EXPERIMENTAL STUDY ON THE FLOW DIRECTION CHANGE IN SAND POCKETS

Untung Budi SANTOSA*, Sumiji KOBASHI**,Takahisha MIZUYAMA**
* Graduate Student
** Kyoto University, Faculty of Agriculture

I Introduction

The debris flow or hyper-concentrate flow is generally deposit at outlet of torrents or apexes, which usually are inflection points of the bed slope and wide of channel. The morphologist of sediment deposition on the outlet of torrent has studied and it has been found that the shape of deposition is control by the sediment discharge, sediment material and topography of the deposition areas. (Mizuyama, at al,1983).

Sand Pockets are appropriate structures to limit the spreading sediment deposit at these areas. Model study of deposition in sand pocket in Mt. Fuji area is seem that the spreading of sediment did not cover all of sand pocket. (Hara, at al, 1992)

A series of experiment to observe the formation processes of debris fan or debris cone deposition at sand pocket were carry out in a laboratory. The changes of flow direction and the formation of debris flow deposition were observed with changing slope of flume, the slope of deposition board and water discharge.

2. Experiment Procedures

A flume; 10 cm's wide, 20 cm's deep and 250 long was connected to a board, 90 cm's wide and 110 cm longs. The slope of flume was changed 5,8,10,15 degrees and the slope of the board was changed 1,3,5 degrees. The sediment material used for the experiment is d_{50}= 0.35 mm, σ = 2,65 g/cm3. The sediment was set in the flume and water supplied at the upstream end of the flume. Process of sediment deposition were filmed by a video camera from vertical view and the elevation of deposition was measure after 45 and 90 second from start of water supply.

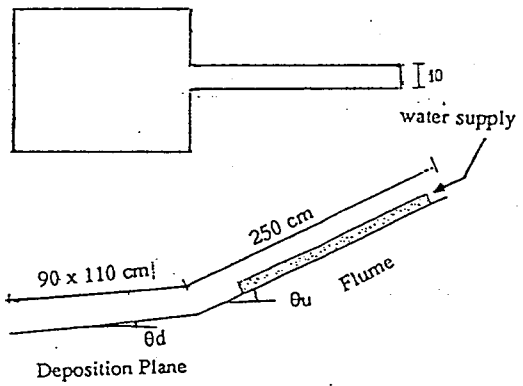

Fig. 1. Plan view of Experiment

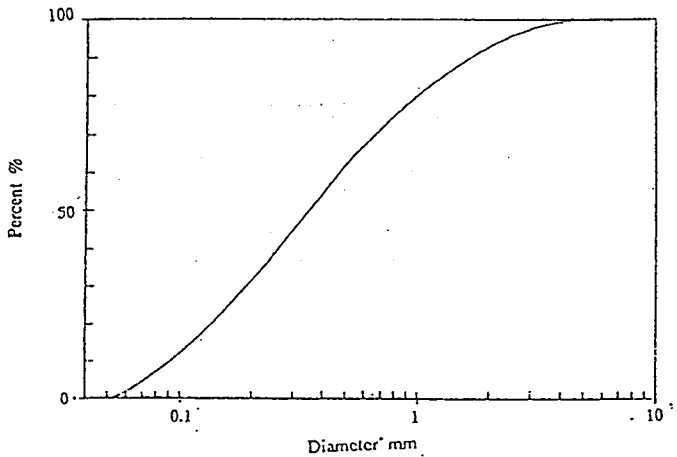

Fig. 2. Grain size

3. Results and Discussion

3.1. The change of flow direction

a. The flow arriving at the deposition plane initially has tendency to go straight. Sediment spreads by the change of flow direction.

b. Hydraulic jumps or hydraulic bores take place at the boundary of deposition and flow condition, when the water discharge is 30 and 20 liters/minute. On the case of water supply is 10 liters/minute the hydraulic jump does not occur, except in the gradient of the flume is 15 degrees.

c. The Maximum angle of the change of low direction occurs at the small water supply (10 l/min) with a large difference of slope gradient between upstream and downstream. (Fig. 3)

