ProtaStructure Design Guide

Space Trusses

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Publisher

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Space Trusses

Space trusses are three-dimensional counterparts of planar trusses. These structures consist of members connected at their ends, often utilizing ball-and-socket joints to create a stable and versatile framework. Space trusses find wide application in various construction projects due to their adaptability and capacity to withstand complex loads. They are commonly used in steel buildings, bridges, and other large-scale structures.

A space truss is a rigid, lightweight structure constructed from interlocking struts in a geometric pattern. Unlike planar trusses, which lie in a single plane, space trusses extend into three dimensions.

Space trusses consist of straight members (often called bars or struts) connected at their ends. These members can be made of steel, aluminum, or other materials.

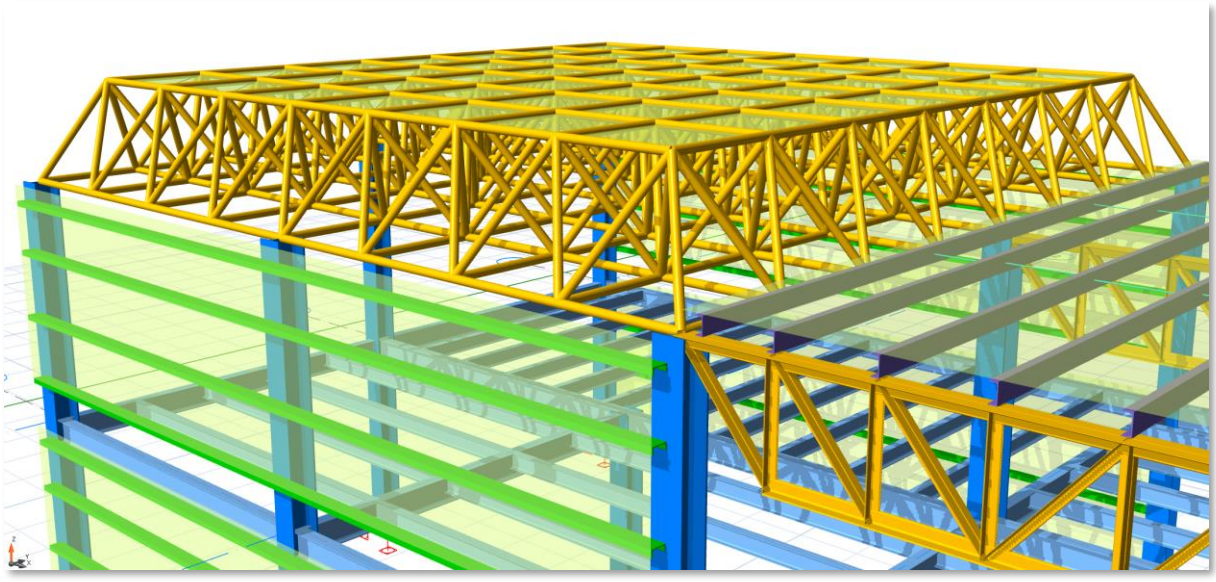
The joints in space trusses are typically ball-and-socket joints, allowing rotational freedom. This flexibility enables the truss to accommodate various load conditions.

Simple space trusses can be obtained by adding three elements at a time to three existing joints and joining all the new members at a point. The most elementary 3D space truss structure is the tetrahedron.

Space frames are used to span large areas with few interior supports. They are commonly found in architectural designs for roofs, canopies, and other large-scale structures.

Space trusses are versatile and efficient, making them valuable components in modern engineering and architecture. ProtaStructure 2025 offers powerful steel modeling macros like trusses, purlins, girts, braces, steel domes, etc. With these macros, creating a fabrication-ready steel model with accurate eccentricities and member positions is very easy.

