ME3455

CFD Lab

Assignment 2

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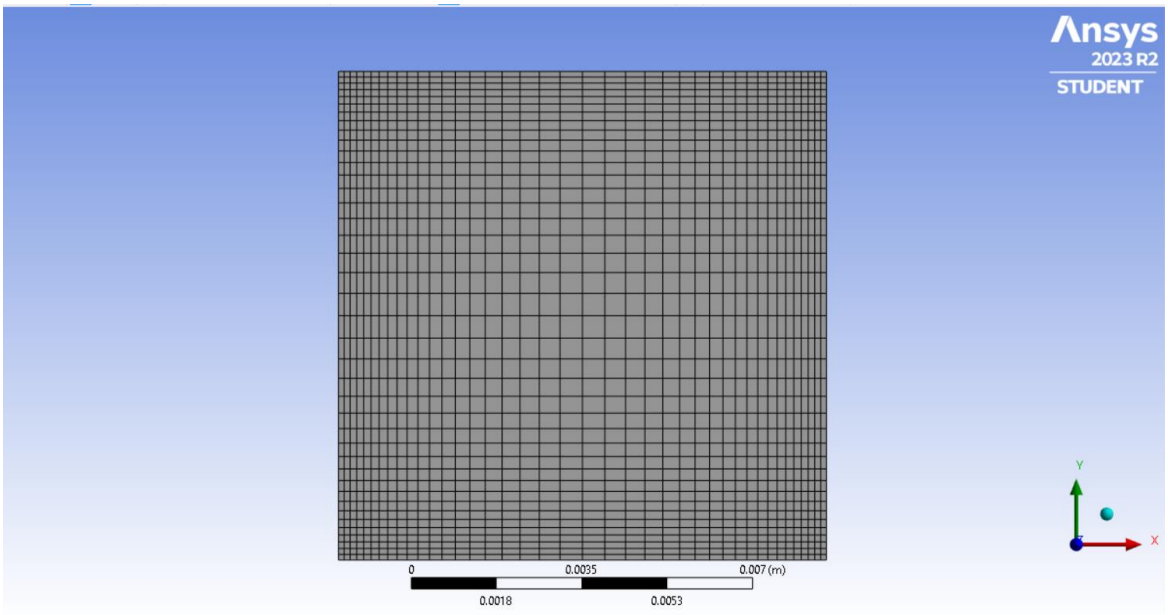
ME21BTECH11001

Question: Solve for the flow in a lid-driven square cavity of length L = 1cm with the top boundary (lid) moving to the right with a speed of U = 0.1m/s. Use a material with ρ = 1 kg/m3 and viscosity μ = 10−5 kg m/s. The dimensions, lid speed and fluid properties imply that the Reynolds number is 100.

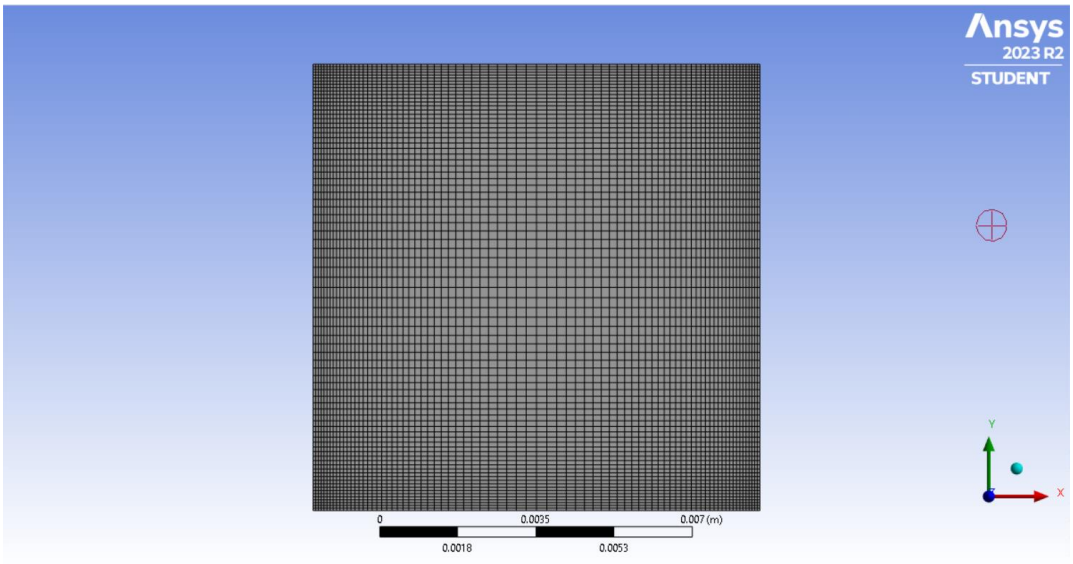
Run simulations on four different grids, with 40 × 40, 80 × 80, 120 × 120 and 160×160 control volumes. Each control volume must be a quadrilateral. For each grid, use biasing towards the corners (Biasing Factor of 4.0 in Ansys Meshing).

