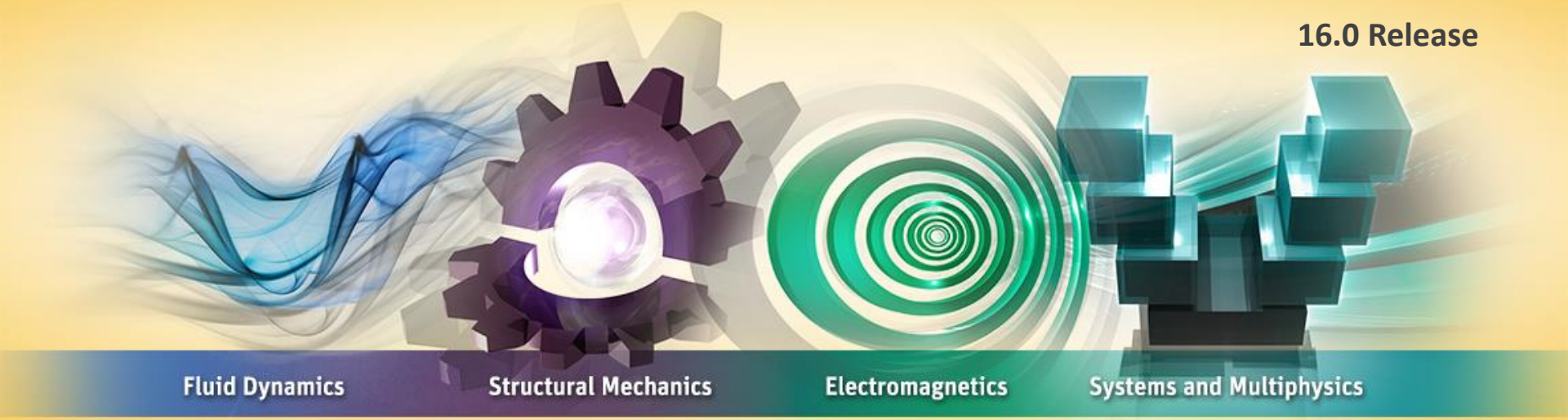
Workshop 4.2 : Mesh Control

16.0 Release



Introduction to ANSYS Mechanical

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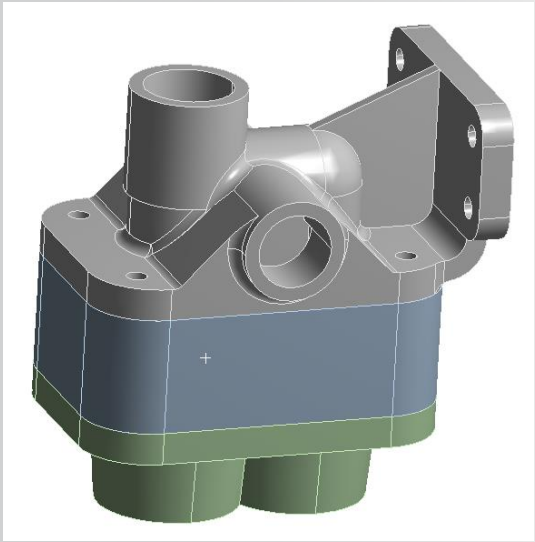
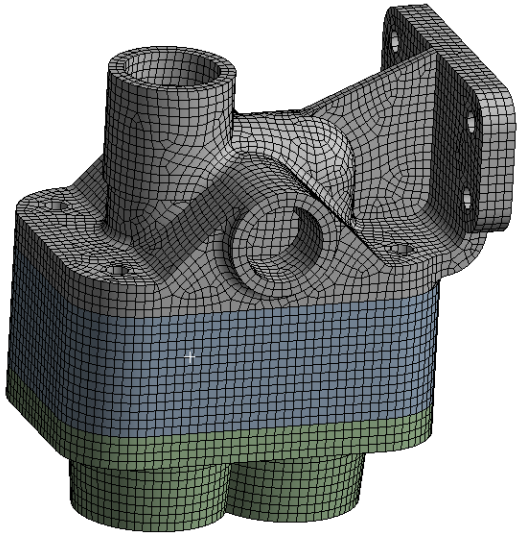
Goals

Use the various ANSYS Mechanical mesh controls to enhance the mesh for the model below.

- **Our goal is to use meshing controls in order to deal with some geometry specification defects.**



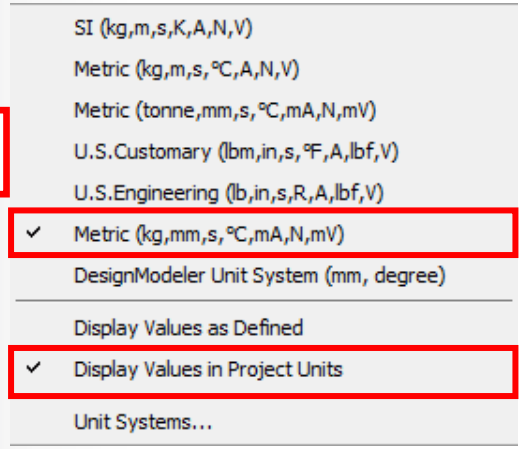


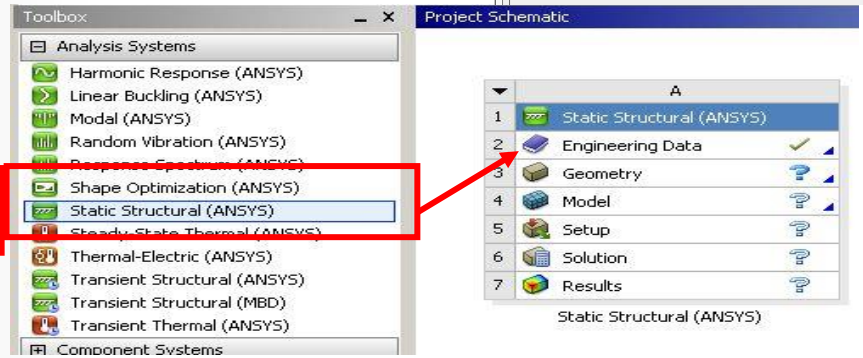
Project Schematic

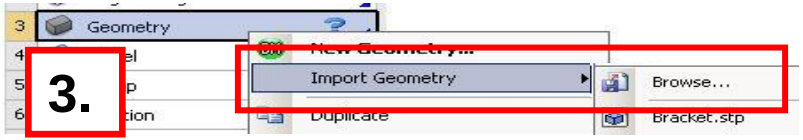
1. From the “Units” menu verify:
   - Project units are set to “Metric (kg, mm, s, ºC, mA, N, mV). If not available in the menu, click on “Unit Systems…” and set them for the active project.
   - “Display Values in Project Units” is checked (on).

