COMPLEX ENGINEERING PROBLEM

ME – 2303 Fluid Mechanics – II
Spring 2022

Due Date: 07th July, 2022

Problem Description

You are a fresh aerodynamics engineer hired in an automotive OEM. You work with design and systems engineering team that is currently working on the exterior shape design for its upcoming subcompact hatchback electric vehicle. The main objective of exterior design is to minimize the drag and lift of EV while running at 130 km/h, so as to gain endurance for a particular capacity of battery pack and maintain drive stability at this speed.

Given in the figure below are the envelope constraints due to occupants and car systems. The maximum length (L_{max}) and height (H_{max}) of the EV should not exceed 3.7m and 1.6m respectively. The wheelbase (L_1) is fixed to **2.6m**. The location of point P_1 which is the junction of bonnet and windscreen is fixed.

The EV is of hatchback configuration, which can employ spoilers. You have to provide the 2D profile of the EV which gives minimum drag and lift. You can use the numerical tools for its determination. Explain and justify your finalized 2D profile with the help of post-processed results.

Submit along with your report the files of simulations.

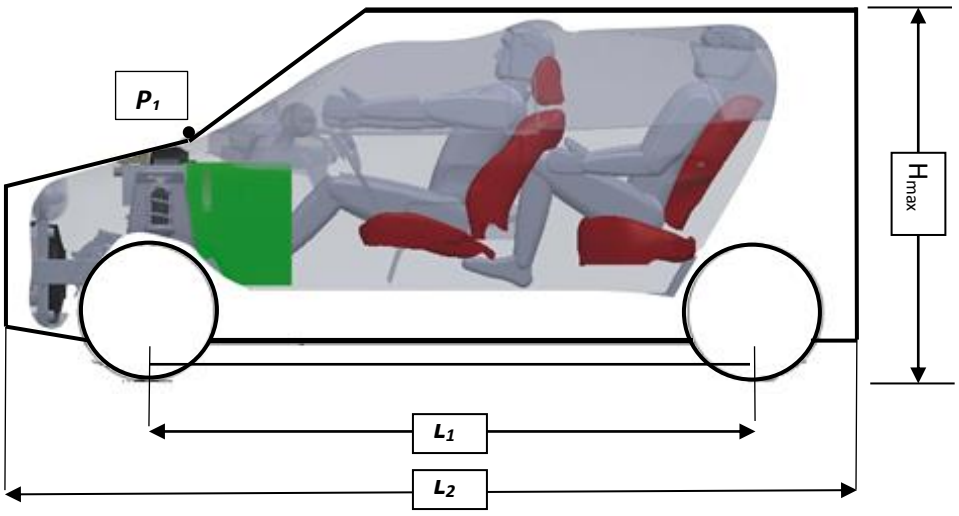


Figure 1: The envelope constraint for the hatchback EV

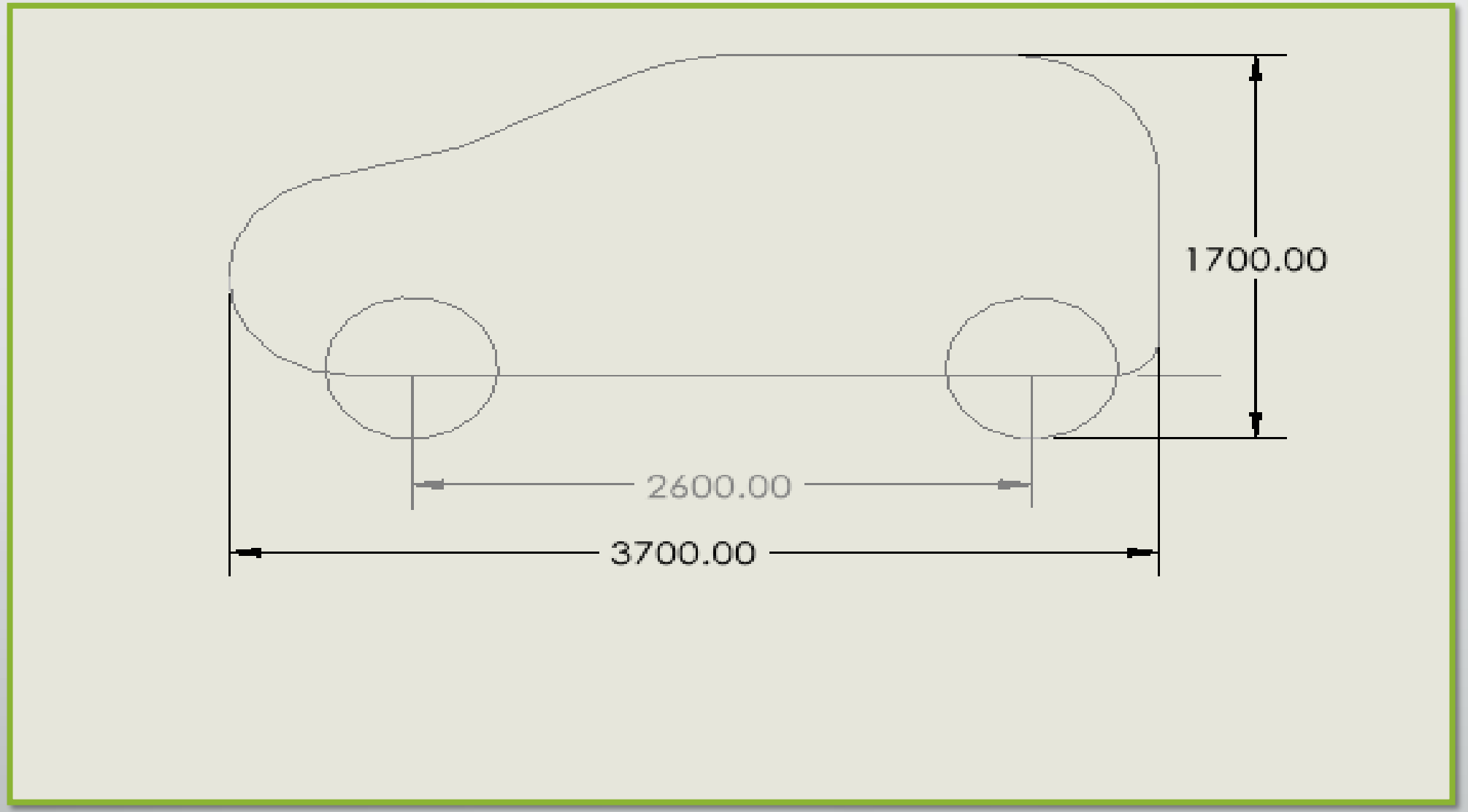
Complex Engineering Problem (CEP)

