ANALYSIS OF FLOOD CONTROL USING THE POLDER SYSTEM AT CAMPUS II BUNG HATTA UNIVERSITY, AIR PACAH, PADANG CITY

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ABSTRACT

Campus II of Bung Hatta University is located in Air Pacah district, this area is prone to flooding. This study aims to control inundation inside the polder after the application of embankment through the use of retention pond and pump. To determine the design discharge of the rainfall and inundation, rainfall data for the last 10 years are analyzed. The design inundation discharge is obtained as 180.69 mm/day, retention capacity of 851.452 m^3 and pump capacity of .5 m^3/sec are applied. Embankment with the height of 80 cm in the viewed point of the campus main gate is apllied.

Keywords : *Polder, Flood, Pond, Pump, Embankment*

INTRODUCTION

The area of campus II of Bung Hatta University is located in the area prone to flooding, this situation will disrupt and damage the fasility within the campus. To solve this problem, polder system is proposed. The polder approach refers to the drainage and flood protection of low-lying areas by means of pumps, canals and embankment [1]. This study will analyze the capacity of the retention pond and pump to be applied, and the height of embankment surrounding the polder area.

METHOD

Rainfall data for the last 10 years, from 2013 to 2022, obtained from Bendung Koto Tuo rainfall station, are analyzed with four methods to determine the design rainfall discharge, they are Normal, Log Normal, Gumble, and Log Pearson III methods [2]. The suitability tof the results are tested with Chi-Square and Smirnov Kolmogorov methods. The design rainfall for the return period of 5 year is analyzed to determine the rainfall intensity with the use of Mononbe method [3], as shown in equation (1).

$$I = (R_{24}/24)(24/t)^{2/3} \quad (1)$$

Where:
I = Rainfall intensity in mm/hour
R_{24} = Maximum rainfall in 24 hours in mm
t = The duration of the rain in hour

To determine the inundation discharge, Rational method is used [4], as shown in equation (2).

$$Q = 0.278 \times C \times I \times A \quad (2)$$

Where:
Q = Inundation discharge in m^3/sec
C = Runoff coefficient
I = Rainfall intensity in mm/hour
A = Catchment area in km^2

The height of the embankment to be applied is based on the flood water level.

RESULTS AND DISCUSSION

The design rainfall discharge is optained through the use of four methods, and tested with suitability methods. Based on the analysis, Normal method appeared to be the most suitable.

Table 1. Rainfall Probability Distribution Analysis

Return Period (year)	Normal Method (mm)
2	157.10
5	180.69
10	193.04
25	205.12
50	214.66

The design rainfall discharge with the return period of 5 year is chosed based on the area of the polder.

Rainfall intensity is analyzed with Mononobe method (1), the rainfall intensity is analyzed with four scenarios of rainfall duration, the are 10 minutes, 1, 2, and 4 hours. The results are used to determine the inundation discharges.

Table 2. Inundation Discharge

Rainfall Duration (hour)	Inundation Discharge (m^3/sec)
0.17	1.973
1	0.598
2	0.376
4	0.237

The inflows of water into the retention pond are based on the four rainfall duration scenarios. The biggest inflow discharge is obtained in the rainfall duration of 10 mintues.

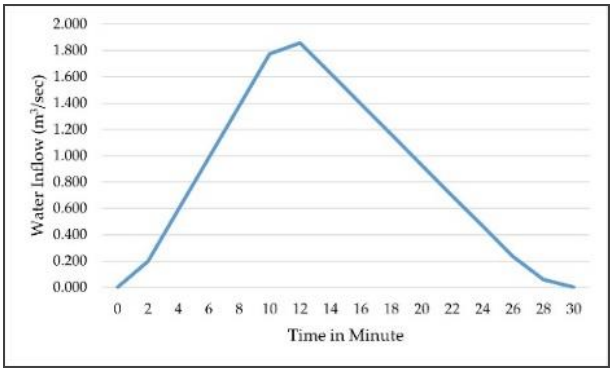

Figure 1. Water Inflow in 10 Minutes of Rain Duration

Based on figure 1, the peak discarge occurs after 10 minutes of rain, this is due to the time the rain water needs to reach the retention pond from the fartest poin of the polder area (concentration time). After the rain stop, the inflow discharge finally slows down.

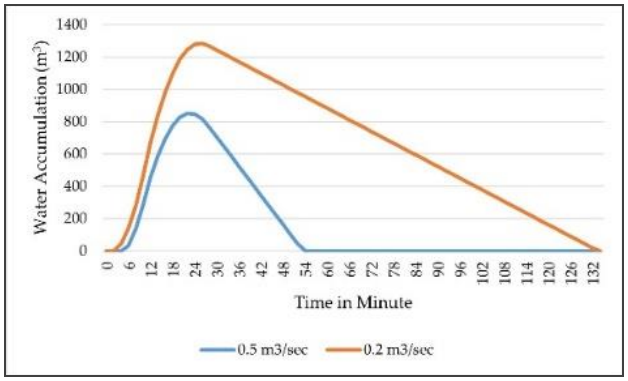

Figure 2. Water accumulation in the Retention Pond

Based on figure 2, the accumulation of water in the retention pond is based on the use of two scenarios of waterpump (0.5 m^3/sec and 0.2 m^3/sec). The smallest maximum accumulation appeared in the use of 0.5 m^3/sec pump with 851.452 m^3

The height of the embankment to be applied is 10 cm higher than the flood water level, based on the viewed point in the main gate, the height of the embankment is 80 cm.

CONCLUSSIONS

To determine the volume of the retention pond and pump of the polder system to be applied, the factor of available land is considered, thus the volume of the retention pond to be applied is chosed as 851.452 m^3 based on the smallest maximum water accumulation from two pump scenarios. The pump to be used is 0.5 m^3/sec pump, and the embankment height to be applied is 80 cm, based on the flood water level of 70 cm in the viewed point in the main gate of the campus.

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