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EVALUATION OF DRAINAGE NETWORK SYSTEM IN HERCULES COMPLEX, BANJARBARU CITY SOUTH KALIMANTAN

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ABSTRACT

Drainage in Banjarbaru City is generally good, but inundation rarely occurs. However, in certain areas, periodic inundation occurs namely inundation for less than 6 (six) months, one of which is in the Landasan Ulin District, which is a transition from swampland to residential use. The research location is the existing drainage canal which is located on several roads of the Hercules complex, Landasan Ulin Village. In general, the drainage channels in the Hercules complex are stone masonry. Improper maintenance causes sedimentation, which impacts drainage channel services. This final project aims to re-evaluate the drainage channels in the residential area of the Hercules complex in Banjarbaru City based on the network system in the residential environment. The analytical method is divided into two. The first is hydrological analysis and hydraulic analysis.

From the results of hydrological and hydraulic analysis and also a comparison of calculations with the existing drainage network system that has been developed, it can be seen from the runoff discharge in the existing channel (Qex) then compared with the calculation of the design flood discharge (Qr) that the cross-sectional dimensions of Box Culvert (60 x 80 x 100), U-Ditch 1 (60 x 75 x 100), U-Ditch 2 (60 x 90 x 100) and U-Ditch cover 5 cm thick is sufficient to accommodate flood discharge two years, five years, ten years, 15 year and 20-year anniversary plans.

Keywords*: Drainage Network System, Design Flood Discharge, Rainfall Intensity, Runoff Discharge*

1. INTRODUCTION

Background

The city of Banjarbaru was originally part of the Banjar district. In 1999 Banjarbaru became an independent city area. Banjarbaru City area is divided into five districts. North Banjarbaru and South Banjarbaru. Drainage in Banjarbaru City is generally good. The research location is an existing drainage canal located on several roads in the Hercules complex. In general, the drainage channels in the Hercules complex are stone masonry. This causes puddles at several points. This final project aims to re-evaluate the drainage channels that have been constructed in the residential area of the Hercules complex in Banjarbaru city based on the network system in a residential area.

Problem Formulation

1. What is the discharge plan for the design of the drainage system at the study site?
2. How is the analysis of the calculation of the channel cross-sectional design in the Hercules Complex drainage system?
3. What is the economical cross-sectional design that can be used at the research location

Research Objectives To

1. Analyze the design flood discharge at the construction site of the Hercules Complex drainage network system.
2. Analyzing the existing drainage network system.
3 Evaluate the drainage network system.

Limitation of the Problem

1. Calculation of canal discharge is based on high rainfall at the Syamsudin Noor Meteorological, Climatological, and Geophysics Agency.
2. Data processing includes: hydrological analysis regarding the calculation of flood discharge and hydraulic analysis concerning the determination of the economic cross-section
3. The calculation of the budget is ignored.

2. THEORITICAL STUDY

Drainage

Drainage means to drain. Drain. Throw away. Or divert water in general. Drainage is defined as a series of waterworks that function to reduce and/or remove excess water from an area or land. To analyze drainage, two aspects are needed, namely hydrological and hydraulic aspects.

Hydrological Analysis

1. The rainfall required in the preparation of the Isohiet map for a water utilization plan and a flood control design is the average rainfall in the entire area concerned.
2. The planned rain forecast is carried out by means of a frequency analysis of the annual maximum average daily rainfall data.
3. Rainfall intensity is the amount of maximum rainfall calculated in a design

4. Time of concentration is the time required for falling rainwater to flow from the farthest point to the watershed outlet (control point) after the soil becomes saturated and small depressions are filled.

   Tc = 0.0195L0.77 . S-0.385
5. In relation to the plan for building water structures. The design magnitude that must be obtained through hydrological analysis activities, in general, can be in the form of a design flood discharge (*design flood*) or mainstay discharge (*dependable flow*).

   Q = 0.00278.C.I.A

Hydraulics Analysis

1. The shape of the drainage channel is generally: trapezium, quadrilateral, and circle. and triangle Rectangular profile A = B x h
2. Flow velocity can be determined by several formulas, namely by the Chezy, Manning, and Strickler formulas. Chezy Formula (V = C $\sqrt{RI}$) , Bazin Formula (C = $\frac{87}{1+\frac{gB}{\sqrt{R}}}$) , Manning Formula (V = $\frac{1}{n}\,.\,R^{\frac{2}{3}}\,.\,I^{\frac{1}{2}}$) , Stickler Formula (V = ks . $R^{\frac{2}{3}}\,.\,I^{\frac{1}{2}}$)
3. The guard height (W) for trapezoid and square road drainage channels is determined based on the formula.

