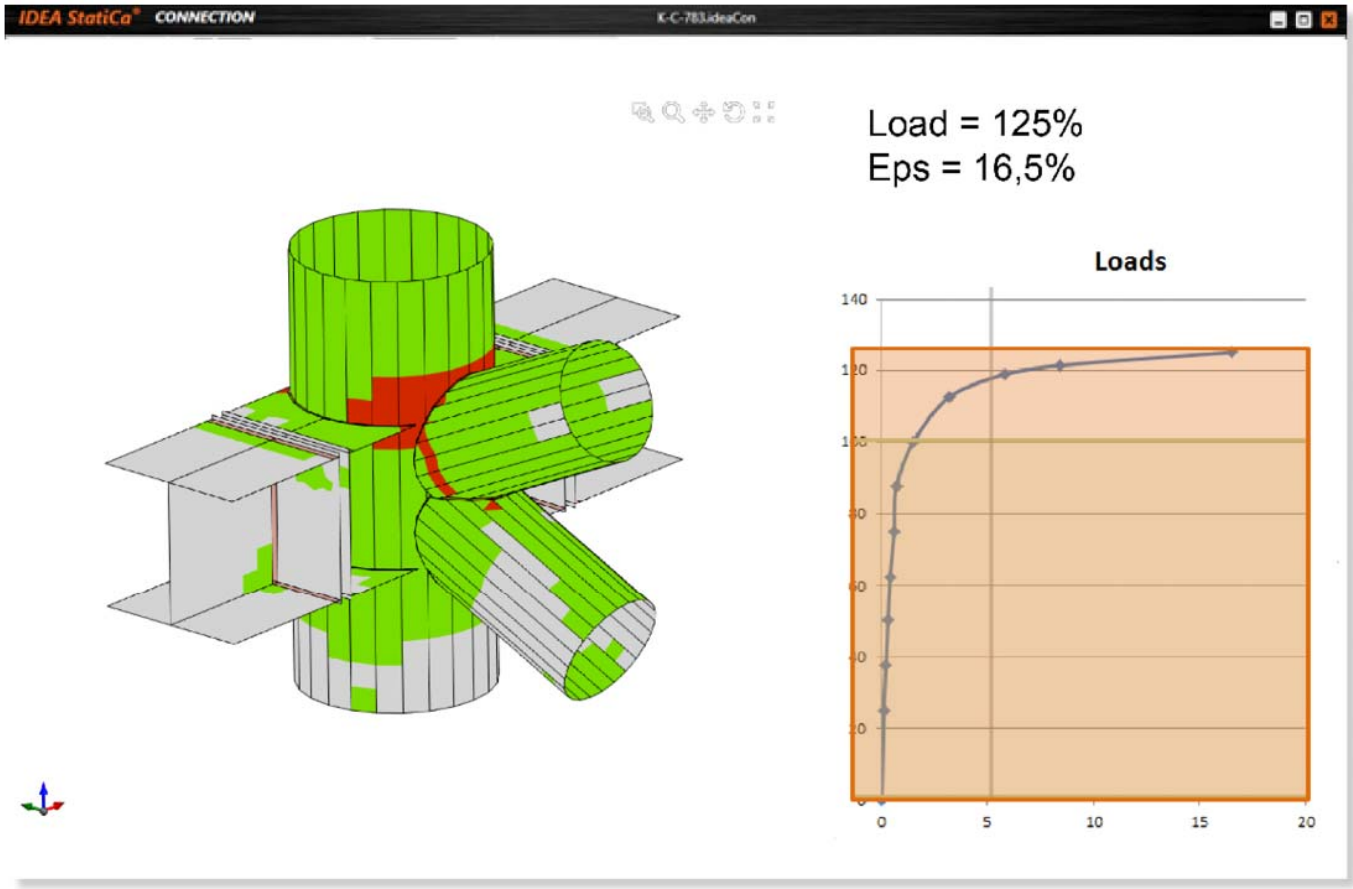
Stress-strain | Buckling analysis | Stiffness analysis | Overall check

HEATHROW AIRPORT – UK



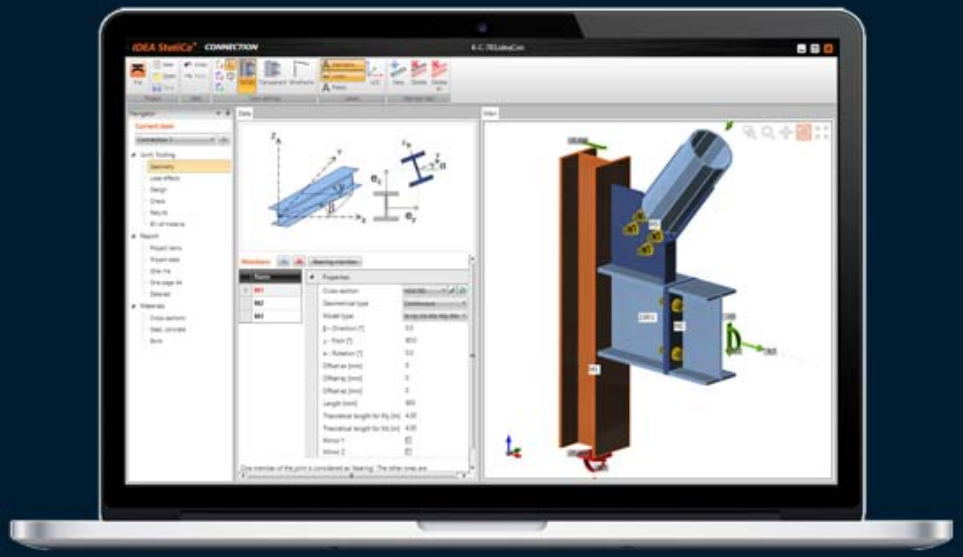
Connection was not designable with the suggested prescribed EC3 requirements and a more generic analysis approach had to be adopted.




IDEA StatiCa CONNECTION
K-C-783.ideaCon
Load = 125%
Eps = 16,5%
Loads
140
120
0
5
10
15
20

We can design and check steel joints of any topology, any loading, in minutes.

