

8/24/00 C

## DIMENSIONAL ANALYSIS

- 1) CORRELATE DATA
- 2) PRODUCE A TESTABLE MODEL
- 3) HOPEFULLY WILL BE USEFUL FOR DESIGN, HOPEFULLY WE WILL  
[CAN] SOME THINK

### HOW TO:

- ① MAKE A LIST OF THE RELEVANT VARIABLES.

$$\Delta P [=] \quad \delimit{m}{L^2} \quad m/Lt^2$$

$$D [=] L$$

$$L [=] L$$

$$V = L/t$$

$$\mu \quad \frac{m}{L} \quad \frac{m}{L^3}$$

3) USE THE BUCKINGHAM PI THEOREM

$$\therefore P - D = 6 - 3 = 3$$

VARIABLES      FUNCTIONAL DIM-  
 DIM-

4) SELECT "D" OF VARIABLES AS RECURRING PARAMETERS

$$\mu$$
~~$$\mu$$~~

$$L$$
~~$$L$$~~

$$D$$
~~$$D$$~~

THESE WILL FORM THE GROUPS THAT ARE 2 BFT. (IMPORTANT, U)

5) FORM DIMENSIONLESS GROUPS THAT ARE PRIOR TO OTHER VARIABLES

$$\mu^* = \mu g^a \frac{U}{R}^b$$

$$L^* = L g^a \frac{U}{D}^b$$

$$D^* = D g^a \frac{U}{D}^b$$

SET UP EQUATIONS TO MAKE THESE DIM



$$a = -1$$
$$b = -1$$

$$-1 + 3 - 1 + c = 0$$
$$c = -1$$

$$M^* = \frac{M}{s u D}$$

$$L^* = L s^a u^b D^c$$

$$m: a = 0$$

$$L: 1 - 3a + b + c = 0$$

$$t: -b = 0$$

$$c = -1$$

$$L^* = \frac{L}{D}$$

$$\Delta P^* = \Delta P s^a u^b D^c$$

$$\Delta m: 1 + a = 0$$

$$L: -1 - 3a + b + c = 0$$

4

SO WE HAVE

$$\therefore \frac{M}{\rho u D} \quad \frac{L}{D} \quad \frac{\Delta p}{\rho u^2}$$

$$\frac{\rho u D}{M}, \quad \frac{L}{D} \quad \frac{\Delta p}{\rho u^2}$$

DEP

INDEP.

$$\frac{\Delta p}{\rho u^2} = \frac{L}{D} \propto \left( \frac{\rho u D}{M} \right)^B$$

THINK A BIT



$$\Delta p_2 - p_1 = p_2 - p_3$$

$$\frac{\Delta p}{\rho u^2} \propto \frac{L}{D} \left( \frac{\rho u D}{M} \right)^B$$

⑤

$$\frac{D \cdot u \cdot \rho}{\mu} = \text{Reynold \#}$$