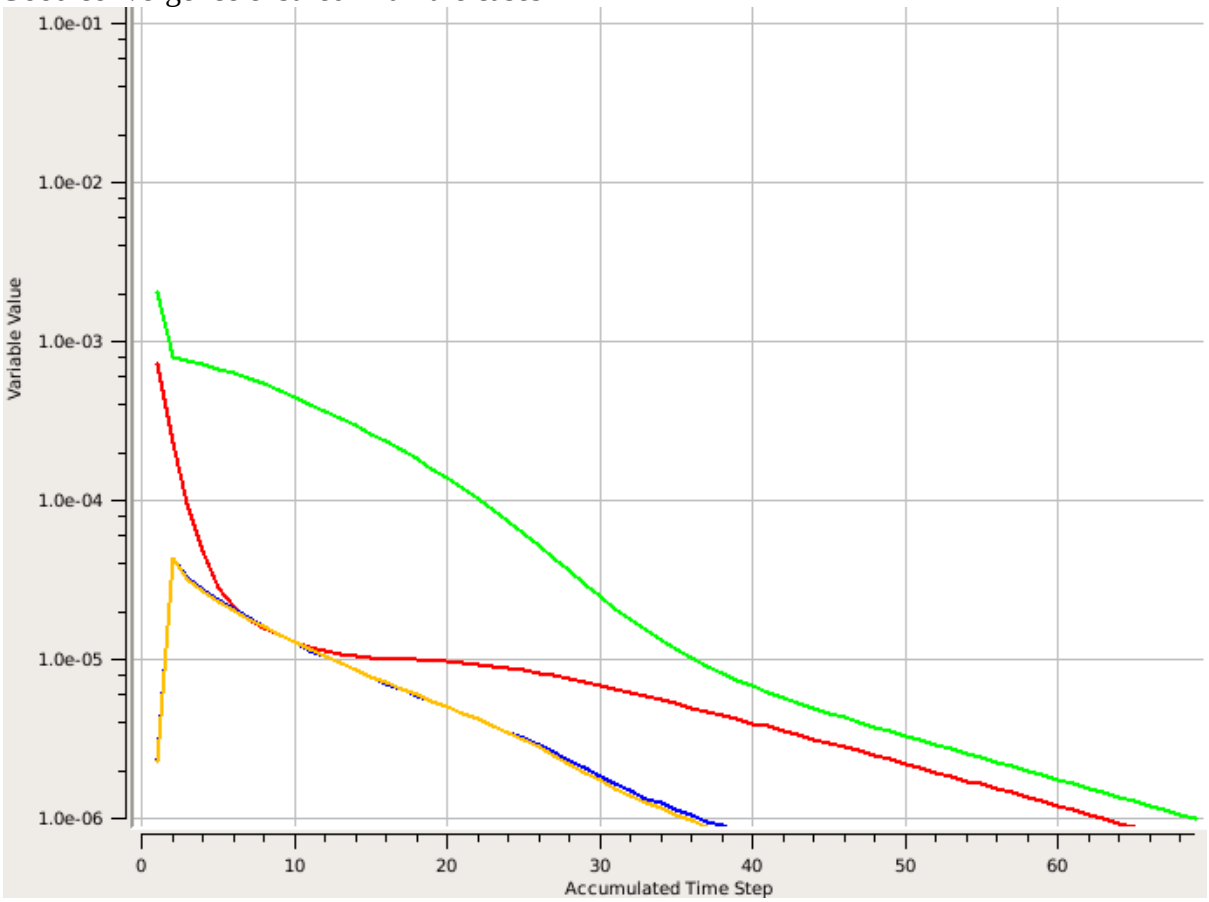
Effect of mesh type and size: Pipe Flow

This is a very interesting simulation using a classic case of developing flow in a circular pipe (one of the most widely investigated and taught flow types).

- A very high level of convergence have been ensured (very low level of residuals) to ensure that machine and convergence error are minimized to insignificant levels.
- *The key highlight is the velocity profile in the boundary layer when calculations were performed using tetrahedrons and the prisms. Note the zig-zag pattern in case of tetrahedrons.*
- The investigation into the cause(s) of such variations and pattern is left to the interested analysts and cfdyna.com would be keen to hear from them.

