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Analysis and Identification of Factors Causing Flooding at Sukabumi City Terminal

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ABSTRACT

The plumbing system is an inseparable part of a multi-storey building. The plumbing system at the hotel is used to provide clean water and hot water needs. To meet the need for clean water in the design of an 8floors building with a total of 45 inhabitants, an average number of 2,706 people per month and 100 visitors per day, a *ground water tank* capacity of 404.5 is required. m3 / and for the top water tank (Roof Tank) used a water reservoir of 21.59 m3. Based on the results of calculations for hot water needs where the toll of hot water needs per day is 12,900 liters including heat loss with 100% hotel occupancy and for heating time, it is obtained 9.79 hours / day using 2 units of heater heater 21.04 Kw.

KEYWORDS
Flood
Drainage
Terminal
Sukabumi

1. Introduction

Floods are one of the natural disasters that often threaten the lives of residents and urban infrastructure in various parts of the world, including in the city of Sukabumi [1], [2]. Sukabumi City Terminal, as one of the important infrastructure in transportation movements in the city, is often a point prone to flooding [3]. Floods that occur at the Sukabumi City Terminal can disrupt population mobility, damage public facilities, and cause significant economic impacts.

To overcome the problem of flooding at the Sukabumi City Terminal, it is important to carry out an in-depth analysis and identify the causal factors. A comprehensive understanding of these factors will help in designing appropriate and effective solutions to reduce the risk of flooding in these areas [4], [5], [6]. This study aims to conduct an in-depth analysis of flooding events at the Sukabumi City Terminal and identify the causal factors that contributed to the flooding. In this context, causal factors can include aspects of rain, urban drainage, land use, natural damage, and human practices that have the potential to trigger flooding [7], [8], [9].

This research is important in efforts to improve the quality of life of Sukabumi City residents and maintain the operational continuity of the Sukabumi City Terminal. With a better understanding of the factors that cause flooding, governments and stakeholders can design more effective policies, strategies and infrastructure to reduce flood risks, protect the environment and ensure smooth mobility in the city.

2. Method

The data collection method in this research uses two types of data, namely primary data and secondary data [10], [11], [12]. Primary data is direct observation carried out in the field regarding what triggers flooding at the Sukabumi city terminal. Observations carried out in the field are direct surveys to the terminal location to obtain data regarding the condition of the flood location [13], [14], [15], [16].

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Secondary data in the form of Sukabumi city terminal site plan data and hydrological data in the form of Sukabumi city rainfall data obtained from related agencies such as the Sukabumi City PSDA and the Sukabumi City Public Works Department.

2.1. Data Processing Methods

The planned data processing method includes several stages including the following:

2.1.1. Rain Intensity Analysis

The rainfall data used in this analysis is monthly rainfall data for an 11 year period from the Cimandiri rain station. Analysis of maximum rainfall in the return period (tr) of the year using the algebraic (arithmetic) average formula. The chosen rainfall frequency distribution analysis is the Pearson III log. As for rainfall, the plan uses return periods of 2, 5, 10, 25, 50 and 100 years. Then the average rainfall intensity (I) is calculated using the mononobe formula to determine the planned flood discharge.

2.1.2. Drainage Channel Repair Concept

The concept of improving drainage channels is based on the basic principle approach to dealing with inundation, namely the ability of the channel to accommodate the planned discharge that occurs [17]. Re-planning of the drainage channel is needed so that the drainage channel is expected to be able to accommodate excess discharge that the existing channel cannot accommodate [18], [19], [20]. Increasing the capacity of drainage channels can be done by increasing the channel width, channel depth or a combination of both [21], [22], [23], [24]. The research flow chart can be seen in Figure 1.

