THESIS

FLOW VELOCITY MEASUREMENTS IN SMALL CHANNELS BY THRUST ROD

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ABSRACT

The methods mostly used for flow measurement in open channels are Weirs, Orifices, Flumes, Current meters, Velocity rods, Magnetic flowmeters, Ultrasonic Flowmeters etc. These techniques require perfect installation of certain fixtures in channel before the flow measurements. Moreover, these techniques have certain limitations e.g. site selection, channel geometery, cost etc. Deflecting velocity rod involves continuous angular measurements of angles and measures flow velocity with an accuracy of ±10%.

A hinged rod of a suitable dimensions when dipped in flowing water, deflection is produced due to hydrodynamic force of flowing water and the rod attains equilibrium in its deflected state. Alternatively, a simple technique was developed using a hollow rod so, that the effect of buoyancy is minimized. The water thrust was counter balanced by providing additional weight "W_A" at a certain distance "S" from the hinged point. The objective of this study was, development of a theoratical relationship for flow velocity measurement using a thrust rod in a small to medium sized prismatic channels and to verify the developed relationship under laboratory and field conditions.

This relationship was developed by immersing a hollow thrust rod equiped with a counter balancing (weight box) moment arm in flowing water. Rod attains equilibrium after adding some weight in the weight box. In its balanced state the sum of all the moments about the hinged point is equal to zero. Keeping in view the assumptions that the channel is prismatic, flow is steady uniform, hinged point of rod is frictionless and pressure distributuion is hydrostatic. The developed relationship relate average flow velocity to the additional weight attached to the thrust rod.

Using thrust rods of different characteristics, the the developed relationship was verified under laboratory as well as under field conditions for different discharges and flow depths. Under laboratory conditions, flow velocity was determined using three thrust rods of different physical properties and the determined values were compared with those measured using current meter and a V notch weir. A velocity coefficient was developed to corelate the errors due to assumptions. While under field conditions most suitable thrust rod based on laboratory results were used and results obtained were compared with the flow velocity measured using digital current meter.

It was found that the difference behaviour between the determined and measured velocities depends upon the shape and weight of rod. The rod of lighter weight gave values closer to the measured. Whereas, the heavier rod under estimated the flow veocity, because the effect of buoyancy was significant and less weight "W_A" was required to counter balance the water thrust. The rod of width twice the thickness gave more accurate estimation of velocity.

From this research it is concluded that a thrust rod provided with a counter balancing moment arm can be used for flow velocity measurements in small to medium sized prismatic channels, within the limits of applicability of the rod used.