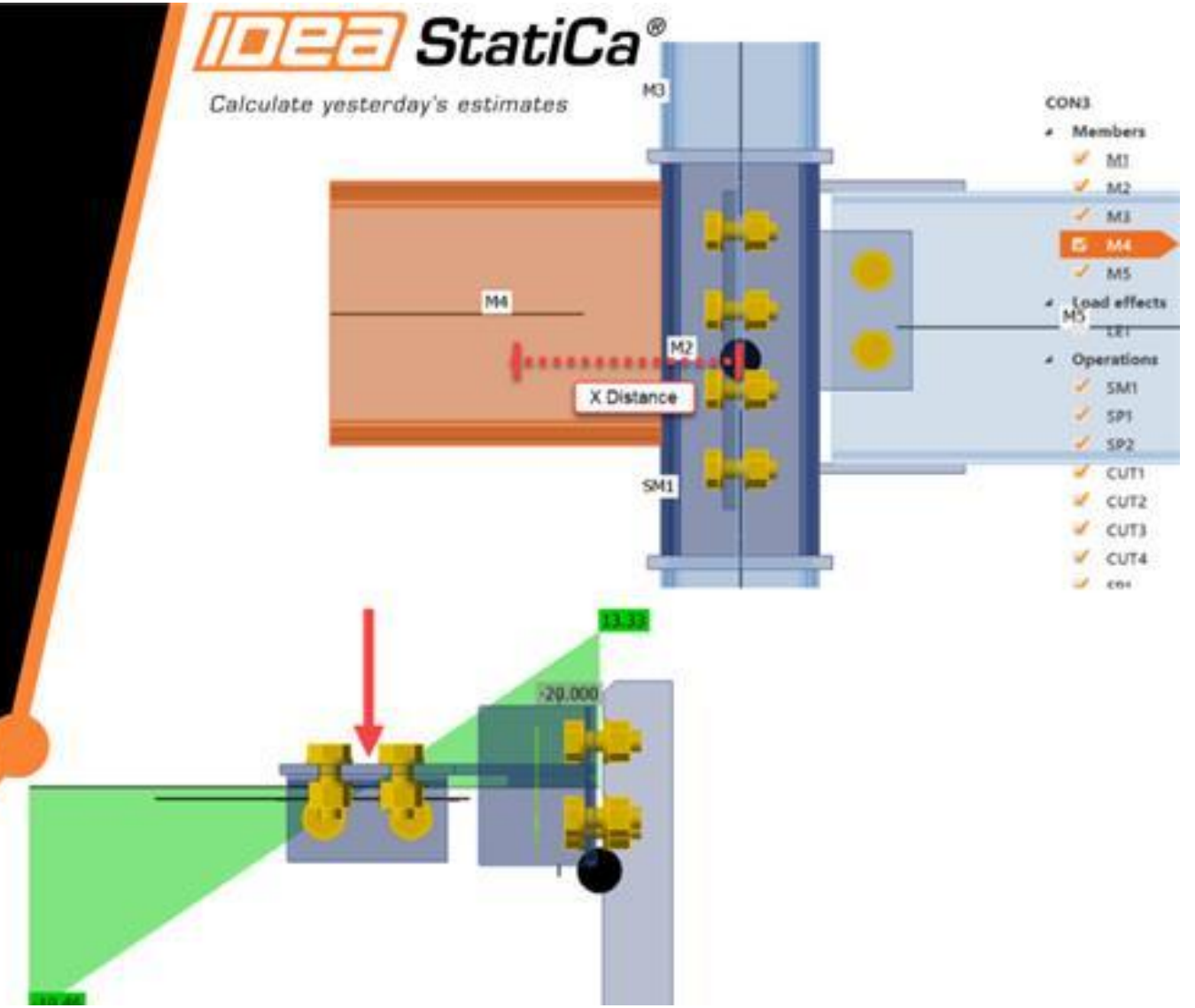
US Webinar

Structural loads in steel connection design

March 29th, 2023

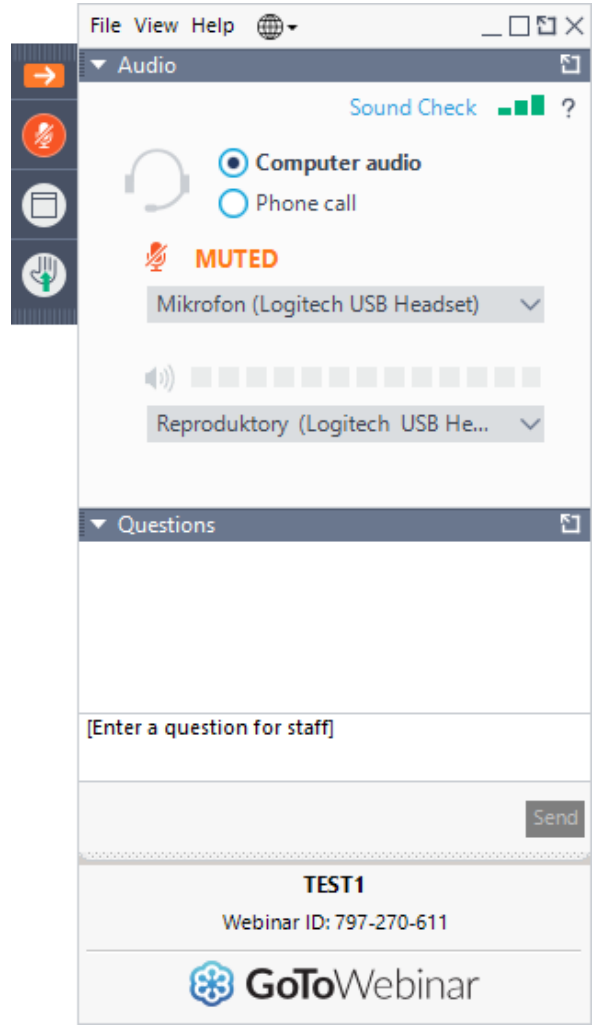


Control Panel

When you first join a session, the Control Panel appears on the right side of your screen. Use the Control Panel to manage your session. To free up space on your desktop, you can collapse the Control Panel and use the Grab Tab to continue to manage your session.

- **Grab Tab**: From the Grab Tab, you can hide the Control Panel, mute yourself (if you have been unmuted by the organizer), view the webinar in full screen and raise your hand.
- **Audio Pane**: Use the Audio pane to switch between Telephone and Mic & Speakers.
- **Questions Pane**: Ask questions for the staff.

