Large Telescope Truss - Physics Setup

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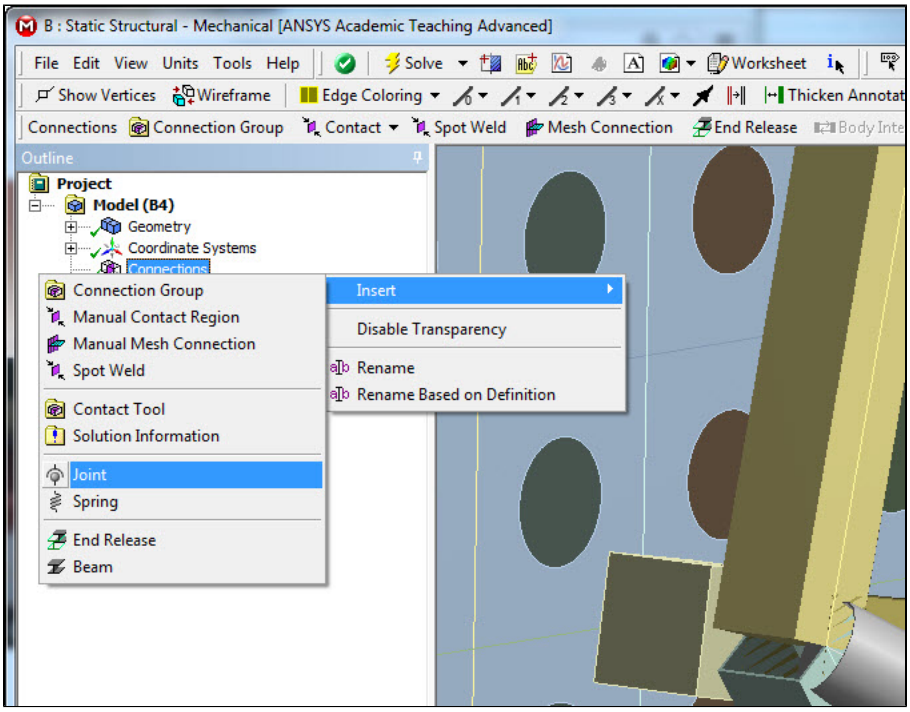
Physics Setup

Now it is time to prepare the connection definitions. Normally, the program's definitions is able to read the geometry and automatically link it correctly with connections. However, we have all the types of geometry: Shell (a 2-D plane that has a defined, but not meshed, thickness), a line body (a 1-D body with a defined, but not meshed, cross-section) and a Solid (a normal, meshed, 3D material), and the program does not automatically know how to connect between those things. Is it a rotating joint, a solid joint, maybe translational?

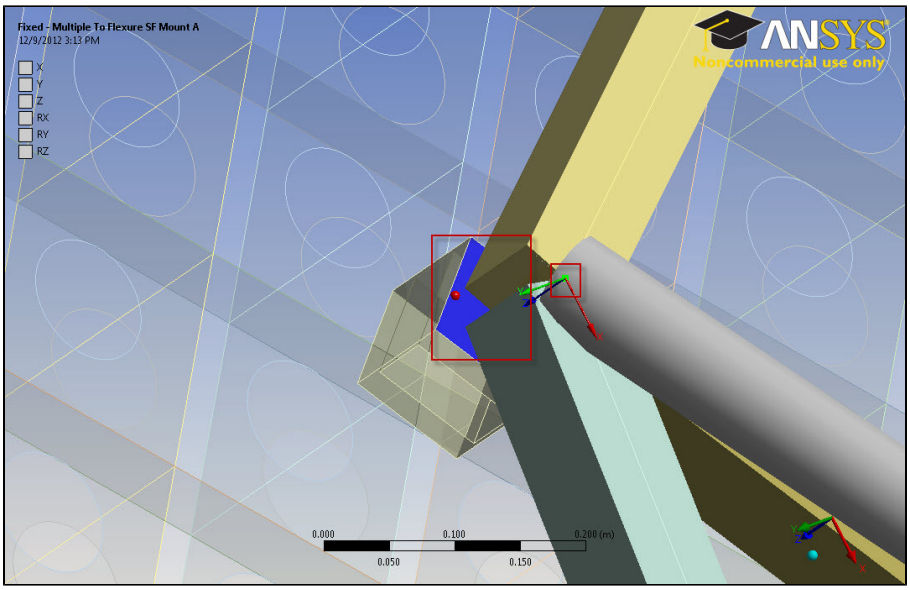
We will have four types of connections we need to define: 1. Rigid joint to surface. 2. Solid surface to Shell Surfaces. 3. Solid edges to shell surfaces and 4. Rigid Joint to Solid surface.

