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Evaluation of The Capacity of The Araya Pump House in Managing Flood of Kalibokor Channel Sisi Jl. Arief Rachman Hakim

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Abstract

Kalibokor Channel is one of the primary channels in East Surabaya. This channel overflows during the rainy season. The inundation height that occurs is between 0-15 cm. Some of the flood-prone areas that the channel passes through are Manyar, Klampis, Gebang Putih, and JL. Arif Rahman Hakim. The Surabaya City Government built the araya pump house as a helper for the Kalibokor channel in order to reduce inundation on Jl. Arief Rachman Hakim and reduce the load on the Kalibokor pump house. The study was conducted by calculating the value of the planned rain and flood discharge, then analyzing the existing one and ending by recommending a new pump capacity design. The results of the analysis calculation obtained that the planned discharge entered the Kalibokor primary channel on the side of Jl. Arief Rachman Hakim is 18.56 m3/s while the existing capacity of the Kalibokor primary channel on the side of Jl. Arief Rachman Hakim can only accommodate a capacity of 16.6 m3/s.

Keywords
Drainage, Flood Control, Long-Storage, Pump House, Shortcut

1. Introduction

a. Background

The large population and increasingly modern city conditions have made changes in the use of green open land into residential buildings and office buildings. This can lead to clean water problems. The problem caused by this water is puddles that often occur during the rainy season. This inundation arises due to the lack of order in the existing drainage system and the arrangement of the existing system.

Some of the flood-prone areas that the channel passes through are Manyar, Klampis, Gebang Putih, and JL. Arif Rahman Hakim. These areas are densely populated and traffic-intensive areas. So that it will cause unrest in the community if there is a flood, such as traffic jams and road damage. So we need an auxiliary pump to overcome it. In this case the auxiliary pump that is used is the Araya Pump House.

Araya Pump House is located on Jl. Arief Rahman Hakim No. 7 Surabaya, to be precise next to the Surabaya Oncology Hospital. The Surabaya City Government built the araya pump house as a helper for the Kalibokor channel in order to reduce inundation on Jl. Arief Rachman Hakim and reduce the load on the Kalibokor pump house. This pump house was built with the aim of being a Kalibokor drain to be divided into the Semolowaru channel.

b. Formulation of the Problem

1. What is the design flood discharge that enters the Kalibokor channel on the side of Jl. Arief Rachman Hakim?
2. What is the existing capacity of the Araya channel and the Kalibokor primary channel?
3. How does the Araya pump house affect the long storage of the Kalibokor channel?

2. Study of Literature

Long storage is a water storage system that utilizes the longitudinal channel of the river itself as a reservoir. In the construction of long storage, a weir is needed as the main building because the weir serves to raise water to a certain elevation so that water can be accommodated in the river. With the storage in long storage, the peak time of flooding can be slowed down so that the downstream flood discharge can be reduced. Therefore, long storage can be used as a structural flood control system.

Each river catchment area has special characteristics and different characteristics, this requires great care in applying an appropriate theory to the relevant drainage area. Therefore, before starting the long storage construction planning, it is necessary to refer to the existing specifications and which are in accordance with the characteristics of the watershed, such as topography, watershed area (DAS), soil data, and environmental conditions.

The literature review is intended to briefly describe the theoretical basics of long storage planning that will be used in the calculation of construction and complementary buildings. The theoretical bases that will be presented include hydrological analysis, hydraulics analysis, dimensional planning and building stability (Soewarno, 1995).

3. Research Method

3.1 Data Source

The data used in this study were sourced from the relevant Department's report. In addition, literature study is also carried out by collecting and studying books, reports, journals and other literature related to the titles discussed in this study as well as data from field surveys and interviews with communities around the research location which are more or less needed. as reference.