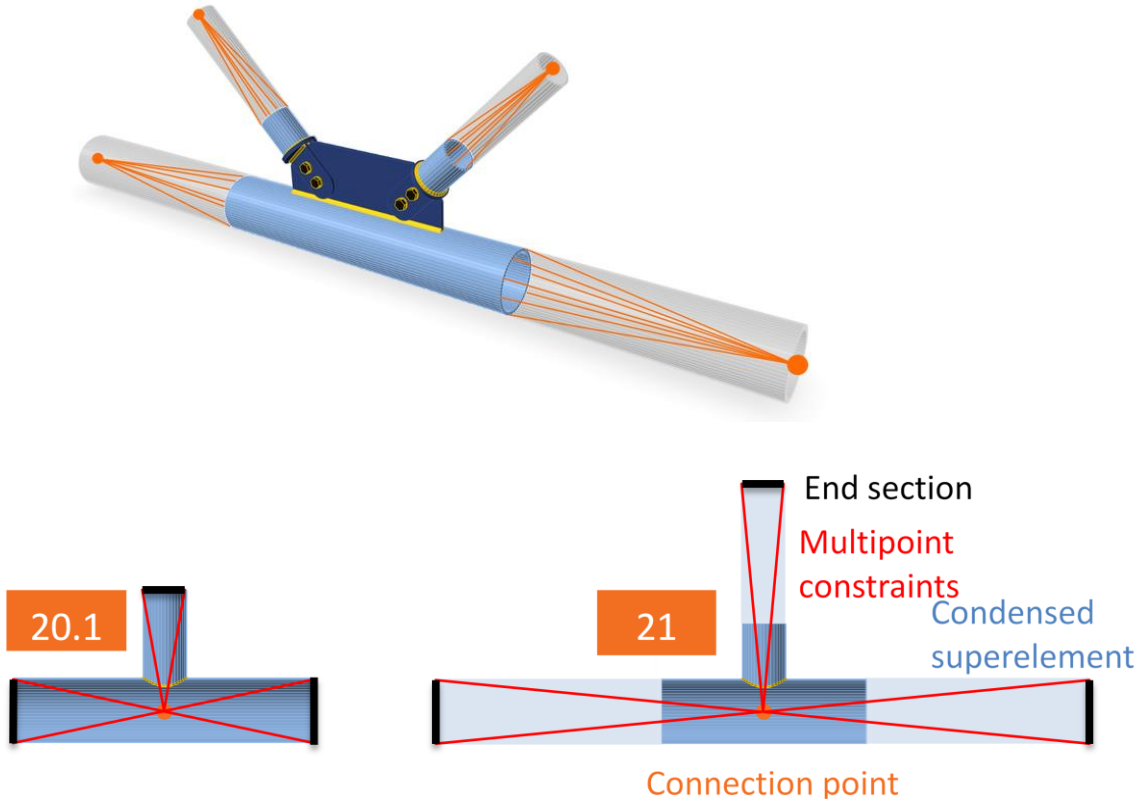
QUESTIONS



Agenda

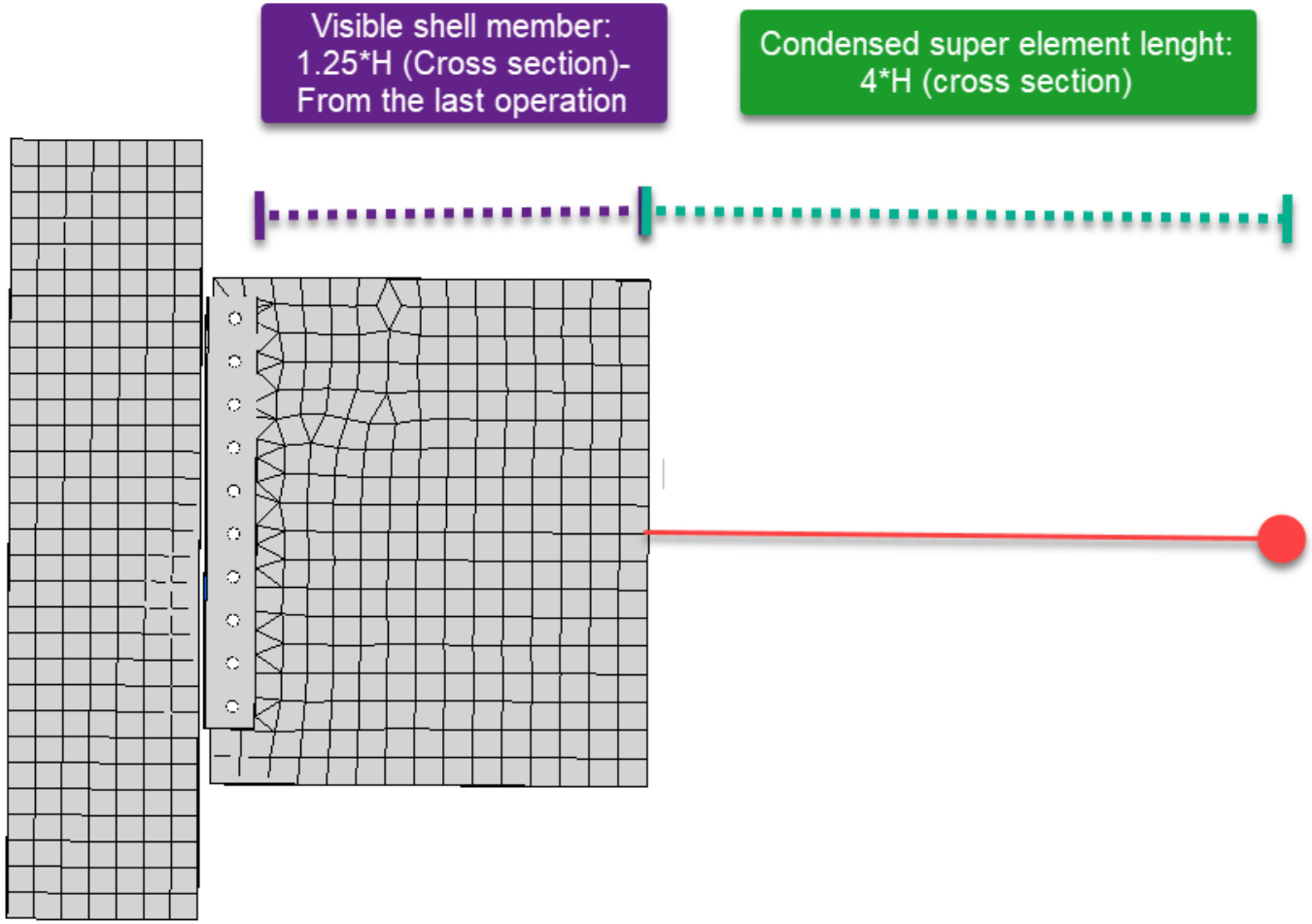
- How IDEA loads the FEA Model?
- Load position
- Loads in equilibrium
- Loads as percentage of member capacity
- Import load combination from Excel

Condensed super elements

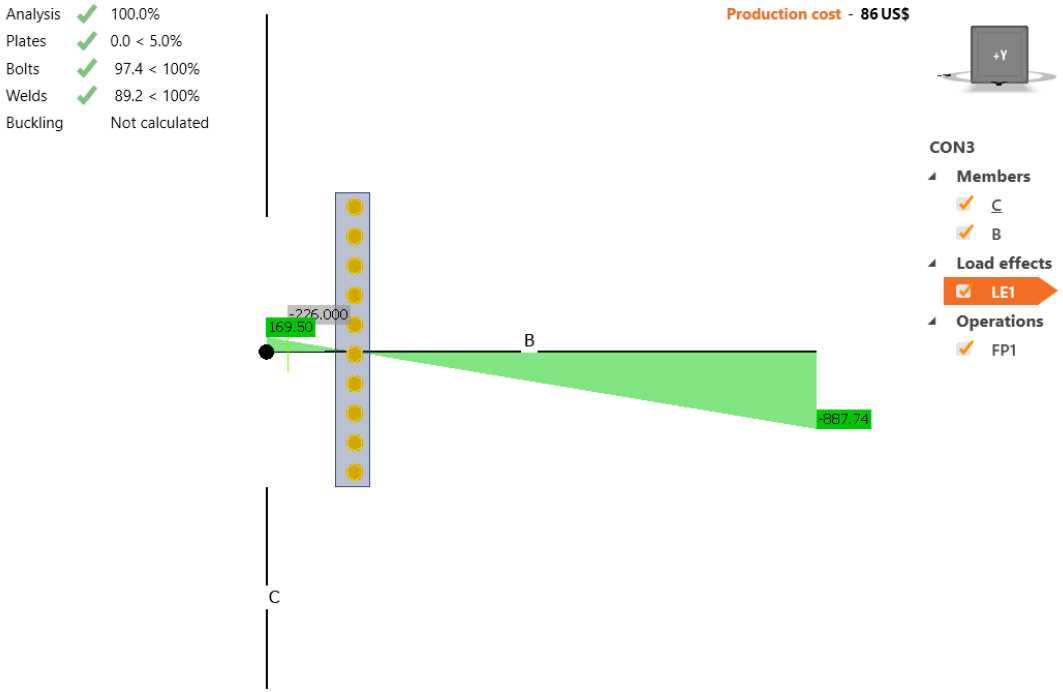


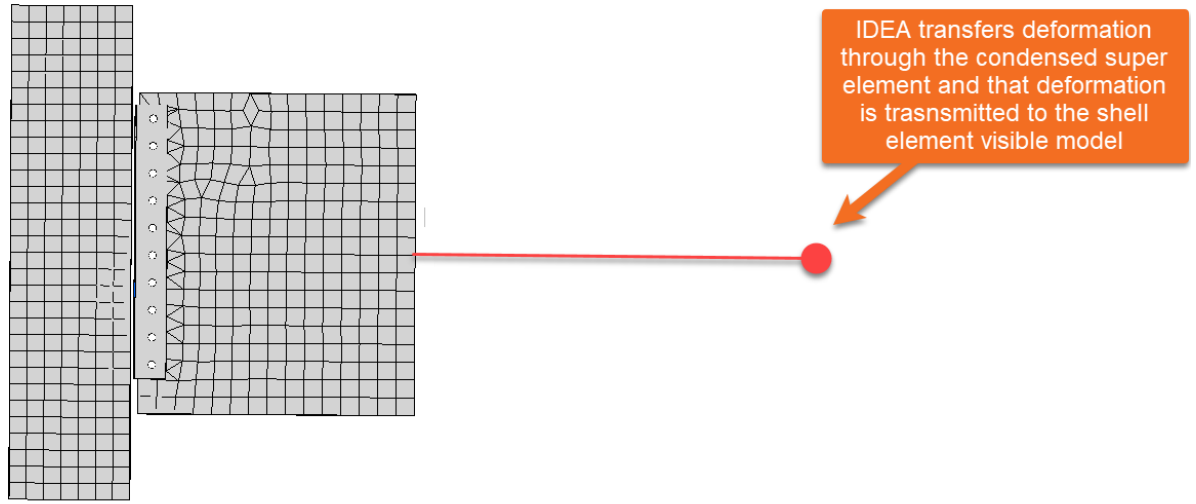
- The real length of the analyzed member is not shown
- Accurate stress/strain and deformation of members
- **Results show better compliance with experimental tests and design code formulations.**
- Knowledge base

