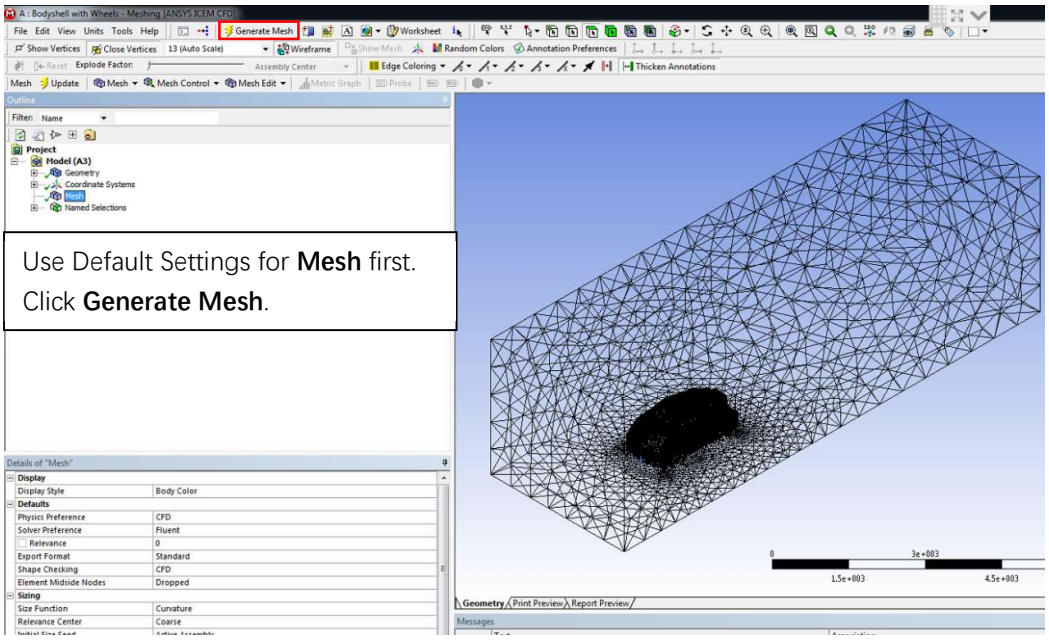
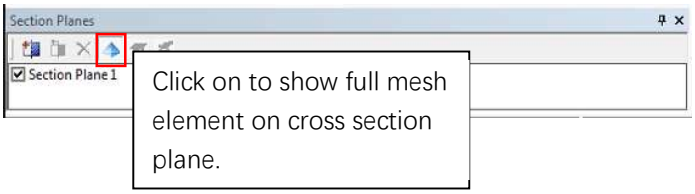
ANSYS Meshing Tutorial

1. Mesh for Fluent Model

1.1 Use Default Mesh to check Geometry.





1.2 Click on **Mesh** to view the **General settings**

Details of "Mesh"	
Display	
Display Style	Body Color
Defaults	
Physics Preference	CFD
Solver Preference	Fluent
Relevance	0
Export Format	Standard
Shape Checking	CFD
Element Midside Nodes	Dropped
Sizing	
Size Function	Curvature
Relevance Center	Coarse
Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Fine
Curvature Normal A...	Default (18.0 °)
Min Size	Default (6.23390 mm)
Max Face Size	Default (623.390 mm)
Max Tet Size	Default (1246.80 mm)
Growth Rate	Default (1.20)
Automatic Mesh Base...	On
Defeaturing Tolera...	Default (3.11690 mm)
Max Dual Layers in Thi...	No
Minimum Edge Length	2.971e-002 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Assembly Meshing	
Advanced	
Statistics	
Nodes	101099
Elements	542503
Mesh Metric	None

Defaults:
Physics Preference: CFD
Solver Preference: Fluent
Relevance: Higher → Finer Mesh
Shape Checking: CFD
Element Midside Nodes: Dropped

Sizing:
Size Function: Curvature
Relevance Center: Select **Fine** from drop-down list for finer mesh
Smoothing: Select **High** from drop-down list for finer mesh
Transition: Select **Slow** from drop-down list for finer mesh
Span Angle Center: Select **Fine** from drop-down list for finer mesh