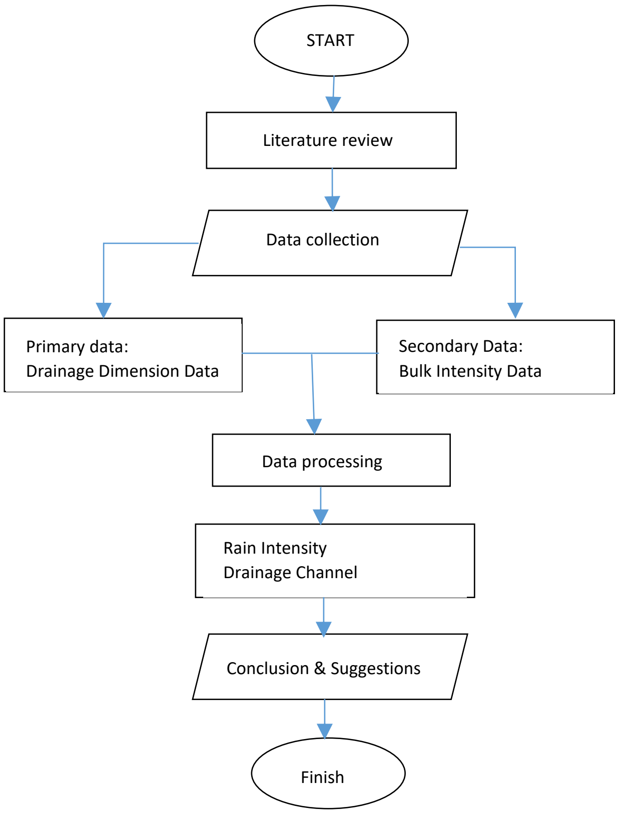

Figure 1. Research Flow Chart

3. Results and Discussion

3.1. Maximum Daily Rainfall

Based on the results of observations of maximum daily rainfall data using data from the Cimandiri Station rain measuring station, the rainfall data observation period used is 11 (eleven) years from 2013 –

2022. Rain data at all rain stations can be used to calculate planned rainfall by Log Pearson III frequency analysis method. The average maximum rainfall can be seen in table 1 below:

Table 1. Average Maximum Rainfall

Year	Average Maximum Rainfall (mm)	Ri (mm)
2012	541	1180
2013	869	946
2014	1180	869
2015	946	770
2016	743	742
2017	587	600
2018	600	588
2019	770	587
2020	588	541
2021	501	537
2022	537	501

3.2. Frequency Analysis

The results of frequency analysis in rainfall calculations using the Log Person III distribution method can be seen in table 2 below:

Table 2. Log Pearson Distribution III

No	Ri (mm)	Log Ri	Log (Ri-Rt)^2	Log (Ri-Rt)^3
1	1180	3,0718820	0,23351	0,01273
2	946	2,9758911	0,13758	0,00260
3	869	2,9390198	0,10064	0,00102
4	770	2,8864907	0,04812	0,00011
5	742	2,8704039	0,03203	0,0003
6	600	2,7781513	-0,06022	-0,00022
7	588	2,7686381	-0,06974	-0,00034
8	587	2,7686381	-0,06974	-0,00034
9	541	2,7331973	-0,10518	-0,00116
10	537	2,7299743	-0,10848	-0,00127
11	501	2,6998377	-0,13854	-0,00266
Jml	7860	31,2221243	0,0000	-0,01050
Rt	714,5	2,83837		
Sd	0,00711			
Cs	3,0			

From the table above, a standard deviation value of 0.00711 and an asymmetry coefficient of 3.0 are obtained. The results of these calculations will be used in rainfall analysis with return period calculations of 2, 5, 10, 25, 50 and 100 years (table 3).

Table 3. Rainfall Calculation

Year (Tr)	Ktr	Rtr (mm)
100	4,051	736,5
50	3,152	725,8
25	2,278	715,4
10	1,18	702,7
5	0,42	694,0
2	-0,396	684,8

To calculate rainfall intensity, the 5 year return period used is the analysis results of the Log Pearson III distribution method.

3.3. Design Rain Intensity

Because hourly rainfall data is not available, the data is derived from daily rainfall based on the estimated duration of rain. The flow concentration time is obtained using methods such as the Kirpich method. The concentration time method was chosen based on the results of calculating the smallest concentration time which resulted in a concentration time of 4 hours. Based on the results of the design rainfall intensity analysis using the Mononobe method, the design rainfall intensity (I) value was 177.1 mm and the design flood discharge (Qr) was 0,531 m^3.

3.4. Channel Improvement Concept

Based on observations, results were obtained using a concentration time of 4 hours, rain intensity with a return period of 5 years which produced quite good simulation quality. Where for runoff and flow tracking respectively it is 0.25% and 0.61%, because the quality will be considered poor if the results obtained are >10%. Based on the simulation results on the drainage channel at the Sukabumi city terminal, a maximum speed of 2.38 m/s was obtained, with the dimensions of the existing channel being B= 0.80 m and H= 1.20 m, and the condition of the channel overflowing during intense rainfall. tall. Therefore, the concept of improving the drainage channel was carried out by increasing the width and depth of the channel. After carrying out the analysis, a new design for the dimensions of the drainage channel was obtained, namely with a width (B) = 1.20 m and a height (H) = 1.40 m.

4. Conclusion

The factor that causes flooding at the Sukabumi city terminal is the existing drainage channel which cannot accommodate water discharge. So improvements were made to the channel by increasing the width and depth of the channel. With an initial width of 0.80 m, the increase was made to 1.20 m and the initial height was 1.20 m to 1.40 m.

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