120 Deposition Control Structures in Sand Pockets

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I. Introduction

The stream flow at an inlet of Sand Pocket plays an important role on the distribution of sediment deposit in the storage area. It does not spread much but change the direction, to deposit sediment radially in the Sand Pocket. Sometimes, the stream flowing in a certain direction, destroys the boundary dike of a sand pocket. It causes a sand pocket not to trap sediment effectively during a debris flood. There are many kinds of Deposition Control Structures, that have been constructed in the field. Debris Flow Breaker made of steel beams, in the Nojiri river, Sakurajima, for instance, reduces or stops the harmful sediment flow before flowing into the sand pocket.

In this study, one of Deposition Control Structures (DCS), dikes to control flow, was picked out. The effectiveness of the control structure is evaluated based on the area of sediment deposit comparing with that without control structures.

II. Purpose of The Study

How DCS, controls the flow in a sand pocket was observed through experiments. The arrangement of structures was emphasized.

a. Dividing a stream into smaller flows, for reducing the harmfulness of sediment flow in a Sand Pocket.
b. Deviating the stream flow, for covering all of the storage area of a sand pocket.

III.Procedure of The Experiment

In the experiment we used a flume 2 m longs, 15cm x 10cm, connecting with a sand pocket model 100 cm x 90 cm and angle of the inlet is 120°. Both of the slopes of the upstream flume and the sand pocket are 5°. Sand, d_{50}= 0.7 mm, was set in the flume in the same thickness. Water supplied at upstream end by 165 cm^3/sec and 330 cm^3/sec. The deposition process was recorded vertically with VTR for 4 minutes. The area of sediment deposition was measured every 1 minute. As a model of DCS, (each dike is 3cm high x 2cm wide x 7.5cm long) 4 dikes and 6 dikes were arranged in deposition area. The positions of two uppermost dikes were set at the inlet of the Sand Pocket model, where a first bend of flow occurred. These structures divided a stream flow and made the flow deviate wider in the downstream. The angle of direction dikes was determined based upon the maximum flow direction change.

IV. Result and Discussion

It is essential to understand the sediment depositional processes when trying to regulate the stream flow in a sand pocket. In nature, some parameters such as a diameter of sediment, initial relief of a deposition area, water discharge, etc. influence the depositional processes. They have wide range and wide variety. In this study the sediment with a small range of diameter distribution and two amounts of water discharge were used in the experiment.

1. The first bending point.

A stream in a sand pocket has a tendency to flow straight and then it deviate to other direction. The first bending point appeared at 10 to 20 cm from the inlet for a small water supply (165 cm^3/sec) and, the point was at 20 to 30 cm for 330 cm3/sec. In this area the stream was still rapid and it was divided and deflected by a small deposition. The bending point was also seen in the lower reach when the secondary fan formations develop.

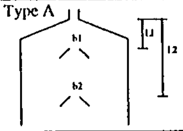
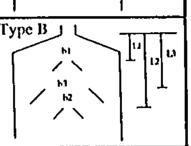
2. Maximum flow direction change.

In the experiments on sediment deposition processes, maximum flow direction change is observed as related to water supply and slope gradient of the deposition area. In small water discharge, the flow deflection angle is large than that for large discharge. The small difference of slope gradient between upstream and downstream gives smaller deflection of flow direction than that for large difference of slope gradient. To reduce an impact of stream flow to the dike, the maximum flow direction change must be considered. However, in this experiment, it was not clearly observed because the experiment model of Sand Pocket is too small.

3. Arrangement of DCS.

The arrangement of DCS has wide variety in field. It much depends on the particular problems or topographical factors in deposition areas. In this experiment, however, a plate for deposition was set to a single slope and deposition control structures are arranged in two types. As type A, 4 dikes were used and type B, 6 dikes were used. The dikes of most upstream site are set on the area of the first bend of flow, for controlling the stream flow.

