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ANALYSIS OF EXPERIMENTAL DATA ON MODERN SLUICE GATE USED IN CANAL

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Key words:-Q, g, y, a, L, Cd, Cc,K$_1$, θ, π

ABSTRACT

Our past experimental data for skew sluice gates with $\theta = \pi/4$, $\pi/3$& $5\pi/12$ for free flow condition have been analyzed to study the effects of various flow and geometrical parameters on discharge coefficient. Here, in this paper we are trying our to develop a generalize equation for discharge coefficient and flow rate for available gate and analysis of data.

I. INTRODUCTION

For the data set of each oblique angle discharge values are computed using generalized equation (4.39). These values are plotted against actual observed discharge values as shown in Fig. 4.13 to 4.15. The average percentage error has been calculated as:

$$e = \sum_{i=1}^{n} \left| \frac{Q_0 - Q_c}{Q_0} \right| \times 100 \qquad (4.40)$$

Where Q_c is computed discharge and Q_0 is observed or actual discharge values. In Fig 4.13 to 4.15 most of the data fall within the tolerance limit of ±5%. Thus it can be concluded that the discharge equation developed in present investigation may be used to measure flow rate in open channels using skew sluice gates with an error of ±5%.

II. EFFICIENCY OF A SKEW SLUICE GATE

In order to examine the efficiencies of skew sluice gates , ratio of discharges, through a skew sluice gate and a normal sluice gate (Q_{skew}/Q_{90}) fitted in the same channel and operating under the same hydraulic condition were computed and plotted against *y/a* as shown in Fig 4.16 to 4.18.

It is clear from these figures that ratio (Q_{skew}/Q_{90}) remain almost constant with increase in *y/a* values for all gates. A perusal of Fig. 4.16 to 4.18 indicates that for $\pi/4$ skew sluice gate a gain of 40% in discharge is obtained and for $\pi/3$ and $5\pi/12$ skew sluice gates a gain of 20% and 10% in discharge is obtained. Hence it can

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be noted that there is always an increase in discharge efficiency with the use of skew sluice gate. Therefore it is beneficial to use skew sluice gate instead of normal sluice gate for same depth, to increase discharge.

III. REDUCTION IN AFFLUX USING SKEW SLUICE GATE

In order to examine reduction in afflux using skew sluice gates graphs between discharge and upstream depth is plotted for a particular gate opening. These graphs are shown in Figs. 4.19 – 4.21.

A perusal of these figures indicates that for low discharges reduction in afflux is less whereas at high discharge its value is more.

Further for $\theta=\pi/4$ and for Q=0.03m^3/sec. upstream depth is 0.2m. Whereas for normal sluice gate upstream depth required is 0.36m.It clearly shows that 0.36m-0.2m=0.16m is afflux reduction which is nearly half of 0.36m.

Similarly, for $\theta=\pi/3$ and for Q=0.025m^3/sec. upstream depth is 0.2m.Whereas for normal sluice gate upstream depth required is 0.28m.It clearly shows that 0.28m-0.2m=0.08m is afflux reduction.

Similarly, for $\theta=5\pi/12$ and for Q=0.025m^3/sec. upstream depth is 0.25m. Whereas for normal sluice gate upstream depth required is 0.28m. It clearly shows that 0.28m-0.25m=0.03m is afflux reduction.