2. From the Toolbox double click “Static Structural” to create a new system.

3. RMB the geometry cell and “Import Geometry” and browse to “assembly_solid.stp”.

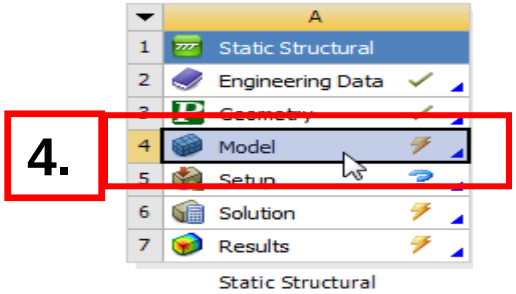




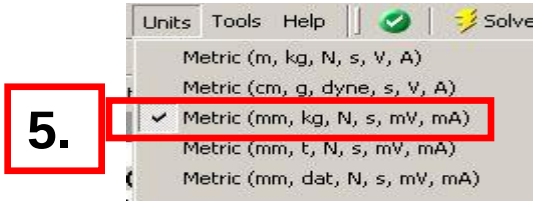


. . . Project Schematic

4. Double click the “Model” cell to open the Mechanical application.



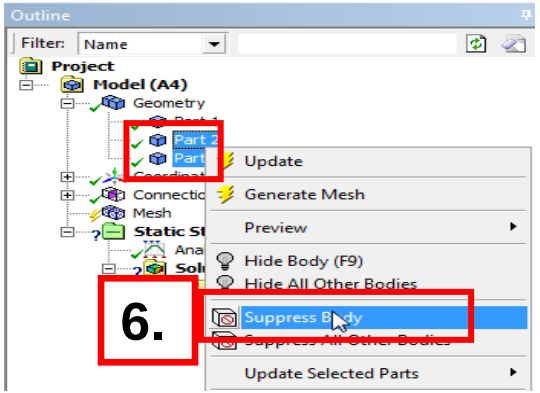
5. Set/verify the working unit system:
   - “Units > Metric (mm, kg, N, s, mV, mA)”.



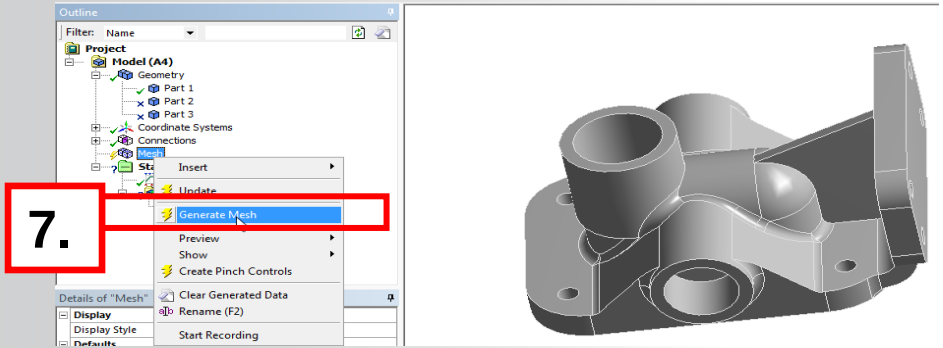
Mesh control

6. Select Part 2 and Part 3 in the Geometry details.

RMB and suppress body. (we'll focus on Part 1 in a 1st step)

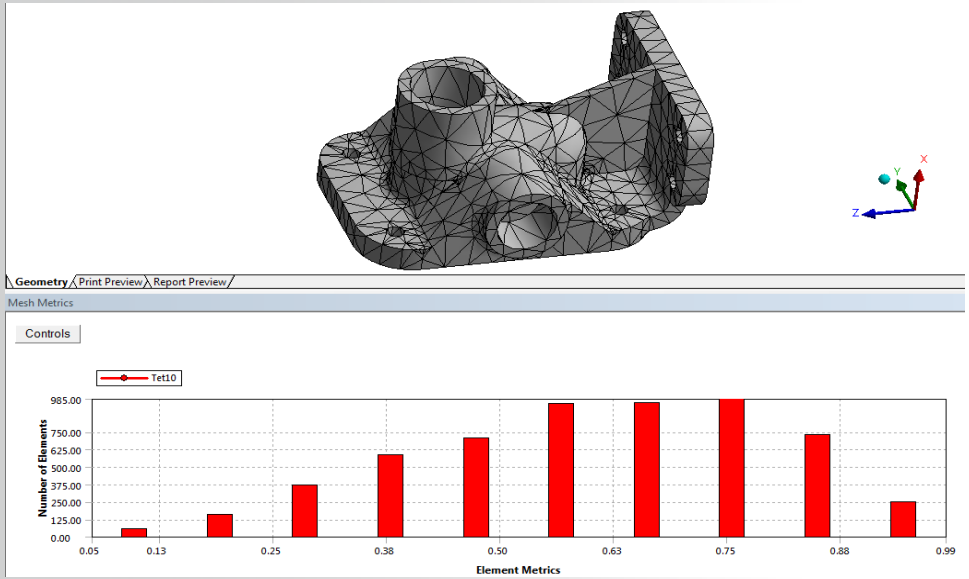


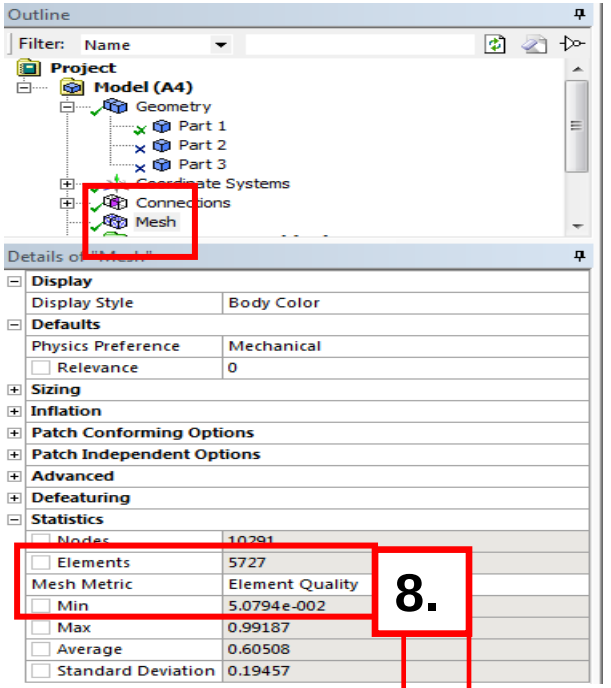
7. RMB on Mesh and click on Generate Mesh to generate a default mesh



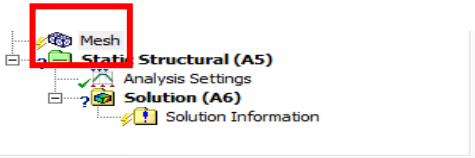
. . . Mesh control

8. From the mesh details -> Statistics, select Mesh Metric and check the element quality.





. . . Mesh control

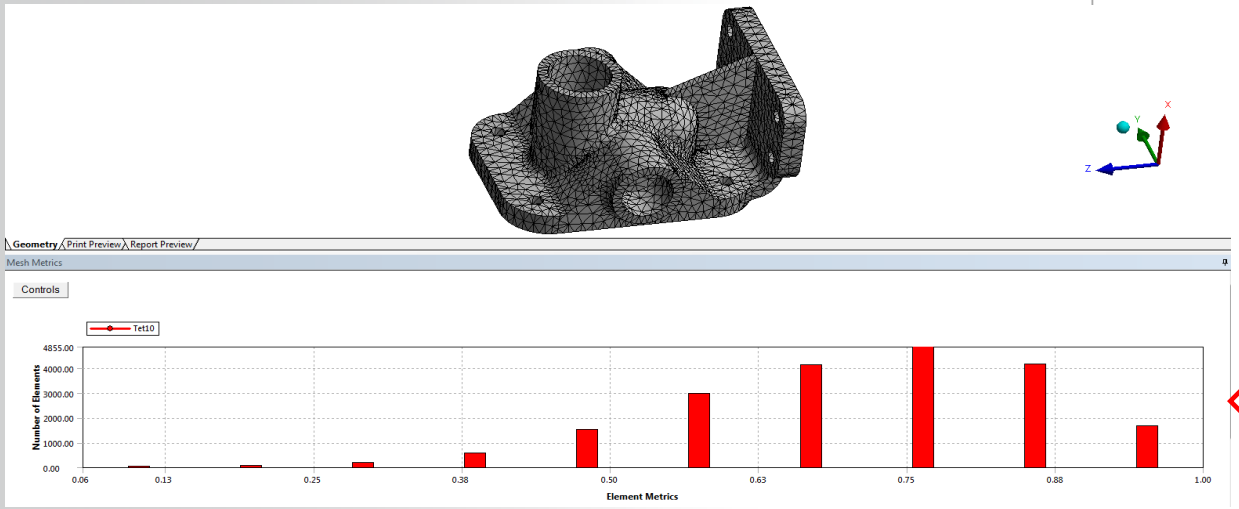


9. From the mesh sizing details, change the element size to 4 mm and regenerate mesh. Re-Check the mesh metric.

Details of "Mesh"

