Research Article

Redesign of Drainage Channels Soekarno Hatta Road Section in Jatimulyo Village Lowokwaru District, Malang City

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Abstract

The purpose of this study was to determine the capacity of the existing channels on Jalan Soekarno Hatta. This study's methodology is to use the Rational $Q = 0.00278.C.I.A$, technique. According to the calculation results, the CIA uses hydrological analysis, land use maps, and rainfall data. During the five-year return period, the design flood discharge of Jalan Soekarno Hatta fluctuated. Channels 1 to 5 have discharge rates of 0.062 m/second, 0.139 m/second, 0.275 m/second, 0.219 m/second, and 0.241 m/second, respectively. The drainage channels are channel 1 of 0.067 m/second, channel 2 of 0.151 m/second, channel 3 of 0.297 m/second, channel 4 of 0.237 m/second, and channel 5 of 0.260 m/second. Throughout the 10-year return period, the discharge volume fluctuates. Drainage channels in Malang City's Soekarno Hatta Street area vary in capacity. We cannot check Channel 3 due to its limited capacity, but Channel 1 can manage floodwater flow. There is insufficient capacity in channels 2, 4, and 5. The dimension rearrangement has consequences for Channels 2, 3, 4, and 5. Channel 2 has a width of 1.50 meters and a height of 1.20 meters. Channels 3, 4, and 5 all have dimensions. Channel 5 has dimensions of 1.50 meters x 1.20 meters in width and height are 1.50 meters by 1.20 meters. Widening and raising the drainage channels are two aspects of the channel redesign that ensure that the channel capacity is sufficient to manage flood flow.

Introduction

The scientific act of draining excess water through irrigation, seepage, or rain is known as drainage, and it is basically used to keep an area from becoming less functional. Suripin (2004) stated this. The flow of water can be moved, removed, or altered through the drainage process, according to Suripin (2004; 7). Surface water management in the land is made possible by drainage, which removes unwanted water, cleans up standing water, mud, and floods, repairs damaged soils, and lowers the groundwater level to the appropriate level. Buildings and roads are managed to drain excess rainwater to prevent flooding.

This research focuses on the problems of Jalan Soekarno Hatta due to the overflow of the existing drainage system during the rainy season. To avoid flooding in this area, it is necessary to make appropriate and efficient efforts, one of which is to analyze the loss of drainage function. The right measures need to be chosen to overcome this problem. One of the city's main highways, Jalan Soekarno Hatta (Suhat), is often flooded in Jatimulyo Village, Lowokwaru District, Malang City. Two- or four-wheeled vehicles must slow down when passing because the water level of an adult is knee-high. One of the water channels there was seen leaking water to the side of the road. This study aims to calculate the

flood discharge during the five- and ten-year rainy seasons on Jalan Sukarno Hatta, as well as to determine the current channel capacity and dimensions of the effective drainage channel rearrangement on the same road section.

1. The research was limited to the right side of the road from Brawijawa Hospital to the Malang State Polytechnic along ± 1.3 km (1,300 m) and did not count the upstream.
2. This study examines rainfall data during 2004–2023.
3. Capacity assessment with a five-year return period.
4. Channel creation with a 10-year maintained and regulated return period and a 5-year return period.
5. It does not discuss the financial plan for the development costs.
6. It does not discuss the calculation of household waste discharge.

Hydrological Analysis

Hydrological analysis, which determines the volume discharge to be calculated to estimate the dimensions of drainage channels, is an initial stage in flood control management and drainage system design. The plan can be used for statistical analysis related to rainfall planning. Various frequency distribution patterns are often used in statistics related to hydrology.

