IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 5, Issue 7, April 2025

Impact Factor: 7.67

Development of Experimental Setup of Venturi and Orifice Meter

Om Shinde , Vedant Landge, Uday Narwade, Yash Takawale, Prof. S. S. Gurav

Students, Department of Mechanical Engineering

Lecturer, Department of Mechanical Engineering

Zeal Polytechnic, Pune, Maharashtra, India

Abstract: *This research aims to manufacture and test a machine for cutting sugar cane buds to develop mechanization of the stage of preparing sugarcane seedlings in the nursery. The developed machine consists of a frame, cutting unit, electric motor, and power transmission system. The machine will save the time, effort, and cost spent on cutting reeds by traditional methods. The machine cuts the sugarcane stalks that are used as seeds and which contain undamaged buds, the operator cuts the groups of sprouts by bud cutting machine. It also aimed at improving agricultural efficiency in sugar cane cultivation. The machine utilizes advanced cutting mechanisms and precision control to ensure accurate and efficient cutting of sugar cane buds, facilitating the propagation process. Key features include adjustable cutting parameters, automated bud detection, and robust construction for durability and reliability in agricultural environments. The performance of the machine was evaluated through field trials, demonstrating significant improvements in cutting accuracy, speed, and overall efficiency compared to traditional manual methods. The adoption of this innovative machine promises to revolutionize sugar cane cultivation practices, offering farmers a cost-effective solution to streamline their operations and increase productivity.*

Keywords: Set Up Of Venturi & Orifice Meter

I. INTRODUCTION

Venturi and Orifice meters are two widely used flow measurement devices that play a crucial role in various industries, including oil and gas, chemical processing, power generation, and water treatment. A Venturi meter uses a converging section, throat, and diverging section to create a pressure drop, which is directly proportional to the flow rate of the fluid. The pressure drop is measured using pressure taps located at the inlet and throat sections, and the flow rate is calculated using the Bernoulli's equation. This design allows for a more accurate measurement of flow rates, especially in applications where high precision is required. The Venturi meter's design also minimizes turbulence and flow disturbances, ensuring a smooth flow profile and reducing the risk of measurement errors.

On the other hand, an Orifice meter uses a plate with a sharp-edged orifice to create a pressure drop, which is measured using pressure taps located upstream and downstream of the orifice plate. The flow rate is calculated using the orifice equation, which takes into account the pressure drop, orifice diameter, and fluid properties. Orifice meters are widely used due to their simplicity, low cost, and ease of installation. They are particularly suitable for applications where the flow rate is relatively constant, and the fluid properties are well understood.

Both Venturi and Orifice meters are reliable and accurate devices that have been used for decades in various applications, including custody transfer, fiscal metering, process control, and monitoring. While Venturi meters are known for their high accuracy and low pressure loss, Orifice meters are widely used due to their simplicity and cost-effectiveness. Understanding the principles, design, and applications of these devices is essential for selecting the right flow measurement solution for a particular industry or application.

By leveraging the strengths of Venturi and Orifice meters, industries can optimize their flow measurement systems, improve process efficiency, and reduce costs. Furthermore, the accurate measurement of flow rates enables industries to monitor and control their processes more effectively, reduce waste, and improve product quality. This, in turn, can lead to increased productivity, reduced energy consumption, and improved environmental sustainability.

II. CONSTRUCTION PROCESS

Design and Planning: The design involves a Venturi-meter with 11 pressure tapping holes to measure pressure variations at different flow velocities, along with pressure measurement scales and an air pressure bulb to regulate flow. The setup will allow both visual and quantitative observation of pressure changes, demonstrating Bernoulli's Principle in a simple, cost-effective, and educationally valuable manner. The system's design ensures ease of use in laboratory settings and provides clear insights into fluid dynamics

FIG. 1.1 **DESIGN OF EXPRIMENTAL SETUP OF BERNOULLI'S PRINCIPLE**

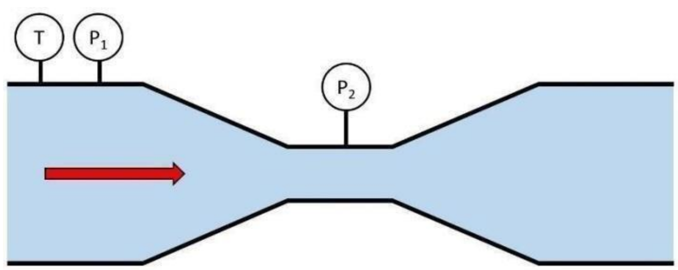

FIG 1.2 DESIGN OF VENTURIMETER.

Material Selection: Appropriate materials like sump tank, water pump, air pressure bulb

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Fig. 2.1 SUMP TANK

Fig. 2.2 WATER PUMP

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Fabrication of Components: working PVC pipe measuring tank fitting.

