AN INNOVATIVE DESIGN OF A PROPORTIONAL TYPE FLOW METER FOR STREAM GAUGING

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ABSTRACT

An innovative method to find geometry of flow meter has been evolved. Experimental results obtained in laboratory flume are provided. An example is worked out.

1. Introduction

Flow data form one of the basic requirements for planning, design, construction and operation of hydraulic structures.

2. Hydraulic Design Principles

Generally, Eq. 1 is used to find discharge (Q) in a flow meter (Fig.1)

$$Q=C_d B_0 H^{3/2} \quad (1)$$

where, C_d is the coefficient of discharge for both free and submerged flow

2.1 Modular Limit /Critical Submergence

Modular limit ($S_{cr}=y_2/y_1$) depends on $r=B_0/B_1$, $R=\Delta/y_1$ and Inlet and outlet head loss co-efficient $C_i=h_{Li}/(V_c^2/2g-V_1^2/2g)$ and $C_0= h_{L0}/(V_c^2/2g-V_2^2/2g)$ respectively(Fig.1).Variation of modular limit (S_{cr}) with C_i ,C_o and r for a typical case R=0.2 is illustrated in Fig.2.(Mazumder,1966)

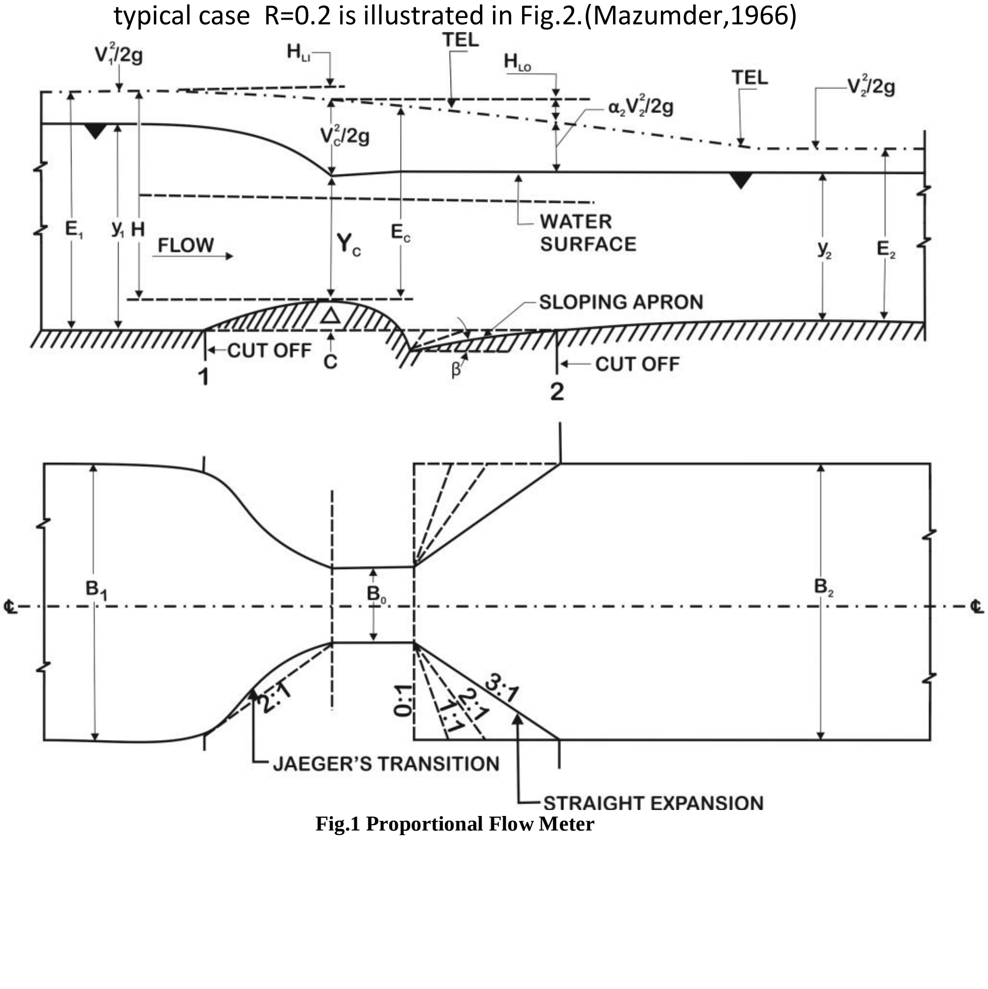

Fig.1 Proportional Flow Meter

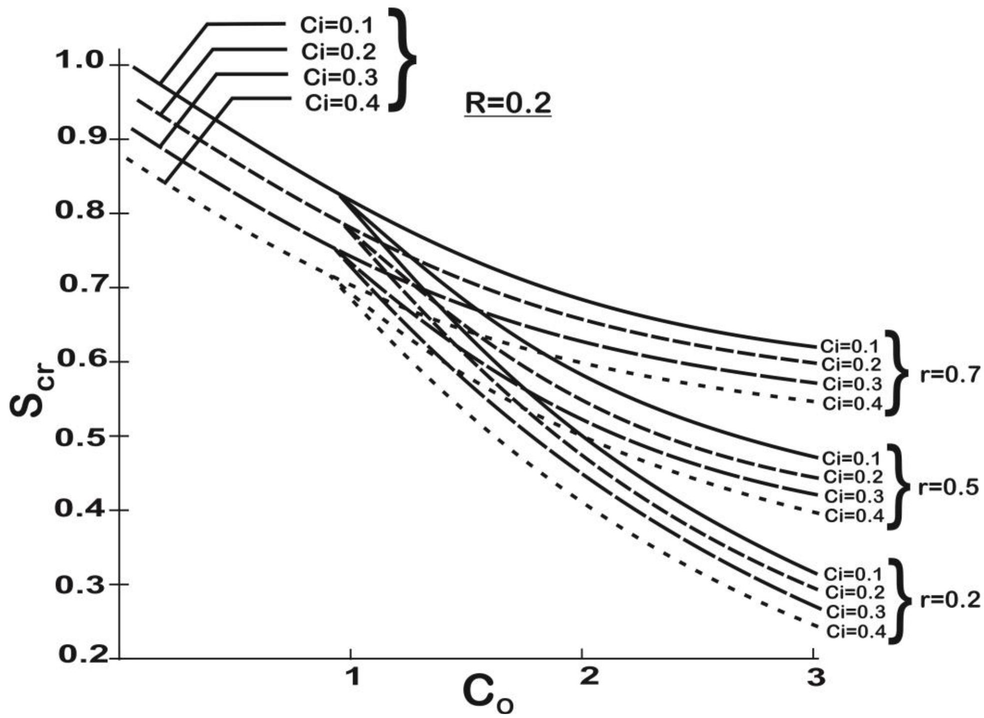

