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The Effect of the door opening on various channel type of flow velocity (Case Study: secondary channel of the Saddang Irrigation Area, Pinrang Regency)

G H Syamsuddin, F Maricar and R T Lopa

Civil Engineering Department, Hasanuddin University, Makassar, Indonesia

Email: gatokhasansyamsuddin@gmail.com

Abstract. Water that flows in channels in free conditions is water that flows in open channels and comes into contact with free air. All flows that enter the open channel system are designed to flow by gravity. The Open channels can be divided into two types, namely artificial and natural channels. Open channels encountered in technical, semi-technical, and non-prismatic irrigation. Research is carried out in line Secondary Regional Irrigation Alitta village Bentenge Subdistrict Paleteang district Pinrang the channel reviewed is a secondary channel which has a different type of channel, namely pair stone channel, concrete lining channel, precast concrete channel, and soil channel which is influenced by 3 door openings, namely 20 cm opening, 30 cm opening and 40 cm opening.

1. Introduction

Water that flows in channels in free conditions is water that flows in open channels and comes into contact with free air. All flows that enter the open channel system are designed to flow by gravity. Open channels can be divided into two types, namely artificial and natural channels [1,2]. Open channels encountered in technical, semi-technical, and non-prismatic irrigation. Analysis of flow in non-prismatic channels requires accuracy due to changes in channel characteristics, one of which is by adjusting the door opening to get the flow velocity [3].

One area that has different types of duct compiler material is D.I. Saddang, South Sulawesi. The Saddang River Region, which covers an area of 10,230 km², is an inter-provincial river area, namely South Sulawesi and West Sulawesi Provinces covering 8 Regencies and 1 City (Pare-pare City, Pangkep Regency, Barru Regency, Pinrang Regency, Enrekang Regency, Enrekang Regency. Tana Toraja, North Toraja Regency, Polewali Mandar Regency and Mamasa Regency). The largest river is the Saddang River with an area of 6.4333 km², the average river length is 182 km, the average width is 80 m, and it has 294 tributaries. There is a Benteng Dam to supply D. I. Saddang with an area of 94,222 Ha and Bakaru Hydroelectric Power (2 × 64 MW) downstream of the Mamasa River. The potential for groundwater is around 1,354 million m³/year.



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2. Methods



Figure 1. FL-03 Current Meter.



Figure 2. Simulation in field.



Figure 3. Data retrieval process.

2.1. Location research

The location of this research was carried out in the secondary channel of the Saddang Irrigation Area, Pinrang Regency.

2.2. Flow velocity measurement methods

The process of conducting research in principle is divided into several parts, that is data collection, data processing, data calculation and analysis, and drawing conclusions.

The procedure of conducting this research follows several stages including [4,5]:

1. Preparation in this preparation stage required cross-channel image data in the field.
2. Conducting research in this stage the analysis is carried out including:
 - a Retrieval of wet channel cross-sectional data.
 - b Set Door Openings 20 cm, 30 cm, 40 cm each type of channel.
 - c Determine channel input and output.
 - d Measuring the width of the channel after that stretch the rope along the channel width at each input and output channel.

- e Make the interval of every 50 cm in each rope on each channel width.
- f Measuring the depth of Input and output of each channel.
- g After obtaining channel depth data then enter into the formula 0.2h and 0.8h.
- h Next, retrieve flow velocity data at each interval that has been determined on each channel type.
- i Furthermore, the data flow velocity of each channel is entered into the observation table and then analyzed the data.
- j From the results of the analysis of the data, it can be seen the value of channel roughness and flow velocity graphs for each type of channel.

2.3. Data calculation method

2.3.1. Flow discharge. Water discharge is the size of the amount of the volume of water that can pass in a place or can be at capacity in a place every one unit of time. Flow discharge (Q) in a cross-section can be expressed in the equation:

$$Q = A.V \tag{1}$$

Description: Q = Debit flow (m³/s); V = Speed Flow (m/s); A = Section Area (m²)

To get the results in the form of discharge flow, then the required formula - a formula commonly is used in the discussion of the hydraulics of the channel open [6].

- a. Wet Cross- sectional Area (A)

$$A = b.y \tag{2}$$

Description: A = Area of Section (m²); b = width of the cross section (m); y = depth of the cross section (m)

- b. Wet circumference (P)

$$P = b + 2y \tag{3}$$

Description: P = Wet circumference (m); b = width of the cross section (m); y = Flow Depth (m)

- c. Hydraulic Fingers (R)

$$R = \frac{A}{P} \tag{4}$$

Description: R = Hydraulic Fingers (m); A = Section Area (m²); P = Wet Roving (m)

2.3.2. Average Flow Speed

$$V = \frac{Q}{A} \tag{5}$$

Description: V = Speed Flow (m/s); Q = Debit flow (m³/s); A = Section Area (m²/s)

2.3.3. The basic slope of the channel. The channel base slope is used in determining the concentration-time value and influences the speed of water flow in the channel, the channel base slope can be determined using the following equation (Suripin, 2004)

$$S_o = \frac{\Delta t}{L} = \frac{(t_1 - t_2)}{L} \tag{6}$$

Description:

- So = Basic channel slope
- Δt = Difference in height of channel base between downstream drainage
- L = Channel length

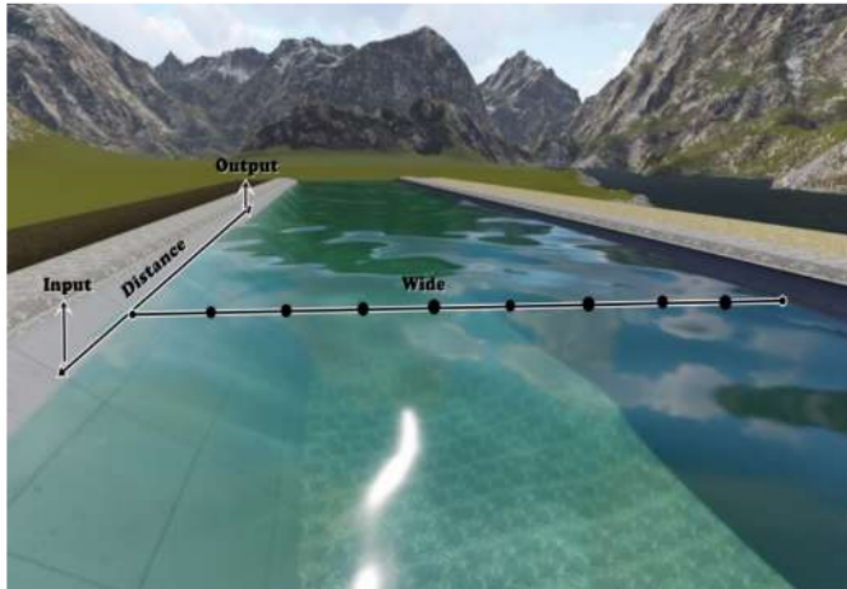
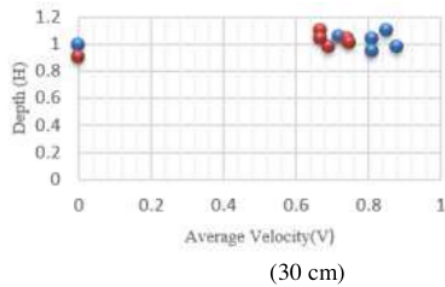
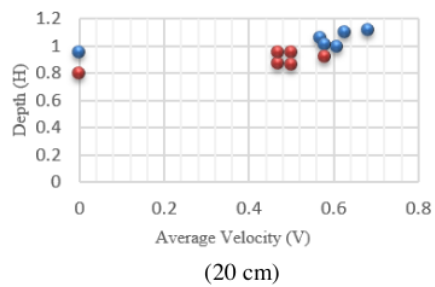
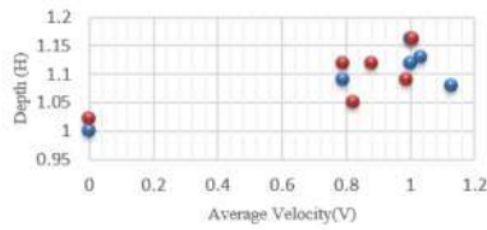


Figure 4. Data simulation in the field.

3. Result and Discussion

3.1. Result stone pair



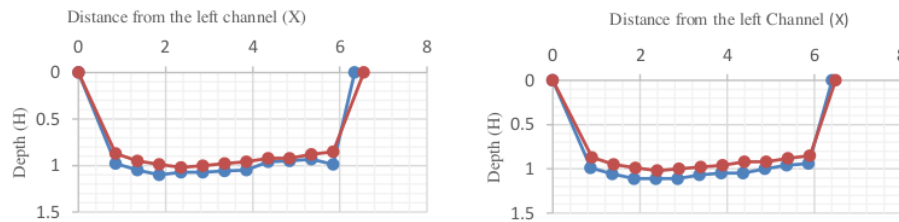


(40 cm)

● Input ● Output

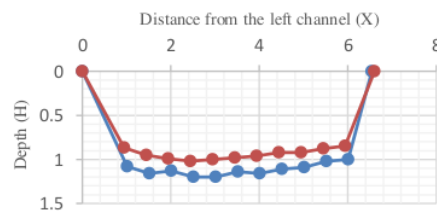
Figure 5. Shows the relationship between V and H with each door opening on the stone pair channel.

Figure 5 shows that the fastest flow velocity is at the 40 cm door opening in Input Channel.



(20 cm)

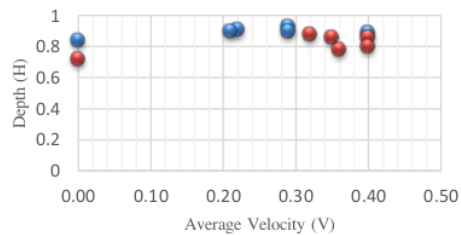
(30 cm)



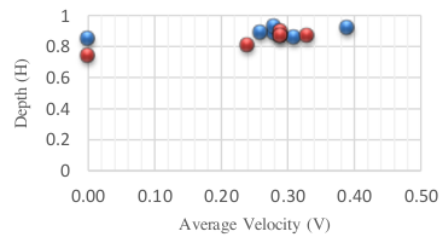
(40 cm)

Figure 6. Channel transverse profile in stone pair channel.

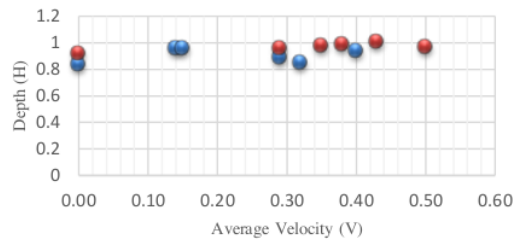
3.2. Result concrete precast



(20 cm)



(30 cm)

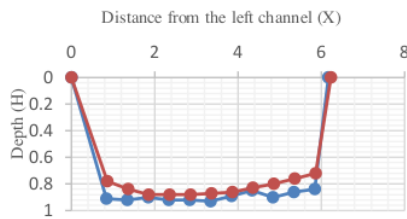


(40 cm)

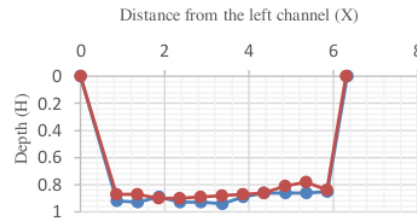
● Input ● Output

Figure 7. Shows the relationship between V and H with each door opening on the Concrete Precast channel

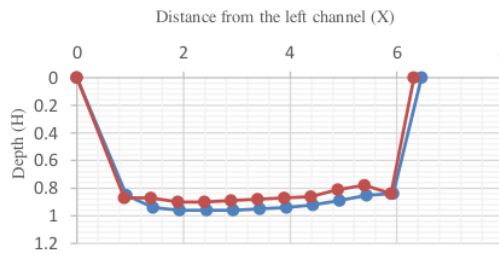
In figure 7 shows that the fastest flow velocity is at the 40 cm door opening in output Channel.



(20 cm)



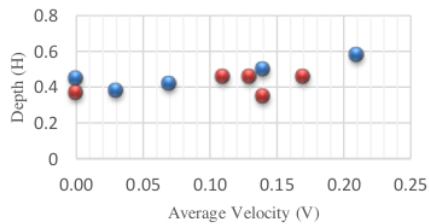
(30 cm)



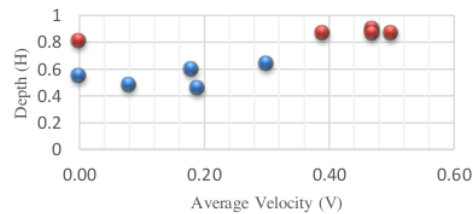
(40 cm)

Figure 8. Channel transverse profile in Concrete Precast channel.