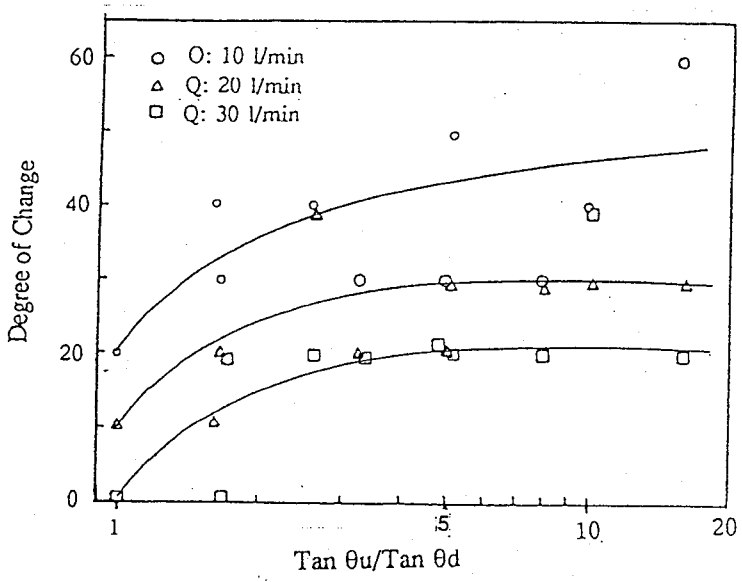

Fig.3. The Maximum Angle of Flow Direction Change.

d. The direction of flow has tendency to approach straighter when the difference of slope gradients in upstream and downstream is smaller. (Fig. 4.)

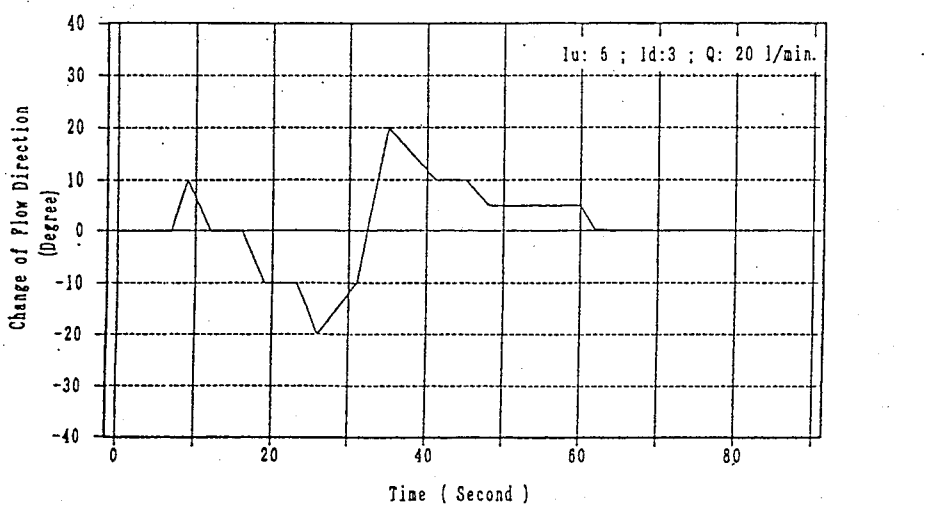

Fig. 4. Temporal Changing of Flow Direction.

e. The differences of slope gradients upstream and downstream is small, the direction of flow is at the center of the sand pocket. In other word the sediment were much deposit at the center part of sand pocket. (Fig. 5. 2)

g. In case that deposition occurs intermittently, when the second flow arrived at the apex, the direction of flow generally took the right or the left or both at the outlet of the flume, because of the former deposit. (Fig. 5.1. and Fig. 5.2.)

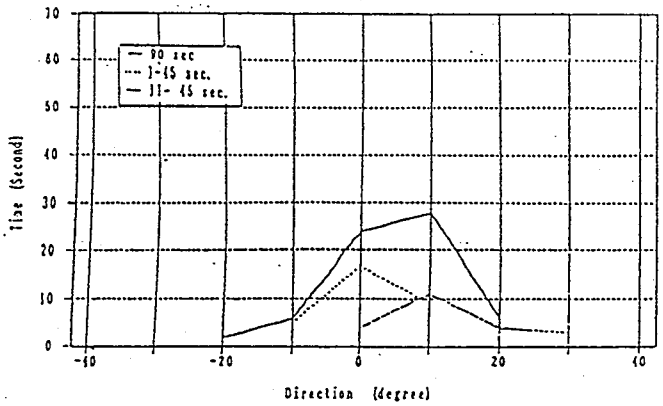

Fig. 5. 1. Time Distribution of Flow Direction Change
Iu : 5 ; Id : 1 ; Q : 20 l/min.

