

Sediment Retention Models Right On The Irrigation Channels

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Abstract— The role of irrigation is very important to increase agricultural production. Utilization of water through a good treatment system for water utilization is implemented effectively and efficiently.

Sediment transport in irrigation can shorten the service life of irrigation networks, due to silting and decreasing capacity, making it difficult for water to reach the surface of the rice fields and irrigate rice fields.

Various efforts have been made to reduce sediment transport in irrigation canals, one of which is commonly done is the manufacture of Sediment Retention Models (SRM). Nevertheless, the sediments continue to enter the irrigation canal in considerable amounts. So in operation and maintenance it requires a high enough cost for such sediment dredging

Given the importance of a sediment-catcher building, special attention needs to be paid to this problem, among others, by creating a sediment-resistant model that has the ability to capture sediment well. In the hope of helping to precipitate sediment so as not to disrupt the function of the channel.

The research will be conducted at the Civil Engineering Laboratory of Muhammadiyah University of Makassar. The purpose of the research is to know the nature of the flow that occurs in the sediment catcher building, to know the volume of basic sediment transport with the calculation directly and compare with the formula approach.

The results showed that the larger volume of sediment flow velocity tended to narrow, from 0.57 m / dt; Vs: 0.0039 m³ / s. to v: 0.16 m / s. ; Vs: 0.0047 m³ / s. Similarly, the smaller the volume of sediment flow velocity tends to expand from 1.4 m / dt; 0.0006 m³ / dt to v: 1.0 m / dt; Vs: 0.0005 m³ / s

Keywords: Sediment Retention Model (SRM), Bed Load, Channel Model

I. INTRODUCTION

To improve agricultural production in addition to improving the quality of seeds, it should also be noted the role of irrigation, for water utilization through a good processing system, so that the utilization of water can effectively and efficiently. Sediment accumulation in irrigation can shorten service life of irrigation network due to silting and decreasing flow rate capacity.

Smooth sediment particles can even clog pores of the soil and inhibit the absorption of water by plants [1]-[3]. However,

not all sediment fractions have the potential to damage the irrigation network.

Various efforts have been made to reduce sediment transport that can reduce the effectiveness of irrigation channels. One of the most common is the construction of sedimentary building. Nevertheless, the sediments still enter the irrigation canal in considerable amounts. So that in the operation and maintenance costs are quite a lot for pengerukkan sediment [1]

One of the parameters to know the effectiveness of a sediment catcher building in sediment sediment is to know the value of efficient sediment deposition in the building. Considering the importance of a sediment catcher building, especially if it is linked to the function and feasibility of a sediment-catching building that costs a considerable amount of money and the very important benefits for operations and maintenance activities on irrigation networks, special attention needs to be paid to this problem, among others by creating a form of sediment-resistant model which has the ability to capture sediment well [4]

Sediment precipitation in sediment retaining buildings is greatly influenced by the length of the building. The longer the building is the greater its level of effectiveness, but if it is too long it can reduce its effectiveness. In addition to the length of the building, the shape of the building also greatly affects the effectiveness of a sediment-catcher building. But the construction of sedimentary traps is too long, in addition to the expensive costs of wall and bottom lining, usually made of stone pairs, so that other efforts are needed to settle sediments with smaller areas and lower costs [5]-[8].

Given the above problems we tried to make a sediment retaining model. In the hope of helping to precipitate the sediment so as not to disrupt the function of the channel, in the hope that all the fields get enough water.

This study will be continued with the use of the Sticking Sediment Adjustment Model in the hope that the results obtained are much better than the previous research, with consideration of the Sticking Sediment Adhesive Holding Model which is used effectively to reduce the sedimentation process in the irrigation canal.

II. METHODS

The research was conducted in the laboratory of Civil Engineering Faculty of Muhammadiyah University of Makassar

A. Open Channel Model

The channel used is a sand channel spread over sand material with trapezium shape. The geometric shape of the channel is a straight channel with a permanent wall, the base width of the channel (B): 0.50 m, channel height (h): 0.20 m and channel length (L): 7.70 m.

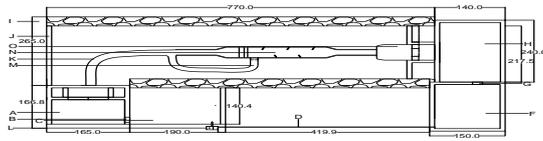


Fig 1. Open Channel Models

B. Sediment Retention Models

The sediment catcher building model with an insulated ring is made of acelik material with a bottom width (b): 40 cm, building height (H): 40 cm, base slope (i): 0.0229, and length of sediment catching building (l): 181 cm.

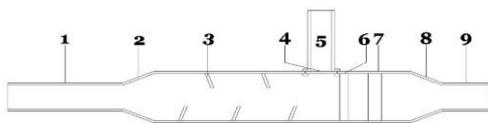
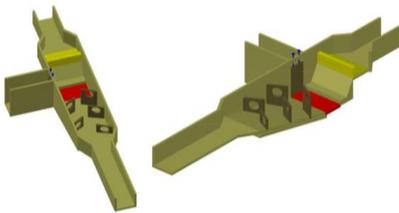


Fig 2. Sediment Retention Model Ringed Partition

C. Design

The type of research used is experimental, where the condition is made and regulated by the researcher by referring to the literature related to the research.

Research begins with the removal of sand material in the Kampili weir around the network of the Kampili irrigation area. The sand material is taken for testing the characteristics of sand material related to the density of the sedimentary mass (ρ_s) and the diameter of the sand grain (d_n). Then the sand is spread over the channel before and after the sediment catcher building.

D. Procedure

Research Procedure

- a. Calibrate all the tools that will be used especially the speed measuring device.
- b. Considering the sediment to be used.
- c. Sediment compacted before drainage
- d. The flow velocity is measured by flow watch.
- e. Water is removed by opening the door carefully rinse. So that the sediment does not get carried away by the flow.
- f. Sediments entering the sediment catcher building are measured in elevation.

- g. Sediments from sediment-catching buildings were collected and then dried, then weighed.
- h. Experiments were conducted with varying discharges and times.

III. RESULTS

A. Froude Number (Fr) and Reynold Number (Re)

To know and determine the type of flow that occurs in the channel during the process of streaming can be explained by the number Froude (Fr), in table 1

TABLE 1. RECAPITULATION OF FROUDE NUMBERS AND REYNOLD NUMBERS (RE)

No	t menit	Q m ³ /det	h m	v m/det	Fr	Re	Keterangan	
1	10	0,00753	0,11	0,67	0,86	38,04	subkritis	laminar
2	15		0,11	0,61	0,73	140,99	subkritis	laminar
3	20		0,10	0,57	0,70	142,52	subkritis	laminar
4	10	0,00374	0,13	0,81	0,85	142,52	subkritis	laminar
5	15		0,13	0,72	0,83	142,52	subkritis	laminar
6	20		0,12	0,18	0,86	142,52	subkritis	laminar
7	10	0,00753	0,12	0,88	1,02	203,84	super kritis	laminar
8	15		0,13	0,81	0,93	188,99	subkritis	laminar
9	20		0,13	0,78	0,87	182,56	subkritis	laminar

A. Influence of Distance to High Deposits

Based on the observation of the effect of distance greatly affect the high sediment around sediment control building, as in figure 3 below.

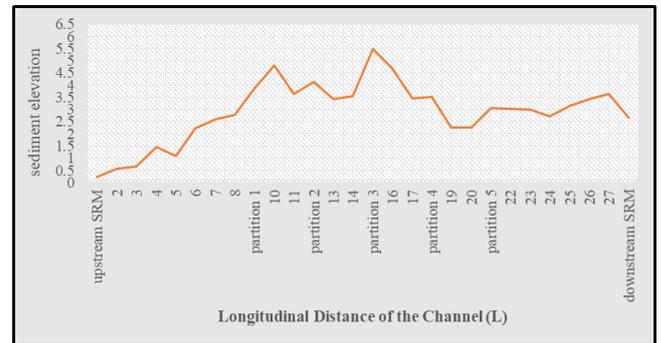


Fig 3. Effect of Longer Distance Channels Against high sediment

Based on Figure 3 it can be seen that the largest sediment volume occurs in section 3 which is 7.03 cm while for the lowest sediment volume occurs in upstream of BPS (Sediment Capture Building) that is 0.11 cm. As for the average value of the highest sediment volume occurs in sept 3 is 5.48 cm and the lowest sediment volume value occurs in the upstream of BPS is 0.24 cm.

B. Effect of Flow Rate on Sediment Volume

The amount of sediment volume is strongly influenced by flow fluctuation fluctuations. The flow conditions in this case the flow velocity also affects the amount of sediment volume as shown below with different discharge variations, it can be shown in Figures 4, 5 and 6

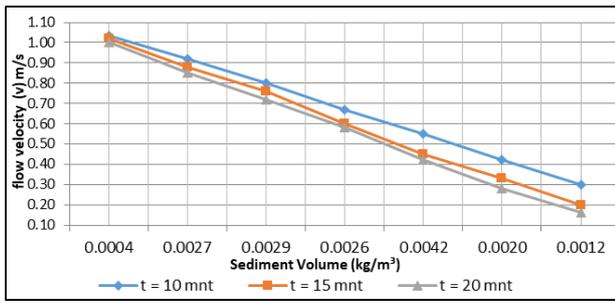


Fig 4. Effect of flow velocity on sediment volume for Q1

Based on Fig. 4 for discharge (Q1) with time variation, it can be seen that the largest sediment volume is found at downstream of SRM is 0.0047 kg / m³ with velocity (v): 0.16 m / s. The smallest sediment volume was found in upstream MPS with 0.0005 kg / m³ with flow velocity value (v): 1.0 m / sec.

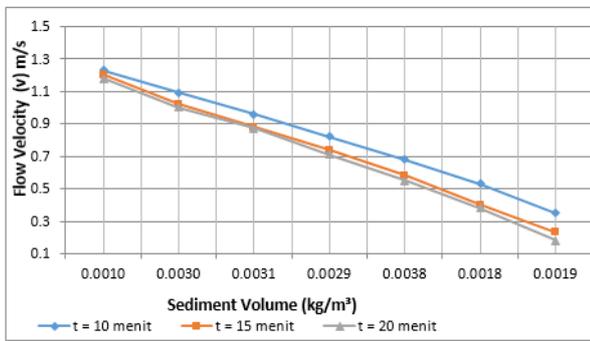


Fig 5. Effect of flow velocity on sediment volume for Q2

Based on Fig. 5 for debiq (Q2) with time variation can be seen the largest sediment volume is in Sekat 4 (Vs): 0.0038 kg / m³ with flow velocity (v): 0,55 m / sec. While the smallest sediment volume is found on the upstream MPS, ie (Vs): 0.0005 kg / m³ with flow velocity (v): 1.2 m / s

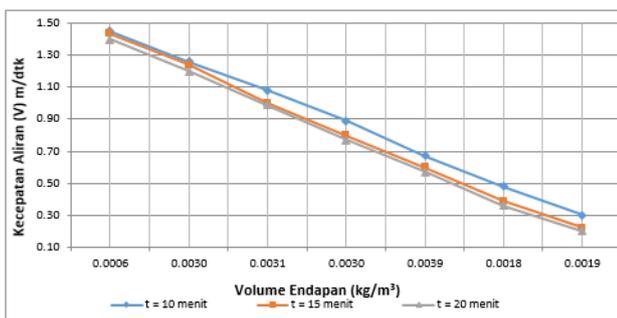


Fig 6. Effect of flow velocity on sediment volume for Q3

Based on Fig. 6 for discharge (Q3) with time variation can be seen on the graph for the largest volume of sediment (Vs. 3) found in section 4 is 0.0039 kg / m³ with flow velocity (v3): 0.57 m / s. While the smallest sediment volume found in upstream BPS is Vs. 3: 0.0006 kg / m³ with flow velocity (v3): 1.40 m / s

From the three images can be concluded that the greater the volume of sediment flow velocity tends to decrease, and vice

versa the smaller volume of sediment flow velocity tends to enlarge.

C. Sediment Volume Analysis with Empirical Approach

To further corroborate the results of this study, this sediment-resistant model study needs to be done to test the sediment volume analysis (Vs) with several empirical approaches, as in table 6 below.

TABLE 2. COORDINATE THE BASIC SEDIMENT TRANSPORT VOLUME ANALYSIS AND PRECIPITATION WITH EMPIRICAL APPROACH

No	Q	h	V	waktu	volume angkutan sedimen			Vol. angkutan
					Meyer-Peter dan Muller	Schocklitsch	Kalinske	sedimen
								perhitungan langsung
1		0,11	0,70	600	0,00402	0,34556	0,10053	0,00228
2		0,11	0,59	900	0,00432	0,43961	0,02526	0,00132
3	1	0,1	0,60	1200	0,00613	0,20173	0,09406	0,00164
4		0,13	0,85	600	0,00172	0,48595	0,0172	0,00271
5		0,13	0,73	900	0,00404	0,6036	0,08612	0,0024
6	2	0,12	0,18	1200	0,00644	0,19349	0,08612	0,00251
7		0,12	0,90	600	0,00203	0,35839	0,01833	0,00319
8		0,13	0,72	900	0,00863	0,62686	0,00761	0,00232
9	3	0,13	0,70	1200	0,00866	0,82347	0,08874	0,00248

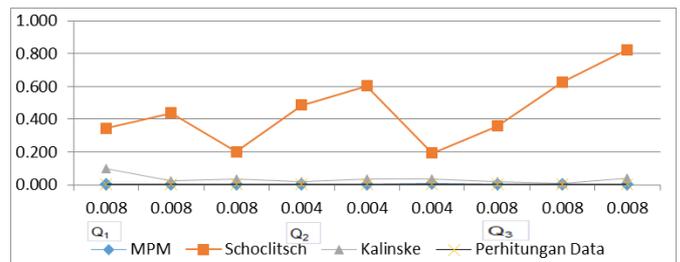


Fig 7. Direct calculations by using the empirical approach.

Based on Table 6 and Fig. 7, the results of the calculations using the empirical approach closest to the calculation result are Meyer Peter and Muller approach.

III. CONCLUSION

From the observation of flow characteristics on the sediment holding model in the upstream part of MPS the super critical flow gradually tends to be sub-critical on the 5th partition. The greater the volume of stream flow sediment tends to decrease, from 0.57 m / dt; Vs: 0.0039 m³ / s. to v: 0.16 m / s. ; Vs: 0.0047 m³ / s. Similarly, the smaller the volume of sediment flow velocity tends to expand from 1.4 m / dt; Vs: 0.0006 m³ / dt to v: 1.0 m / dt; Vs: 0.0005 m³ / s

IV. ACKNOWLEDGEMENTS

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