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3.2 Research Flowchat

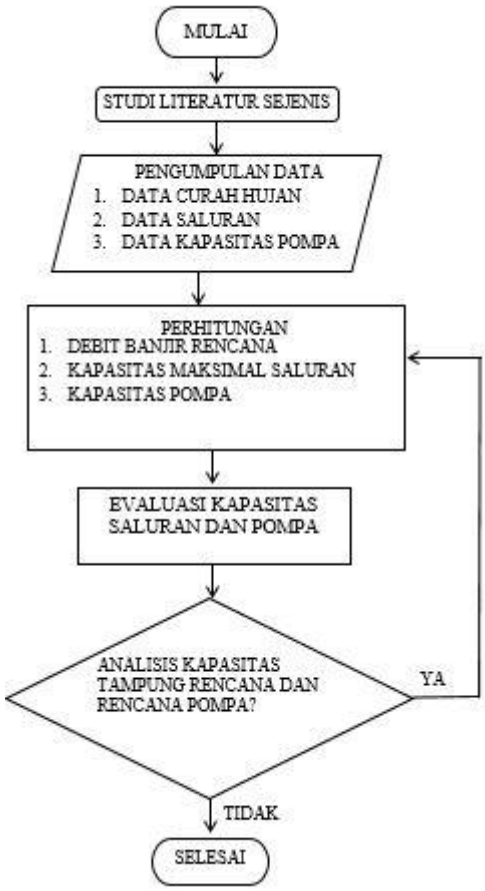

Figure 1. Research Flowchart

4. Results and Discussion

Tabel 1. Data Curah Hujan

No	Year	Curah hujan Maksimum (mm)		
		Stasiun Keputih	Stasiun Wonorejo	Stasiun Gubeng
1	2011	78	94	98
2	2012	85	95	106
3	2013	80	85	87
4	2014	134	100	83
5	2015	84	109	63
6	2016	164	121	108
7	2017	124	122	114
8	2018	49	85	73
9	2019	50	66	76
10	2020	102	97	107

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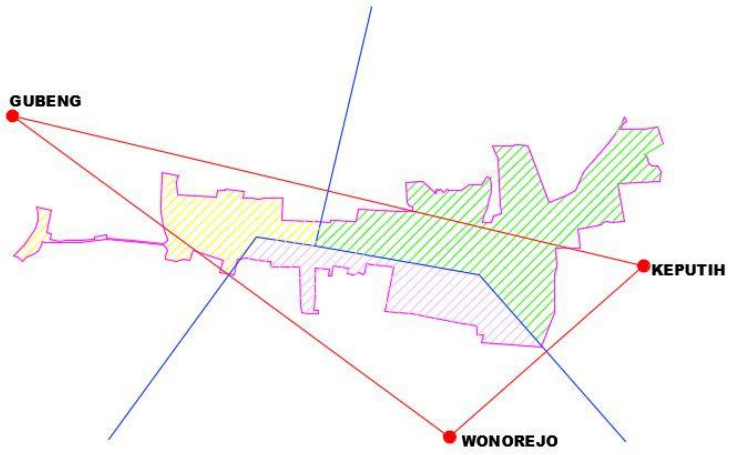

(Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2014)
Figure 2. Poligon Theissen Kalibokor

Luas DAS:
Stasiun Keputih = 4,5533992 km2
Stasiun Wonorejo = 1,7745811 km2
Stasiun Gubeng = 1,5752509 km2
Total Luas DAS = 7,9032312 km2

Tabel 2 Data Curah Hujan Stasiun

No.	Year	Curah Hujan
1	2011	82,19
2	2012	84,26
3	2013	84,91
4	2014	115,40
5	2015	85,03
6	2016	141,19
7	2017	121,96
8	2018	60,27
9	2019	58,77
10	2020	100,88
TOTAL		934,85

Metode Log Person III
Log Xt = Log Xrt +(k*S)
Xt = 10^Log Xt

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Tabel 3. Perhitungan Intensitas Curah Hujan

