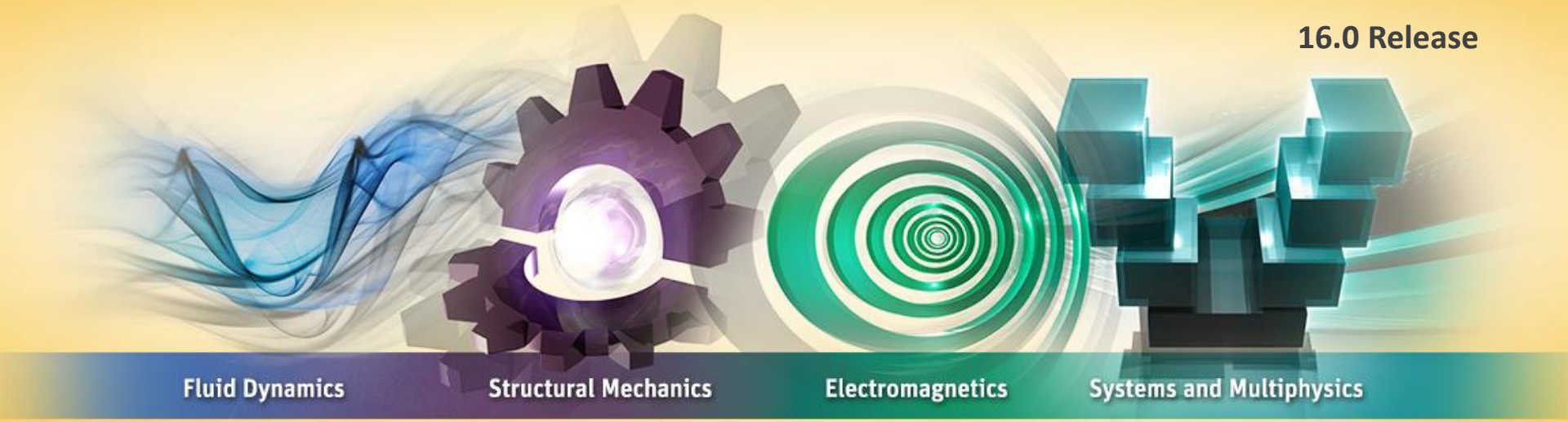
Workshop 3.3
Object Generator

16.0 Release



Introduction to ANSYS Mechanical

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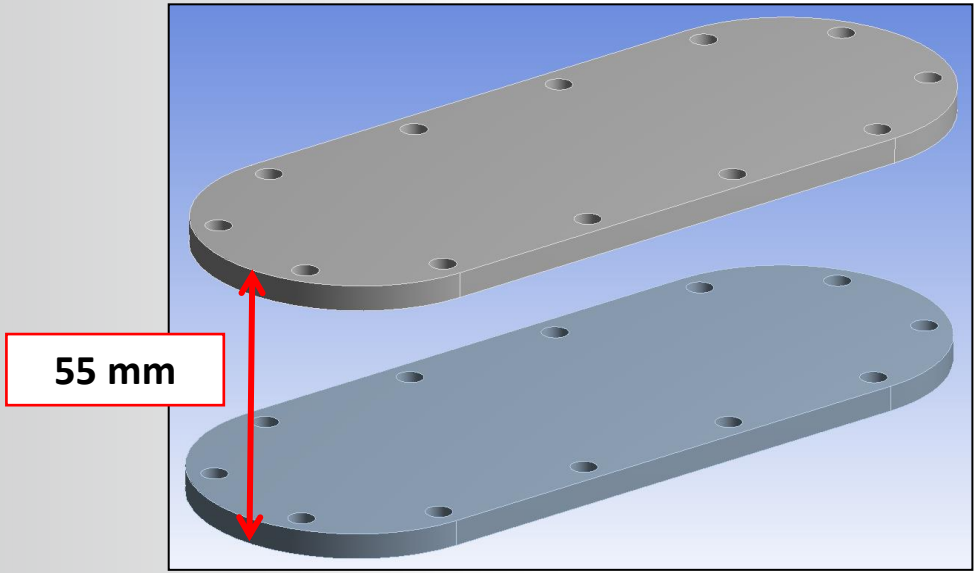
Goals

Workshop 3-3 consists of 2 plates separated by 45 mm. Each plate contains 12 holes which are to be connected using beam connections. Instead of creating 12 individual beam connections we'll create a single beam and use the Object Generator in Mechanical to create the remainder.

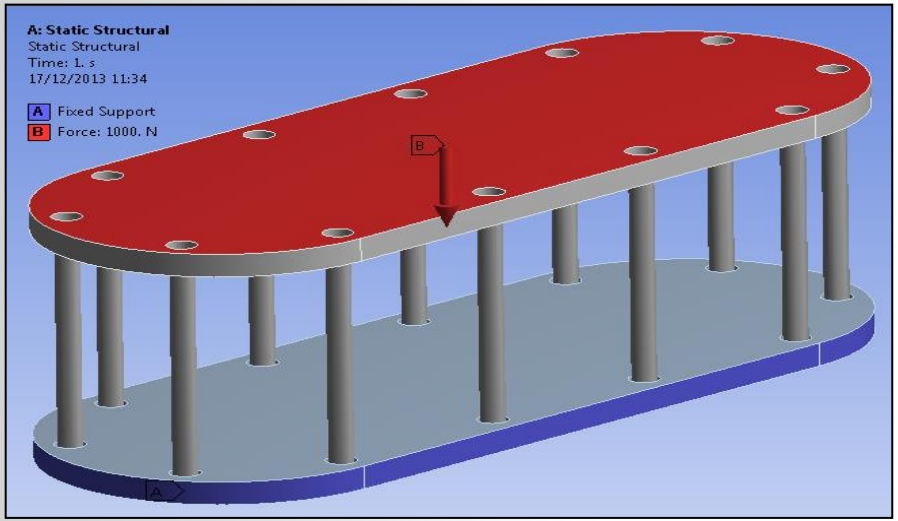


Assumptions

We'll assume that one of the plates is fixed around its edges.