1. Rigid Joint to Surface.

First, we need to create a Joint Connection: Right click on Connections and select Insert>Joint.



Now, use the Vertex tool to select the point where the line bodies intersect, "above" the flexure mount and apply it as the "Mobile" Geometry selection. Then select the face of the flexure mount near the vertex (using the surface select tool) and then apply it as the Reference Geometry selection.

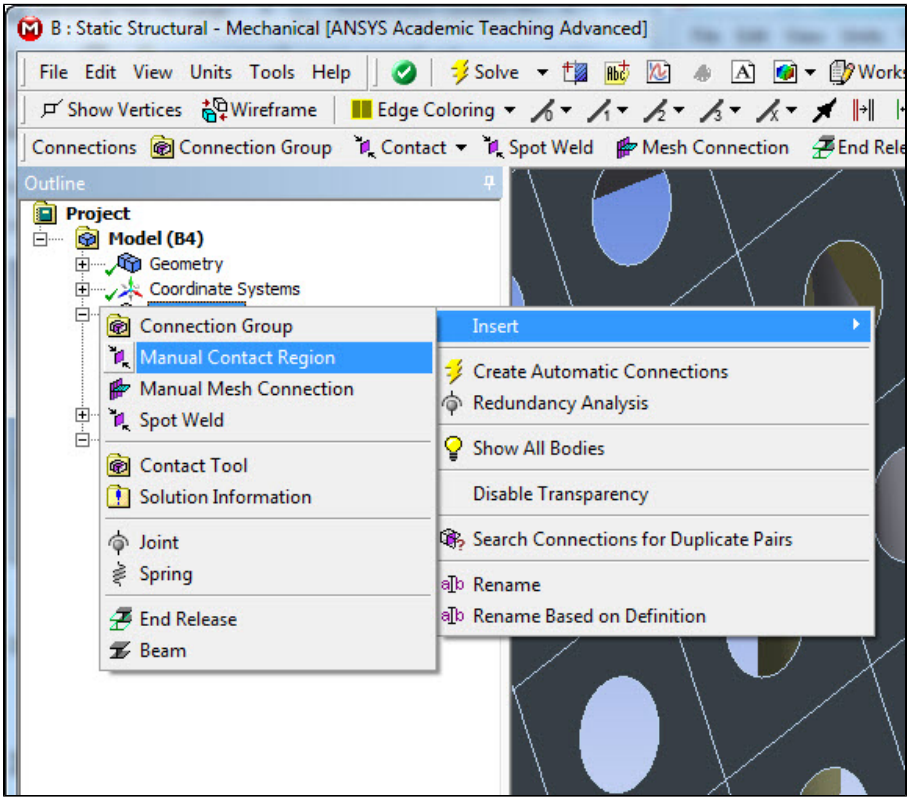


Do this for the remaining flexure mounts, and the center submount. There should be a total of 9 Joints created from this.