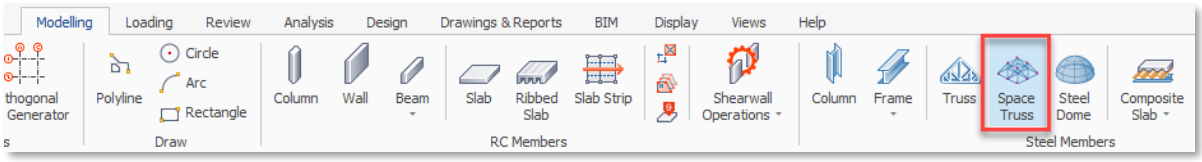
In ProtaStructure 2025, we have developed Space Truss macro. This is a powerful addition to our steel modeling arsenal. With this macro, you can specify a region and insert a space truss parametrically. You can control parameters such as cell size, number of rows and columns, curvature and more.



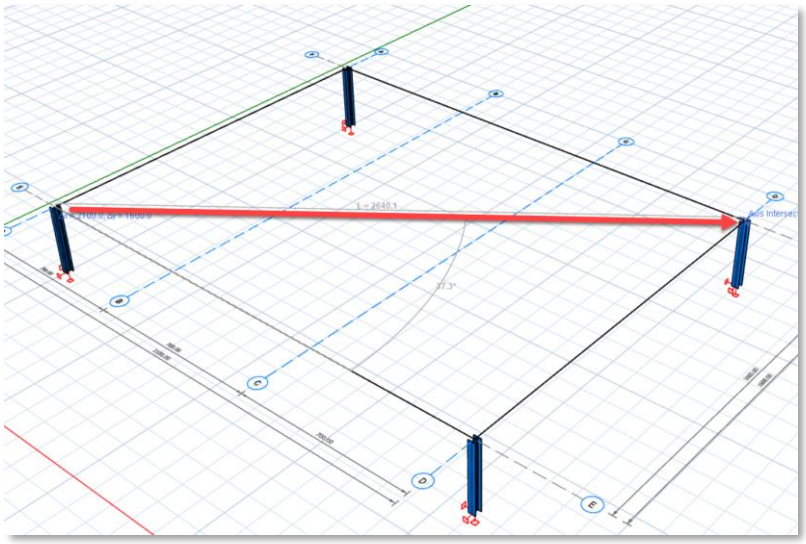
Inserting a Space Truss

To insert a steel space truss:

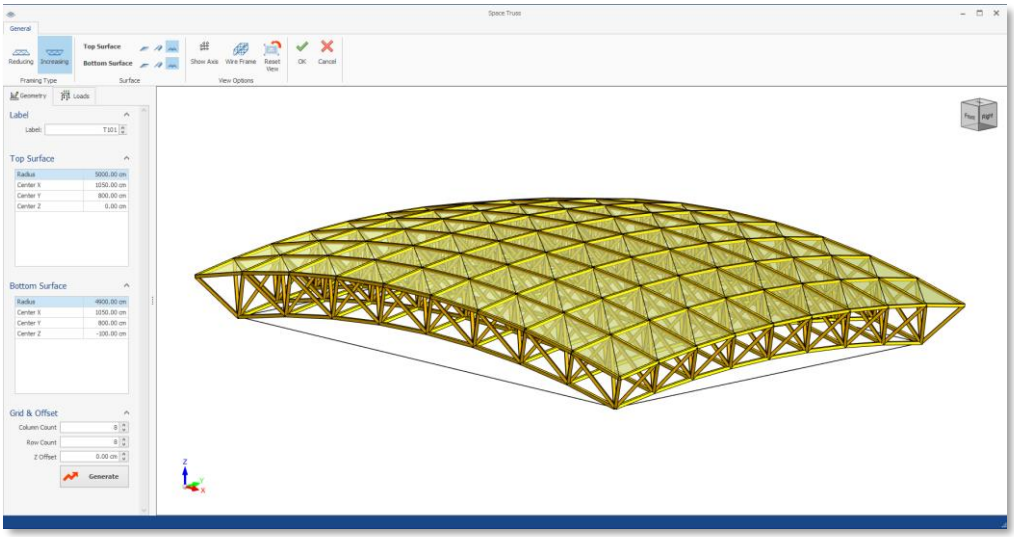
1. Pick the Space Truss command on the **Modeling > Steel Members** ribbon tab.

