

MAE 560

Applied CFD

Project-3

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Name	Task	Collaboration
Anurudh Kamma	Task 2	Geometry
Anurudh Kamma	Task 3	Table Calculation

Task – 1

a)

(D1) The Reynold's Number can be given from

$$Re = \frac{\rho v D}{\mu}$$

Here we know that the Diameter of the circle is 4 cm i.e

$$D = 0.04 \text{ m}$$

The density of the water is $\rho = 998.2 \frac{\text{kg}}{\text{m}^3}$

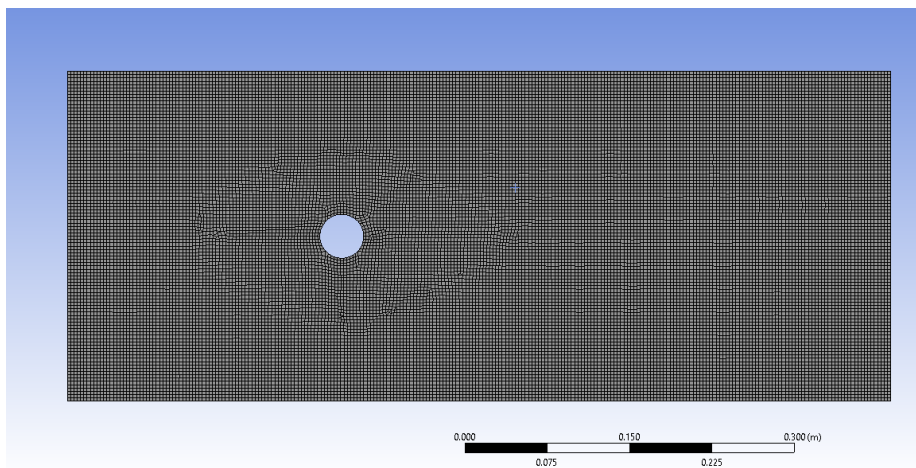
The velocity of the stream is $v = 0.025 \text{ m/s}$

The dynamic viscosity of water is $\mu = 0.001003 \frac{\text{kg}}{\text{m s}}$

So, the Reynold's Number is $Re = 995.214$

(D2)

A 2-D cylinder is created on a plane with a diameter of 4 cm and the origin as the center. A computational domain is also created around the cylinder with the given dimensions as shown in the figure 1.1 below and is meshed with 3mm element size.



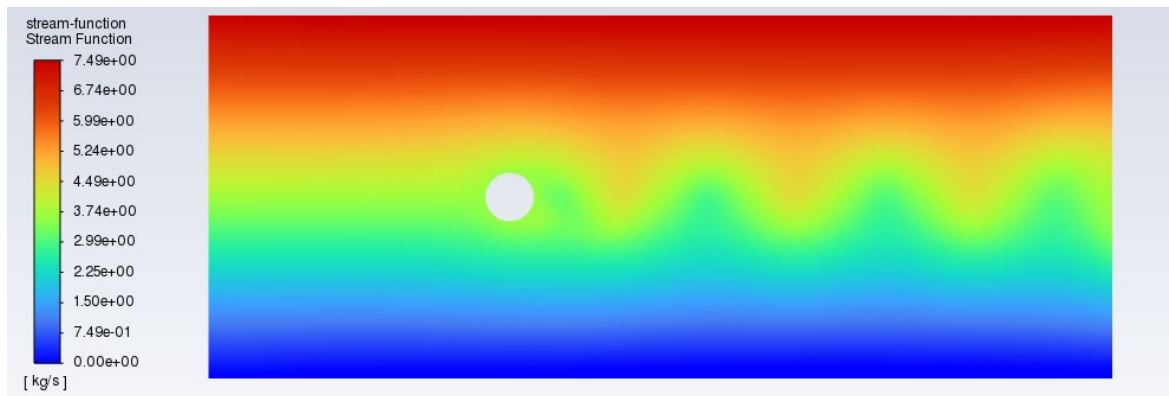
Time Advancement	
Type	Method
Fixed	User-Specified
Parameters	
Number of Time Steps	Time Step Size [s]
12000	0.00999999776483
Max Iterations/Time Step	Reporting Interval
20	1
Profile Update Interval	
1	