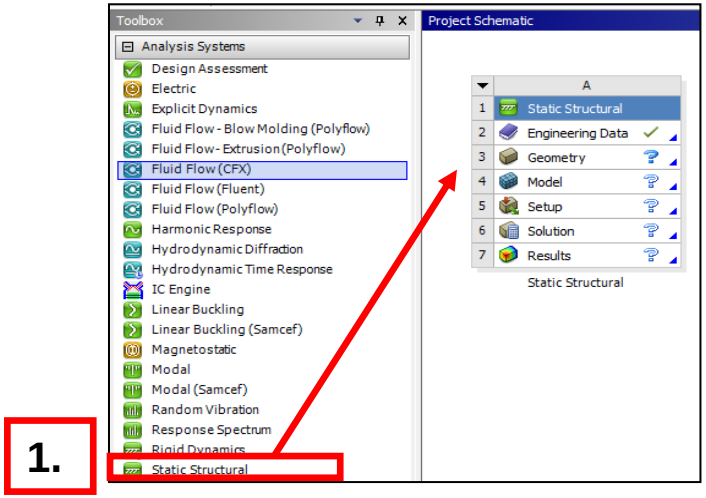
The plates will be joined using the Body to Body bolt feature.

A force load (1000 N) will be applied to the top surface of one of the plates.

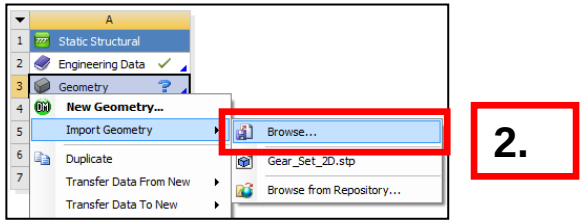


Project Schematic

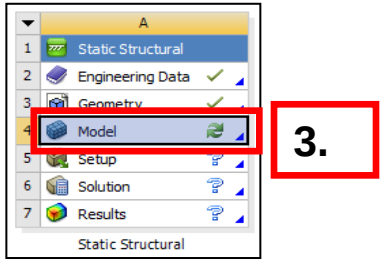
1. From the Toolbox insert a “Static Structural” system into the Project Schematic.



2. From the Geometry cell, RMB and “Import Geometry > Browse”. Import the file “Bolt_Plates.stp”.

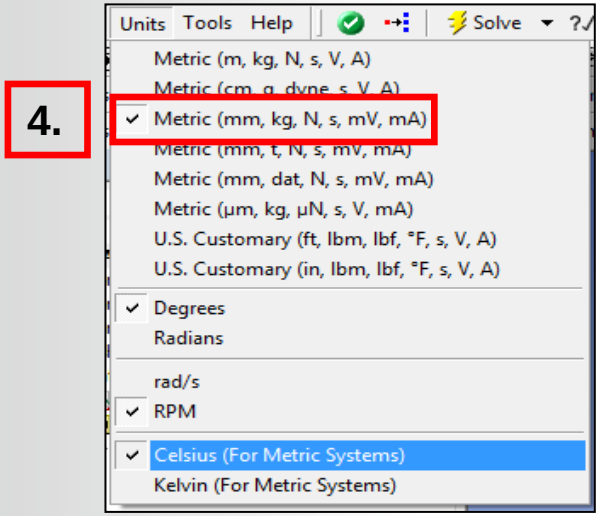


3. Double click the “Model” cell to start the Mechanical application.



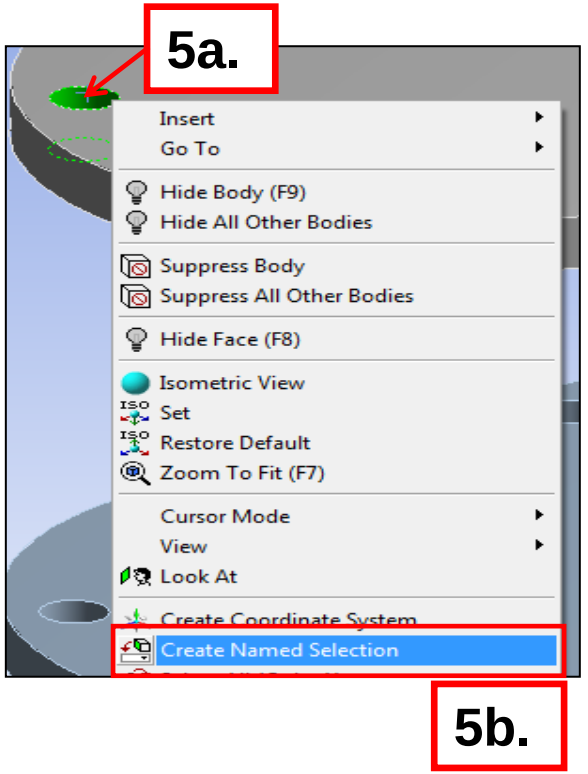
Preprocessing

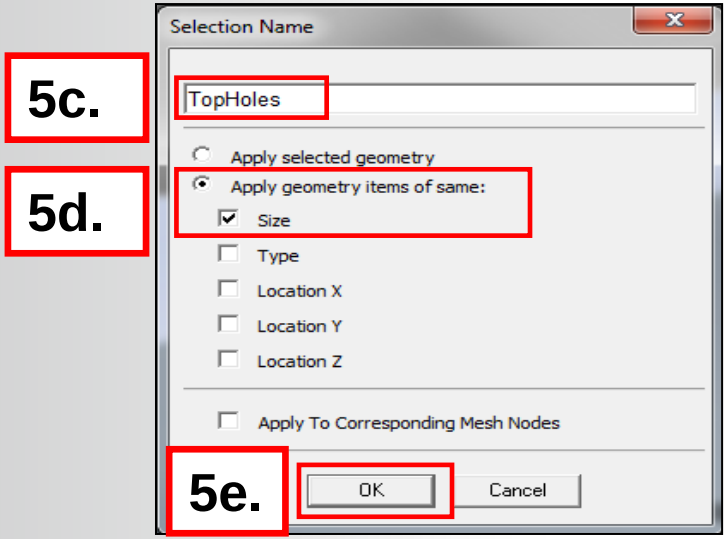
4. **Set the working unit system:**
   - **“Units > Metric (mm, kg, N, s, mV, mA)”.**