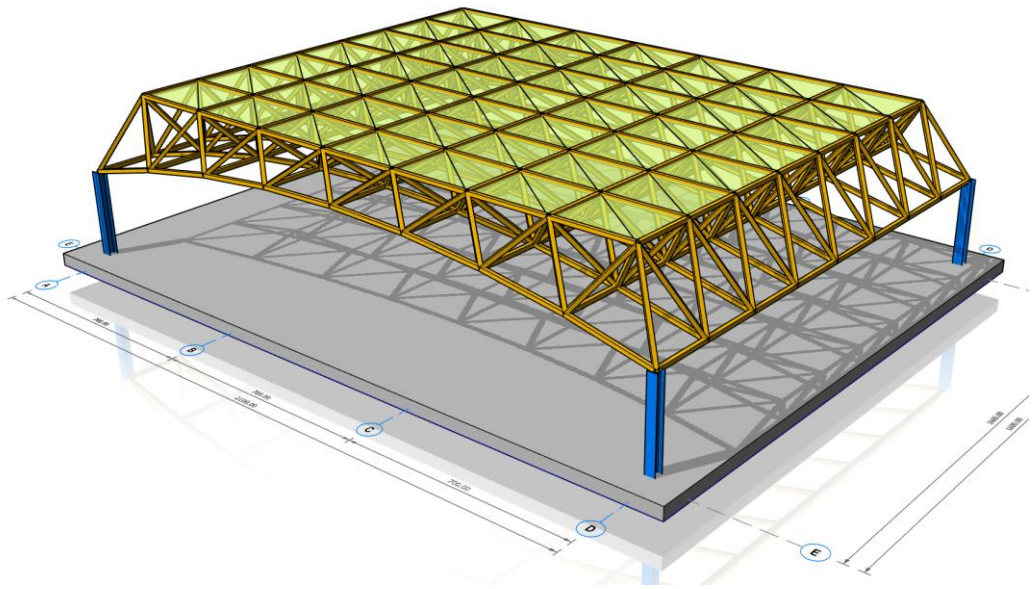


2. Draw a rectangular area on the screen where the space truss will be placed. Space trusses can only be placed in a rectangular area.



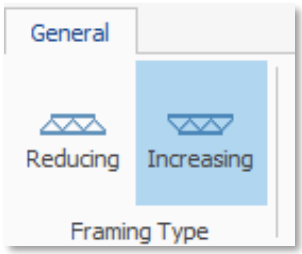
3. The parametric Space Truss Editor will be launched. On this editor, you can control the parameters for top and bottom surface separately. Additionally, you can change the steel profile to be used in space truss, define uniform loads and change number of truss grids.





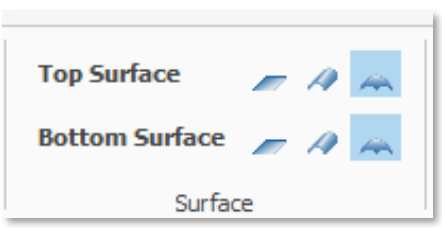
Framing Type

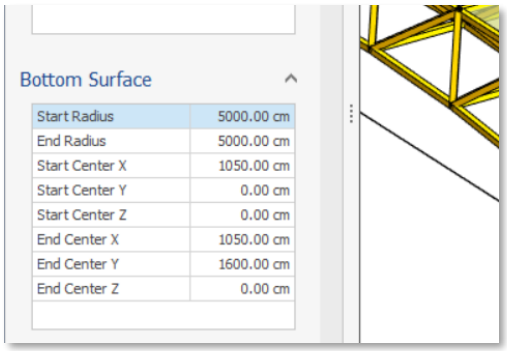
You can select **Reducing** or **Increasing** option for auto-generation of space truss pattern. The icons on the toolbar being self-explanatory, the **Reducing** option creates bottom surface larger than the top surface while **Increasing** option does the opposite.