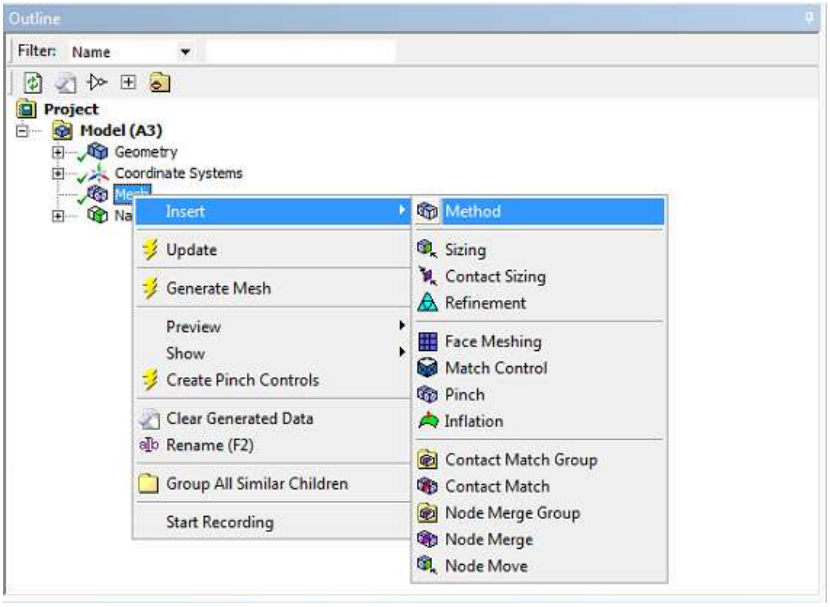
Inflation:
Maximum Layers: Default = 5 layers
Increase Maximum Layers number for finer Mesh
Reduce Growth Rate for finer Mesh

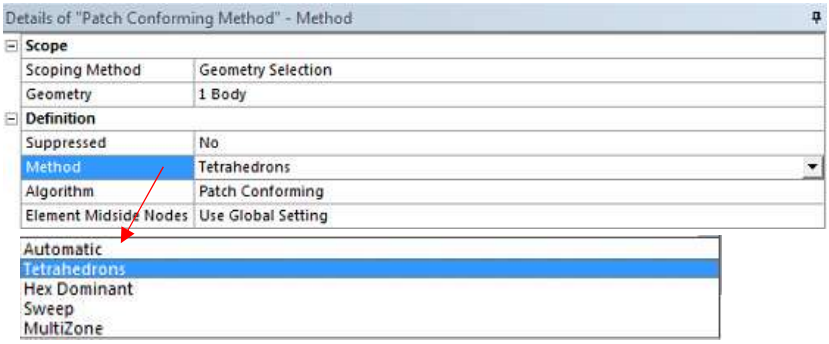
Statistics:
Use **Elements** to check the number of mesh cells (542503).

*Finer the Mesh is, more mesh cells generated, more Computer memories required to run the simulation. Be aware of the out of memory error may happen with a finer mesh geometry.

1.3 Define **Method** used for Mesh Element

Right Click **Mesh → Insert → Method**





Above are few types of mesh from **Method** drop-down list.

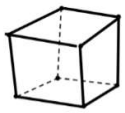
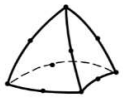
Select **Tetrahedrons** from **Method** drop-down list.

Select **Patch Conforming** from **Algorithm** drop-down list.

Click **Generate Mesh**.

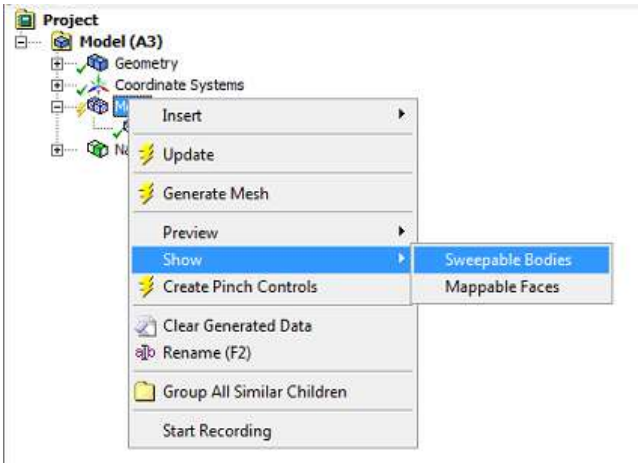
Workbench meshing use **Sweep** as the default method.

However, for the body cannot be swept, **Tetrahedrons** is the default method.

Hexahedral Methods	**Sweep:** Sweep requires topologically consistent source and target faces (same number of vertices per face with a smooth path from the source to the target) **Multizone:** Use the Hexa blocking method (courtesy of the ICEM Advanced Meshing Module) that internally segments bodies into topologically consistent pieces **Hex Dominant**	 Hex Cell
Tetrahedron Methods	**Patch Conforming:** The mesh must conform to the boundaries of the faces, yielding a very fine mesh in regions with small faces. **Patch Independent:** The mesh is not required to conform to the boundaries of the faces. This is useful when there are many small faces which would normally produce a very fine mesh.	 Tet Cell

To check **sweepable Geometry**: Right Click **Mesh → Show → Sweepable Bodies**

(Workbench will highlight the sweepable bodies)