Member lenghts

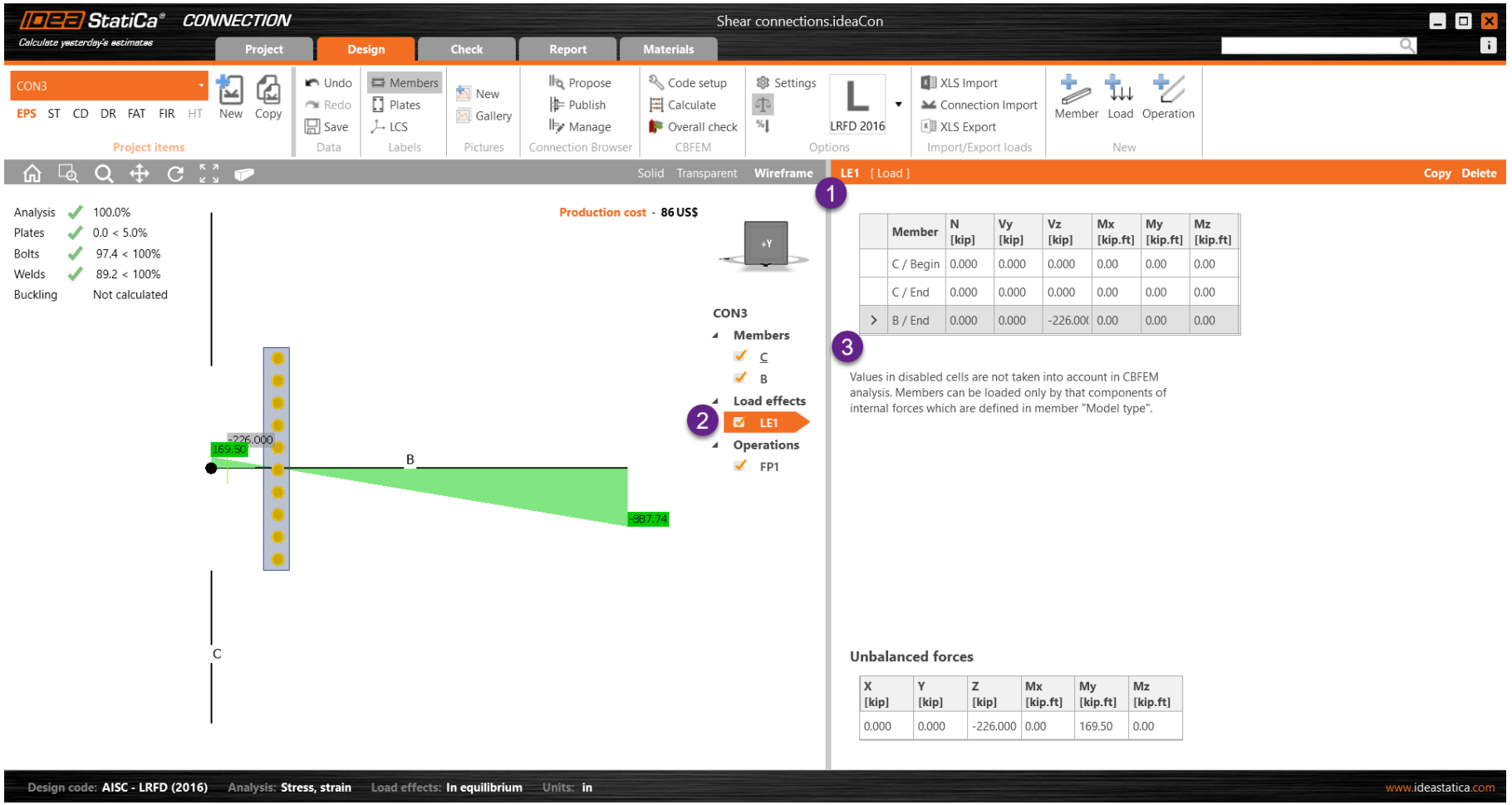


How IDEA loads the model?