a)

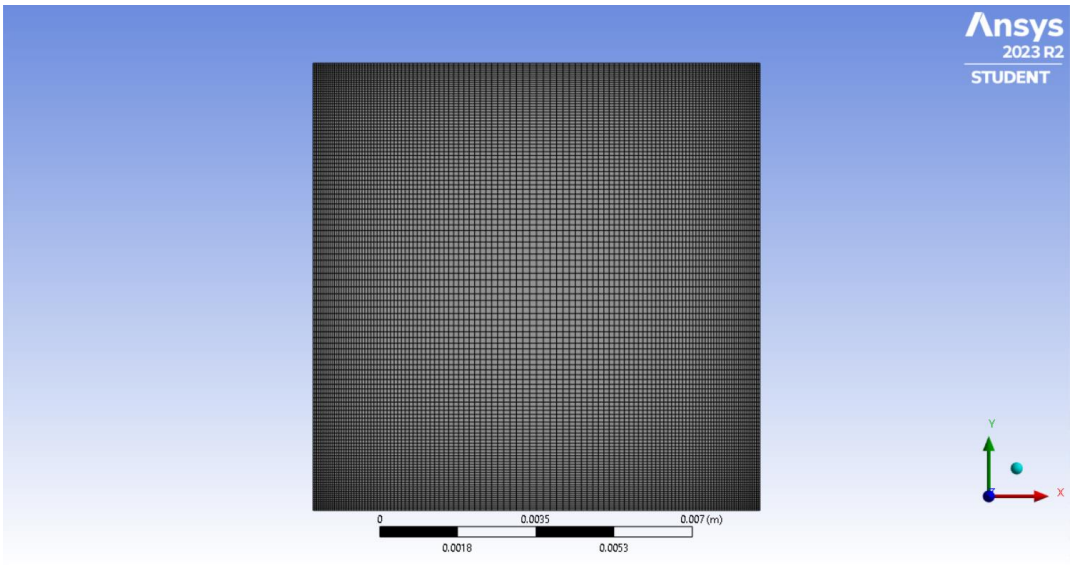
1. 40X40 mesh



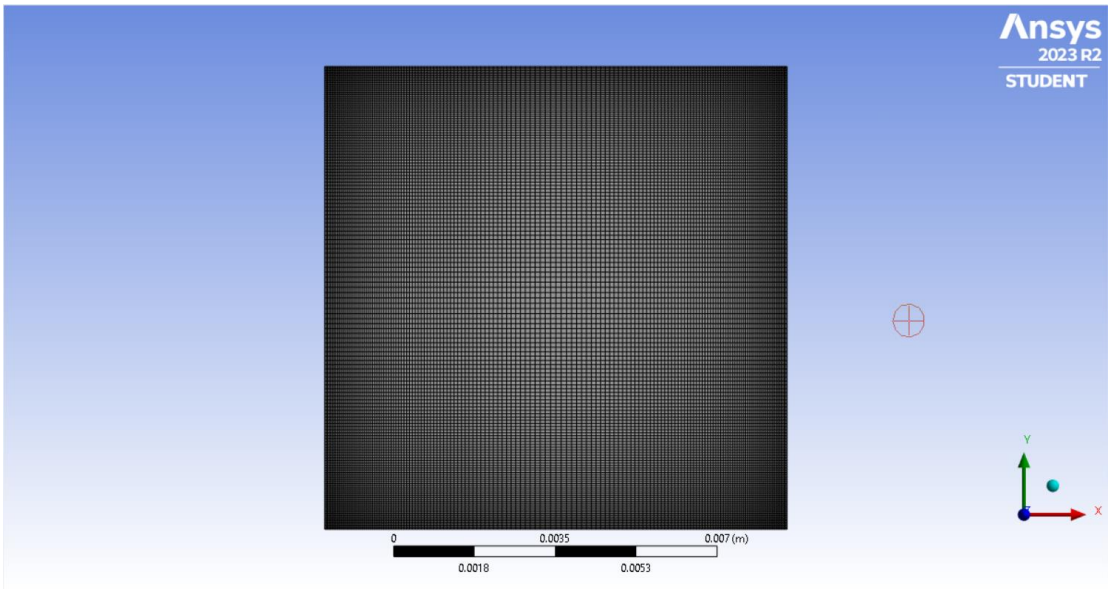
2. 80X80 mesh



3. 120X120 mesh



4. 160X160 mess

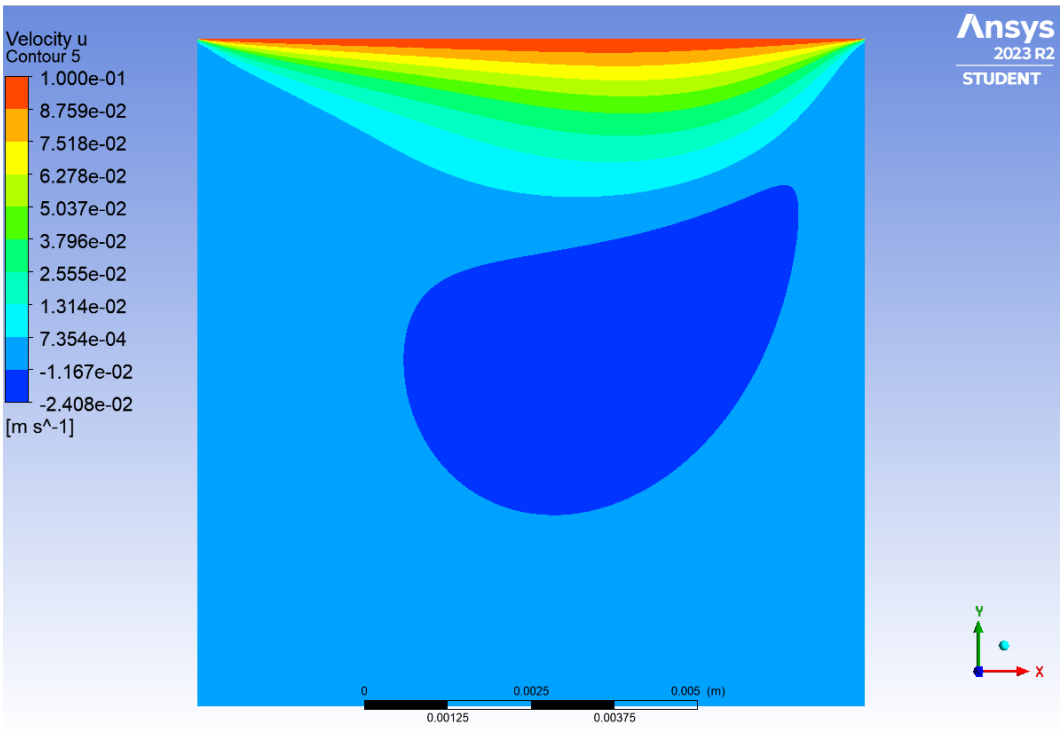


Control volumes need to be concentrated near the edges, especially for higher Re simulations. Therefore, the meshing is finer (Bias = 4) near the edges to study the properties their more accurately.