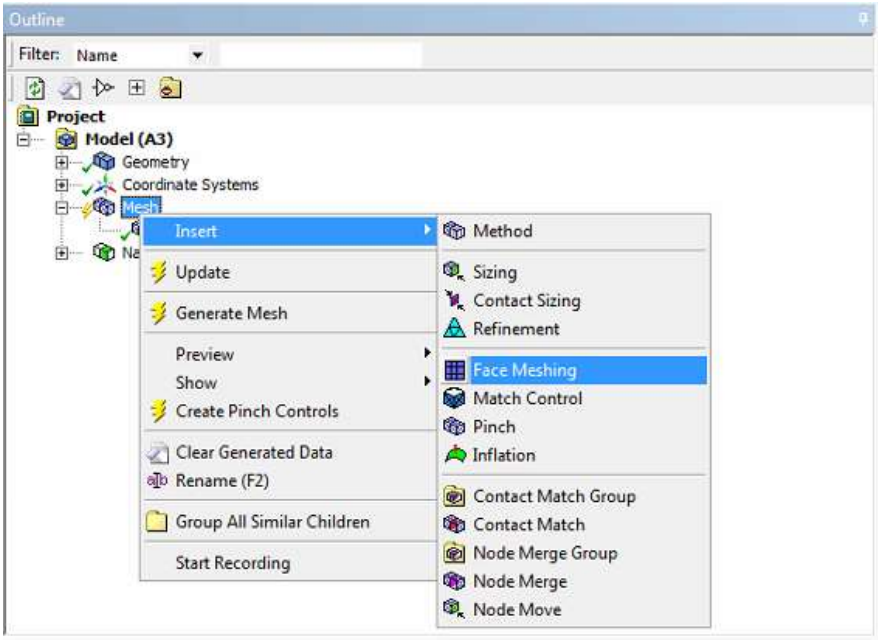


*__Hexahedrons__ can be more accurate when aligned with the flow direction. However, it is not always possible to align the mesh with the flow direction.

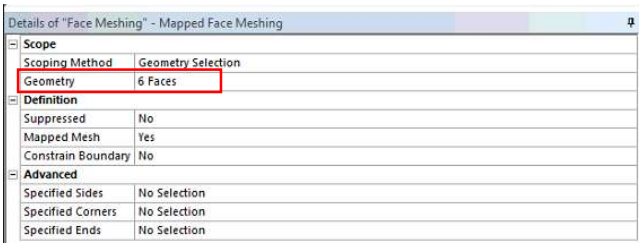
*__Hexahedral mesh__ cannot be generated for the sample geometry.

1.4 Define **Face Meshing** for specific surfaces

Face meshing controls enable you to generate a free or mapped mesh on selected faces.



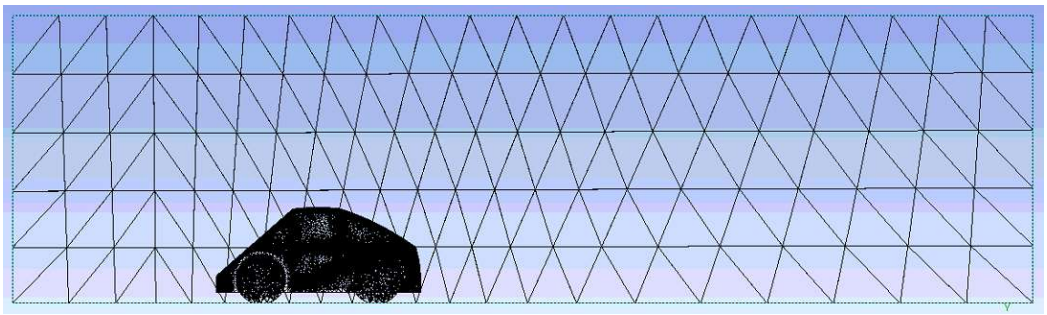
Face Meshing for boundary surfaces:



Select the inlet, outlet, floor and three side walls.

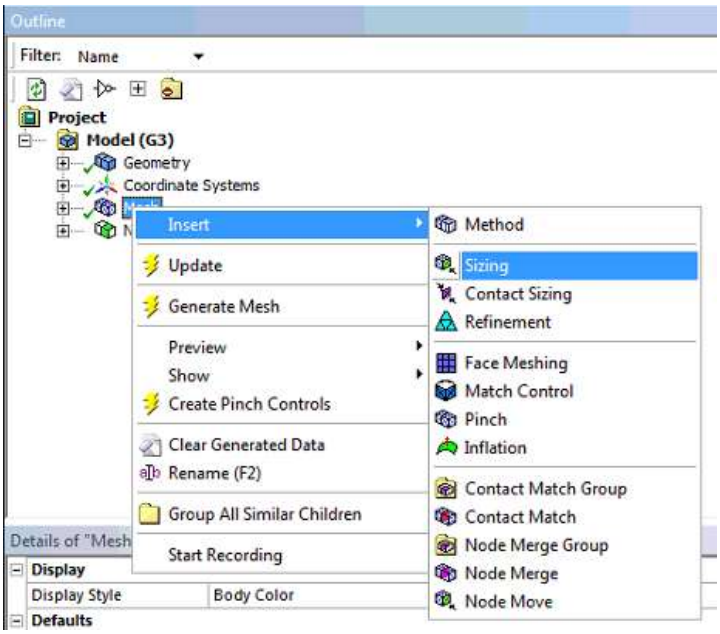
Click **Apply** for **Geometry**.