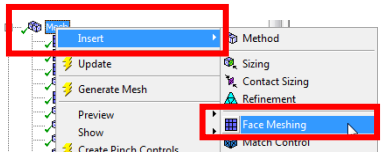
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	4.0 mm
Initial Size Seed	mbly
Smoothing	
Transition	

9.



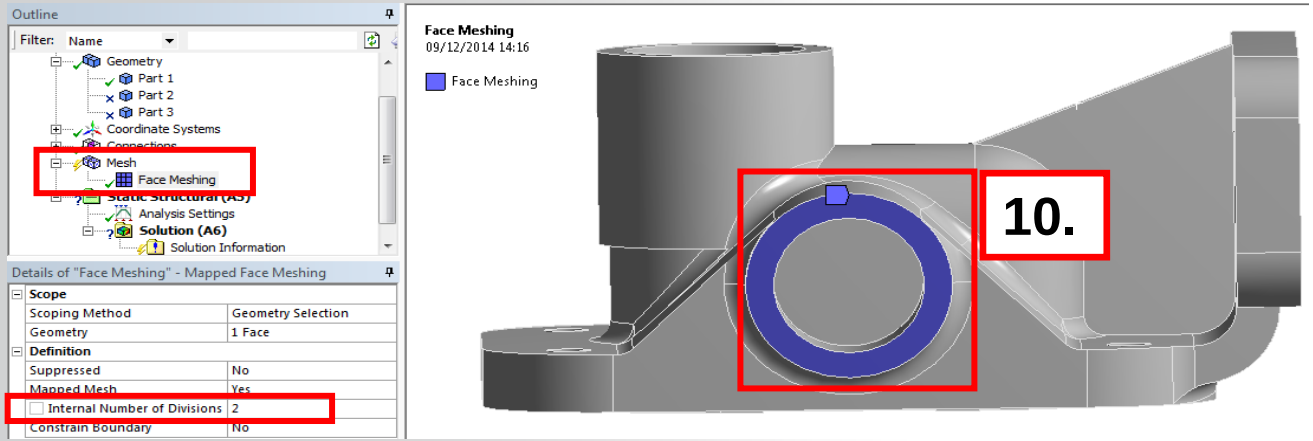
. . . Mesh control

RMB

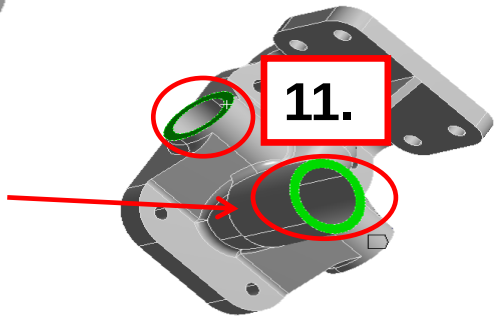


10. Insert a Face Meshing at the cylindrical surface shown below

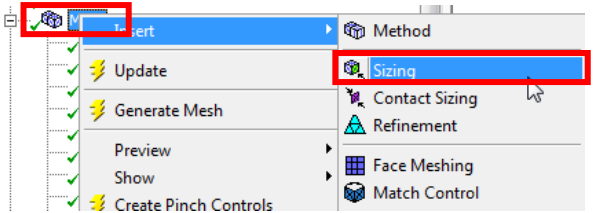
And set the internal Number of divisions to 2.



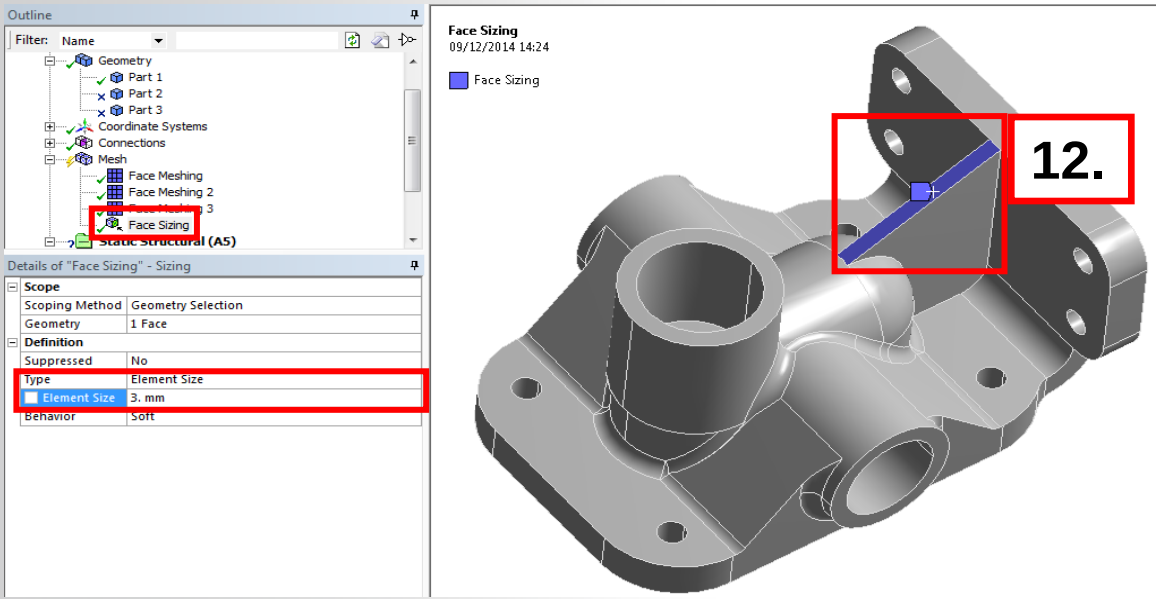
11. Repeat the same control to the 2 other cylindrical surfaces shown here.



. . . Mesh control



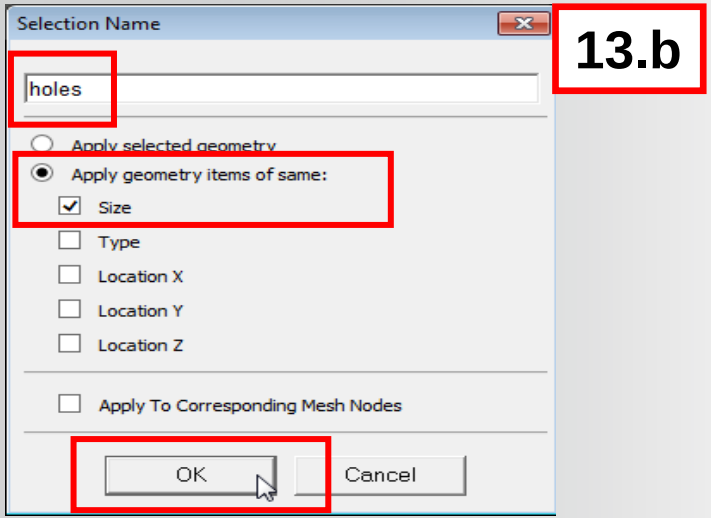
12. Insert a Face sizing of 3 mm as element size at the surface shown below.