Details of "Mesh"	
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	CFD
Solver Preference	Fluent
Element Order	Linear
<input type="checkbox"/> Element Size	3.e-003 m
Export Format	Standard

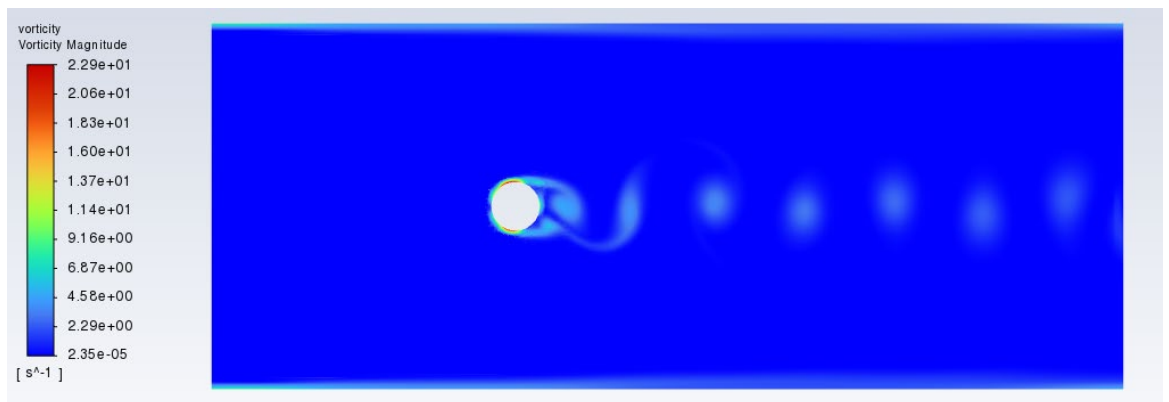
Statistics	
<input type="checkbox"/> Nodes	25280
<input type="checkbox"/> Elements	24914

D3)

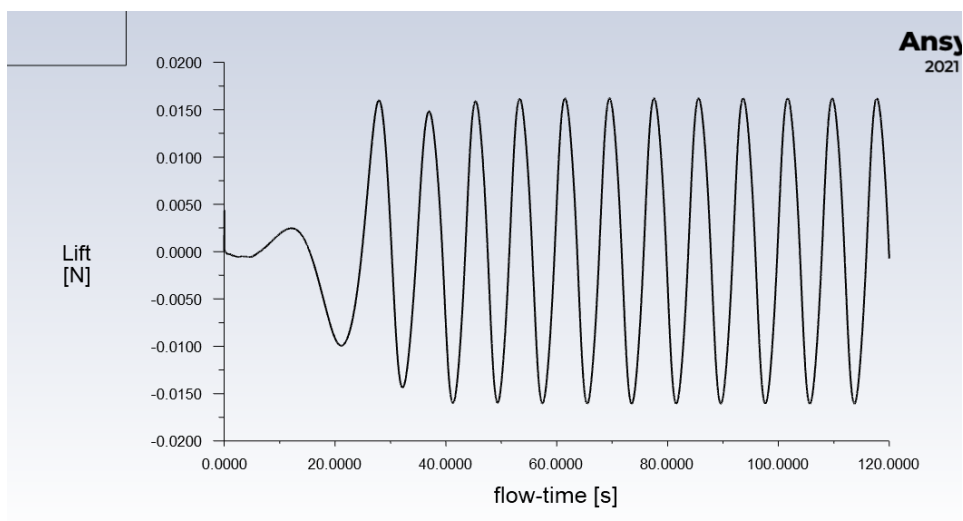
Stream function Contour:



Vorticity Magnitude Contour

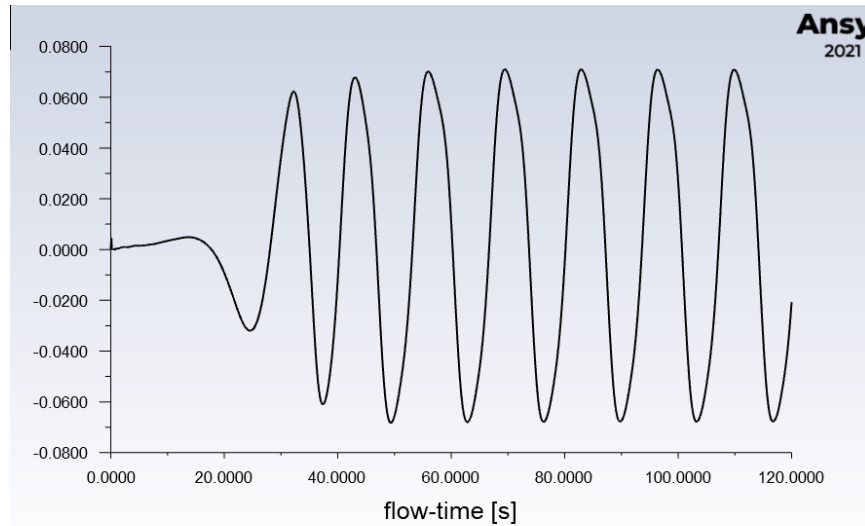


Lift Force Plot: The maximum and the minimum values of lift are 0.165 N and 0.1 N



b)
D5)

Lift Force Plot for Run1: The maximum and the minimum values of lift are 0.071 N and 0.062 N



Lift Force Plot for Run2: The maximum and the minimum values of lift are 0.026 N and 0.037 N

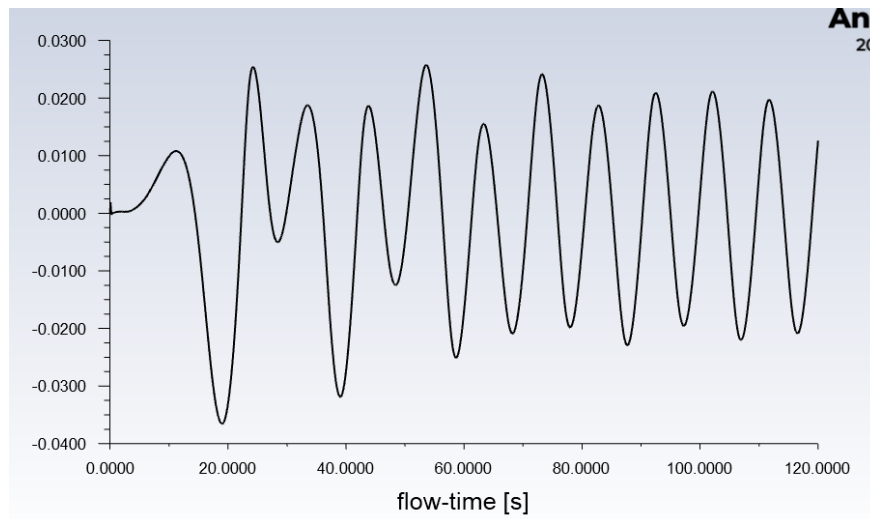
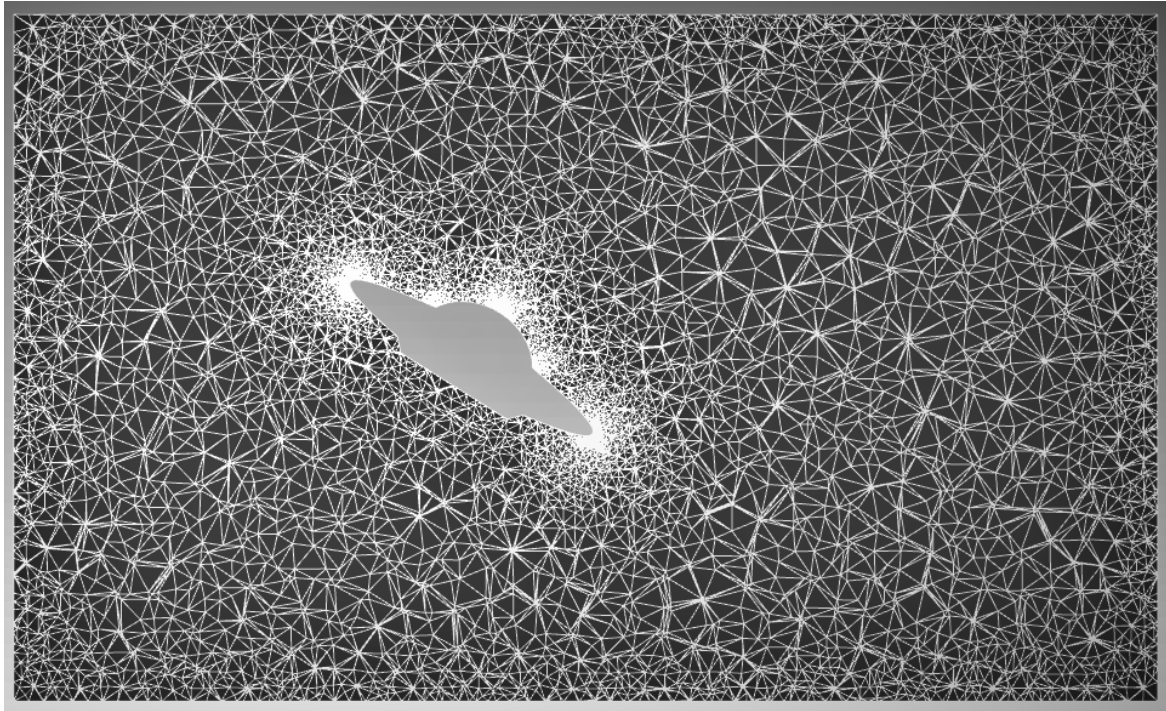