Top Surface and Bottom Surface Shape

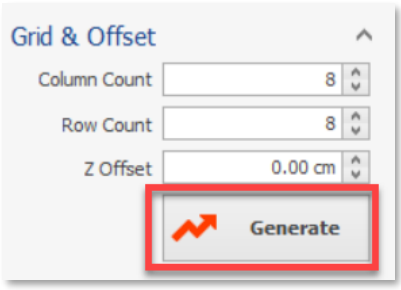
The space truss module is quite powerful, so that it allows you to specify different curvature for top and bottom surfaces of the truss. The parameters on the left panel will change depending on the surface type. **Planar**, **cylindrical** and **spherical** surfaces can be selected.





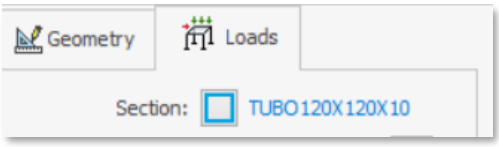
Adjusting Grid & Offset

You can specify number of grids (space truss triangular modules) in terms of Column Count and Row Count. You can also enter an offset value in Z direction to shift the entire truss. You must click the **Generate** button to apply the changes.



Changing Profiles

You can change the steel profile to be used in truss rods using the Section button under Loads tab.

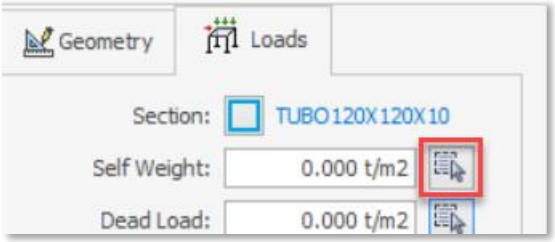


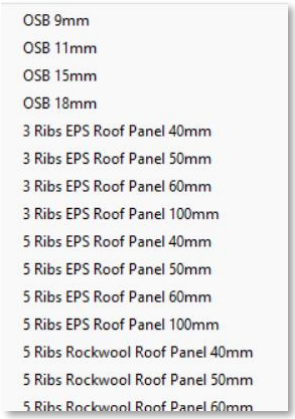
Applying Loads on Space Truss

The self-weight of the truss members itself is automatically calculated. We have provided fields for easy application of uniform loads on truss cladding.

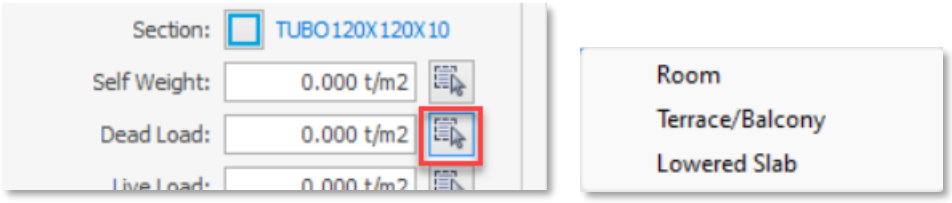
The cladding object that facilitates the load transfer will be automatically inserted on the space truss and is an inseparable part of the truss. That means you cannot delete it. Apart from the uniform loads specified in the space truss editor, You can assign any loads on the space truss using the **ProtaStructure Load Editor.**

Self-Weight: Enter the self-weight of the cladding in this field. The self-weight will depend on the type of the cladding profile. We have provided a library of cladding loads for easy application of cladding self-weight. You can access the cladding load library by clicking the small button next to Self-Weight field.

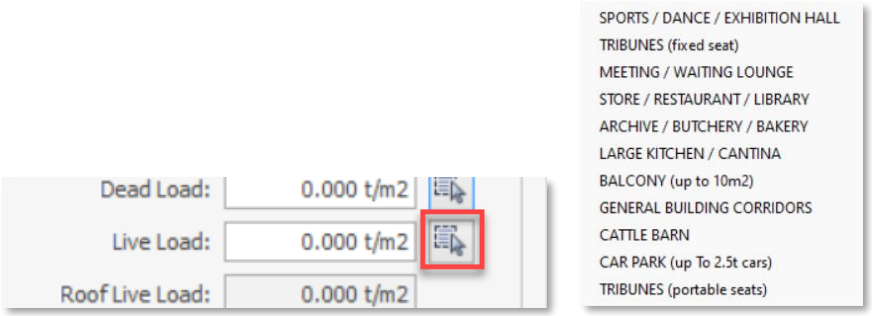




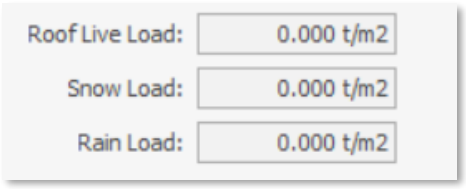
Dead Load: Enter the additional dead loads (finishes etc.) in this field. ProtaStructure already has a library of additional dead loads. You can access the cladding load library by clicking the small button next to Dead Load field. The library editor is in **Building Setout > Slab Additional Loads** ribbon tab.