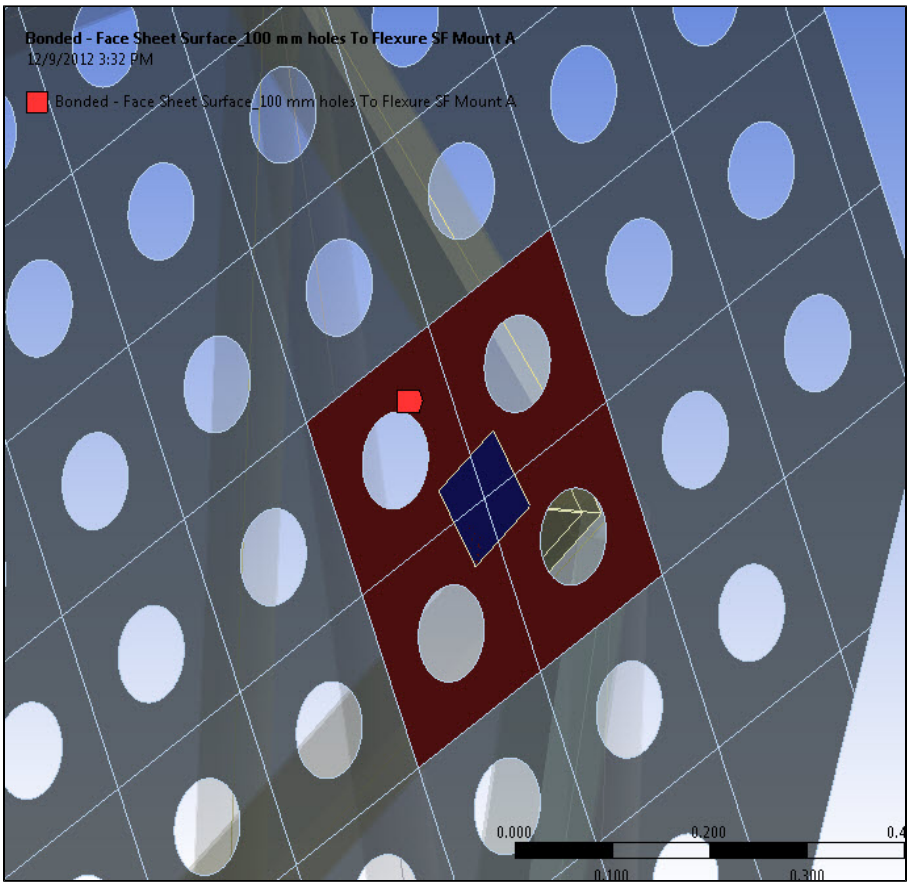
2. Solid Surface to Shell Surface

Hide the Bodies so only the shell model of the subframe closest to the Flexure mount is showing.

Insert a new Manual Contact Region. Right Click on Connections, Insert>Manual Contact Region.



For this contact, you will want to select the four faces of the shell geometry (Face Sheet Surface_100mm holes) and apply it as the Target body (Red). Then select the flexure mount surface near it and apply it as the contact bodies (blue). You should be able to select it through the shell model.

