

Energy Eq: $h_1 + h_p = h_2 + h_T + h_m + h_f$ } $h_m = k \frac{V^2}{2g}$
 friction loss

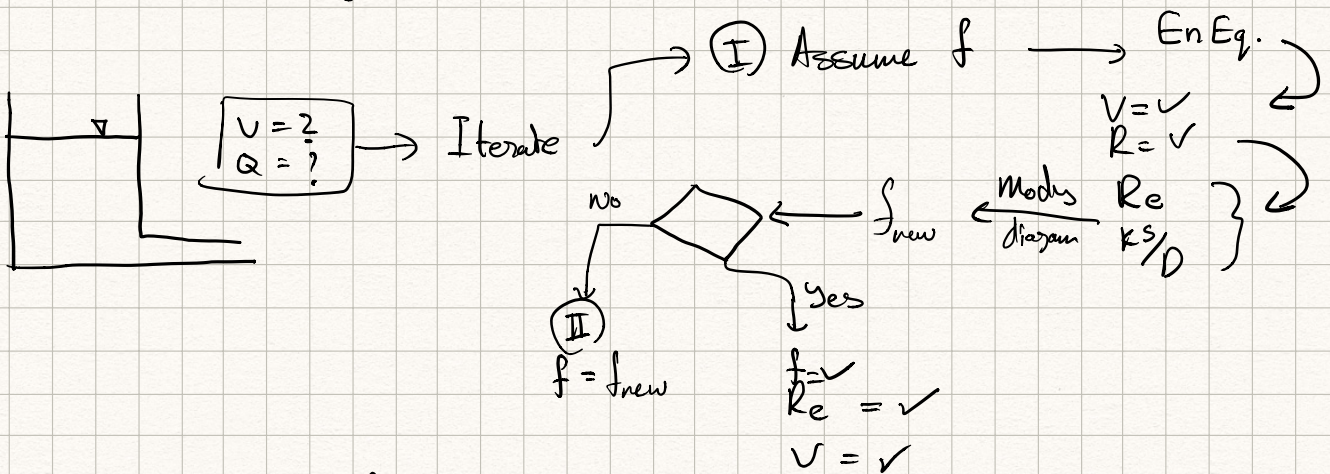
$h_f = \frac{fL}{D} \frac{V^2}{2g}$ → f → flow regime { Laminar
Turbulent

$Re = \frac{\text{inertia force}}{\text{viscous force}} = \frac{\rho V D}{\mu}$

$Re < 2000$ - Laminar

$Re > 2000$ - Turbulent { Fully/complete $f =$
 $f = f(k_s/D, Re)$
 Smooth $f = f(Re)$

$\Delta z = \frac{V^2}{2g} + \frac{fL}{D} \frac{V^2}{2g}$



Initial $f \rightarrow$ Fully turbulent