Click **Generate Mesh**

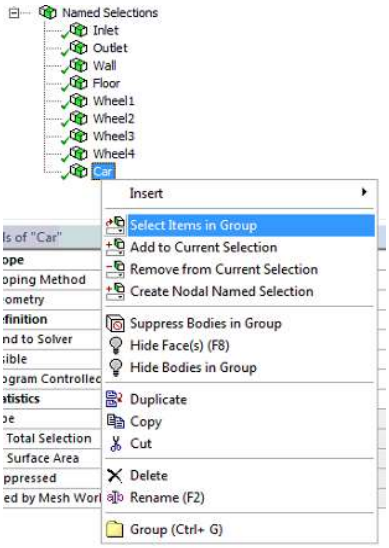


1.5 Define **Face Sizing** for specific surfaces

Face Sizing controls the mesh based on a sphere of influence, whereby any region of the mesh that is contained within the sphere will be given the chosen sizing



Face Sizing for bodyshell surfaces



To select the **bodyshell surfaces** as the **Geometry**:

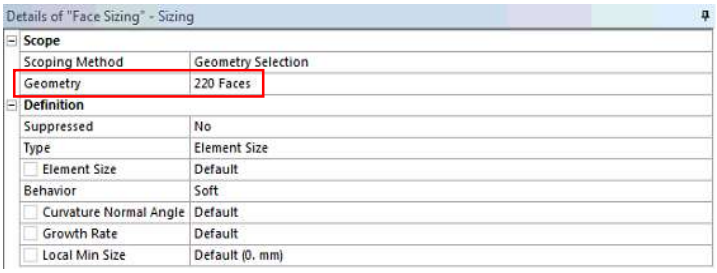
Right click on **Car** under **Named Selections**

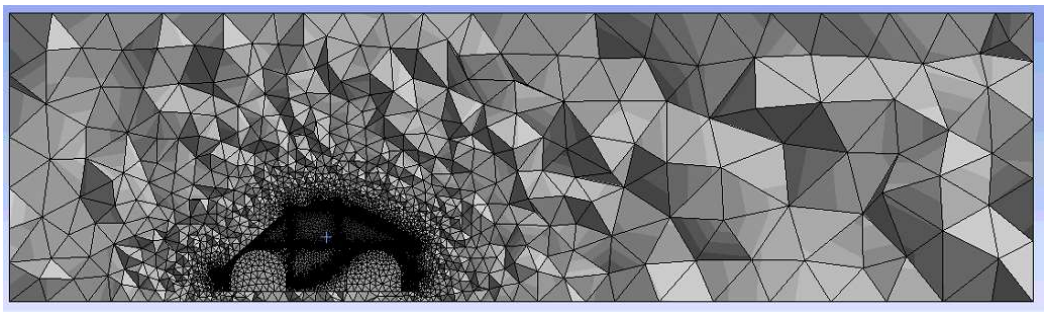
Click **Select Items in Group** (All the bodyshell surfaces will be highlighted in the view window)

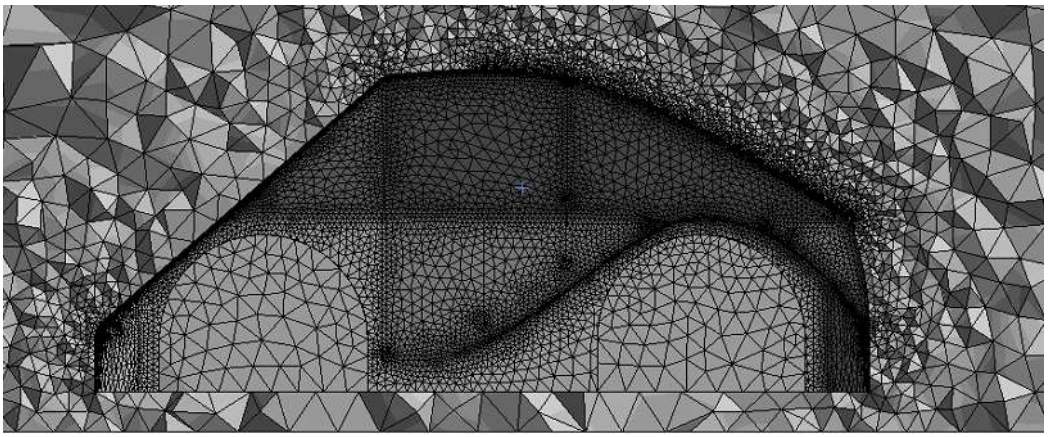
Go back to **Detail of "Sizing"** window by click on **Sizing** under **Mesh**

