(1) Purpose

Drawings + Diagrams

Sources

- Robert L. Mott | Joseph A. Untener
"Applied Fluid Mechanics, 7th edition
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Design Considerations

Colby C. Burnam

Pre-Test 1

Power = $h \gamma Q$

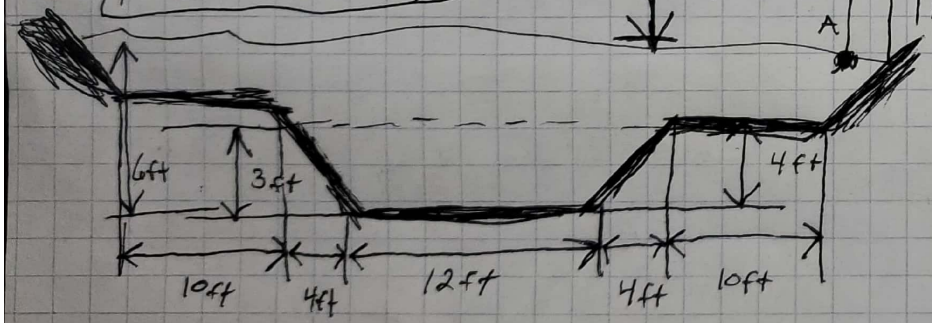
$P = (10ft)\gamma\left(3.387 \frac{ft^3}{s}\right)$

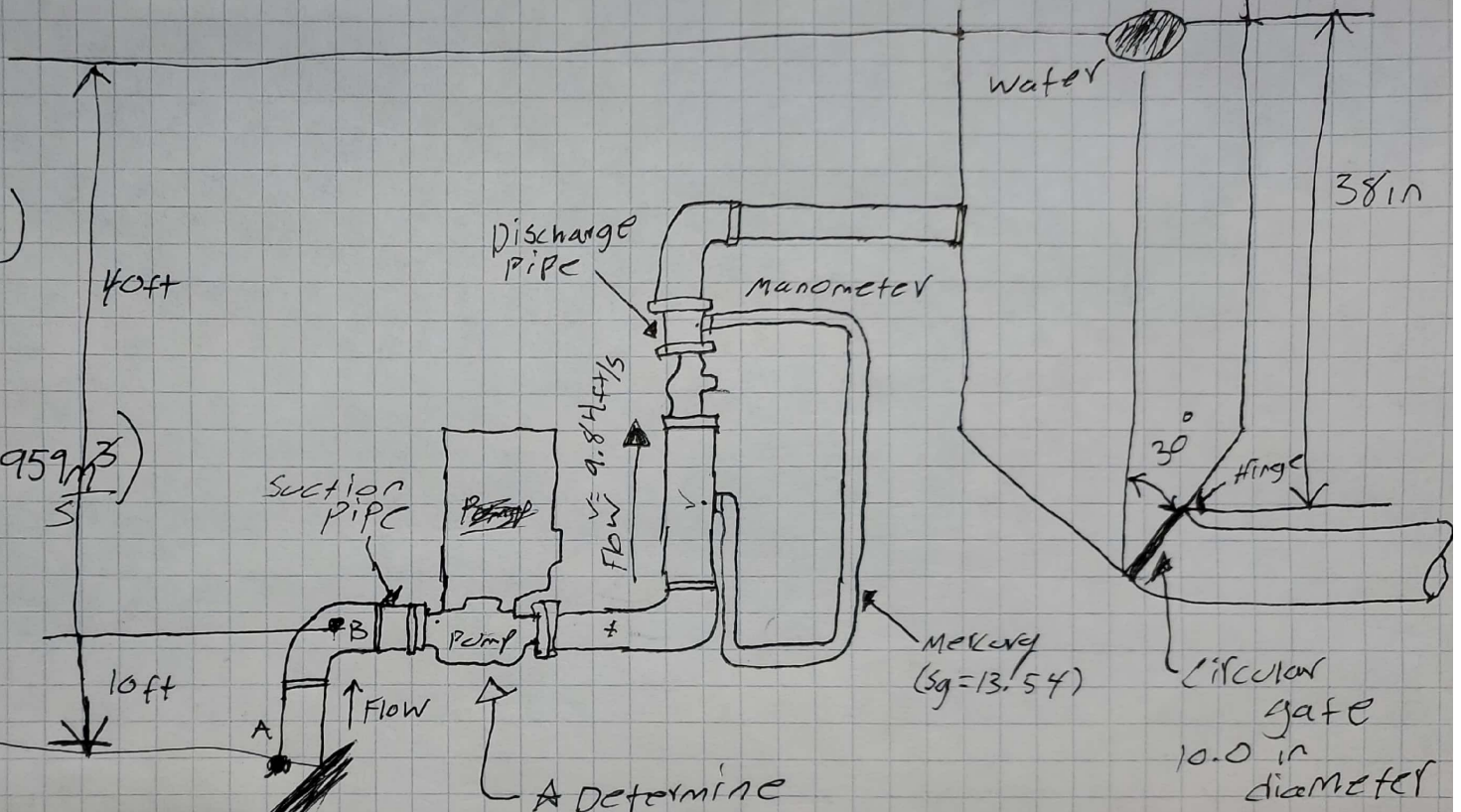
$\gamma = 9.81 \frac{kN}{m^3}$

$= (3.048m)\left(9.81 \frac{kN}{m^3}\right)\left(0.0959 \frac{m^3}{s}\right)$

$P = 2.867 \frac{kN \cdot m}{s}$

$P = 0.0028 \frac{NM}{s}$





A Determine required Pump Power @ 60% eff.

