Planning Weir Jeruk Gulung In Troso Village, Pecangaan district, Jepara Regency

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Abstract : Lack of water availability for agricultural land during the dry season results in less optimal agricultural productivity, This is what happened in Troso Lor village, Pecangaan sub-district, Jepara Regency. In order to meet water needs continuously and maintain the availability of water sources, efforts are needed in the framework of protecting, developing, controlling and utilizing water resources. For this reason, a construction plan for the Jeruk Gulung Dam on the Jeruk Gulung River will be planned as an effort to utilize water sources for irrigation in the Troso village area, Pecangaan sub-district, Jepara regency. Meanwhile, the results of the analysis of irrigation water requirements are used for channel hydrological analysis. After planning the weir construction, the weir stability control is carried out against rolling, shear, eccentricity and soil bearing capacity . Meanwhile, the results of the analysis of irrigation water requirements are used for channel hydrological analysis. After planning the weir construction, the weir stability control is carried out against rolling, shear, eccentricity and soil bearing. Based on the results of the analysis and planning of the Jeruk Gulung Dam, the data obtained for the area of rice fields is 16 Ha with a requirement of 0.019 m^3 / s of irrigation water with a fixed weir type with 100.1347 m^3 / sec flood discharge. The width of the weir is 19.2 m with an effective width of 17.7 m and a width of 1 m for rinsing.

Keywords : Fixed Weir, Discharge, Irrigation.

1. Introduction

Drought often occurs during the dry season, this occurs almost every year, among others, farmers are affected by the drought, because farmers need water to meet their crop needs, both rice and secondary crops(1). Farmers who live in Troso village, Pecangaan sub-district, Jepara district have faced similar problems, so far the farmers still lack water, especially in the dry season, even though the area is abundant in the rainy season, the Jeruk Gulung River water sources have not been used or used. be utilized optimally. For this reason, there is an idea to take advantage of the water in the Jeruk Gulung river by making a weir that functions to raise the water level flowing in the river so that irrigation water needs for agriculture can be fulfilled properly despite the dry season conditions that hit Troso Village, Pecangaan District, Jepara Regency.(2)(3) The research objective was to determine the hydrological characteristics and to determine the height of the weir's weir stability.

2. Research Methods

The research method used is quantitative research in accordance with the conditions in the field. The data used consists of data on the height of the lighthouse, the width of the weir, the effective width of the weir, the water level above the lighthouse and the water level downstream of the weir in Troso village, Pecanggaan district.(4)(5)

3. Results and Discussion

In planning a water construction construction, the most important analysis to review is the hydrological analysis. Hydrological analysis is needed to determine the maximum water discharge by using rainfall data as well as stability and construction to be built.

3.1. Maximum Rainfall Data

Rainfall data used in the calculation is daily rainfall data obtained from the PSDA Serang Lusi Juana Hall.

Table 1 Calculation of Maximum Rainfall Arithmetic Mean Method

year	Pecangaan Station	Kedung Station	Stasiun Bate	Average	Cumulative Refrensi
2011	136	132	70	112.67	112.67
2012	91	84	86	87.00	199.67
2013	50	82	31	54.33	254.00
2014	140	210	60	136.67	390.67
2015	211	145	12	122.67	513.33
2016	145	189	63	132.33	645.67
2017	167	108	11	95.33	741.00
2018	176	146	18	113.33	854.33
2019	99	93	75	89.00	943.33

3.2. Planned Flood Discharge Analysis

a. Method Haspers

Table 2 Calculation of Flood Discharge Using the Haspers Method

Period of year	R24 **(mm)**	Rt **(mm/day)**	Qn **($m^3/s/km^2$)**	Q **(m^3/s)**
2	88.417	84.965	5.312	133.315
5	90.573	86.843	5.429	136.263

10	91.329	87.501	5.470	137.294
25	91.912	88.006	5.502	138.087
50	92.188	88.245	5.517	138.462
100	92.381	88.412	5.527	138.724

3.3. Need for irrigation water

Based on data obtained from the Department of Public Works and Spatial Planning (PUPR), the city of Jepara, the results of the water need for irrigation in Troso village are 0.019 m^3 / s with an area of 16 Ha.(6)

3.4. Weir Construction Planning

The weir building that is planned is in the form of a Mercu Weir / threshold construction that is placed across the river channel, with the intention of increasing the level of river water to be flowed through the primary, secondary and tertiary channels useful for planned irrigation(5)(7)(8). Based on the need for irrigation water in the fields, the highest elevation of the rice fields must be below the water level at the weir as shown in Figure 1.

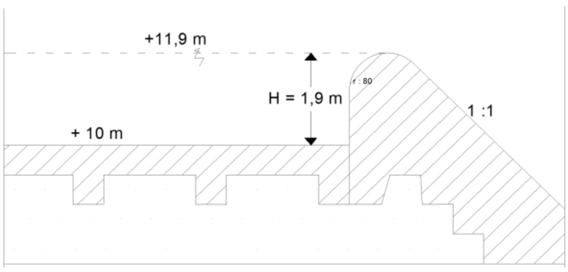

Figure 1 Height Mercu of weir

From Figure 1, the elevation data of the weirs is + 119 m, while the elevation of the river bed at the upstream of the weir is +10 m so the height of the weir is 1.9 m. In the measurement results, the average river width was 24 m. Then the width of the Orange Gulung weir lighthouse Bb = 1.2 x 16 = 19.2 m. So the width of the weir lighthouse is 19.2 m. As illustrated in Figure 2 The effective width of the weir.

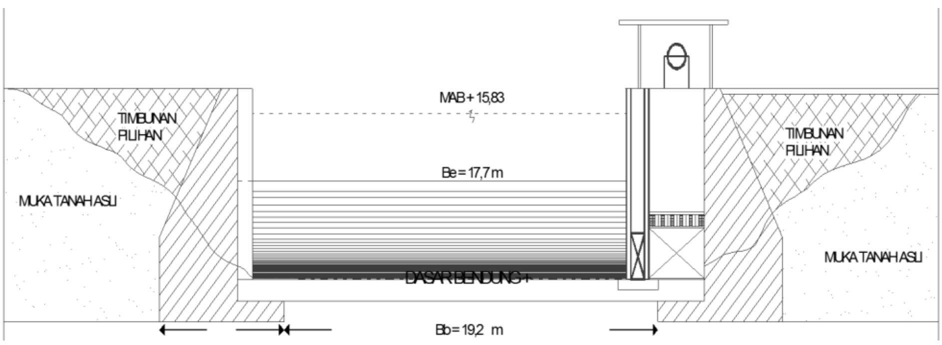

Figure 2 Weir Width and Effective Width of Weir

Planning of this weir is planned for 1 pillar and 1 door flush, where the width of the pillar (t) is planned at 0.50 m and the width of the door (b) is 1.00 m Whereas for the effective weir lighthouse width, it is obtained 17.7 m for a per-square discharge width of 5.66 m^3 / s while the critical depth is obtained 1.48 m.

3.5. Form of Mercu Weir

The shape of the weir lighthouse is planned to use a round type shape with a slope of 1: 1. The He value (total high energy) above the weir lighthouse is 4.03 m Based on the results of the above calculations, the curved radius of the weir mercu (r) is 0.5 He <r <0.15 He: 2.04 <r <0.61 so the value of r is taken = 0.8 m

Table 3 Trial and Error Elevation of the Mercu

Q	Cd	Be	akar (2/3.g)	He	0.5 He	0.15 He
100.137	1	17.7	2.556	6.0495	3.025	0.907
100.137	1.1	17.7	2.556	4.9054	2.453	0.736
100.137	1.2	17.7	2.556	4.6020	2.301	0.690
100.137	1.31	17.7	2.556	4.0347	2.017	0.605
100.137	1.4	17.7	2.556	3.6520	1.826	0.548
100.137	1.5	17.7	2.556	3.2929	1.646	0.494

The value of r is used at 0.83 m. based on previous calculations (He and r) Determine the value of C0, namely by the ratio between He / r = 4.03 / 0.8 = 5.1 obtained the price of C0 = 1.48, while to determine the value of C1, namely by the ratio between HHe = 1.94.03 = 0.46, the price of C1 = 0.88 is obtained.So the calculated Cd. Based on the results of the above calculations, it can be concluded that the value of Cd (assumption) is acceptable because Cd (assumption) = Cd count.hitungan adalah: Cd = C0 x C1 = 1,48 x 0,88 = 1,31 m. Based on the results of the above calculations, it can be concluded that the value of Cd (assumption) is acceptable because Cd (assumption) = Cd count.

