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OPTIMIZATION OF PIANO KEY WEIR FOR DAM

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ABSTRACT:

Non gated spillways are most suitable for small of medium catchment area and for large catchment area gated spillway is more suitable. For safety and cost reason, the fully gated spillway will be avoided in near future and non gated spillway will be accepted solution. Non gated spillway is hydraulically more effective and safe in operation. The discharge capacity of spillway is directly propositional to the crest length. Many types of weirs have been developed with the purpose to increase the crest length. Among these types the recently developed, Piano key weirs prove to be more advantageous regarding hydraulic performance compare to ogee weirs. Moreover its small foundation width makes the Piano key weir cost effective solution to increase the discharge capacity. Still today only initiatory design procedure is available which cannot be generalized.

KEYWORD:Piano key weir, Ogee weir, Spillway.

1. INTRODUCTION:

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The Piano key weir concept was recently developed by Blanc of the University of Briska (Algeria) and Lemperiere (Hydrocoop) in Franch. (Lemperiere and Ouamane, 2003). Similar to Labyrinth weir, Piano key weir crest is folded in plan to increase discharge, however it has a smaller foundation width compare to labyrinth weir, due to overhanging on both side.

The typical Piano Key weir has folded rectangular crest layout (in plan) with sloping inlet and outlet key floor that are cantilever on both side of the spillway foundation width. Figure.1 shows a typical Piano Key weir geometry.

2. EXPERIMENTAL DATA FOR PIANO KEY WEIR:

The experiments have been carried out on 1:35 scale model of basic Piano key Weir geometry shown in Figure.1 for optimization. For this purpose four various Piano Key weir models were selected and tested in 0.85 m. wide and 1.5 m. deep flume at various discharge. The hydraulic data for piano key weir model shown in Figure: 2.

3. TESTING PROCEDURE:

First of all, model was set in flume and leak test was carried out to check all joints were water tight. The model result was collected for discharge ranging from 8.41 m^3/s/m. to 69.30 m^3/s/m. Discharge were measured by using the calibreted rectangular SWF. Water level had been maintained to stabilise for a minimum five minute. To varify that stable flow condition had been achived, then readings were taken at various chainage on upstream and down stream weir. A spread sheet was used to calculate the total head and weir discharge co-efficient (Cd) at various flow rate.

4. RESULT ANALYSIS AND DISCUSS:

Table no: 1 show the Geometric parameters of various studied piano key weir models. Experimental Results tabulated in table no: 2 and prepared graphs Figure: 4 show the Relationship between Discharge vs. Cd and Figure: 5 show the Relationship between Discharge vs. Head.

5. CONCLUSION:

In this study Piano Key Weir optimization investigation have focused on effect of outlet key, inlet key ratio. With increasing discharge, interference of nappe in outlet key also increase which result in decrease discharge capacity. The ratio of b_o/a_i affects the performance of Piano key weir. The width of outlet key increase, its ability to collect all of the flow from the inlet key increase and discharge it downstream with minimum local submergence condition. Submergence effect in outlet key reduces the discharge capacity of weir. At high discharge, the performance of upstream apex dropdown due to local submergence at upstream side of outlet key. The ratio of discharge co-efficient curve was plotted with various discharges. The data in Table 2 show that b_o/a_i = 1.35, geometry is the most efficient of the 4 geometry tested.

6. REFERANCE:

a. Deniz karaeren and Zafer bozkus, Civil engineering dept., middle east technical university, Turkey. (May-2015). Comparison of performance of labyrinth and piano key weirs in increasing the spillway capacity of dam.

b. Dams, piano key weirs, tidal energy and energy storage (www.hydrocoop.org) in piano key weirs triple the spillway discharge, (june-2015).

c. S. Erpicum, A. Silvestri, B.J. Dewals, P. Archambeau, M. Pirotton, HECE, Argenco dept.., university of liege, Belgium. (Nov-2013). Second international workshop on labyrinth and piano key weir, Paris, France.

d. F. lemperiere (Hydrocoop), A. Ouamane (Biskra university) and J.P. vigny (Hydrocoop) (Sept-2013). Piano key weir could be used most African spillway (www.hydrocoop.org/piano-key-weirs).