Fig. 3.1 GRINDING & PVC PIPE FITTING

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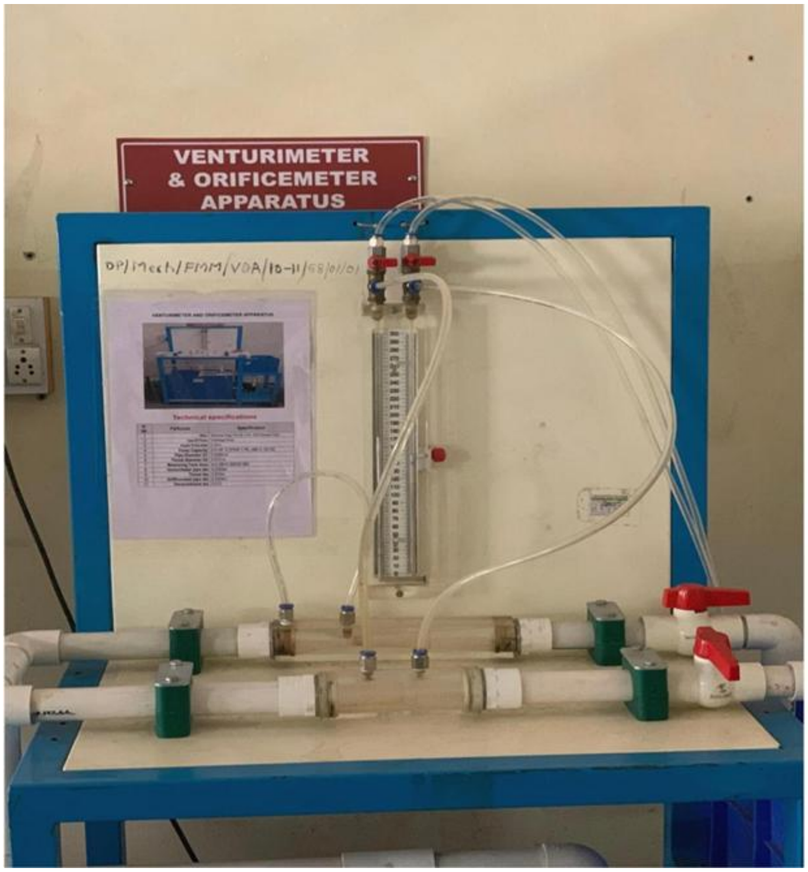

Fig. 4.1 Assemble of set-up

Testing and Calibration: System tested at various flow rates. Pressure and velocity readings are measured and compared with theoretical values. Calibration of flow measuring instruments is done.

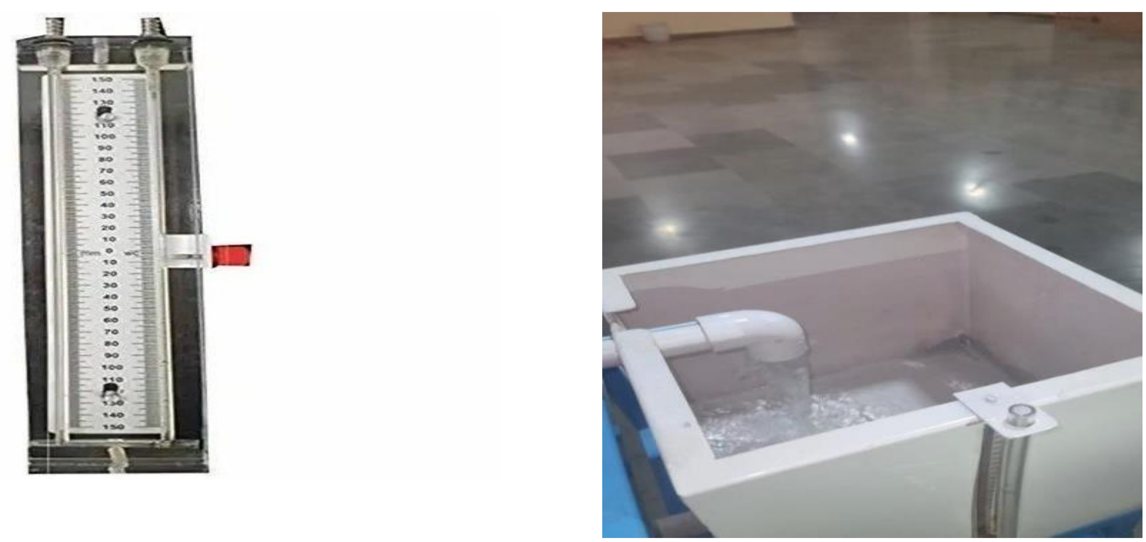

Fig 5.1 Water Tank & Manometer

III. METHODOLOGY

1. THEORY

The methodology chapter outlines the experimental or simulation techniques employed to assess the performance of Venturi and Orifice meters. This section provides a comprehensive description of the setup, procedures, and analysis methods used to generate the data required for comparison.

Where,

P = Pressure

V = Velocity at the point

Z = Potential head from datum w = Specific Weight

Bernoulli's equation for section 1 & 2 are

$$\frac{P_1}{w} + \frac{V^2{}_1}{2g} + Z_1 = \frac{P_2}{w} + \frac{V^2{}_2}{2g} + Z_2$$

But all the real fluids are viscous and hence offer resistance to flow. Thus there are always some losses in fluid flows and hence in the application of Bernoulli's equation, these losses have to be taken into consideration. Therefore Modified Bernoulli's equation is

$$\frac{P_1}{w} + \frac{V^2{}_1}{2g} + Z_1 = \frac{P_2}{w} + \frac{V^2{}_2}{2g} + Z_2 + h_L$$

Where,

h_L =Loss of head between section 1 and 2 Section velocity.

$$V_x = \frac{Q_x}{A_x}$$

Where,

Q_x =Discharge through section

$$= \frac{Volumeofwater}{Timerequiredtocollectwaterinwatertankfor\ 0.1mrise}$$

$$= \frac{Areaoftank \times Riseofwaterlevel}{Time}$$

IV. CONCLUSION

This project focused on the study and analysis of Venturi and Orifice meters, two of the most commonly used flow measurement devices in various industries. The primary objective was to evaluate their performance, validate their accuracy, and identify potential areas for improvement in their application. Below are the key findings derived from the project:

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