Live Load: Enter the live loads in this field. You can access a quick list of imposed load values by clicking the small button next to Live Load field.



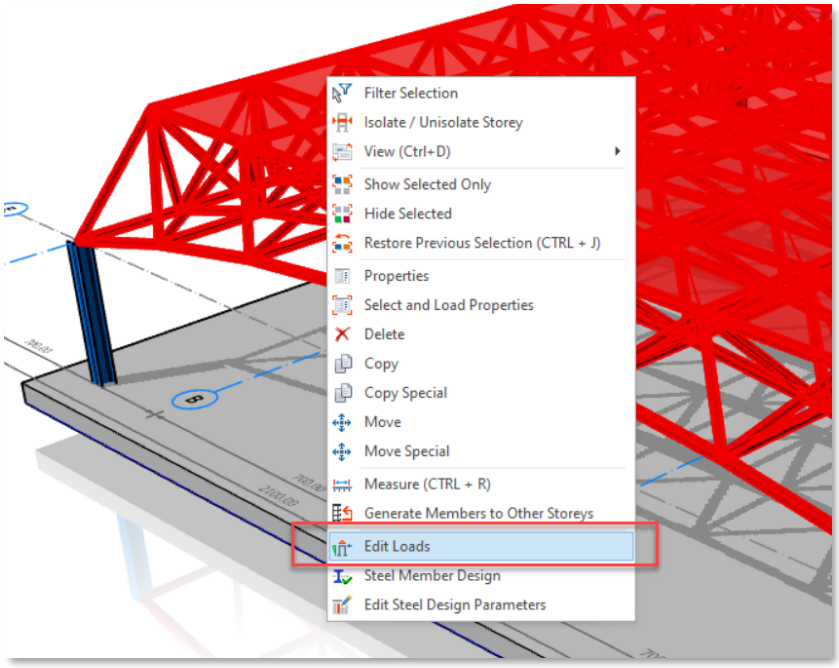
Roof Live Load, Snow Load and **Rain Load** fields will be activated if the associated load cases are defined in the Load Combinations Editor.



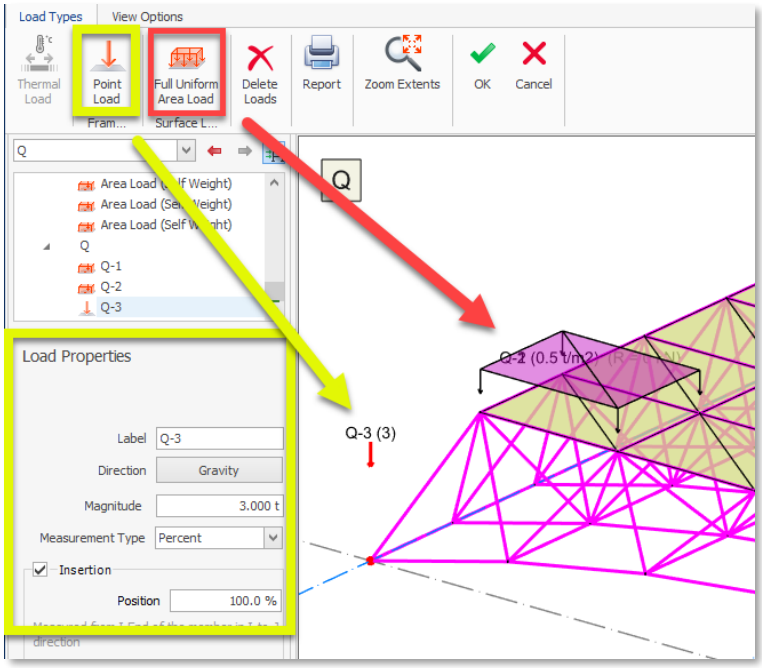
Applying Loads on Space Truss via Load Editor

If you want to add further loads on the space truss, you can do so by using the ProtaStructure Load Editor.