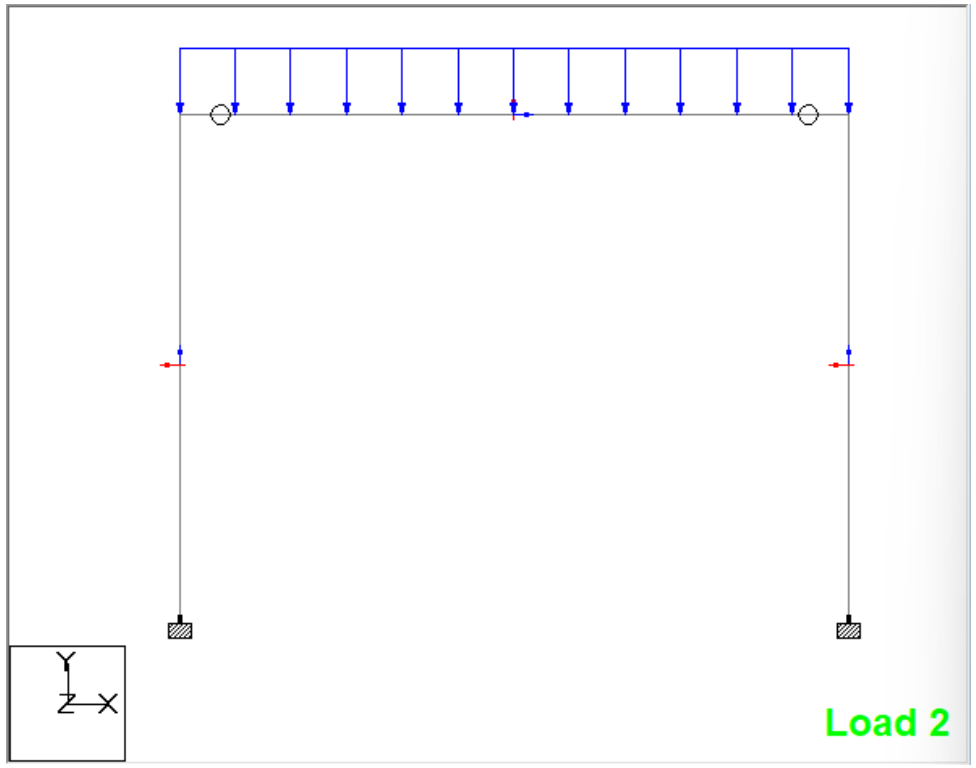


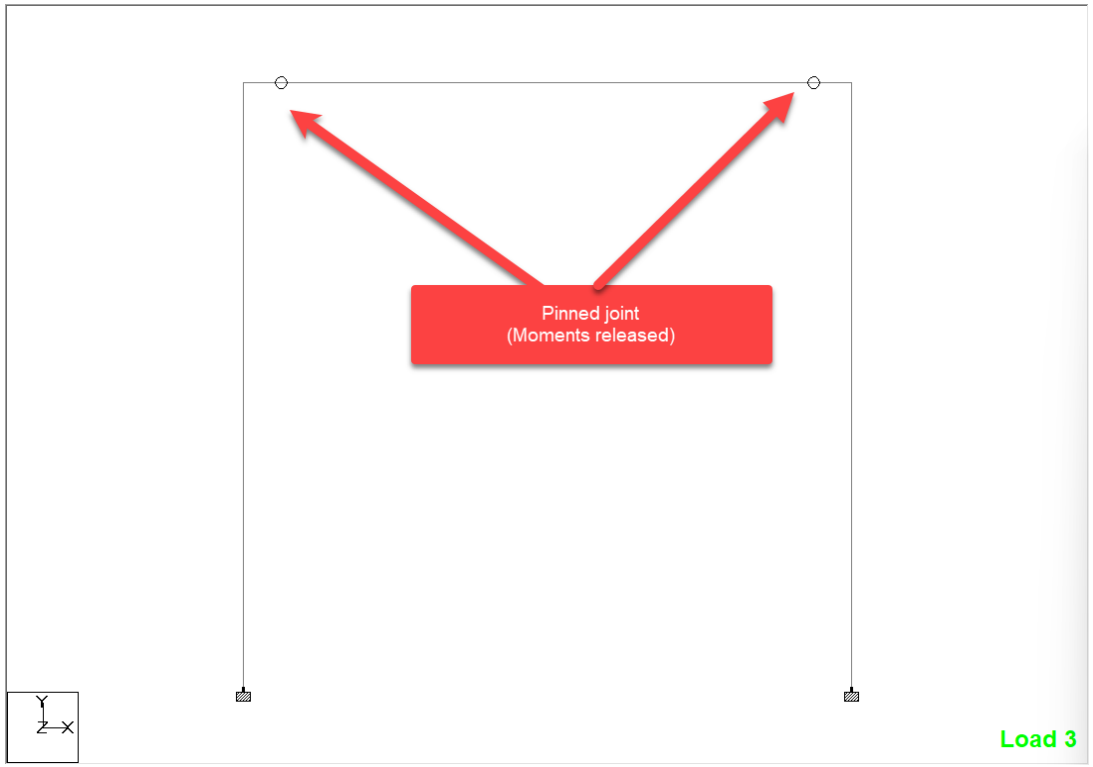


Moment diagram

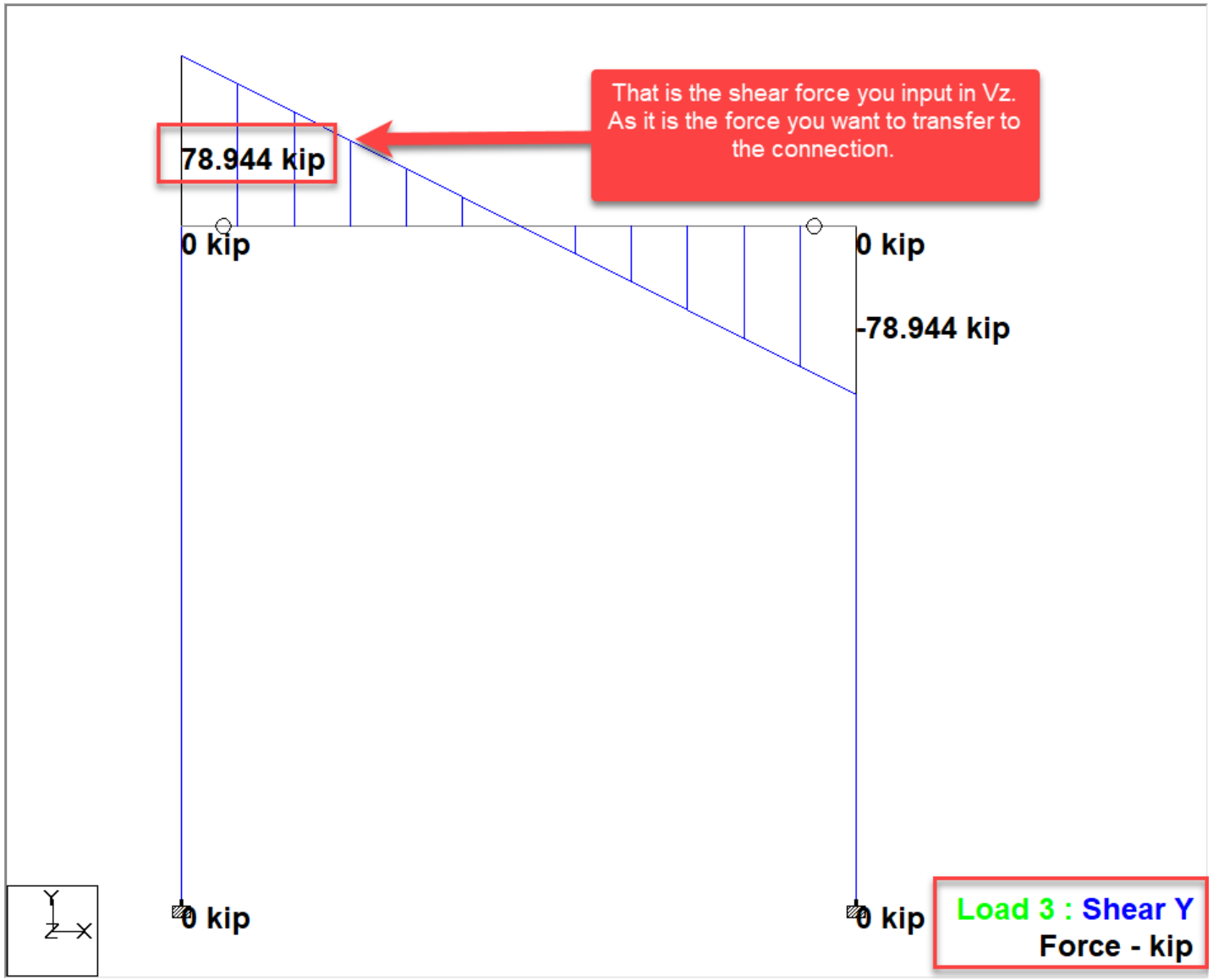


Example: Frame with released moments and uniform load

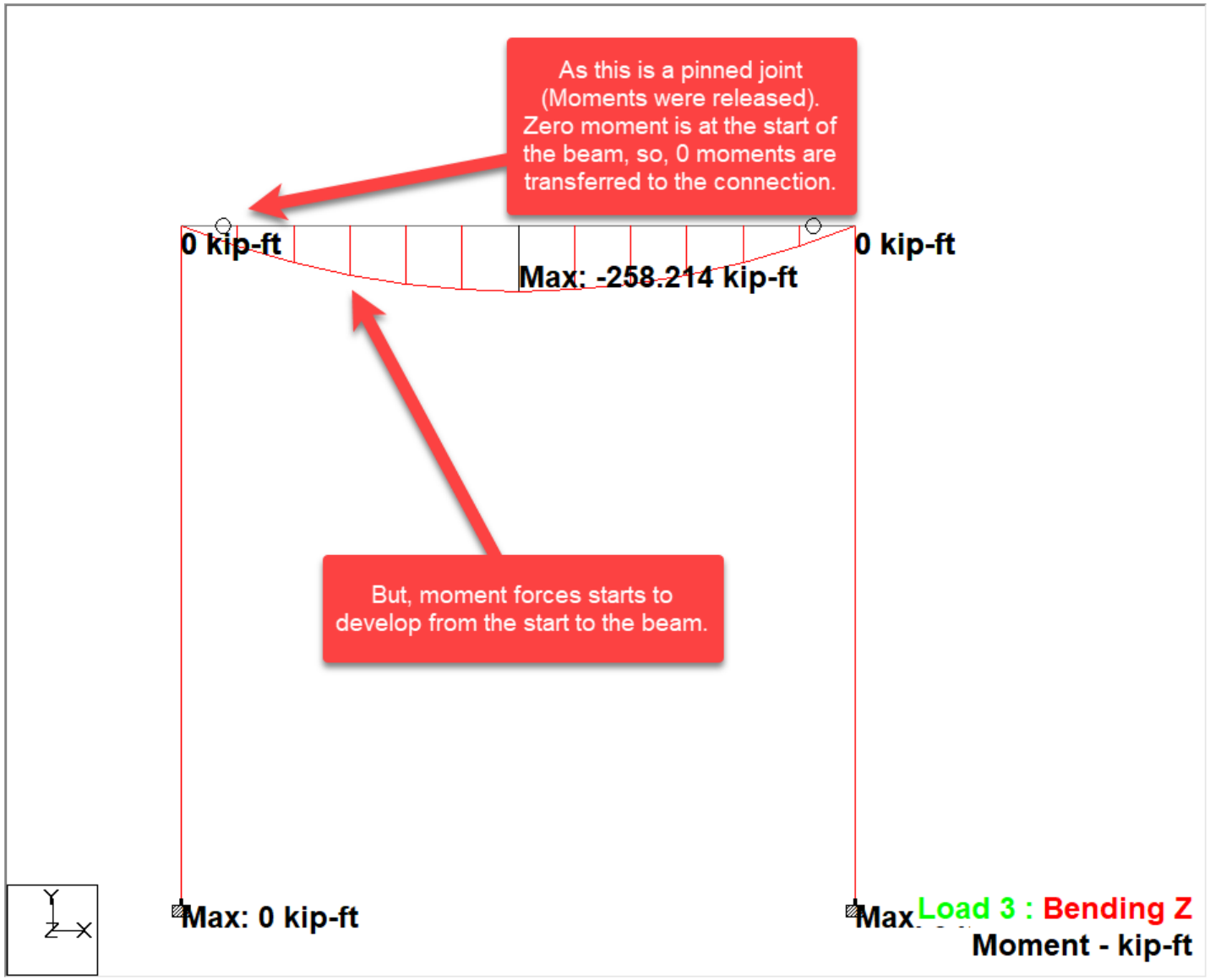




Shear force results

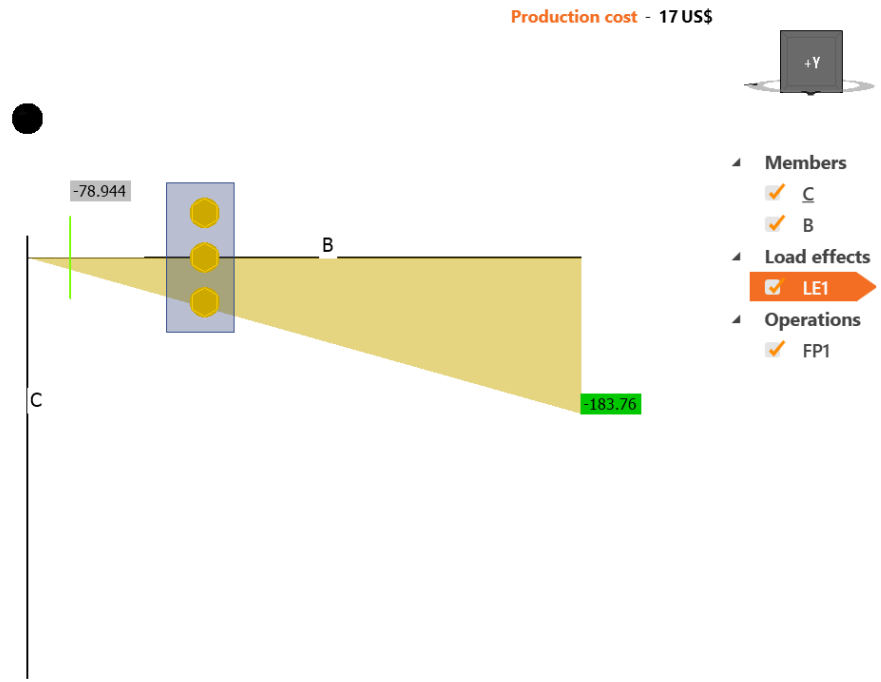


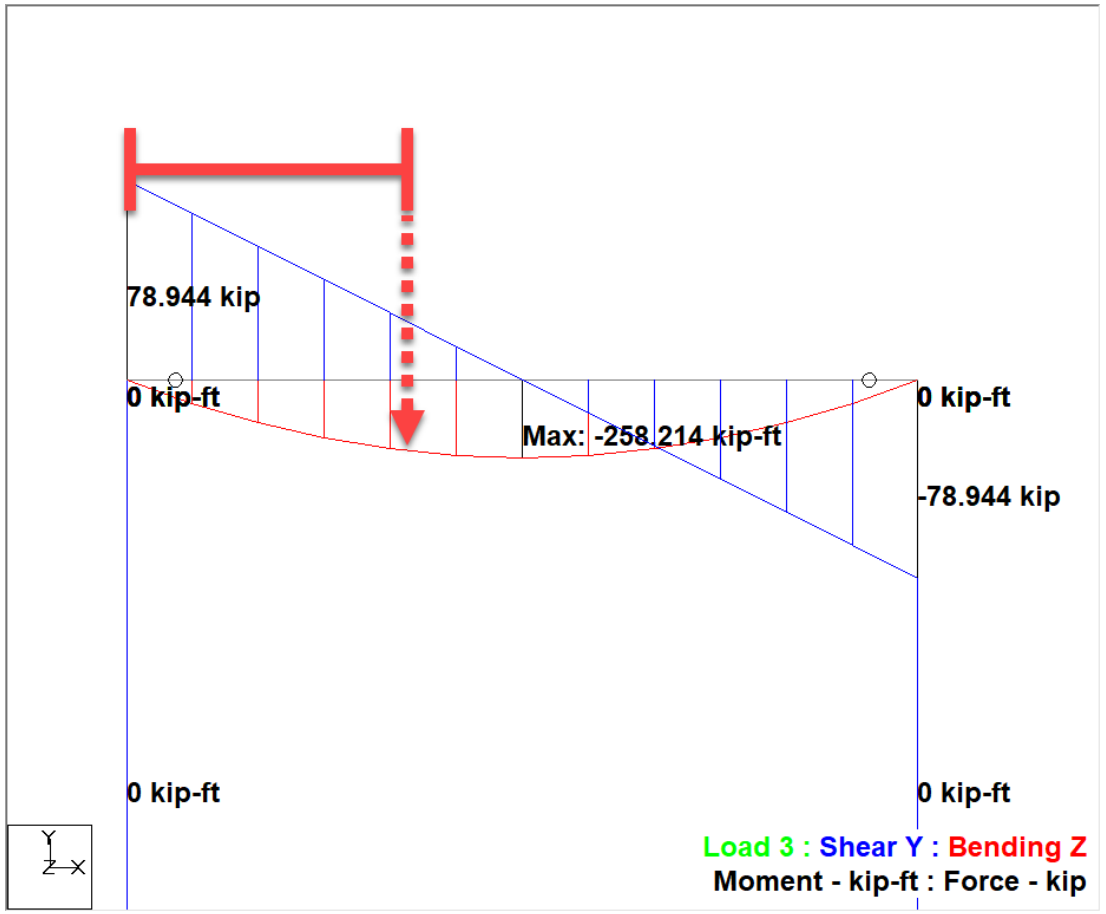
Moment results



Moments at the end of the member

- L*Shear: 2.33ft*78.944kips=183.93





IDEA StatiCa®

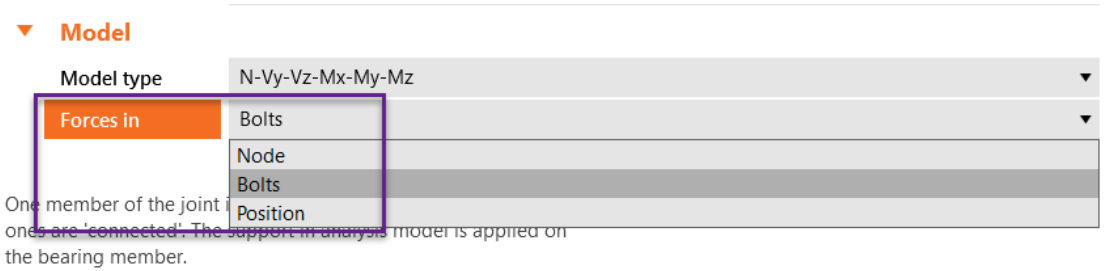
Load position

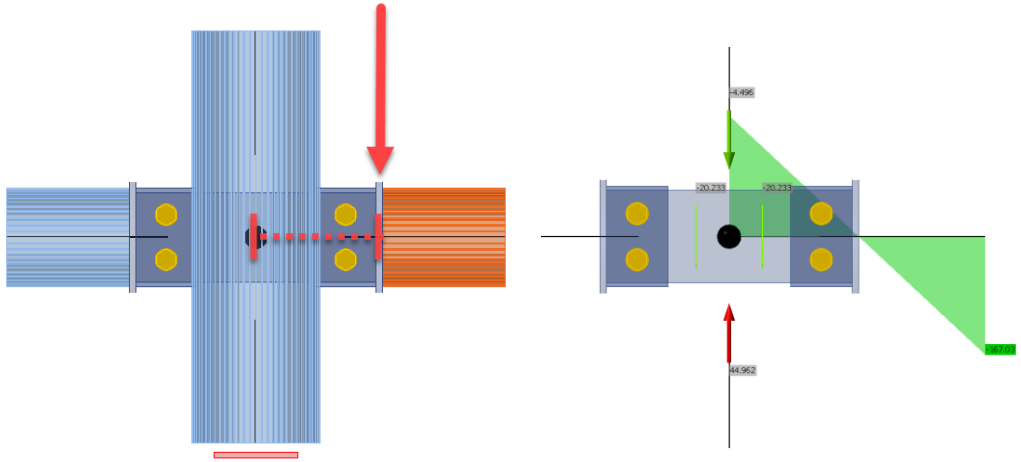
Distance along the member to place a shear force, it is taken from the start of the member

