STORM RUNOFF ANALYSIS CONSIDERING HOUSE RAINWATER DRAINAGE SYSTEM FOR A SMALL URBAN WATERSHED IN SWEDEN

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1. INSTROCTION

Heavy rainfall and poor drainage facilities cause inundation in urban watershed. The improvement of rainwater drainage facilities and assessment of inundation risk assessment through inundation simulations are considered important for flood control[1]. Under climate change situation and the increase of the rainfall, it is necessary to concern about how to simulation the flood damage in urban watershed[2]. This paper presents storm runoff model considering house rainwater drainage systems. The model is instituted in a case study of Palmviken watershed in Arvika, Sweden (Fig 1). At first, we collected the information of foundational urban landscape GIS delineation of Palmviken watershed and the aerial photograph of the building and road's arrangement and location information of the rainwater sewer with vector type GIS data and elevation data of 1 m resolution. Secondly, grasping the particular land use situation and rainwater drainage of houses by field observation. Lastly, we apply for a small urban watershed and investigated the usefulness of proposed model from the inundation analysis with the data of flood damage event in 2006 in Sweden. The effectiveness of the proposed model is illustrated and discussed.

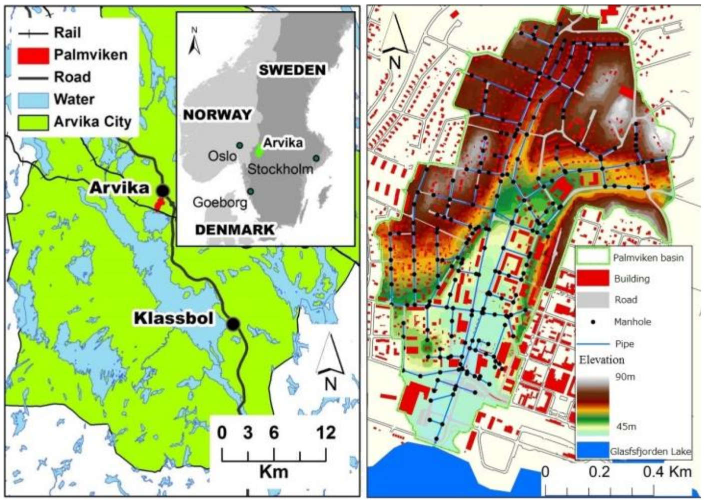
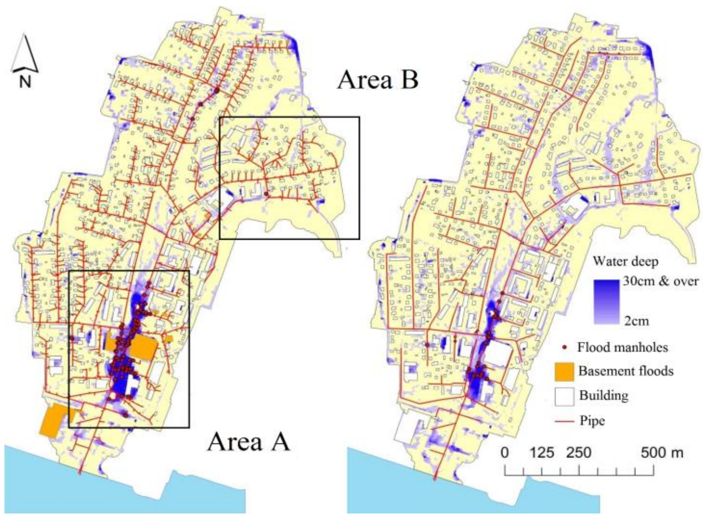


Fig. 1 Location of the Palmviken catchment

2. MODEL APPLICATION TO THE PALMVIKEN WATERSHED

In order to apply the storm runoff model, the urban landscape GIS delineation of Palmviken was gotten from Arvika, we constructed advanced urban landscape GIS delineation with consider about modeling the realistic storm drainage faithfully that reproducing the rainwater route as faithful as possible. It is constructed by using the aerial photograph and field observation so that we could check the connection between houses to the rainwater sewer pipe and the information of street inlets. As there are no design materials of rainwater drainage plan as that time, we use the rainwater sewer pipe data which got by field observation during the flood damage in July 2006. As a result, more than 1,000 branches from main pipes to houses were added manually. Land use number that has been built is about 18,000. Impervious area rate is about 47%. The element numbers of rainwater pipe, street inlets and manholes we constructed are 1841, 319 and 947.