TRY THIS NEW WORKFLOW



14-day trial

Drop us an email
juraj.sabatka@idea-rs.com

Visit our website
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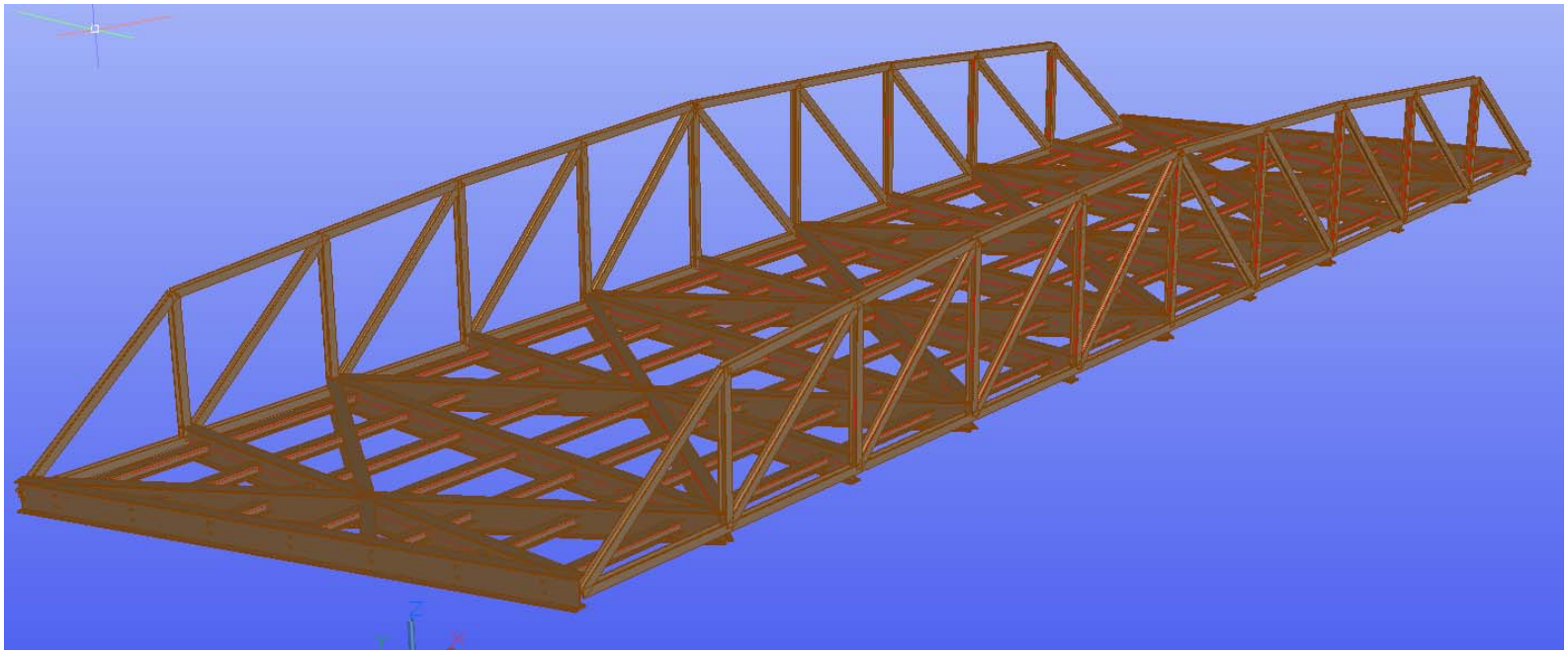
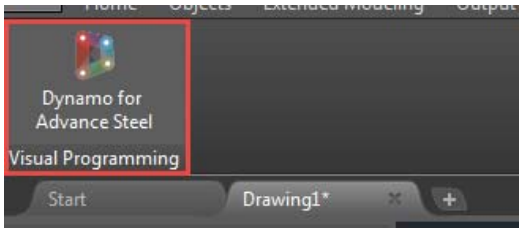
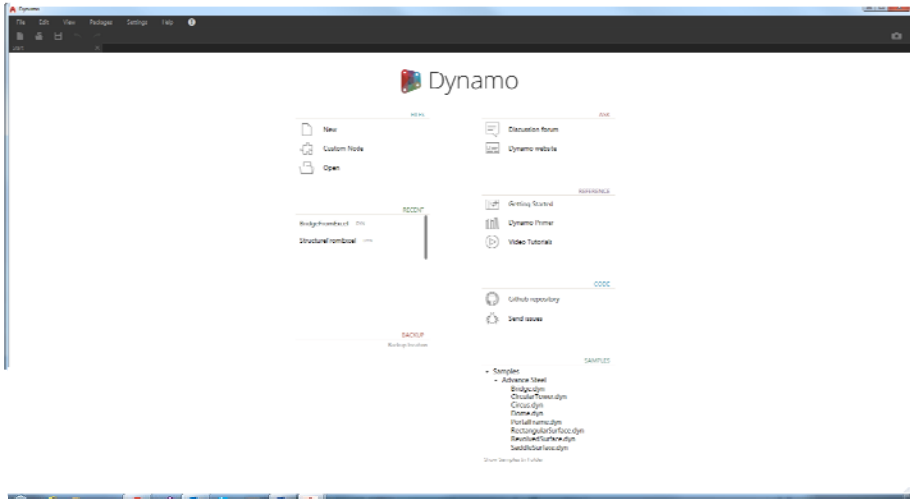
Computational BIM and Autodesk Advance Steel

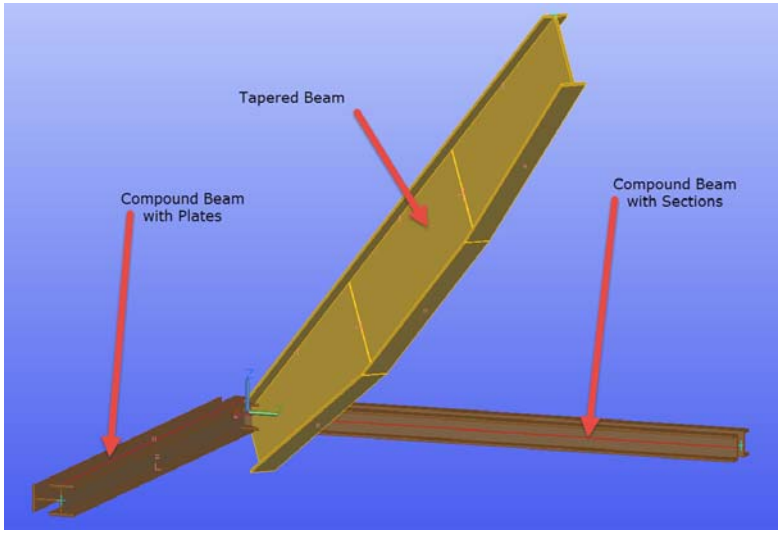


Dynamo for Autodesk Advance Steel

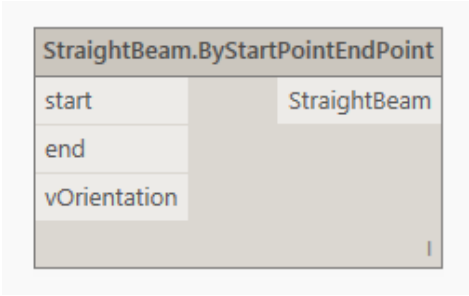
- New for 2017.1
  - New nodes…
- WARNING!!!