. . . Preprocessing

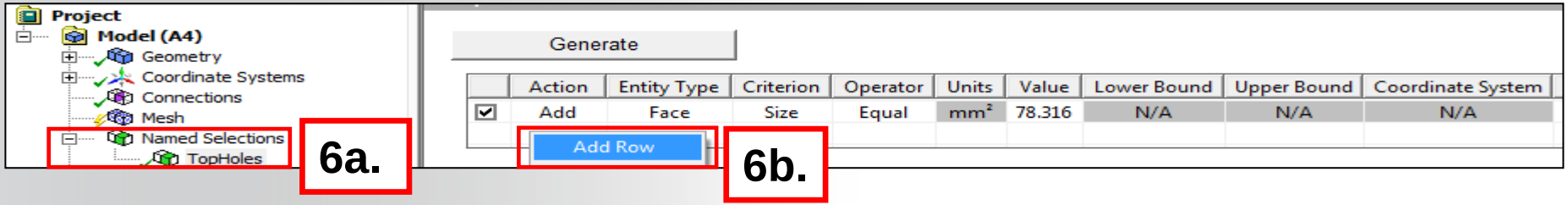
5. Create 2 Named Selections:
   a. Select a face on one of the holes in either plate (which hole or plate is arbitrary).
   b. RMB > Create Named Selection.
   c. In the dialog box enter the name “TopHoles”
   d. Set “Apply geometry items of same: Size”.
   e. OK



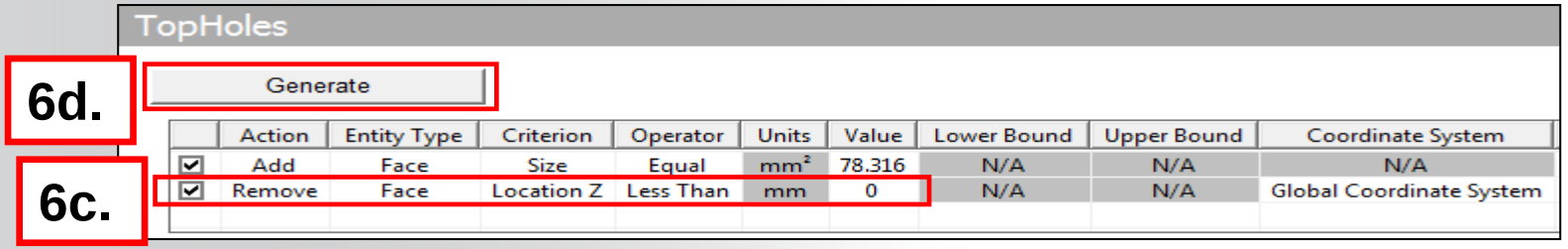


. . . Preprocessing

6. Modify the Named Selection:
   a. Highlight the “TopHoles” named selection branch.
   b. In the worksheet table RMB > Add Row.

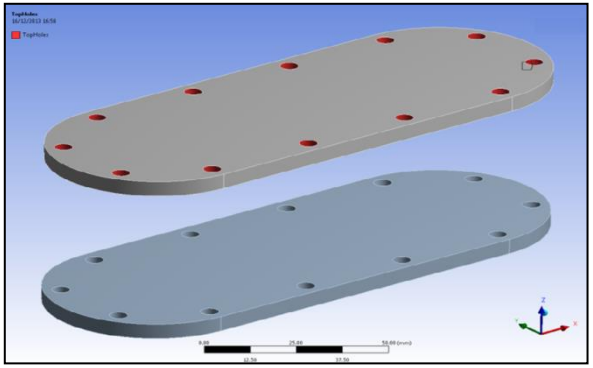


   c. Configure the new row as shown below.
   d. Generate

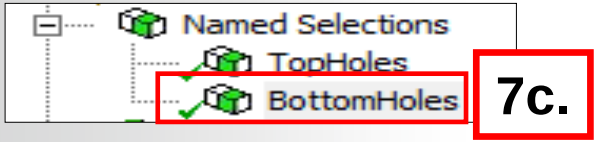


. . . Preprocessing

The result of the configuration can be seen in the figure on the right. We chose to remove the faces located less than zero which resulted in the holes in the bottom plate being removed from the NS (note the global coordinate system).

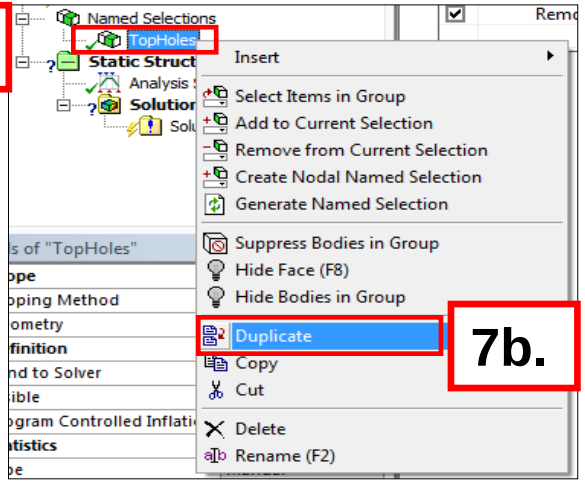


7. Create a second Named Selection:
   a. Highlight the "TopHole" NS.
   b. RMB > Duplicate.
   c. RMB on Topholes 2 and Rename the new NS "BottomHoles".



7c.

7a.



7b.

. . . Preprocessing

8. Modify the "BottomHole" NS:
   a. Change the operator field from "Less Than" to "Greater Than".
   b. Generate then click into Graphics tab.

Graphics | Worksheet

8b.

