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THE STUDY ON SEDIMENT MOTION AND THE MODEL OF DAM BREAK ON THE MOVABLE BED BY SPH METHOD

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Introduction

The sediment transport in all kinds of water flows is the discussion that some researchers are interested in. The damages caused by these transports like scoring of the water structures foundation, the rush of sediments to the water facilities or deposit of sediments in storages can be known as the cases which demonstrate the essential understanding of sediment motion in engineering sciences. Moreover, on the discussion about dam failure or current control structures as embankments and levees or the flowing of large amount of water like the rush of surges to the beaches and the sediments scoring and erosion of bed, the multiphase flowing is made which cause not only damage of structures but also, due to morphological changes and environmental damages.

Simulation of sediments behavior

However the movements of sediments have different unclear parts but, progress of science and new calculation methods can predict the changes of sediment behavior with remarkable approximation.

One of the methods for simulating sediments is assumed Bingham-Plastic for sediments behavior. The visco-plastic fluids have an "un-sheared" or "solid zone" under their yield stress point and their constitutive law represents a multi-valued function [1]

$$|\mathbf{D}| \le \frac{\tau_y}{2\alpha\mu} \rightarrow \tau = 2\alpha\mu\mathbf{D} \qquad (1)$$
$$|\mathbf{D}| > \frac{\tau_y}{2\alpha\mu} \rightarrow \tau = \left(\frac{\tau_y}{|\mathbf{D}|} + 2\mu\right)\mathbf{D}$$

D is the second principal invariant of shear strain rate $\mathbf{D} = (\nabla\mathbf{v} + \nabla\mathbf{v}^T)/2$.

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Discussion and Conclusion

1- Pattern of sediment movement

In this study, SPH method is dealt with the study of sediment motion. In this model a channel with the longitudinal slope of 0.001m and water depth of 1.00 m is considered and the space between SPH particles is 0.02m, the 6 number of sediment particles are chosen accidentally from different places of bed surface and inception motion of sediments are compared with Deplas et.al [2] experimental study. In this comparison which is shown in figure (1) the patterns of SPH sediments motion are in good agreement with experimentally study.

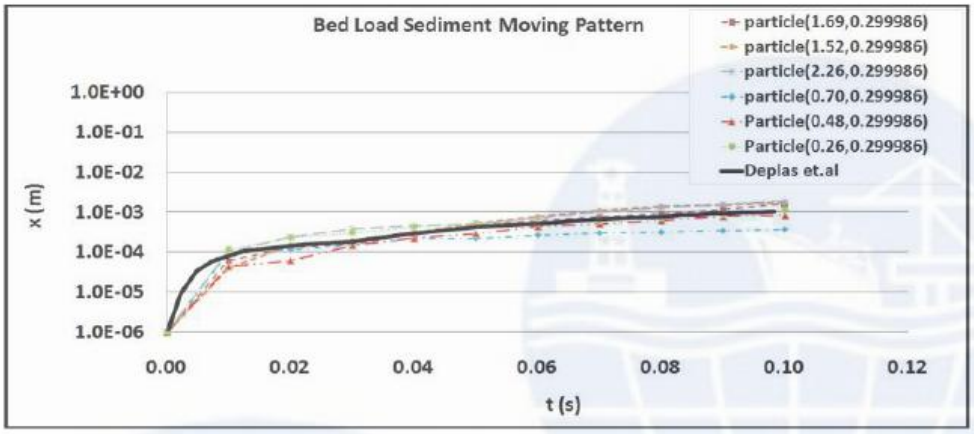

Fig. 1) Comparison of experimentally work and SPH on pattern of sediment motion

2- Dam break

In the discussion of dam break on the movable bed, according to suggested model of Spinewine [3] which is done experimentally, a flume is considered by 6m longitude and a gate which is located in the center of the flume. The general model is shown in figure (2). In the current work, this experiment is modeled by SPH. In this work the sediment are saturated [3].

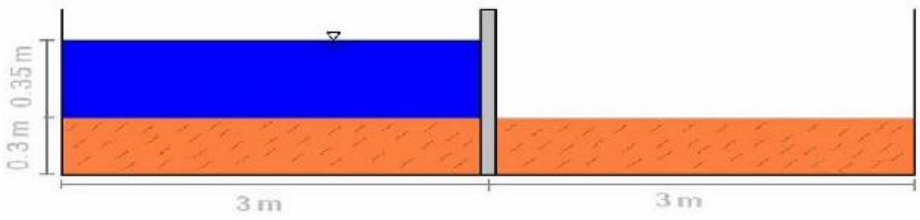

Fig.2) The general model of dam break at t=0s

Usually, in dam breaks model, the gate is not used. It is suggested that a column of water at t=0s and after this time the water flows suddenly but as it can be seen in figure(3) by locating

the gate and creating similar model to the experimental work, it can be represented more desirable and similar to the fact. This figure is related to the dam break at t=0.25s after gate opening.

With the study of water flows to downstream at t=0.25, 0.5, 0.75s and its comparison to the experimental studies and MPS model, the ability of SPH in modeling of sediments and interaction of water and sediment as a multiphase circumstances can be found. These conditions can be simulated well by using this method and desirable conclusions may be found.

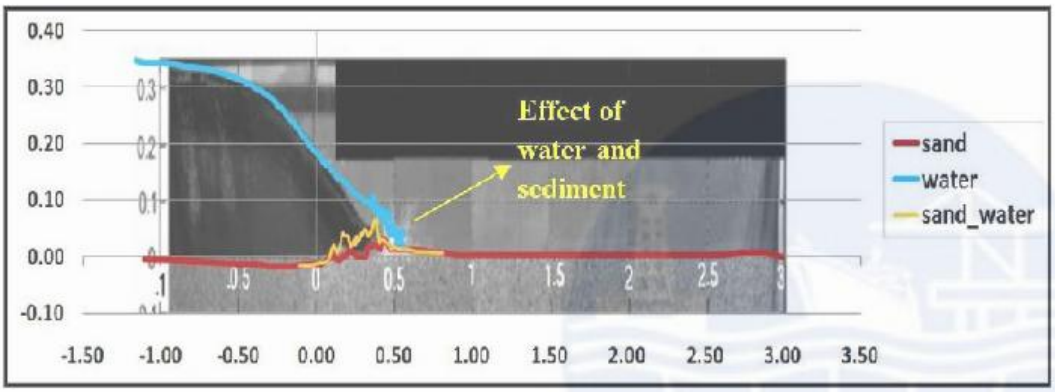

Fig.3) Comparison of experimentally dam break with SPH model at t=0.25s

Results

By the achieved results, it can be shown that SPH as a numerical method has the modeling sediment motion ability to a remarkable extent which is shown in the pattern of sediment motion and also in the dam break problem results. With the comparison of bed changes with the experimentally studies, it can be seen that the hump is produced under the front negative wave which is caused by dam failure and bed erosion is associated with.

References

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