T	R 24						
(Jam)	R2	R5	R10	R20	R25	R50	R100
	94,3491	114,0885	124,5623	130,4906	133,5579	138,6319	142,6612
1	32,7090	39,5523	43,1833	45,2386	46,3019	48,0610	49,4579
2	20,6054	24,9164	27,2038	28,4985	29,1684	30,2765	31,1565
3	15,7248	19,0148	20,7604	21,7484	22,2596	23,1053	23,7769
4	12,9806	15,6963	17,1373	17,9529	18,3749	19,0730	19,6274
5	11,1863	13,5267	14,7685	15,4714	15,8350	16,4366	16,9144
6	9,9060	11,9785	13,0782	13,7007	14,0227	14,5554	14,9785
7	8,9386	10,8087	11,8010	12,3626	12,6532	13,1339	13,5156
8	8,1772	9,8881	10,7958	11,3096	11,5755	12,0153	12,3645
9	7,5597	9,1413	9,9805	10,4556	10,7013	11,1079	11,4307
10	7,0469	8,5213	9,3036	9,7464	9,9754	10,3544	10,6554
11	6,6131	7,9967	8,7308	9,1463	9,3613	9,7170	9,9994
12	6,2404	7,5460	8,2388	8,6309	8,8337	9,1694	9,4359
13	5,9161	7,1539	7,8107	8,1824	8,3747	8,6929	8,9455
15	5,3778	6,5030	7,0999	7,4379	7,6127	7,9019	8,1316
16	5,1513	6,2291	6,8009	7,1246	7,2921	7,5691	7,7891
17	4,9473	5,9824	6,5316	6,8424	7,0033	7,2693	7,4806
18	4,7623	5,7587	6,2874	6,5866	6,7414	6,9975	7,2009
19	4,5937	5,5548	6,0648	6,3534	6,5027	6,7498	6,9460
20	4,4393	5,3681	5,8609	6,1398	6,2841	6,5229	6,7125
21	4,2972	5,1963	5,6733	5,9433	6,0830	6,3141	6,4976
22	4,1660	5,0376	5,5001	5,7618	5,8973	6,1213	6,2992
23	4,0443	4,8905	5,3395	5,5936	5,7251	5,9426	6,1153
24	3,9312	4,7537	5,1901	5,4371	5,5649	5,7763	5,9442

Tabel 4. Rekapitulasi Analisis Debit Banjir Rencana Saluran Tersier

No	Tertiary Channel Name	Hasper	Rasional	Weduwen
1	Sal. Manyar Tirtoyoso	1,739798881	0,761132	3,3645235
2	Sal. Manyar Sabrangan	1,594179409	0,813575	2,7557176
3	Sal. Manyar Tirtosari	0,809838756	1,325663	0,6376216
4	Sal. Manyar Tortomoyo Sabrangan	0,936450227	1,205389	0,8480809
5	Sal. Raya Manyar Indah	0,555457189	1,652808	0,3290473
6	Sal. Klampis Ngasem	0,674652179	1,481627	0,4567548
7	Sal. Klampis Asih	0,961101155	1,184287	0,8942091
8	Sal. Klampis Indah	0,815039633	1,320287	0,6454396
9	Sal. Manyar Kertoadi Selatan	0,687648753	1,465108	0,4723756
10	Sal. Klampis Sacharosa	0,963703982	1,182098	0,8991829

Tabel 5. Rekapitulasi Analisis Debit Banjir Rencana Saluran Sekunder

No	Tertiary Channel Name	Hasper	Rasional	Weduwen
1	Sal. Sekunder Manyar Tirtosari	2,281669262	2,10129	2,1827089
2	Saluran Manyar Tirtomoyo	1,619274702	2,634083	1,1203773
3	Sal. Sekunder Manyar Tirtoyoso	2,281669262	2,10129	2,2289777
4	Sal. Sekunder UPB	2,945073908	1,739219	3,9686571

Tabel 6. Rekapitulasi Analisis Debit Banjir Rencana Saluran Primer

No	Channel Name Primer	Hasper	Rasional	Weduwen
1	Sal. Kalibokor Sisi Jl. Menur Pumpungan	6,659733044	4,679935	7,0895069
2	Sal. Primer Kalibokor Sisi Jl. Arief Rachman Hakim	9,497251257	3,526657	16,668175

In this case, the method used is the Hasper method because the calculation results are the most suitable.

Tabel 7. Perbandingan Debit Eksisting dan Debit Rencana Saluran Tersier

Channel Name	Q eksisting	Q Plan	Description
Sal. Manyar Tirtoyoso	1,431801511	1,739798881	NOT OK
Sal. Manyar Sabrangan	2,155802893	1,594179409	OKE
Sal. Manyar Tirtosari	1,431801511	0,809838756	OKE
Sal. Manyar Tortomoyo Sabrangan	0,861311735	0,936450227	NOT OK
Sal. Raya Manyar Indah	1,033574082	0,555457189	OKE
Sal. Klampis Ngasem	1,618467243	0,674652179	OKE
Sal. Klampis Asih	2,155802893	0,961101155	OKE
Sal. Klampis Indah	0,789689048	0,815039633	NOT OK
Sal. Manyar Kertoadi Selatan	3,752381489	0,687648753	OKE
Sal. Klampis Sacharosa	1,618467243	0,963703982	OKE

Tabel 8. Debit Yang Masuk Ke Sal. Sekunder Manyar Tirtoyoso

Channel Name	Q Plan
Sal. Manyar Tirtoyoso	1,431801511
Sal. Manyar Sabrangan	2,155802893
Sal. Manyar Tirtosari	1,431801511
Sal. Manyar Tortomoyo Sabrangan	0,861311735
Total	5,880717651

Tabel 9. Debit Yang Masuk Ke Sal. Sekunder UPB

Channel Name	Q Plan
Sal. Klampis Asih	0,9611012
Sal. Klampis Indah	0,8150396
Sal. Manyar Kertoadi Selatan	0,6876488
Sal. Klampis Sacharosa	0,963704
Total	**3,4274935**

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Tabel 10. Perbandingan Debit Eksisting Dan Total Debit Rencana Saluran Sekunder

Name	Q Eksisting	Q Plan	Q Enter	Q Plan Total	Description
Sal. Sekunder Manyar Tirtosari	3,752381489	2,281669262	0	2,281669262	OKE
Sal. Sekunder Manyar Tirtomoyo	8,081220356	1,619274702	0	1,619274702	OKE
Sal. Sekunder Manyar Tirtoyoso	5,468988617	2,281669262	5,880717651	8,162386913	NOT OKE
Sal. Sekunder UPB	8,081220356	2,945073908	3,427493523	6,372567431	OKE

Tabel 11. Debit Yang Masuk Ke Sal. Primer Kalibokor Sisi Menur Pumpungan

Channel Name	Q Plan
Sal. Raya Manyar Indah	0,5554572
Sal. Klampis Ngasem	0,6746522
Sal. Sekunder Manyar Tirtosari	2,2816693
Sal. Sekunder Manyar Tirtomoyo	1,6192747
Sal. Sekunder Manyar Tirtoyoso	8,1623869
Total	**13,29344**

Debit Yang Keluar Dari Sal. Primer Kalibokor Sisi Menur Pumpungan

a. Sebesar 20% debit yang keluar menuju Sal. Menur
b. Sebesar 20% debit yang keluar menuju Sal. Teratas

Tabel 12. Perbandingan Debit Eksisting dan Total Debit Rencana yang masuk ke Sal. Primer Kalibokor Sisi Menur Pumpungan

Name	Q Eksisting	Q Plan	Q Enter	Q Out Ke Sal. Menur	Q Out Ke Sal. Teratas	Q Plan Total	Description
Sal. Primer Kalibokor Sisi Menur Pumpungan	16,608812	6,659733	13,2934402	3,990634658	3,192507726	12,7700309	OKE

Tabel 13. Debit yang masuk ke Sal. Primer Kalibokor Sisi Arief Rachman Hakim

Channel Name	Q Plan
Sal. Sekunder UPB	3,4274935
Sal. Primer Kalibokor Sisi Menur Pumpungan	12,770031
Total	**16,197524**

Debit Yang Keluar Dari Sal. Primer Kalibokor Sisi Arief Rachman Hakim

a. Sebesar 15% debit yang keluar menuju Sal. Araya Barat
b. Sebesar 15% debit yang keluar menuju Sal. Araya Timur