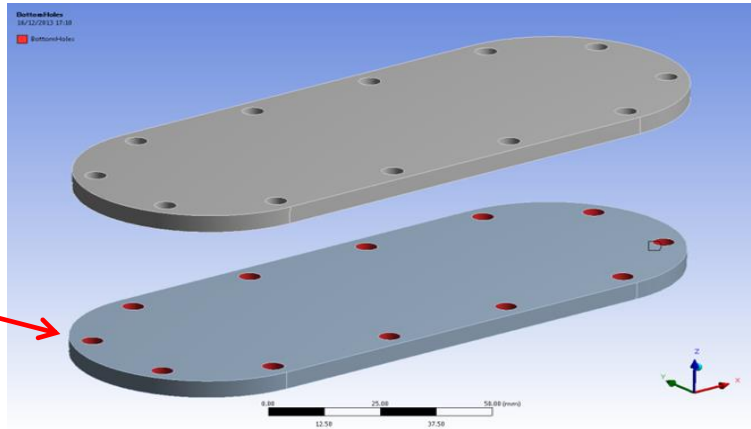
BottomHoles

Generate

	Action	Entity Type	Criterion	Operator	Units	Value	Lower Bound	Upper Bound	Coordinate System
☑	Add	Face	Size	Equal	mm^2	78.316	N/A	N/A	N/A
☑	Remove	Face	Location Z	Greater Than	mm	0.	N/A	N/A	Global Coordinate System

8a.

As shown here, this single modification reverses the selection set to only those faces in the bottom plate.

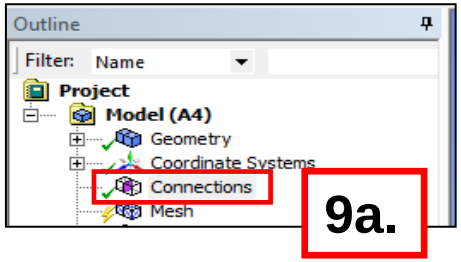


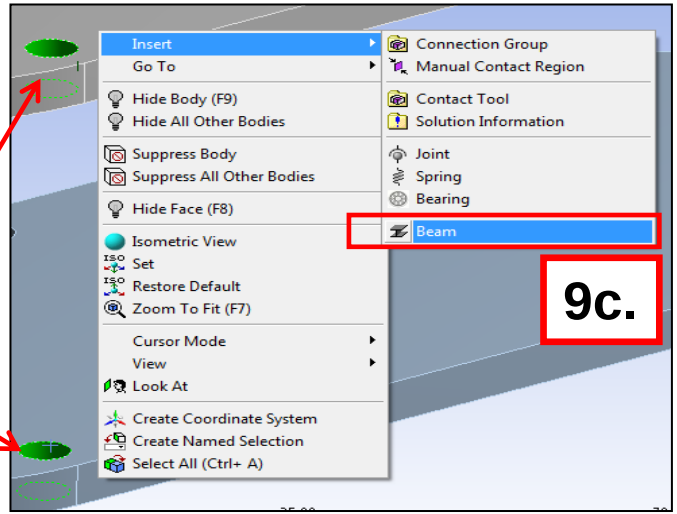
. . . Preprocessing

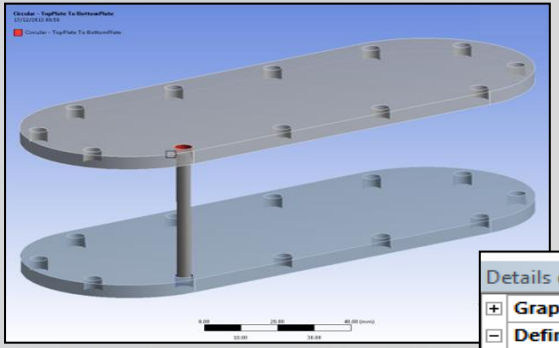
9. Create a Beam Connection:
   a. Highlight the Connections branch.
   b. Hold the CTRL key and select 2 opposing holes, one from each plate.

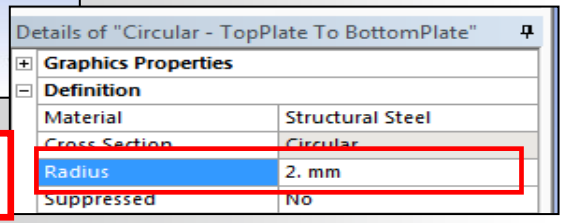
   Again the actual pair of holes selected is arbitrary.

   c. RMB > Insert > Beam.
   d. In the beam details enter a radius of 2 mm.



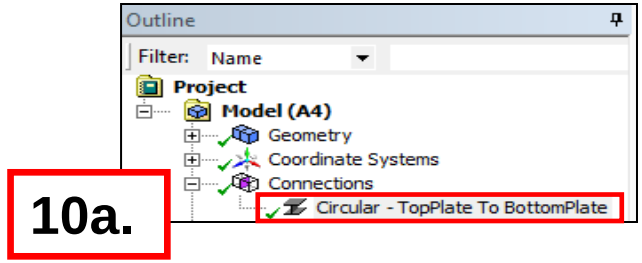


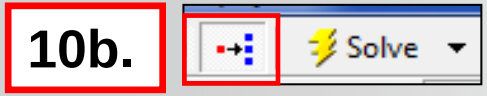




. . . Preprocessing

10. Start the Object Generator:
    a. Highlight the beam branch under Connections.
    b. Toggle on the Object Generator icon.





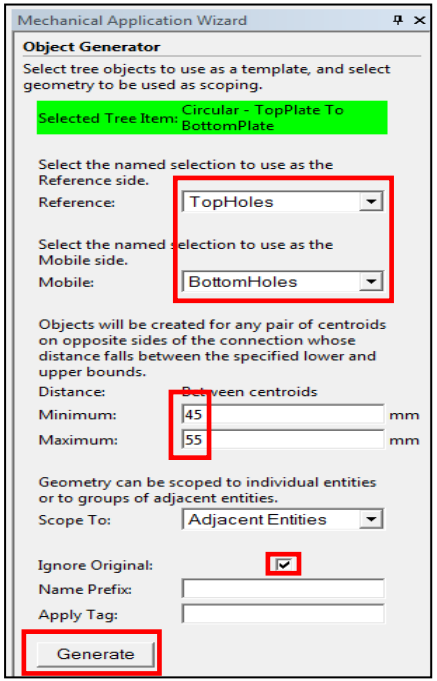
Configure the Object Generator as shown here:

The “Reference” and “Mobile” fields allow access to the Named Selections created earlier.

