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Evaluation of The Drainage System for Handling Flooding Floods in Villa Ciomas Indah Area, Ciomas Rahayu Village, Ciomas District, Bogor Regency

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Abstract: This study aims to evaluate the capacity of drainage channels in dealing with flooding puddles. This study used the calculations of hydrology analysis and hydraulic analysis to find out the capacity of flooding and debit. Research instruments use documentation in the form of archives are obtained from government offices by collecting primary data and secondary data. Data analysis uses comparative deskritif quantitative t-shirt analysis. The results showed that the conduit capacity (Qsal) that its cross-sectional form and used stone partners with a wide size of the channel (B) 80 cm and the depth of the channel (h) 70 cm can not accommodate a 10-year flood debit plan, so an evaluation was carried out to be 100 cm × 100 cm.

Keywords: evaluation, channel drainage, floods

Introduction

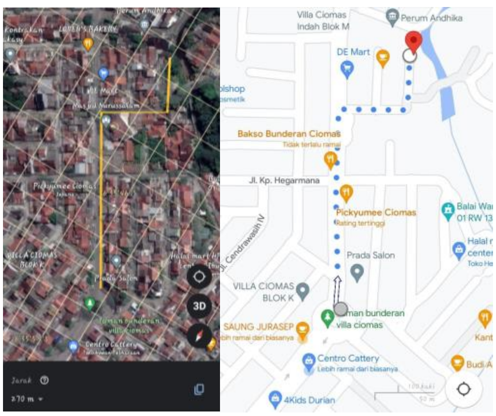

Figure 1. Drainage Flow Map

According to Suripin (2004), drainage is a series of water buildings that function to reduce and/or dispose of excess water from a land, so that the land can be optimally functional. The drainage system consists of the primary and secondary channels. Based on its distribution system, urban drainage is planned to be separated by wastewater disposal channels. Drainage channels can be openly planned and closed by considering soil willingness factors, financing, operations, and maintenance.

The Villa Ciomas Indah area is in Ciomas Village, Rahayu, Ciomas District, Bogor Regency. Villa Ciomas Indah has a land area of 318.427 m². Where 155.663,76 m² was used for the effective area of kavling, 86.359,24 m² was used for public facilities, and the remaining 76.404 m² were used for road areas and channels. The Villa Ciomas Indah area has 5 RW, from RW 10 to RW 14, which has 1997 Head of Families with a population of 5610 people, so that per family has an area for around ±77,95 m². This causes Villa Ciomas Indah Region to become a dense residential area.

Drainage is one of the important aspects in supporting the infrastructure of a region. The bad drainage system can cause flooding that has a negative impact on society. Villa Ciomas Indah has always

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experienced a problem of flooding in every year, this is due to the presence of natural phenomena such as high rainfall so that the drainage channel capacity can not accommodate human debit and behavior that is difficult to control.

Flooding occurs at the point of Bunderan Villa Ciomas Indah area to Selahuni Village, this has been due to the impact of regional topography conditions that has decreased from the main entrance of Villa Ciomas Indah to the direction of 600 meter, where elevation at the main entrance of Villa Ciomas Indah is in 235 meter, while the Maslok Dalam villa, and Donel is worth Masl. Therefore, in this study, we will be discussed about the evaluation of the drainage channel in the direction of the flow of water towards a river boy, namely the right channel from the direction of the Ciomas Villa Ciomas Indah point to the 270 meter river.

Method

The method used in this study is a quantitative comsetal t-shirt method that has problems in the form of a cause-and-effect relationship, to test the rainfall analysis and drainage calculation of the drainage canal effect that can accommodate the debit of floods. The calculations use hydrology analysis and hydraulic analysis. Hydrology analysis contains calculations of rainfall frequency analysis, the suitability of rain distribution, the volume of rainwater reservoir, concentration time, rational modified debits. Then for the hydraulic analysis contains the dimension of cross-sectional cross, flow speed, and flow debits. Before calculating, it first collects research instruments in the form of documentation obtained from the government office to collect primary and secondary data information. A data analysis used is the magnitude of the volume of flood flow which goes through a unit of time (m^3/second) less than the drainage channel capacity that can fit. The following is the formula to calculate the data analysis technique used:

If $Q10 < Qsal$, Then the volume of flow that can be held has been safe.

Q10 = 0,278 × C × Cs × I × A

Qsal = A × V

Result and Discussion

1. Data Description

The data needed in calculations consisted of primary data and secondary data. Here's the data division:

a. Primary Data

1) The area of regional land is 318.427 m^2
2) Solid area of settlement with Coefficient of Drainage (C) is 0,4
3) The Coefficient of Drainage (C) for roads and duct is 0,7
4) Using Kala Medium/Small and Area of Drainage Visor Area 10-100 ha is 5 years, but in this planning it is used for 10 years
5) The track length is 270 m, divided into 3 points of the area. The trajectory of the first area is 160 m, the second area is 60 m, and the third area is 50 m.
6) The shoulder width of the road in the first area was 6 m, then for the shoulder of the road in the second and third area, which was 4 m.
7) Width of the channel is 80 cm and channel depth is 70 cm.
8) Rectangular stone material is in terms of the coefficient of manning (n) obstained are 0,030.
9) High value of rain (Th) uses a 10 year old plan gumbel is 0,42538 mm.
10) The coefficient of concrete or house barriers (nd) is 0,013.
11) Upstream elevation is 216 m dan downstream elevation is 213 m.
12) Road pavement drainage area is 3%.
13) Drainage area is 1,1% (obtained from $i = \frac{upstream\ elv. - downstream\ elv.}{channel\ length} \times 100\%$).

b. Secondary Data

The secondary data used is rainfall data for the last 10 years obtained from the BMKG Bogor to take 3 Rain Observation Posts around Villa Ciomas Indah area, namely Pos Ome, Pos Dramaga, and Pos Cibalagung. Here are the average rainfall data taken from the three posts.