   W = $\sqrt{0.5}x\,\sqrt{h}$

2 METHOD

The design method used is field research, which was carried out in the area of Hercules Complex, Landscaping Ulin Village. Banjarbaru City, as well as analyzing existing data. This chapter will explain how the design will be carried out.

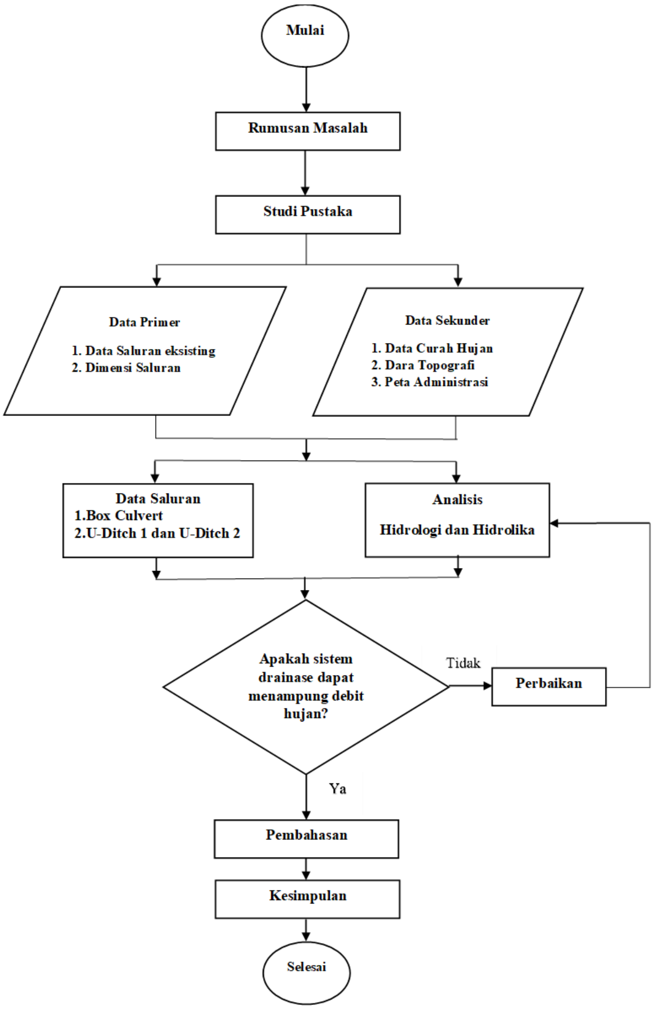
Data Primer

Primary data is data obtained by conducting field surveys. Direct surveys in the field are carried out by making observations such as the size of the existing dimensions and the location of the road drainage channels.

Data Secondary

Secondary data was obtained from existing surveys and research data, and data were obtained from agencies related to the research location. One of them is the annual maximum daily rainfall data for the Banjarbaru Station, with a data length of 20 years.

Flow Chart



3 RESULTS AND DISCUSSION

Design Rain Calculation and Maximum Rainfall Analysis

Periode Ulang T (tahun)	Dist. Gumbel (mm)	Dist. Normal (mm)	Dist. Log Normal (mm)	Dist. Log Pearson III (mm)
2	107,5008	113	108,3529	104,6788
5	148,2697	145	138,3327	136,2608
10	175,2644	162,0650	157,2145	159,6451
15	190,4664	168,9451	165,6628	169,8355
20	201,1550	175,8251	174,5651	180,6764