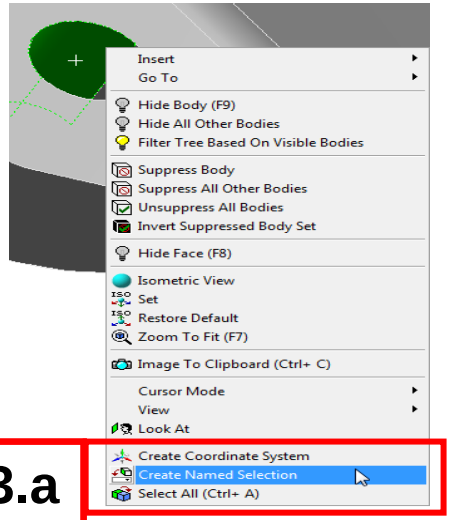
. . . Mesh control

13. a. Select one of the 2 surfaces in the 8 holes (half of the hole) and RMB create named selection.

13. b. In the named selection details, change the name to ‘holes’ and choose apply geometry items of same size.



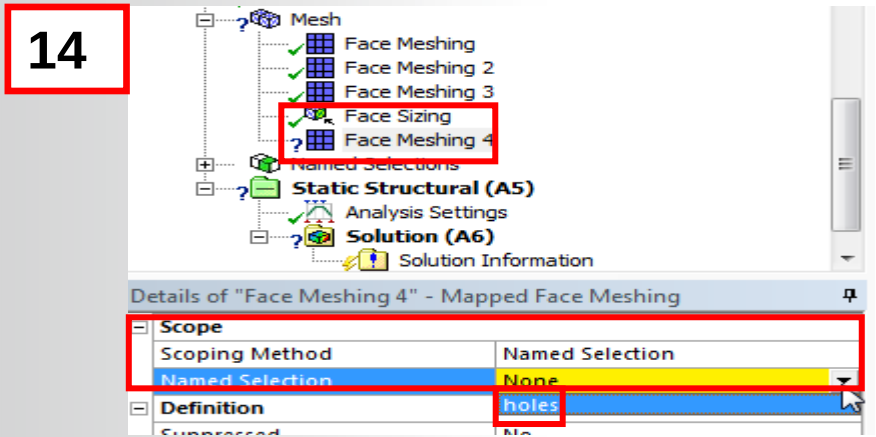
13.b



13.a

. . . Mesh control

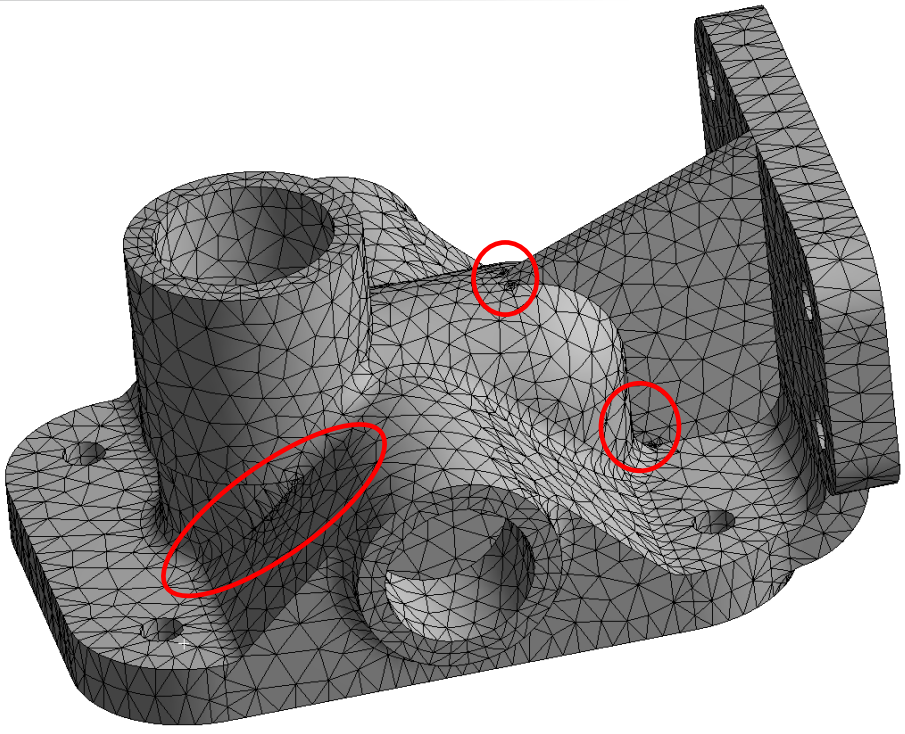
14. Insert a Face Meshing control and change the Scoping Method to Named Selection. In the Named Selection select holes.



- After re-generating the mesh, you can see that the number of distorted elements has being reduced by checking the mesh metric.

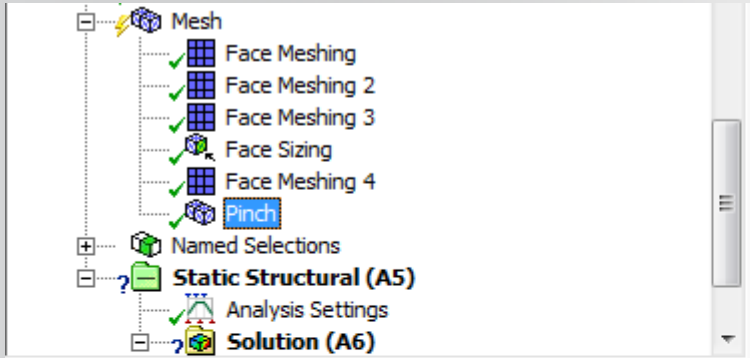
Geometry correction technics

- We will now focus on dealing with some geometric specifications like the ones shown here:



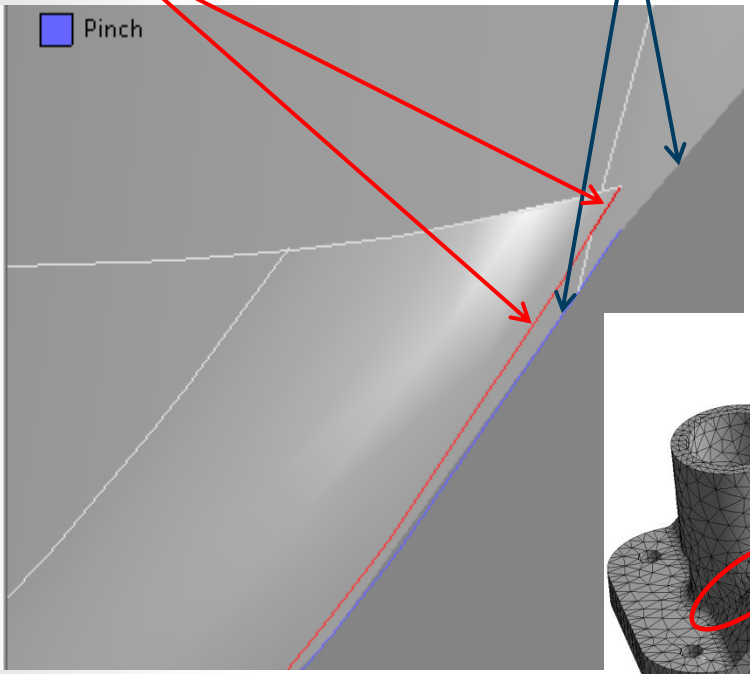
Pinch

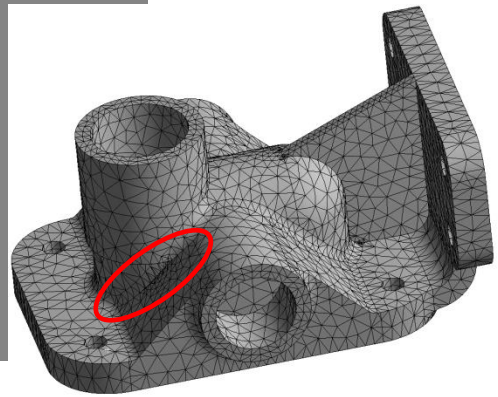
15. Insert a pinch control and choose as master Geometry the 2 edges in blue. As Slave Geometries, choose the two edges in red. Set the tolerance to 2 mm.