Group Members:

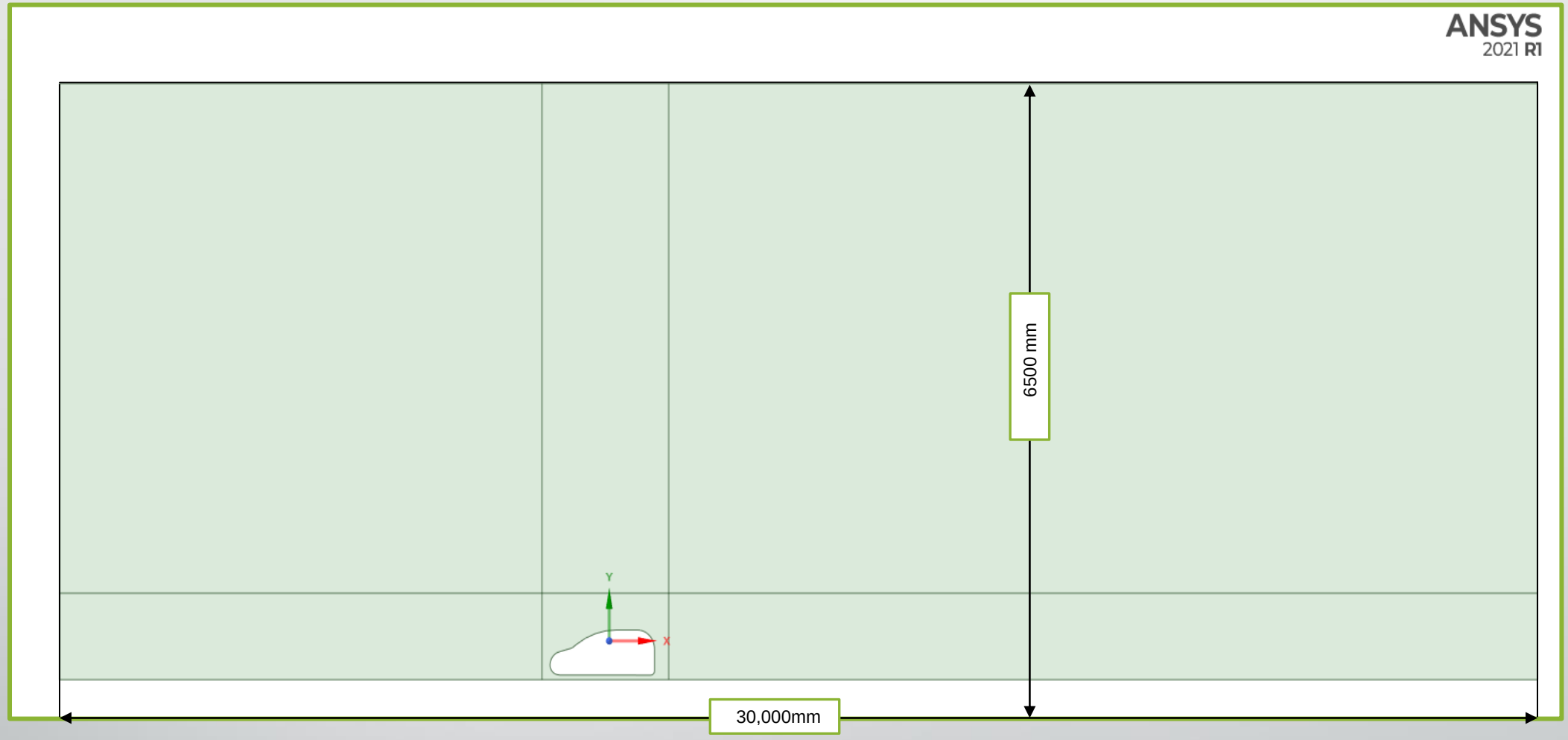
Kamil Rasheed Siddiqui ME-201024

Syed Ali Abbas ME-201018

2D Profile Sketch