Click **Apply** for **Geometry**

Click **Generate Mesh**







Details of "Face Sizing" - Sizing

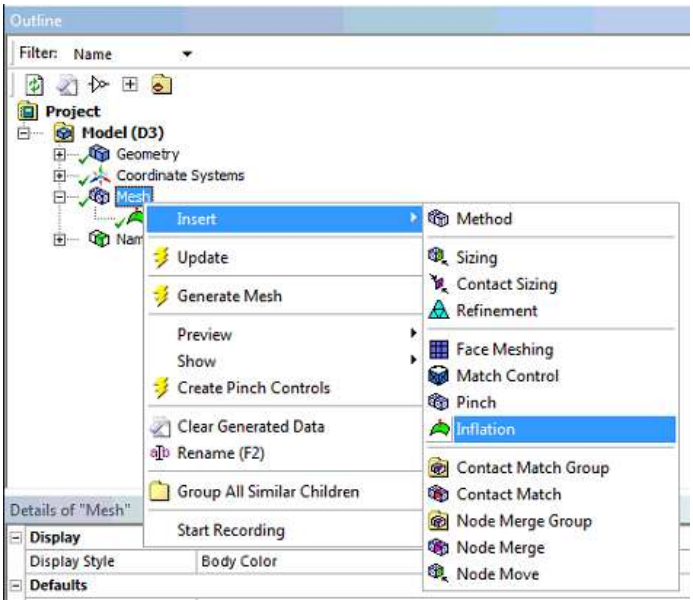
Scope	
Scoping Method	Geometry Selection
Geometry	220 Faces
Definition	
Suppressed	No
Type	Element Size
Element Size	Default
Behavior	Soft
Curvature Normal Angle	Default
Growth Rate	Default
Local Min Size	Default (0. mm)

Above mesh is generated by using default element size.

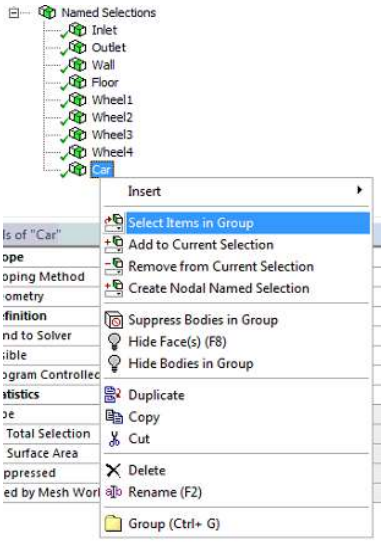
To achieve finer mesh, set smaller element size for this option.

1.6 Define **Inflation** for specific surfaces

Inflation is useful for **CFD boundary layer resolution**, electromagnetic air gap resolution or resolving high stress concentrations for structures.



Inflation from bodyshell surface



Select the **Computation Domain** (Solid Body) for **Geometry** in **Detail of "Inflation".**

Click **Apply** for **Geometry.**

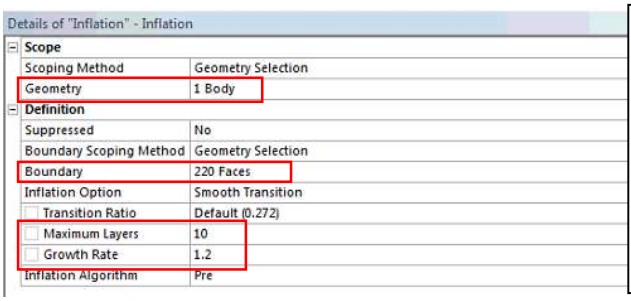
Right click on **Car** under **Named Selections.**

Click **Select Items in Group**

Go back to **Detail of "Inflation"** window by click on **Inflation** under **Mesh.**

Click **Apply** for **Boundary**.