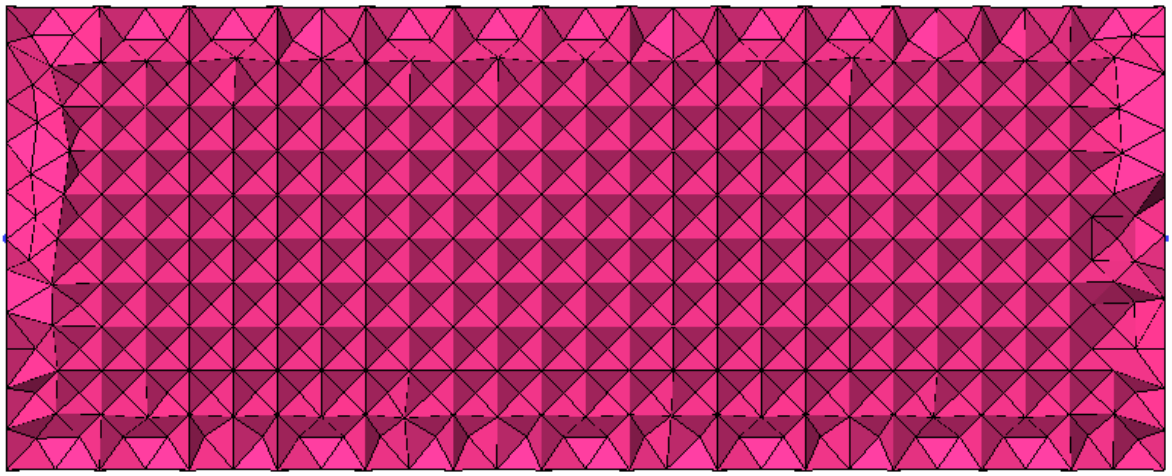
Convergence

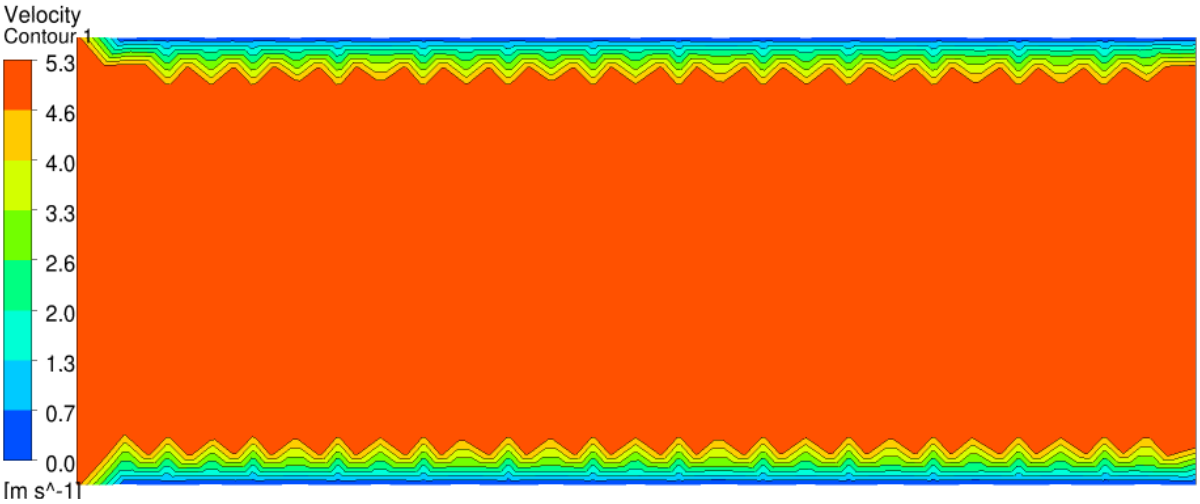
Good convergence ensured in all the cases

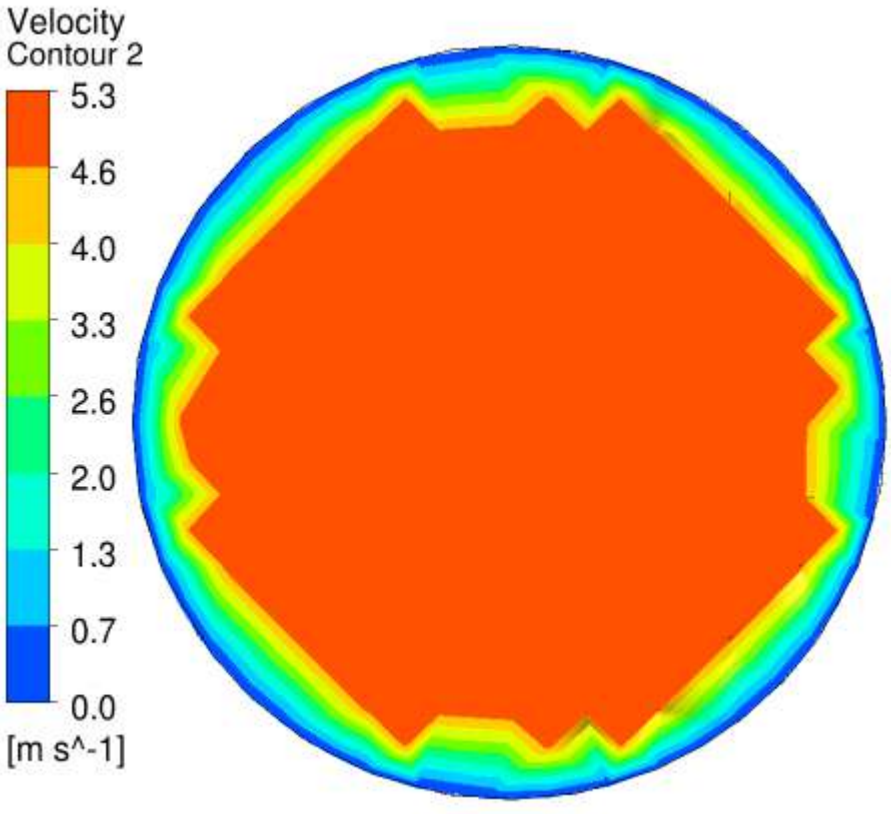


Coarse Mesh:

Uniform Tetrahedrons with maximum size of 2 mm

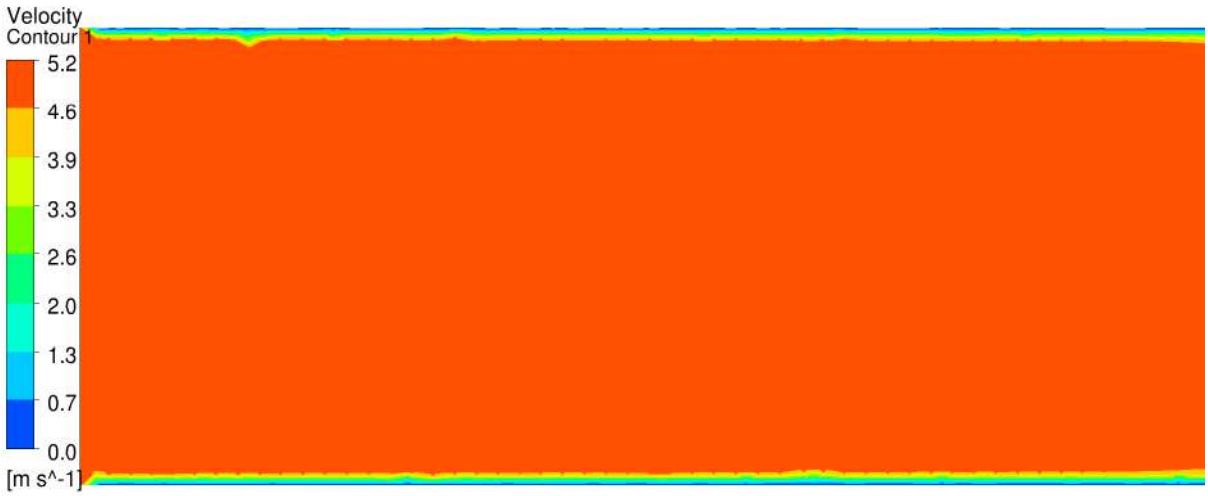


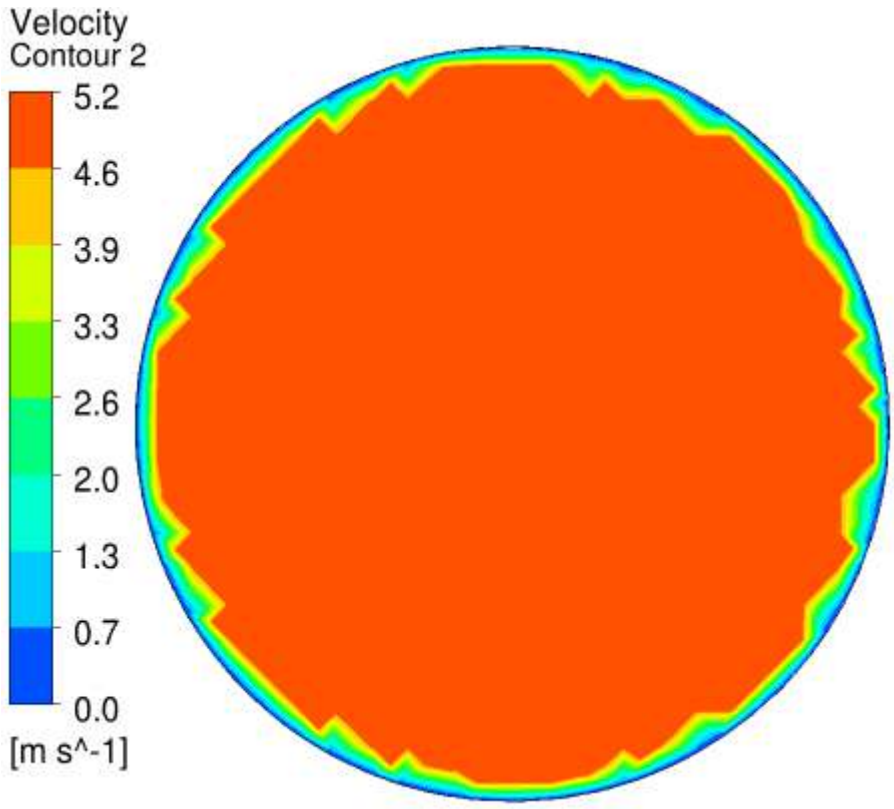

Velocity
Contour 1
5.3
4.6
4.0
3.3
2.6
2.0
1.3
0.7
0.0
[m s^-1]

