

Structure Tool in Freecad: how to use

1 Intro info:

FreeCAD is open-source software that can integrate with Python packages.

Structure Tool is a FreeCAD extension for structural analysis, utilizing the Pynite kernel to perform calculations and display results

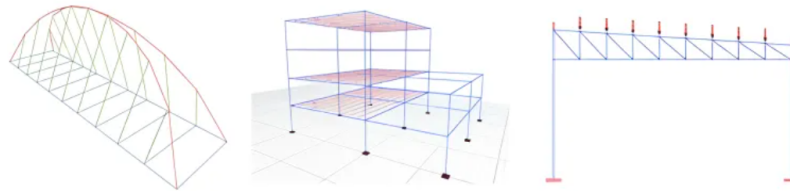


Figure 1:

2 How to use:

From Freecad select Structure Tool WB

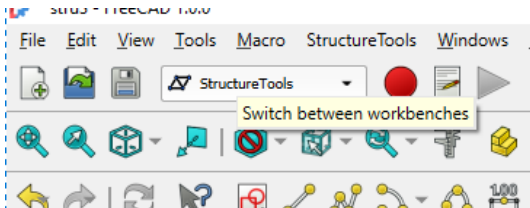


Figure 2:

- * Click New button to create empty model
- * Click Line on toolbar to create line for beam/ column structure

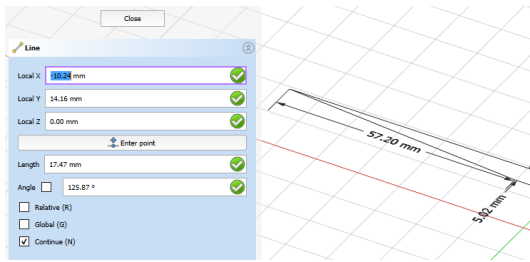


Figure 3:

* Select endpoint of line then click support button

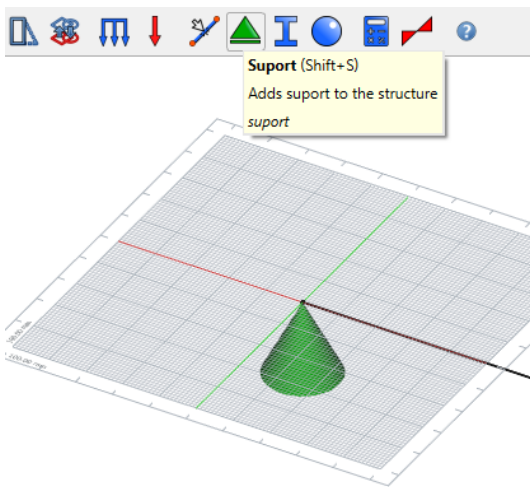


Figure 4:

– in tab of support select restraint required

Base	
► Placement	[[0.00 0.00 1.00]; 0.00 °; (0.00 mm 0.00 mm 0.00 mm)]
Label	Support
Object Base	Line [Vertex1]
Draw	
Scale Draw	1.00
Rotation	
Fix Rotation X	✓ true
Fix Rotation Y	true
Fix Rotation Z	true
Translation	
Fix Translation X	true
Fix Translation Y	true
Fix Translation Z	true

Figure 5:

* Create & assign section
 – Click sketch button to make a sketch. Sketch will be in plane XY (important note) and try to make sketch in center of (0,0,0)