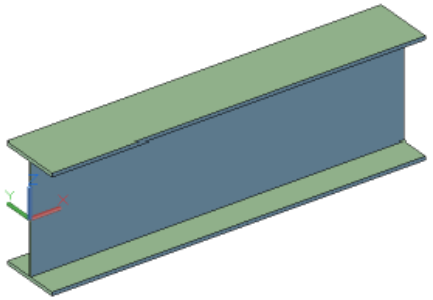


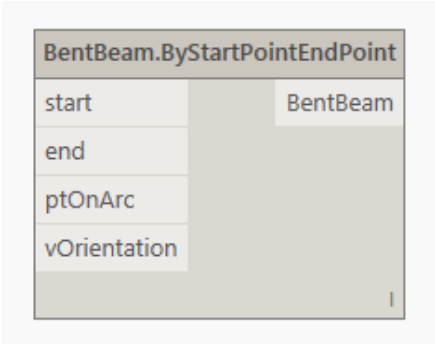


Dynamo nodes



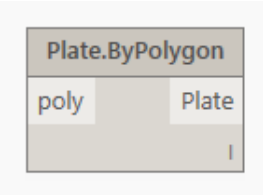
- Straight beam



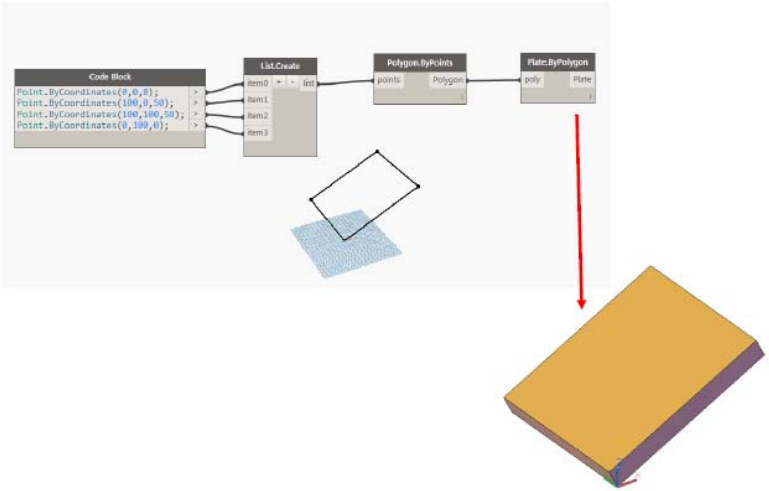


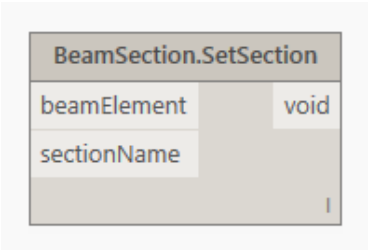
- Bent beam

Dynamo nodes



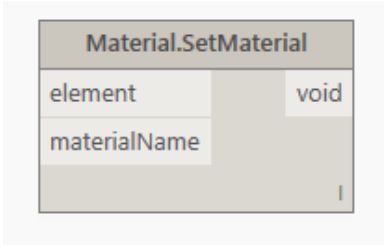
- Plate



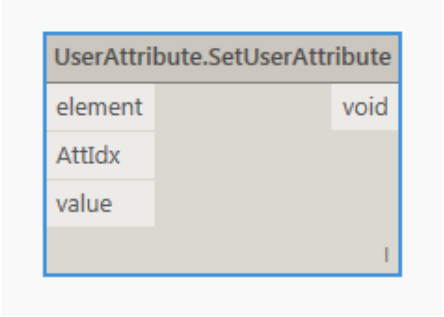


- Beam section

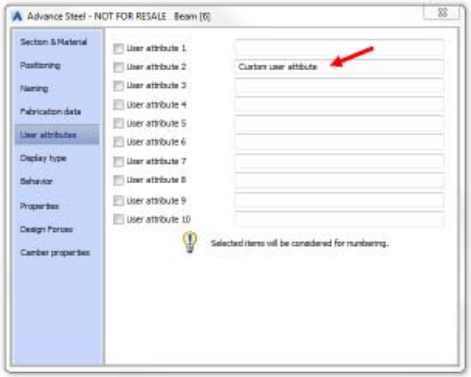
Dynamo nodes



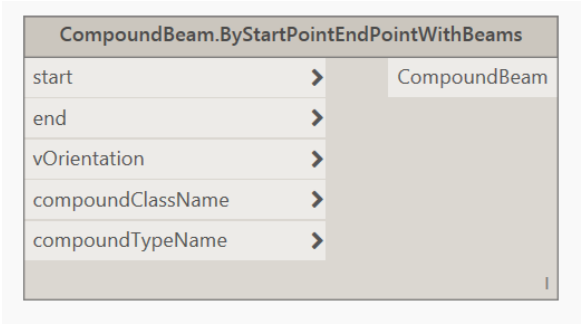
- Material



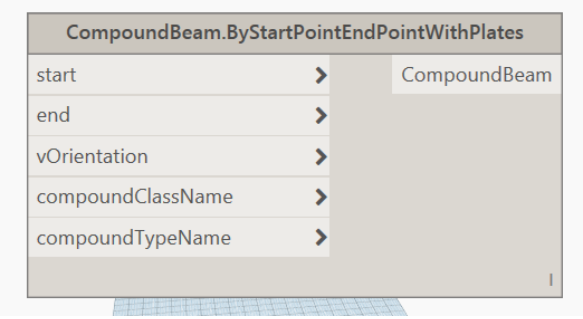
- User attribute
  - Model role
  - Description



Dynamo nodes (new)

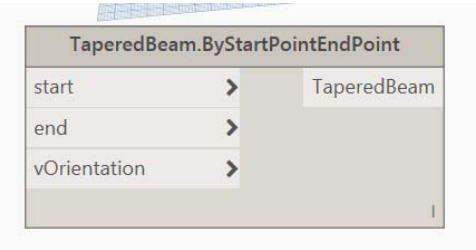


- Compound beam (beams)

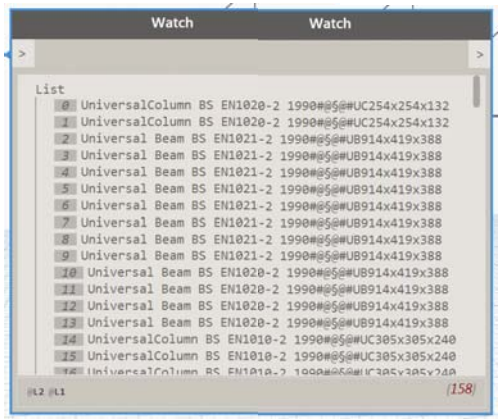


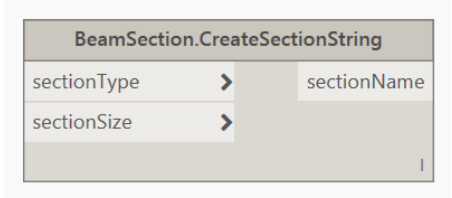
- Compound beam (plates)

Dynamo nodes (new)