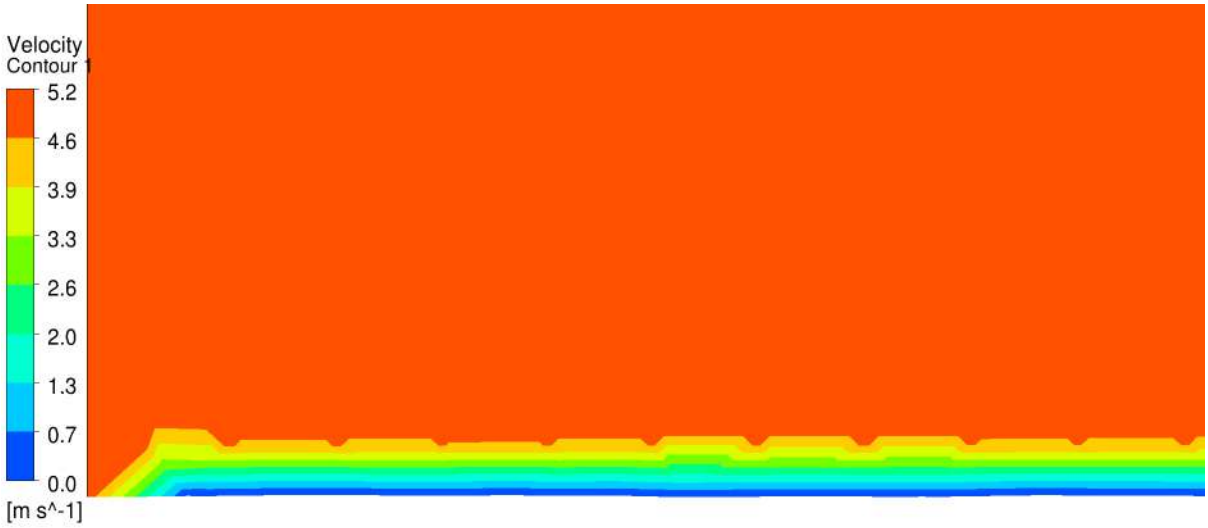

Velocity
Contour 2
5.3
4.6
4.0
3.3
2.6
2.0
1.3
0.7
0.0
[m s^-1]

Fine Mesh:

Uniform Tetrahedrons with maximum size of 1 mm

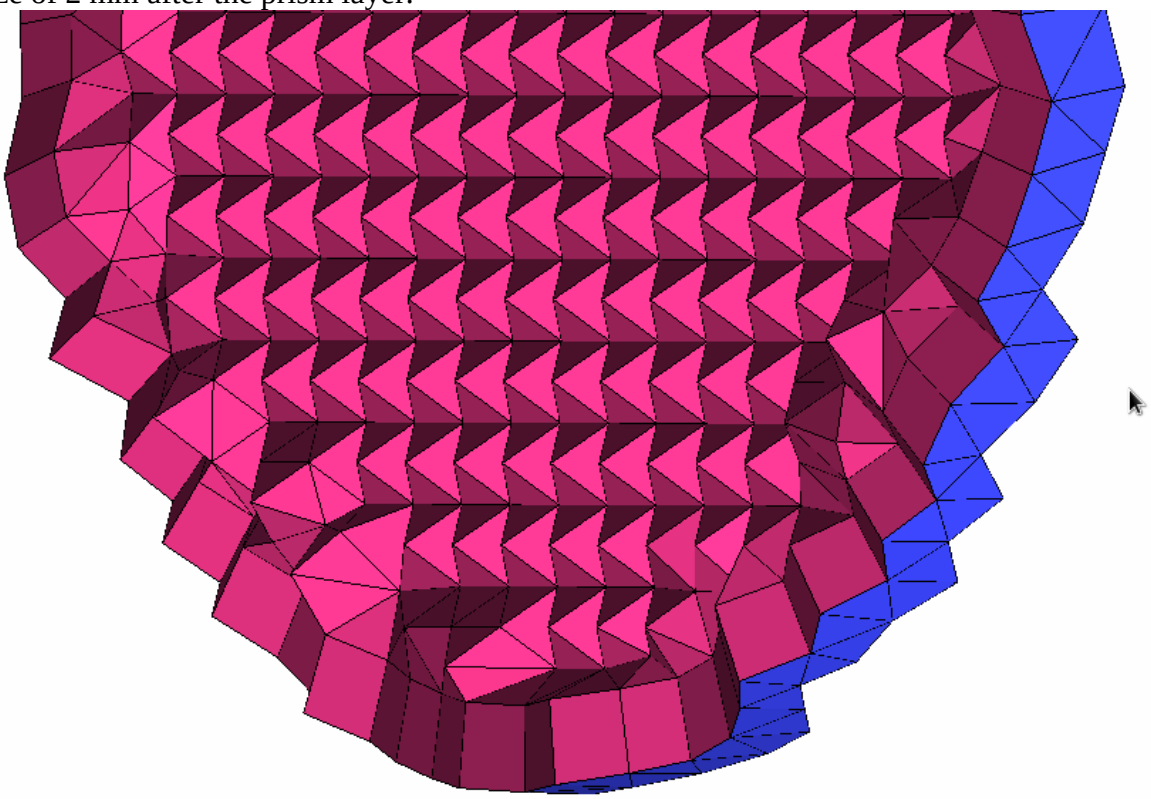


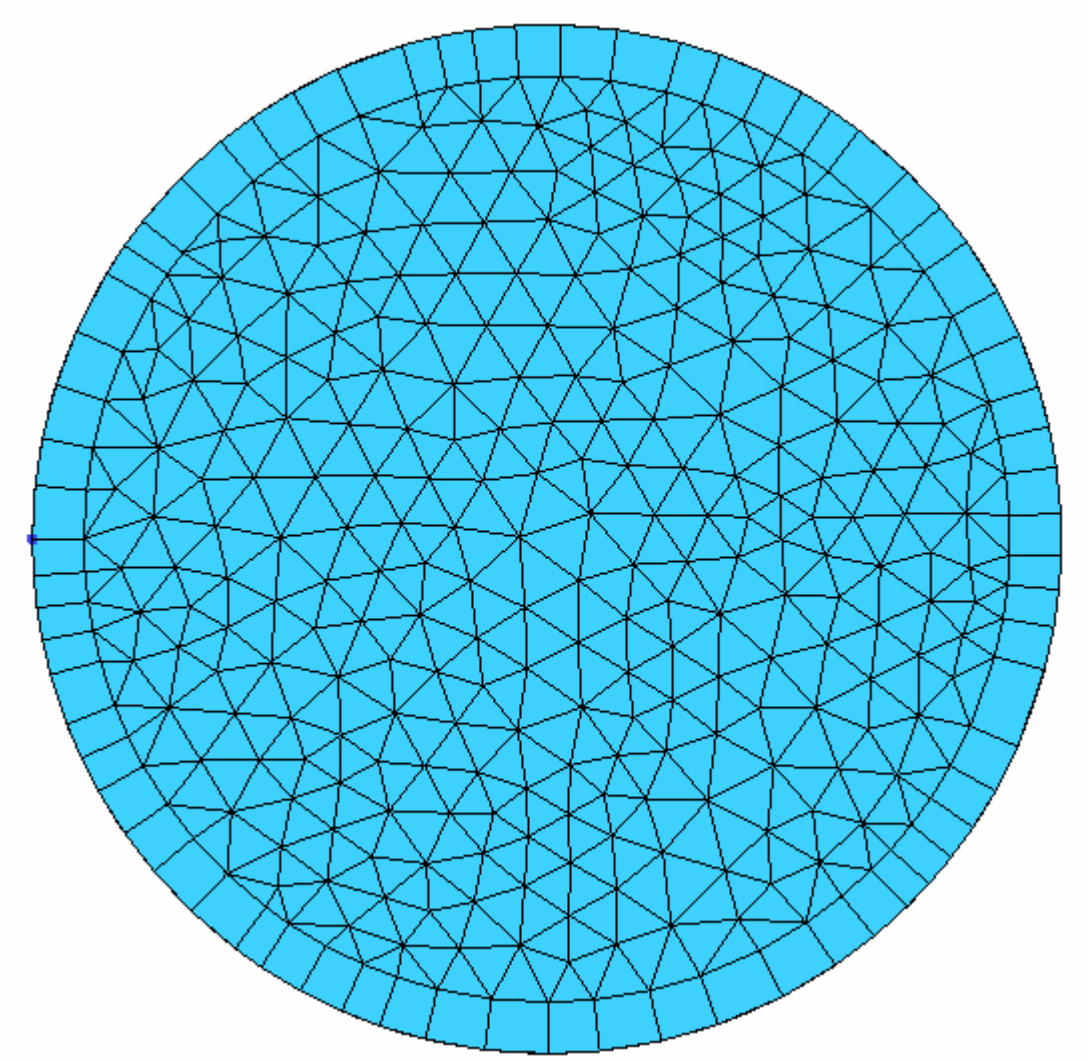


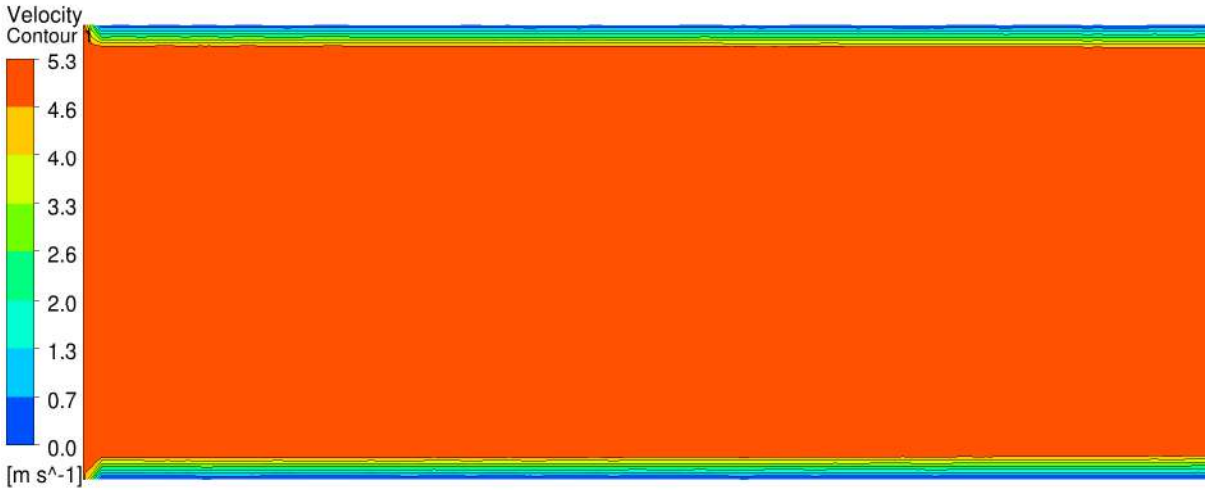


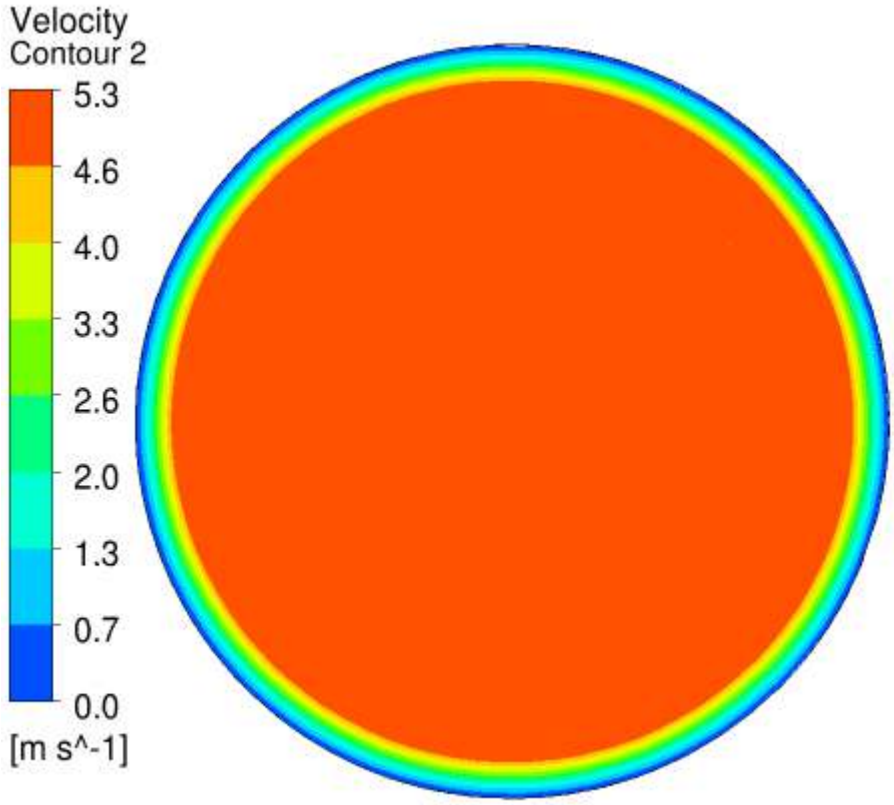