Table 1. Arrangement of The Deposition Control Structures
Unit : Cm

No	Q	L1	L2	L3	b1	b2	b3	Remarks
N1	165							no structure
N2	330							no structure
1	165	10	40		5	5		Type A 
2	330	10	40		5	5		
3	165	20	40		5	5		
4	330	20	40		5	5		
5	165	30	50		5	5		
6	330	30	50		5	5		
7	165	20	50	40	5	5	30	Type B 
8	330	20	50	40	5	5	30	
9	165	20	60	50	5	5	30	
10	330	20	60	50	5	5	30	
11	165	30	60	50	5	5	30	
12	330	30	60	50	5	5	30	

The opening space between these dikes was 5 cm (b1). Dikes were set on the center and the distances (L1) ranged 10 to 30 cm from inlet. For type A, the second DCS were set at 40 - 60 cm from inlet (L2). The opening space between structure (b2) is 5 cm. In type B, the other dikes set between uppermost structures and lower structures(L3).

4. The width of sediment deposit

In the experiment type A, a stream flowed straight first. The upper dikes divided the stream to both sides and forced to deflect left and right widely in the deposition area. In the middle part, the stream flowed straightly then it is trained by next dikes in downstream. Sediment deposit in the center, causes a stream bed to rise gradually, from upstream toward the downstream. The sediment deposit also occurred from downstream toward the downstream due to the boundary dike. In the experiment type B, the process is similar to type A, yet, the deflection of streams on left and right sides was trained wider by dikes in the middle reach of the model.

The sediment deposit areas were measured by a computer scanning. Figure 1 shows the result of the experiment for the small water discharge (165 cm3/sec). At one minute, type A, type B and no dikes (exp. N1) have almost the same area of deposition. The area becomes different as time passes In type A, exp. no. 5, the area of deposition increases linearly with time. Type B, exp.no.9, the sediment spread more widely at the beginning, reduces the rate of widening. The DCS in the middle part (L3) trains a stream flow spreading widely. In experiment with a large water discharge (330 cm^3/sec), the widening of sediment deposit has similar trends for type A and type B. At 4 minutes, the width of sediment deposit does not change much. The stream flowed straightly to the outlet of the sand pocket and sediment flowed out from the model. The stream bed rose and buried the upper dikes.

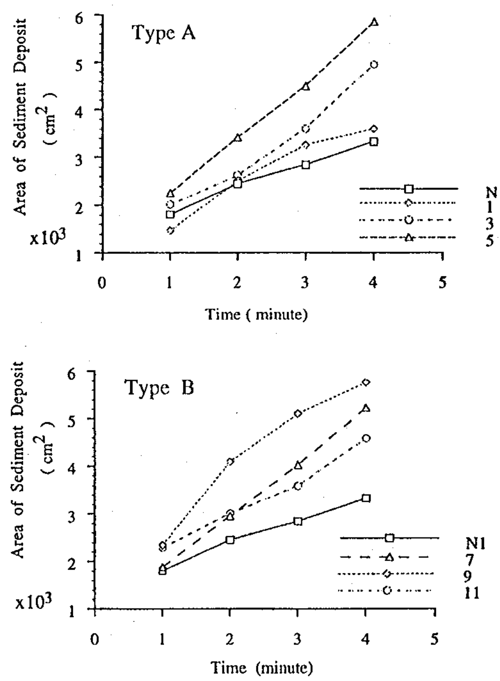


Figure 1. Effect of DCS on Sediment Deposit

V. Conclusion

The Deposition Control Structure (DCS) using dikes is capable to make the stream flow spread widely in a model of a sand pocket. The upper dikes take an important role to divide a stream flow to both sides and force the stream to deflect left and right widely in the deposition area. The stream flows return to the center of the sand pocket, when upper one of DCS have been buried by sediment. The position of upper dikes should be in the area of first bending of stream flow.

Type B regulated the stream better than type A, at the beginning. The difference, however, becomes smaller as time passed. As result, a simple arrangement, type A is better.

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