1. Select the space truss on the screen
2. Right click and pick **Edit Loads** command.



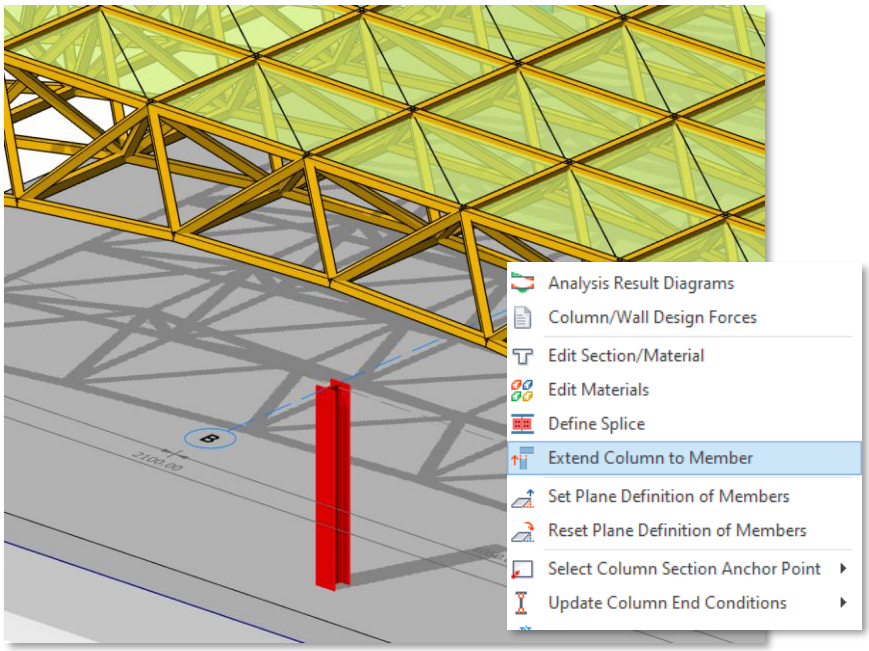
3. On the load editor you can assign **Uniform Area Loads** on any region on the truss cladding or **Point Loads** on any joint under any load case (except seismic and notional load cases)