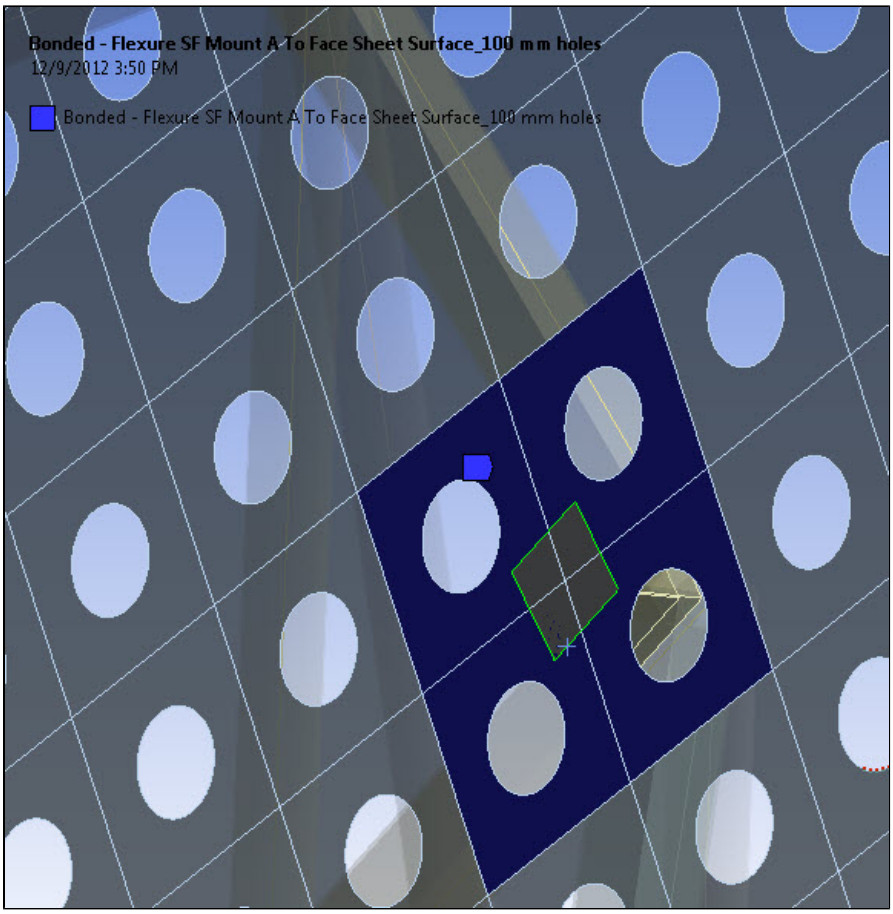


Repeat for the remaining seven flexure mount and center subframe connections.

3. Solid Edges to Shell Surfaces

We also need to bind the edges of the Flexure Mount to the shell surface to make sure the model doesn't twist and turn between the planes (in other words, we're restraining the rotational movement.)

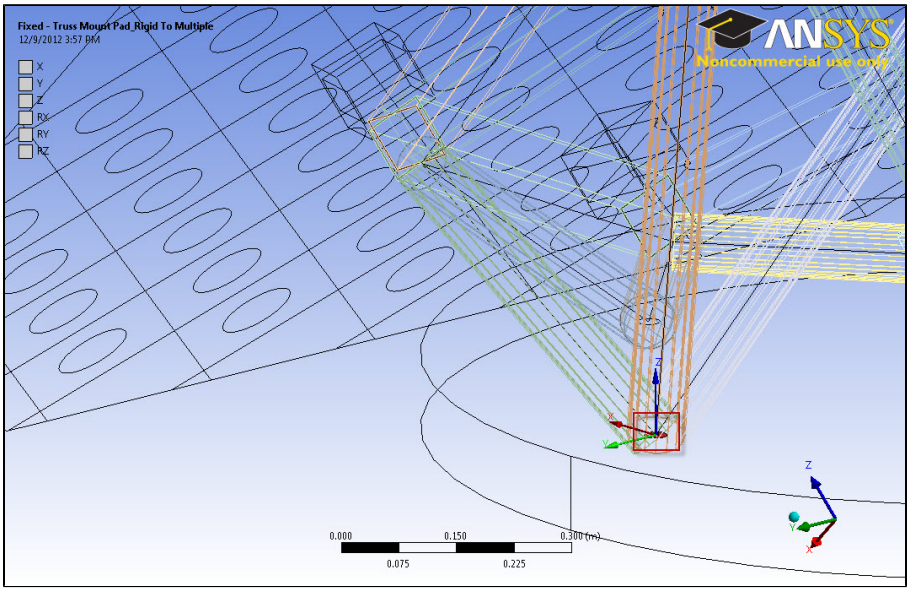
This step is very similar to step 2, except that you should select the Edges of the Flexure mount as the Contact bodies (4 edges), and the same shell surfaces as the target bodies (4 bodies).



Repeat for the remaining mounts.