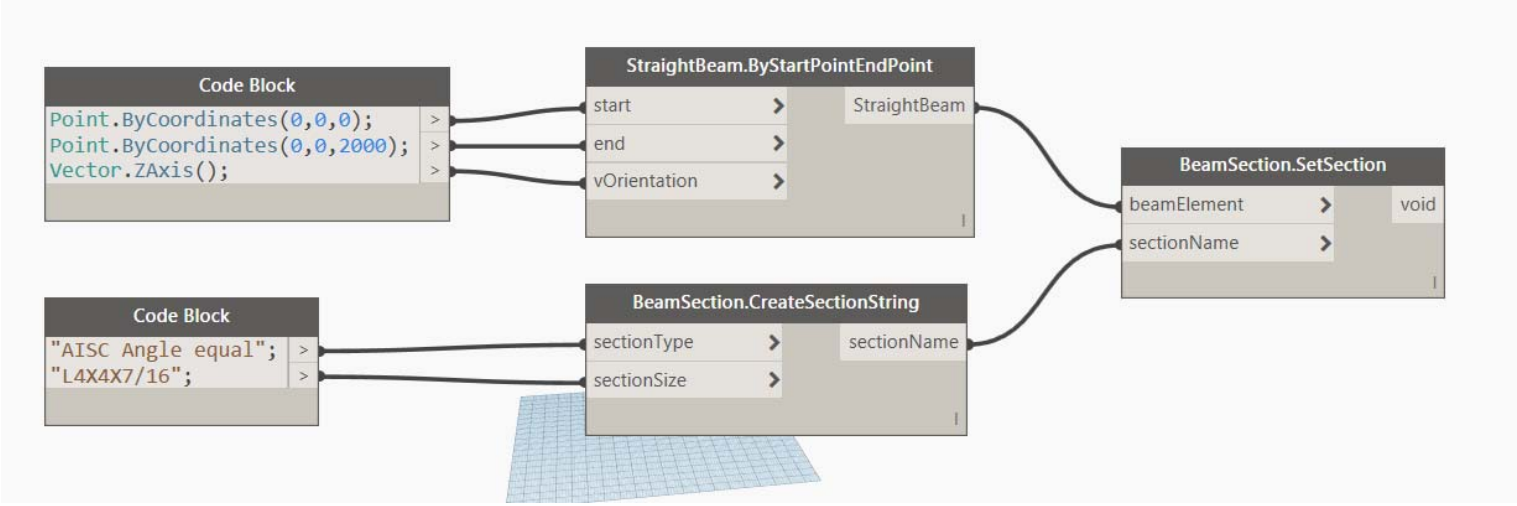
- Tapered beam



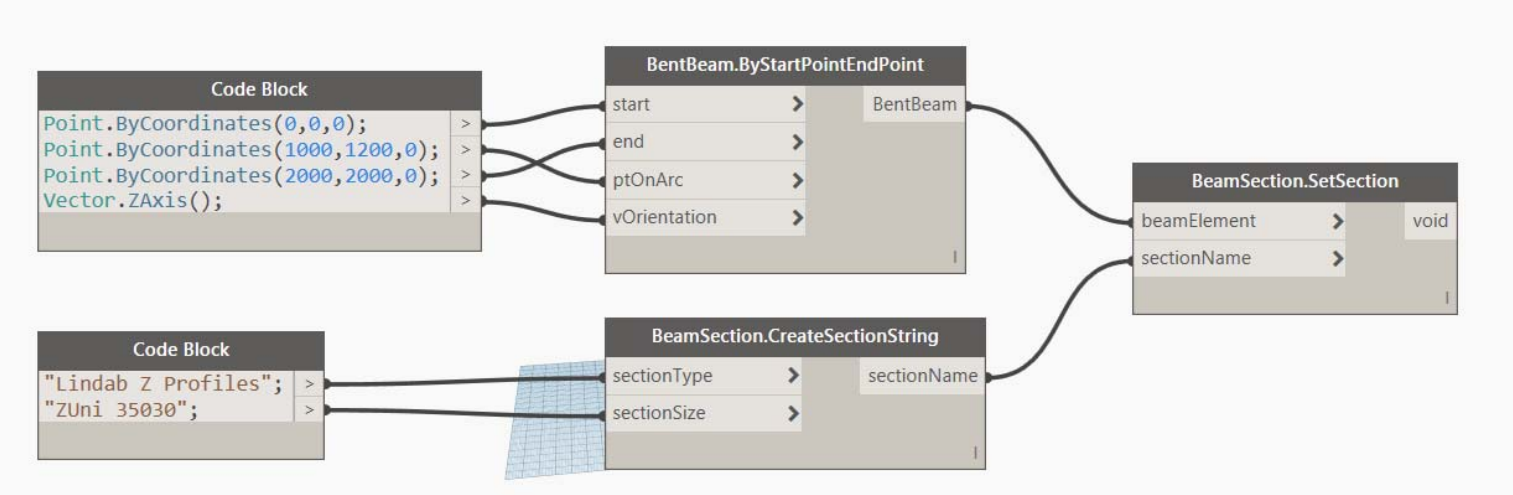


- Beam section string

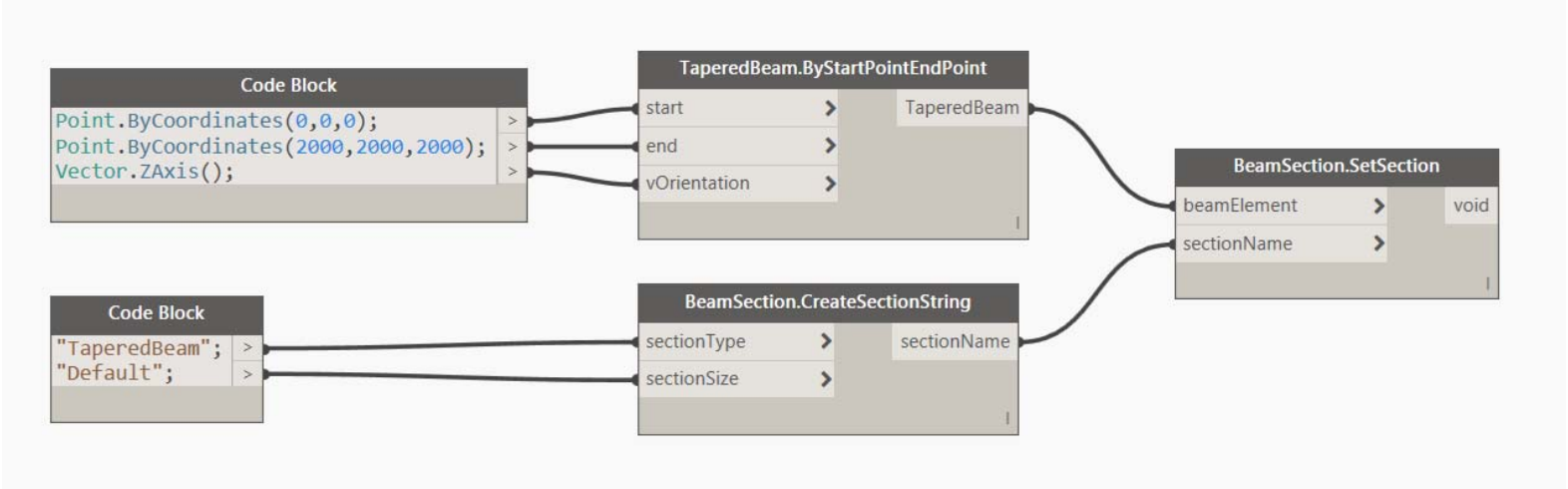
Examples


Code Block
Point.ByCoordinates(0,0,0);
Point.ByCoordinates(0,0,2000);
Vector.ZAxis();
StraightBeam.ByStartPointEndPoint
start
end
vOrientation
StraightBeam
BeamSection.SetSection
beamElement
sectionName
void
Code Block
"AISC Angle equal";
"L4X4X7/16";
BeamSection.CreateSectionString
sectionType
sectionSize
sectionName

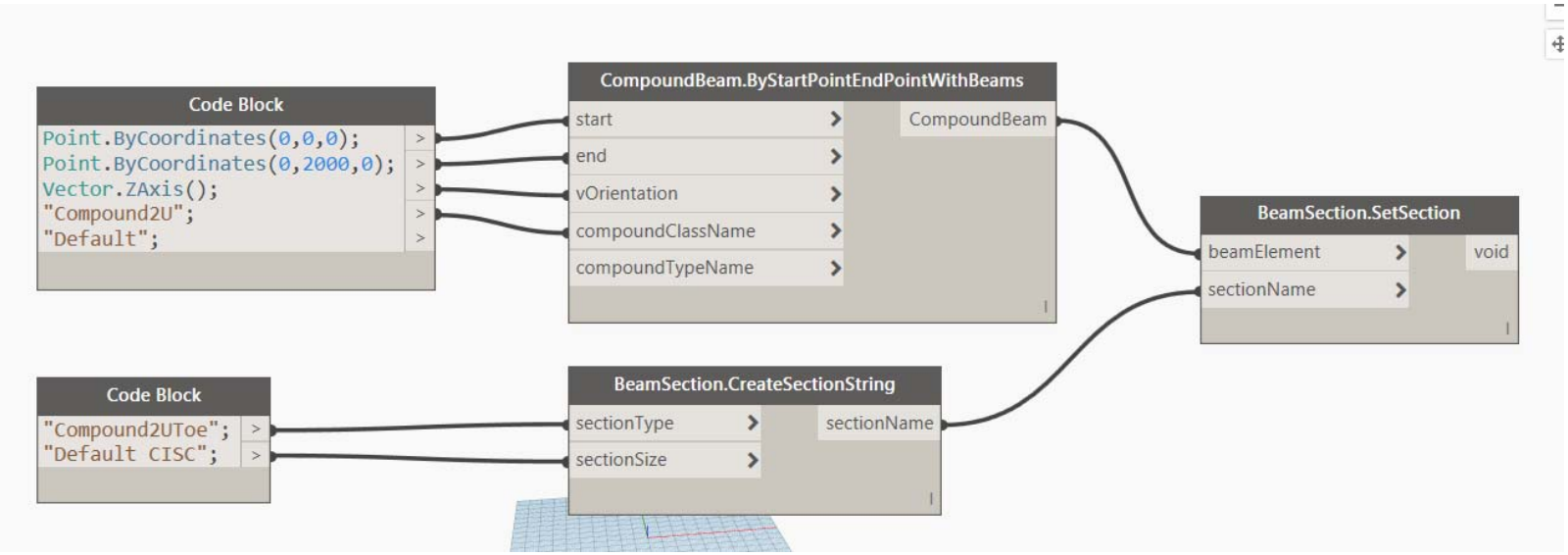
Examples


Code Block
Point.ByCoordinates(0,0,0);
Point.ByCoordinates(1000,1200,0);
Point.ByCoordinates(2000,2000,0);
Vector.ZAxis();
BentBeam.ByStartPointEndPoint
start
end
ptOnArc
vOrientation
BentBeam
BeamSection.SetSection
beamElement
sectionName
void
Code Block
"Lindab Z Profiles";
"ZUni 35030";
BeamSection.CreateSectionString
sectionType
sectionSize
sectionName

