

Dimensionless numbers :

Dimensionless numbers are those numbers which are obtained by dividing the inertia force by viscous force or gravity force or pressure force or surface tension force or elastic force.

These dimensionless numbers are also called non-dimensional parameters. Some of the important dimensionless numbers are:

1. Reynold's number
2. Froude's number
3. Euler's number
4. Weber's number
5. Mach's number.

Reynold's number : (Re)

Defined as the ratio of inertia force of a flowing fluid and the viscous force of the fluid.

$$\begin{aligned} \text{Inertia force (F}_i) &= \text{Mass} \times \text{Acceleration of fluid} \\ &= \rho \times V \times \frac{v}{\text{time}} \quad \text{--- } Q = AV \\ &= \rho \times \frac{V}{\text{time}} \times v \\ &= \rho \times AV \times v \quad \left[\frac{V}{\text{time}} = Q = AV \right] \\ &= \rho AV^2 \end{aligned}$$

$$\begin{aligned} \text{Viscous force (F}_v) &= \text{Shear stress} \times \text{Area} \\ &= \tau \times A \end{aligned}$$

$$\tau = \frac{\mu}{L} \times v \times L = \mu \times \frac{v}{L} \times A$$

$$Re = \frac{F_i}{F_v} = \frac{\rho AV^2}{\mu \times \frac{v}{L} \times A} = \frac{\rho v L}{\mu} = \frac{v \times d}{\nu} \quad \left[\nu = \frac{\mu}{\rho} \right]$$

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