4. Rigid Joint to Solid Surface

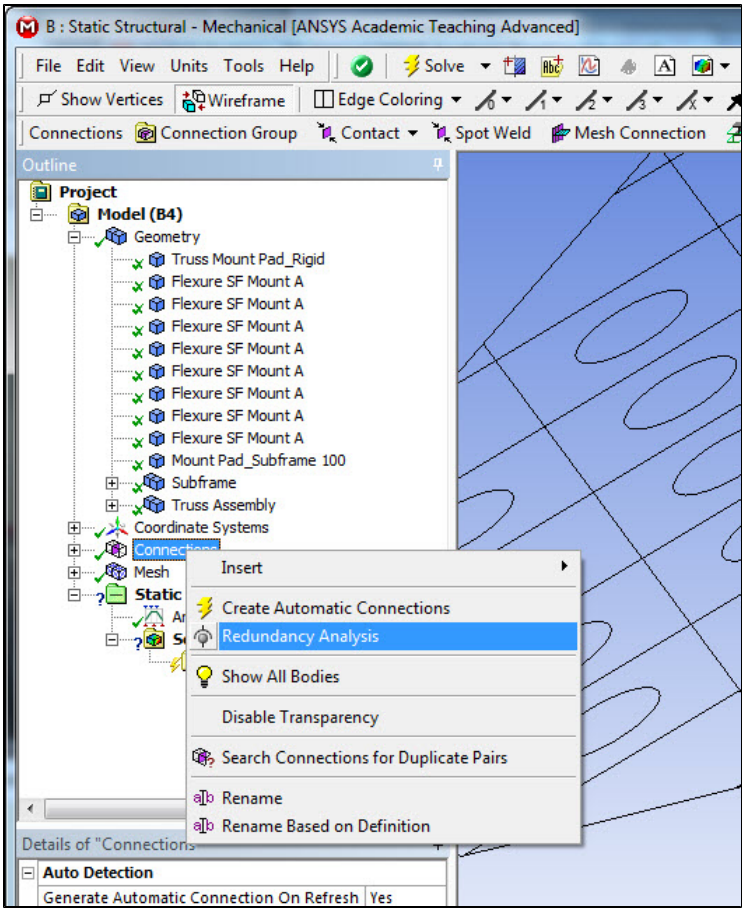
Now is the time to use the alterations to the mount pad we made in the Geometry step. Create a new Joint connection, and select the the created surface on the mount pad as the Reference geometry. Select the vertex of the line bodies as the Mobile geometry selection.



Repeat for the remaining mounts: 6 vertices.

You should now have a total of 9 Joint Connections, 17 Surface Connections, and 6 joint connections.

Run the Redundancy tool to make sure you haven't over-defined a connection.