Table 1 Design Rain and Maximum Rainfall Analysis

Gumbel Calculation, Normal, Log Normal dan Log Pearson III

Periode Ulang T (tahun)	Dist. Gumbel (mm)	Dist. Normal (mm)	Dist. Log Normal (mm)	Dist. Log Pearson III (mm)
2	107,5008	113	108,3529	104,6788
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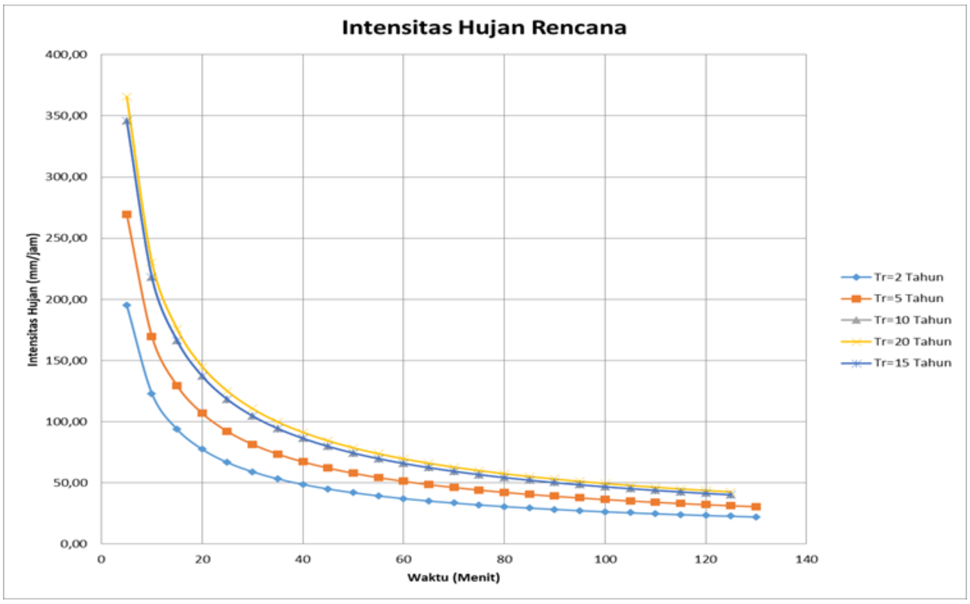
Table 2 Summary Of Gumbel, Normal, and Log Pearson III Calculations

Based on the results of the Chi-Square Test and the Smirnov-Kolmogorov Test, the type of distribution that meets the theoretical requirements and will be used for further calculations is the Gumbel distribution. Because the value of the chi-square test is calculated, the Gumbel distribution is smaller than the other distributions, and in the Smirnov Kolmogorov test, only the Gumbel Distribution and the Normal Distribution are accepted. So that the distribution used for further calculations is the Gumbel distribution.**Intensity Rainfall**

Lama Hujan	Intensitas Hujan dengan Periode Ulang				
t (menit)	Tr = 2 tahun	Tr = 5 tahun	Tr = 10 tahun	Tr = 15 tahun	Tr = 20 tahun
5	195,34	269,42	318,48	346,10	365,52
10	123,06	169,73	200,63	218,03	230,26
15	93,91	129,53	153,11	166,39	175,73
20	77,52	106,92	126,39	137,35	145,06
25	66,81	92,14	108,92	118,36	125,01
30	59,16	81,60	96,45	104,82	110,70
35	53,38	73,63	87,03	94,58	99,89
40	48,84	67,36	79,62	86,53	91,38
45	45,15	62,27	73,61	79,99	84,48
50	42,09	58,05	68,61	74,57	78,75
55	39,49	54,47	64,39	69,97	73,90
60	37,27	51,40	60,76	66,03	69,74
65	35,33	48,73	57,60	62,60	66,11
70	33,63	46,38	54,83	59,58	62,93
75	32,12	44,30	52,36	56,90	60,10
80	30,76	42,43	50,16	54,51	57,57
85	29,55	40,75	48,17	52,35	55,29
90	28,44	39,23	46,37	50,39	53,22
95	27,43	37,84	44,73	48,61	51,33
100	26,51	36,57	43,22	46,97	49,61
105	25,66	35,40	41,84	45,47	48,02
110	24,88	34,32	40,56	44,08	46,55
115	24,15	33,31	39,38	42,79	45,20
120	23,48	32,38	38,28	41,60	43,93
125	22,85	31,51	37,25	40,48	42,75
130	22,26	30,70	36,29	39,44	41,65

Table 3 Rain Intensity with Return Period

The correlation between the intensity and duration of rain can be seen in the following figure



Concentration Time

According toKirpich (1940), the Tc value is as follows:

tc = $0{,}0195\ x\ L^{0,77} x\ S^{-0,385}$

With the length of the drainage channel in the Hercules Complex with a length of view of 645 m and the average slope of the land (sloping) is 1%, the calculation can be written as follows:

tc = $0{,}0195\ x\ 317^{0,77} x\ 0{,}01^{-0,385}$

tc = 0,0819 hour

Recapitulation of Draft Flood Debit

No	Kala Ulang T (tahun)	Debit Rancangan (m^3/s)
1	2	0,11009
2	5	0,15184
3	10	0,45228
4	15	0,49151
5	20	0,51909