Table for amplitude and Time Period for all the above Lift Force Plots:

	Amplitude	Period (in sec)
Circular Cylinder	0.142	9.3
Run 1	0.0675	12.2
Run 2	0.0415	9.6

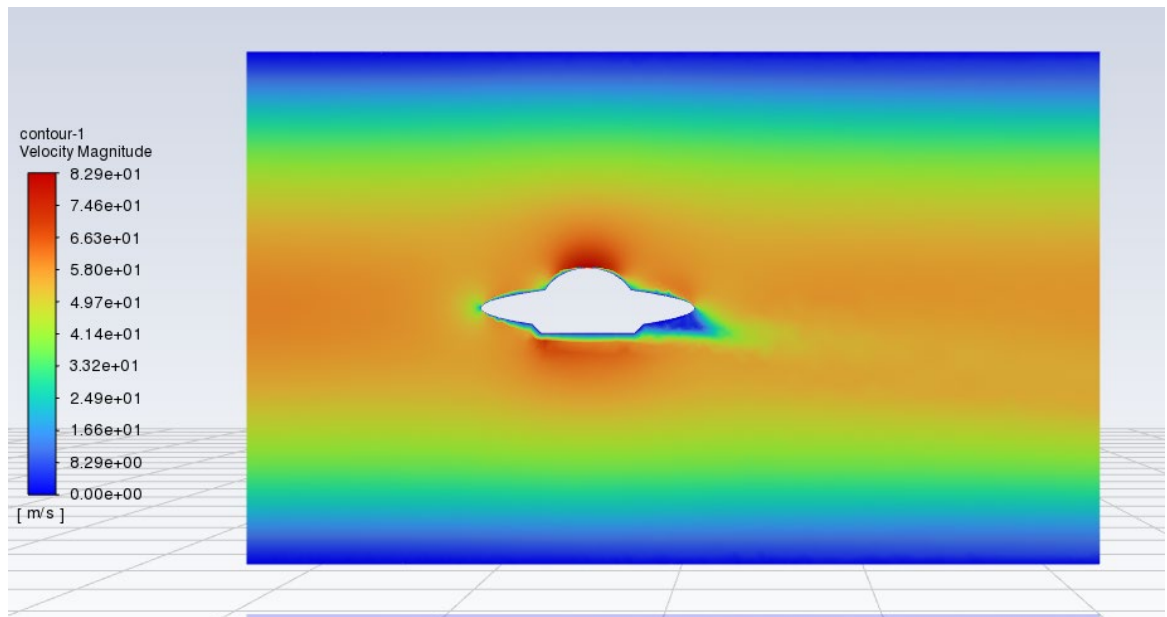
Task 2:

D6) Mesh along the plane of symmetry

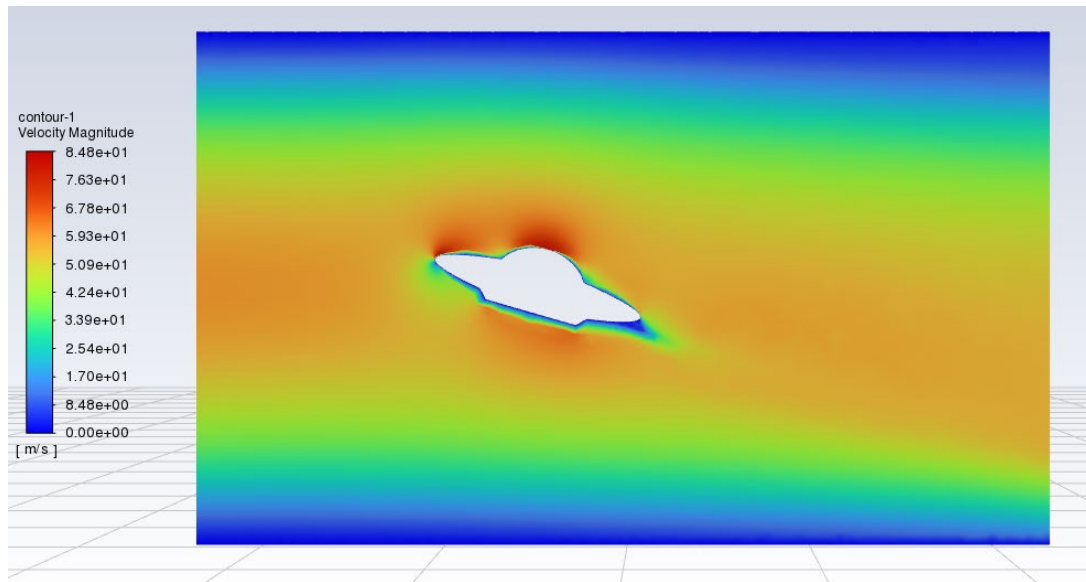


D7) X-Velocity Contour on the plane of symmetry for

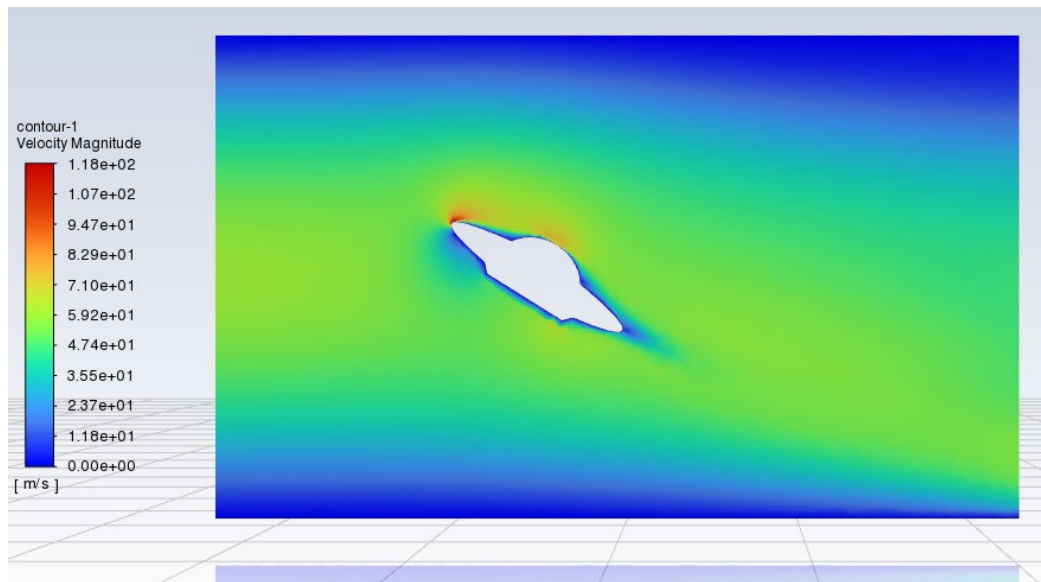
a) $\theta = 0^\circ$



b) $\theta = 16^\circ$



c) $\theta = 32^\circ$



D8)