Rainfall Plan

Two approaches are used to calculate the planned rainfall, which are as follows:
E.J. Gumbel's Method

Gumbel method: based on daily rainfall records, this technique is used to detect anomalous (extreme) events. This approach is ensured using the following formula:

$$X = \bar{X} + s.K \dots\dots\dots\dots\dots (1)$$
$$K = \frac{Y_t - Y_n}{S_n} \dots\dots\dots\dots\dots (2)$$

Pearson Log Type III Method
1. Convert data into *logarithmic formI*, X = log X
2. Calculate the average price:

$$Log\ \bar{X} = \frac{\sum_{i=1}^{n} \log X_i}{n} \dots\dots\dots (3)$$

3. Calculate the price of the standard deviation:

$$s = \left[\frac{\sum(\log x_i - \log \bar{x})}{n-1} \right]^{0,5} \dots\dots (4)$$

4. Calculation of the stiffness coefficient:

$$G = \frac{\sum(\log X_i - \log X_i)^3}{(n-1)(n-2)S^3} \dots\dots\dots (5)$$

5. Logarithmic calculation of rain or flood with repetition period T with the formula:

$$\log X_T = \log \bar{X} + K.S \dots\dots (6)$$

Compatibility Test

Chi-Square Test

$$Xh^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \dots\dots\dots\dots (7)$$
$$E_i = \frac{n}{k} \dots\dots\dots\dots\dots\dots (8)$$

The following equation is used to determine the number of distribution classes:

$$K = 1 + 3{,}22 \log n \dots\dots\dots (9)$$

Uji Smirnov-Kolmogorov
1. Determine the magnitude of the probability of each data.
2. From the output of the data visualization (distribution equation), sort the value of each theoretical probability.
3. Find the biggest difference between actual and theoretical probabilities using these two probability values.

$$D = maksimum\ (P(X_n) - P(X_n)) \dots\dots (10)$$

Flood Discharge Analysis Rational Method

Based on the volume of rainfall flow to be channeled by the Rational Method, the dimensions of the channel are designed. When calculating flood flows from rainfall, the common rational technique is most often used. Basically, this logical equation looks like this:

$$Q = 0{,}278 \times C \times I \times A \dots\dots (11)$$

C Value Based on Land Use

The main determinants of C are the slope of the land, the vegetation of the ground cover, the intensity of rainfall, and the rate of soil infiltration, or the proportion of impermeable land.

Rain Intensity (I)

The height of the rainfall in millimeters per hour expressed in units of time is called the intensity of rainfall.

Subarkah (1980) gives the following formula:

$$I = \frac{R}{24} \left(\frac{24}{t_c}\right)^{\frac{2}{3}} \dots\dots\dots\dots (12)$$

Channel Capacity

Manning's formula, which reads as follows, is used to plan a uniform flow:

$$V = \frac{1}{n} R^{2/3} S^{1/2} \dots\dots\dots\dots (13)$$
$$Q = \frac{1}{n} A R^{2/3} S^{1/2} \dots\dots\dots\dots (14)$$
$$R = \frac{P}{A} \dots\dots\dots\dots\dots\dots (15)$$

Information:
Q = line discharge (m³/sec)
A = wet cross-section area of the channel (m²)
R = finger ± hydraulic finger (m)
n = coefficient of duct roughness
S = channel base slope
P = wet circumference (m)
V = average speed (m/sec)

Materials and Methods

The location of the Drainage Channel Rearrangement study is in Jatimulyo Village, Lowokwaru District, Malang City, on Jalan Soekarno Hatta. The drainage channels in the Jalan Soekarno Hatta area are currently

in the form of open and closed channels. The drainage channel has problems due to sedimentation and excessive accumulation of garbage, so that the capacity of the channel is reduced.
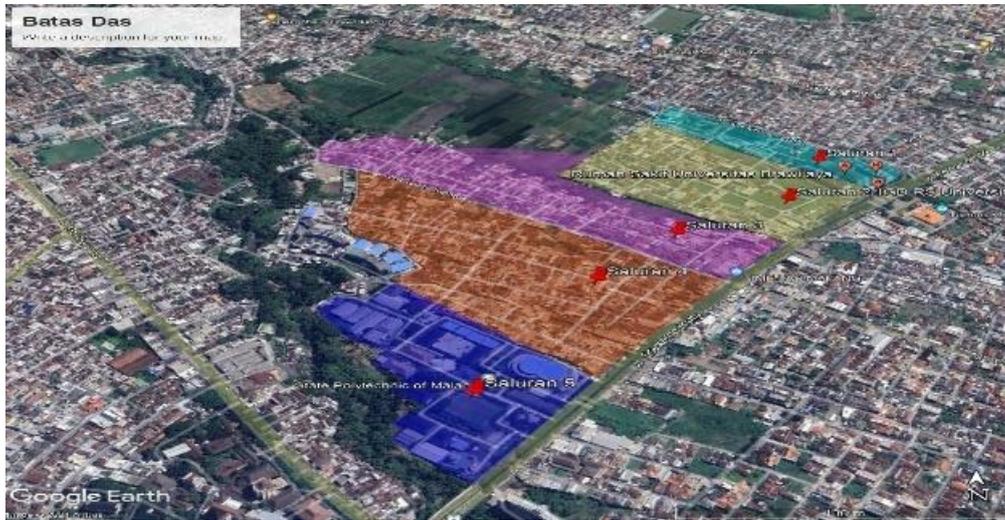