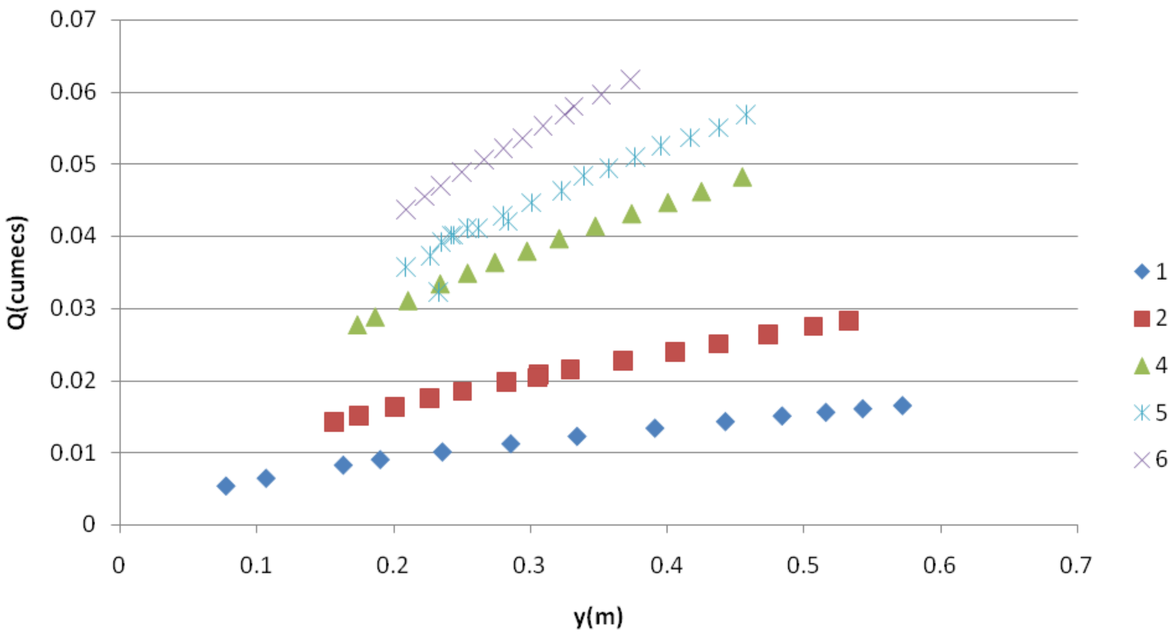

Fig.4.1 Variation of discharge with depth
(θ=45°)

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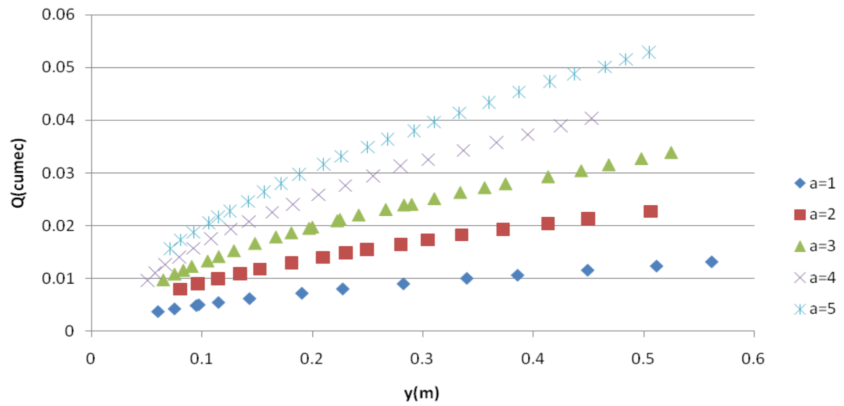

Fig.4.2 Variation of Discharge with Depth (ɵ=60°)

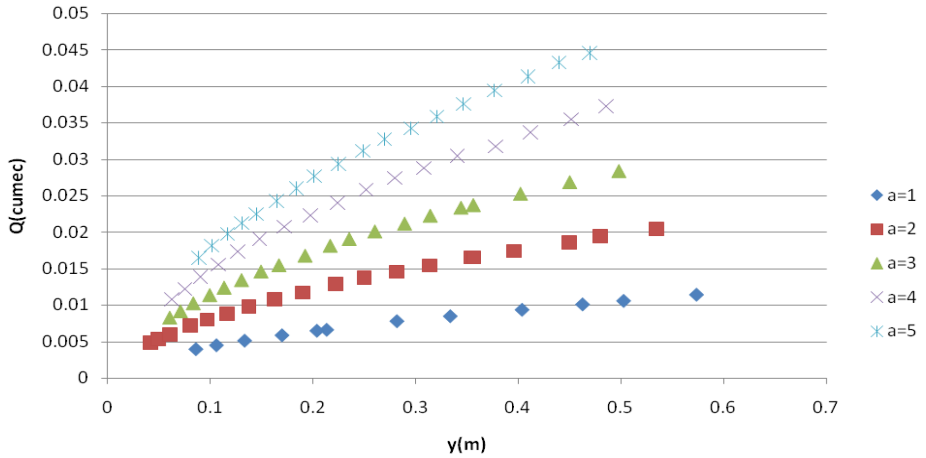

Fig.4.3 Variation of Discharge with Depth (ɵ=75°)