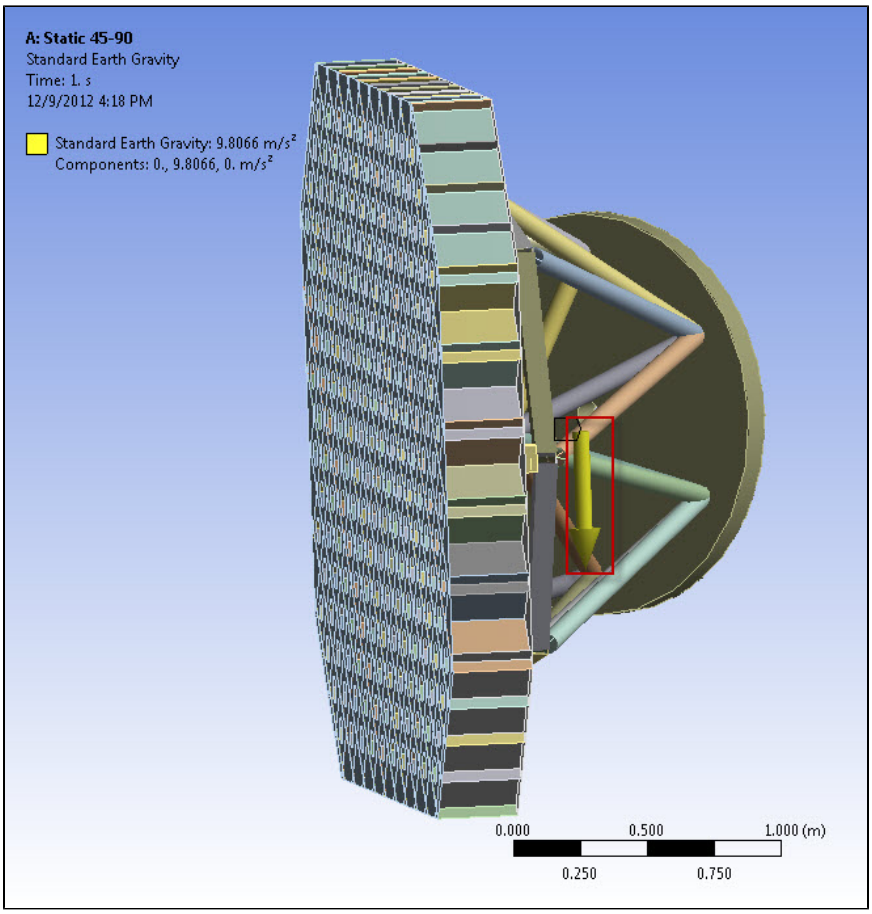


Physics Setup

Now that the Connections have been setup, we need to setup the physics. This is a pretty simple setup: the only forces are the gravity on the truss itself, and the gravity applied by the mirrors on the truss.

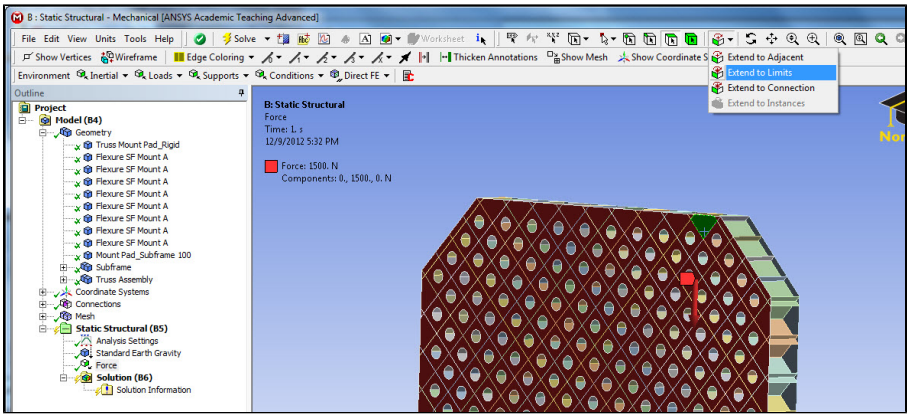
First, apply Earth's gravity to the entire system. Remember that the system has been rotated 90 degrees, so gravity is not in the Z coordinate system of the Geometry. Instead, it is in the Y.

Right click on Static Structural. Insert>Standard Earth Gravity change the direction to +Y Direction.



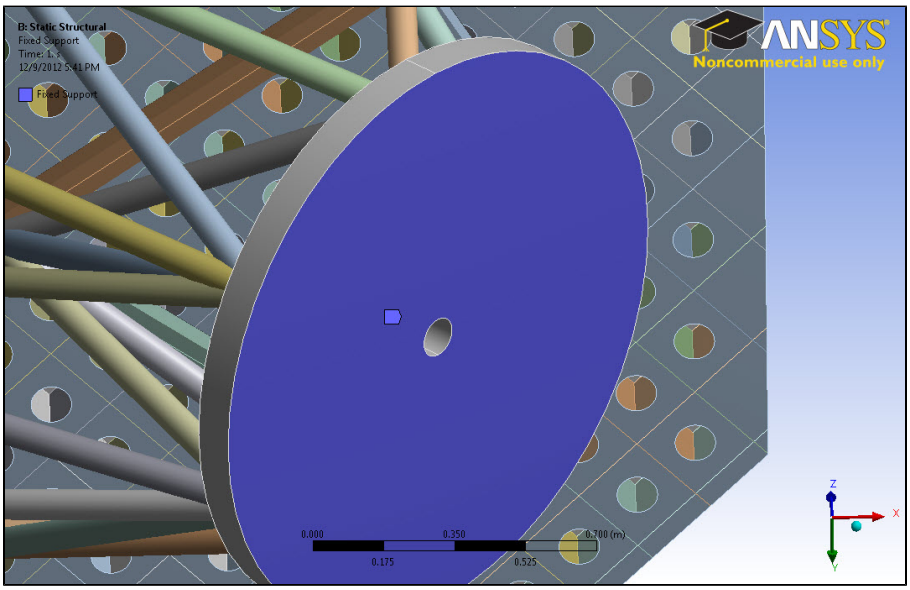
Scope	
Geometry	All Bodies
Definition	
Coordinate System	Global Coordinate System
X Component	0. m/s² (ramped)
Y Component	9.8066 m/s² (ramped)
Z Component	0. m/s² (ramped)
Suppressed	No
Direction	+Y Direction