Details of "Pinch" - Pinch

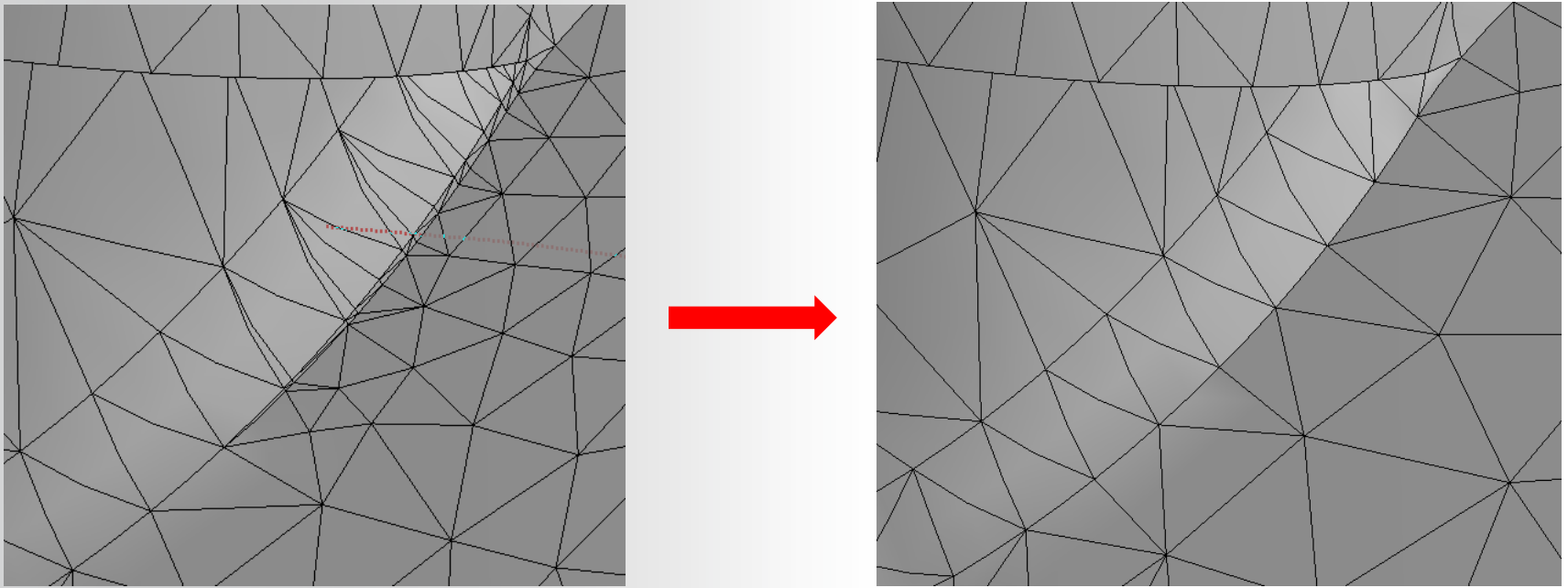
Scope	
Master Geometry	2 Edges
Slave Geometry	2 Edges
Definition	
Suppressed	No
Tolerance	2. mm
Scope Method	Manual



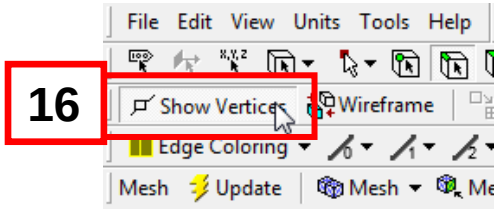


. . . Pinch

- **After generating the mesh check the result and compare it to the original mesh on the corresponding area.**

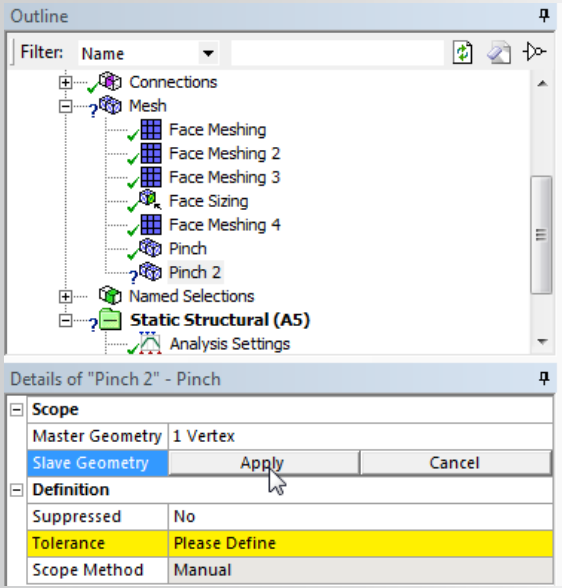


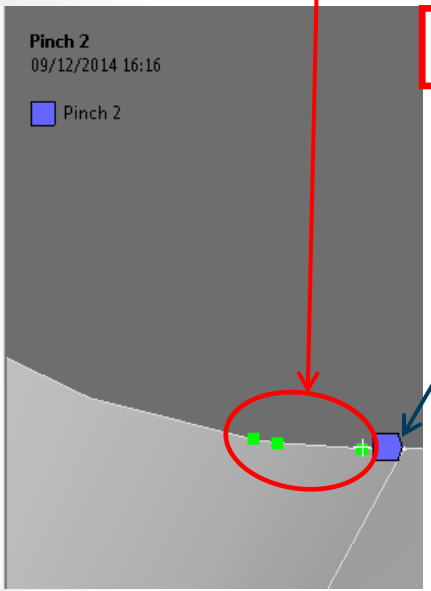
. . . Pinch



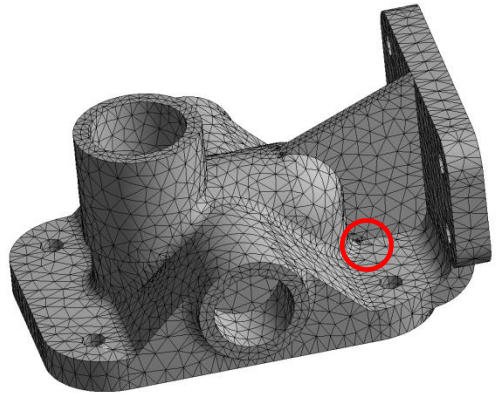
16. Clear generated mesh and Turn the Show vertices on:

17. Insert another pinch control and choose as master Geometry the vertex in blue. As Slave Geometries, choose the three following vertices. Set the tolerance to 2 mm and Mesh.