By default, member starting point is on the node (unless you modify the ex offset)

Indicates the inflection point in the moment diagram (hinge)

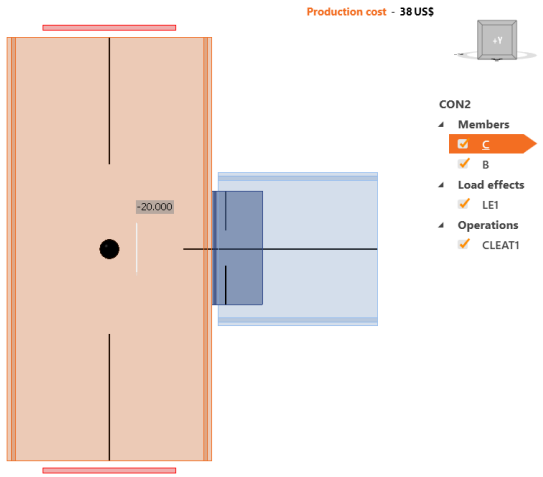
Each member has its own load position input



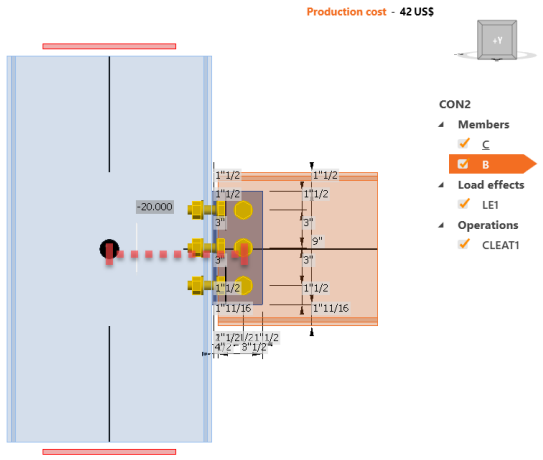


https://www.ideastatica.com/support-center/how-to-define-correct-load-position

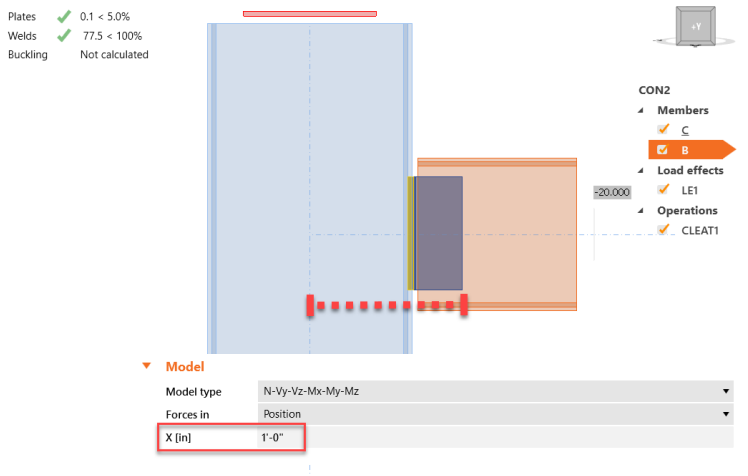
Node, bolts or position?



Node: Starting point of the member, usually at the node unless you modify ex offset



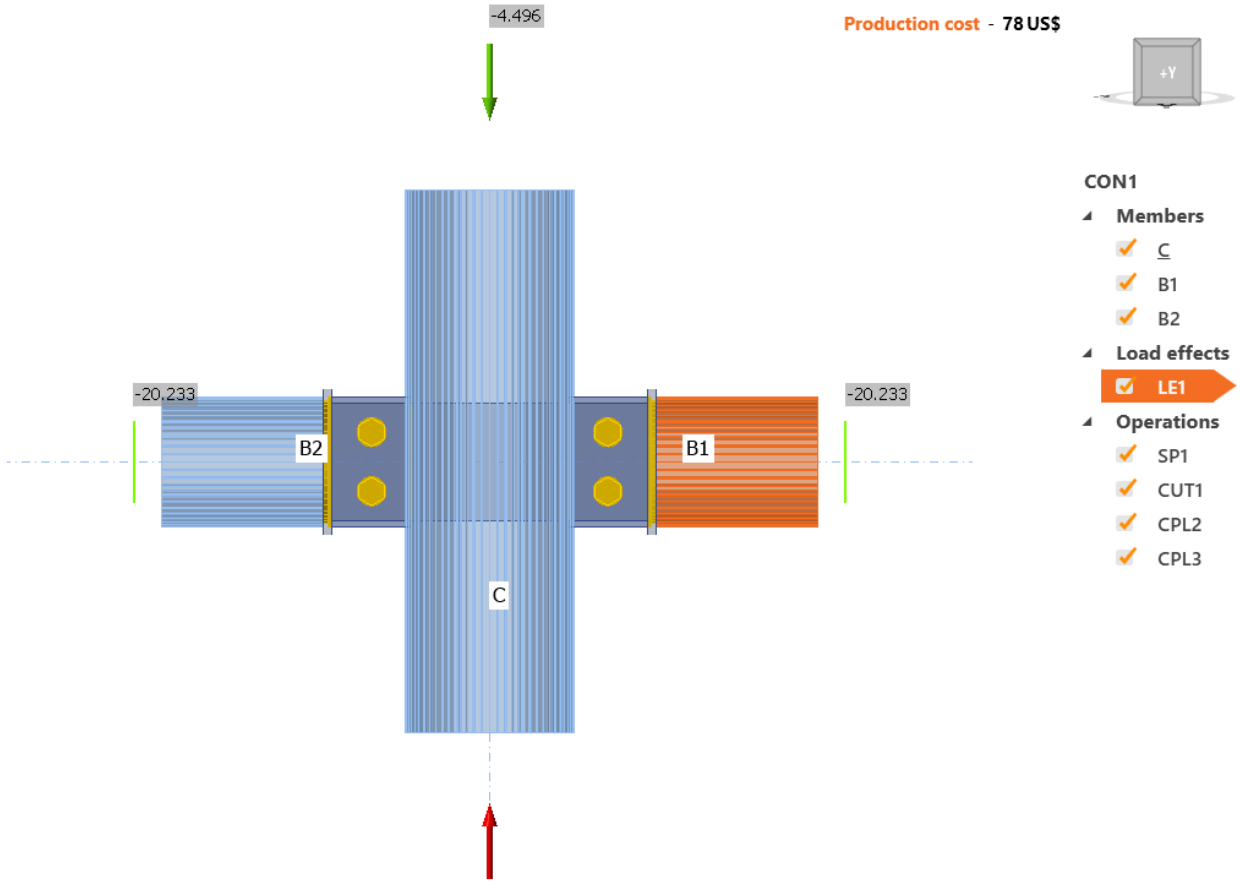
Bolts: Valid when an operation contains bolts (shear plate, cleat, etc)