During analysis, set Case A as proposed model, Case B as



(a) Case A (c) Case C

Fig. 2 Maximum flood depths and flood manholes.

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the proposed model (with street inlets), Case C as previous model (without street inlets). The initial water levels was set as 46.5 m. The model was tested by using 10 minutes rainfall which got from rain-gauge station at 3 km north of watershed in July 2006. The analysis about the route of ground surface and rainwater sewer pipe is performed at about 0.2 second intervals. Fig. 2 shows the maximum discharge on the ground surface, manholes and street inlets which overflow water depth more than 0.1 m and the pipeline used for the analysis were showed in Case A and Case C.

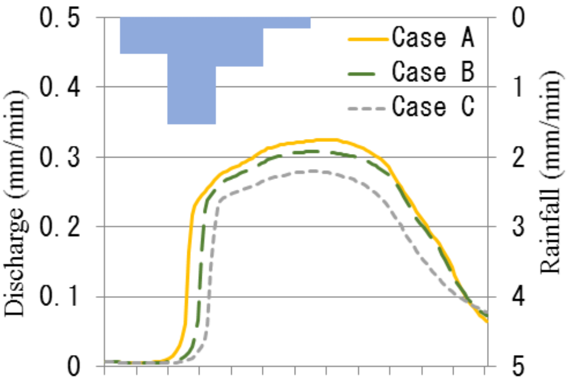

Fig. 3 Storm runoff analysis of rainfall event in Palmviken watershed in 2006

3. RESULT AND DISCUSSION

As shown in Fig. 3, among three cases, the peak value of discharge of Case A is the highest, Case C is the lowest. It could be read that, the connection with the house and rainwater pipe and the existence of street inlet on the ground surface influencing the discharge to the lake. Many of the ground surface overhead flooding are concentrated in Area A (Fig. 2). Although the discharge and range is Case A bigger than Case B, Case B bigger Case C in the upper watershed Area B, the inundation depth in Case C is bigger than the result in Case A. In Case A, due to the rainwater from sewer pipe and street inlet in upper watershed going to the lower watershed, lead to increase the flood depth in Area A, the flood arrival time in Case A has become faster and peak value of runoff depth get higher than other Cases. On the basis of the survey from Arvika Municipality, the inundation range is notarized roughly match with Area A, though the measurement information of the flooded area in this study has not been obtained.

Table. 1 Number of buildings in each water depth

Inundation depth (m)	Number of building (basement inundation)	
Under 0.01	19	(1)
0.01-0.019	156	(1)
0.02-0.039	360	(8)
0.04-0.059	60	(4)
0.06-0.079	27	(1)
0.08-0.99	0	(0)
0.10-0.19	40	(3)
0.20-0.29	14	(1)

Table 1 shows the number of buildings and inundated basement in each water depth. The proportion of inundation depth under 0.1m is approximately under 3% in basement , the inundation risk will exceed about 10% when the flood depth over 0.1m. Therefore it is considered that, when the flood depth of surrounding building is over 0.1m, the risk of basement inundation will increase. In addition, because of the rainwater on the ground surface is set as inflow without any barriers in this simulation, the later simulation should pay more attention to the local situation change, though the relationship between the inundation of manhole and basement inundation is not be read .

4. CONCLUSON

This study has been evaluates and examines the usefulness of the storm runoff model by comparing the storm runoff characteristics and watershed flood properties which are got from proposed model and previous models. Firstly, we collected the information of foundational urban landscape GIS delineation and built advanced urban landscape GIS delineation concluding houses, connection between the houses and sewer pipe, especially the information of street inlet on the ground surface by field observation. And then, application on a small watershed in Arvika, Sweden. Lastly the effectiveness of the proposed model is illustrated by comparing the previous models.

REFERENCE

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2) Amaguchi, H, Kawamura.A, Olsson, J, Takasaki,T, Nakagawa, N.: A proposal of storm runoff model considering rain drainage of a house and its application for a small urban catchment