Since we know the outer distance between the plates is 55 mm, we enter 45 and 55 for min/max distances.

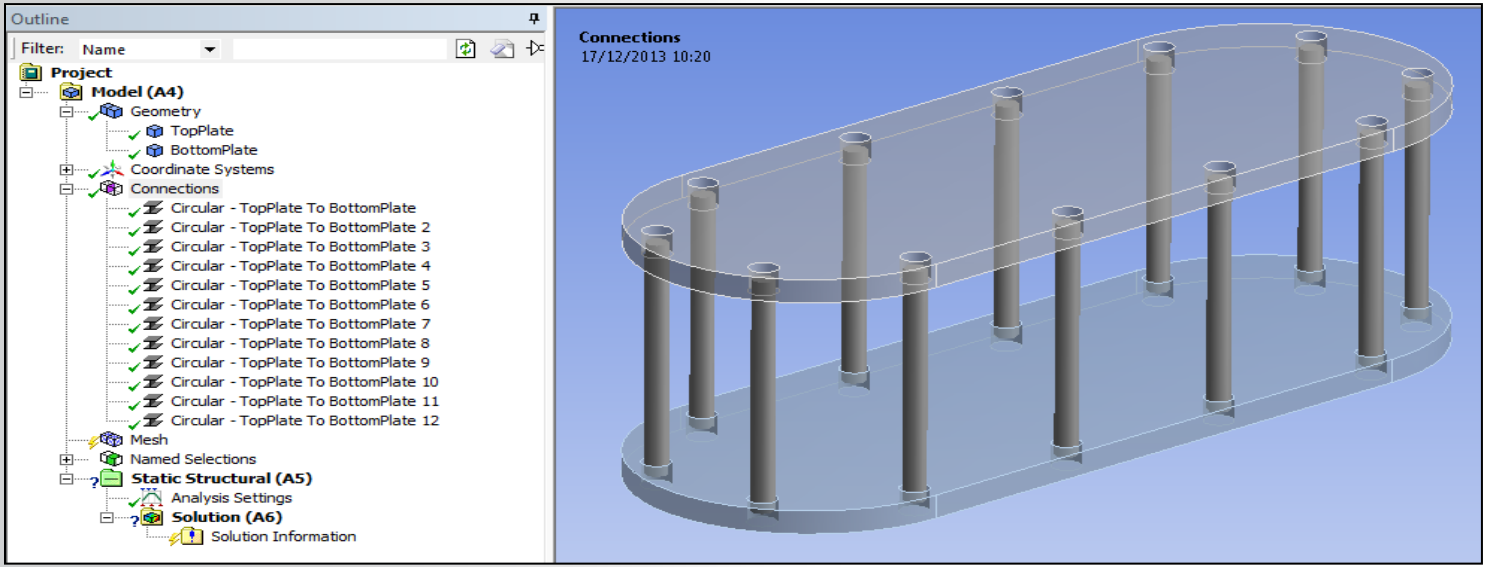
Since our named selections are defined between all 12 holes we leave “Ignore Original” checked so the existing beam is not duplicated.

11. Generate.



. . . Preprocessing

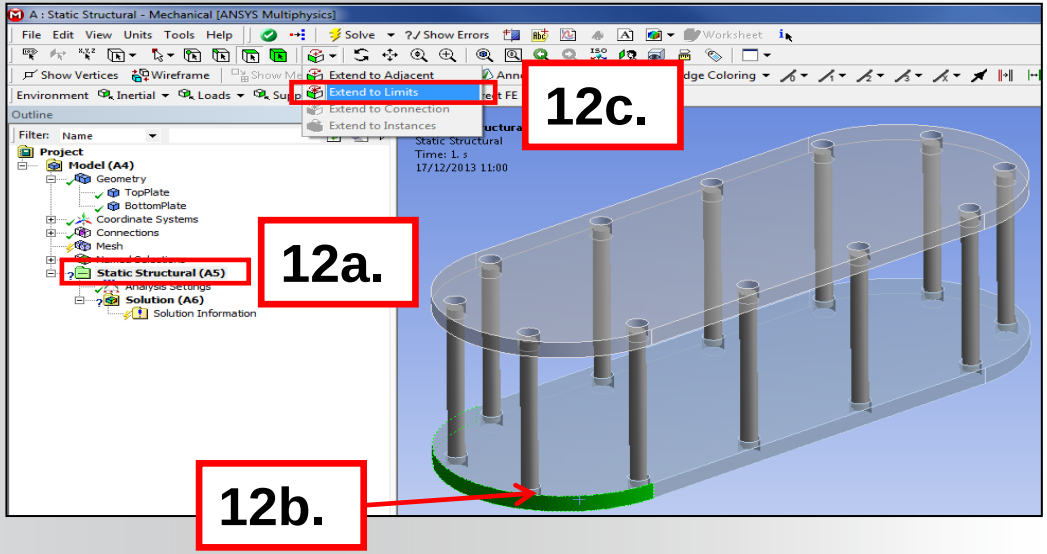
Graphically all 12 beam connections can be seen. A check of the connections branch verifies this. Close the Mechanical Application Wizard Window on the Right Hand Side.

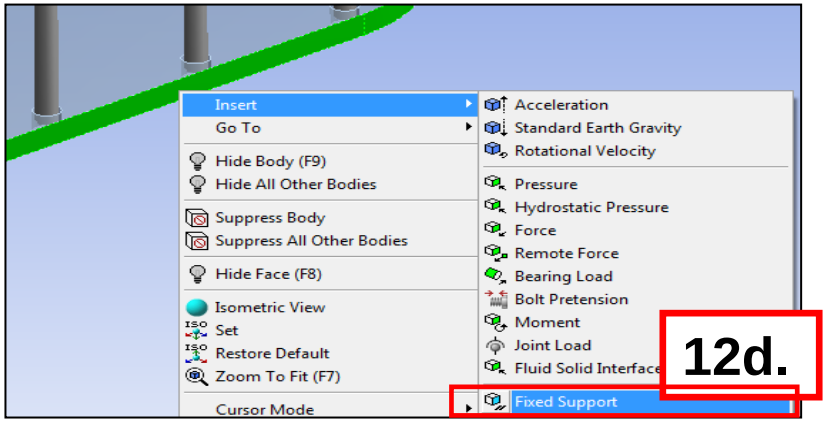


Next we'll apply some simple boundary conditions, solve the model and see how the beam probe can be used to extract the reactions seen by the beams.

