Energy
Chapter 4.5

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Fluvial Hydraulics
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Potential Energy

- The energy of position
- Physics gives us…
  - U=mgy

Potential Energy

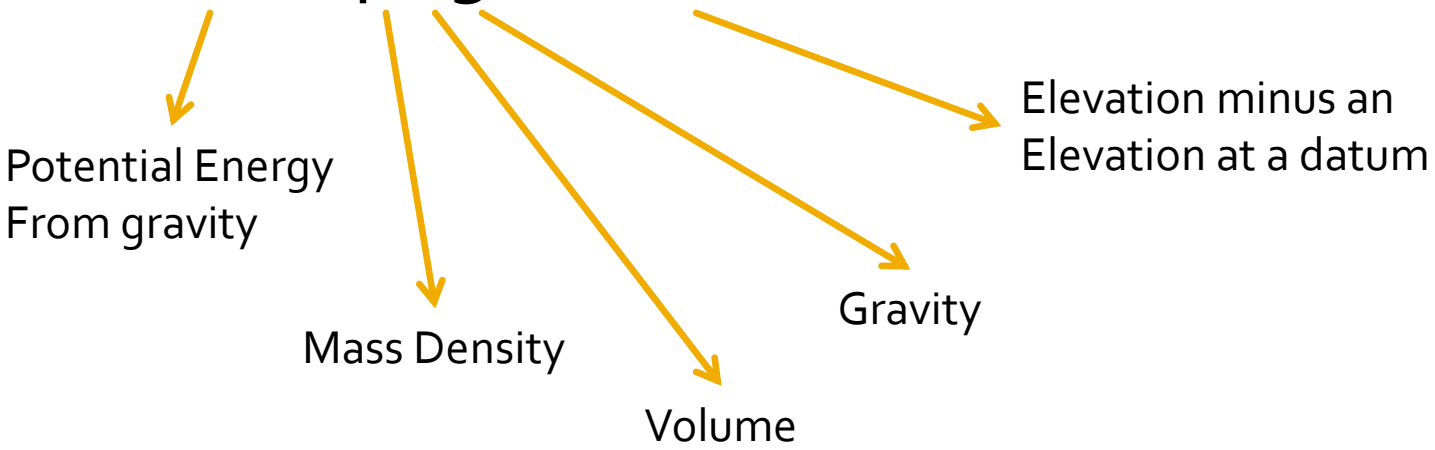
Mass

Gravity

Height

Potential Energy

- Dingman gives us…
  - $PE_g = \rho V g (z_a - z_o)$



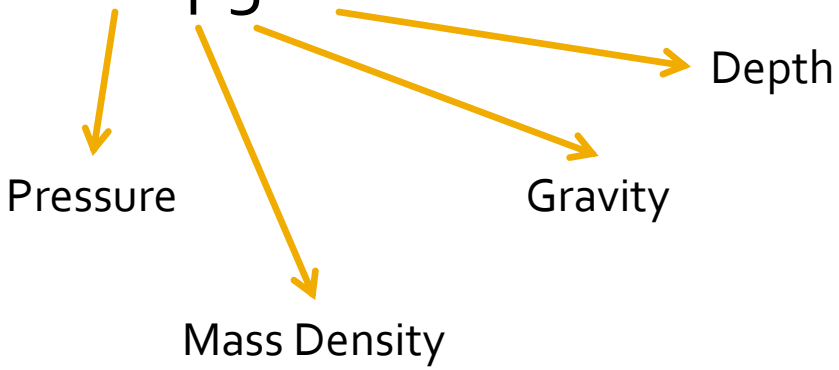
  - Let's simplify by putting our datum at zero…
    - $(z_a - z_o) = z$

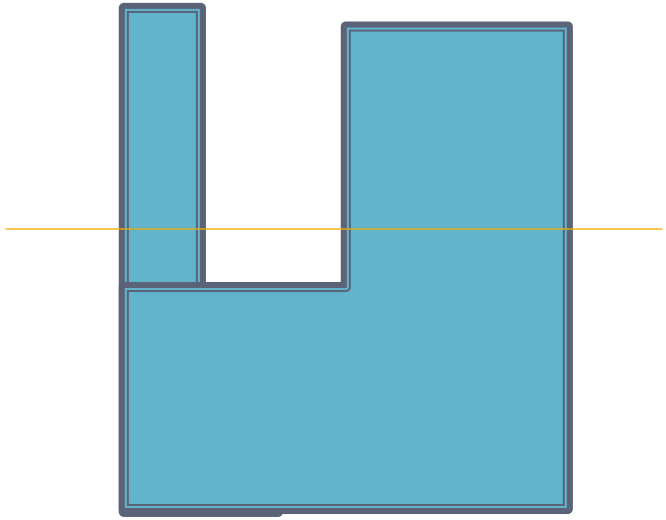
Potential Energy

- How do they relate?
- $U=mgy$
  - $\rho V=m$
    - $(\rho=m/V)$
- $PE_g=\rho Vgz$