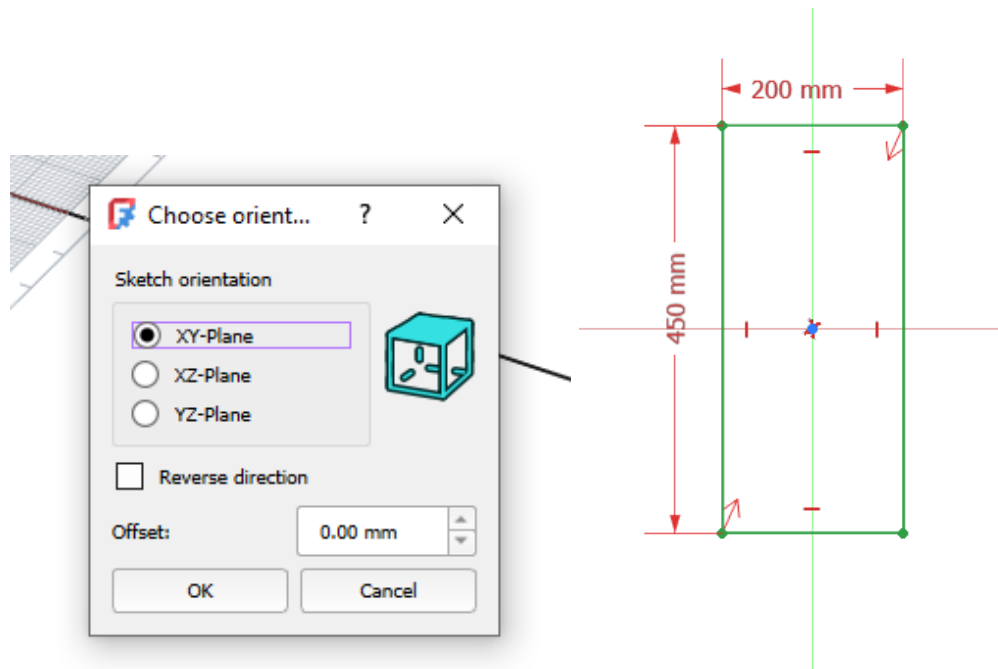


Figure 6:

- Convert sketch to wire

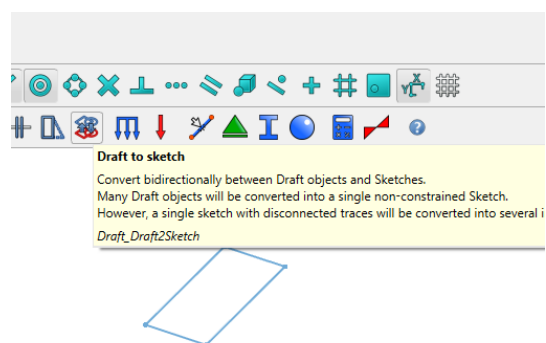


Figure 7:

- from wire created, select make face

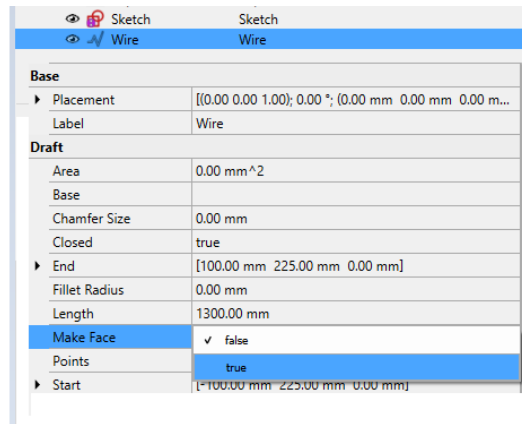


Figure 8:

- put pointer on created face then click section button (important note)

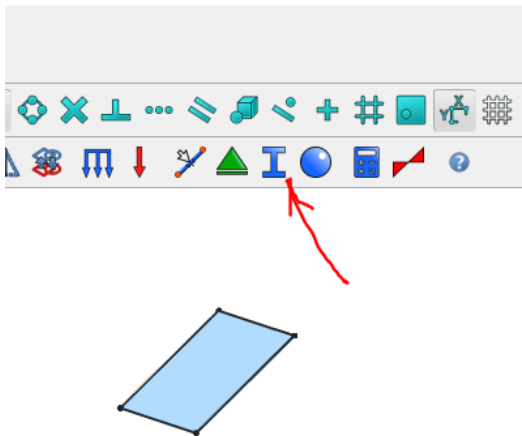


Figure 9:

- section will create with parameter for moment inertia info

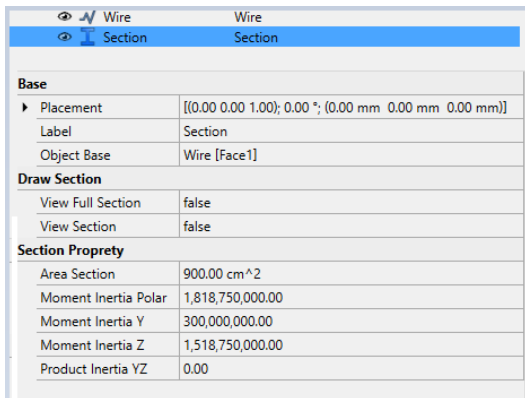


Figure 10:

* Create material

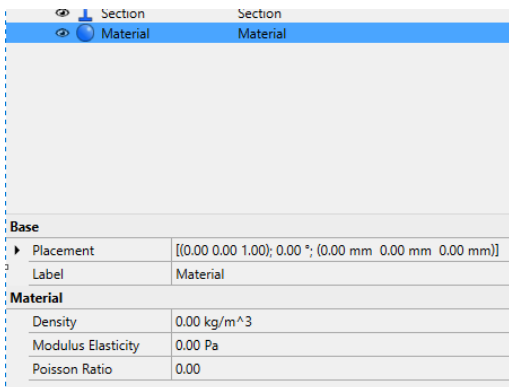


Figure 11:

* Select line & define section, material

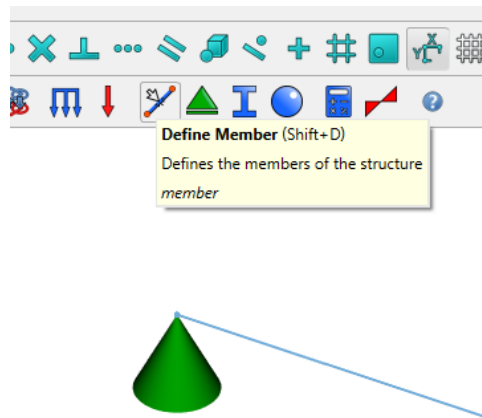


Figure 12:

– in line tab properties will appear Structure info

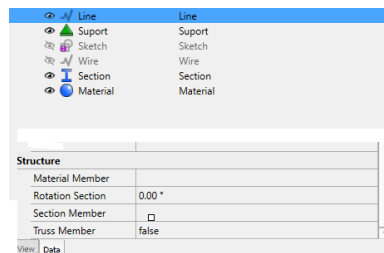


Figure 13:

– click "..." then select material, section already defined in list

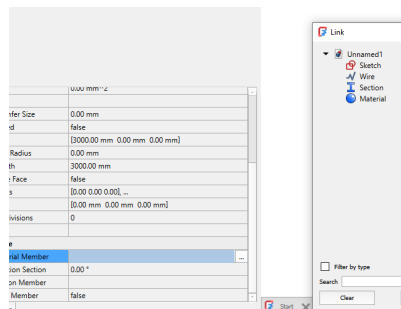


Figure 14:

* select line structure and apply load

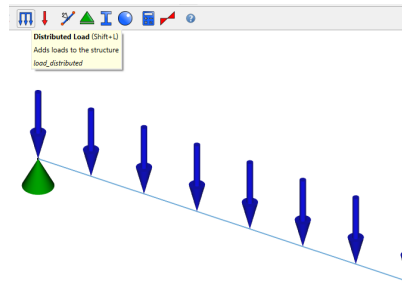


Figure 15:

* select whole model by box selection (important note)

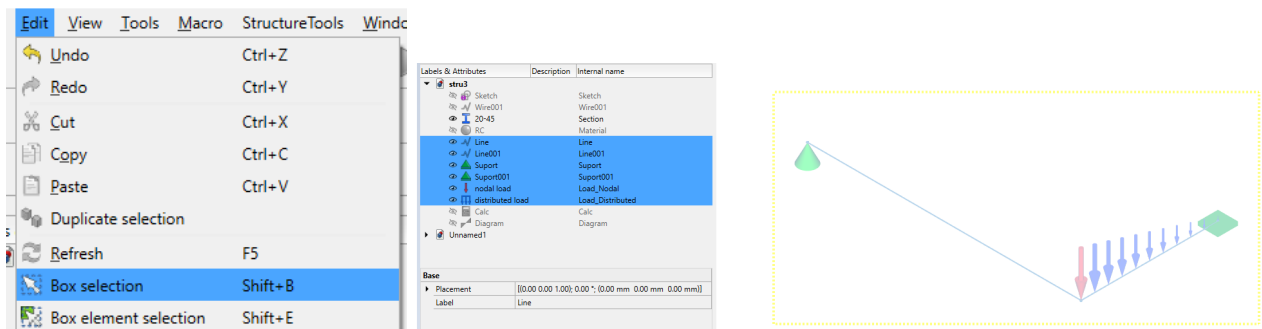


Figure 16:

– click Calc button to run analysis

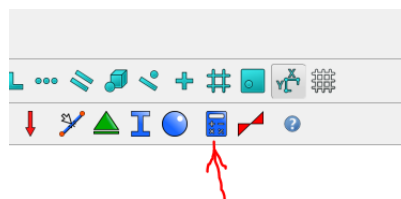


Figure 17:

– Calc will appear in tab properties with values moment, shear, deflection



Calc	Calc
Diagram	Diagram
Num Points Deflection	4
Num Points Moment	5
Num Points Shear	4
Num Points Torque	3
Result Axial	
Axial Force	[0.0,0.0,0.0,0.0,0.0,0.0]
Result Deflection	
Deflection Y	[0.0,-0.00015188954245395927,-0.00029240320163...
Deflection Z	[0.0,0.0,0.0,0.0,0.0,0.0,0.0]
Max Deflection Y	[0.00,-0.00]
Max Deflection Z	[0.00,0.00]
Min Deflection Y	[-0.00,-0.00]
Min Deflection Z	[0.00,0.00]
Result Moment	
Max Moment Y	[0.00,0.00]
Max Moment Z	[-0.00,22.23]
Min Moment Y	[0.00,0.00]

Figure 18:

* click diagram to see BD or SD

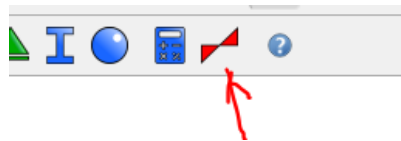


Figure 19:

– on tab properties of diagram, select "true" to show value on beam

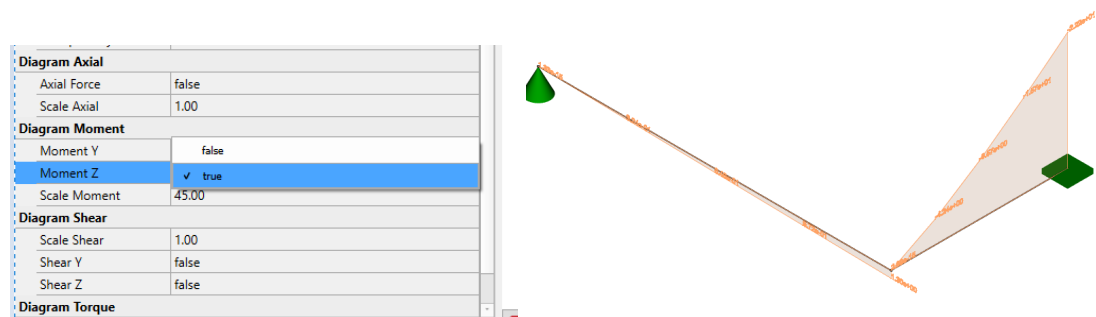


Figure 20:

3 New add-ins:

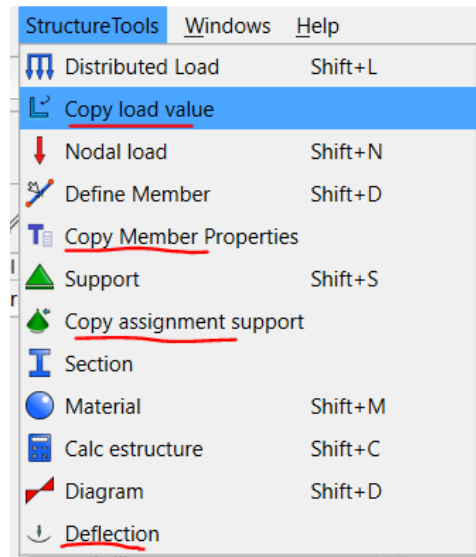


Figure 21:

