Bernoulli’s Equation

Water flows through a smooth, horizontal venturi meter with an entrance diameter of 375 mm and a throat diameter of 125 mm. If the pressure difference between these sections corresponds to a head of 457 mm of water, determine the mass flow rate in kg/s.

To calculate the **mass flow rate** through the venturi meter, we will use **Bernoulli’s principle** and the **continuity equation**.

### Given Data:

**Diameter at entrance (Section 1):**

**Diameter at throat (Section 2):**

**Pressure head difference:**

**Density of water:**

### Step 1: Cross-sectional Areas

The areas of the entrance and throat are given by:

Substitute the values of and :

### Step 2: Bernoulli’s Equation Between Two Points

The Bernoulli equation, assuming negligible height differences and no losses, is:

Rearranging for the velocity difference (using the pressure difference in terms of head):

Simplify (cancel ):

Thus:

### Step 3: Continuity Equation

From the continuity equation:

Solve for in terms of :

### Step 4: Substitute into Bernoulli’s Equation

Substitute into :

Factor out :

Solve for :

Take the square root to find :

### Step 5: Calculate

First, calculate the ratio :

Now calculate :

Substitute into the equation for using ( and ):

### Step 6: Calculate Mass Flow Rate

The mass flow rate is given by:

Substitute , , and :

### Final Answer:

The mass flow rate is approximately: