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Technical Planning of Drainage Channels on Gatot Subroto Road, Banjarmasin Eastern District

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ABSTRAK

Floods are a frequent disaster in Indonesia, particularly during the rainy season. To prevent damage, efforts are being made to improve drainage channels that can accommodate rainwater wells. However, water congestion in Gatot Subroto Road, Banjarmasin Eastern District, and Banjarmachin City along drainage channels is observed due to blockages or storage. A study aimed to determine rainfall leakage on the main channel on Gatot Subroto road using direct field observation, data collection, and processing. The study found that the main channel, with a capacity of 4,8502 m3/dt, can accommodate rain spills

INTRODUCTION

Floods are one of the most frequent disasters in Indonesia, especially during the rainy season from November to mid-December. According to the BNPB (National Disaster Management Agency), (2021) flooding is a natural disaster or natural phenomenon that can cause damage. The environmental problem that we often encounter in our country at the moment is the occurrence of floods in the rainy season, and one of the efforts to prevent these floods is by making drainage channels or repairing drainages that can accommodate rainwater wells. In general, drainage is defined as a series of water buildings that serve to reduce or remove excess water from an area or land so that the land can function optimally. Drainage is also understood as an attempt to control the quality of groundwater in relation to salinity.

In the field of civil engineering, drainage can be defined as one of the technical actions to reduce excess water, whether from rainwater, irrigation, or river water, from an area or land.

We observed water congestion in Gatot Subroto Road, Banjarmasin Timur District, and the town of Banjarmasin along the drainage canals due to several factors. One of these is that the water in one of the drains does not flow normally due to the influence of drainages or blockages on the draining canals, causing the fluid to flood and eventually stagnate in the surrounding area.

The drainage canals also serve as flood controls, so it's important to determine whether they can accommodate the planned drains or not. Flooding causes water congestion around the drainage canals, leading to blockages in the surrounding area. Therefore, there is a need for technical planning of drainage channels on the Gatot Subroto Road in Banjarmasin Eastern District regarding the capacity of drains. To take channel capacity into account, it is necessary to construct a drainage network in a particular area.

METHODS

The drainage system's repair research location is Gatot Subroto Road, Banjarmasin Eastern District, Banjarmasin City. To ensure the smooth progression of this research, we require both primary and supporting data. The primary data requested are channel dimensions, existing channel discharge capacity, water flow direction, and inlet and outlet conditions. The secondary data includes 10-year daily rainfall data sourced from three different stations.

At this stage, the data analysis is done by calculating the data. There are two stages to the data being calculated. Some of the calculations used in hydrological analysis are figuring out planned rainfall using frequency analysis, the Gumbel distribution, the normal distribution, the person log type III, the probability distribution tests for quadratic chi tests, the smirnov Kolmogorov test, the flow coefficients, the concentration time (tc), the area (A), and the counter surface flow (QH). The Hydraulic Analysis Computations involve the Counting of Existing Drainage Channels (Qs). (if not elligble) The data processing results obtained are Qh (rain flow) and Qs (channel discharge).

RESULTS AND DISCUSSION

Hydrological Analysis

The result of the calculation of the maximum rainfall for the past 10 years is based on calculations from previous research conducted at the observation location using different planning methods. For the calculation of the maximum precipitation, the formula is as follows: The average value for the known 3 station data for the years 2013-2022 is 128.6. Table 1 below displays the results for the maximum rainfall.

Table 1. Maximum Daily Rainfall

No	Year	Maximum Annual Rainfall (mm)			
		Kerta Hanyar Station	Tatah Makmur Station	Sungai Tabuk Station	Average
1	2013	95.0	113	95.5	101.17
2	2014	108.0	110	100.6	106.20
3	2015	113.5	117.5	391	207.33
4	2016	91.0	137.5	94.5	107.67
5	2017	106.0	140	165.8	137.27
6	2018	107.0	78.5	103	96.17
7	2019	73.5	139	103	105.17
8	2020	103.5	160.5	98.3	120.77
9	2021	150.5	145	226.7	174.07
10	2022	157.0	115	120	130.67
∑xi		1105.0	1256.0	1498.4	1286.5
N		10	10	10	10
X average		110.5	125.6	149.8	128.6

Table 2 below shows the homogeneity test calculations for Kertak Hanyar and Tatah Makmur stations.i.

Table 2. Calculation of Homogeneity Testing of Kertak Hanyar and Tatah Makmur Stations

No	Kertak Hanyar (Xli)	(Xli-Xi)	(Xli - Xi)^2	No	Tatah Makmur (Xli)	(Xli-Xi)	(Xli - Xi)^2
1	95.00	-15.5	240.25	1	113	-12.6	158.76
2	108.00	-2.5	6.25	2	110	-15.6	243.36
3	113.50	3.00	9.00	3	117.5	-8.1	65.61
4	91.00	-19.5	380.25	4	137.5	11.9	141.61
5	106.00	-4.5	20.25	5	140	14.4	207.36
6	107.00	-3.5	12.25	6	78.5	-47.1	2218.41
7	73.50	-37	1369	7	139	13.4	179.56
8	103.50	-7	49	8	160.5	34.9	1218.01
9	150.5	40	1600	9	145	19.4	376.36
10	157,00	46.5	2162.25	10	115	-10.6	112.36
∑	1105,00		5848.5	∑	1256		4921.4
X_1	110.5			X_2	125.6		
S_1	254918,00			S_2	233.842		
dk	18						
σ	257.839						
	a=5%, dk=18, obtained t table = 1.734						
t count	-66.495						
Conclusion	t count < t table, mean Stasiun Kertak Hanyar and Stasiun Tatah Makmur being homogeneous						

Distribution Compliance Test

This distribution compatibility test is intended to determine the truth of a frequency distribution hypothesis. In the distribution compatibility test, there are two methods: the Chi-square and the Kolmogrof-Smirnov methods. If the X 2 < X2Cr result is acceptable, then it can be concluded that the probability distribution test results with the Chi-squared test method for normal distribution and log normal are acceptable. Table 3 below provides a summary count of comparisons.

Table 3. Comparison Recapitulation Count

Probability Distribution	X^2_{count}	X^2_{cr}	Information
Gumbel	7	5.991	Rejected
Normal	3	5.991	Accepted
Log Normal	3	5.991	Accepted
Log Pearson type III	7	5.991	Rejected

The accuracy or matching test calculation above leads to the conclusion that there are only two acceptable distributions for rainfall data: the normal distribution and the normal log. We must compare the results of the Smirnov-Kolmogorov test calculations for the normal and log distributions again to determine which distribution is most acceptable.

Table 4. Recapitulate Match Test or Square Chi Match

Probability Distribution	X^2 count	X^2 cr	Information
Gumbel	7	5.991	Rejected
Normal	3	5.991	Accepted
Log Normal	3	5.991	Accepted
Log Pearson type III	7	5.991	Rejected

From the table, if the critical ΔP maximum result is accepted, then it can be concluded that all the probability distributions calculated by the Smirnov-Kolmogorov test method for gumbel, normal, normal log, and Pearson type III log distributions are accepted.

Table 5. Recapitulation of Conformity or Matching Tests Smirnov Kolmogorov

Probability Distribution	Δ Max	ΔP cr 5%	Information
Gumbel	0.15	0.41	Accepted
Normal	0.17	0.41	Accepted
Log Normal	0.18	0.41	Accepted
Log Pearson type III	0.13	0.41	Accepted

The table shows that all distributions pass the Smirnov-Kolmogorov test calculation. By comparing the square chi test results, we can conclude that the distributions obtained from the two calculations are both normal and lognormal. To determine the most acceptable distribution between the two results, examine the one with the smallest value, where the normal distribution result was 0.17 and the log normal was 0.18. Therefore, we can conclude that the drainage channel on Gatot Subroto Road in Banjarmasin Eastern District, Banjarmasin City, uses a normal distribution with a 2-year renewal period of 128,6467 mm.

Ground Drainage Planning Analysis

The location of Gatot Subroto Road is at coordinates of 3°19'24.1"S South latitude and 114°37'10.5"E. Figure 1 below shows the catchment area.

Figure 1. Catchment Area Directional Flow

From the results of the calculation of the area area on the area A1 on the left of the road, the area of the residential area is 0.002540 km2, while the surface area of the asphalt road is 0,000224 km2. The area of the A5 area on the left of the road has a population area of 0.002850 km2, while the area of asphalt roads is 0,000224 km2. The A2 area on the right of the road has a population area of 0.002850 km2, whereas the area of asphalt roads is 0,000196 km2. The area of the A3 area on the left of the road has a population area of 0.002598 km2, while the area of asphalt roads is 0,000196 km2. The area of the A6 area on the right of the road has a population area of 0.002598 km2, while the area of asphalt roads is 0,000314 km2. The A4 area on the left of the road has a population area of 0.002492 km2, whereas the area of asphalt roads is 0,000314 km2. The A4 area on the right of the road has a population area of

0.002492 km2, whereas the area of asphalt roads is 0,000224 km2. The area of the A5 area to the left of the road has a population area of 0.001568 km2, while the area of asphalt roads is 0,000224 km2. The area of the A5 area on the right of the road has a population area of 0.001568 km2 while the area of asphalt roads is 0,000224 km2. The area of the A6 area to the left of the road has a population area of 0.002486 km2 while the area of asphalt roads is 0,000224 km2. The area of the A6 area on the right of the road has a population area of 0.002484 km2, while the area of asphalt roads is 0,000190 km2. Area B1 on the right of the road has an inhabited area of 0,025985 km2, while the area of asphalt roads is 0,001002 km2. The area of C2 on the right of the road is 0,018915 km2, and the area of asphalt roads is 0,001176 km2.

The flow coefficient for the settlement area is 0.7, and the road A1 to the right is 0.9, according to the calculation results. The run-off coefficient in area A1 on the right side of the road is 0.72. The run-off coefficient in area A1 on the right side of the road is 0.72. The flow factor value for the settlement area is 0.7, and the value for the right road A1 is 0.9. The running-off factor is 0.72 in the area of the left A1 road obtained, the outcome of the running-off factor is 0.72. The run-off coefficient is 0.71 in area A2 on the right side of the road. The flow factor value for the settlement area is 0.7, and the value for the right road, A2, is 0.9. On the area of the left A2 road obtained, the outcome of the running-off factor is 0.71. The run-off coefficient is 0.71 in area A3 on the right side of the road. The flow rate for the settlement area is 0.7, and the A3 road on the left is 0.9. In areas A3 to the left of the street, the run-off rate is 0.72. In area A4 on the right side of the road, the run-off coefficient is 0.72. The flow rate for the settlement area is 0.7, and the A4 road on the left is 0.9. In area A5 to the right of the road, the run-off coefficient is 0.73. The flow factor value for the settlement area is 0.7, and the value for the right road A5 is 0.9. On the area of the left A5 road obtained, the outcome of the running-off factor is 0.73. The run-off coefficient in area A6 on the right side of the road is 0.72. The flow factor value for the settlement area is 0.7, and the value for the right road A6 is 0.9. On the area of the left A6 road obtained, the outcome of the running-off factor is 0.71. In area B1 on the right side of the road, the run-off coefficient is 0.71. The flow coefficient value for the settlement area is 0.7, and the C1 road is 0.9. The run-off coefficient is 0.71 in area C1 on the right side of the road. The flow rate for the settlement area is 0.7, while the road C2 on the left is 0.9.

The cumulative result for the planned rainfall discharge on the main channel C2 right road over a period of 2 years is 2,6105 m3/dt. Table 6 below presents the calculated planned rainfall discharge (Qn).