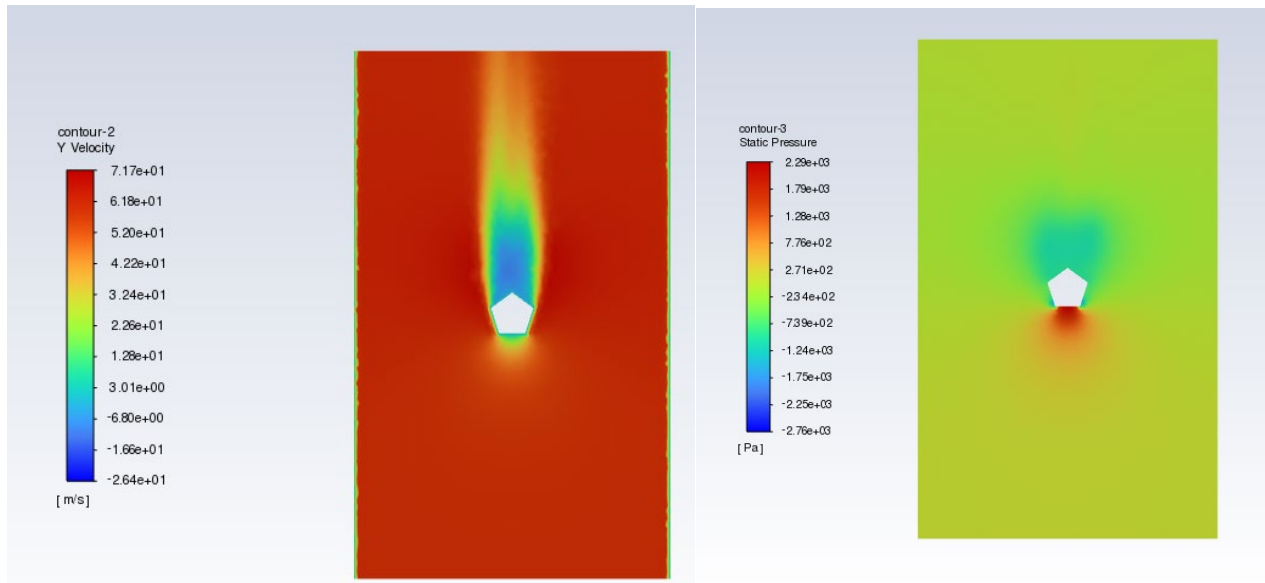
The values of lift force and drag force as a function of tilt angle is given in the table below:

	Lift Force(N)	Drag Force (N)
$\theta = 0^\circ$	19	11
$\theta = 16^\circ$	85	36.5
$\theta = 32^\circ$	122	116.5