Examples


Code Block
Point.ByCoordinates(0,0,0);
Point.ByCoordinates(2000,2000,2000);
Vector.ZAxis();
TaperedBeam.ByStartPointEndPoint
start
end
vOrientation
TaperedBeam
BeamSection.SetSection
beamElement
sectionName
void
Code Block
"TaperedBeam";
"Default";
BeamSection.CreateSectionString
sectionType
sectionSize
sectionName

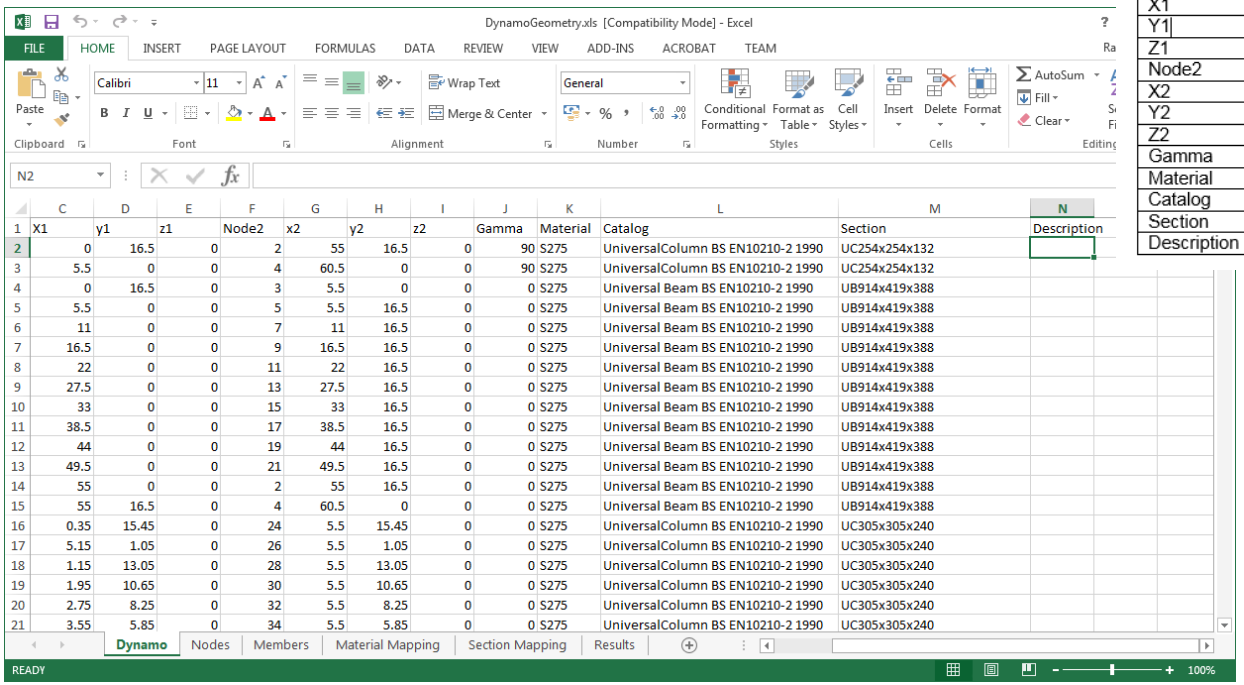
Examples


Code Block
Point.ByCoordinates(0,0,0);
Point.ByCoordinates(0,2000,0);
Vector.ZAxis();
"Compound2U";
"Default";
CompoundBeam.ByStartPointEndPointWithBeams
start
end
vOrientation
compoundClassName
compoundTypeName
CompoundBeam
BeamSection.SetSection
beamElement
sectionName
void
Code Block
"Compound2UToe";
"Default CISC";
BeamSection.CreateSectionString
sectionType
sectionSize
sectionName

Putting it all together…

- Using Microsoft Excel

Contents	Formula
Member	=Members!A[ROW]
Node1	=Members!B[ROW]
X1	=VLOOKUP(B[ROW],Nodes,2)
Y1	=VLOOKUP(B[ROW],Nodes,3)
Z1	=VLOOKUP(B[ROW],Nodes,4)
Node2	=Members!C[ROW]
X2	=VLOOKUP(F[ROW],Nodes,2)
Y2	=VLOOKUP(F[ROW],Nodes,3)
Z2	=VLOOKUP(F[ROW],Nodes,4)
Gamma	=Members!F[ROW]
Material	=VLOOKUP(Members!E[ROW],Materials,2)
Catalog	=VLOOKUP(Members!D[ROW],Sections,2)
Section	=VLOOKUP(Members!D[ROW],Sections,3)
Description	



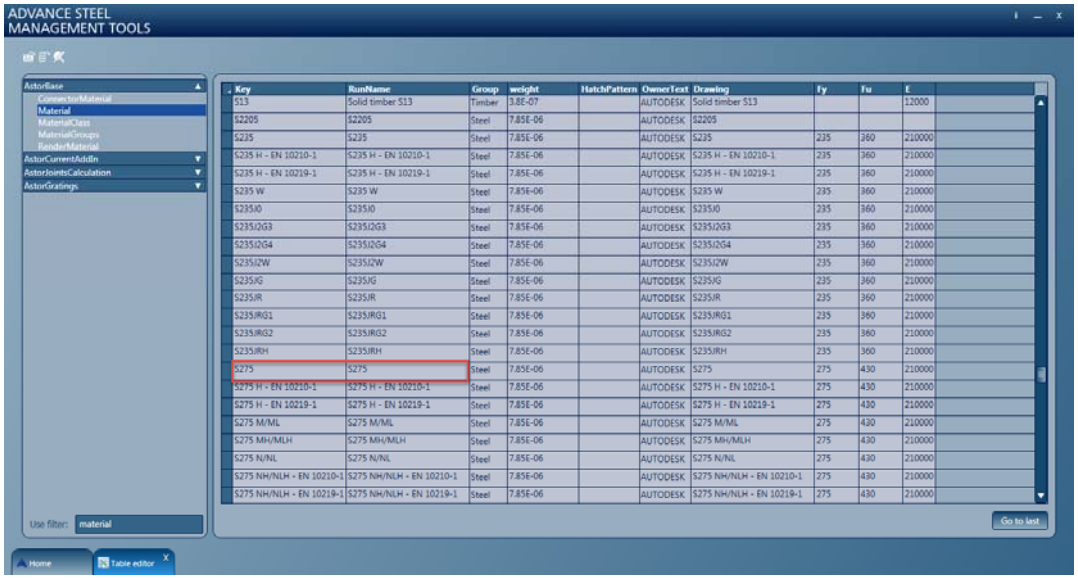
	C	D	E	F	G	H	I	J	K	L	M	N
1	X1	y1	z1	Node2	x2	y2	z2	Gamma	Material	Catalog	Section	Description
2	0	16.5	0	2	55	16.5	0	90	S275	UniversalColumn BS EN10210-2 1990	UC254x254x132	
3	5.5	0	0	4	60.5	0	0	90	S275	UniversalColumn BS EN10210-2 1990	UC254x254x132	
4	0	16.5	0	3	5.5	0	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
5	5.5	0	0	5	5.5	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
6	11	0	0	7	11	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
7	16.5	0	0	9	16.5	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
8	22	0	0	11	22	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
9	27.5	0	0	13	27.5	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
10	33	0	0	15	33	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
11	38.5	0	0	17	38.5	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
12	44	0	0	19	44	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
13	49.5	0	0	21	49.5	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
14	55	0	0	2	55	16.5	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
15	55	16.5	0	4	60.5	0	0	0	S275	Universal Beam BS EN10210-2 1990	UB914x419x388	
16	0.35	15.45	0	24	5.5	15.45	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	
17	5.15	1.05	0	26	5.5	1.05	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	
18	1.15	13.05	0	28	5.5	13.05	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	
19	1.95	10.65	0	30	5.5	10.65	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	
20	2.75	8.25	0	32	5.5	8.25	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	
21	3.55	5.85	0	34	5.5	5.85	0	0	S275	UniversalColumn BS EN10210-2 1990	UC305x305x240	