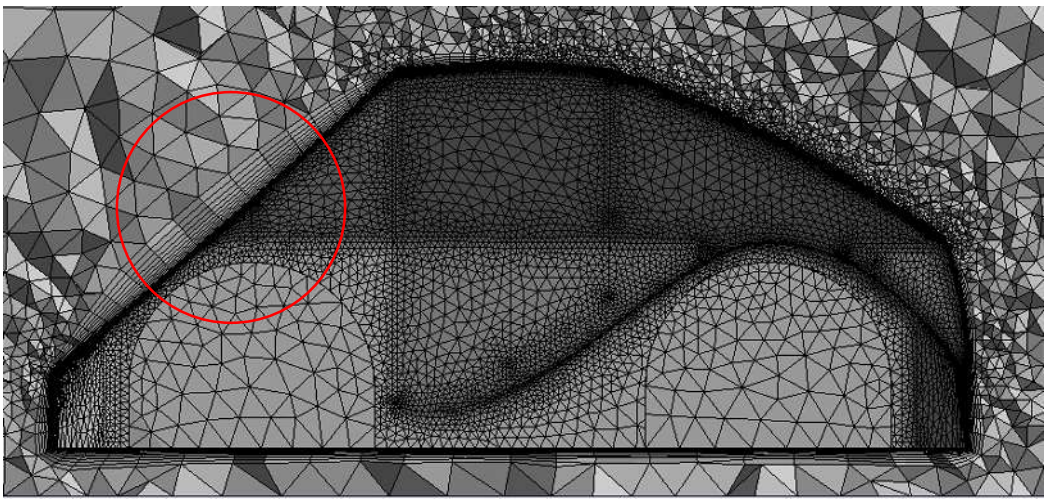
Click **Generate Mesh.**



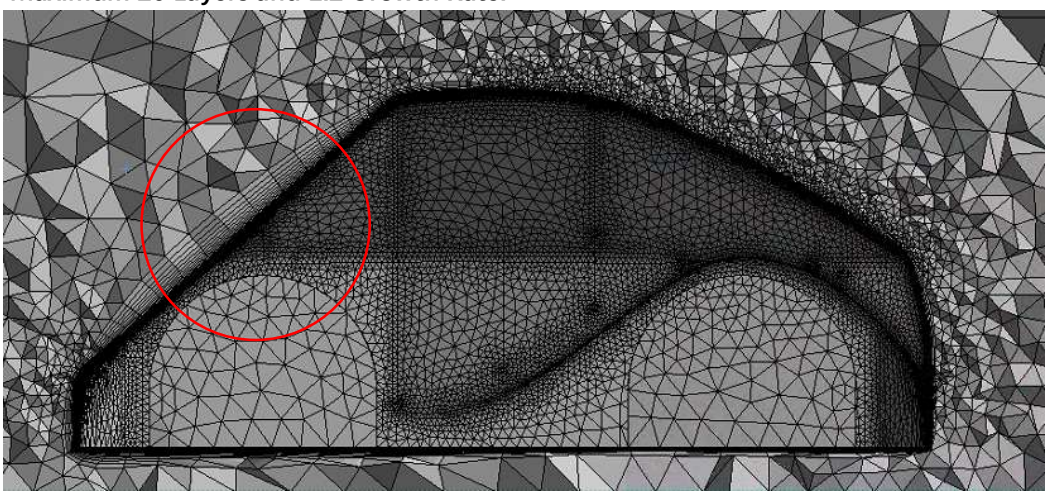
Maximum Layers:
More Layers → Finer Mesh

Growth Rate:
Smaller Value → Finer Mesh

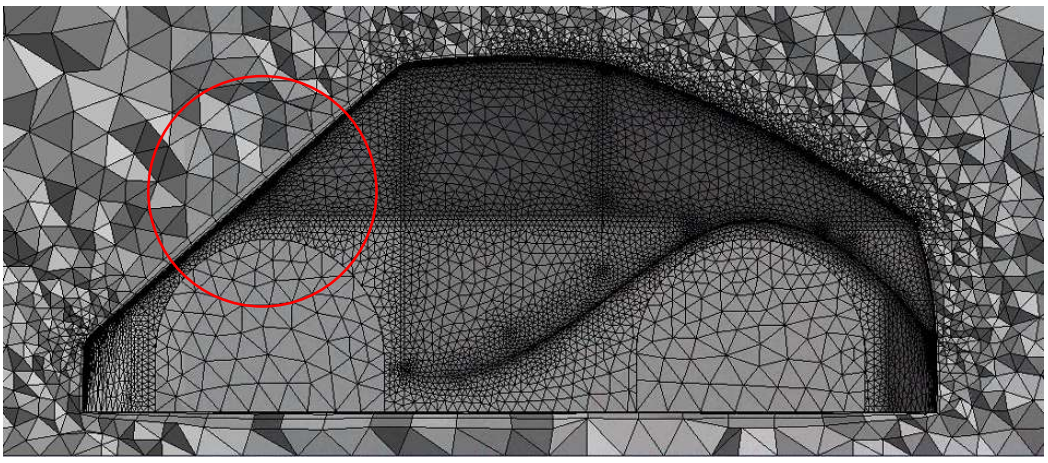
Maximum 10 Layers and 1.2 Growth Rate:



Maximum 20 Layers and 1.2 Growth Rate:



Maximum 10 Layers and 2.5 Growth Rate:



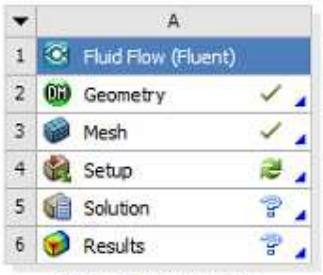
1.7 Update **Mesh** in **Workbench**

Close **Meshing** window once finished.