e. F. lemperiere (Hydrocoop), A. Ouamane (Biskra university), (July-2013). The piano key weir a new cost efficient solution for spillways ‘Hydropower and dams’ journey of the international hydropower association.

f. Phillips M.A., Lesleighter E.R., Piano key weir spillway, upgrade option for a major dam. international workshop labyrinth and piano key weirs II (2013). 159-168, CRC press, Boca raton.

g. Kabiri Samani, A., Javaheri A., Discharge coefficient for free and submerged flow over piano key weir. J. Hydraulic research, 50(1), 114-120.

h. M. Leite Ribeiro, M. Bieri, J-L, Boillat, A.J. Schleiss, and N. Sharma (Feb. 2012) Discharge Capacity of Piano Key Weir.

Table 1. Geometrical Characteristics of the studied PK Weir

(all dimensions are in cm.)

Model No.	L/B	bo/ai	P	Pm	ai	bo	w	B	S in.	S out.	t
PK1 M1	3.42	1.00	13.10	8.75	13.30	13.30	35.00	85.00	0.50	0.50	0.80
PK2 M1	3.42	1.20	13.10	8.75	12.10	14.60	35.00	85.00	0.50	0.50	0.80
PK2 M2	3.42	1.35	13.10	8.75	11.40	15.30	35.00	85.00	0.50	0.50	0.80
PK2 M3	3.42	1.45	13.10	8.75	10.90	15.90	35.00	85.00	0.50	0.50	0.80

Table 2. Cd at 50 m. Chainage (U/S)

Discharge in cu.m./s/m	Ogee Weir		PK1 M1 (1:1)		PK2 M1 (1:20)		PK2 M2 (1:35)		PK2 M3 (1:45)	
	H	Cd	H	Cd	H	Cd	H	Cd	H	Cd
	L/B =1.00		L/B =3.42		L/B =3.42		L/B =3.42		L/B =3.42	
8.41	3.36	0.463	1.54	1.491	1.44	1.649	1.47	1.598	1.30	1.922
21.01	5.04	0.629	3.63	1.029	2.94	1.412	2.77	1.544	3.01	1.363
33.62	6.76	0.648	4.96	1.031	4.76	1.097	4.66	1.132	4.76	1.097
46.23	8.19	0.668	6.36	0.976	6.23	1.007	6.27	0.997	6.33	0.983
58.54	9.59	0.668	7.83	0.905	7.42	0.981	7.46	0.973	7.49	0.967
69.30	10.88	0.654	8.38	0.968	8.47	0.952	8.40	0.964	8.68	0.918

