Chapter 3 : Basic Equations Of Fluid Flow

Important Terms ⇒

★ **Streamline :** It is defined as the fluid path in the stream of fluid. It is an imaginary curve in a mass of flowing fluid so drawn that at every point on the curve the net velocity vector, u is tangent to streamline.Tangent at any point gives the direction of flow. Two streamlines can't intersect.

★ **Skin Friction :** Friction generated in an unseparated boundary layer.

★ **Form Friction :** Appears when boundary layer separation occurs and leads to wake formation.

★ **Path line :** Actual path followed by every single particle. Two path lines can intersect.

★ **Streak line :** Real lines executed by stream or chain of fluid particles.

★ **Assumptions of Navier-Stokes equation :**

1. Incompressible flow
2. Newtonian fluid
3. Irrotational flow
4. Continuum Approximation
5. Constant Temperature

Important Formulas ⇒

1. **Average Velocity :** $$\bar{V} \equiv \frac{\dot{m}}{\rho S} = \frac{1}{S}\int_s u\, dS$$

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2. **Mass Velocity :** The advantage of using *G* is that it is independent of temperature and pressure when the flow is steady (constant m) and the cross section is unchanged (constant S).

$$\bar{V}\rho = \frac{\dot{m}}{S} \equiv G$$

3. **Momentum correction factor :**

$$\beta = \frac{1}{S}\int_S \left(\frac{u}{\bar{V}}\right)^2 dS$$

4. **Kinetic energy correction factor :**

$$\alpha = \frac{\int_S u^3\, dS}{\bar{V}^3 S}$$

5. **Bernoulli equation for flow of incompressible flow :**

$$\frac{p_a}{\rho} + \frac{gZ_a}{g_c} + \frac{\alpha_a \bar{V}_a^2}{2g_c} + \eta W_p = \frac{p_b}{\rho} + \frac{gZ_b}{g_c} + \frac{\alpha_b \bar{V}_b^2}{2g_c} + h_f$$

6. **Angular Momentum Equation :**

$$T = F_\theta r_2 = \frac{\dot{m}}{g_c}(r_2 u_{\theta 2} - r_1 u_{\theta 1})$$

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