Fig.2 Variation of S_{cr} with C_i, C_o and r(R=0.2)

2. Proportional Flow Meter

Mazumder (2020) developed the unique flow meter by simultaneous constriction in both horizontal and vertical plains as shown in Fig.1. It always acts under free flow condition in the design flow range Q_{max} and Q_{min}. Equations (2) and (3) give the width (B_0) and corresponding rise in bed (Δ) at control section.

$$Bo = [0.7\,(Q_{max}^{2/3} - Q_{min}^{2/3}) / (E_{1max} - E_{1min})]^{3/2} \qquad (2)$$

$$\Delta = E_{1max} - 3/2\,[(Q_{max} / B_0)^2 / g]^{1/3} \qquad (3)$$

3.1 Experimental Investigations

Mazumder and Deb Roy (1999) conducted 24 experiments in flume with smooth entry and straight outlet side walls. Adverse floor slope (β) was provided to eliminate flow separation and obtain uniform velocity distribution at exit.

$$\beta = \tan\text{-}1[(2y_c/B_0)\{(\delta^2+\delta+1)/(2+\delta+\lambda+2\lambda\delta)\}\tan\theta \qquad (4)$$

here, $\delta = y_c/y_2$, $\lambda = B_1/B_0$ and θ =Angle of divergence of side walls downstream.

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