– Load copy use for copy value load from selected distribute line to other ones

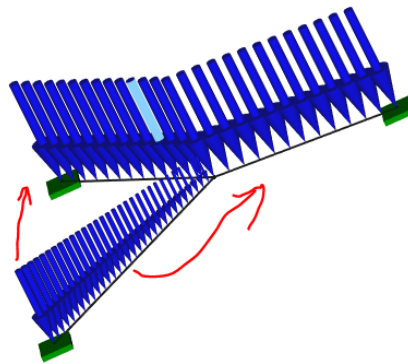


Figure 22: Before copy load

select source distribution load then select other ones to overwrite value

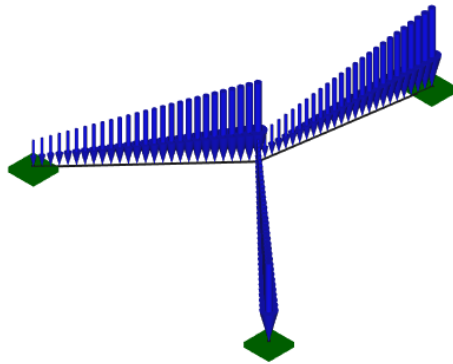


Figure 23: After copy load

- Copy support assignment use for copy assignment from selected support to other ones

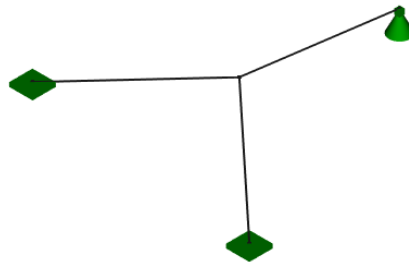


Figure 24: Before copy

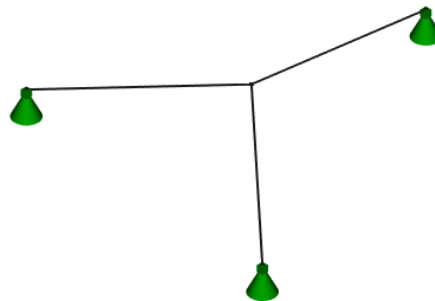


Figure 25: After copy

- Show deflection results

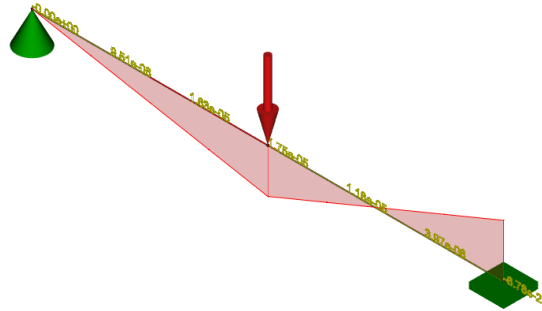


Figure 26:

4 Summary:

We gratefully acknowledge Maykow Menezes for his development of Structure Tools. This extension provides a user-friendly way to visualize and interpret Pynite results within FreeCAD, significantly reducing the need for direct Pynite coding expertise. You can explore the project and its source code at: <https://github.com/maykowsm/StructureTools>.

We extend special thanks to Yorik Van Havre for developing FreeCAD Platform

5 Appendix: Testing result

5.1 Example 1:

* Simple beam under uniform load & bending diagram

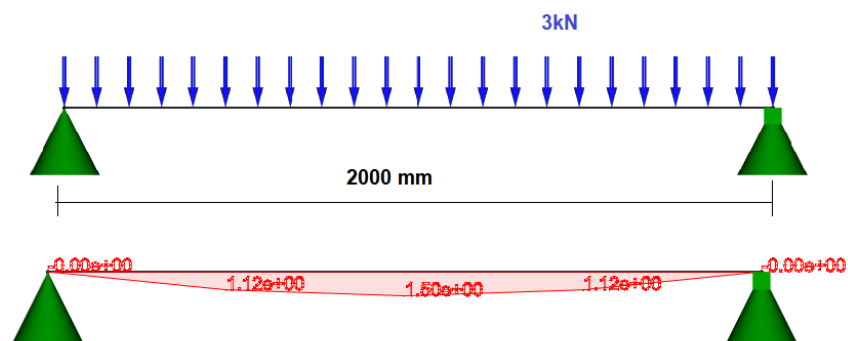


Figure 27:

* Result by anatruct - Python package

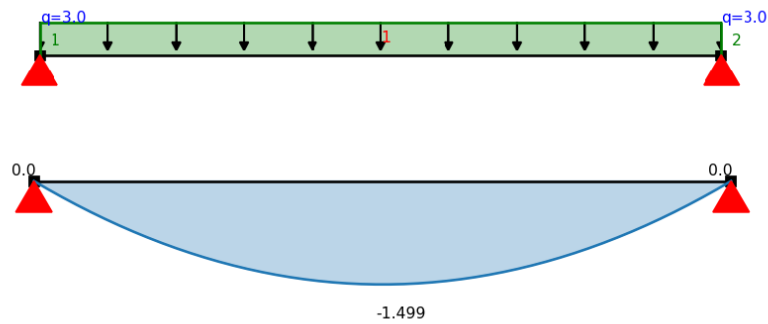


Figure 28:

5.2 Example 2:

* Simple beam under uniform load, point load & bending diagram

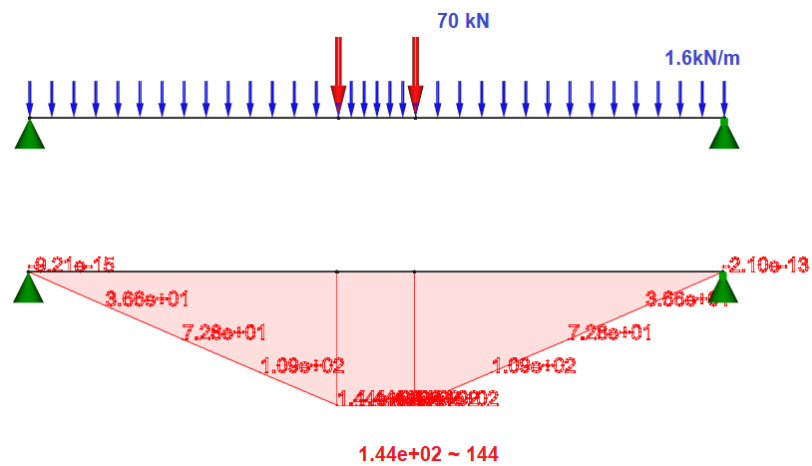


Figure 29:

* Result by anatruct - Python package

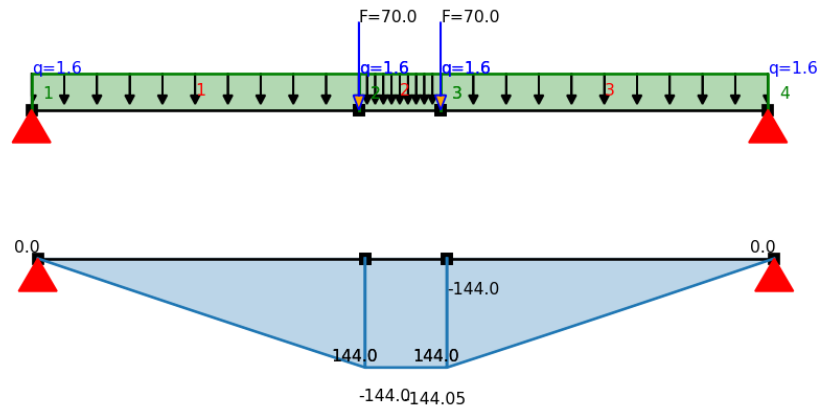


Figure 30:

* Result by Ftool

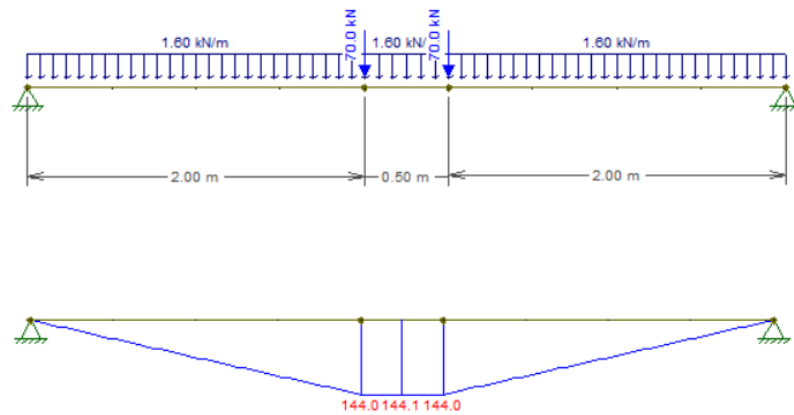
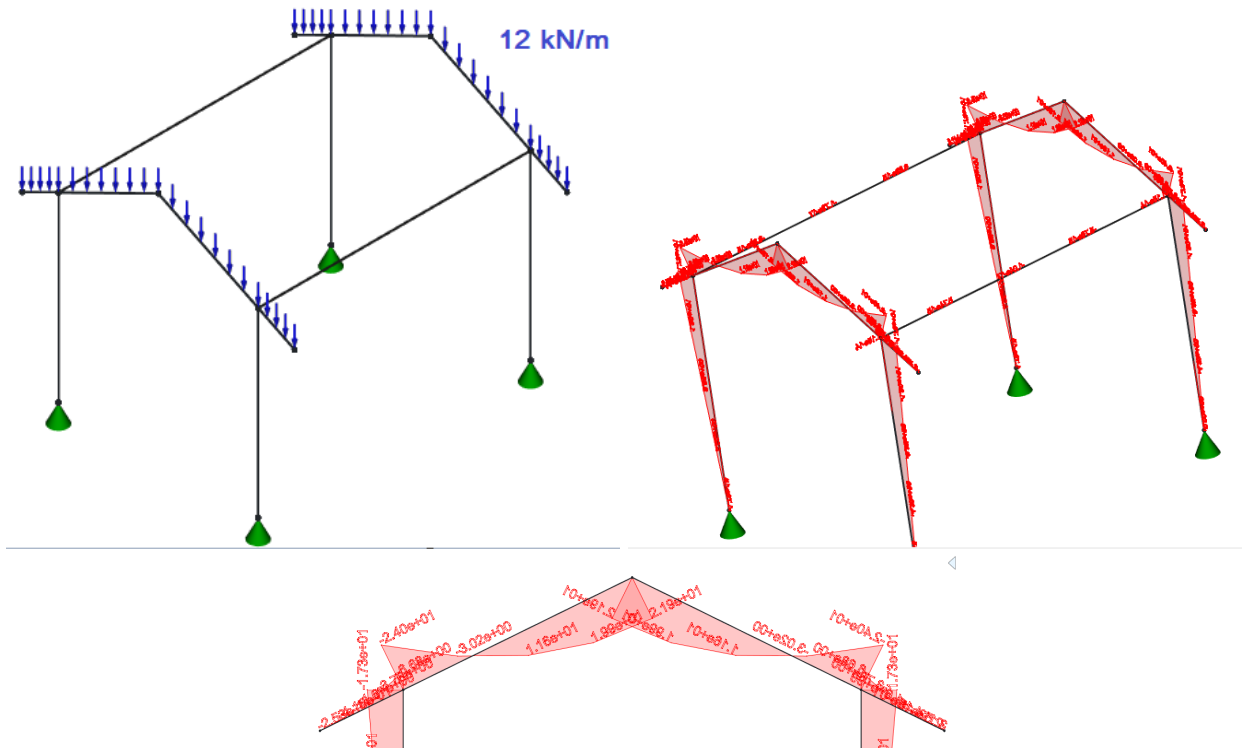