$P = 0.000003753\ hp$

$P = 3.75 \times 10^{-6}\ hp$

$\gamma_{h2o} =$

Data & variables

Procedure

Calculations

Summary

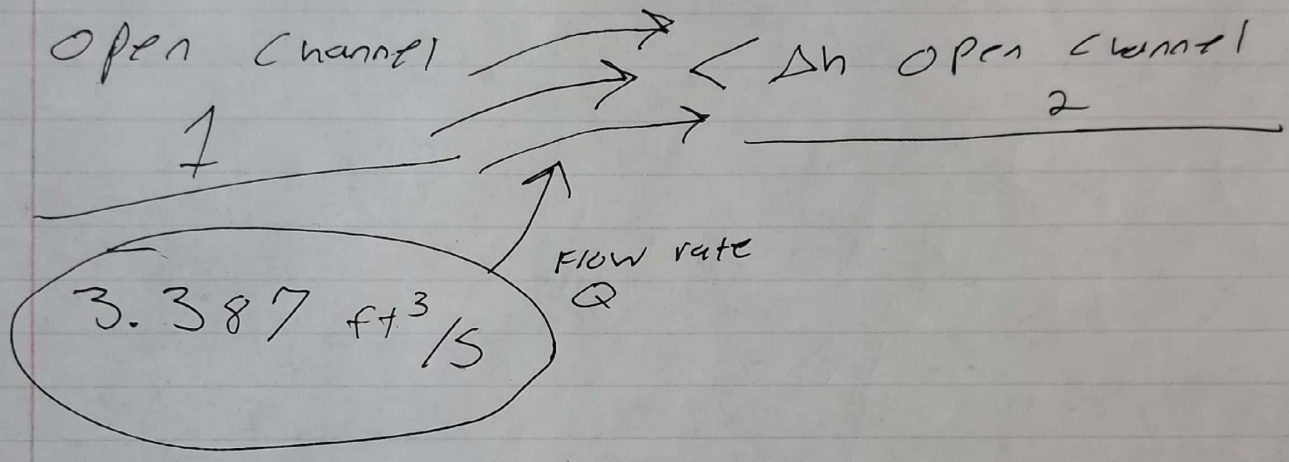
Materials

Analysis

Fluid mech pre-test 1

Colby C. Barnam

Design: Move water@ (60°F) → (15.56°C) from a large open channel to another one with a higher Δh



a) Determine required pump power (HP) efficiency 60%

$L_{suction} = 11\,ft$ $L_{Discharge} = 2500\,ft$

$K_{Valve} = 5.3$ (resistance coefficient)

Select Pipe Diameter: (Table F1 appendix)

Desired flow velocity: 3 m/s

Bernoulli's

$$h_A + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_{L12}$$

a) Determine Pump Power

$10\,ft = \Delta h$

$-F = \Delta h \gamma$

$P = \gamma Q h_A$

Fluid flow velocity $= 3\ m/s \rightarrow$ velocity $9.84\ ft/s$

Volumetric flow rate $= 3.387\ ft^3/s$

$Q = \frac{V_{olume}}{\Delta t}$ (ft^3 / s) $\uparrow$ $\frac{ft^3}{s}$

$Q = VA$ Mass Flow rate

$Q = 3.35\ ft^3/s$

Velocity · Area

$3.35\ \frac{ft^3}{s} = (9.84\ \frac{ft}{s}) \cdot (0.34\ ft^2)$

$3.387\ \frac{ft^3}{s} = 9.84\ \frac{ft}{s} \cdot A$

$1\ m/s = 3.28\ ft/s$

$3 \cdot 3.28 = 9.84\ ft/s$

$3.387\ \frac{ft^3}{s} = A$

$9.84\ ft/s$ Input to Table F1

$0.34\ ft^2 = A$

NPS 2.5"

$ID = 2.469\ in$

b) Manometer - U - tube = 20 inches

$$\frac{\Delta P}{\gamma} = K\frac{V^2}{2g}$$

Determine reading

$P = 0.322 \frac{N}{m^2}$

or

$P = 0.322$ Pascals

$K =$ ~~5.3~~

$V = 9.84$ ft/s

~~γ 9.81 $\frac{kN}{m^3}$~~

sg	γ
13.54	132.8 $\frac{kN}{m3}$

$g = 9.81 \frac{m}{s^2}$

C) Determine
- Pump Power (HP)
- Manometer reading
  - different flow rates from $0 \frac{ft^3}{s}$ to $4 \frac{ft^3}{s}$

Plot required Pump power vs. flow rate

$Q = 1.8408 \times 10^{-6}$

Determine half of previous required Pump Power. Then provide the corresponding Flow rate

b) $\frac{\Delta P}{\gamma} = k\frac{v^2}{2g}$

$k_{valve} = 5.3$

$v = 9.84\ \frac{ft}{s} \rightarrow 3\ \frac{m}{s}$

$\gamma_{Merc} = 132.8\ \frac{kN}{m^3}$

$g = 9.81\ \frac{m}{s^2}$

$P = k \cdot \frac{v^2}{2g} \cdot \gamma$

$132.8\ \frac{kN}{m^3} / 1000 = 0.1328\ \frac{N}{m^3}$

$= (5.3)\left(\frac{9.84\ ft}{5}\right)^2 ($

$P = \frac{(5.3)(3\ m^2)^2 (0.1328\ \frac{N}{m^3 2})}{2(9.81\ \frac{m}{s^2})} = \frac{6.33456}{19.62}$

$P = 0.322\ N/m^2$

or

$P = 0.322$ Pascal