Table 1: Total Maximum Rainfall Data

Year	Rmax (mm)	Ri (mm)
2013	399,02	399,02
2014	352,43	398,64
2015	260,81	364,58
2016	364,58	352,43
2017	342,44	348,17
2018	273,28	342,44
2019	296,12	339,67

2020	398,64	296,12
2021	348,17	273,28
2022	339,67	260,81

2. Rainfall Frequency Analysis

Analysis of rainfall frequency using 4 methods, namely normal methods, gumbel, normal log, and iii loging. In this calculation, this calculation chooses one method with a greater value, the goal is to anticipate the heavy rain in the future.

Then the analysis of the frequency of rainfall is obtained by the distribution analysis of the gumbel method which is greater between the 4 existing methods. After that take the high value of rain with the 10-year plan, saat in 425,38 mm.

3. Rainfall Distribution Test

The suitability test of rainfall distribution is needed by parameter examiners to test the distribution match of data samples on the expected opportunity distribution function may represent that. In the test conformity of rainfall distribution using the chi-ads tests and the smirnov kolmogorov tests.

In both rainfall distribution tests obtained that 4 methods represent the distribution of rainfall data samples on the opportunity distribution.

4. Rainwater Shelter Volume

Rainwater runoff from the roof of the building will be accommodated by a rainwater shelter to reduce the rainwater runoff. Here's the formulation of the rainwater shelter volume: $V = 0{,}855 \times Ctadah \times Atadah \times th$.

Table 2: The Result Of The Rainwater Shelter Rain Reservoir Volume

Area	Wide (m²)	C reservoir	Th (m)	Total Volume (m³)
Kavling	155.663,76	0,4	0,42538	22.645,9
Public Facilities	86.359,24	0,4	0,42538	12.563,5
Road and Channel	76.404	0,7	0,42538	19.451,6
Total Area	318.427			54.661

5. Concentration Time

Concentration time is a time required by rainwater that falls to flow from the point of falling to the DAS output place after the ground becomes saturated.

Drainage channels are divided into 3 areas. The first area with a 160-meter trajectory length, the second area with a 60-meter track length, and a third area with a length of 50 meters track. The following are the results of the concentration time obtained:

Table 3: Concrentration Time Results

Area	TC (menit)
1	6,03715
2	3,75676
3	3,48676

6. Rational Flood Debits

A flood debit is magnitude of flow in the volume of flow through a cross-section per unit of time (m^3/second). There are several shortcomings of rational methods, namely: the capacity of the catching area of the rainwater does not take into account and rain is expected evenly throughout the catchment area. To overcome the shortage, this method is modified, called rational modified methods. Here's a rational modified method formula: $Q = 0{,}278 \times C \times Cs \times I \times A$.

The following are the results of calculating the 10-year flood debit in the rational method.

Table 4: The Debits Of Plan 10 Years (Q10)

Area	Debit/Q (m³/detik)
1	0,59028
2	0,32857
3	0,24512

7. Channel Cross Section

Channel cross-section using a form of rectangular cross section with stone partner materials. The width of the channel is 80 cm and the depth of the channel is 70 cm.

Table 5: Channel Dimensional Calculation

Area	B (m)	h (m)	A (m²)	P (m)	R (m)
1	0,8	0,7	0,56	2,2	0,2545
2	0,8	0,7	0,56	2,2	0,2545
3	0,8	0,7	0,56	2,2	0,2545
Trial	1	1	1	3	0,3333

In the study tried to include design trial data, with a 100 cm tract width and the depth of the channel of 100 cm. This aims for the next calculation.

8. Flow Speed

The speed of water flow in the drainage canal, which is obtained from the Manning formula. This calculation is used in order to determine the speed of the plan flow is less than allowed speed. Here are the results of the calculations:

Table 6: Flow Speed

Area	Vren (m/det)	Vijin (m/det)	Vren < Vijin
1	0,73330	1,5	Ok
2	0,73330	1,5	Ok
3	0,73330	1,5	Ok
Trial	0,87772	1,5	Ok

9. Flow Debit

Flow debits can be said to be the capacity of the channel in housing flowing amounts of water. In the calculation of this debit calculation to know the amount of water that flows in a cross-section of each unit of the second and also a benchmark whether the debit of the flood can be accommodated or not by the debit/capacity of the channel.

Drainage flow discharge is calculated from the water flow speed alliance with a channel-sectional area. Then, after that it was checked for control to find out the flood plans of 10 years (Q10) less than the debit of the channel or channel (Qsal). If not Ok, it means that the capacity of the channel or debit flow of the channel (Qsal) cannot accommodate a 10-year flood plan (Q10).

Table 7: Channel Reinforcement Control

Area	Q10 (m^3/det)	Qsal (m^3/det)	Q10 < Qsal
1	0,59028	0,41064	Not OK
2	0,32857	0,41064	Ok
3	0,24512	0,41064	Ok
Trial	0,59028	0,87772	Ok

Conclusion

The results of the evaluation of flood debits for 10 years by debit flow of channels or the drainage inview of the Villa Ciomas Indah Region shows that the drainage capacity of 80 cm × 70 cm can't accommodate a flood flow of 10 years, which was carried out to be 100 cm × 100 cm. When the design trial of 100 cm × 100 cm, it is obtained that the result that the drainage system can accommodate the flood debits of a 10-year plan.

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