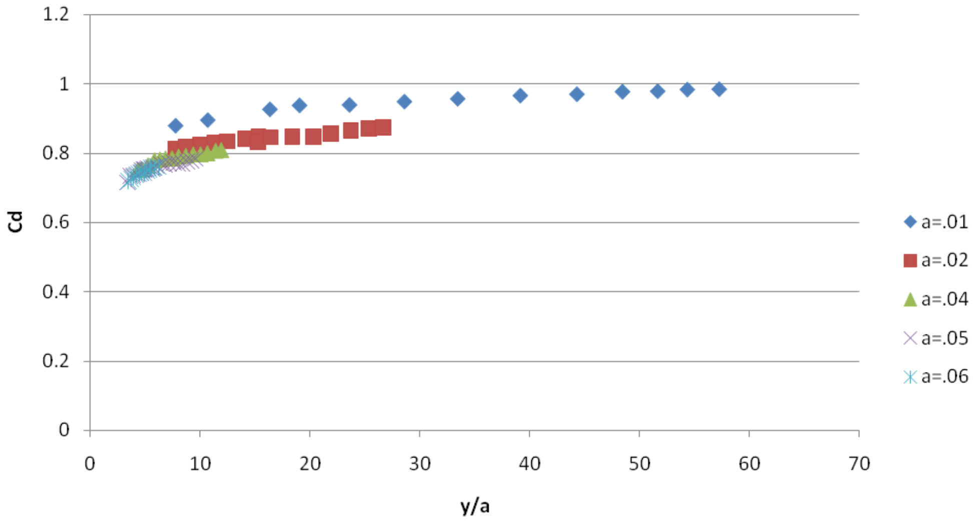

Fig.4.4 Variation of Cd vs y/a (ɵ=45°)

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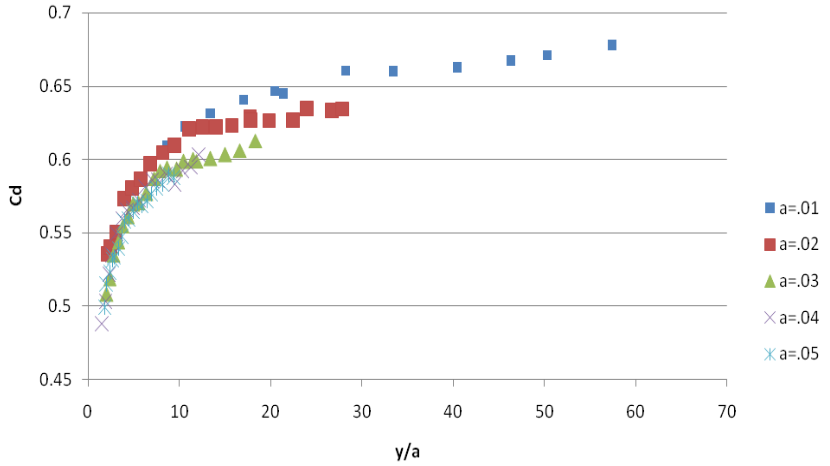

Fig.4.5 Variation of Cd vs y/a
(ɵ=60°)

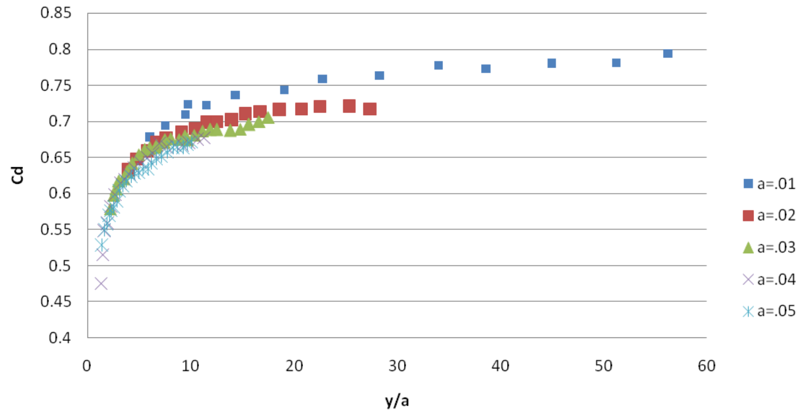

Fig.4.6 Variation of Cd vs y/a
(ɵ=75°)