Next, we need to apply the force from the mirrors attached to the truss. This is a force of 1500N in the direction of gravity. We need to apply this across this to the outside subsurface, which has 280 faces. Instead of selecting them all manually, simply select one, and then use the "Extend to limits" function. This will quickly select all the faces in that plane.

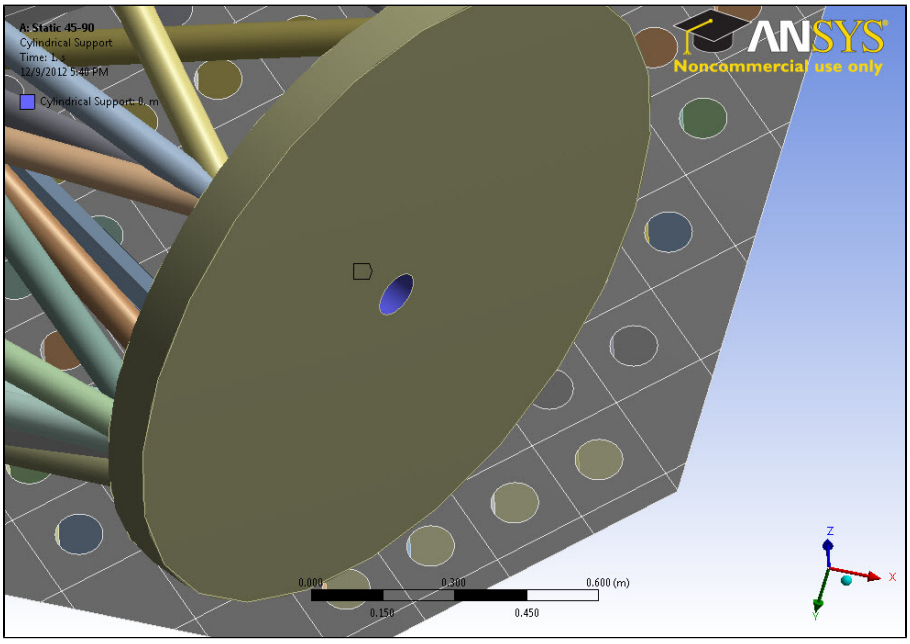


Using the Components definition, create 1500N in the positive Y direction.

Lastly, we need to create the support on the Truss. Create a fixed support at attach it to the bottom of the mount pad.



While this fixes one direction of motion, it does not prevent the base pad from translational movement parallel to its plane. To constrain this, we create a Cylindrical Fixed Support and apply it to the middle hole.



We don't want to over-constrain it, so make sure only the Tangential definition is fixed, letting the Radial and Axial movements be free.

Scope	
Scoping Method	Geometry Selection
Geometry	1 Face
Definition	
Type	Cylindrical Support
Radial	Free
Axial	Free
Tangential	Fixed
Suppressed	No

This completes the Setup of the Truss's physical attributes.

Go to Step 5: Numerical Solution

Go to all ANSYS Learning Modules