Step 1 – Format Microsoft Excel

- Dynamo
  - Where it all comes together
- Nodes
  - X, Y, Z
- Members
  - Node, Node
- Material mapping
- Section mapping

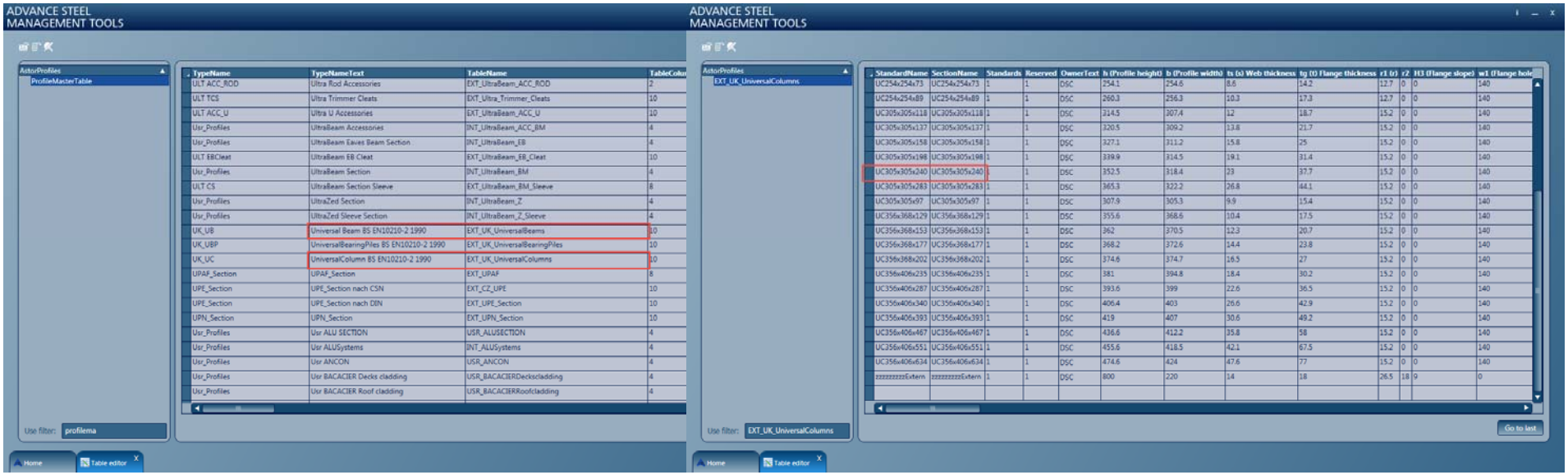
Autodesk Advance Steel knowledge required

- Material mapping
  - AstorBase database (or Management Tools)

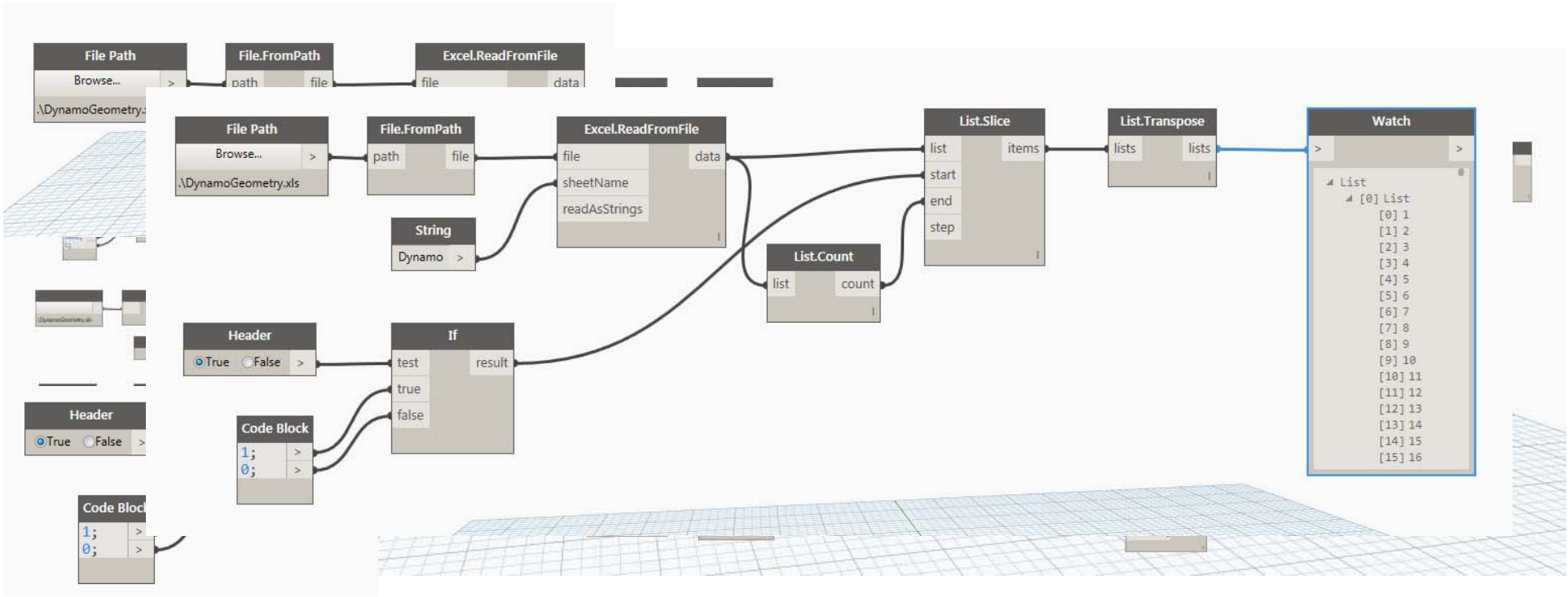


Autodesk Advance Steel knowledge required

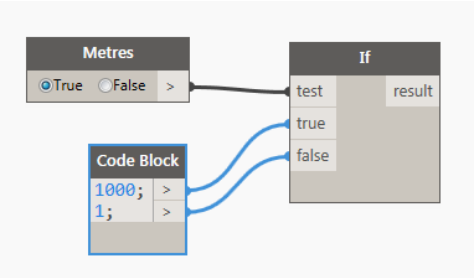
- Section mapping
  - AstorProfiles database (or Management Tools)