Figure 1. Research Location

Data Collection

Primary Data: The existing conditions of the channel, including dimensions, slopes, conditions of the surrounding environment and a map of the situation.
Secondary Data: topographic data, land use data, rainfall data.

Results

BMKG Online is a source of rainfall data needed for hydrological studies. For further study, the rainfall station has provided data from 2004 to 2023.

Table 1. Rainfall Data

No	Year	Date	Rx (mm)
1	2004	15-Mar	76
2	2005	12-Feb	65
3	2006	4-Jan	65
4	2007	20-Des	81
5	2008	30-Mar	120
6	2009	16-Nov	82
7	2010	9-Aprl	68
8	2011	25-Mar	78
9	2012	10-Of	98
10	2013	10-Of	98.2
11	2014	27-Aprl	96.1
12	2015	19-Feb	91.6
13	2016	24-Feb	97.1
14	2017	1-Mar	87
15	2018	3-Of	107.4
16	2019	11-Feb	96.7
17	2020	11-Feb	84.6
18	2021	28-Feb	145
19	2022	5-Aprl	95.7
20	2023	4-Of the	70.9

Source: BMKG data

Rainfall Data Outlier Test

Table 2. Rainfall Data Outlier Test

No	Year	Max rainfall	Standard string	Standardize Absolutely	Outlier
1	2004	76	-0.541	0.541	Ok
2	2005	65	-1.210	1.210	Ok
3	2006	65	-1.210	1.210	Ok
4	2007	81	-0.237	0.237	Ok
5	2008	120	2.132	2.132	Ok
6	2009	82	-0.177	0.177	Ok
7	2010	68	-1.027	1.027	Ok
8	2011	78	-0.420	0.420	Ok
9	2012	98	0.796	0.796	Ok
10	2013	98.2	0.808	0.808	Ok
11	2014	96.1	0.680	0.680	Ok
12	2015	91.6	0.407	0.407	Ok
13	2016	97.1	0.741	0.741	Ok
14	2017	87	0.127	0.127	Ok
15	2018	107.4	1.367	1.367	Ok
16	2019	96.7	0.717	0.717	Ok
17	2020	84.6	-0.019	0.019	Ok
18	2021	145	3.652	3.652	Outlier
19	2022	95.7	0.656	0.656	Ok
20	2023	70.9	-0.851	0.851	Ok
Rata2	84.91				
Deviation	16.46				

Source: Calculation Results

Based on the Outlier Test of rainfall data, 2021 will have rainfall of 145 mm, which is much more than average. Because the figure is higher, the second maximum rainfall of 118.8 mm is used for 2021.

Rainfall Calculation Plan

1. Rain Calculation of the Pearson III Log Method Design

Table 3. Rain Calculation of the Pearson III Log Method Design

No	X	Log X	With the %	Log X- Log Xrt	(Log X- Log Xrt)^2	(Log X- Log Xrt)^3
1	65	1.813	4.762	-0.129	0.017	-0.00214501
2	65	1.813	9.524	-0.129	0.017	-0.00214501
3	68	1.833	14.286	-0.109	0.012	-0.00130829
4	70.9	1.851	19.048	-0.091	0.008	-0.00075939
5	76	1.881	23.810	-0.061	0.004	-0.00022772
6	78	1.892	28.571	-0.050	0.002	-0.00012340
7	81	1.908	33.333	-0.033	0.001	-0.00003724
8	82	1.914	38.095	-0.028	0.001	-0.00002211
9	84.6	1.927	42.857	-0.015	0.000	-0.00000305
10	87	1.940	47.619	-0.002	0.000	-0.00000001
11	91.6	1.962	52.381	0.020	0.000	0.00000802
12	95.7	1.981	57.143	0.039	0.002	0.00005947
13	96.1	1.983	61.905	0.041	0.002	0.00006814
14	96.7	1.985	66.667	0.044	0.002	0.00008258
15	97.1	1.987	71.429	0.045	0.002	0.00009320
16	98	1.991	76.190	0.049	0.002	0.00012016
17	98.2	1.992	80.952	0.050	0.003	0.00012675
18	107.4	2.031	85.714	0.089	0.008	0.00070793
19	118.8	2.075	90.476	0.133	0.018	0.00234928
20	120	2.079	95.238	0.137	0.019	0.00258837
Sum		38.838		0.000	0.119	-0.001
Rerata		1.942				
S		0.079				
Cs		-0.067				
ck		-0.689				

Source: Calculation Results

Table 4. Calculation of Rainfall Plan with Repeat Time

Fish ulang	Pr (%)	Cs	G	Log Xrt	S	Log X	X(mm)
5	20	-0.067	0.845	1.942	0.079	2.009	102.020
10	10	-0.067	1.274	1.942	0.079	2.043	110.315

Source: Calculation Results

1. Rain Calculation Design Gumbel Method

Table 5. Rain Calculation Design Gumbel Method

No	Year	Rx	(Rx-X) ^3
1	2005	65	-13574.95
2	2006	65	-13574.95
3	2010	68	-9070.49
4	2023	70.9	-5788.37
5	2004	76	-2124.30
6	2011	78	-1279.06
7	2007	81	-484.66
8	2009	82	-322.12
9	2020	84.6	-77.04
10	2017	87	-6.38
11	2015	91.6	20.68
12	2022	95.7	320.72
13	2014	96.1	380.29
14	2019	96.7	482.81
15	2016	97.1	560.50
16	2012	98	764.81
17	2013	98.2	816.09

18	2018	107.4	6377.94
19	2021	118.8	26851.77
20	2008	120	30210.99
Sum		**1777.1**	**20484.28**
Average rainfall		**88.855**	**10628.40**
Sd		**16.10**	
In		**0.5235**	
Sn		**1.0628**	
Cs		**0.2869**	

Source: Calculation Results

Compatibility Test

The results of the Chi-Square and Smirnov-Kolmogorov consistency tests show that the Pearson Type III Log is acceptable as a rainfall reference for flood discharge calculations. For the 5-year return period, the estimated rainfall is 102.02 mm, and for the 10-year return period, the estimate is 110.32 mm.

Table 6. Calculation of Rainfall Plan with Repeat Time

Repeat time (Tr)	YT	X
5	1.500	103.65
10	2.250	115.02

Source: Calculation Results

Perhitungan Debit Banjir Rencana Akibat Air Hujan

Table 7. Calculation of Flood Discharge Analysis for 5 Year Anniversary

Channel Segment	Flow Coefficient (C)	I-5 Th(mm/Jam)	Luas Das	Q-5 Th
Channel 1	0.698	11.944	0.027	0.062
Channel 2	0.458	10.197	0.107	0.139
Channel 3	0.443	18.143	0.123	0.275
Channel 4	0.514	9.575	0.161	0.219
Channel 5	0.883	12.901	0.076	0.241

Source: Calculation Results

Table 8. Calculation of Flood Discharge Analysis for the 10-Year Anniversary

Channel Segment	Flow Coefficient (C)	I- (mm/Jam)	Luas Das	Q-10 Th
Channel 1	0.698	12.915	0.027	0.067
Channel 2	0.458	11.026	0.107	0.151
Channel 3	0.443	19.619	0.123	0.297
Channel 4	0.514	10.354	0.161	0.237
Channel 5	0.883	13.950	0.076	0.260

Source: Calculation Results

Channel Hydraulics Analysis

Steps to calculate the capacity of drainage channels on Jalan Soekarno Hatta:

1. Calculating cross-sectional area (A):
   A = $b \times h$ Water
   = 0.70 x 1.614
   = 1,130 m²
2. Calculating the wet cross-section of the channel (P):
   P = $b + 2h$
   = 0.70 + (2 x 1.16)
   = 3,020 m
3. Calculating the radius of the hydraulic:
   R = $\frac{A}{P}$
   = $\frac{1,130}{3,020}$
   = 0.374 m
4. Calculating the channel base flow rate (V):
   V = $\frac{1}{n} x R^{\frac{2}{3}} x S^{\frac{1}{2}}$

$$= \frac{1}{0,018} \times 0,374^{\frac{2}{3}} \times 0,020^{\frac{1}{2}}$$
$$= 0.367 \text{ m/s}$$

5. Calculating channel capacity (Qs):

    Qs $= A \times V$
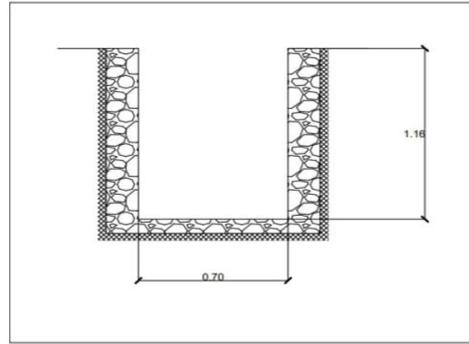
    $= 1.130 \times 0.367 = 0.414 \text{ m}^3/\text{sec}$

Figure 3. Existing Channel Dimensions
Source: Autocad

Table 9. Check Channel Capacity with 5 Years Recurrence

	Ruas Saluran	Q5th(m³/dt)	b(m)	H(m)	W (m)	h Air	A(m²)	P(m)	R(m)	n	S	V(m/dt)	Q(m³/dt)	Cek	Ket
Saluran 1	S1-A	0.062	1.60	1.10	0.20	0.376	0.602	3.800	0.158	0.015	0.033	0.102	0.061	0.000	Saluran Cukup
	S2-A	0.062	1.84	1.00	0.20	0.339	0.624	3.840	0.162	0.015	0.029	0.099	0.062	0.000	Saluran Cukup
	S3-A	0.062	1.78	1.04	0.20	0.374	0.665	3.860	0.172	0.015	0.020	0.093	0.062	0.000	Saluran Cukup
	S4-A	0.062	1.30	1.35	0.20	0.390	0.507	4.000	0.127	0.015	0.120	0.123	0.062	0.000	Saluran Cukup
	S5-A	0.062	2.26	1.9	0.20	0.362	0.819	6.060	0.135	0.018	0.050	0.076	0.062	0.000	Saluran Cukup
	S6-A	0.062	3.10	3.2	0.20	0.363	1.127	9.500	0.119	0.018	0.044	0.055	0.062	0.000	Saluran Cukup
Saluran 3	S1-C	0.275	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 2	S1-B	0.414	0.70	1.16	0.20	1.614	1.130	3.020	0.374	0.018	0.020	0.367	0.414	0.000	Saluran Tidak Cukup
	S2-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-B	0.414	0.56	1.05	0.20	1.786	1.000	2.660	0.376	0.018	0.025	0.414	0.414	0.000	Saluran Tidak Cukup
	S4-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-B	0.414	0.30	0.70	0.20	2.384	0.715	1.700	0.421	0.018	0.031	0.579	0.414	0.000	Saluran Tidak Cukup
	S6-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S7-B	0.414	0.70	0.80	0.20	1.250	0.875	2.300	0.380	0.018	0.031	0.473	0.414	0.000	Saluran Tidak Cukup
	S8-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 4	S1-D	0.219	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2-D	0.219	0.80	1	0.20	0.763	0.611	2.800	0.218	0.018	0.167	0.359	0.219	0.000	Saluran Tidak Cukup
	S3-D	0.219	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 5	S1-E	0.460	0.70	1.37	0.20	1.251	0.876	3.440	0.255	0.015	0.133	0.526	0.460	0.000	Saluran Tidak Cukup
	S2-E	0.460	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-E	0.460	0.80	1	0.20	1.277	1.022	2.800	0.365	0.018	0.033	0.450	0.460	0.000	Saluran Tidak Cukup
	S4-E	0.460	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-E	0.460	0.95	0.92	0.20	1.058	1.005	2.790	0.360	0.018	0.036	0.458	0.460	0.000	Saluran Tidak Cukup
	S6-E	0.460	0.95	1.54	0.20	1.253	1.191	4.030	0.295	0.018	0.057	0.386	0.460	0.000	Saluran Tidak Cukup

Source: Calculation Results

Drainage Channel Replanning

Because the existing channel capacity is not enough for Supporting the estimated flood flow, the drainage channel at the research site was redesigned.

Table 10. Replanning of Drainage Channels with a 5-Year Recurrence Period

	Ruas Saluran	Q5th(m³/dt)	b(m)	H(m)	W(m)	h Air	A(m²)	P(m)	R(m)	n	S	V(m/dt)	Q(m³/dt)	Cek	Ket
Saluran 1	S1-A	0.062	1.60	1.10	0.20	0.378	0.604	3.800	0.159	0.015	0.033	0.103	0.062	0.000	Saluran Ekssting
	S2-A	0.062	1.84	1.00	0.20	0.339	0.624	3.840	0.162	0.015	0.029	0.099	0.062	0.000	Saluran Ekssting
	S3-A	0.062	1.78	1.04	0.20	0.374	0.665	3.860	0.172	0.015	0.020	0.093	0.062	0.000	Saluran Ekssting
	S4-A	0.062	1.30	1.35	0.20	0.390	0.507	4.000	0.127	0.015	0.120	0.123	0.062	0.000	Saluran Ekssting
	S5-A	0.062	2.26	1.9	0.20	0.362	0.819	6.060	0.135	0.018	0.050	0.076	0.062	0.000	Saluran Ekssting
	S6-A	0.062	3.10	3.2	0.20	0.363	1.127	9.500	0.119	0.018	0.044	0.055	0.062	0.000	Saluran Ekssting
Saluran 3	S1-C	0.275	1.50	1.20	0.20	0.723	1.085	3.900	0.278	0.018	0.031	0.253	0.275	0.000	Saluran Rencana
Saluran 2	S1-B	0.414	1.50	1.20	0.20	0.893	1.340	3.900	0.344	0.018	0.020	0.309	0.414	0.000	Saluran Rencana
	S2-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-B	0.414	1.50	1.20	0.20	0.861	1.292	3.900	0.331	0.018	0.025	0.321	0.414	0.000	Saluran Rencana
	S4-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-B	0.414	1.50	1.20	0.20	0.829	1.244	3.900	0.319	0.018	0.031	0.333	0.414	0.000	Saluran Rencana
	S6-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
	S7-B	0.414	1.50	1.20	0.20	0.829	1.244	3.900	0.319	0.018	0.031	0.333	0.414	0.000	Saluran Rencana
	S8-B	0.414	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 4	S1-D	0.219	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2-D	0.219	1.50	1.00	0.20	0.472	0.709	3.500	0.202	0.018	0.167	0.310	0.220	0.000	Saluran Rencana
	S3-D	0.219	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 5	S1-E	0.460	1.50	1.20	0.20	0.635	0.952	3.900	0.244	0.015	0.133	0.483	0.460	0.000	Saluran Rencana
	S2-E	0.460	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-E	0.460	1.50	1.20	0.20	0.850	1.275	3.900	0.327	0.018	0.033	0.361	0.460	0.000	Saluran Rencana
	S4-E	0.460	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-E	0.460	1.50	1.20	0.20	0.837	1.256	3.900	0.322	0.018	0.036	0.366	0.460	0.000	Saluran Rencana
	S6-E	0.460	1.50	1.20	0.20	0.777	1.165	3.900	0.299	0.018	0.057	0.395	0.460	0.000	Saluran Rencana

Source: Calculation Results

Table 11. Channel Control Plan with a 10-Year Recurrence Period

	Ruas Saluran	Q10th(m³/dt)	b(m)	H(m)	W(m)	h Air	A(m²)	P(m)	R(m)	n	S	V(m/dt)	Q(m³/dt)	Cek	Ket
Saluran 1	S1-A	0.067	1.60	1.10	-	0.388	0.620	3.800	0.163	0.015	0.033	0.108	0.067	0.000	Saluran Ekssting
	S2-A	0.067	1.84	1.00	-	0.348	0.640	3.840	0.167	0.015	0.029	0.104	0.067	0.000	Saluran Ekssting
	S3-A	0.067	1.78	1.04	-	0.384	0.683	3.860	0.177	0.015	0.020	0.098	0.067	0.000	Saluran Ekssting
	S4-A	0.067	1.30	1.35	-	0.400	0.520	4.000	0.130	0.015	0.120	0.130	0.067	0.000	Saluran Ekssting
	S5-A	0.067	2.26	1.9	-	0.372	0.841	6.060	0.139	0.018	0.050	0.080	0.067	0.000	Saluran Ekssting
	S6-A	0.067	3.10	3.2	-	0.373	1.157	9.500	0.122	0.018	0.044	0.058	0.067	0.000	Saluran Ekssting
Saluran 3	S1-C	0.297	1.50	1.2	-	0.700	1.050	3.900	0.269	0.018	0.044	0.283	0.297	0.000	Saluran Rencana
Saluran 2	S1-B	0.448	1.50	1.2	-	0.917	1.375	3.900	0.353	0.018	0.020	0.326	0.448	0.000	Saluran Rencana
	S2-B	0.448	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-B	0.448	1.5	1.2	-	0.883	1.325	3.900	0.340	0.018	0.025	0.338	0.448	0.000	Saluran Rencana
	S4-B	0.448	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-B	0.448	1.50	1.20	-	0.851	1.277	3.900	0.327	0.018	0.031	0.351	0.448	0.000	Saluran Rencana
	S6-B	0.448	-	-	-	-	-	-	-	-	-	-	-	-	-
	S7-B	0.448	1.50	1.20	-	0.851	1.277	3.900	0.327	0.018	0.031	0.351	0.448	0.000	Saluran Rencana
	S8-B	0.448	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 4	S1-D	0.237	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2-D	0.237	1.50	1	-	0.485	0.727	3.500	0.208	0.018	0.167	0.327	0.237	0.000	Saluran Rencana
	S3-D	0.237	-	-	-	-	-	-	-	-	-	-	-	-	-
Saluran 5	S1-E	0.498	1.50	1.2	-	0.651	0.977	3.900	0.251	0.015	0.133	0.509	0.498	0.000	Saluran Rencana
	S2-E	0.498	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3-E	0.498	1.50	1.2	-	0.872	1.308	3.900	0.335	0.018	0.033	0.380	0.498	0.000	Saluran Rencana
	S4-E	0.498	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5-E	0.498	1.5	1.2	-	0.860	1.289	3.900	0.331	0.018	0.036	0.386	0.498	0.000	Saluran Rencana
	S6-E	0.498	1.5	1.2	-	0.797	1.196	3.900	0.307	0.018	0.057	0.416	0.498	0.000	Saluran Rencana

Source: Calculation Results

Conclusion

From the results of the calculation, it was obtained that the discharge of the flood design on Jalan Soekarno Hatta was obtained with a variable discharge amount for the 5-year re-season, namely channel 1: 0.062 m³/s, channel 2: 0.139 m³/s, channel 3: 0.275 m³/s, channel 4: 0.219 m³/s, channel 5: 0.241 m³/s and for a 10-year re-season, namely channel 1: 0.067 m³/s, Channel 2: 0.151 m³/s, Channel 3: 0.297 m³/s, Channel 4: 0.237 m³/s, Channel 5: 0.260 m³/s.

The capacity of drainage channels in the Jalan Soekarno Hatta area, Malang City, channels that are sufficient to accommodate flood discharge, namely channel 1, for channel 3 cannot check capacity due to closed channels, and for channels that are not enough, namely channel 2, channel 4, and channel 5.

The result of the replanned dimensions is channel 2, channel 3, channel 4, and channel 5. With the dimensions of channel 2 which are width: 1.50 m and height 1.20 m, the dimensions of channel 3 are width: 1.50 m and height 1.20 m, channel 4 dimensions are width: 1.50 m and height 1.00 m, and channel 5 dimensions are width: 1.50 m and 1.20. In the replanning of drainage channels, it focuses on increasing the size of the channel width and channel height so as to obtain sufficient channel capacity to withstand flood discharge.

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