457.204 Elementary Fluid Mechanics and Lab.
Elementary Test

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ET 5: Bernoulli's Theorem Demonstration

1. Objective

To investigate the validity of Bernoulli's Theorem as applied to the flow of water in a tapering circular duct.

2. Theory

Considering flow at two sections in a pipe, Bernoulli's equation is written as:

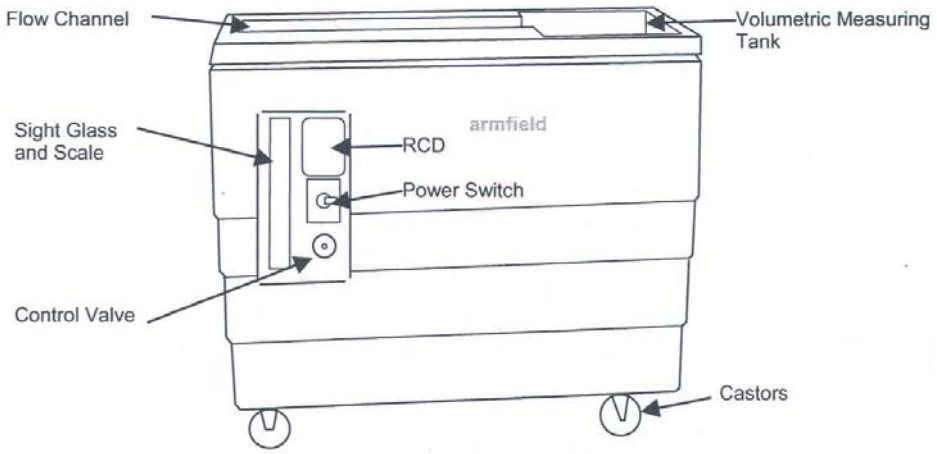
$$\frac{U_1^2}{2g} + \frac{P_1}{\gamma} + Z_1 = \frac{U_2^2}{2g} + \frac{P_1}{\gamma} + Z_2 + h_f = H \qquad (1)$$

Hence if Bernoulli's Theorem holds true:

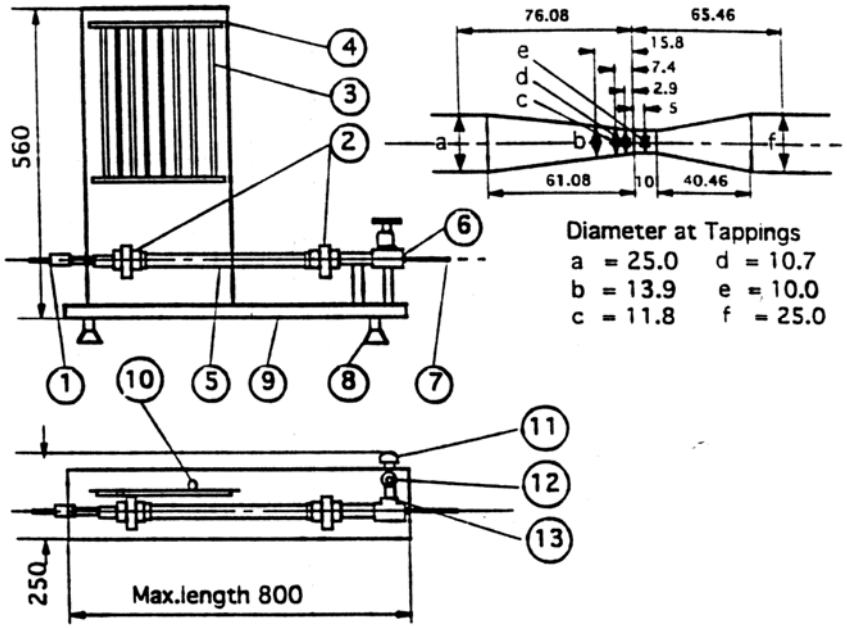
$H = \frac{U^2}{2g} + h$ is constant at all sections along the duct.

3. Equipment Set-up

1) Hydraulics Bench



2) Bernoulli's Theorem Demonstration Apparatus



4. Procedure

① Note the radius of the duct area connected to the manometer and compute the potential head z.

② Calculate the flowrate with a stopwatch and the volumetric tank level.

③ Calculate mean velocity of each cross section with flowrate and cross sectional area.

④ Use the mean velocity to compute Reynolds number and velocity head.

⑤ Measure the pressure head by reading Manometer level.

⑥ Sum of potential head(①), velocity head(④) and pressure head(⑤) is total head.

⑦ Measure the total head of each cross section.

⑧ Compare the computed total head(⑥) with measured total head(⑦)

⑨ Repeat process ② - ⑤ 5 times with each other flowrate.

5. Results

① Plot total head curve..

② The computed total head is larger than the measured total head. What are the reasons? How is it related to the Reynolds number? What measures can be taken to compensate the error?

③ The headloss of an abrupt enlargement in a circular duct is $h_L = K_L \frac{(V_2 - V_1)^2}{2g}$.

Find the headloss coefficient. Compare the results to Fig 9.15 in the Text p.360.