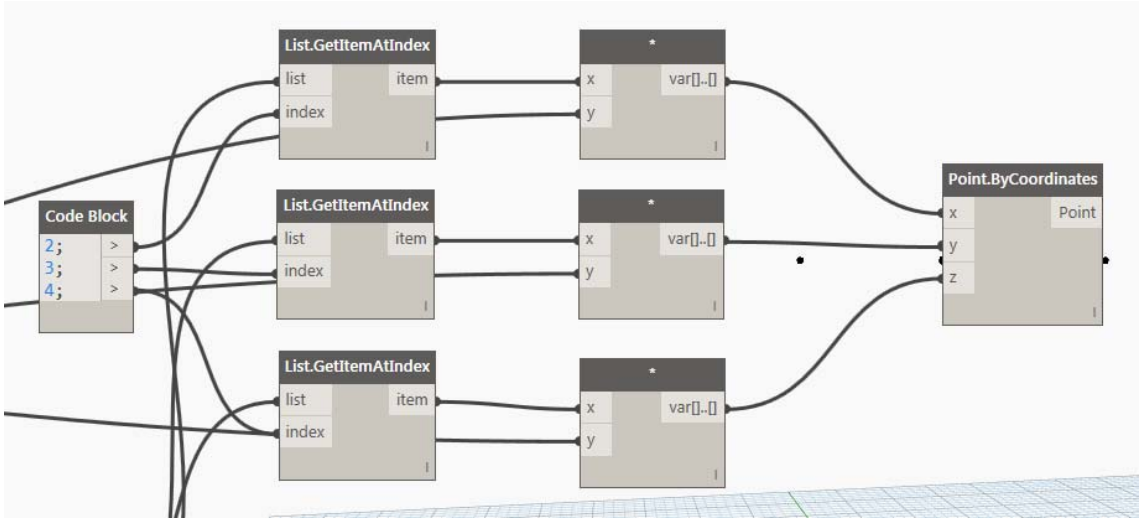


Step 2 – The Dynamo Graph

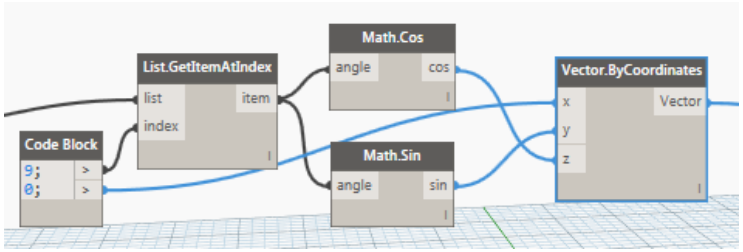


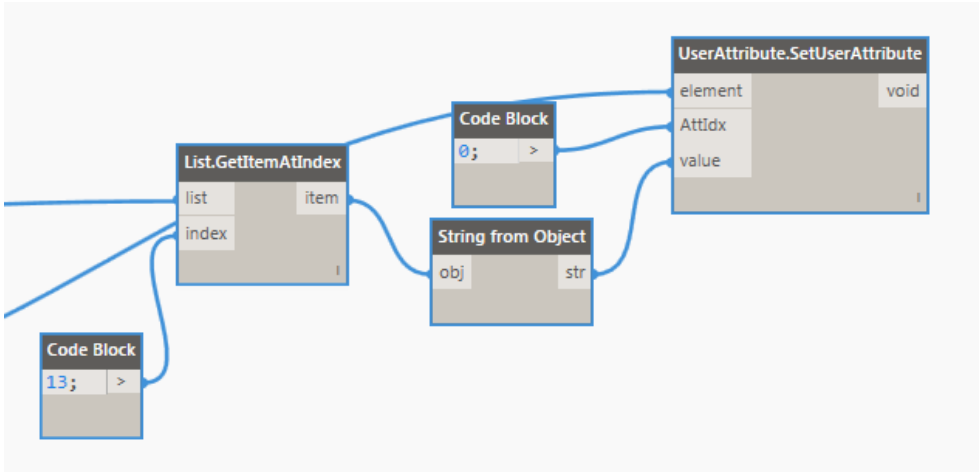
Step 2 – The Dynamo Graph

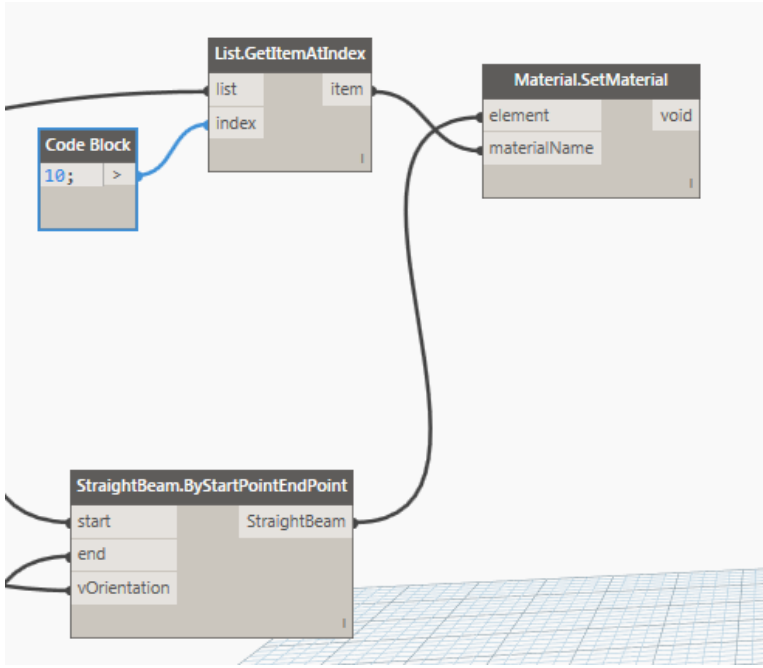




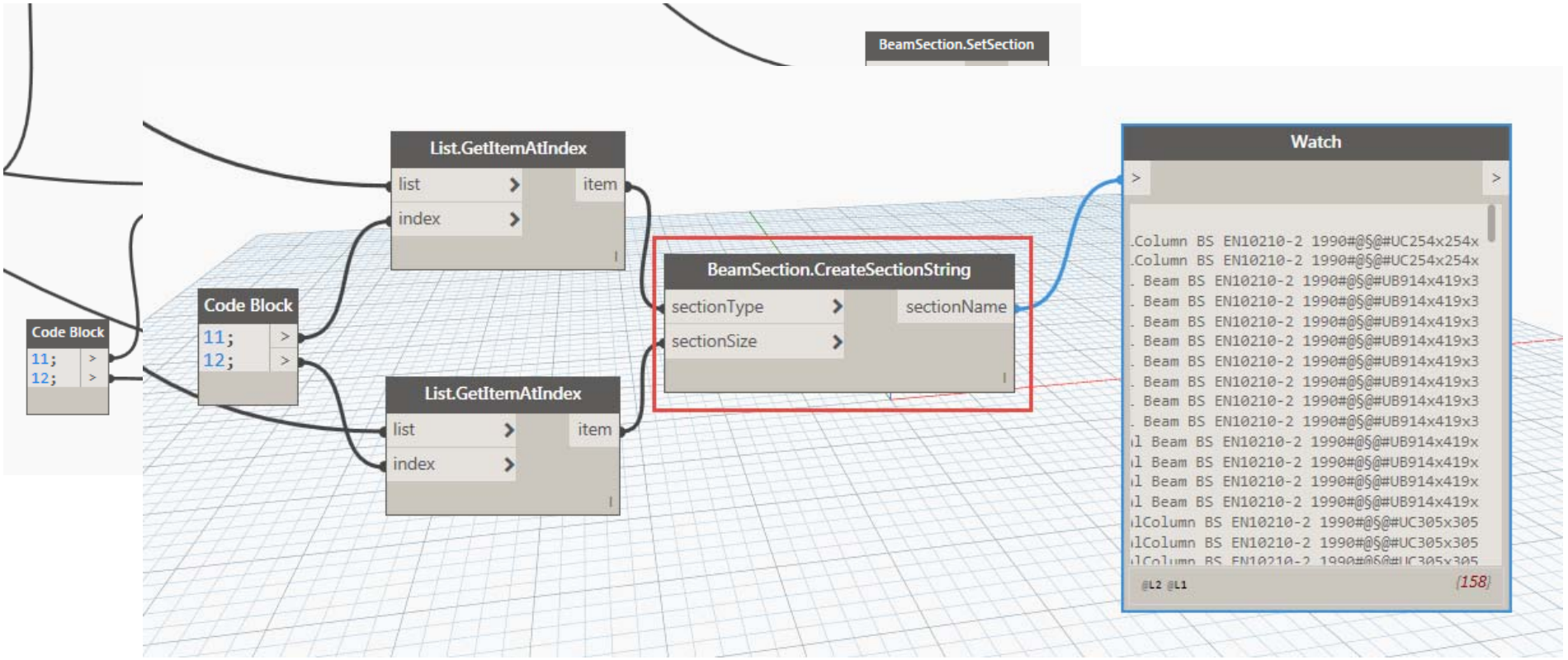
Step 2 – The Dynamo Graph







Step 2 – The Dynamo Graph



Additional thoughts

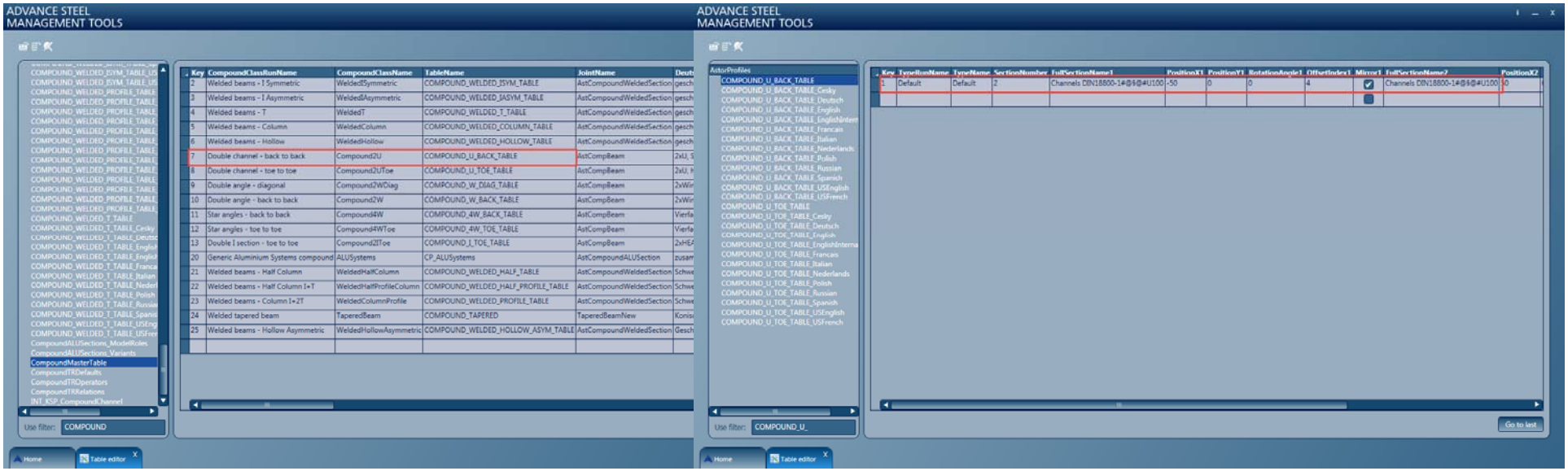
- Beam nodes
  - Straight
  - Bent
  - Compound*
  - Tapered*

Need to distinguish between different types of member for modelling purposes – how?