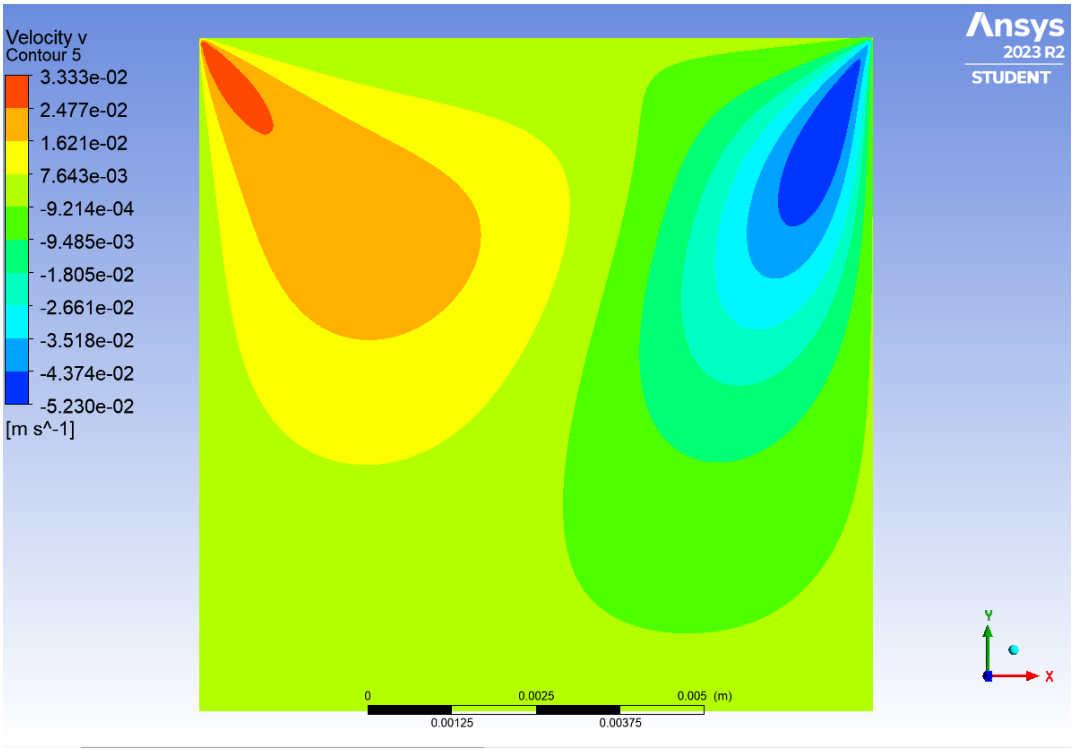
b)