Tabel 14. Perbandingan Debit Eksisting dan Total Debit Rencana yang masuk ke Sal. Primer Kalibokor Sisi Arief Rachman Hakim

Name	Q Eksisting	Q Plan	Q Enter	Q Out Ke Sal. Araya Barat	Q Out Ke Sal. Araya Timur	Q Plan Total	Description
Sal. Primer Kalibokor Sisi Arief Rachman Hakim	16,60881183	9,497251257	16,19752443	3,854216353	3,2760839	18,564475 43	NOT OKE

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Tabel 15. Perhitungan Debit Yang Keluar Dari Sal. Primer Kalibokor

Name	Q Eksisting	Q Plan	Q Enter	Q Plan Total	Description
Sal. Menur	2,155802893	3,212298694	3,990634658	7,202933352	NOT OKE
Sal. Teratas	2,155802893	0,684103624	3,192507726	3,87661135	NOT OKE
Sal. Araya Barat	2,155802893	1,068355643	3,854216353	4,922571995	NOT OKE
Sal. Araya Timur	2,155802893	2,4394927	3,2760839	5,715576599	NOT OKE

Tabel 16. Perhitungan Kebutuhan Pompa Eksisting Rumah Pompa Araya = 1 m3/det

	Q Maks m3/detik	Vt m3	ntc detik	Qp m3
Polder Pompa Araya	2,16	40	3600	1,937

Tabel 17. Analisa pompa eksisting Rumah Pompa Araya untuk kapasitas Sal. Araya Timur

Channel	Qp Sal	Kapasitas Pompa Eksisting	Analisis
Sal. Araya Timur	1,937	1	NOT OKE

Selisih kapasitas pompa yang dibutuhkan = 0,937 m3/sec
Perhitungan Kebutuhan Pompa Untuk Debit Rencana
Kapasitas Tampung Debit Saluran = 2,155802893
Kapasitas Debit Masuk = 5,715576599
Selisih Debit = 3,559773706

Tabel 18. Perhitungan Kebutuhan Pompa Untuk Debit Rencana

	Q Maks m3/detik	Vt m3	ntc detik	Qp m3
Polder Pompa Araya	3,56	40	3600	3,279

Tabel 19. Analisa pompa eksisting Rumah Pompa Araya untuk Debit rencana Sal. Araya Timur

Channel	Qp Sal	Capaciti Pompa Eksisting	Analisis
Sal. Araya Timur	3,279	1	NOT OKE

Based on the above calculation, it is known that the pump capacity for the Araya Pump House in the non-rainy conditions and the planned Q5 rain conditions are both insufficient.

5. Conclusions and Suggestions

1. Sum of flow plan Kalibokor chanel Arief Rachman Hakim side.

Table 20.

No	Name	Q (m3/det)
1	Q10 Sal. Kalibokor sisi Arief Rachman Hakim	9,49
2	Q masuk dari Sal. Kalibokor sisi Menur Pumpungan	16,19
	TOTAL	25,68

Tabel 21. Debit yang keluar dari Sal. Kalibokor sisi Arief Rachman Hakim

No	Name	Q (m3/det)
1	Q keluar menuju Sal. Araya Barat	3,85
2	Q keluar menuju Sal. Araya Timur	3,27
	TOTAL	7,12

2. Existing dimensions Sal. Arief Rachman Hakim's Kalibokor side is 16.6 m3/s, while the accumulated discharge plan is Sal. The Kalibokor on the side of Arief Rachman Hakim is 18.65 m3/s. Then there is an overflow of 1.96 m3/s. After normalization and removal of sediment in the channel, it was found that the discharge was able to be accommodated by Sal. Arief Rachman Hakim's Kalibokor is 22.58 m3/s.
3. The operation of Araya Pump House is still not able to accommodate the discharge that enters Sal. East Araya. An additional pump capacity of 2.25 m3/s is required.
4. To deal with the inundation that occurred in the Kalibokor channel, efforts were made to repair the collapsed slab around the Kalibokor channel using sheet pile walls, build a pump house at the side of the West Araya channel, build bozem and mini bozes around the Kalibokor channel.

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