

OpenFOAM Textbook Companion
Fluid Mechanics-Yunus Cengel and John Cimbala
Example 10.12, Page No: 550

OpenFOAM version 3.0.1

Code was compiled on Ubuntu 14.04 and executed on Mac OSX.

MESH DETAILS

Mesh type : Structured Mesh using 'blockMesh' command.

Mesh stats	
points	1417048
faces	2826524
internal faces	1409476
Cells	706000
Faces per cell	6
Boundary patches	6

The command “checkMesh” can be used to check for the mesh/grid quality and to ascertain whether there are any negative volumes present.

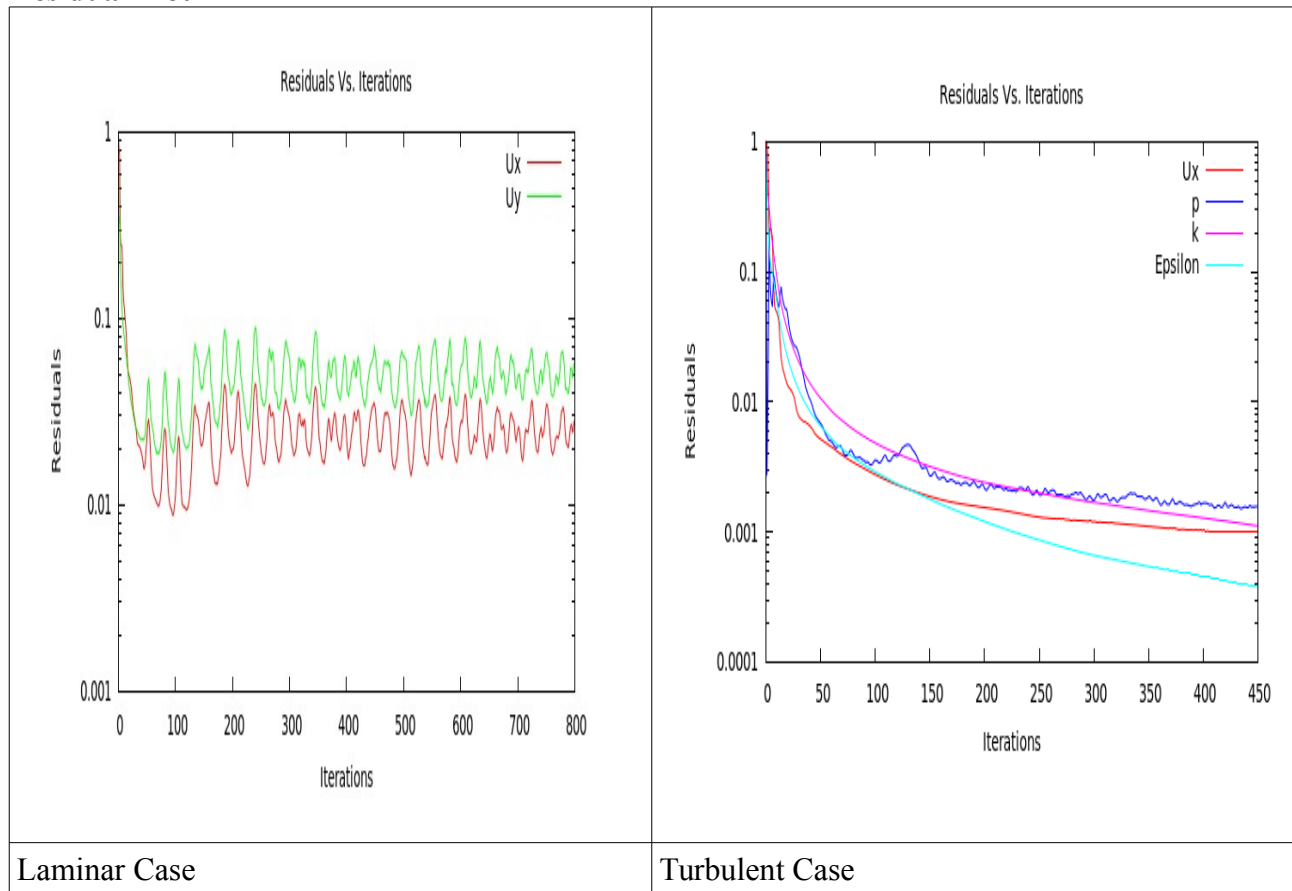
SOLVER DETAILS

Solver type : simpleFoam solver
RAS simulation kEpsilon and laminar model

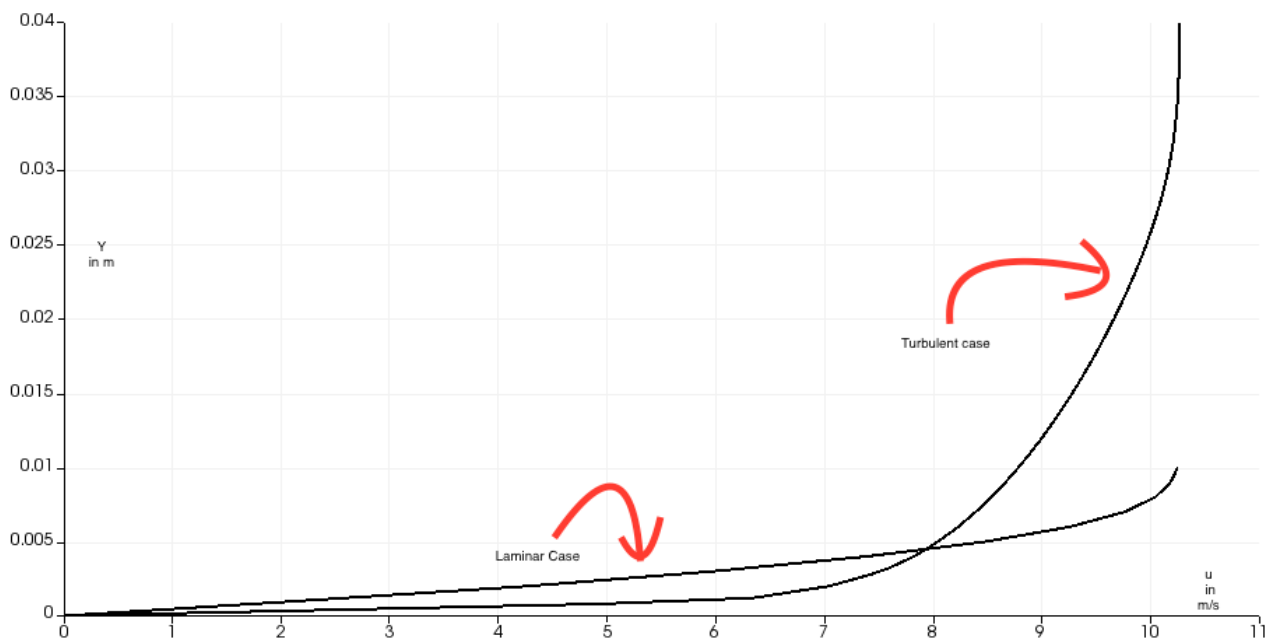
Material : Air ($\rho=1.204\text{ kg/m}^3$ and $\nu=1.516\cdot 10^{-5}$)

RESULTS

Residual Plot



Boundary layer plot



Local Skin friction Coefficient

post processing utility wallShearStress can be used to obtain τ_w which yields the local skin friction by the following computation in paraview

$$C_f = \frac{2 \cdot \tau_w}{\rho \cdot U_\infty^2}$$

Value of C_f at (3.52, 1.01, 0.005) is $3.6 \cdot 10^{-3}$ which is well within the error bound of the value computed in analytical solution.

NOTE: Skin friction cannot be computed in laminar case using this process.

Boundary layer development

The capture of boundary layer can be done as follows:-

Boundary layer exists till the point where velocity reaches about 95%-99%. Hence plot at 11 intervals from 2 m to 3.52 m have been considered, and corresponding distances have been noted. A simple python code was used to obtain the plot.