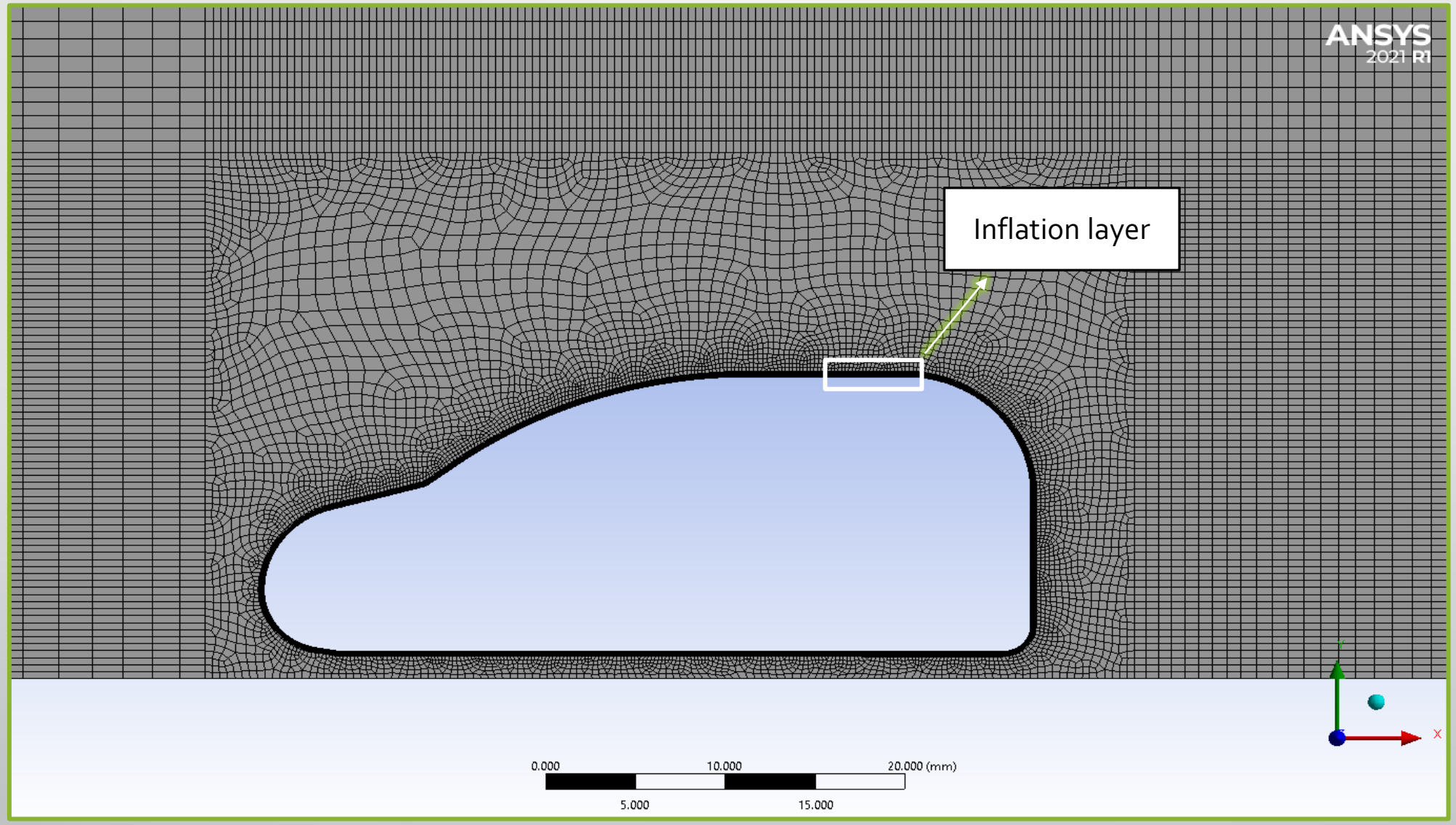
Enclosure



Length: 33,000 mm

Width:6500 mm

Mesh Settings



Settings

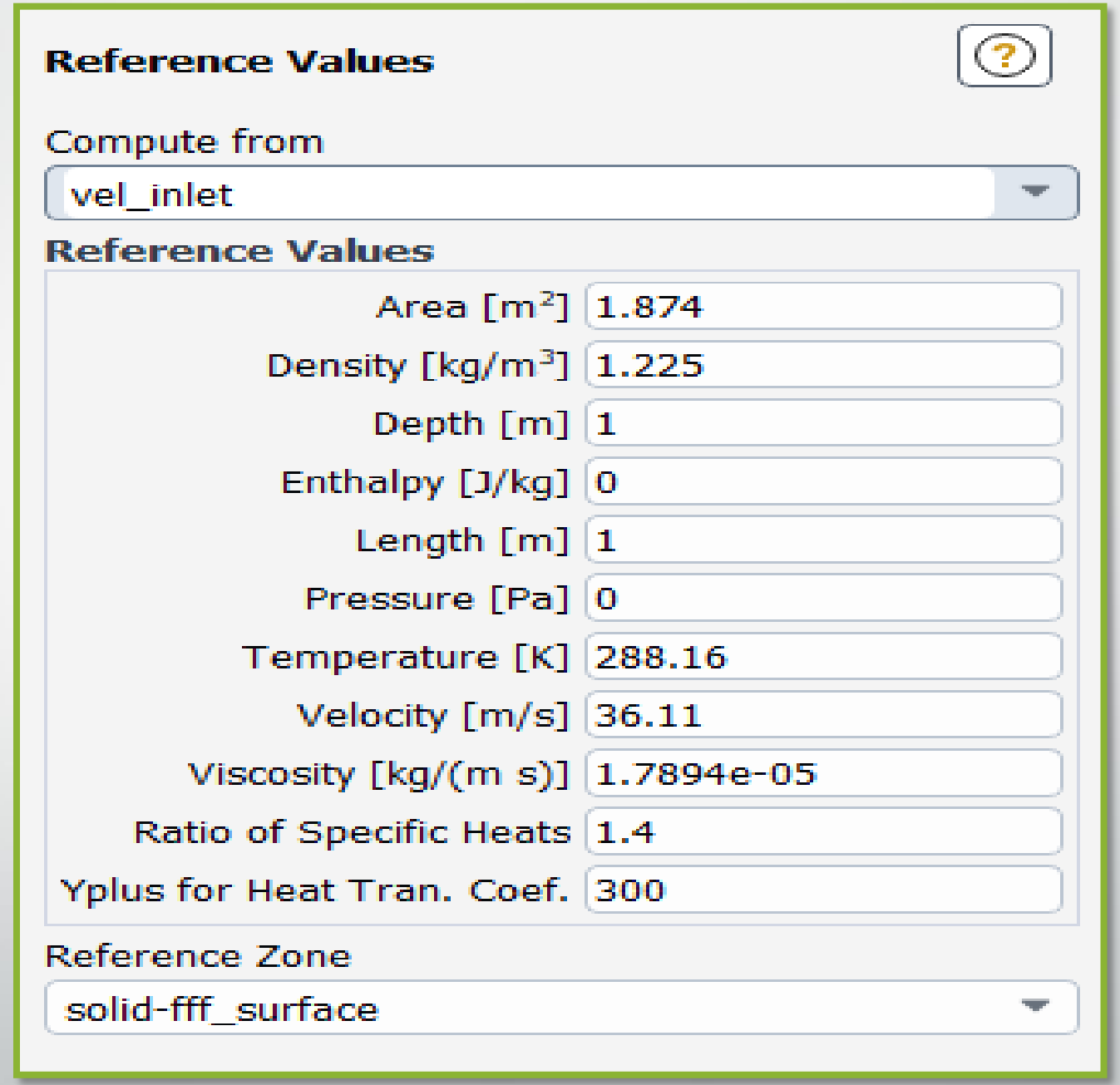
Viscous Model:

- K-epsilon
- Realizable
- Standard wall functions

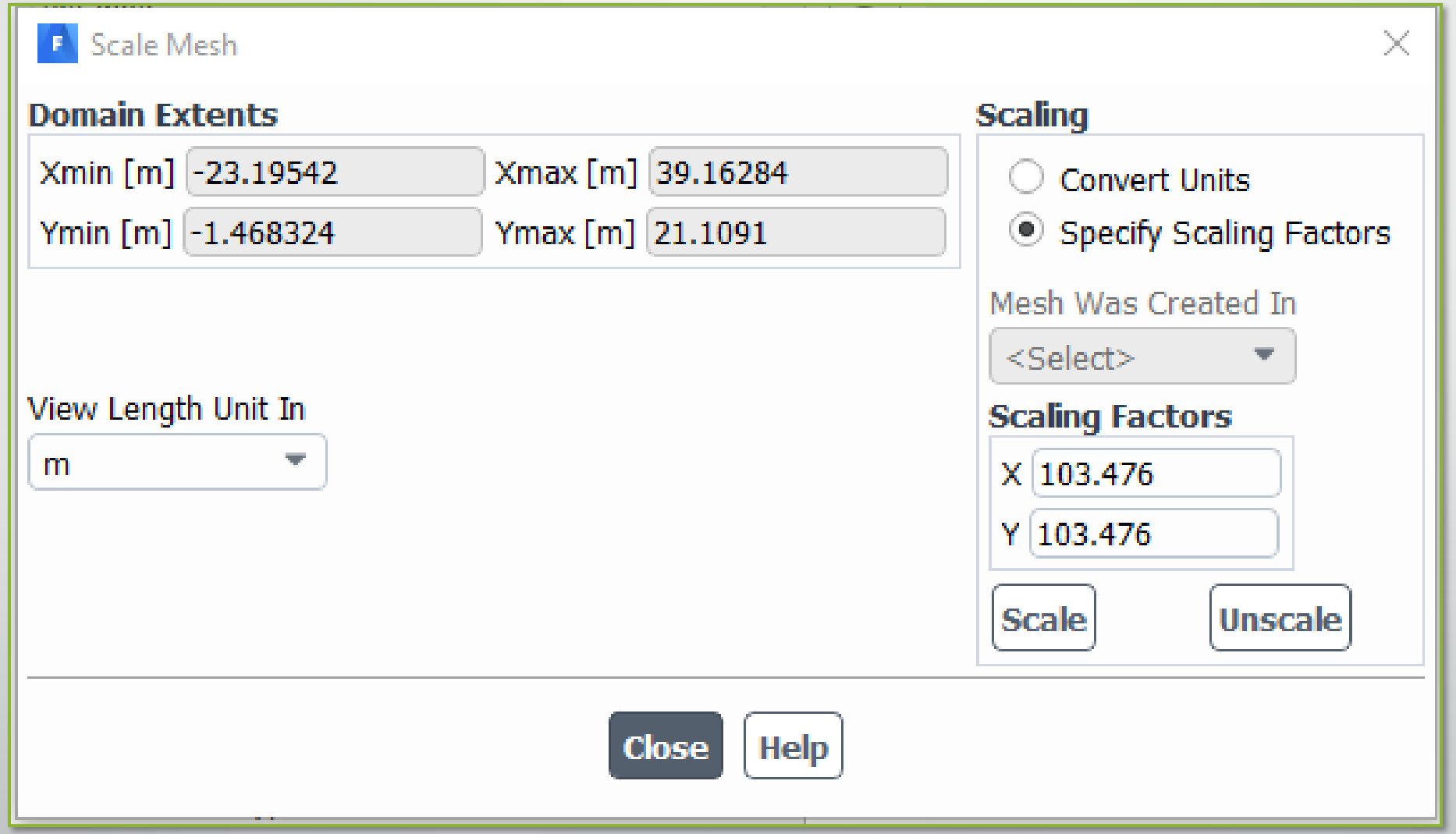
Velocity magnitude: 36.111 m/s

Area: 1.874 m^2

Density: 1.225 kg/m^3



