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Development of Bernoulli's Test Rig

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Abstract-Bernoulli's Theorem is a key pillar of fluid mechanics, showing the idea of energy conservation for fluids that are flowing under perfect conditions. It tells us that in a smooth, steady flow of a fluid that can't be squashed and isn't sticky, the total of its pressure energy, kinetic energy, and potential energy per unit volume stays the same. This theorem gives us big insights into how fluids behave and is super helpful for studying and designing systems where fluids move, like aircraft wings, pipelines, and ventilation setups. This paper digs into the theory behind Bernoulli's Theorem, how it comes from Euler's equations, and its real-life uses and limits. The study also talks about experiments that prove it works and looks at how things like stickiness and compressibility affect it, giving a full picture of its importance in today's engineering and physics.

RELEVANCE

Bernoulli's Theorem is a super important concept for understanding how fluids behave. Simply put, when a fluid moves faster, its pressure goes down. This idea, figured out by Daniel Bernoulli way back in the 1700s, connects a fluid's speed, pressure, and height. It's a basic rule in fluid mechanics that says the total energy of a flowing fluid – including its pressure,
Movement, and position – stays the same, as long as the fluid isn't compressed, doesn't stick to anything, and flows smoothly. This is really useful in lots of engineering and science fields. We can write this concept as a mathematical equation...

$$p_1 + \frac{1}{2}pv^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

WORKING

Bernoulli's apparatus is used to show Bernoulli's principle, which says that when a fluid (like water) moves faster, its pressure drops, and when it slows down, the pressure increases.

Here's how it works:

1. Setup: Bernoulli's apparatus is usually a long channel with different widths along its length, and it has water flowing through it. You might also see pressure gauges (or manometers) to measure pressure at different points in the tube.
2. Fluid Flow: When fluid flows through the channel, it moves at different speeds depending on the width of the tube. In narrower sections, the fluid speeds up, and in the wider sections, it slows down.
3. Pressure Change: According to Bernoulli's principle:
   - In the narrow sections where the fluid speeds up, the pressure drops.
   - In the wider sections where the fluid slows down, the pressure goes up.
4. The apparatus has tube at different points along the channel. This tube shows that in the narrower parts of the tube, the pressure is lower, and in the wider parts, the pressure is higher. This is exactly what Bernoulli's principle predicts.

Fig. No.1.(Test Rig of Bernoulli's Theorem.)

Drawing of various components

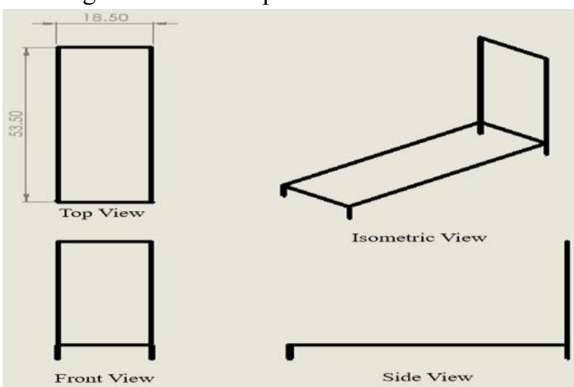


Fig. No.1.1. (2D and 3D drawing of Base frame)

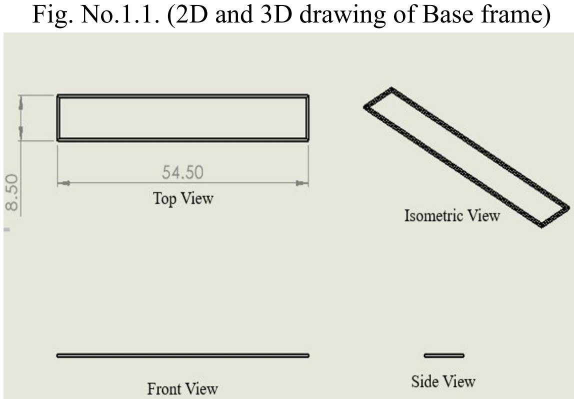


Fig. No.1. 2. (2D and 3D drawing of tank supporting frame)

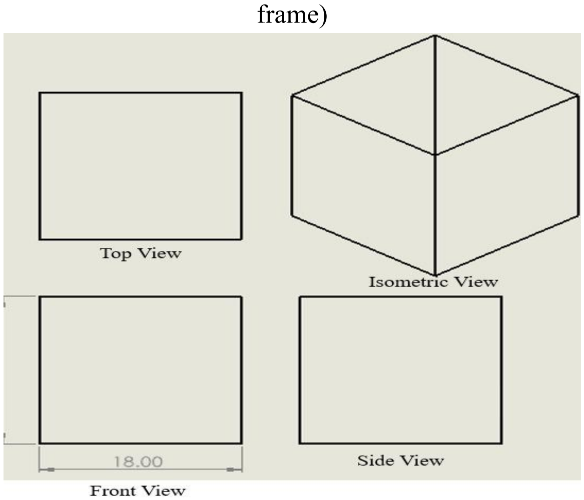


Fig. No.3.(2D and 3D Drawing Of Measuring Tank)