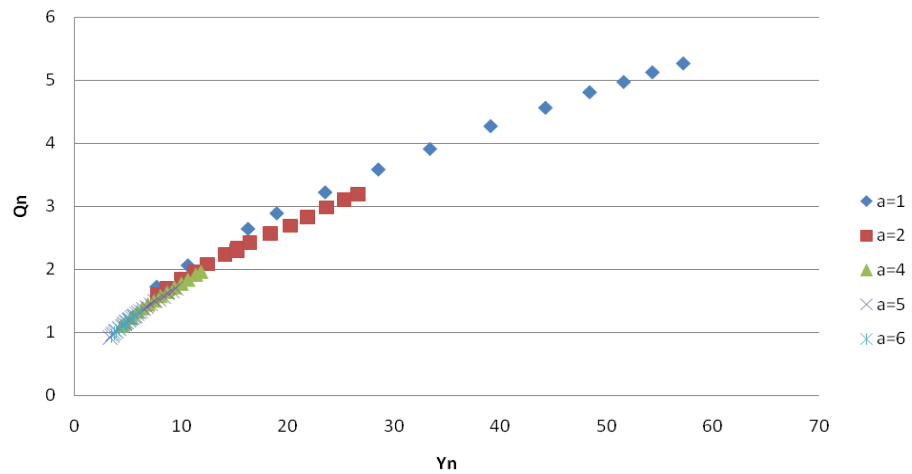

Fig.4.7 Variation of Qn vs Yn
(ɵ=45°)

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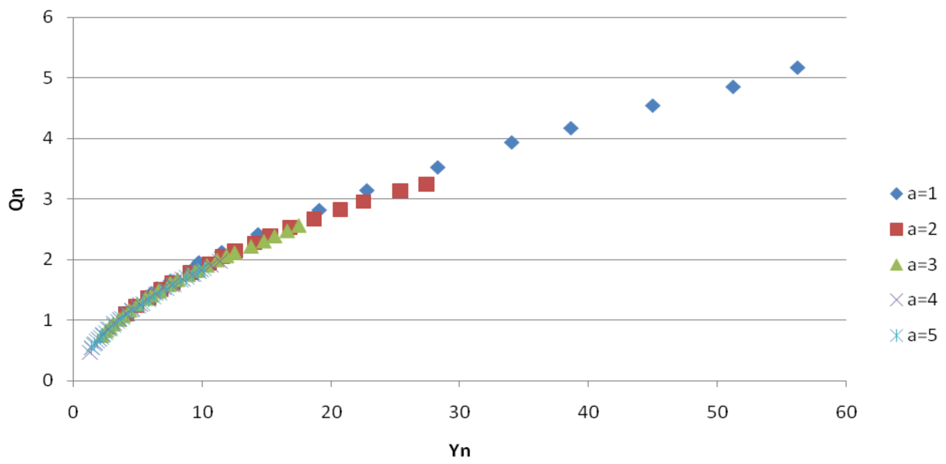

Fig.4.8 Variation of Qn vs Yn
(ө=60°)

IV. CONCLUSION

1. Skew sluice gates can easily be used as a precise discharge metering device.

2. Simple generalized equation of the form $C_d=A(y/a)^n$ for skew sluice gate could not be obtained, due to scatter in points corresponding to coefficient *A* and exponents *n*.

3. Generalized equation in terms of dimensionless discharge Q_n and dimensionless depth Y_n has been obtained. Using this equation, discharge through skew sluice gate can be computed with an error of ±5%.

4. From curves showing Q_{skew}/Q_{90} vs *y/a*, it is clear that there is gain in discharging capacity. This gain is more in case of π/4 skew sluice gate and less in case of 5π/12 skews sluice gate.

5. Larger flow area below skew sluice gate is available for the same depth relative to the conventional normal sluice gate and this reduces afflux on the upstream of the sluice gate. These reductions in afflux is more in case of π/4 skew sluice gate and less in case of 5π/12 skew sluice gate.

6. Since the discharging capacity of these sluice gates is more, the requirement of free board in channels gets reduced and hence sections can be designed more economically. Also with its simple geometric shape it is easy to design and fabricate high discharging sluice gates, even in existing channels.

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