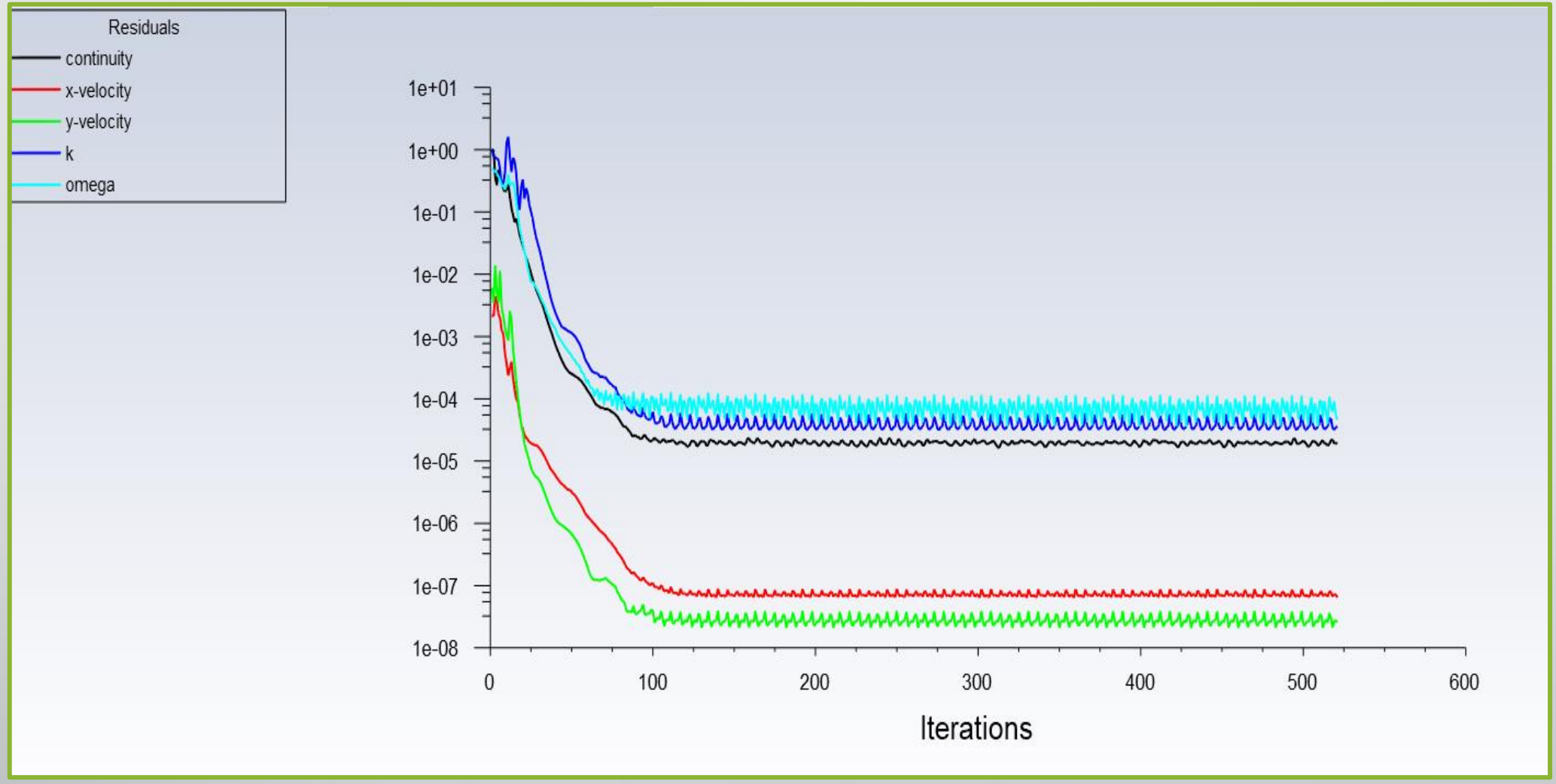
Scaling Factor



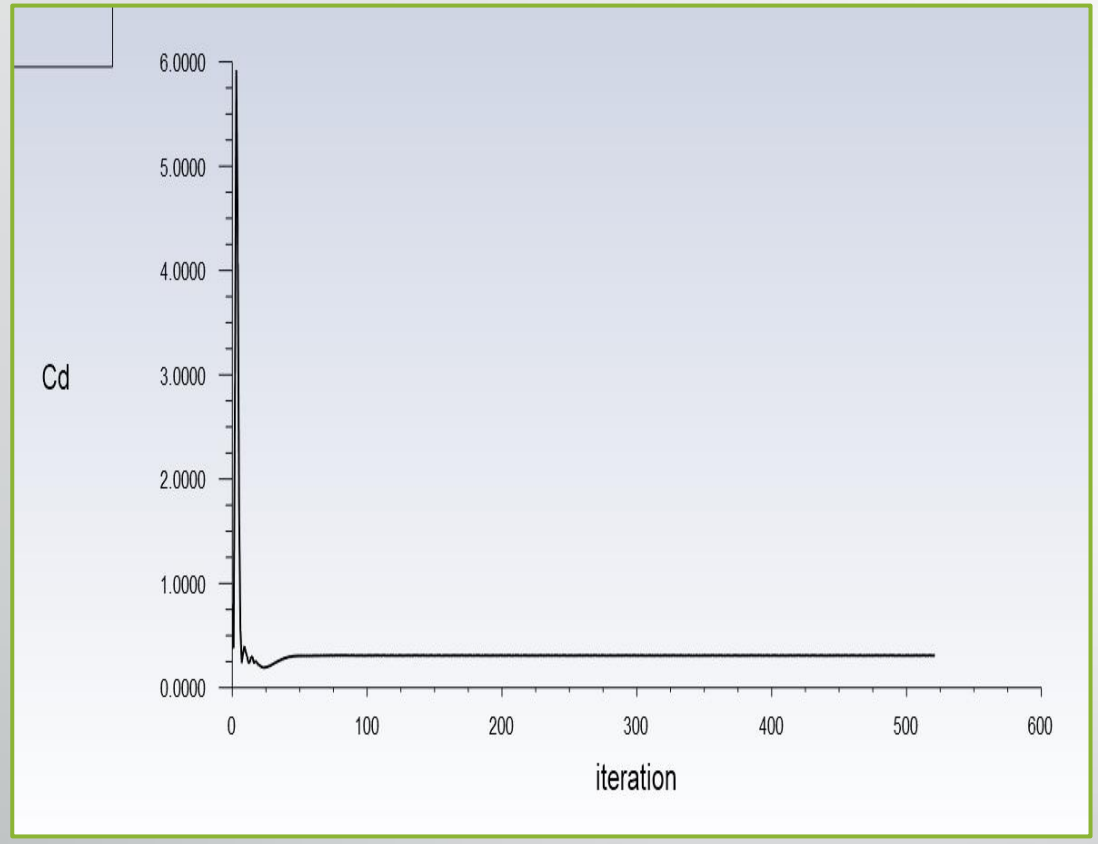
X-Axis: 103.476

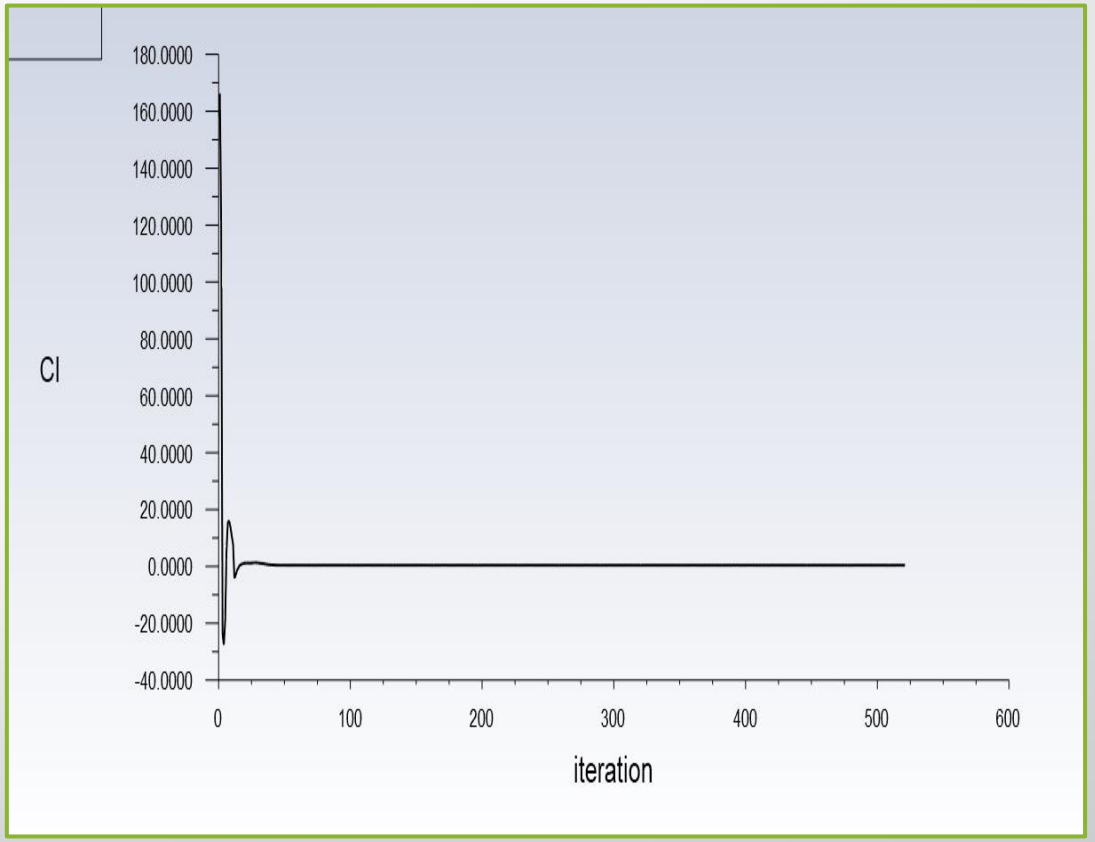
Y-Axis: 103.476

Iterations


Residuals
continuity
x-velocity
y-velocity
k
omega
1e+01
1e+00
1e-01
1e-02
1e-03
1e-04
1e-05
1e-06
1e-07
1e-08
0
100
200
300
400
500
600
Iterations