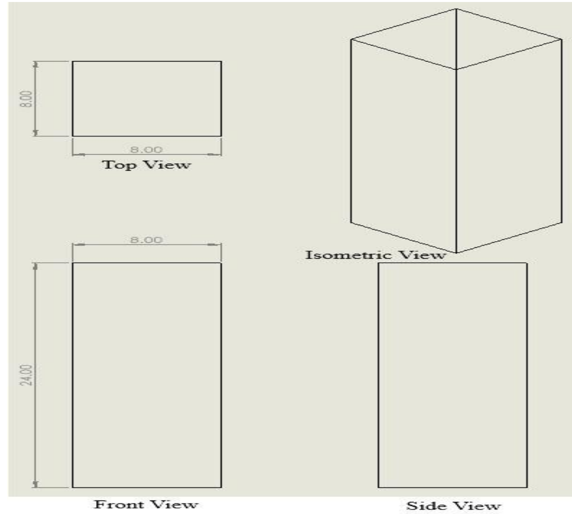


Fig.No.4. (2D and 3D Drawing of Collecting tank)

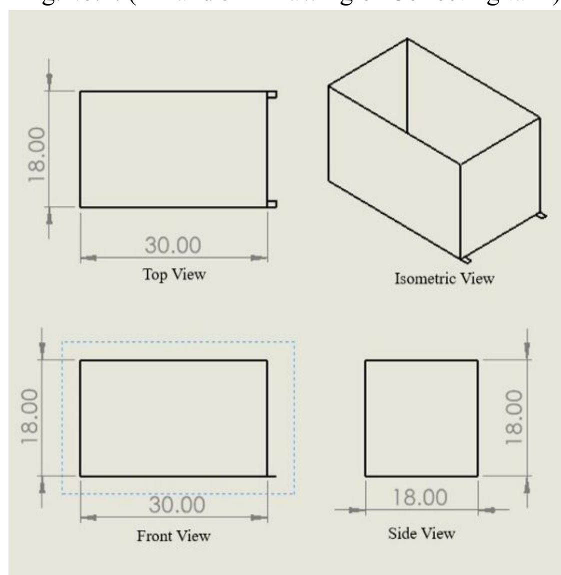


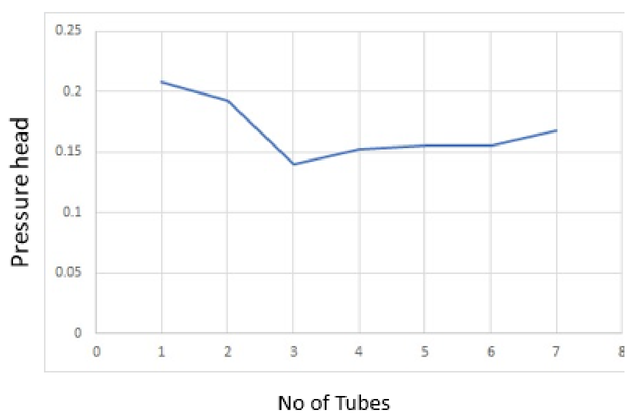
Fig.No.5 (2D and 3D Drawing of storage tank)

Actual Procedure follow

1. Start the pump and waiver will flow in the pipe line
2. Open the valve so that the water can enter in the pipe of varying cross section.
3. Open the outlet valve after rising water in piezometer.
4. Maintain level of water
5. Record head shown in the piezometer
6. Measure discharge in the measuring tank.
7. Note the time taken for collecting of water by stop watch
8. Vary the discharge.
9. Repeat the procedure as above.

Testing Results

Tube No	Cross sectional area of the pipe	Velocity 'V'	velocity head	Pressure head	Total head= velocity head+ pressure head
	M^2	m/sec	$\frac{v2}{2g}$	$\frac{p}{w}$	$(v2/2g)+\frac{p}{w}$
1.	0.0436	0.033	5.55×10^{-5}	0.208	0.208
2.	0.0037	0.030	4.58×10^{-5}	0.193	0.193
3.	0.0196	0.022	2.466×10^{-5}	0.140	0.140
4.	0.0239	0.024	2.93×10^{-5}	0.152	0.152
5.	0.0240	0.024	2.93×10^{-5}	0.155	0.155
6.	0.0240	0.024	2.93×10^{-5}	0.155	0.155
7.	0.0289	0.026	3.44×10^{-5}	0.168	0.168



CONCLUSION

1) Velocity head at respective point $= \frac{v^2}{2g} = 4.58 \times 10^{-5} m$
2) Pressure head $\frac{p}{w} = 0.208\ m$
3) Total head $= \frac{P}{W} + \frac{V^2}{2g} = 0.208$m

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