Prism Mesh in Boundary Layer

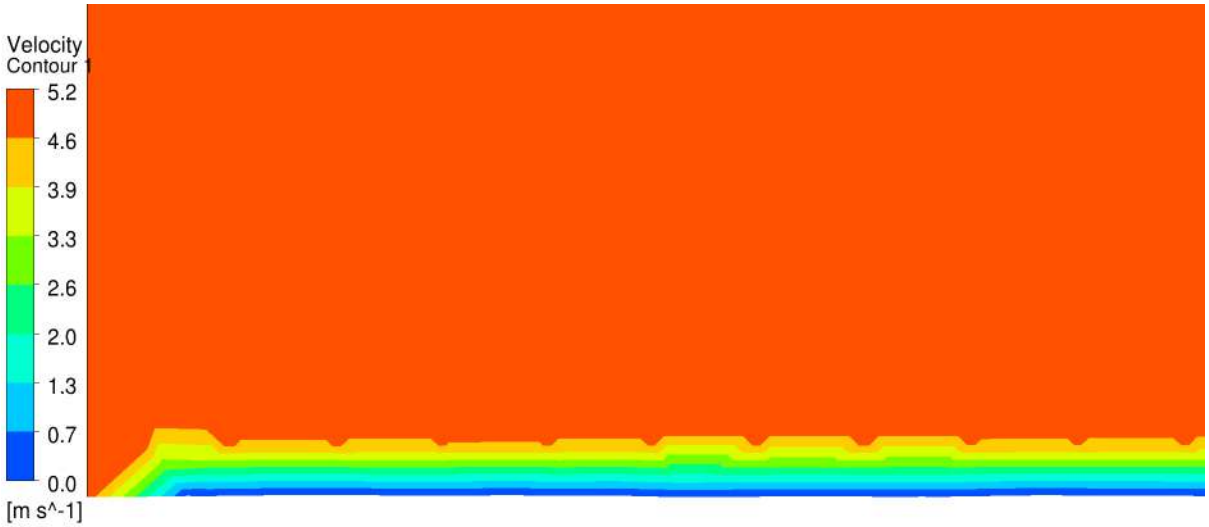
Prism layer height 2 mm and number of layers is 1, uniform Tetrahedrons with maximum size of 2 mm after the prism layer.