. . . Preprocessing

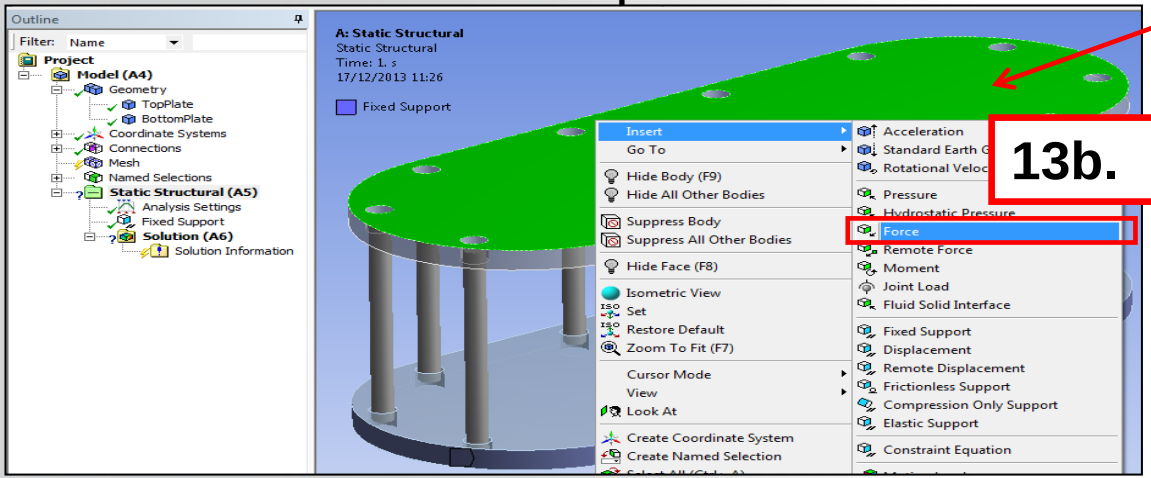
12. Add a fixed constraint to the bottom plate:
    a. Highlight the Static Structural branch:
    b. Select one of the side faces on the bottom plate.
    c. Choose “Extend to Limits” (status bar should indicate 4 faces selected).
    d. RMB > Insert > Fixed Support.





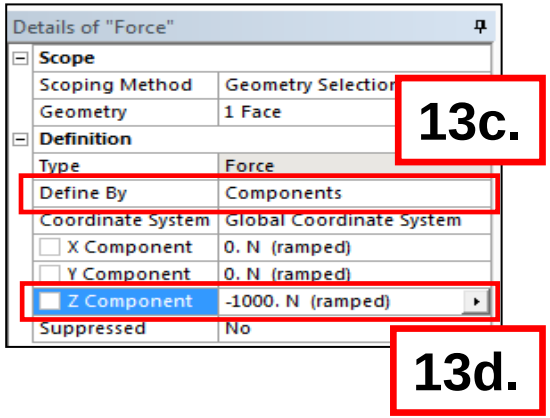
. . . Preprocessing

13. Add a Force Load to the top plate:
    a. Highlight the top face of the top plate.
    b. RMB > Insert > Force.
    c. Change “Define By” to “Components.
    d. Enter 1000 N for the Z component in the force details.



13a.

13b.



13c.

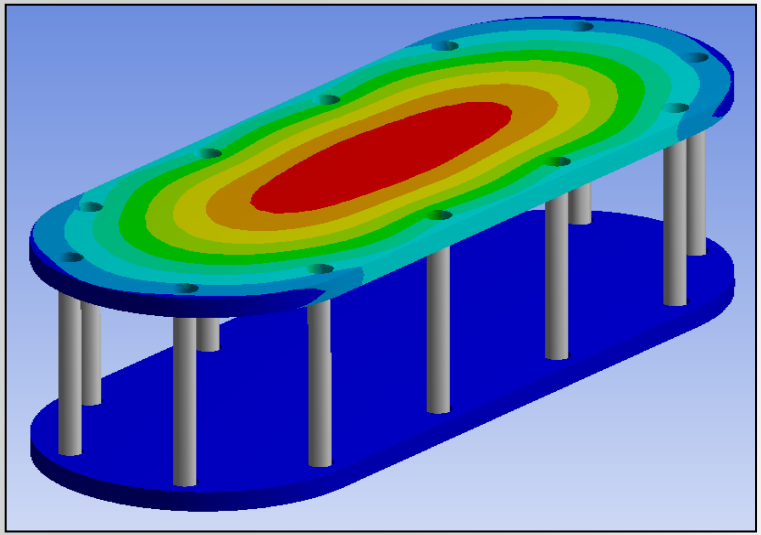
13d.

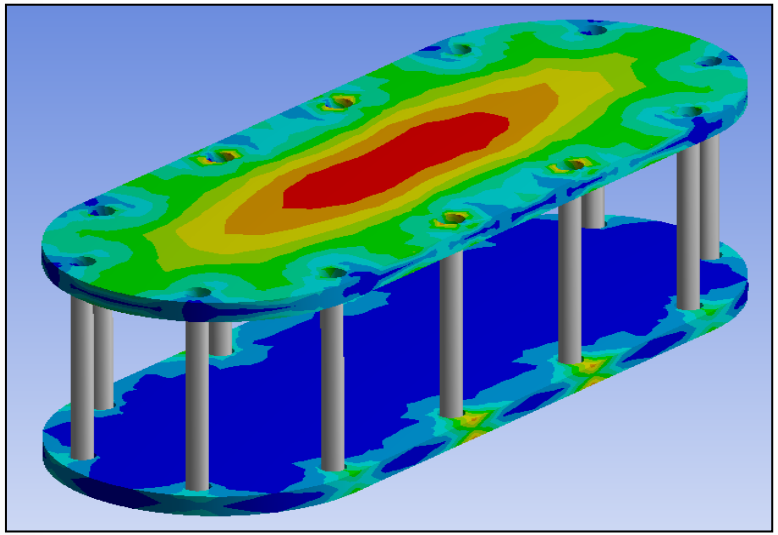
14. Solve

14.