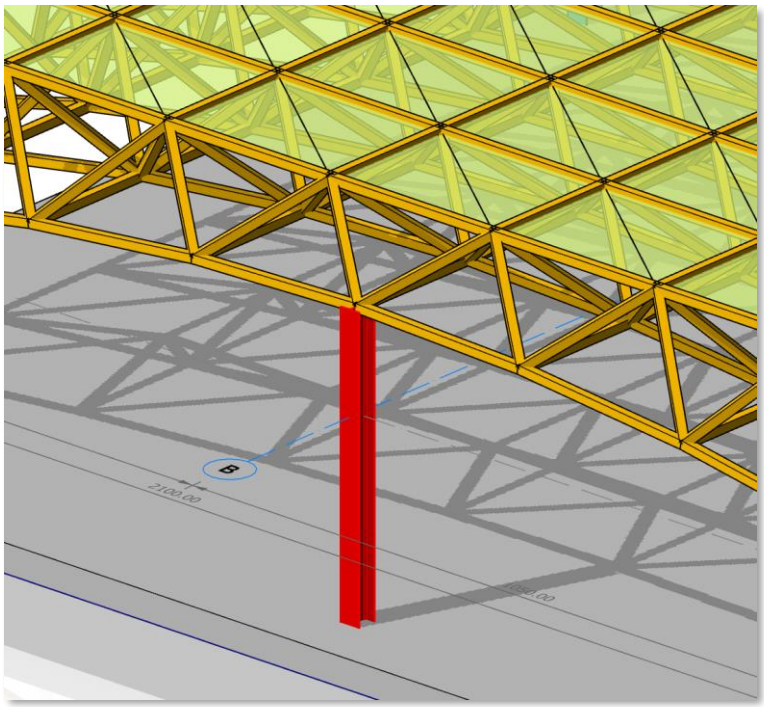


Extending Top of the Columns to Space Truss

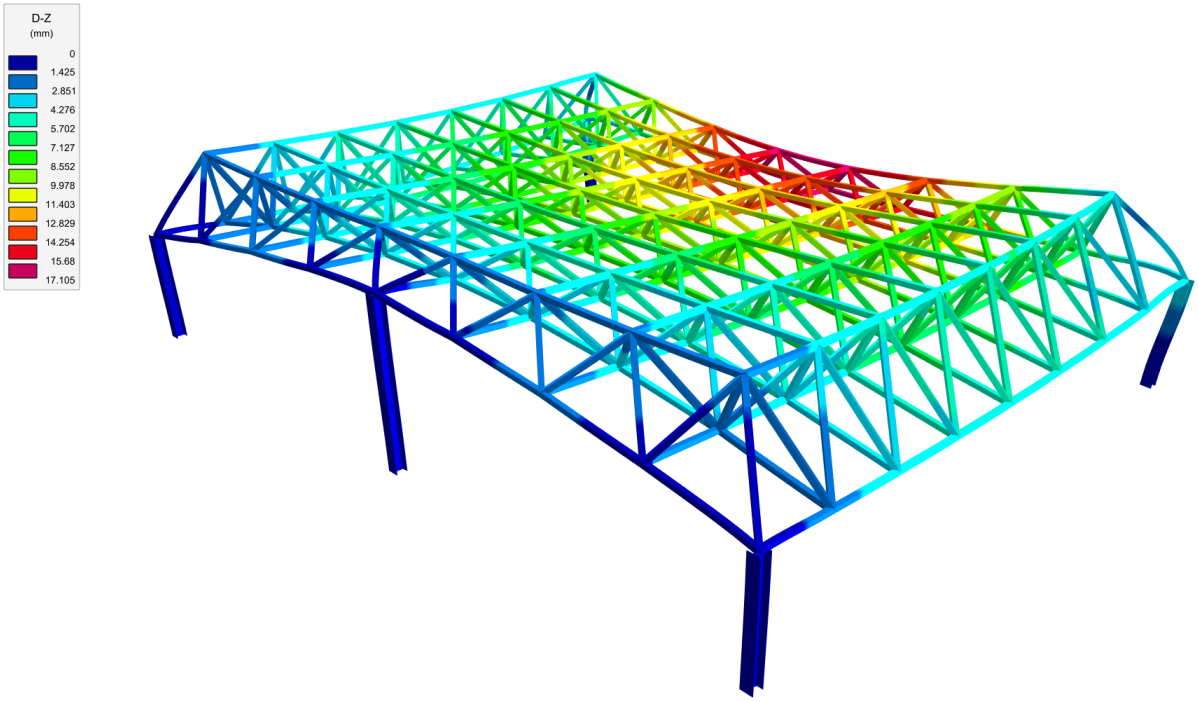
We also enhanced existing features around recently introduced ones. For example, you can extend an existing column to a selected space truss. So that it becomes very easy to place the intermediate supports after space truss insertion. To extend a column to a space truss:

1. Select the column and pick "**Extend Column to Member**" command on the right-click menu.
2. Pick the space truss.
3. The extend command will calculate the nearest point on the bottom surface of the space truss and assign a **Del Z-Top** value to the column.