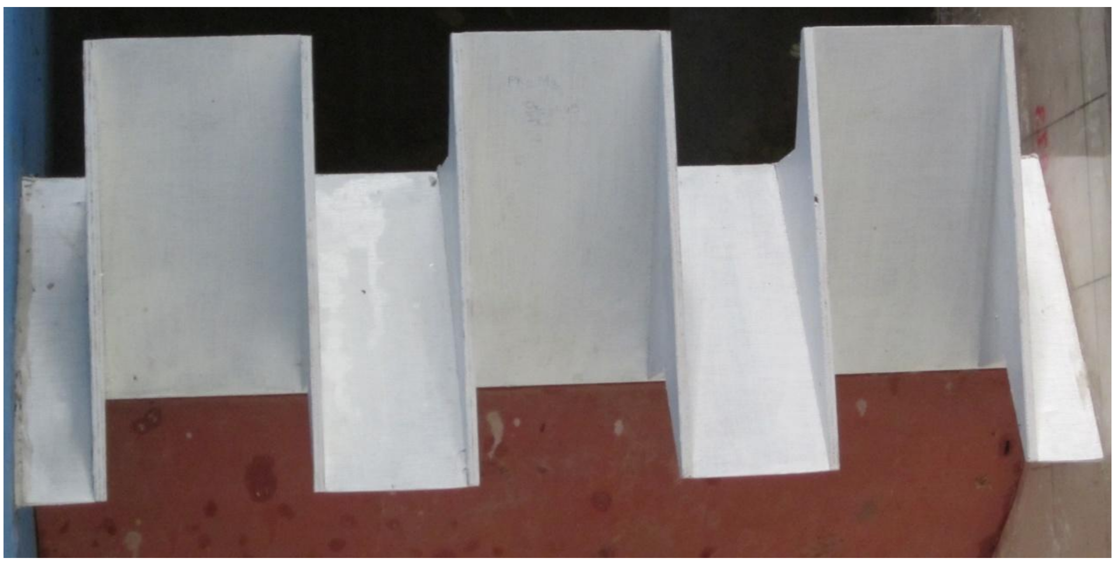

Figure 1. PK2 M3 weir Model

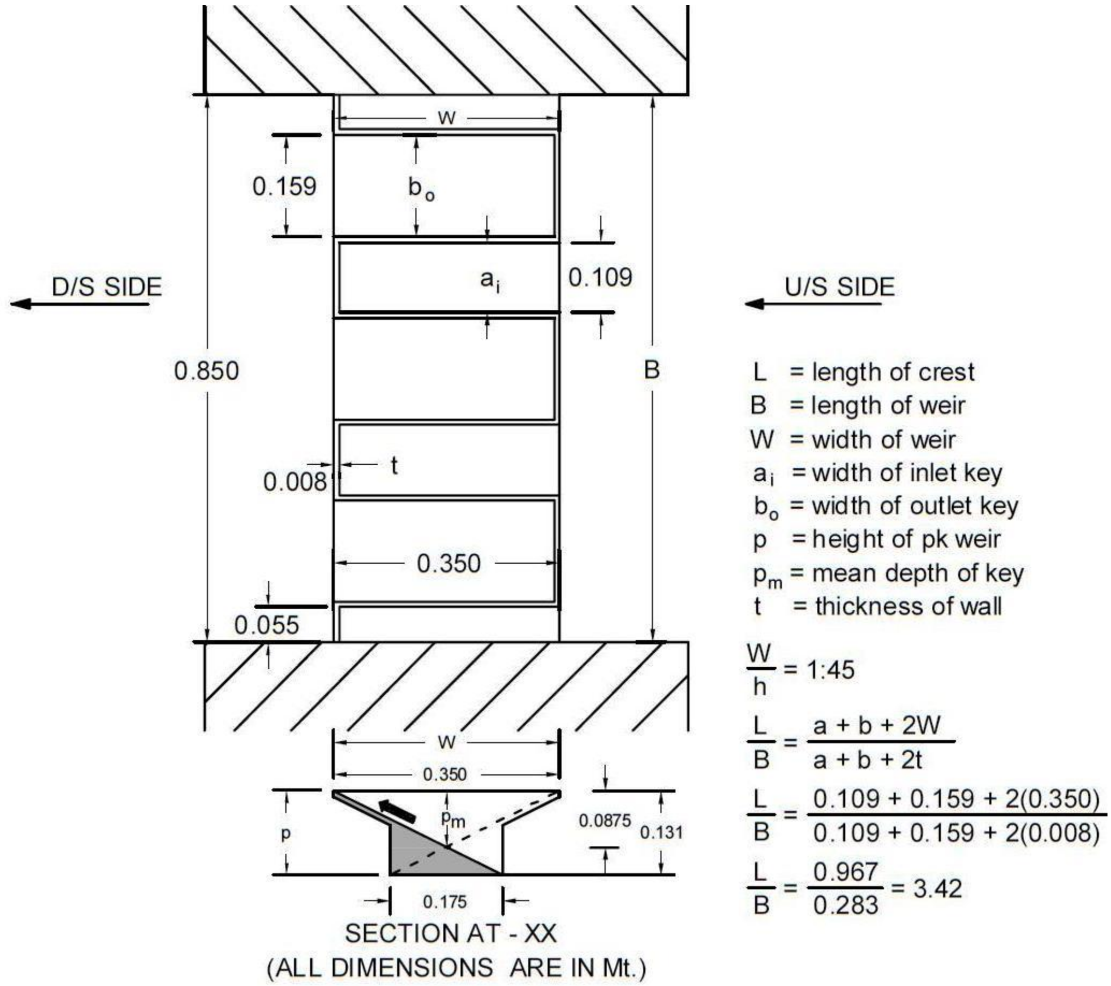