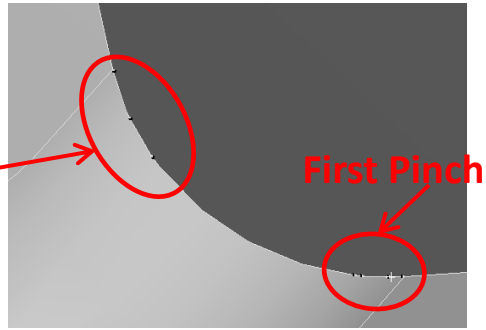




17

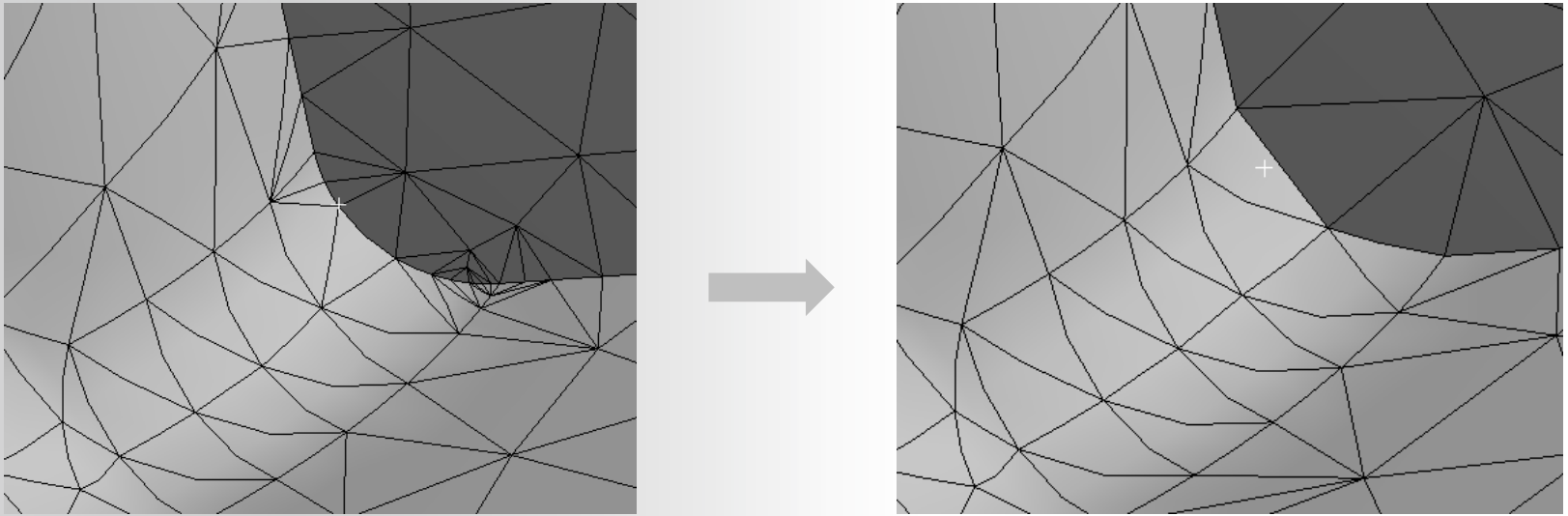


. . . Pinch



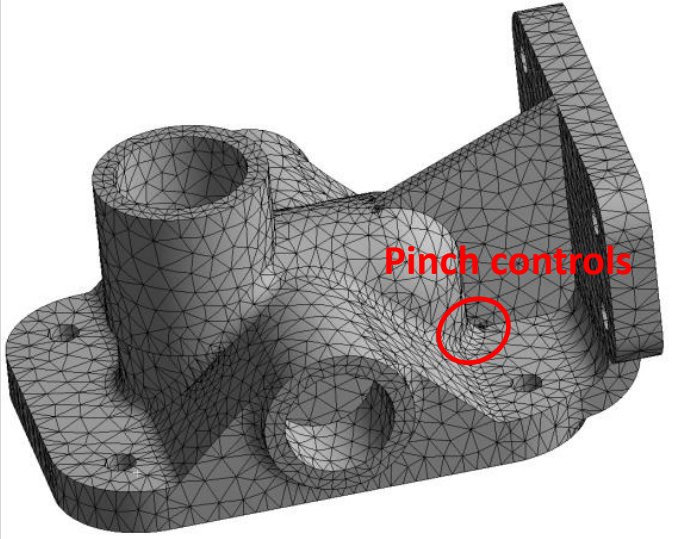
18. Repeat the pinch control at the following points: Change the tolerance value if needed.

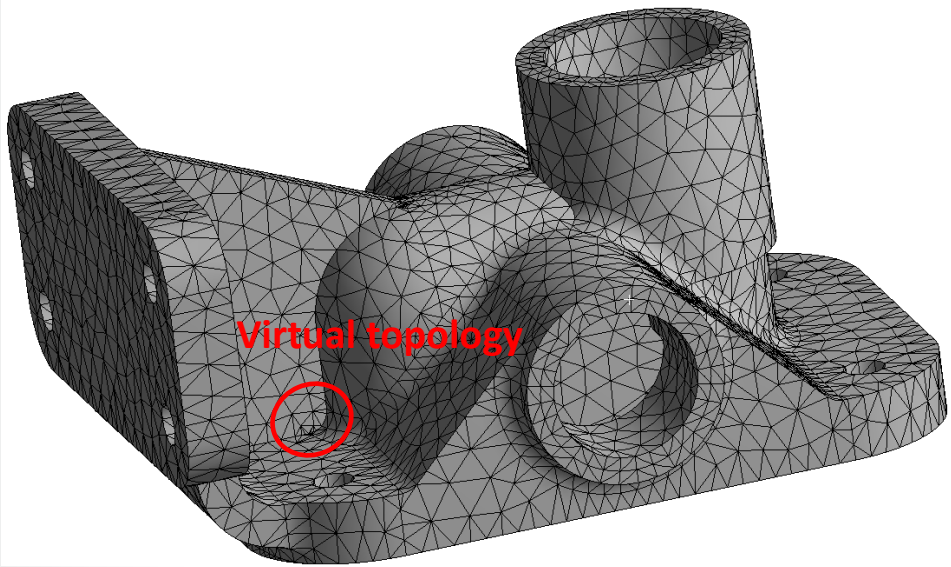
- **Compare the mesh at the corresponding area**



Virtual topologies

- The Pinch controls done here can sometimes be replaced by virtual topologies .
- We will create a virtual topology in the other side of the 2 created pinch controls:





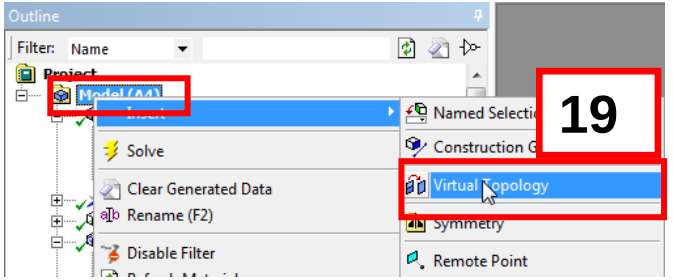
. . . Virtual topologies

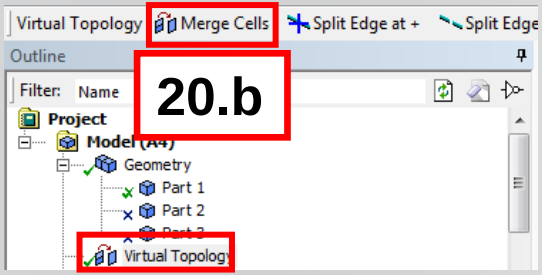
19. From the model control RMB and insert Virtual Topology.

