

Characteristics of Laminar and turbulent flow in pipes

	Laminar	Turbulent
Visible characteristics	Flow in layers parallel to boundary	Chaotic velocity fluctuations
Reynolds Number	“Low” <2000	“High” >5,000
Mixing	“small” molecular diffusion	“large” large scale Eddies
Velocity Profile	“Parabolic”	“Fuller”
Shear Stress	Lower	Higher
Solution	Analytical $V_c = \frac{\Delta P D^2}{L 16\mu}$	Empirical: Dimensional analysis and experimentation

Typical flows:

Ex 1. air duct (1ft by 2 ft), $V=3$ ft/s, $\nu = 1.6 \times 10^{-4}$ ft²/s $Re \approx 20,000$

Ex 2. water pipe (D= 1ft), $V=5$ ft/s, $\nu = 1.2 \times 10^{-5}$ ft²/s $Re \approx 400,000$

Ex 3. River (h=10ft), $V=1$ ft/s, $\nu = 1.2 \times 10^{-5}$ ft²/s $Re \approx 800,000$

TURBULENT FLOWS ARE UBIQUITOUS

Laminar flow is EXCEPTION not RULE!