Figure 2. PK2 M3 Model Detail

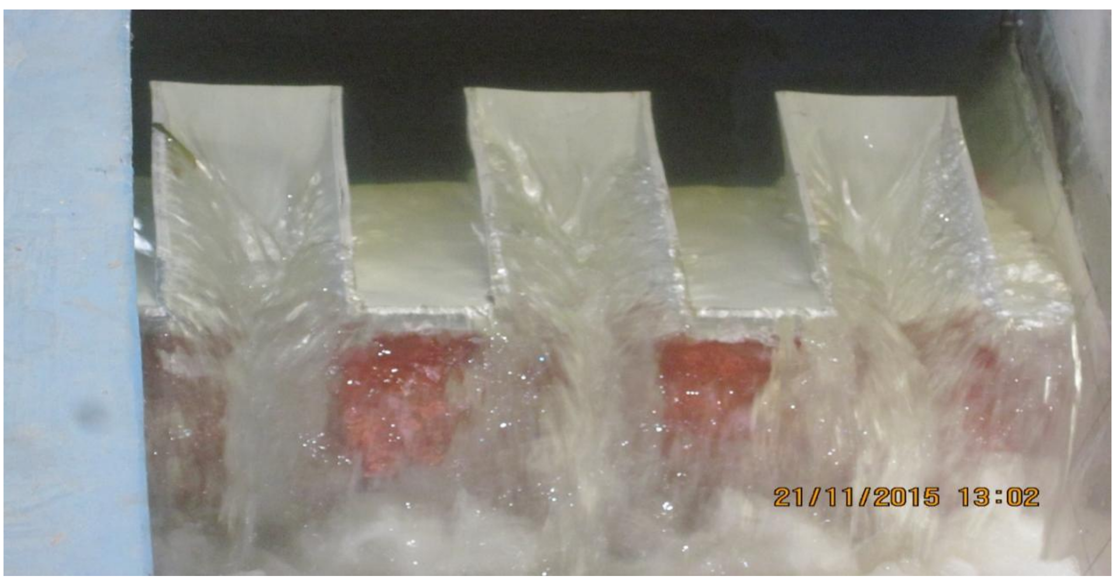

Figure 3. PK2 M3 Model Photo

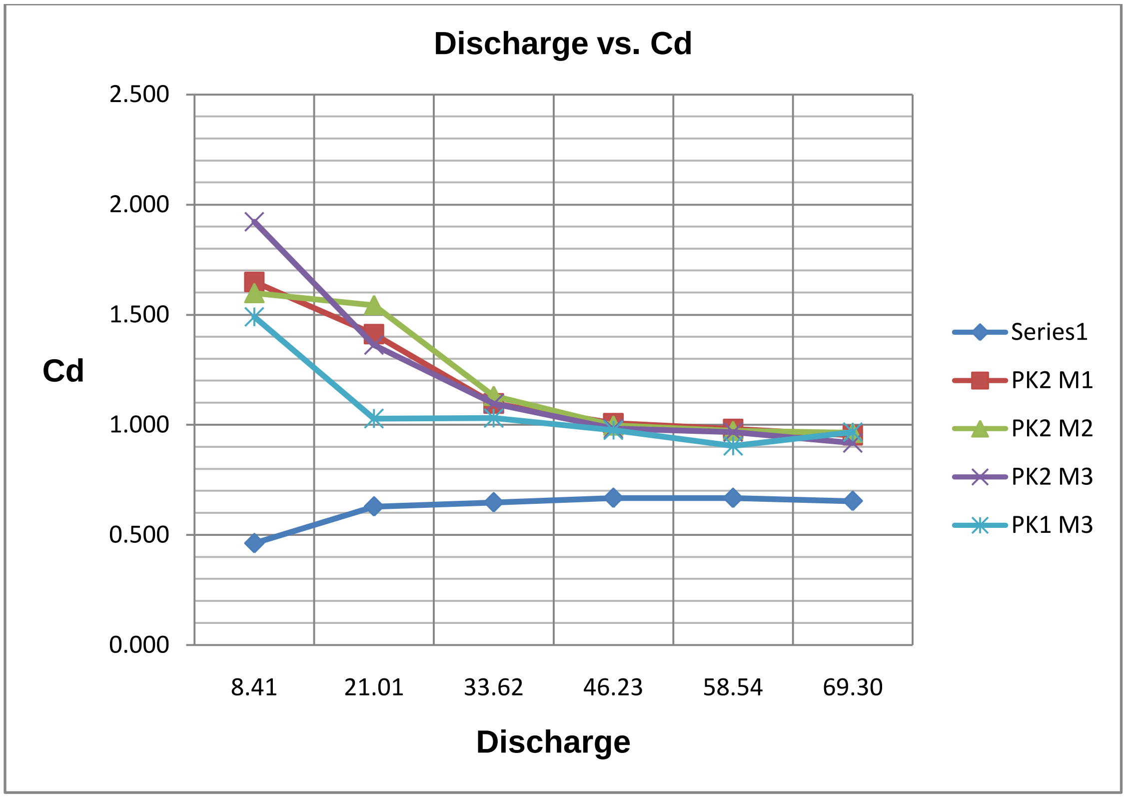