. . . Postprocessing

Insert Total Deformation and Equivalent Stress results and evaluate. The plots would indicate that the solution progressed as expected and we can now look more closely at the beam connections.



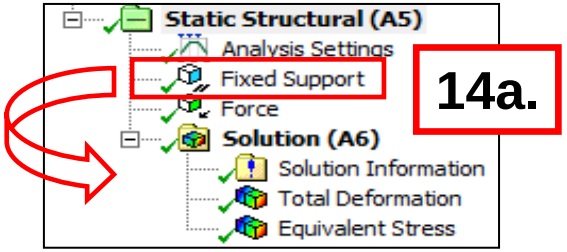


. . . Postprocessing

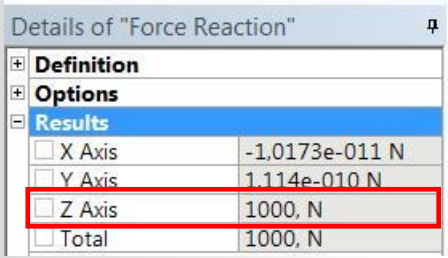
14. Verify the overall reaction force in the model:

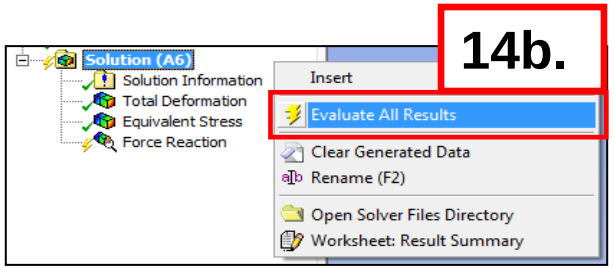
    a. Drag & Drop the “Fixed Support” in the tree onto the Solution branch.

    b. RMB > Evaluate All Results to calculate the “Force Reaction” result object.



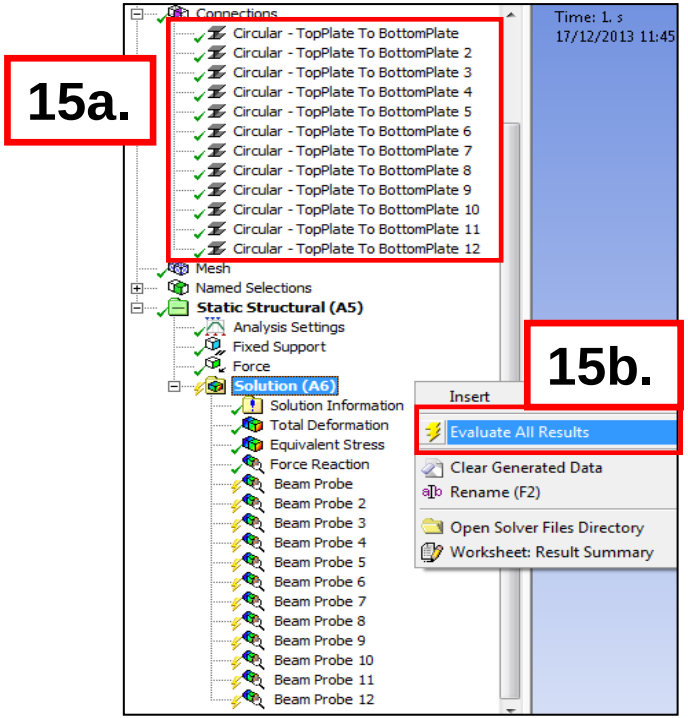
A check of the details for the force reaction indicates we have a force balance in the solution.

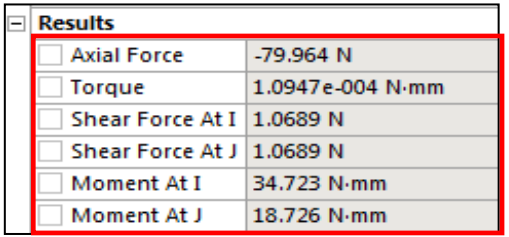




. . . Postprocessing

15. Retrieve beam probe results:
    a. Drag & Drop the 12 branches representing the circular beams (use Shift key to multi-select) onto the Solution branch.
    b. RMB > Evaluate All Results.



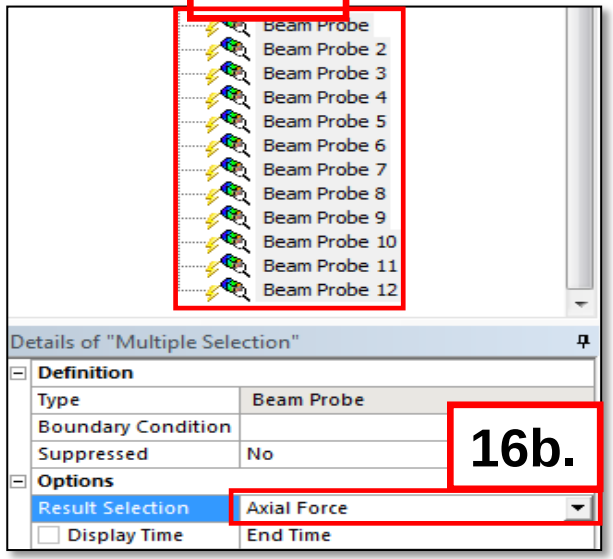


As the details from one of the beam probes shows there are a number of quantities returned for each beam. Our goal is to verify the axial forces in the beams so we'll reconfigure the probes.