Position: Distance input needed

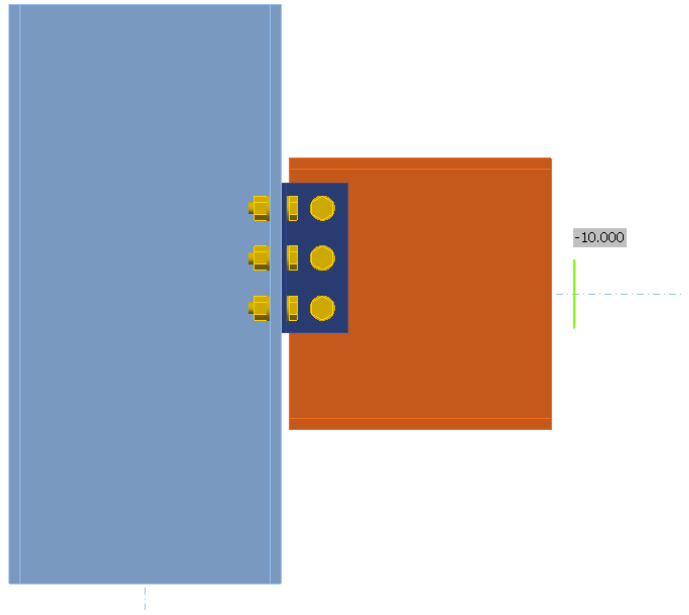
[Location of the hinge investigation]

Examples



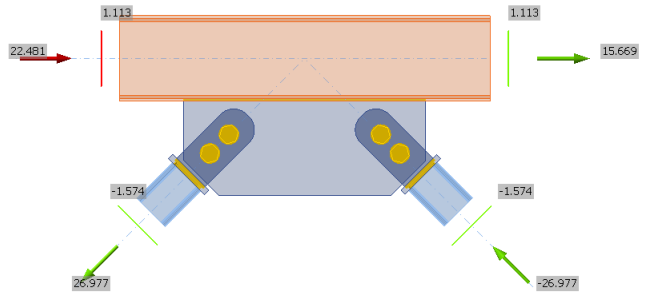
Production cost - 78 US$

CON1
- Members
  - C
  - B1
  - B2
- Load effects
  - LE1
- Operations
  - SP1
  - CUT1
  - CPL2
  - CPL3



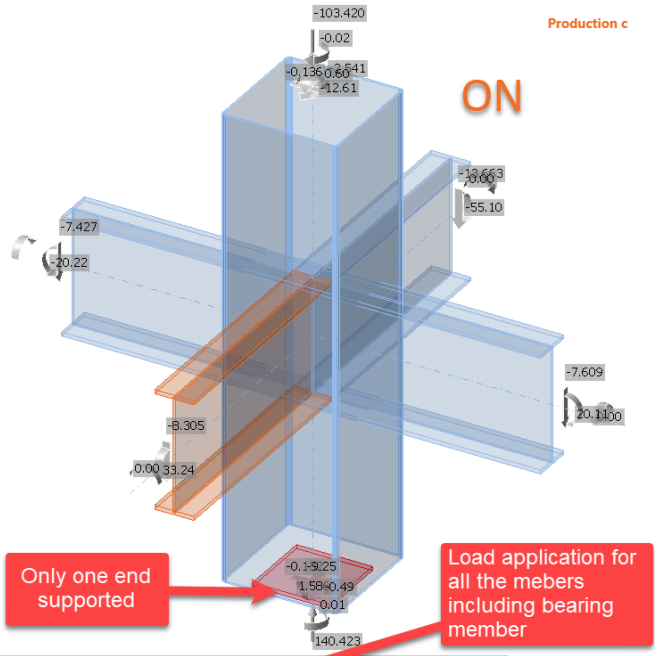
Production cost - 42 US$

CON2
- Members
  - C
  - B
- Load effects
  - LE1
- Operations
  - CLEAT1



Production cost - 75 US$

CON3
- Members
  - CH
  - D1
  - D2
- Load effects
  - LE1
- Operations
  - SP1
  - CPL1
  - CPL2



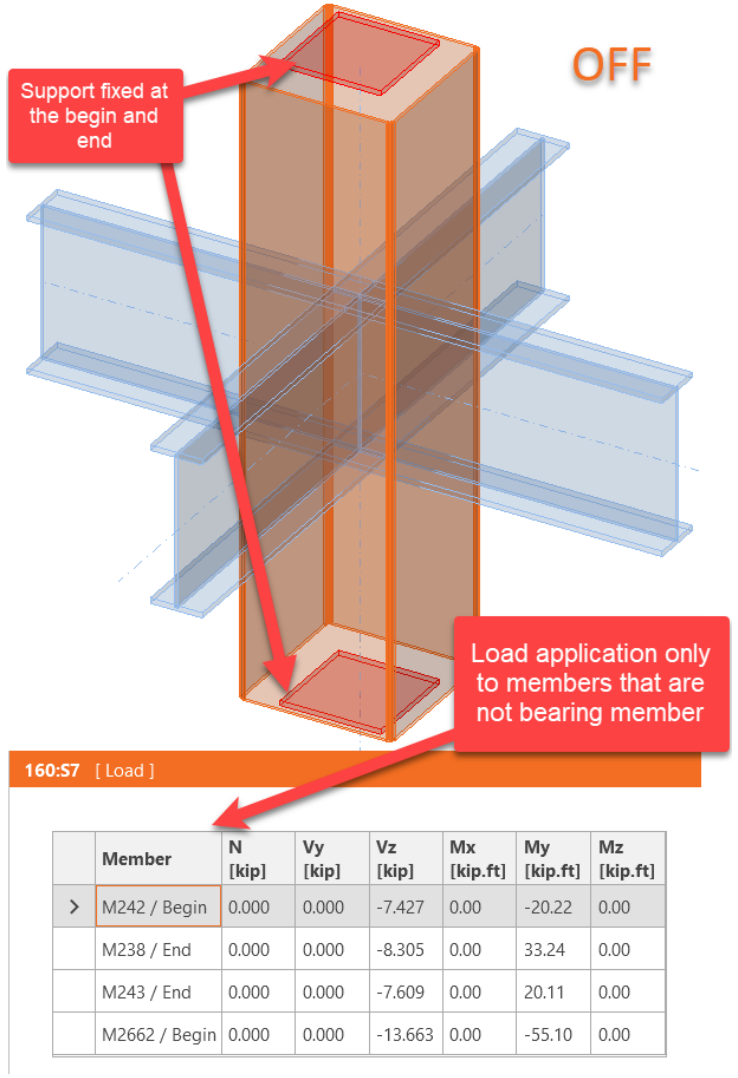
160:S7 [Load]

	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
>	M242 / Begin	0.000	0.000	-7.427	0.00	-20.22	0.00
	M175 / Begin	140.423	1.586	-0.132	0.01	-0.49	-9.25
	M175 / End	-103.42(	-2.541	-0.136	-0.02	0.60	-12.61
	M238 / End	0.000	0.000	-8.305	0.00	33.24	0.00
	M243 / End	0.000	0.000	-7.609	0.00	20.11	0.00
	M2662 / Begin	0.000	0.000	-13.663	0.00	-55.10	0.00

Unbalanced forces

X [kip]	Y [kip]	Z [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
0.268	-0.955	0.000	0.00	0.00	-0.01

Joint statics check



160:S7 [Load]

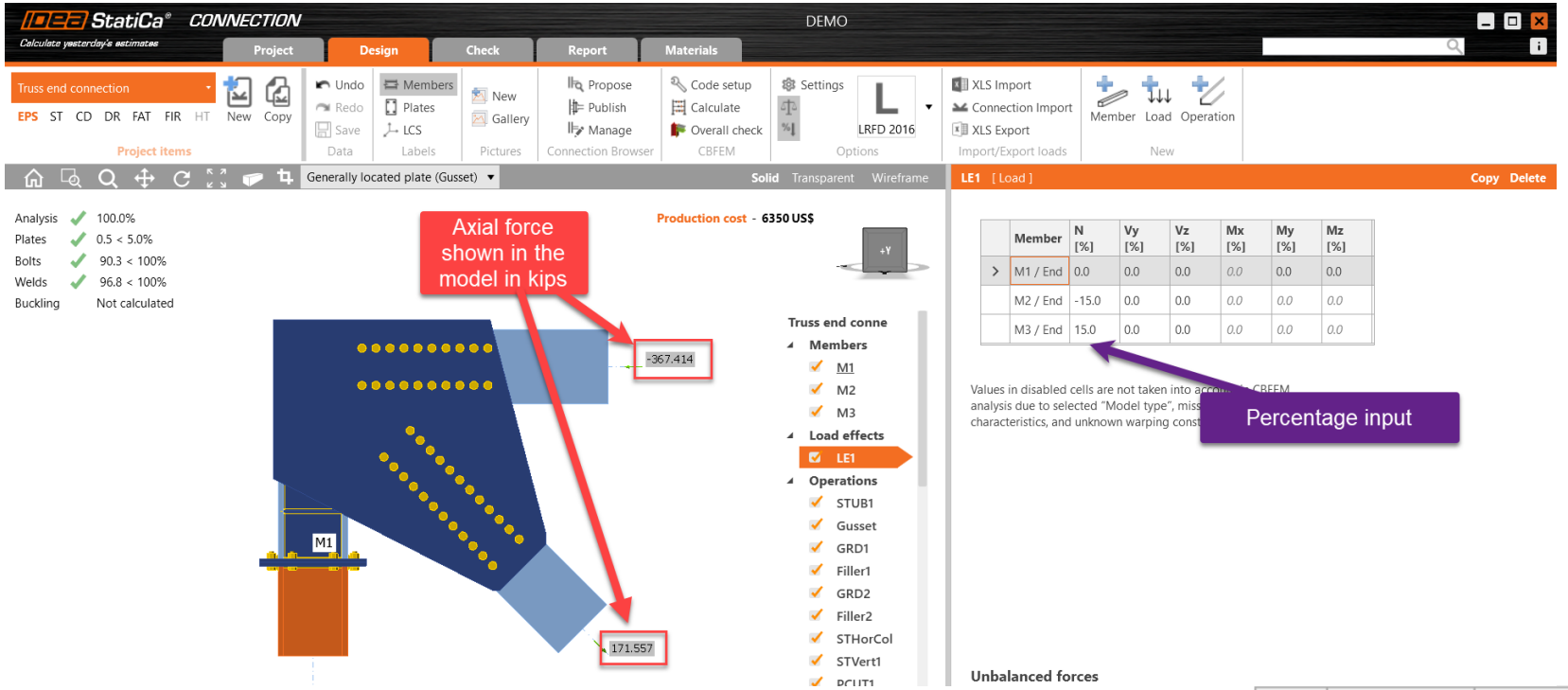
	Member	N [kip]	Vy [kip]	Vz [kip]	Mx [kip.ft]	My [kip.ft]	Mz [kip.ft]
>	M242 / Begin	0.000	0.000	-7.427	0.00	-20.22	0.00
	M238 / End	0.000	0.000	-8.305	0.00	33.24	0.00
	M243 / End	0.000	0.000	-7.609	0.00	20.11	0.00
	M2662 / Begin	0.000	0.000	-13.663	0.00	-55.10	0.00

Loads in equilibrium: On/Off

Loads in equilibrium

https://www.ideastatica.com/support-center/equilibrium-and-supporting-member

Loads as a percentage of member capacity



Loads - percentage

	Member	N [%]	Vy [%]	Vz [%]	Mx [%]	My [%]	Mz [%]
>	B / End	0.0	0.0	-100.0	0.0	0.0	0.0

Loads as a percentage of member capacity

LRFD

$$N = A * Fy * \phi$$

$$Vy = Ay * Fy * \left(\frac{\phi}{\sqrt{3}}\right)$$

$$Vz = Az * Fy * \left(\frac{\phi}{\sqrt{3}}\right)$$

$$My = Zy * Fy * \phi$$

$$Mz = Zx * Fy * \phi$$

ASD

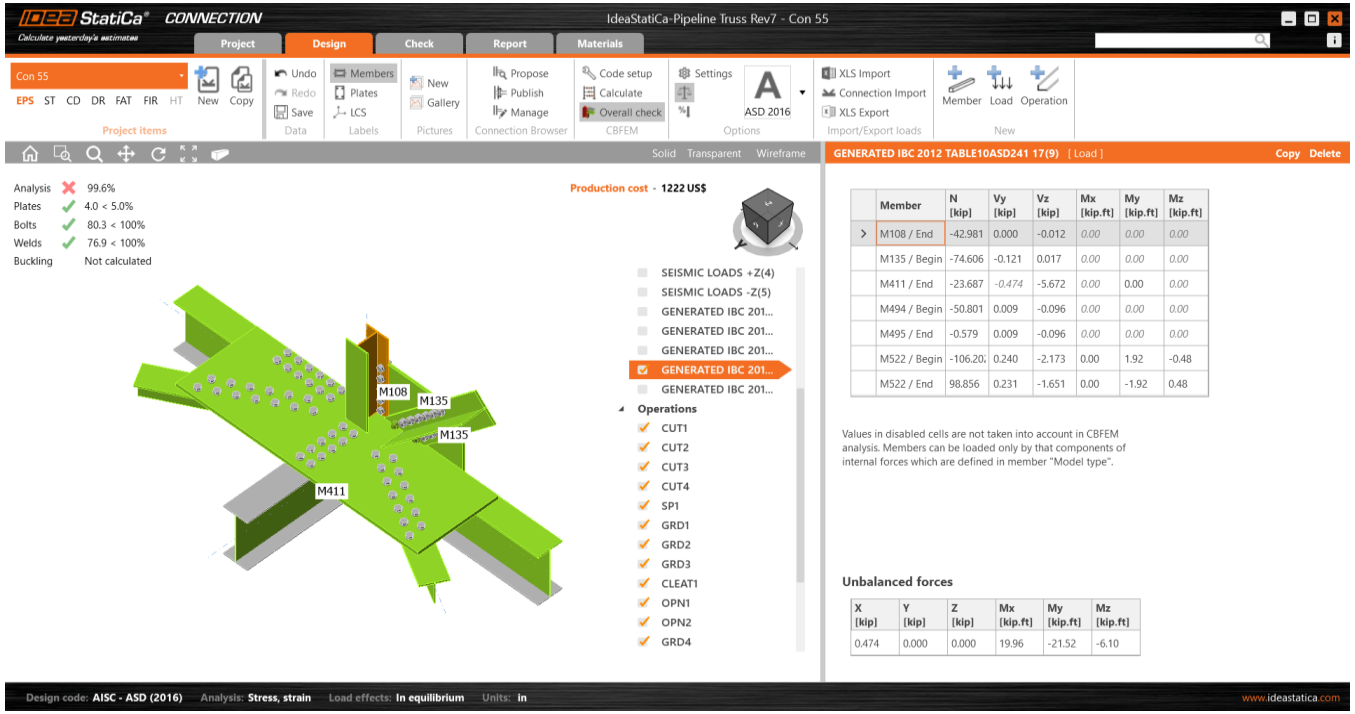
$$N = \frac{A * Fy}{\Omega}$$

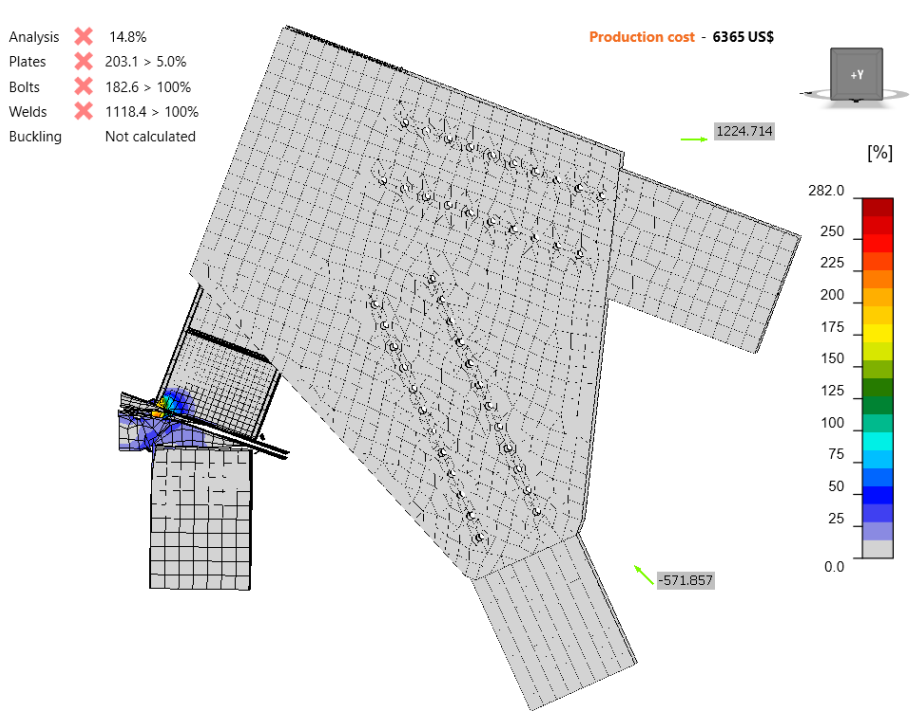
$$Vy = (Ay * Fy/\sqrt{3})/\Omega$$

$$Vz = (Az * Fy/\sqrt{3})/\Omega$$

$$My = \frac{Zy * Fy}{\Omega}$$

$$Mz = \frac{Zx * Fy}{\Omega}$$


StatiCa CONNECTION
Calculate yesterday's estimate
IdeaStatiCa-Pipeline Truss Rev7 - Con 55
Project
Design
Check
Report
Materials
Con 55
EPS ST CD DR FAT FIR HT
New
Copy
Undo
Redo
Save
Members
Plates
LCS
New
Gallery
Propose
Publish
Manage
Code setup
Calculate
Overall check
Settings
ASD 2016
XLS Import
Connection Import
XLS Export
Member
Load
Operation
Project items
Data
Labels
Pictures
Connection Browser
CBFEM
Options
Import/Export loads
New
Solid
Transparent
Wireframe
GENERATED IBC 2012 TABLE10ASD241 17(9) [Load]
Copy
Delete
Analysis 99.6%
Plates 4.0 < 5.0%
Bolts 80.3 < 100%
Welds 76.9 < 100%
Buckling Not calculated
Production cost - 1222 US$
M108
M135
M135
M411
SEISMIC LOADS +Z(4)
SEISMIC LOADS -Z(5)
GENERATED IBC 201...
GENERATED IBC 201...
GENERATED IBC 201...
GENERATED IBC 201...
GENERATED IBC 201...
Operations
CUT1
CUT2
CUT3
CUT4
SP1
GRD1
GRD2
GRD3
CLEAT1
OPN1
OPN2
GRD4
Member | N [kip] | Vy [kip] | Vz [kip] | Mx [kip.ft] | My [kip.ft] | Mz [kip.ft]
M108 / End | -42.981 | 0.000 | -0.012 | 0.00 | 0.00 | 0.00
M135 / Begin | -74.606 | -0.121 | 0.017 | 0.00 | 0.00 | 0.00
M411 / End | -23.687 | -0.474 | -5.672 | 0.00 | 0.00 | 0.00
M494 / Begin | -50.801 | 0.009 | -0.096 | 0.00 | 0.00 | 0.00
M495 / End | -0.579 | 0.009 | -0.096 | 0.00 | 0.00 | 0.00
M522 / Begin | -106.20 | 0.240 | -2.173 | 0.00 | 1.92 | -0.48
M522 / End | 98.856 | 0.231 | -1.651 | 0.00 | -1.92 | 0.48
Values in disabled cells are not taken into account in CBFEM analysis. Members can be loaded only by that components of internal forces which are defined in member "Model type".
Unbalanced forces
X [kip] | Y [kip] | Z [kip] | Mx [kip.ft] | My [kip.ft] | Mz [kip.ft]
0.474 | 0.000 | 0.000 | 19.96 | -21.52 | -6.10
Design code: AISC - ASD (2016)
Analysis: Stress, strain
Load effects: In equilibrium
Units: in
www.ideastatica.com