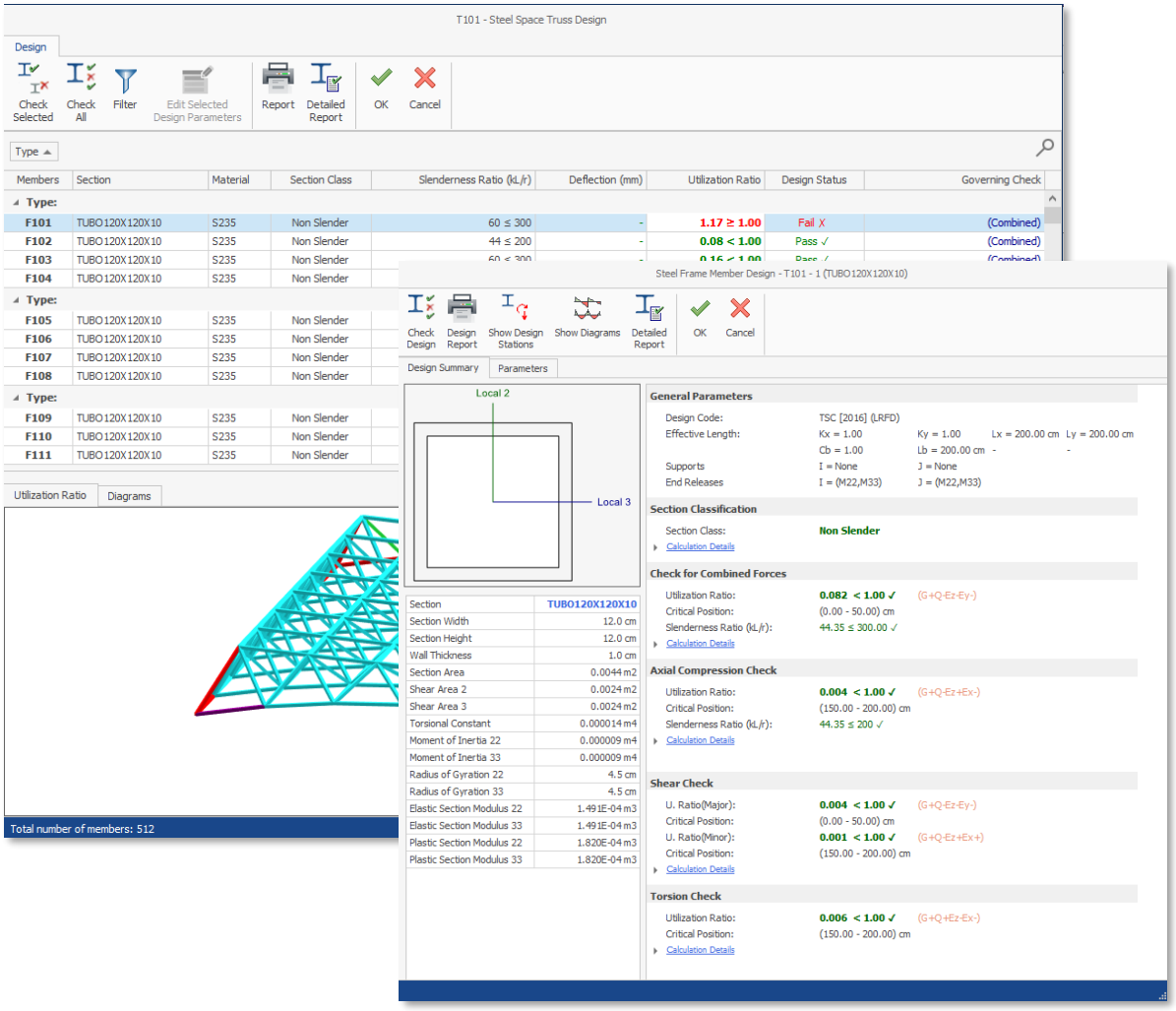


Design of Space Trusses



After you analyze the building with space truss, you can continue with designing the space truss members. There is a dedicated design interface where you can check the sub members and control the whole process in a well-coordinated environment. To access the space truss design:

1. Select the space truss member
2. Pick the **Steel Member Design** command on the right click menu
3. Click **Check All** button to design all space truss sub members. The steel design will take place for sub members using a multi-threaded approach utilizing computer's all available CPU cores.
4. Alternatively, you can access the design of all space trusses via **Design > Space Trusses** ribbon tab.



Important

ProtaStructure can only design the members of a space truss. Ball & Socket joint design is currently out of ProtaStructure and ProtaSteel's scope.

Thank You…

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