. . . Postprocessing

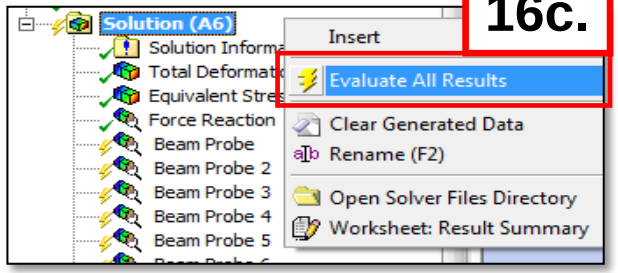
16. Modify the beam probes to retrieve only axial results:
    a. Highlight all the beam probes in the Solution branch (use Shift key to multi-select).
    b. In the details set the “Result Selection” field to “Axial Force”.
    c. “Evaluate All Results”.

16a.

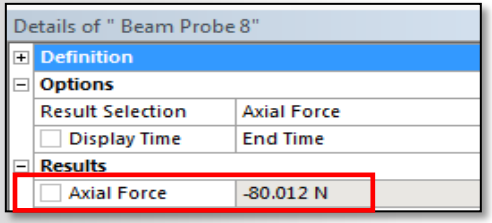


16b.

16c.

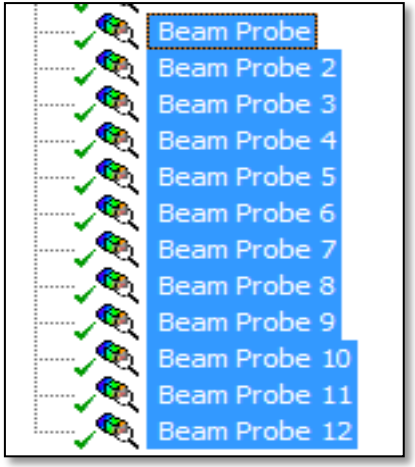


Results now show only the axial forces are returned to the beam probes.

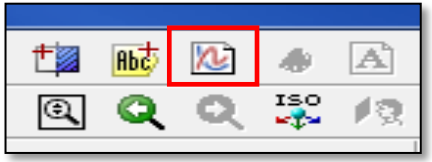


. . . Postprocessing

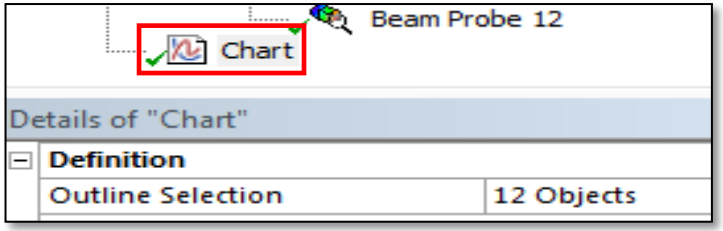
- A convenient way to combine all the probe results in one location is to use the chart/table feature and export the data to a spreadsheet.
- *Since not all training machines may have Microsoft Excel installed we'll simply describe the procedure here.*



- First highlight all the beam probes in the tree. Then select the Chart/Table icon from the toolbar.

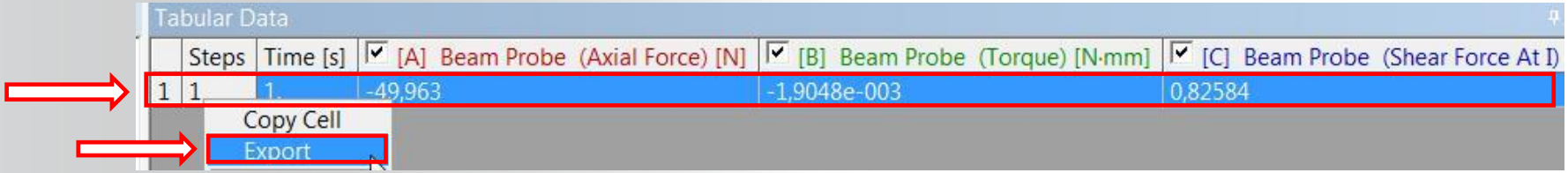


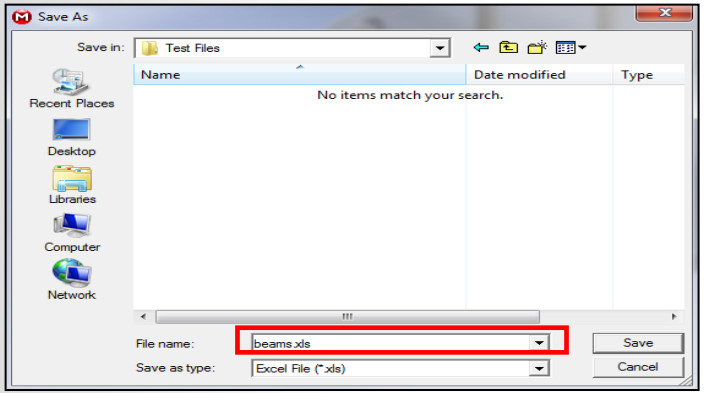
- A new chart object is displayed in the tree. Notice the details in this case, indicate the chart relates to 12 objects.



. . . Postprocessing

- A closer look at the table area shows each of the axial force values from the beam probes is shown in individual columns.
  - Clicking in the “Steps” column selects the entire row of data and a RMB will allow an “Export” of the data (*.xls or *.txt formats).





. . . Postprocessing

- As shown below a simple summation formula in Excel verifies the combined values for all beam connections.

Time [s]	[A] Beam	[G] Beam	[M] Beam	[S] Beam	[Y] Beam	[AE] Bean	[AK] Bean	[AQ] Bear	[AW] Bea	[AAC] Bea	[AAI] Bea	[AAO] Bea
1	-49,963	-49,936	-49,889	-79,897	-49,948	-120,11	-120,14	-79,987	-79,876	-120,09	-120,21	-79,945
	force summation		-999,991									

- This workshop has shown how the object generator can be used to create multiple beam connections. The object generator can be used for essentially any object in the tree that allows duplication (e.g. RMB > Duplicate).

Go further!

If you finish this workshop and find yourself with extra time, you could try the following steps:

1. Delete all the beams generated by the “Object Generator”;
2. Go back to the “Object Generator” settings window;
3. Experiment with the “Distance” settings (increasing the range from the original values off 45 and 55);
4. Experiment with picking/unpicking the “Ignore Original” setting.

