Study on Bed Variation at a River Confluence Associated with the Barrage Water

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1. Introduction

The Kakogawa River whose catchment area is 1,730km^2 and length is 96.0km, is located in the south of Hyogo Prefecture, the mid-west in Japan, as shown in Fig. 1. The influence of runoff due to barrage water and the Mino River tributary, combined with a meander in the river upstream from the large barrage on the Kakogawa River (Kakogawa Barrage), has promoted the development of a sand bar on the river bank opposite the confluence. The sand bar, which has hardened, currently deflects the passage of water back to the left bank and has decreased the usable water surface area of the river. The objective of this study was to survey the river topography in the vicinity of the Mino River confluence and identify the factors responsible for sand bar development by model experiment and numerical analysis.

Fig. 1. Kakogawa River

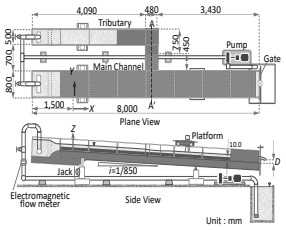

Fig. 2. Experimental Channel

2. Model experiment and numerical analysis on riverbed variation characteristics of confluence

2.1 Experiment

Experiments using the channel, which was modeled based on the confluence of Kakogawa River and Mino River, were conducted in order to the channels at the tributary junction was performed to assess the influence of the barrage water and the river meander upstream The experiments were conducted in a open channel with 8.0 m long, 0.8 m main channel wide 0.48m tributary channel wide and 1/850 bed slope as shown in Fig. 2. The width of this channel corresponds with 1/250 scale of the river. The channel has a water level adjusting weir in order to control the water elevation at the downstream end of the channel. The nearly uniform coal dust was used in the experiments as the bed material. The coal dust has a mean grain diameter d_m of 1.3 mm and a specific gravity s of 1.47.The experimental conditions are listed in Table 1. In the table, Q_M= main flow quantities, Q_T= tributary flow quantities, T= experiment duration, H_D= height of weir.

Table 1. Experimental conditions

Number	T (hr)	Q_M (l/s)	Q_T (l/s)	H_D (cm)
Case1	1.0	5.0	1.0	0.0
Case2				1.0

2.2 Numerical analysis

The simulation model Nays2DH (iRIC, 2014) and NaysCube (iRIC, 2011) was applied to the investigation in this study. The channel was divided into 411 and 100 grids for the longitudinal and lateral directions, respectively. Then, the longitudinal grid size (x) and the lateral grid size (y) are the same as 0.02 m. The Manning's roughness coefficient is taken as n = 0.020, respectively.

2.3 Results and Discussion

Fig. 3 illustrates the experiment results and numerical analysis results of the flume experiments. Fig. 3 (a)-(c) show the results of model experiment, two-dimensional analysis, and three-dimensional analysis (elevation change), respectively. The scour occur at the confluence area by the flow mixing area. And the deposition occur at the inside area (dead water region) of flow mixing area. In Case1, with its nothing the barrage water, the sand bar wasn't occurred and observable river-bed lowering of the bar occurred. But in Case 2, with its occurred the barrage water, the sand bar developed at the upstream of confluence and the scour depth of the confluence area becomes small.

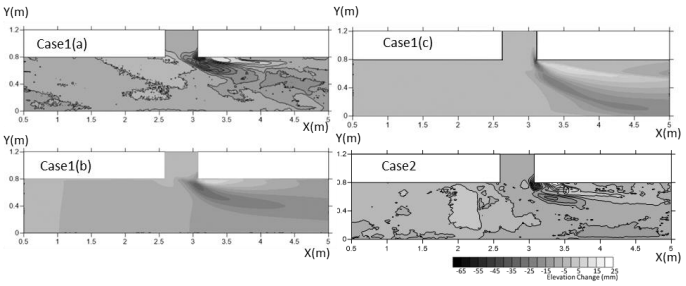

Fig. 3. Experiment and numerical analysis results

3. Conclusions

The results obtained in this study are summarized as follows:

(1) In the experiment and numerical analysis without effect of upstream meander, the sandbar didn't appear because the flow became uniform at the upstream.

(2)The mechanisms of river bed variation process were clarified by the reproduction calculation of the experiments.

Acknowledgments

The present study was financially supported by the Grant-in-Aid for Scientific Research (B) (Project No. 26289164, Leader: Kohji Michioku)

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