Coefficient of Drag and Lift

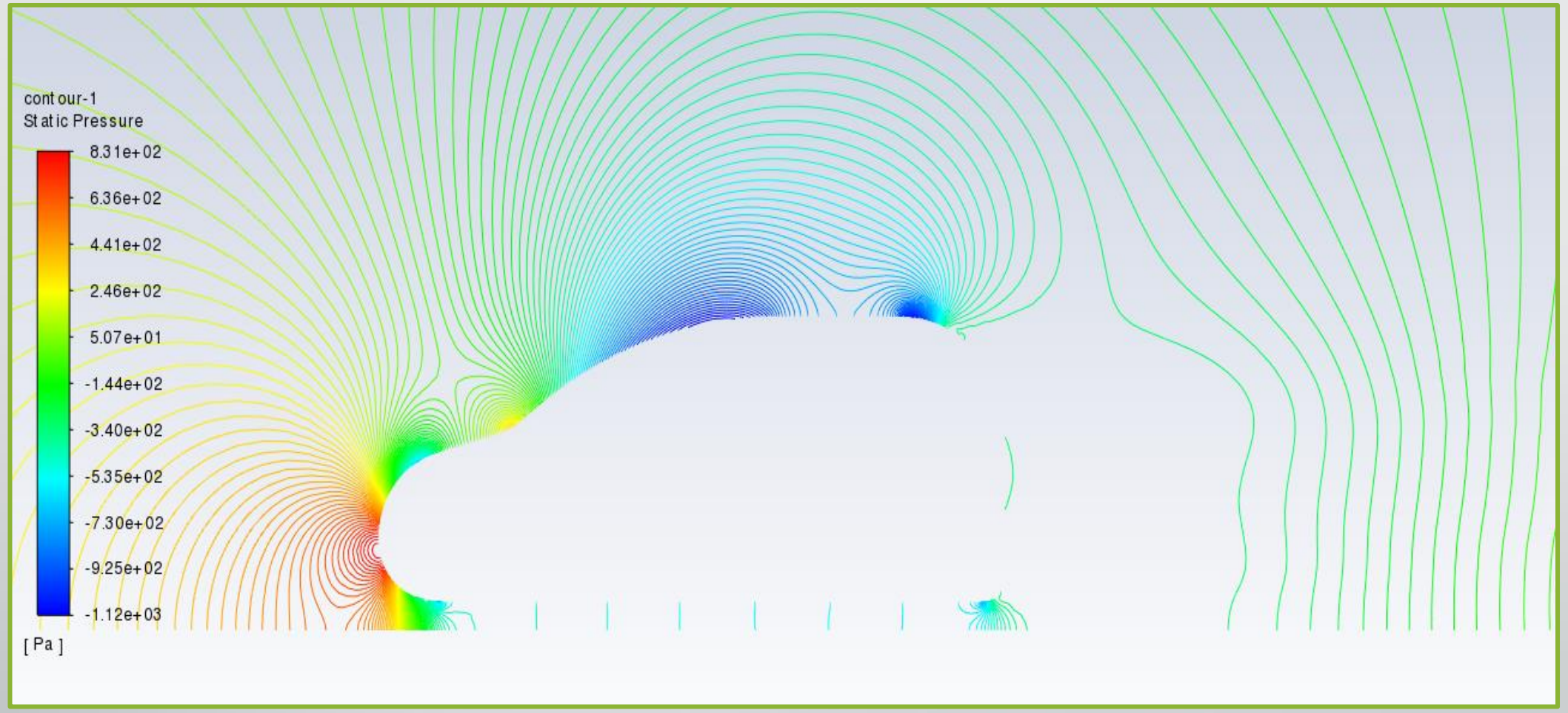




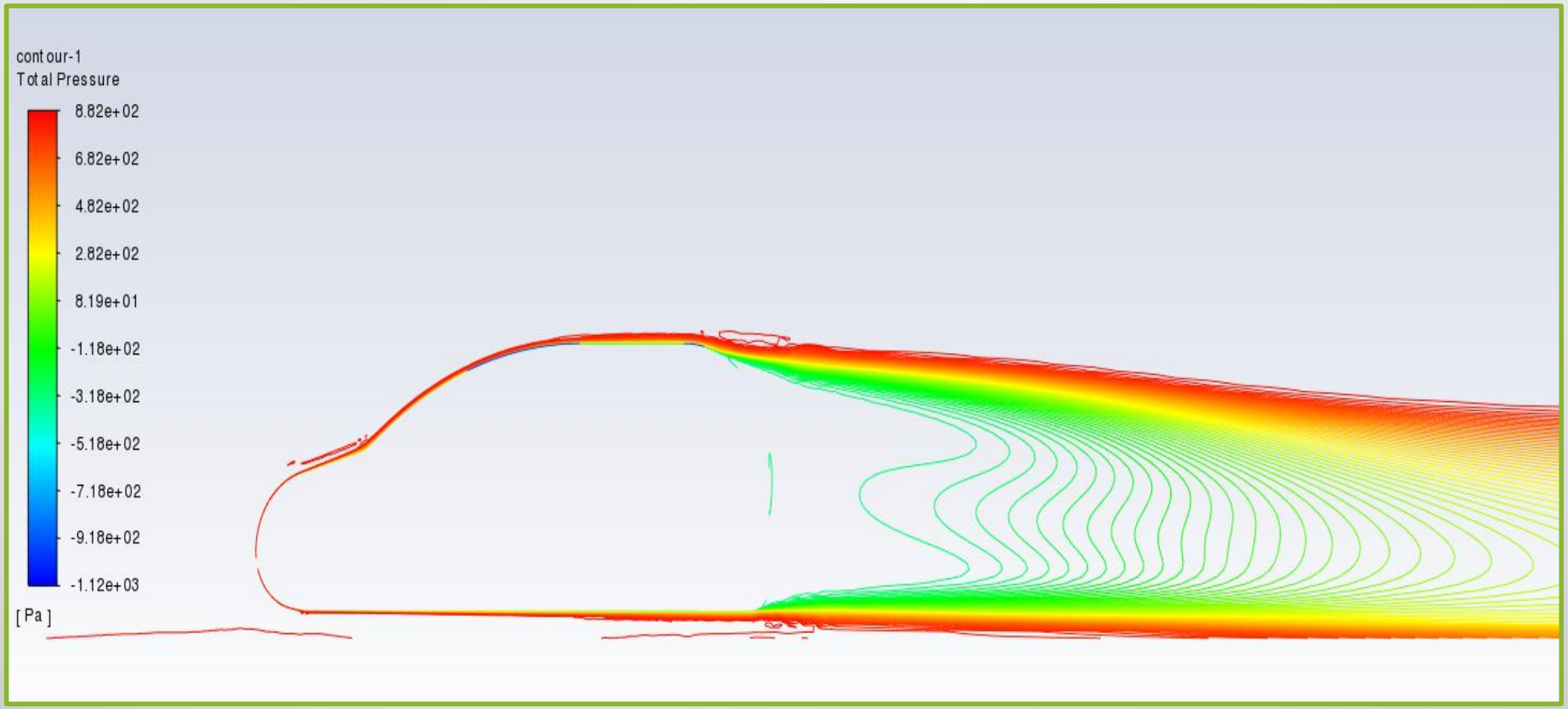
Cd

Cl

Pressure Contours

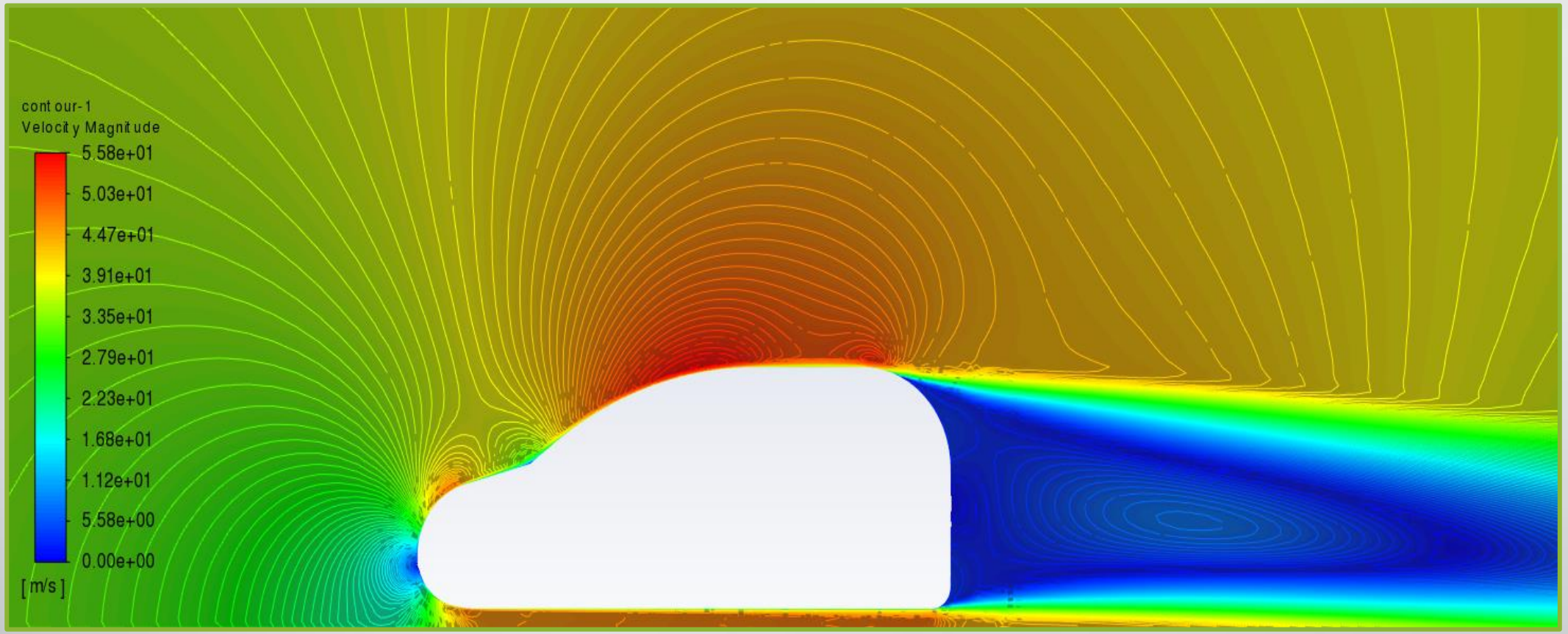


