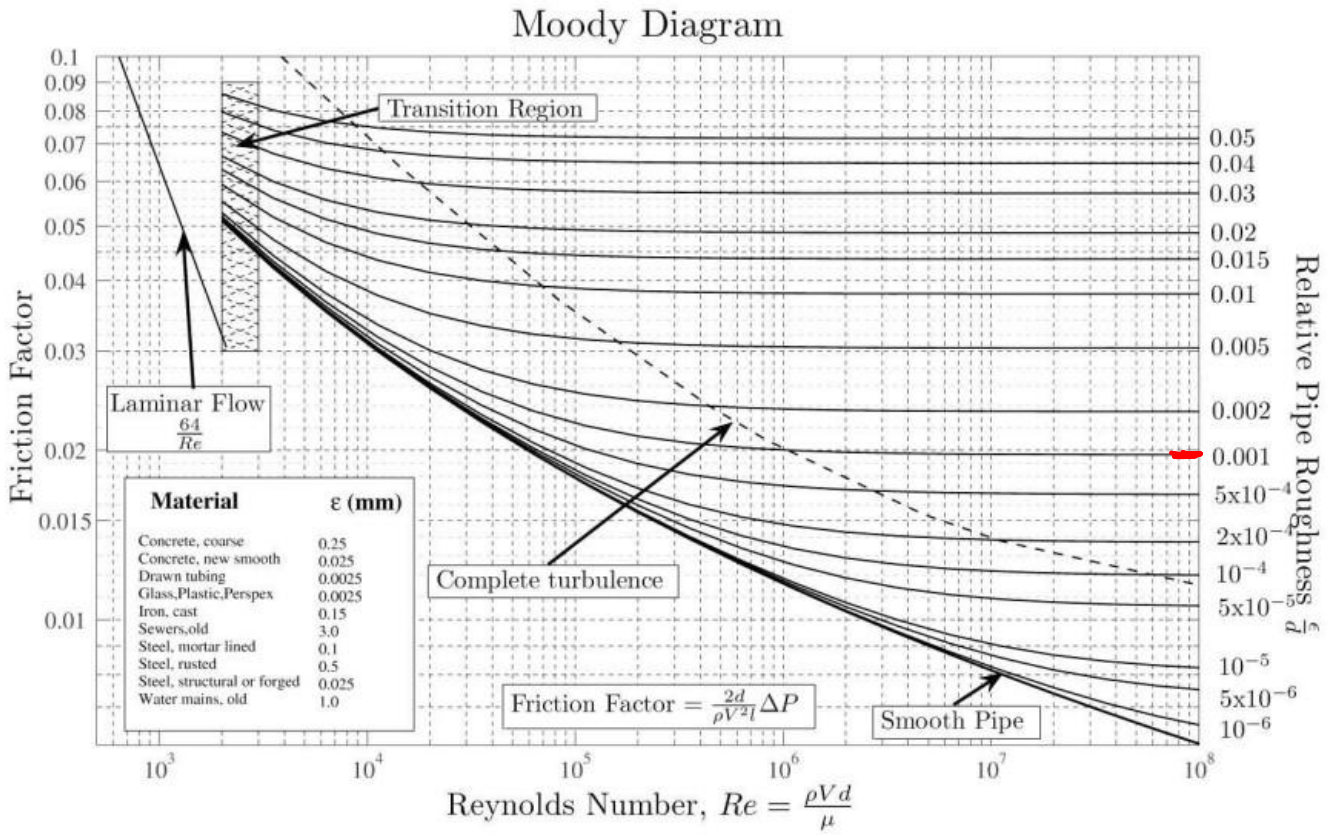
Chap. 5, p. 45-47

I cast iron: $\varepsilon = 0.15$ mm

pipe diameter: $D = 15$ cm

$\Big\} \; k = \frac{\varepsilon}{D} = 0{,}001$



fluid: water $\mu = 10^{-3}$ Pas

$\dot{V} = 360\ l/h = 0{,}0001\ \frac{m^3}{s} \Rightarrow \dot{V} = A \cdot \bar{u}$

$\Rightarrow \bar{u} = \frac{\dot{V}}{A} = \frac{\dot{V}}{\frac{\pi}{4} D^2}$

$= 0{,}006$ m/s

$\Rightarrow Re = \frac{\rho \bar{u} D}{\mu} \approx 850 \Rightarrow$ laminar flow

Chap. 5, p. 45-47 (cont'd)