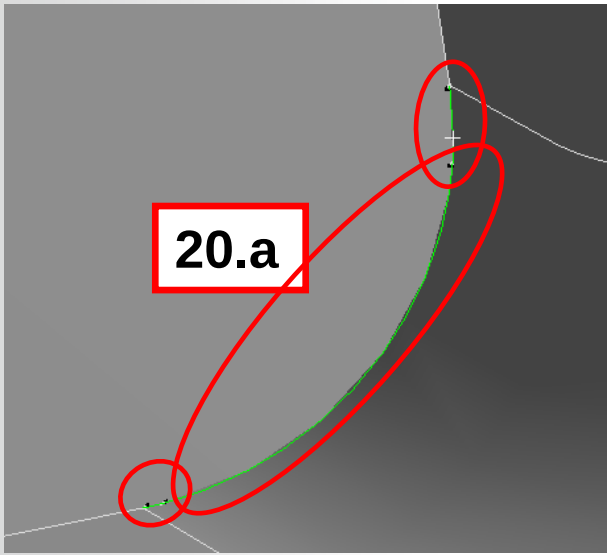
20. a. Select the 3 edges in the corresponding area.

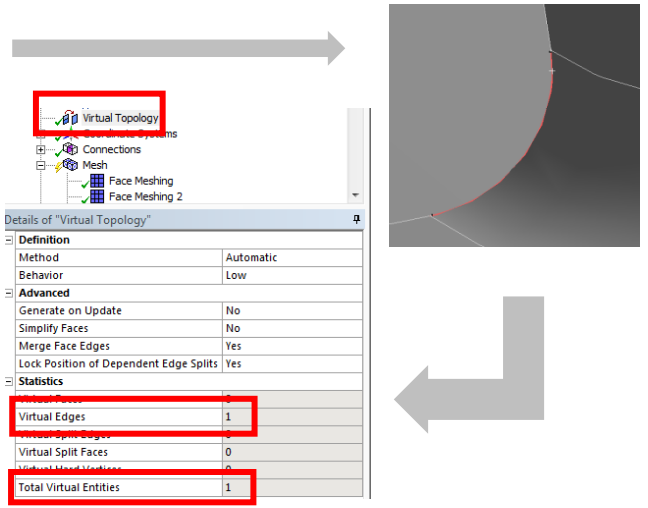
20. b. Click on Merge Cells.

Generate the mesh and Compare.



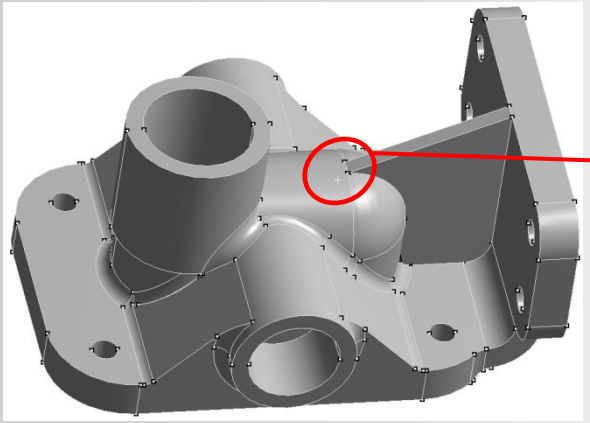


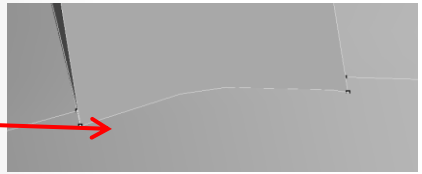


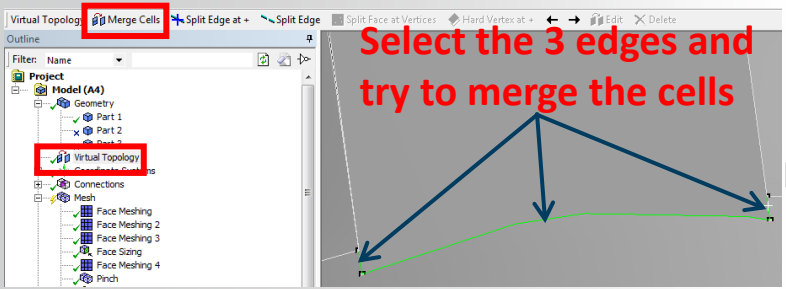


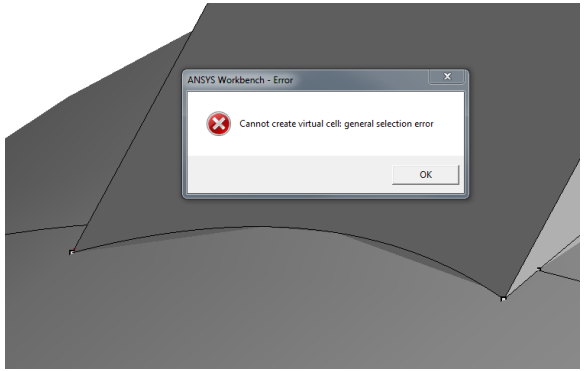
Virtual topologies vs Pinch

- **Pinch and VT are complementary tools. In some cases if one could not be applied, try the other one:**