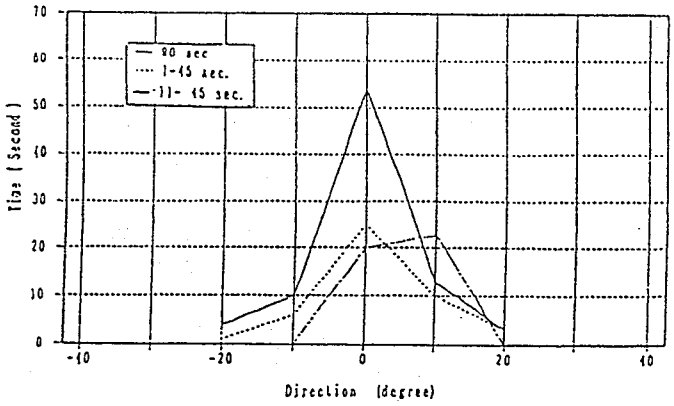

Fig. 5. 2. Time Distribution of Flow Direction Change
Iu : 5 ; Id : 3 ; Q : 20 l/min.

3.2. Depth of deposition

The depth of deposition increased continuously until the temporary equilibrium stage of slope was attained. The maximum thickness of deposition is generally observed at the inflection point. The longitudinal profile of the thickness for 10 liters/ minute at the time of 45 second is shown in fig. 6

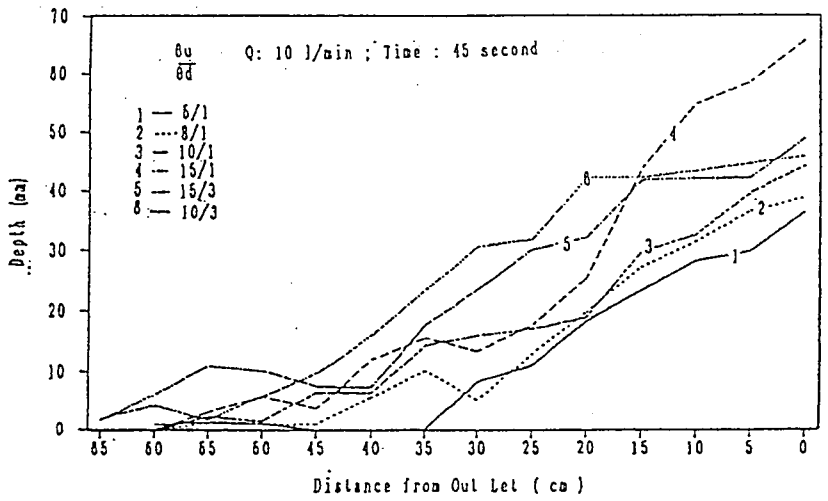

Fig.6. The Depth of Deposition

3.3. Shapes of deposition

A series of experiments shows a wide variety of depositional shapes. The deposition shapes are generally depend on not only the variation of flow direction but also sediment supply from the upstream.

a. The cross section shape the diposition is generally convex shape with the temporary channel was form in upper side.

b. Depositional shape for small differences gradient between upstream and downstream are more slender than the larger differences ones.

c. In case for small difference of gradient with large water supply, the view of deposition shape is triangular.

4. Conclusion

a. The flow direction has large change by the small magnitude of flood and big differences of slope gradient between upstream and downstream.

b. The flow direction has tendency to be straight (staying at center) when the difference between the slope gradients at upstream and downstream is small.

c. Design for dike of inlet wing in sand pocket is necessary to be consider with the maximum angle of flow direction change and the differences slope gradient between upstream and downstream.

d . The breaking of dike or overtopping flow in sand pocket, may be caused by the small magnitude of flood.

References

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