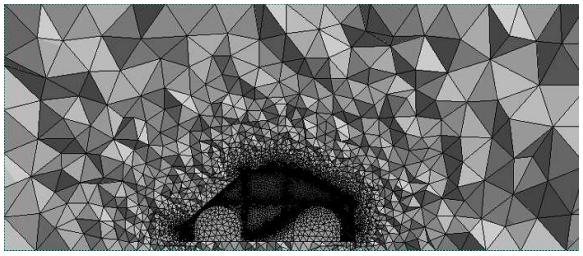
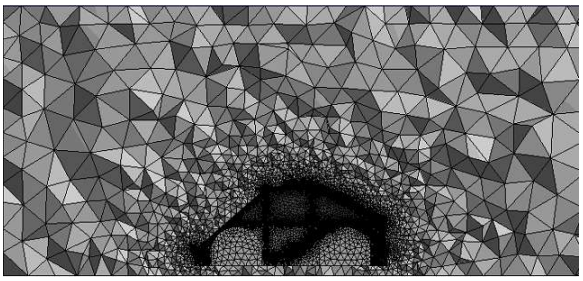
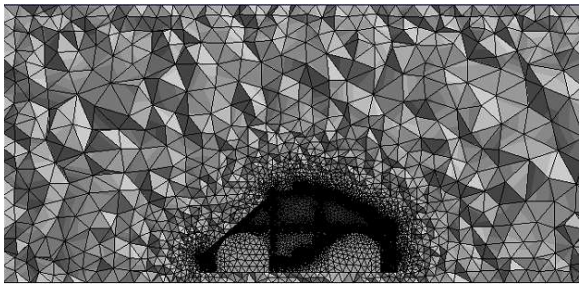
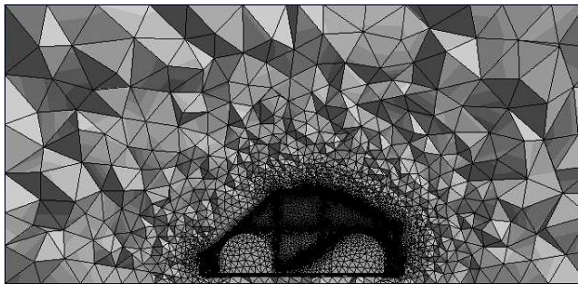
Go back to **Workbench**.

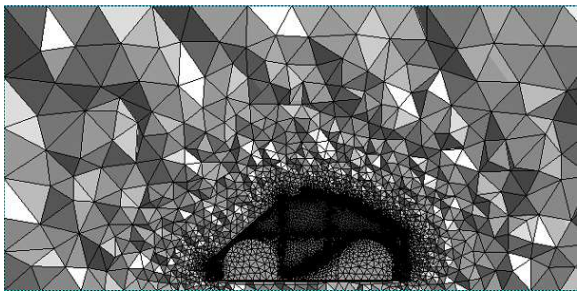
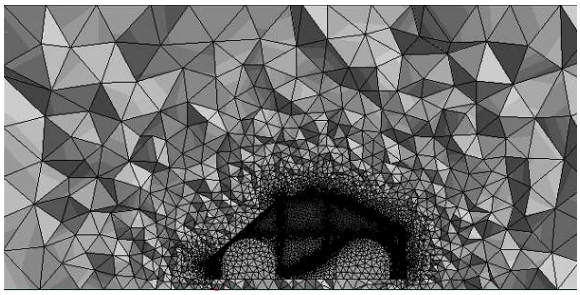
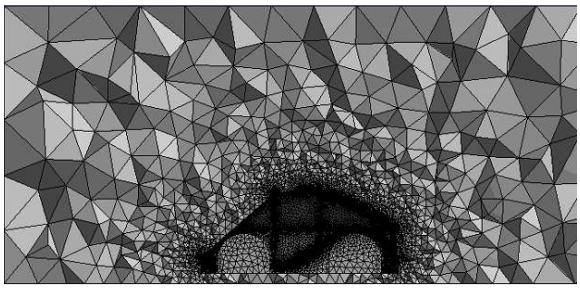
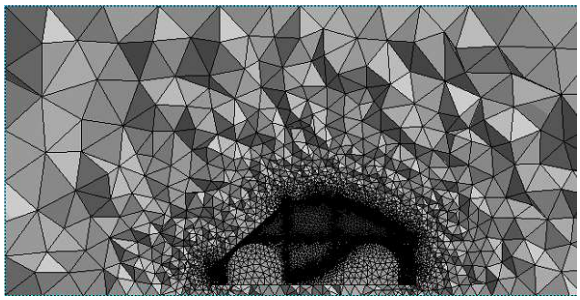
Right Click on **Mesh** to open tools bar, Left Click **Update**.