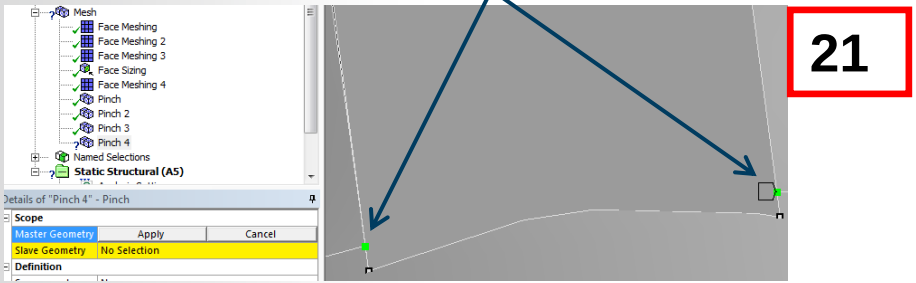




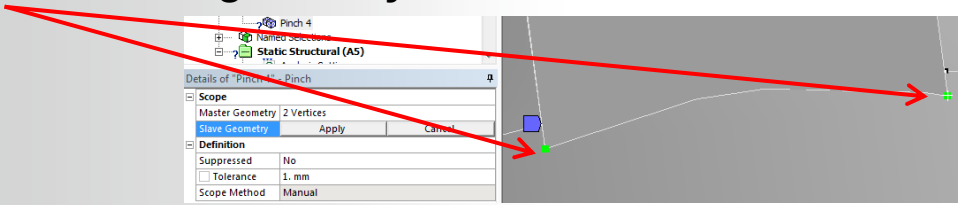
…Virtual topologies vs Pinch

- **In these cases, the pinch control should be used:**

21. Insert a Pinch Control and select the 2 following points as master geometry:

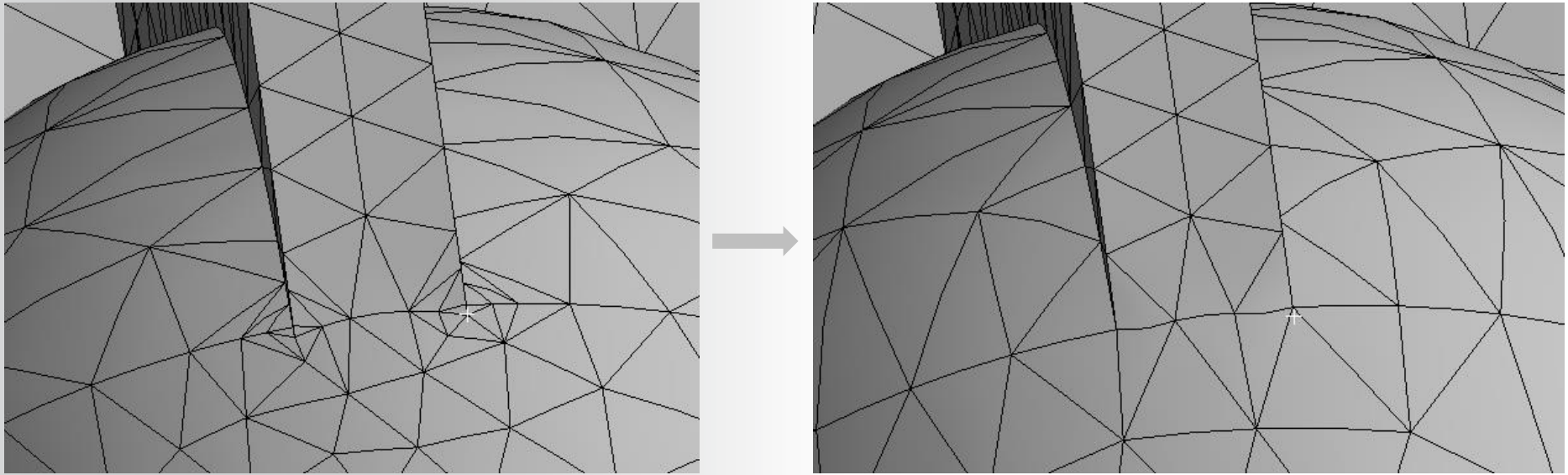


And the other two points as slave geometry with a tolerance of 1 mm.



…Virtual topologies vs Pinch

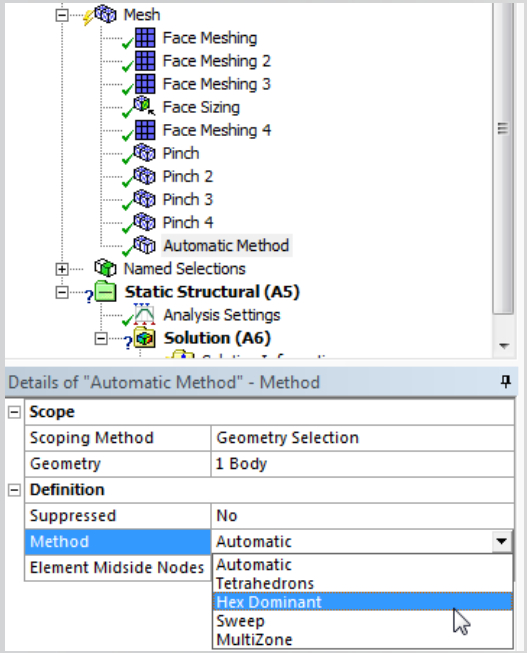
- **Check the difference between the generated meshes before and after this operation:**

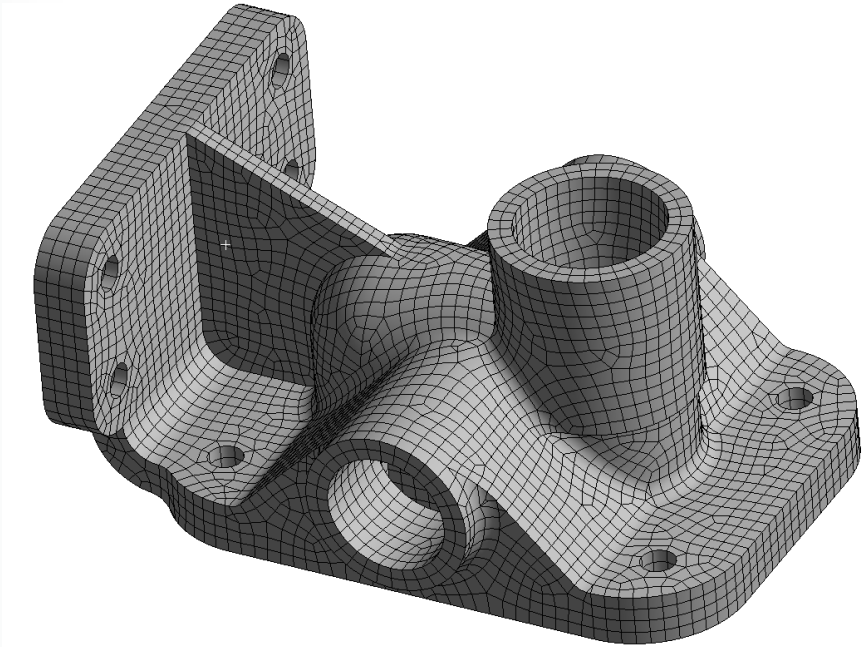


Go Further!

- In this exercise we focused on the sizing and the cleaning operations.
- The user may test some methods in order to have hex elements.

Test the Hex Dominant method on the Part 1 body.

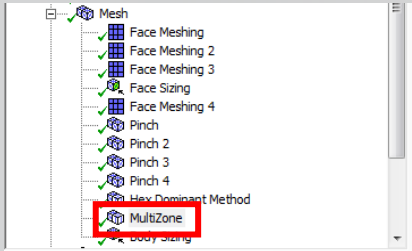




. . . Go Further!

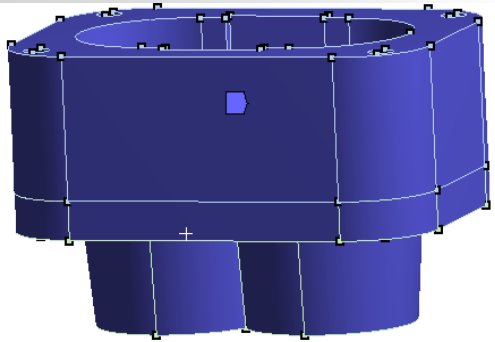
- **Unsuppress Part 2 and Part 3 bodies.**

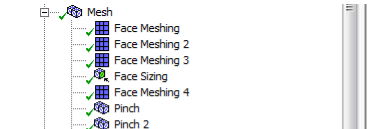
Test the Multizone method on both bodies.
Insert a body sizing of 5 mm as element size to both bodies



Details of "MultiZone" - Method

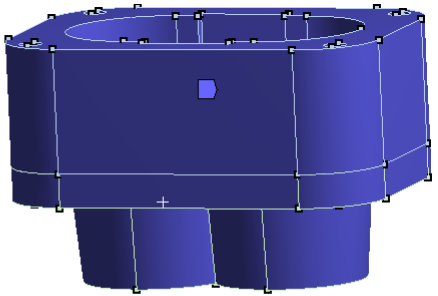
Scope	
Scoping Method	Geometry Selection
Geometry	2 Bodies
Definition	
Suppressed	No
Method	MultiZone
Mapped Mesh Type	Hexa
Surface Mesh Method	Program Controlled
Free Mesh Type	Hexa Dominant
Element Midside Nodes	Use Global Setting
Src/Trg Selection	Automatic





Details of "Body Sizing" - Sizing

Scope	
Scoping Method	Geometry Selection
Geometry	2 Bodies
Definition	
Suppressed	No
Type	Element Size
Element Size	5. mm



. . . Go Further!

Test the inflation on the Part 2 body.
With a body sizing of 3mm.