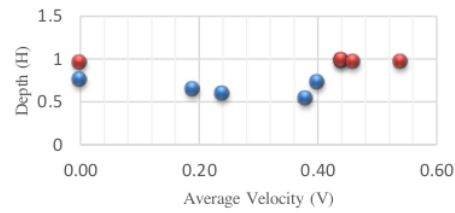
3.3. Result soil channel



(20 cm)



(30 cm)

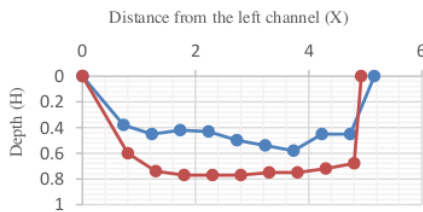


(40 cm)

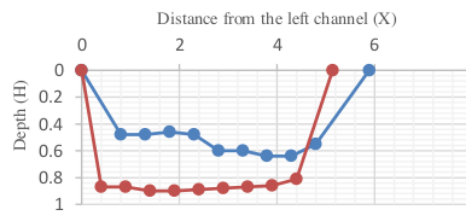
● Input ● Output

Figure 9. Shows the relationship between V and H with each door opening on the Concrete Precast channel.

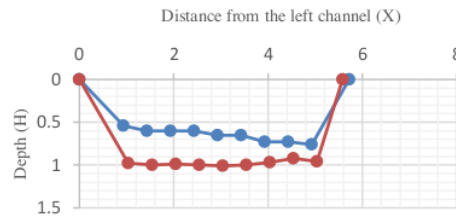
In figure 9 shows that the fastest flow velocity is at the 40 cm door opening in output Channel.



(20 cm)



(30 cm)



(40 cm)

Figure 10. Channel transverse profile in Concrete Precast channel.

Table 1. Result in each channel type

Channel Type	Door Opening	Velocity (m/s)		Section Area (m ²)		Wet Roving (m)	
		Input	Output	Input	Output	Input	Output
Pair stone channel	20 cm	0.61	0.49	5.66	4.92	12.67	12.75
	30 cm	0.81	0.70	5.51	5.56	12.63	12.78
	40 cm	0.99	0.90	6.13	6.06	12.88	12.89
Lining concrete channel	20 cm	0.75	0.74	3.71	3.81	10.35	10.66
	30 cm	0.92	0.83	4.06	4.15	10.71	10.80
	40 cm	0.91	0.85	3.43	3.65	10.83	10.87
	20 cm	0.28	0.37	4.87	4.51	12.36	12.39

precast concrete channel	30 cm	0.30	0.29	4.88	4.65	12.54	12.52
	40 cm	0.26	0.39	5.00	5.31	12.75	12.57
Soil channel	20 cm	0.11	0.14	2.03	2	10.15	10.10
	30 cm	0.18	0.46	2.40	3.68	10.99	10.09
	40 cm	0.30	0.47	2.86	4.44	11.11	10.99

In table 1 shows that the fastest flow velocity is in the channel of the stone input channel at the opening 40 cm, and the late flow is in the ground channel at the input channel and at the door opening 20 cm.

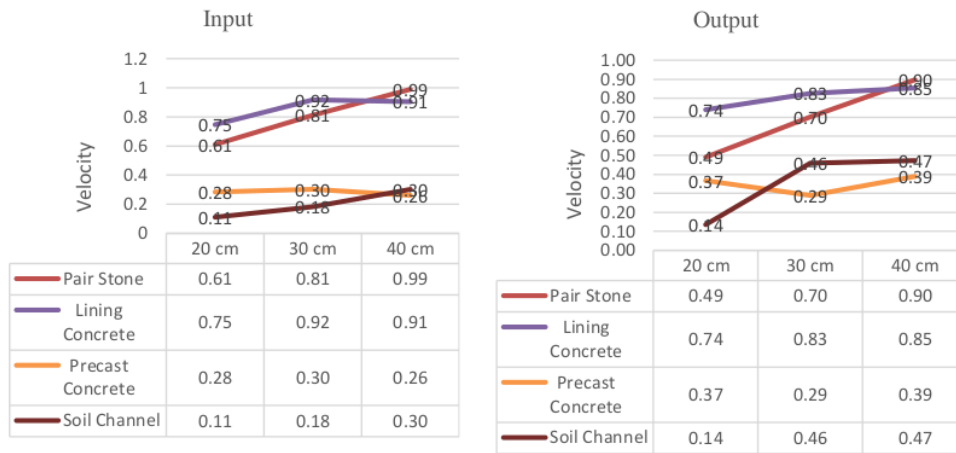


Figure 11. Graph of the relationship between velocity and door openings.

4. Conclusions

The magnitude of the flow velocity is influenced by the height of the door opening. the greater the door opening height the greater the flow velocity that occurs. Besides the flow velocity is also influenced by the basic characteristics of the channel.

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