# Numerical Investigation of Flow over a 2-Dimensional Circular Cylinder under unsteady state

**Abstract:**

This work deals with a numerical study of a two - dimensional, incompressible, and steady state non-rotating circular cylinder. The Reynolds number is varied between 120 to 240 in a step of 20. Navier – Stokes and continuity equations were solved numerically by using finite volume technique is conducted with FLUENT version (6.2) package program. Stream lines, vorticity contours, pressure, lift, and skin friction coefficients results are presented along curve length of cylinder at each value of Reynolds number. The results of lift coefficient and stream lines and vorticity contours were compared with other previously published research that presented support the validity of results.

## Problem statement

Consider the steady state case of a fluid flowing past a cylinder, as illustrated in fig1. Obtain the velocity and pressure distributions when the Reynolds number is chosen between 120 to 240. In order to simplify the computation, the diameter of the cylinder is set to 1m, the x component of the velocity is set to 1m/s and the density of the fluid is set to 1kg/m$^3$. Thus, the dynamic viscosity must be set to $8.333\times10^{-3}$ kg/m$^*$s in order to obtain the desired Reynolds number. First, we will specify a velocity inlet boundary condition. We will set the half of the outer boundary as a velocity inlet with a velocity of 1m/s in the x direction. Next, we will use a pressure outlet boundary condition for the right half of the outer boundary with a gauge pressure of 0 Pa. Lastly, we will apply a no slip boundary condition to cylinder wall. However, because this is a transient system, initial conditions at t = 0 are required. The aforementioned boundary conditions are illustrated below:

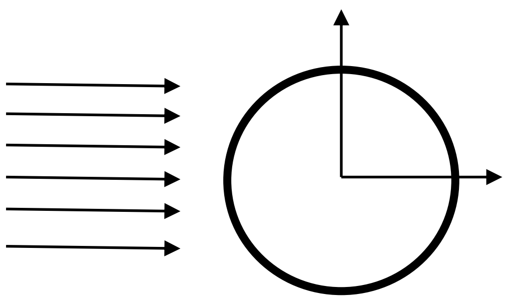

**Fig. 1**

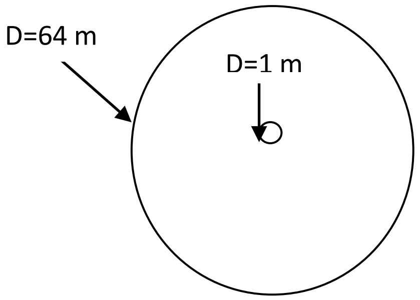


Fig. 2

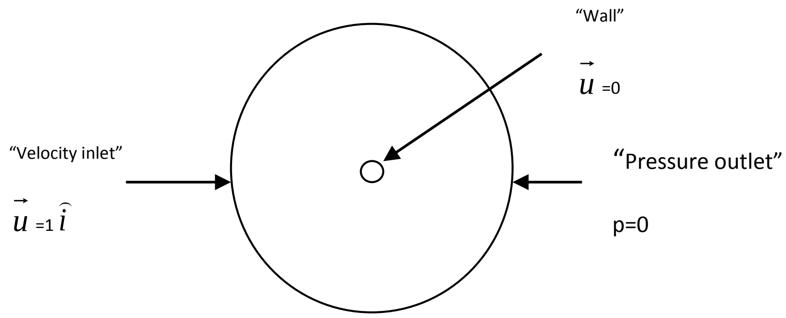


fig. 3

Following are the initial condition that you will need to solve the problem

Re =120 to 240

D = 1 m (inner diameter)

D = 64 m (external diameter)

Vx =1 m/s

Density = 1 kg/m$^3$

Dynamic viscosity = $8.333\times10^{-3}$ kg/m*s

t = 0

Gauge pressure = 0 Pa