USE OF HOUSE STORAGE TO CONTROL THE STORMWATER DISCHARGE IN URBANIZED BASIN

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1. INTRODUCTION

Komatsu river is a stream of 3.5 km long which flows down the central part of Miyazaki city and joins with Ohyodo river as shown in figure 1. Komatsu drainage basin occupies 3.54 km^2 and most of the area is commercial–residential land. The inundation of this basin is caused by excess discharge and restriction of stream flow with sluice at the down stream end. To control it rain–storm drainage facilities have been applied for this river. In this paper, flood control by means of house storage is applied in simulation of numerical stormwater discharge analysis.

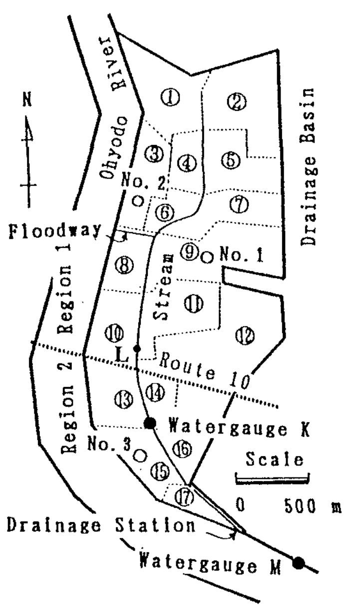

Figure 1 Outline of Komatsu river

2. ANALYSES

A runoff model was constructed to simulate stormwater discharge from Komatsu river drain–age basin[3]. The model consist of three submodels i.e. rainfall excess analysis, surface runoff analy–sis and flood routing analysis model. The study area was divided into seventeen subbasins as shown in figure 1.

2.1. Rainfall excess analysis

In this numerical model, the infiltration rate is evaluated theoretically by an analysis of saturat–ed–unsaturated flow[2]. The unsaturated character–istic curves are identified from the results of the field measurements carried out at three measuring points, No.1–No.3 shown in figure 1.

The assumption used in this analysis are that the groundwater table exists at a depth of 1.9m below the ground surface and that the initial water content in the unsaturated zone distributes linearly from the measured value at the ground–water table. The percent imperviousness data before 1988 measured from aerial photograph and after 1988 estimated from SPOT–XS satellite remote sensing data[1].

The rainfall excess intensity (R_E) for the analysis of overland flow on the subbasin with house storage is evaluated by equation(1). The principal outline of house storage is shown in figure 2. The house storage functions like water storage facility constructed to catch rain water from the roof. There is normal water flow from such a household when the house storage is completely full.

$$R_E=\alpha DR(1-\beta)+\alpha DR\beta\delta \qquad :R<i_1 \qquad (1)$$
$$R_E=\alpha DR(1-\beta)+\alpha DR\beta\delta+(1-D)(\alpha R-i_1) \qquad :R\geq i_1$$

α:rainfall loss factor for evaporation etc., D:per–cent imperviousness of subbasin, R:rainfall inten–sity, i_1 seepage rate at the ground surface, β:per–cent of household installed with the house stor–age, S_V:house storage volume and A_F:roof area. δ=0 when S_V is less than the total volume of storage rain water $\Sigma AFR\Delta t$ and δ=1 when the house storage is full.

2.2. Surface Runoff Analysis

Komatsu river was simplified and modeled into rectangular slopes inclined to the river. The dimension of subbasin were obtained from a topographic map of scale 1/5,000. The kinematic wave method was used to simulate the subbasin overland flow.

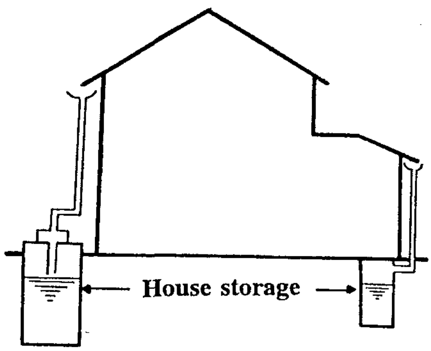

Figure 2 Outline of house storage.

2.3. Flood Routing Analysis

Assuming a trapezoidal channel section, the movement of flood wave through river is simulated by the kinematic wave method.

3. RESULT

The model is applied to estimate the change of flood after the application of house storage. The lowest point of the river bank is in station L shown in figure 1. Therefore, at this point inundation is easy to generate. From this reason the simulation of water level before and after installing the house storage are compared in this station. With reason of discharge from subbasin No.9–No.13 have relatively big effect to the water level at station L, the house storage is applied only in

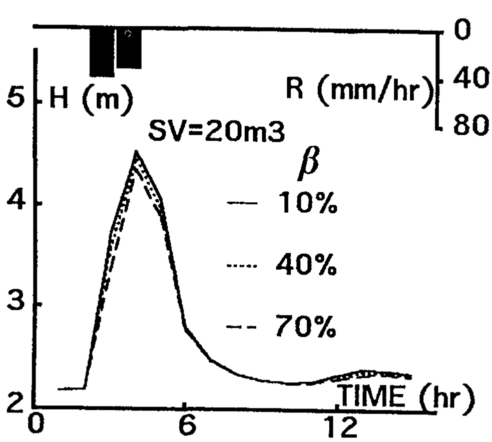

Figure 3 Response to rainstorm

these subbasins. With assumption of A_F 138m^2, S_V 20m^3 and D of the basin in 1991, the water level at station L is simulated in several β. The results are shown in figures 3 and 4 for the rainstorm shown in figure 3. The results show the mitigation effect of S_V 20m^3 to the rainstorm; that is, the peak water level is slightly lowered even high percent of β. Figure 4 shows the decrease of peak water level according to the change of storage volume. The bank elevation at station L is 4.4m, therefore to avoid the inundation the house storage requires installation of 60% households with storage volume 12m^3.

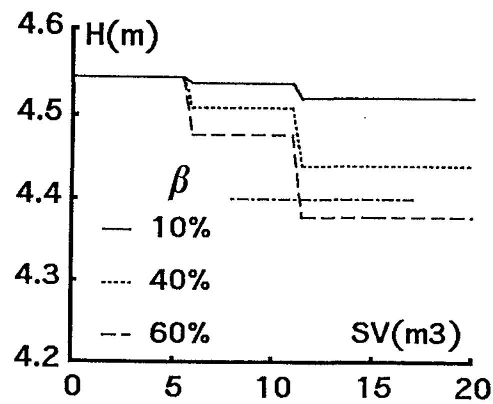

Figure 4 Decrease of peak water level

4. CONCLUSION

The numerical model is applied to estimate the change of water level especially at station L according to the installation of house storage on subbasins No.9–No.13. In case of Komatsu basin the effective design of house storage to make peak water level lower than river bank at station L is β 60%, S_V 12m^3 with assumption R_F 138m^3 and rainfall data as shown in figure 3. From this study the results show that the house storage has functioned to mitigate the stormwater from urbanized basin.

REFERENCES

1. Deguchi,C., and Sugio,S.(1994). Estimations for Percentage of Impervious Area by The Use of Satellite Remote Sensing Imagery. Wat.Sci. Vol.29,No.1–2,pp. 135–144.
2. Neumen, S.P.(1973). Saturated–unsaturated seepage by finite elements. Proc. ASCE, Vol .99, HY12, pp.2233–2250.
3. Sugio,S., and Deguchi,C.(1993). Simulation of Stormwater Discharge From Small Urban Watershed. Proc. ICUD, Vol 1, pp. 579–584.