Table 4 Recapitulation of Draft Flood Debit

Hydraulic Analysis

B(m)	H(m)	h (m)	S	V (Izin)	n	Q (m3/detik)	Q saluran eksisting (Qeks) (m3/detik)	Kala Ulang	Qr= (m3/detik)	Kontrol
0,6	0,8	0,08	0,010000	1,5	0,013	1,3382	1,3382	2 Tahun	0,1100	Ok
								5 Tahun	0,1517	Ok
								10 Tahun	0,4520	Ok
								15 Tahun	0,4912	Ok
								20 Tahun	0,5187	Ok
0,6	0,8	0,08	0,010000	1,5	0,013	1,3382	1,3382	2 Tahun	0,1100	Ok
								5 Tahun	0,1517	Ok
								10 Tahun	0,4520	Ok
								15 Tahun	0,4912	Ok
								20 Tahun	0,5187	Ok
0,4	0,6	0,08	0,010000	1,5	0,013	0,5212	0,5212	2 Tahun	0,1100	Ok
								5 Tahun	0,1517	Ok
								10 Tahun	0,4520	Ok
								15 Tahun	0,4912	Ok
								20 Tahun	0,5187	Ok

Table 5 Design Return Period 2, 5, 10, 15, and 20 Year

After a comparison of the existing discharge and design discharge per cross-sectional size, the results obtained are Box Culvert 60 x 80 x 100 x 15, U-Ditch 40 x 60 x 100, and U-Ditch 60 x 80 x 100 enough to accommodate the existing design discharge.

B (m)	H (m)	h (m)	P (m) B+2xH	A (m2) BxH	R (m) A/P	n	Q eks	S	S rerata
0,6	0,8	0,08	2,2	0,48	0,2182	0,013	1,3382	0,002895	0,00352
0,6	0,8	0,08	2,2	0,48	0,2182	0,013	1,3382	0,002895	
0,4	0,6	0,08	1,6	0,24	0,1500	0,013	0,5212	0,004771	

Then the range of land slopes that can be used in the calculation is obtained, namely 0,01 (S_{eks}) dan 0,00352 (S hitting).

Table 6 Maximum S Calculation Result

B(m)	H(m)	f (m)	H1(m)	Luas (A) (m2)	S	n	P (m)	R (m)	V	Q Saluran Alam Desain (Qd) (m3/detik)	Kala Ulang	Qr= (m3/detik)	Kontrol
0,4435	0,4218	0,20	0,6218	0,2758	0,01	0,013	1,68709	0,1635	2,2997	0,6342	2 Tahun	0,1100	Ok
0,5004	0,4502	0,20	0,6502	0,3253			1,80077	0,1807	2,4584	0,7998	5 Tahun	0,1517	Ok
0,7535	0,5767	0,20	0,7767	0,5852			2,30691	0,2537	3,0826	1,8040	10 Tahun	0,4520	Ok
0,7773	0,5887	0,20	0,7887	0,6131			2,35466	0,2604	3,1364	1,9228	15 Tahun	0,4912	Ok
0,7934	0,5967	0,20	0,7967	0,6321			2,38682	0,2648	3,1723	2,0052	20 Tahun	0,5187	Ok

Table 7 Calculation of Design Channel Dimensions with Comparison of Design Channel Flow and Design Flow

From the table above, it can be concluded and evaluated that the drainage system that has been built shows that the cross-sectional size is sufficient to accommodate the discharge design for return periods of 2 years, five years, ten years, 15 years, and 20 years. The size of the cross-sectional dimensions is obtained with the design discharge as input data for comparative analysis with existing drainage channels.

4 CONCLUSIONS AND SUGGESTIONS

Conclusion

From the results of the analysis and discussion to answer the formulation of the problem from the evaluation of this study, it can be concluded that

1. From the results of the analysis of the design flood discharge at the construction site, the drainage network system of the Hercules Complex has quite high rainfall and is likely to overflow if construction is not carried out.

2. Based on the results of the analysis of the existing drainage network system in the Hercules Complex area, after construction, it can accommodate relatively high rainfall, with a Box Culvert cross-section (60 x 80 x 100), U-Ditch 1 (60 x 75 x 100), U-Ditch 2 (60 x 90 x 100) and also the closed type

3. From the results of the evaluation of the drainage network system that has been carried out, it can be compared from the design flood discharge and the existing drainage network system that has been developed, it can be concluded that it does not overflow and is sufficient to accommodate quite high rainfall.

Suggestions

Based on the conclusions that have been obtained from the research results, suggestions that can be given are as follows:

1. The BMKG data is incomplete, such as the data for 2010 and 2013, so it cannot be analyzed and adding years to be analyzed.

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