Pressure Potential Energy

- Hydrostatic Pressure
  - The pressure only depends on depth
  - $P=\rho g d$

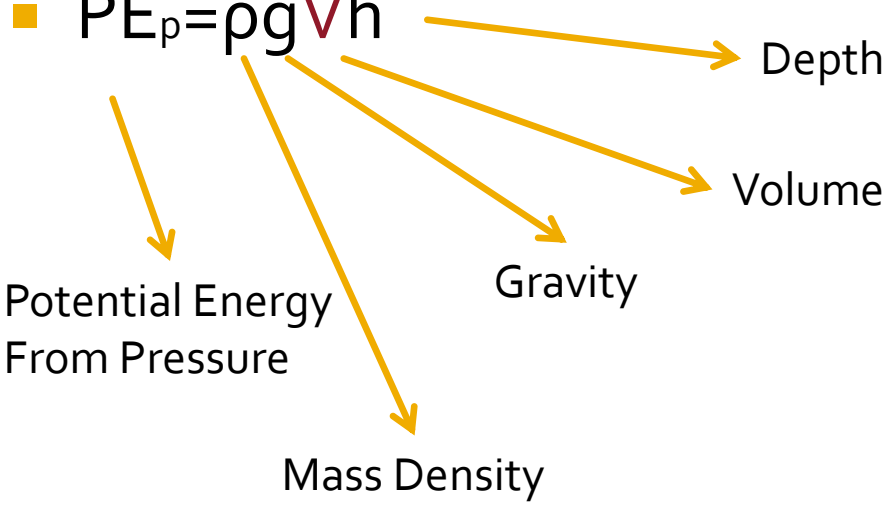




Pressure Potential Energy

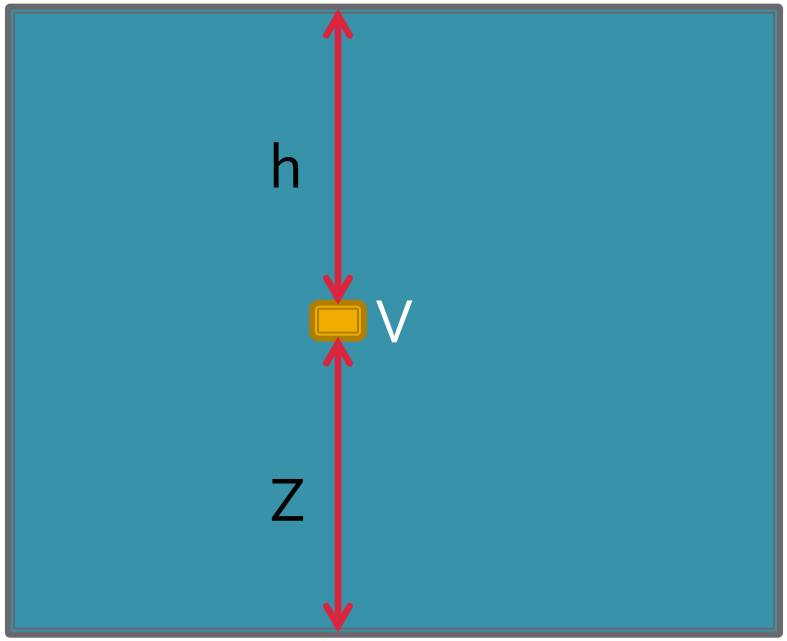
- Since we have a volume to be concerned with…

- $PE_p = \rho g V h$



Total Potential Energy

- $PE = PE_g + PE_p$ ----Total Potential Energy
  - $= \rho g V z + \rho g V h$



(ρg are just properties of the water)

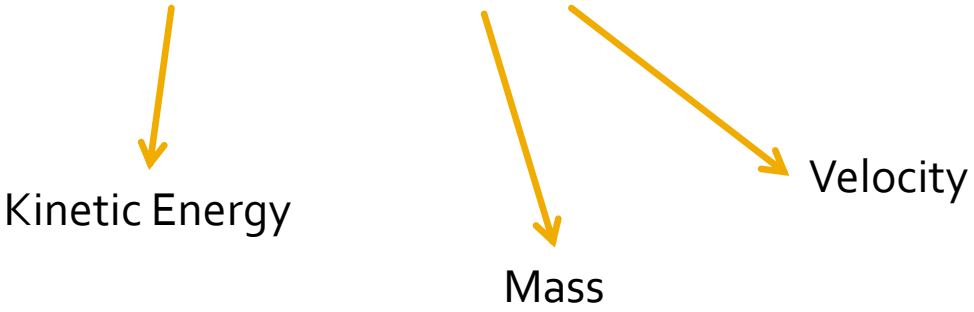
Kinetic Energy

- The Energy of Motion

Kinetic Energy

- The Energy of Motion
- Without going through the calculus…

- $KE = \frac{1}{2} m v^2$



Or… in Dingman…

KE = ½ mu^2

Head

- Head is a nice way to simplify these energy equations further
- We can simply divide out the common terms of ρgV
  - (or γV if you prefer)

- PE = ρgVz + ρgVh … becomes…

Head

- $h_{PE} = z + h$ --- Potential Head
- $h_g = z$ --- Elevation Head
- $h_p = h$ --- Pressure Head

Head

- Kinetic Energy Head or Velocity Head
- If we divide KE by ρgV, we get…
- $h_{KE} = u^2/2g$

Head

- Total Head

$h = h_g + h_p + h_{KE}$

- But wait! What about friction from the boundary layer?

Head

- Friction results in heat which is energy (or head) lost … (h_e)
  - So… from two points in a stream…

- $h_2 - h_1 = h_{g2} - h_{g1} + h_{p2} - h_{p1} + h_{KE2} - h_{KE1} + h_e$
  - (Head (or energy) is conserved)