Static Pressure Contours



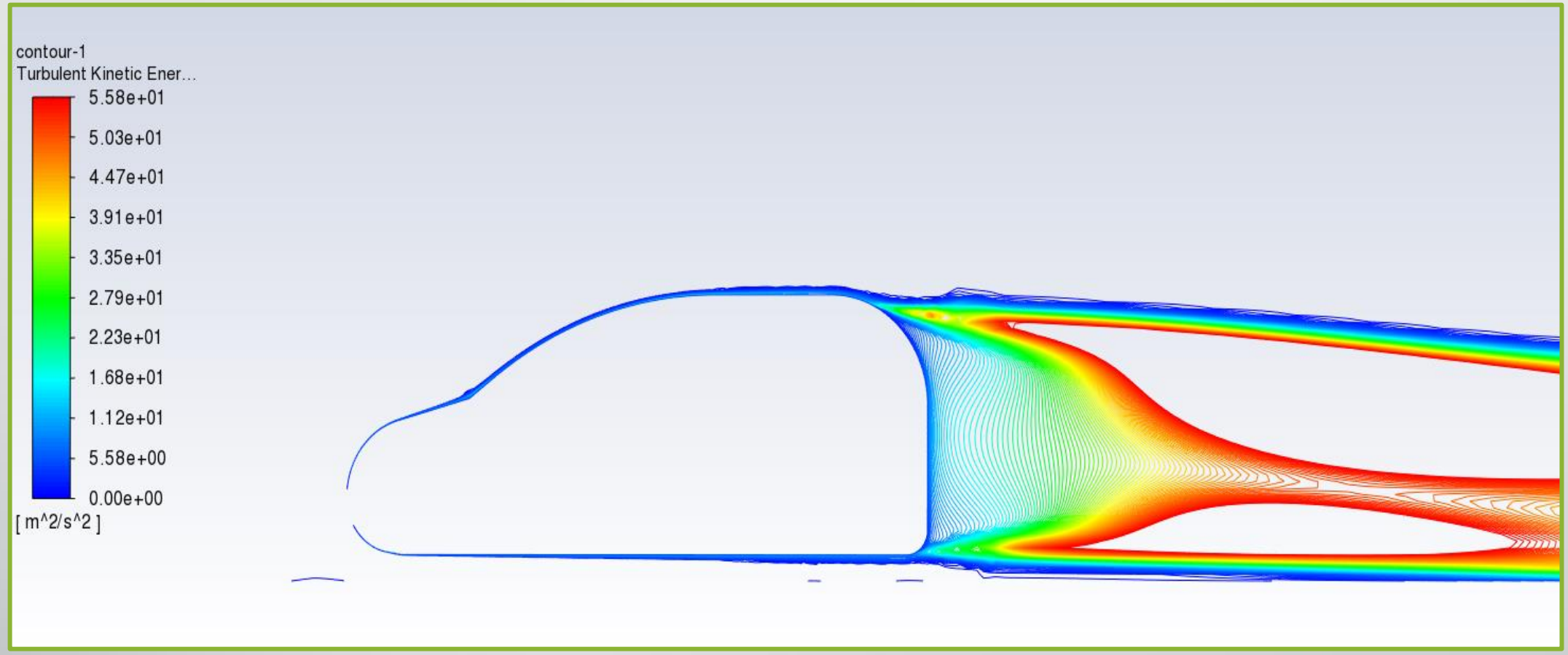
Total Pressure

Velocity Contour



Velocity Magnitude

Kinetic Energy Contour



Turbulent Kinetic Energy