1. **120X120 mesh**

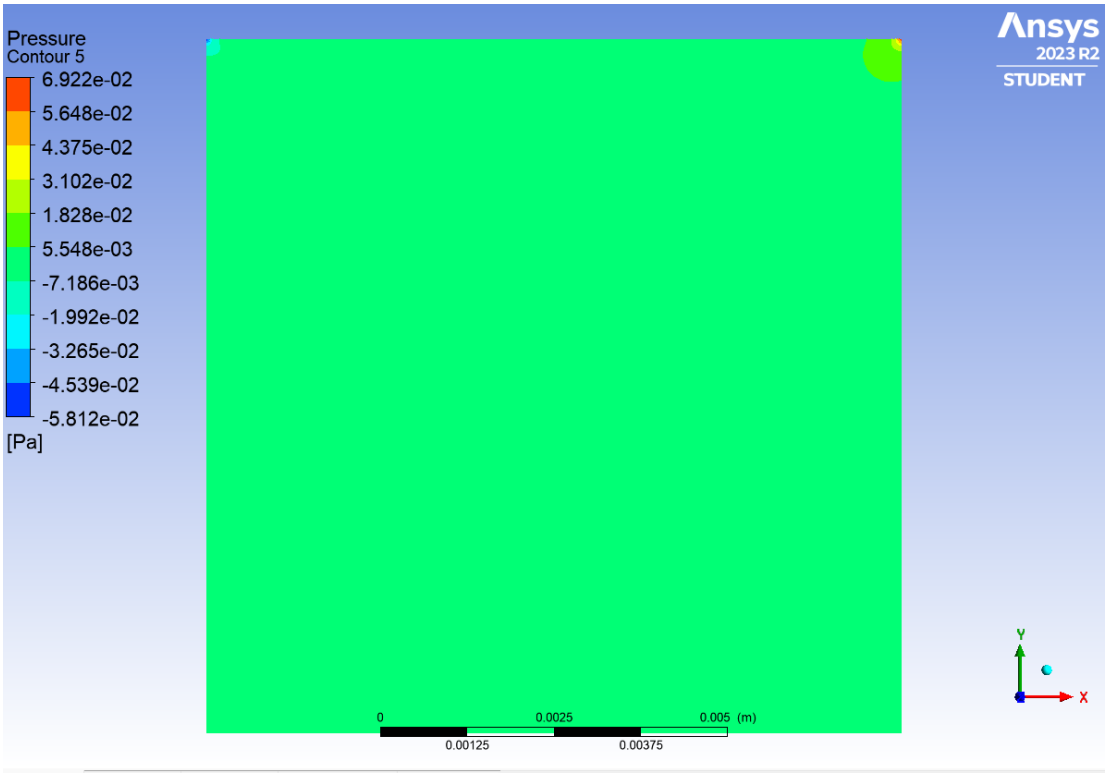
Contours of X component velocity ->



Contours of Y component velocity ->

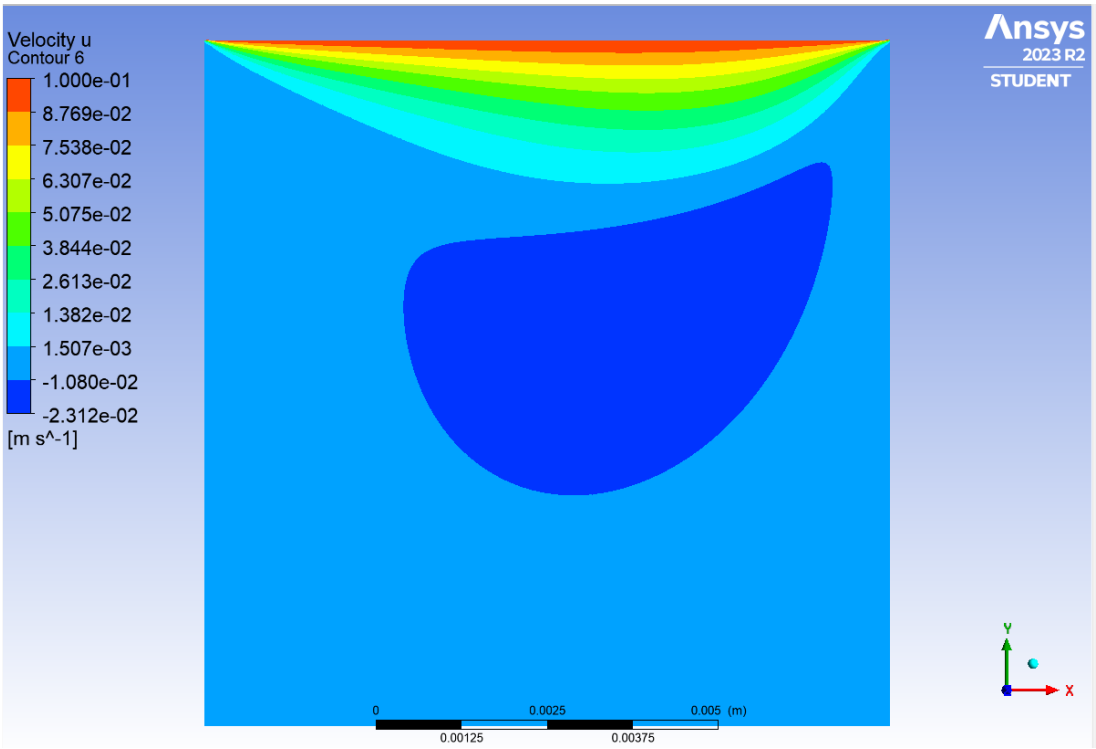


Pressure ->

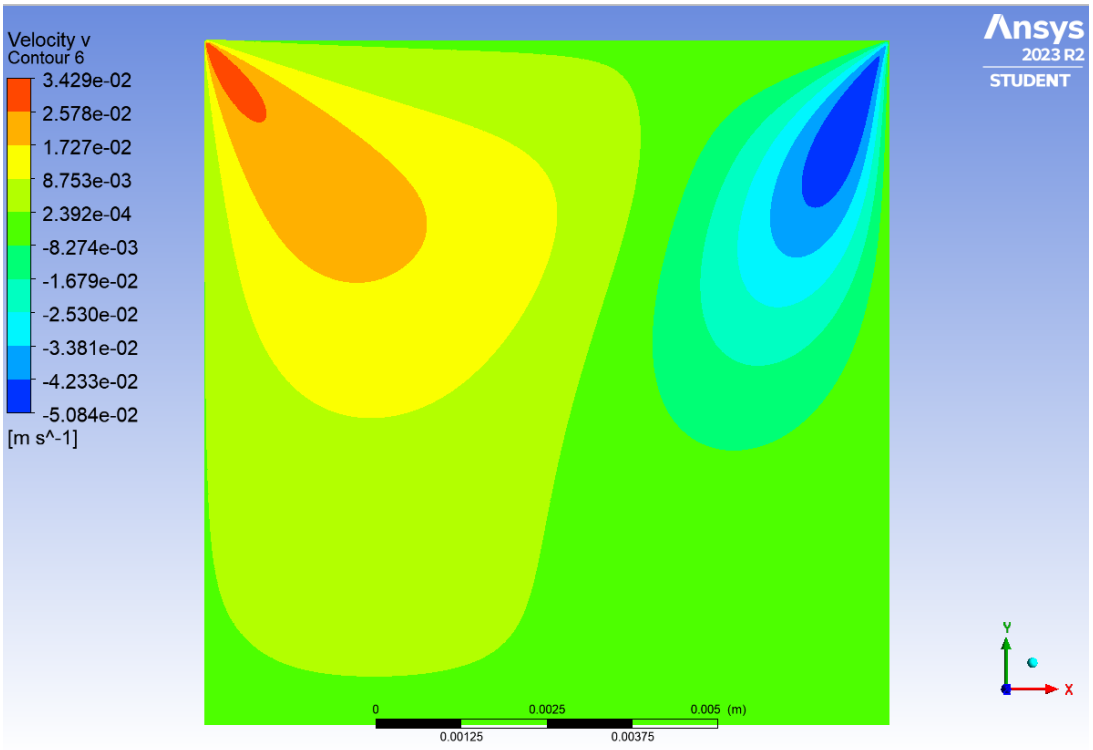


2. 160X160 mesh

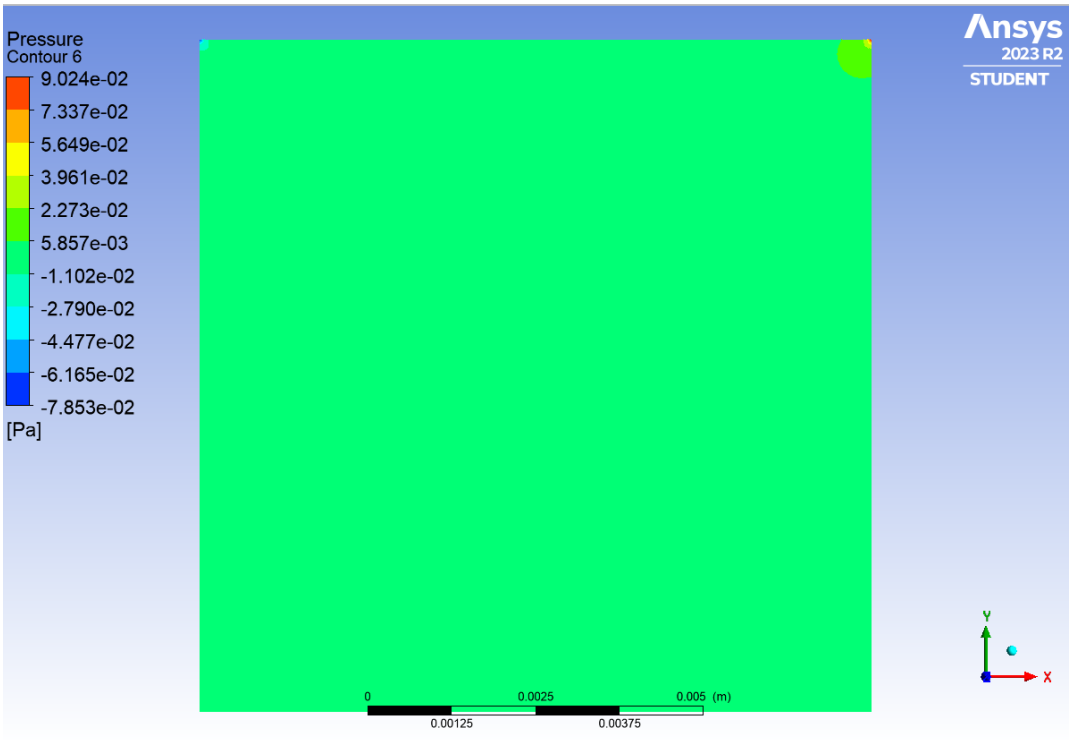
Contours of X component velocity ->



Contours of Y component velocity ->



Pressure ->



Observation of above results: -

- Movement of lid (U,0) causes higher velocities in positive x direction near the lid, when compared to bottom of cavity. The bottom of cavity has less x velocity in opposite direction (momentum conservation).
- Movement of water in x direction causes the water to go down (assuming there is no spilling of water) on the right side. Thus, by momentum conservation the left-side experiences an upward movement by small amount.
- Displacement of water in positive x direction causes it to collide with the top right corner causing the pressure there to rise.
- Increasing the number of meshes results in accurate results.

c)