- * - more application knowledge required…

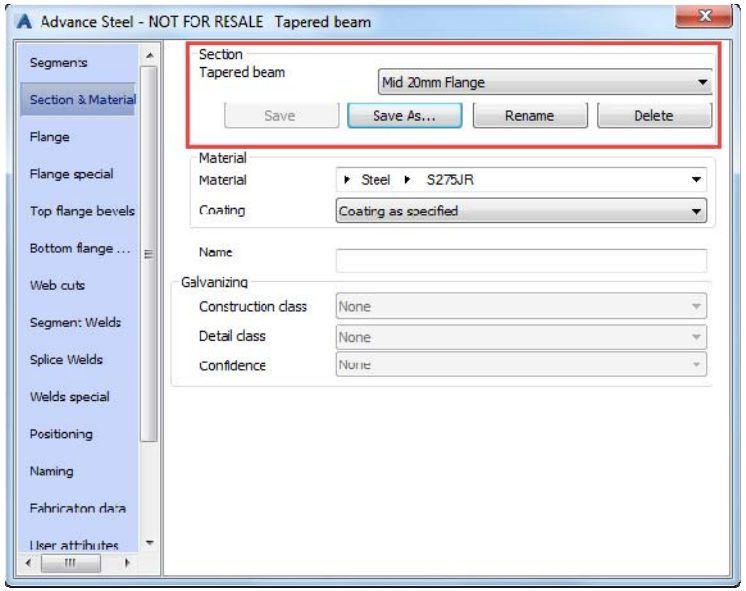
Autodesk Advance Steel knowledge required

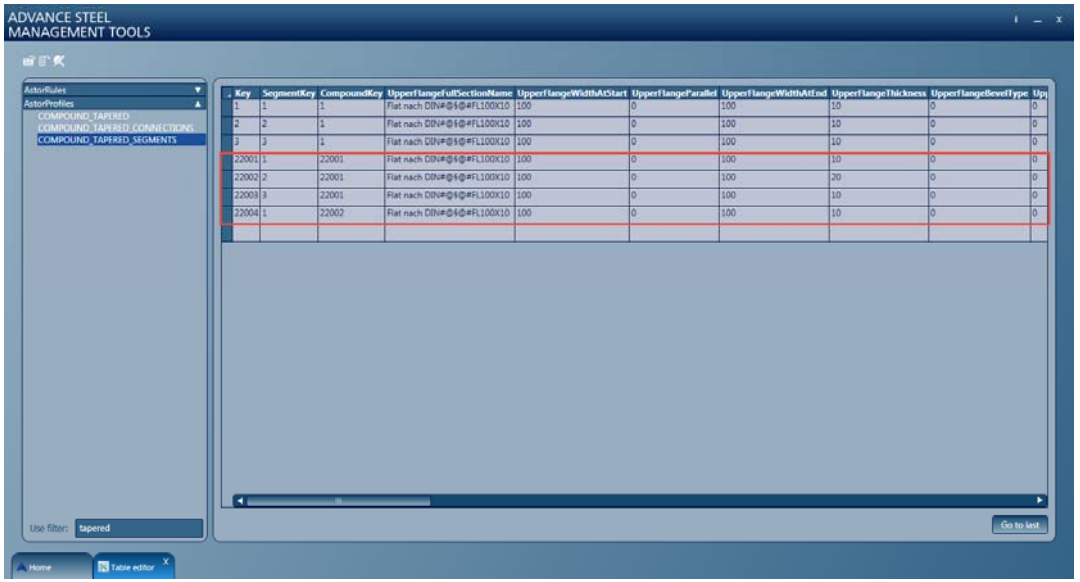
- AstorProfiles database (or Management Tools)



Autodesk Advance Steel knowledge required

- Autodesk Advance Steel
- AstorProfiles database (or Management Tools)





Where next?

- More connections
- Tighter integration
- More nodes

- The future is bright

Questions?

Thankyou!

How did I do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**