ME393: Lab Exam (Group 2)

18th Nov 2021

Laminar Flow Through a Pipe with Uniform Heat Flux

Laminar flow of Mercury through a circular pipe is modeled, with uniform heat flux across the wall. A fully developed laminar velocity profile is prescribed at the inlet. The resulting pressure drop and exit temperature are compared with analytical calculations for Laminar flow. Only half of the 2–D domain is modeled due to symmetry. **The problem needs to be simulated as axisymmetric.**

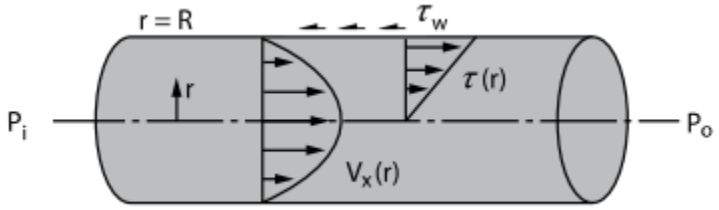

Figure 1

Assumptions: Flow is laminar, steady and incompressible.

Material properties	Geometry	Boundary Conditions
Density = 13529 kg/m^3 Viscosity = 0.001523 kg/m-s Specific Heat = 139.3 J/Kg-K Thermal Conducitivity = 8.54 W/m-K	Length of the pipe = 0.1 m Radius of the pipe = 0.0025 m	Fully Developed Velocity profile at the inlet. Inlet Temperature = 300 K Heat Flux across wall = 5000 W/m^2

Results:

(i) Show the contours of velocity magnitude and pressure.

(ii) Plot the velocity profile at the middle section of the pipe and compare it with the fully developed velocity profile at the inlet.

(iii) Calculate the pressure drop. Analytically, the pressure drop = 1 Pa. Comment on your results.

(iv) Calculate the centerline temperature at the outlet. Analytical value = 341 K. Comment on your results.