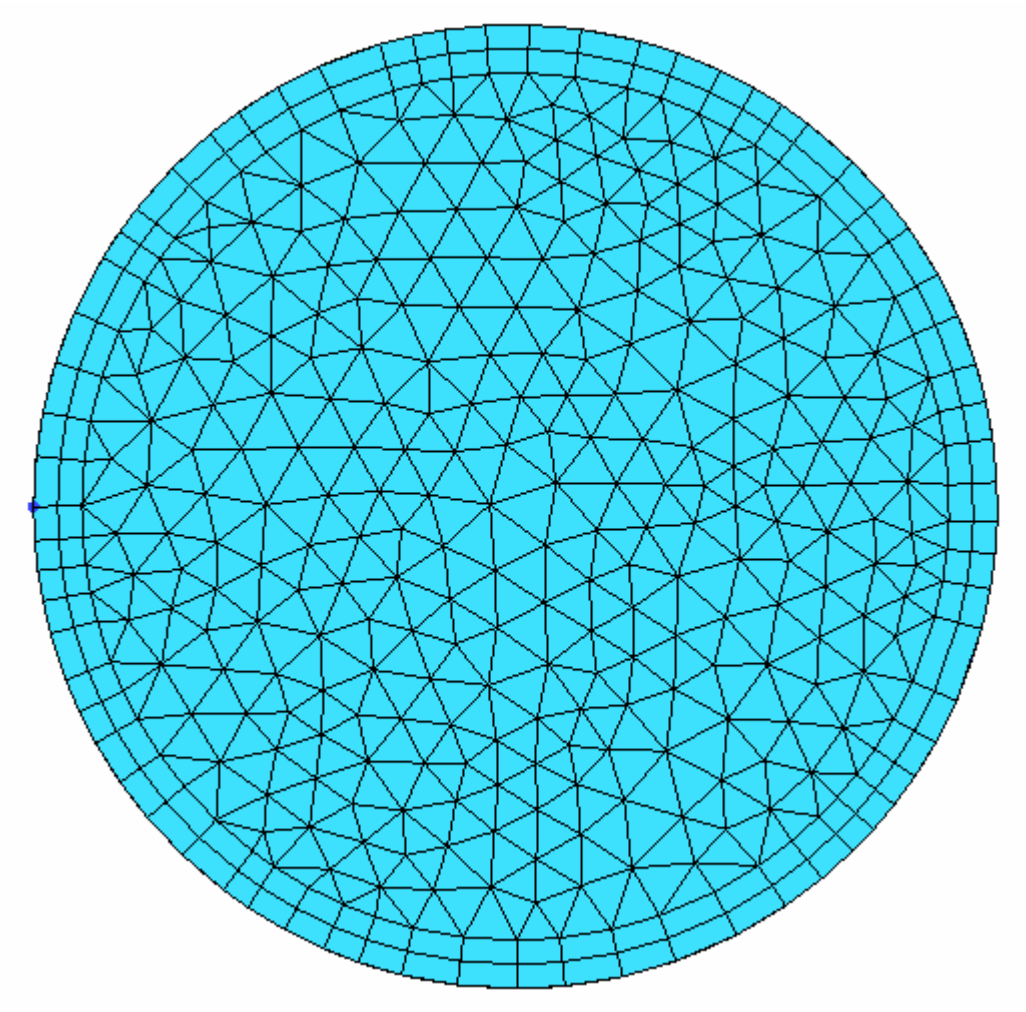

Velocity
Contour
5.3
4.6
4.0
3.3
2.6
2.0
1.3
0.7
0.0
[m s^-1]

