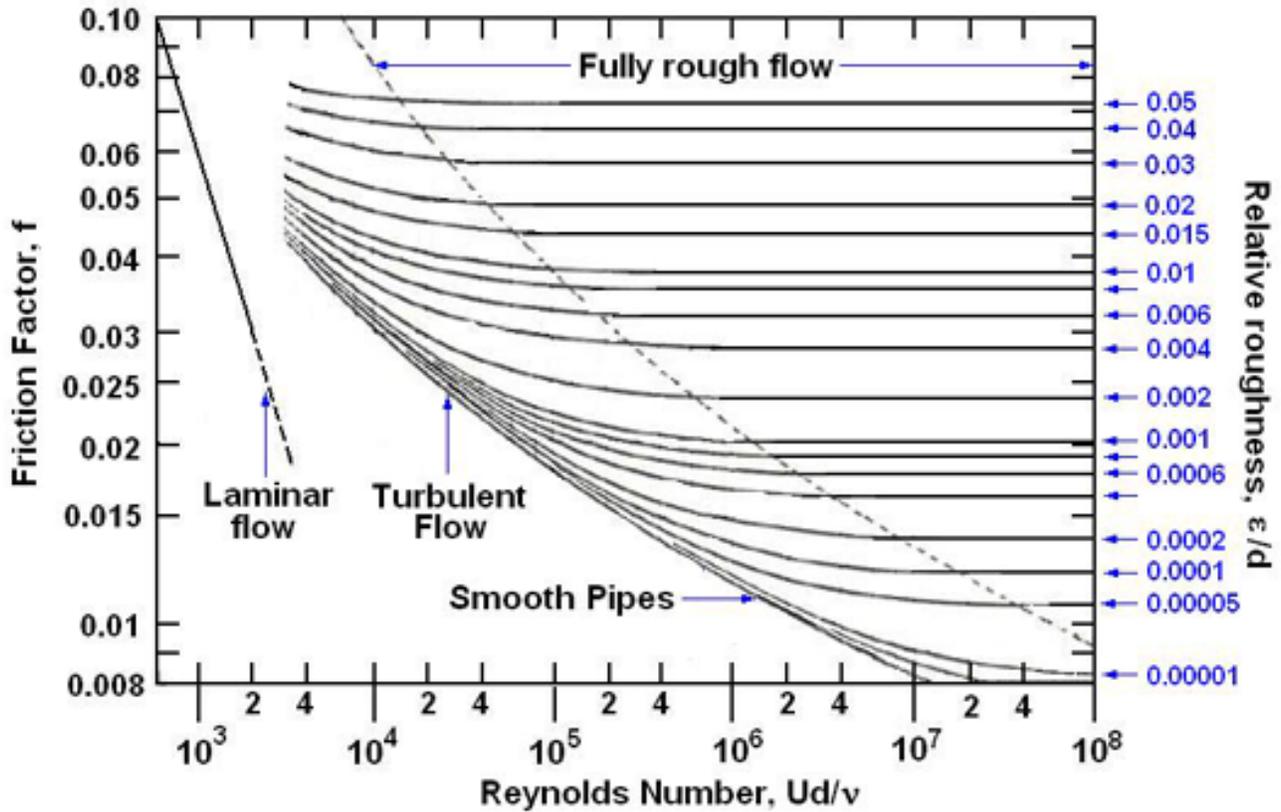


Problem 270C

A long ventilation duct is used to transport air at normal temperatures (density, $\rho = 1.2 \text{ kg/m}^3$, kinematic viscosity, $\nu = 2.3 \times 10^{-6} \text{ m}^2/\text{s}$). The duct has a smooth interior surface, a circular cross-section with a diameter of 0.5 m and is 50 m long. A pressure difference of 1 kg/m s^2 is applied between the two ends of the duct. Using the data in the graph below, find (by trial and error or other means) the average velocity of flow through the duct.



[Note that the friction factor, $f = d(-dp/dx)/\frac{1}{2}\rho U^2$, $Re = dU/\nu$ where d is the diameter and U is the volumetric average velocity of flow.]