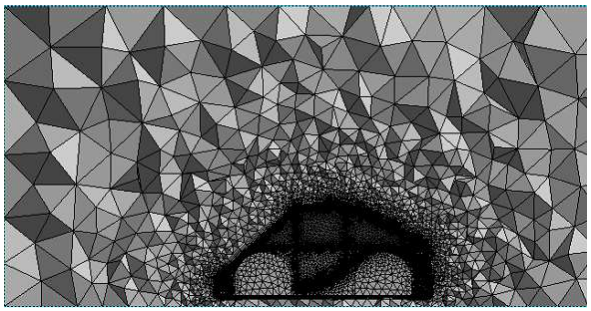
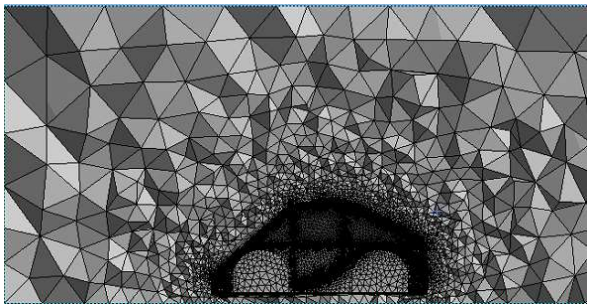
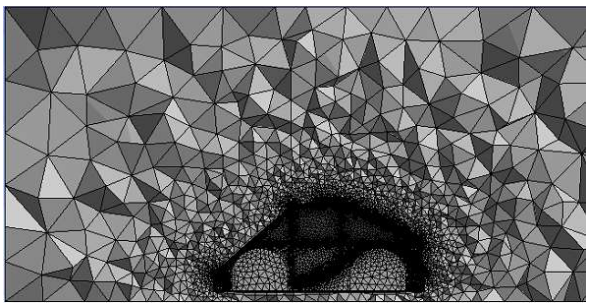
Green tick will show once finish updating mesh.

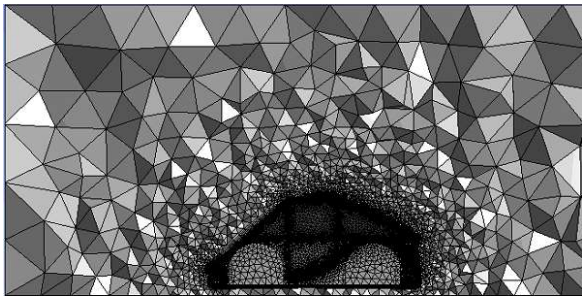


1.8 Simulation results vs. Different Mesh Method

Mesh	Simulation Results
Default Mesh 	# of Cells: 542503 Drag Force: -7.6128963 Drag Coefficient: -0.25776556 Lift Force: 11.11897 Life Coefficient: 0.37647794
Relevance Center: Medium 	# of Cells: 611209 Drag Force: -8.5794657 Drag Coefficient: -0.29049269 Lift Force: 12.601839 Life Coefficient: 0.4266865 **Simulation Warning**: convergence tolerance of 1.000000e-06 not reached during Hybrid Initialization.
Relevance Center: Fine 	# of Cells: 718458 **Simulation Warning**: convergence tolerance of 1.000000e-06 not reached during Hybrid Initialization. **Simulation Error**: Floating Point Exception
Inflation: 10 Layers and 1.2 Growth Rate 	# of Cells: 753280 **Simulation Error**: Floating Point Exception

Inflation: 10 Layers and 2.5 Growth Rate 	# of Cells: 835766 **Simulation Error**: Floating Point Exception
Method: Tetrahedrons and Patch Conforming 	# of Cells: 542503 Drag Force: -7.6128963 Drag Coefficient: -0.25776556 Lift Force: 11.11897 Life Coefficient: 0.37647794 Same results with the **Default Mesh**.
Face Matching for boundary surfaces 	# of Cells: 541291 Drag Force: -8.3986013 Drag Coefficient: -0.28436837 Lift Force: 9.5361404 Life Coefficient: 0.32288432
Face Sizing for Bodyshell Surfaces 	# of Cells: 541110 Drag Force: -8.5204003 Drag Coefficient: -0.28849242 Lift Force: 8.653673 Life Coefficient: 0.2930049

Face Sizing on Bodyshell Surfaces + Inflation: **Maximum 10 Layers and 1.2 Growth Rate** 	# of Cells: 752754 Drag Force: -7.8827652 Drag Coefficient: -0.26690269 Lift Force: 7.2710853 Life Coefficient: 0.24619181
Face Sizing on Bodyshell Surfaces + Inflation: **Maximum 20 Layers and 1.2 Growth Rate** 	# of Cells: 1043913 **Simulation Error**: Out of Memory
Face Sizing on Bodyshell Surfaces + Inflation: **Maximum 10 Layers and 2.5 Growth Rate** 	# of Cells: 834700 **Simulation Error**: Floating Point Exception
Face Sizing on Bodyshell Surfaces + Inflation: **Maximum 15 Layers and 1.2 Growth Rate**	# of Cells: 901563 **Simulation Error**: Out of Memory
Face Sizing on Bodyshell Surfaces + Inflation: **Maximum 10 Layers and 1.5 Growth Rate**	# of Cells: 800910 **Simulation Error**: Floating Point Exception

Face Sizing on Bodyshell Surfaces + Inflation: Maximum 10 Layers and 1.2 Growth Rate + Face Matching on Boundary Surfaces + Method: Tetrahedrons 	# of Cells: 751624 Drag Force: -7.4444113 Drag Coefficient: -0.25206053 Lift Force: 7.5327256 Life Coefficient: 0.25505077

End