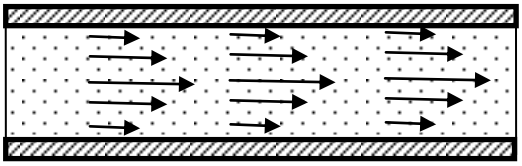
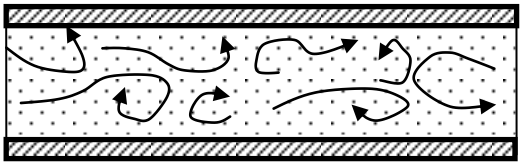
LECTURE 6- ENERGY LOSSES IN HYDRAULIC SYSTEMS

FREQUENTLY ASKED QUESTIONS

1.Differentiate between Laminar flow and Turbulent flow

Laminar flow	Turbulent flow
Laminar flow is characterized by the fluid flowing in smooth layer or laminae. In this type of flow, a particle of in a given layer stays in that layer. For laminar flow , the friction is caused by the sliding of one layer or particle of fluid over another in a smooth continuous fashion	Turbulent flow is characterized by the fluid flowing in random way. Movement of particle fluctuates up and down in a direction perpendicular as well as parallel to mean flow direction. This mixing action generates turbulence due to the colliding fluid particles. This causes considerable more resistance to flow and thus greater energy losses than that produced by laminar flow
	

2. List main causes of turbulence in fluid flow

(a) High fluid velocity

(b) Large Surface roughness of pipe

3Define Reynolds number and list its range for laminar and turbulent flow

2.8 REYNOLDS'S NUMBER

It is dimensionless number refereed to a compressible or incompressible fluid flow. It was postulated by British engineer Osborne Reynolds. The Reynolds's number set criteria by which the fluid flow regime may be distinguished.

$$R_e = \frac{\rho V D}{\mu}$$

$where\ \rho\ is\ density\ kg/m^3$, V= velocity of fluid (m/s), D= Diameter of the pipe (m) and μ is absolute or dynamic viscosity Pa-s or ms/m^2

Laminar flow In laminar flow region, the flowis characterized by the smooth motion of the laminae or layers. When there is no macroscopic mixing of adjacent fluid layer for the flow in the laminar regimes, the Reynold number is less than 2000.

Turbulent flow In turbulent flow region, the flowis characterized by the random motion of the fluid particles in three dimensions in addition to mean motion. There is considerable macroscopic mixing of adjacent fluid layers and significant velocity fluctuations. For the turbulent flow, the Reynolds number is greater than 4000

Transition flow In transition regime of flow, the flow is in transition between the laminar flow and turbulent flow. The Reynolds number lies between 2000 and 4000.

4. Briefly explain the method to calculate the Equivalent length of a valve or fitting
Equivalent length technique

We can find a length of pipe that for the same flow rate would produce the same head loss as a valve or fitting. This length of pipe, which is called the equivalent length of a valve or fitting can be found by equating head losses across the valve or fitting and the pipe.

$K\left(\frac{V^2}{2g}\right) = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$which gives $L_e = \left(\frac{KD}{f}\right) L_e$ is the equivalent length of a valve or fitting

6. Define: relative roughness and k factor of a valve or fitting

Relative roughness is defined as the pipe inside surface roughness divided y the pipe inside diameter. $Relative\ roughness = \frac{\varepsilon}{D}$

The K factor equals the head loss divided by the velocity head. $K = {H_L}\Big/{\left(\frac{V^2}{2g}\right)}$.

7. Write an expression for pressure drop down a pipe in terms of friction factor.

$$H_L = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$$

$$H_L = \frac{64}{R_e}\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$$