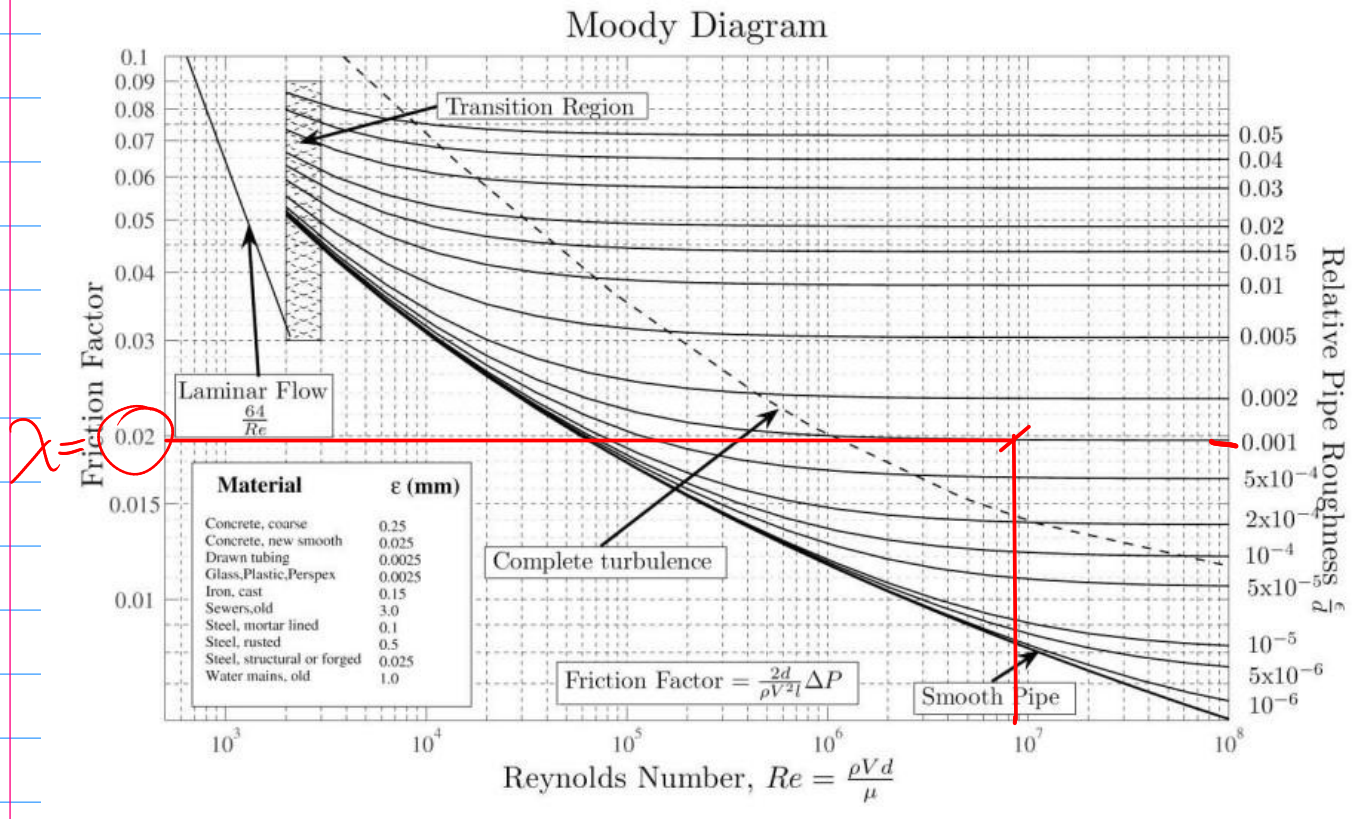
$\Rightarrow \lambda = \frac{64}{Re} = 0{,}075$ (no need for k)

$\Rightarrow \Delta p_L = \frac{L}{D} \lambda \frac{\rho}{2} \bar{u}^2 =$

II $\dot{V} = 1 \ m^3/s$ all other quantities the same

$\Rightarrow \bar{u} = 56 \ m/s$

$\Rightarrow Re = 8500000$ turbulent flow



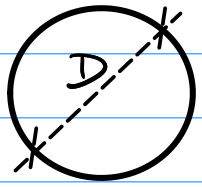
$$\Delta p = \frac{L}{D} \lambda \frac{\rho}{2} \bar{u}^2 = 426 \text{ bar}!$$

That's a lot!

---

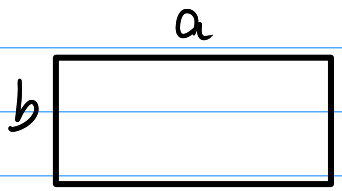
p. 48

hydraulic diameter $D_h = \frac{4A}{S}$



$A = \pi \cdot \frac{D^2}{4}$

$S = \pi D$



$A = a \cdot b$

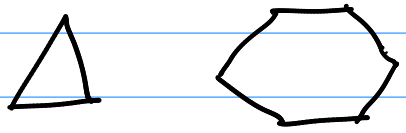
$S = 2a + 2b$

$\Rightarrow D_h = \frac{4 a \cdot b}{2a + 2b}$

$\Rightarrow D_h = \frac{\frac{1}{4} \cdot \pi \frac{D^2}{4}}{\pi D} = D$

korrekt value for round pipe

other cross section shapes:



. . . .

FD, Chap 5, p. 57

$$\Delta p_L = \ldots = \rho v_1^2 \left(\frac{A_1}{A_2}\right)^2 - \rho v_1^2 \frac{A_1}{A_2} + \frac{\rho}{2} v_1^2 \left(1 - \left(\frac{A_1}{A_2}\right)^2\right)$$

$$= \frac{\rho}{2} v_1^2 \left(2\left(\frac{A_1}{A_2}\right)^2 - 2\frac{A_1}{A_2} + 1 - \left(\frac{A_1}{A_2}\right)^2 \right)$$

$$= \frac{\rho}{2} v_1^2 \left(1 - 2\frac{A_1}{A_2} + \left(\frac{A_1}{A_2}\right)^2 \right)$$

$$= \frac{\rho}{2} v_1^2 \left(1 - \frac{A_1}{A_2} \right)^2$$