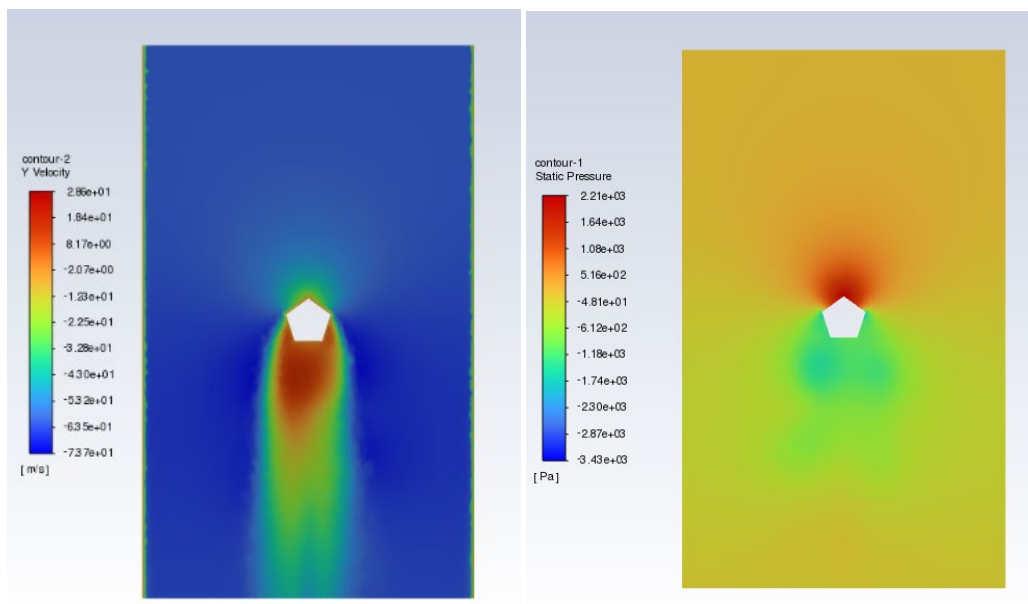
Task 3:

D9) The Static Pressure and the y-velocity plots on the horizontal plane with $z=1.25\text{m}$ for Run1 and Run2 are given respectively:

For Run 1:



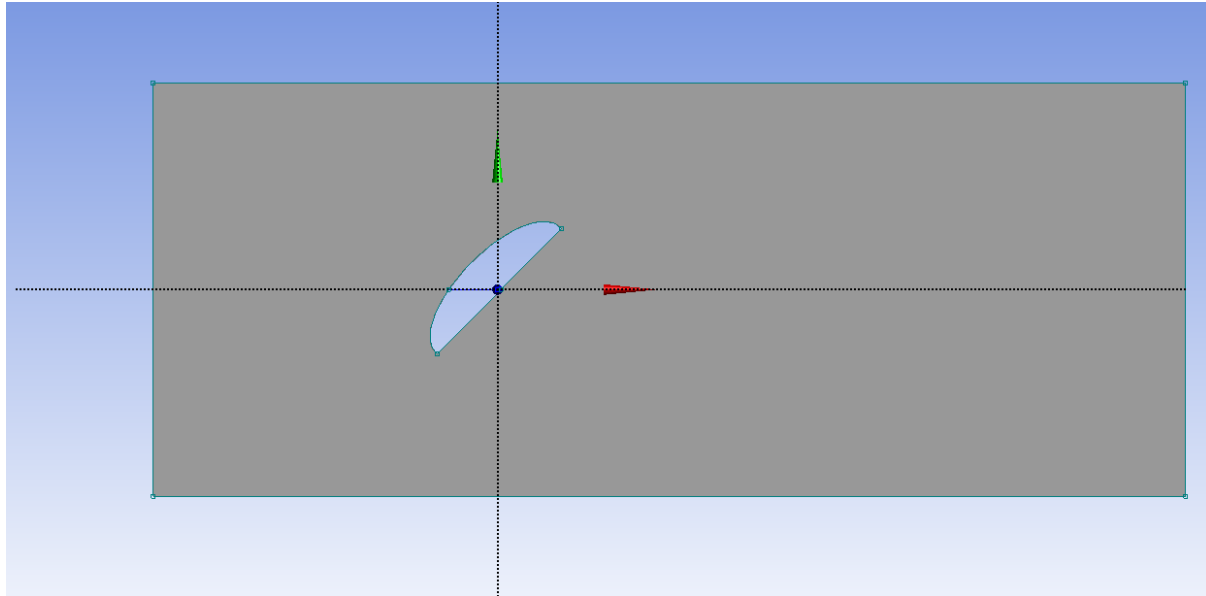
For Run 2:



D10)

	Total Drag (N)	Pressure term of drag (N)	Viscous Term of drag (N)
Run 1	5434.392919	5428.598633	5.7942858
Run 2	8963.54665	8955.75293	7.7937202

D11) The geometry for the design of asymmetric cylinder is given below:



D12) The plot of lift force vs time from transient simulation is given below