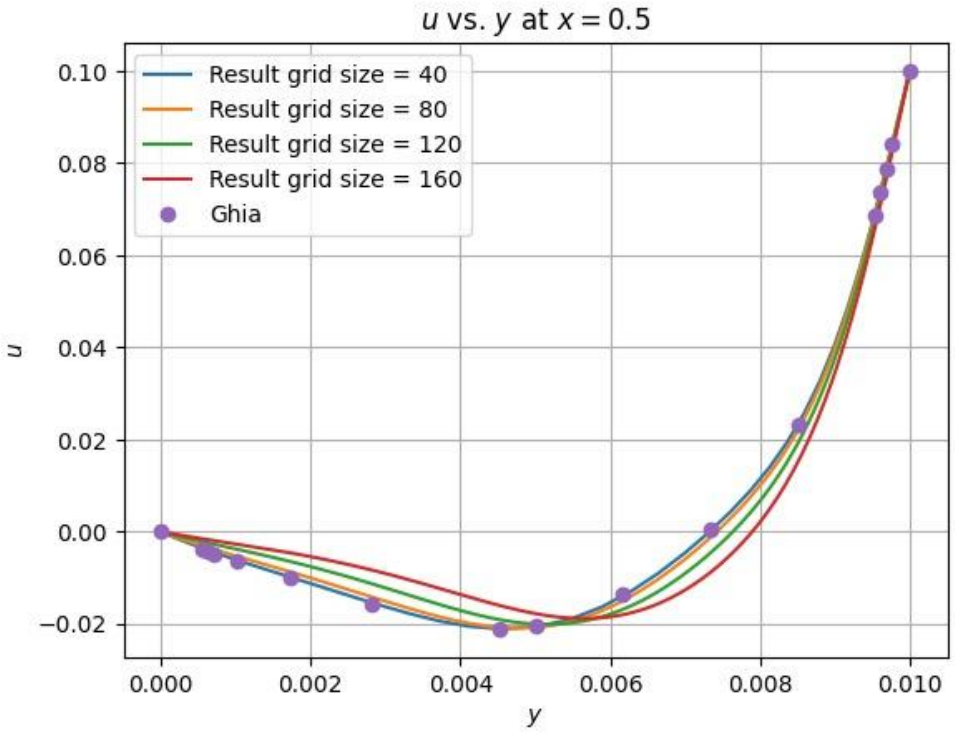


Fig: Profiles of u vs y

d)

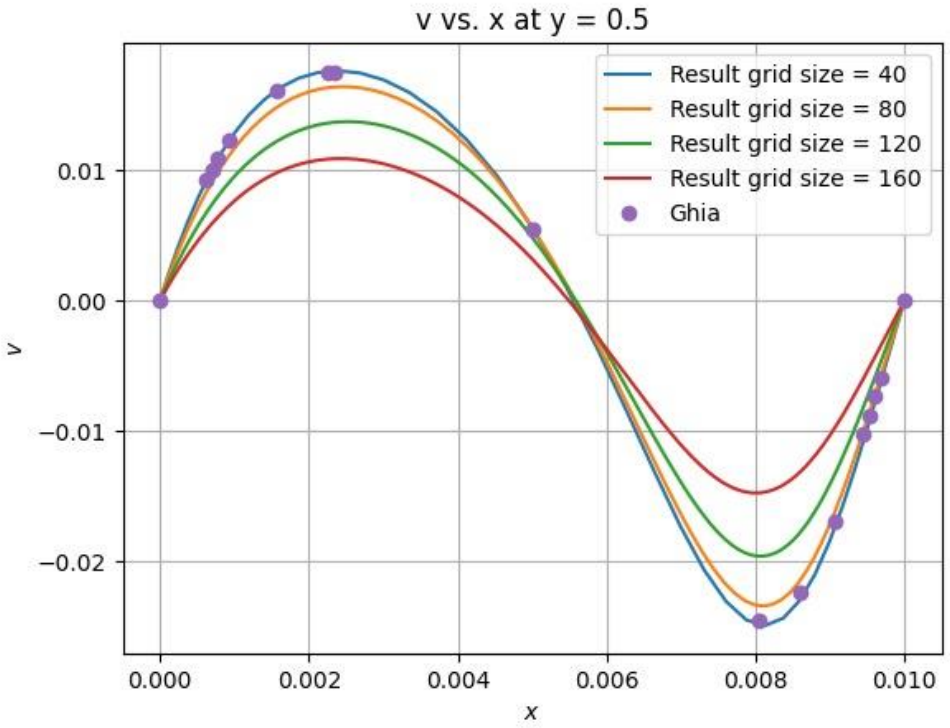


Fig: Profiles of v vs x

Increasing the number of meshes results in accurate results.

Our result fits around the Ghia plot closely.