Table 6. Plan Rain Debit Calculation (QH)

Area	Return Period	Luas (A) m^2	α	Rain Intensity (It) m/s	The Planned Rainfall Discharge m^3/s (α.β.It.A)	Cumulative
A1 on the right side	2	2763.7	0.72	0.00005968	0.1181	0.1181
A1 on the left side	2	2763.7	0.72	0.00005968	0.1181	0.2363
A2 on the right side	2	3074.4	0.71	0.00005968	0.1311	0.3674
A2 on the left side	2	3046.4	0.71	0.00005909	0.1283	0.4957
A3 on the right side	2	2794.4	0.71	0.00005974	0.1192	0.6149
A3 on the left side	2	2912	0.72	0.00005961	0.1252	0.7402
A4 on the right side	2	2806	0.72	0.00005989	0.1214	0.8615
A4 on the left side	2	2716	0.72	0.00005999	0.1167	0.9783
A5 on the right side	2	1792	0.73	0.00006256	0.0813	1.0595
A5 on the left side	2	1792	0.73	0.00006256	0.0813	1.1408
A6 on the right side	2	2710	0.72	0.00006001	0.1165	1.2574
A6 on the left side	2	2676.8	0.71	0.00006004	0.1148	1.3722
B1 on the right side	2	26987.2	0.71	0.00002840	0.5423	1.9144
C1 on the right side	2	8817.25	0.71	0.00004944	0.3089	2.2233
C2 on the right side	2	20091	0.71	0.00002708	0.3873	2.6105

Hydraulic analysis

The main channel dimensions on street C2 are on the right side of the road. From the units of definition, the calculation of the canal dimensions can be seen in Table 7 below.

Table 7. Channel Dimension Calculation Definition Unit

Name	Formula	Unit
Channel Width	B	m
Channel Height	H	m
Channel Slope	I	%
Wet Cross-sectional Area (Fs)	B . H	m^2
Wet Cross Section Tour (Ps)	B + 2H	m
Hydraulic Radius (Rs)	Fs / Ps	m
Flow Speed (V)	$\frac{1}{n}(Rs)^{2/3}(I)^{1/2}$	m/s
Channel Discharge (Qs)	Fs . V	m^3/s

The computations reveal that the main canal's discharge output, 4,8502 m3/dt, surpasses the rainfall result for the two-year plan, 2,6105 m3/dt, indicating the main canal's capacity to handle rainfall. Table 8 below displays the requirements for Q Rain Planning and Q Channel C2 Right Road.

Table 8. Requirements Q Planning ≤ Q Channel C2 Right Road

Year	Q Planning (Qr)	Q Channel (Qs)	Information
2	26.105	48.502	Qualified

Then, from the calculation of the capacity of the above channel on the drainage road Gatot Subroto, it can be concluded that on the main channel C2, the right road qualifies because of the planned Q rainfall ≤ Q channel. Therefore, the drains on the Gatot Subroto road are capable of accommodating the rain spill.

CONCLUSION

Findings from the studies to improve the drainage system in Gatot Subroto Kec. Banjarmasin East City Banjarmachin showed that the square shape of the main channel had a large capacity on the primary channel C2 right road, measuring 4,8502 m3/dt, with a planned flow of rain of 2,6105 m3/dt over a period of two years. This is where the Q rain planed ≤ Q channel. So on the principal channel of the subroto road drainage, Gatot is able to accommodate the rain. According to the calculation, the main canal is 280 cm by 90 cm. The major capacity of the channel is 4.850 2 m3/d with a planned rain flow of 2.6105 m3/d. With this, the major channel can accommodate rain and flow on the main channel running well without causing congestion of the water, and the inclination of the principal canal is 0.1%. So it can help to maintain the flow speed and sedimentation prevention by optimizing the dimensions and efficiency of the main canal. Canals can improve the resistance of water and water systems.

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