Figure 4. Discharge vs. Cd

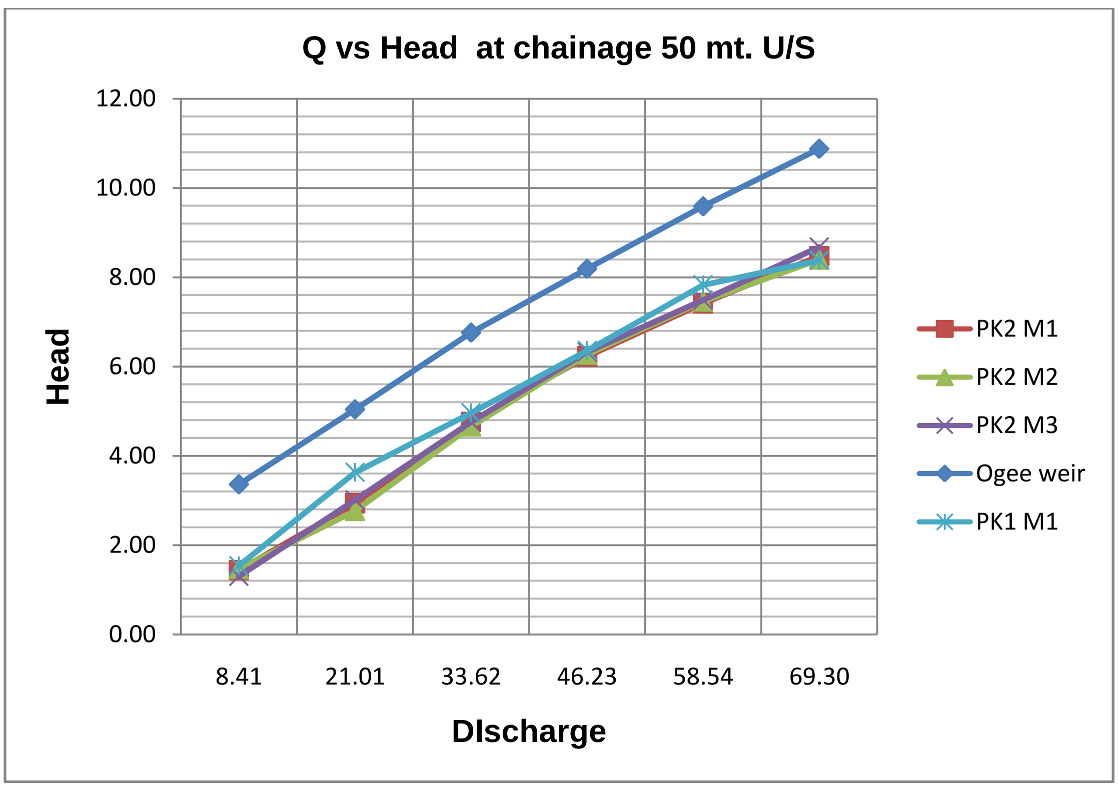

Figure 5. Discharge vs. Head at Chainage 50 mt. U/S