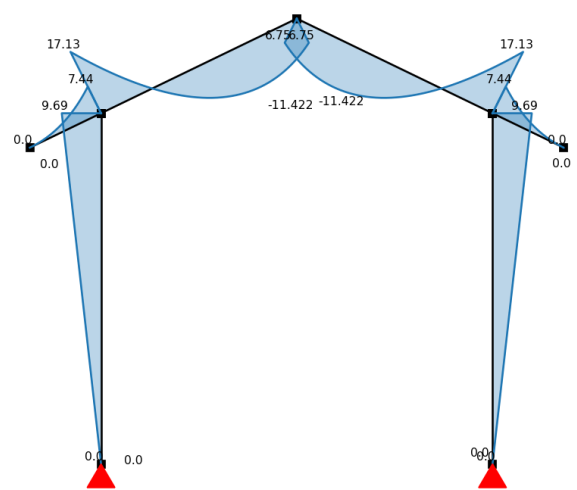
Figure 31:

5.3 Example 3:

* Frame structure uniform load & bending diagram



* Result by Structure Tool



* Result by Anastruct

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A key advantage of Structure Tool is its ability to perform analysis on 3D models, a capability often limited in other free software packages

6 Notes & Troubleshooting

In here, listing down some troubleshooting need to avoid:

- + Do not group lines (members)
- + With model have many frames or member structures, may need to 'Calc' one frame first before replicate
- + Section properties can copy from other file to current working file

Structure	
Material Member	Material (Steel)
Rotation Section	0.00 °
Section Member	Section001 (Box75x75x4)
Truss Member	false

Figure 34:

- + Tick 'false' truss member even when model for truss
- + Lines (members), supports, distribute loads, nodal load must not be turned off

Draw Section	
View Full Section	true
View Section	false
Section Properties	

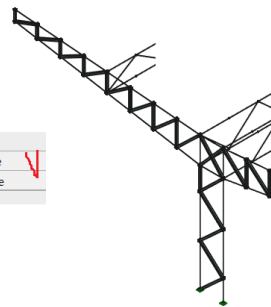


Figure 35:

- + View section assign full 3d to review which one not assign section or wrong assignment

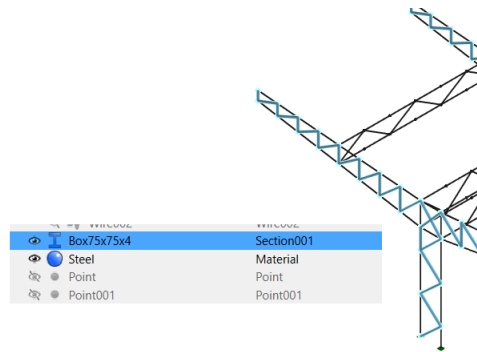


Figure 36:

Or put pointer on declared section then it will highlighted which one assigned for.
This is a drawback because re-rendering in FreeCAD can be slow with large models

+ With above feature of section can draft calculate weight of members with assigned section
Do same thing, put point on declared section, at draw section → view full section: true
then using Center of Mass macro to get weight for those selected

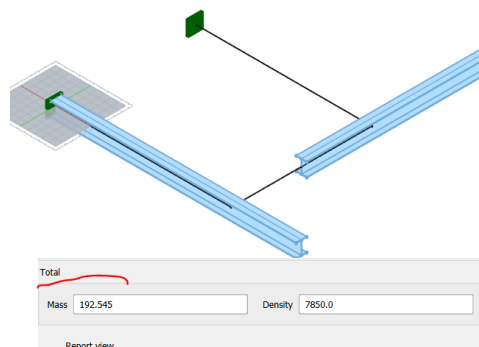


Figure 37:

+ Due to the reasons mentioned earlier, the resulting calculation model can have a large file size – even for models with a moderate level of complexity. This can result in files several megabytes in size

Result Deflection	
<u>Deflection Y</u>	true
Deflection Z	false
Diagram Moment	
<u>Moment Y</u>	false
Moment Z	false

Figure 38:



+ In the resultant dialog box, the Y-axis denotes the vertical direction of the model, whereas the Z-axis corresponds to the lateral or horizontal direction (defining a section in the XY plane)