Location Plan of Sabo Dams Using the Hydraulic Model Experiment: The Upper Makawa River in Japan

Naoto NAKAMURA[1*], Takeshi OSAKA[2], Takashi ISHII[2], Kenichi TERASAKI[2], Kyouko YAMANE[2], Takashi KONNO[1], Hitoshi NAGAI[1], Keisuke YOSHIDA[1] and Yuki NISHIGUCHI[1]

[1] CTI Engineering, Co., Ltd, Japan
[2] Ministry of Land, Infrastructure, Transport and Tourism, Japan
*Corresponding author. E-mail: naoto-nakamura@ctie.co.jp

INTRODUCTION

Many landslides occurred in the Makawa River basin due to heavy rainfall July 11, 2011 in Japan. A lot of sediment deposited at the upstream section of the Oritate dam which is located in upper Makawa river. The campsites and the road approaching toward the famous tourist spot are located around the Oritate dam. There is the plan to build the low sabo dams that are environmentally friendly in this area to protect these properties.

In this area, the sediment tends to deposit because river width is wide and slope of stream bed is gentle. Thus, if low sabo dams are built in this area, they may be buried in the future. While, eccentric flow and bank erosion occur easily because there are many unstable sediment in this area. So, the sediment movement is considered to be very complex in this area.

Kimura (1990) mentioned that the size of low sabo dam and the interval between low sabo dams should be planned based on the basin characteristics because there is no general standard. And, Oda et al, (2000) pointed out that the hydraulic model experiment was valid method for verifying the complex sediment movement.

Therefore, we verified the sediment movement characteristics in this area and examined the efficient and effective location plan of low sabo dams using a hydraulic model experiment in addition to a numerical simulation. In this report, we mainly report the experiment part.

EXPERIMENTAL CONDITIONS

The topography of the model was made based on the LP data that had been acquired in 2015. The model area was upstream 1.5 km section of the Oritate dam. We set the scale of the model 1 to 80 considering particle size distribution of this area.

The experiment conditions are shown in **Tab.1**. To experiment under the various conditions, we estimated that the amount of fluid of rainfall was 150 year-probable flood or a year- probable flood, and that the sediment concentration was equilibrium, a quarter of equilibrium, or zero percent. Also, we did the experiments under the condition of no dams to verify the river course characteristics, and did the experiments under the condition of dams set to examine the efficient and effective location plan. The original location plan of sabo dams was made using only a numerical simulation. The improvement location planing of sabo dams was made considering the result of Case3.

RESULTS

The section of 550 to 1,000m was deposited area in the case of Case1-1,1-2, and 2-2. On the other hand, this section was eroded area in the case of Case2-1. This result means that this section might

become eroded area or deposit area depending on conditions. Therefore, we considered that it was necessary to dispose the low sabo dams in this section to prevent eroding.

Fig.1 shows the comparison between the amount of river-bed fluctuation of Case3 and that of Case1-1. There was no significant difference between them at the downstream section of 1,000m point (**Fig.1**). We considered that the dam can't show an effect sufficiently at the section around 1,000m point because river width is wide and this area is deposition area. Therefore, we removed the dam-C and located dam-A, -B, and -D at equal intervals in the improvement location plan (**Fig.2**).

The sediment runoff volume from the model area of Case3 was approximately 60,000m^3 and that of Case4 was approximately 58,000m^3 and almost equal to that of Case3. It means that the dam location plan of Case4 was more efficient than that of Case3 because the number of dams of the improvement location plan is one less than that of the original plan. Also, low sabo dams weren't buried, although a lot of sediment deposited at the downstream section of 1,000m point.

CONCLUSION

It is important to know the eroded section, whether dams are buried, the efficacy of sabo dams, and where local scouring occur, and these phenomena were verified in the experiment. In this area, we consider that we made the better location plan of low sabo dams using a hydraulic model experiment in addition to a numerical simulation.

Tab.1 Experiment conditions

Case	Probable flood	Supplied sediment	Sabo dam	Assumed phenomenon
1-1	150 year	equilibrium	None	Plan flood occur under the current situation
1-2	1 year	None	None	Sediment discharge after the plan flood(Case1-1)
2-1	1 year	None	None	Sediment discharge under the current situation
2-2	1 year	1/4 equilibrium	None	Plan flood occur under the condition that water route is fixed (after Case2-1).
3	150 year	equilibrium	Origin	Plan flood occur under the current situation
4	150 year	equilibrium	Improvement	Plan flood occur under the current situation

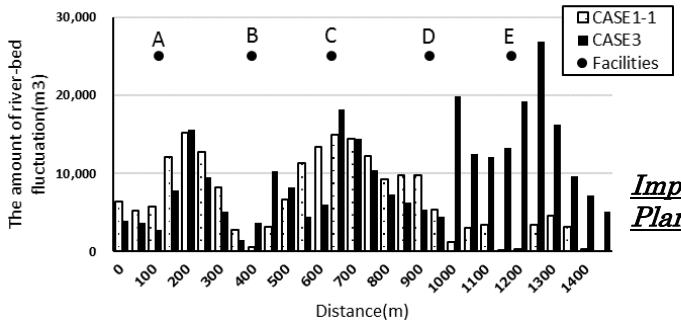

Fig.1 River-bed fluctuation (Case1-1 and 3)

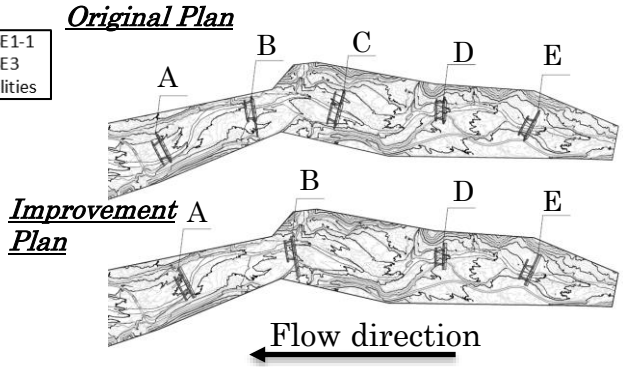

Fig.2 The location plan

REFERENCE

Kimura. (1990) Stabilizing Effects of Groundsels on Streambed(Ⅰ) -Characteristics of Streambed Deformation-, Res. Bull. Fac. Agr. Gifu Univ. (55):37-43

Oda et al. (2000) Adequateness and Usefulness on the Hydraulic Model Experiment at Uono River – Flood Damage in Uono River on September 15-16, 1998 -, Journal of the Japan Society of Erosion Control Engineering, Vol.52, No.6, p32-37

Keywords: sediment movement characteristic, hydraulic model experiment, Facility location plan