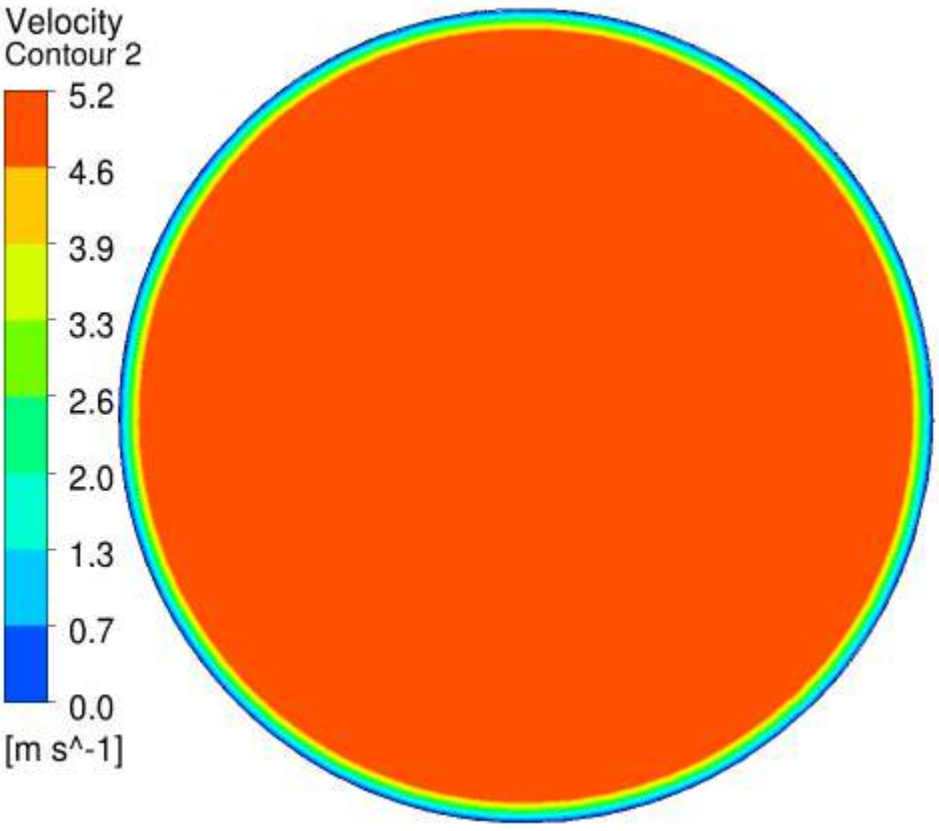


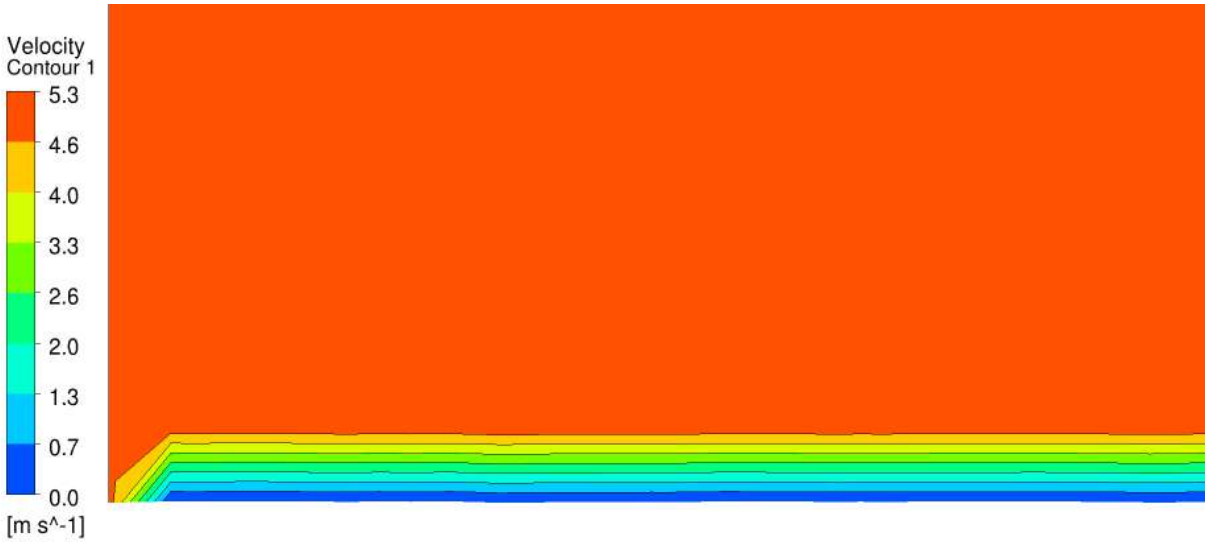


Prism Mesh in Boundary Layer

Prism layer height 1 mm and number of layers is 2 created by splitting the first layer used in previous section, uniform tetrahedrons with maximum size of 2 mm after the prism layers.




Velocity
Contour 2
5.2
4.6
3.9
3.3
2.6
2.0
1.3
0.7
0.0
[m s^-1]


Velocity
Contour 1
5.3
4.6
4.0
3.3
2.6
2.0
1.3
0.7
0.0
[m s^-1]