Analysis 14.8%
Plates 203.1 > 5.0%
Bolts 182.6 > 100%
Welds 1118.4 > 100%
Buckling Not calculated
Production cost - 6365 US$
+Y
1224.714
-571.857
[%]
282.0
250
225
200
175
150
125
100
75
50
25
0.0

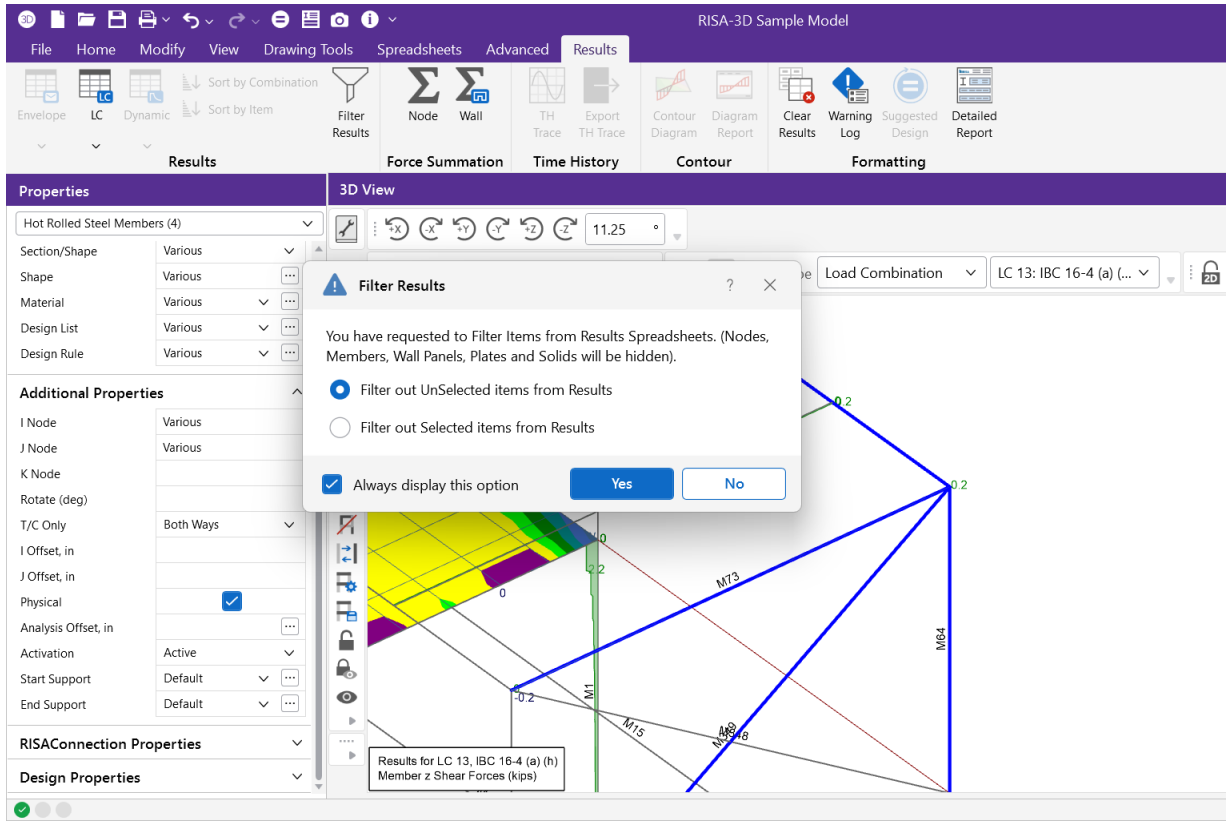
Examples

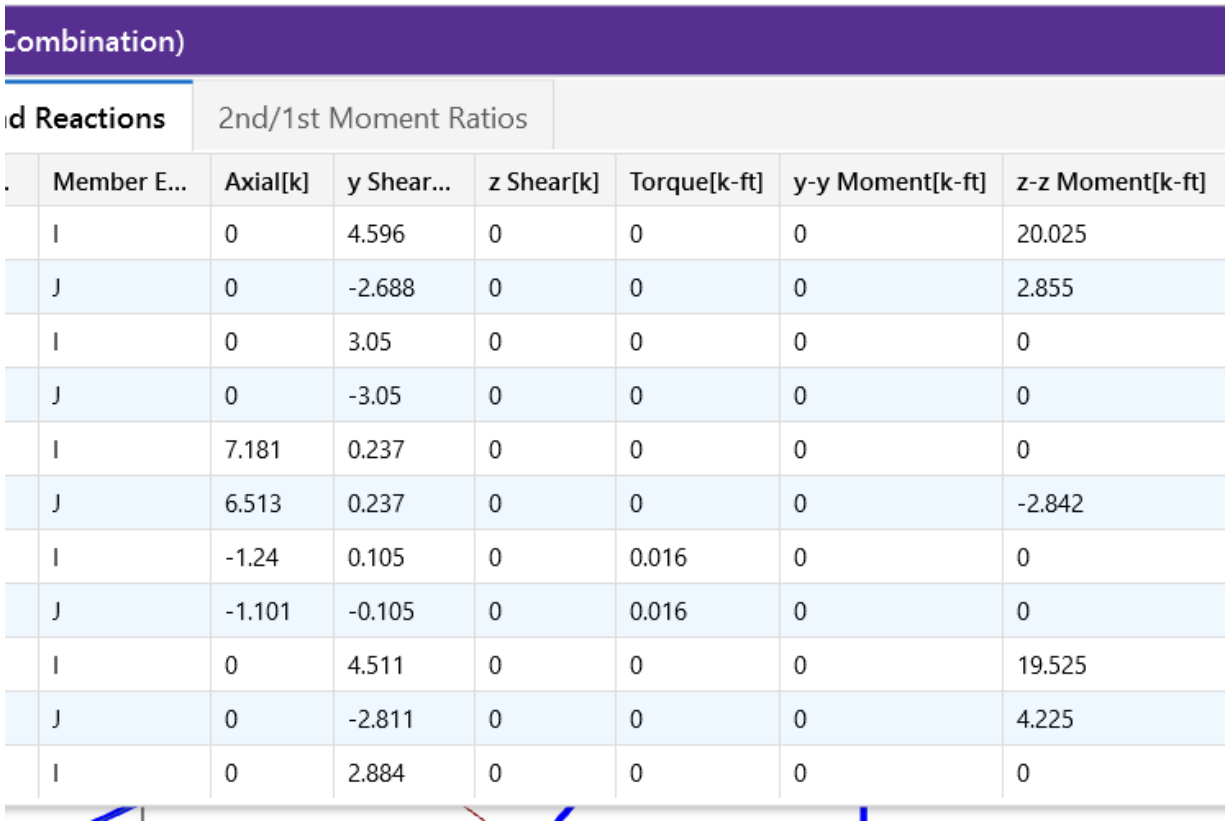
Import load combination from Excel

1. Match the IDEA members name to the other software naming convention
2. XLS Export
3. Use the template provided by IDEA
4. Data process in Excel to match local axis
5. Verify the units in IDEA and the source
6. Click XLS Import and paste it

	A	B	C	D	E	F	G	H	I
1	Load	Beam	Position	N[kip]	Vy[kip]	Vz[kip]	Mx[kip.ft]	My[kip.ft]	Mz[kip.ft]
2	LE1	M64	End	0	0	0	0	0	0
3	LE1	M73	End	0	0	0	0	0	0
4	LE1	M72	End	0	0	0	0	0	0
5	LE1	M349	End	0	0	0	0	0	0
6									
7									

Example RISA





Combination)

d Reactions | 2nd/1st Moment Ratios

Member E...	Axial[k]	y Shear...	z Shear[k]	Torque[k-ft]	y-y Moment[k-ft]	z-z Moment[k-ft]
I	0	4.596	0	0	0	20.025
J	0	-2.688	0	0	0	2.855
I	0	3.05	0	0	0	0
J	0	-3.05	0	0	0	0
I	7.181	0.237	0	0	0	0
J	6.513	0.237	0	0	0	-2.842
I	-1.24	0.105	0	0.016	0	0
J	-1.101	-0.105	0	0.016	0	0
I	0	4.511	0	0	0	19.525
J	0	-2.811	0	0	0	4.225
I	0	2.884	0	0	0	0

Q&A

What's next?

Next webinars…

- What's new in **IDEA StatiCa V23**? US Edition – May 3rd
- Stiffness analysis – May 31st

Live events

- NASCC April 12-14
- Booth #1636