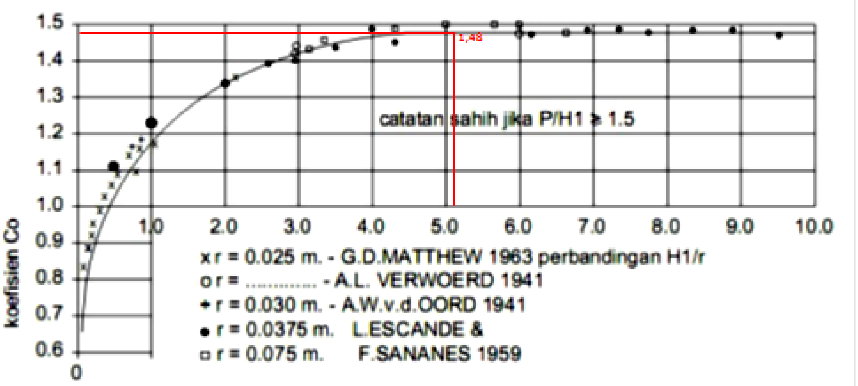

Figure 3 The values of the coefficient C0 for round threshold weirs as a function of the ratio He / r

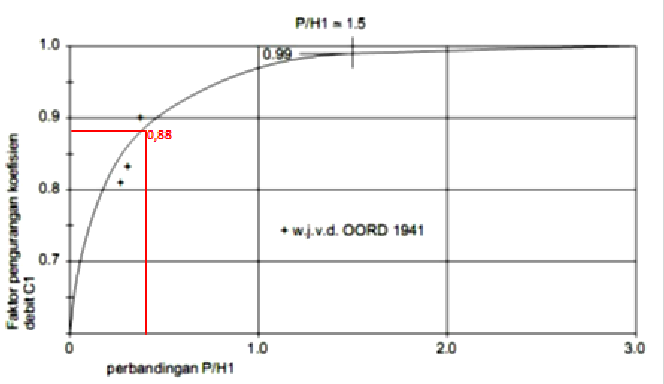

Figure 4 The values of the C1 coefficients for round threshold weirs as a function of the H / He ratio

3.6. Water Level above Mercu Weir

The water level above the weir lighthouse is calculated using a formula : h = He – k h = 4,03 – 0,101 = 3,929 m

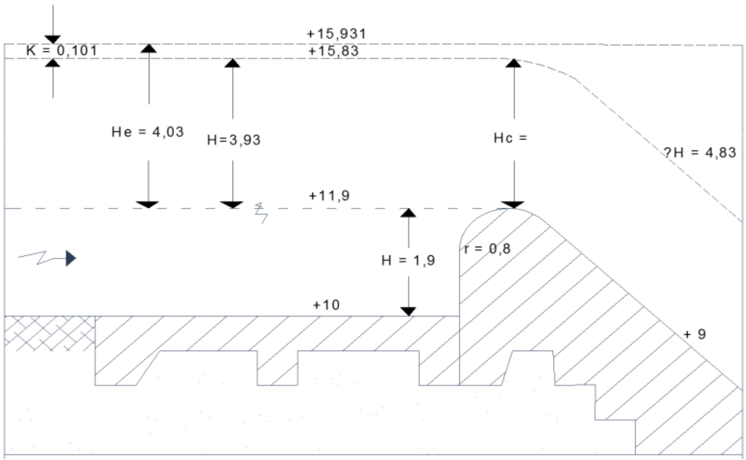

Figure 6 Water Level Above Mercu

3.7. Flood water level in the downstream weir

To find out the flood water level downstream of the river, a table of the relationship between river discharge and river cross-sectional elevation is made first(9)(10), below is a river cross-sectional table.

Table 4 Trial and Error River cross section elevation

riverbed elevation	H (m)	B (m)	M	A (m^2)	P (m)	R (m)	V (m/s)	Q (m^3/s)
2								
3	1	17.7	1	18.7	20.528	0.911	0.184	3.4
4	2	17.7	1	39.4	23.357	1.687	0.277	10.9
5	3	17.7	1	62.1	26.185	2.372	0.348	21.6
6	4	17.7	1	86.8	29.014	2.992	0.406	35.2
7	5	17.7	1	113.5	31.842	3.564	0.456	51.8
8	6	17.7	1	142.2	34.671	4.101	0.501	71.3
9	7	17.7	1	172.9	37.499	4.611	0.542	93.7

10	8	17.7	1	205.6	40.327	5.098	0.579	119.1
11	9	17.7	1	240.3	43.156	5.568	0.614	147.6
12	10	17.7	1	277	45.984	6.024	0.647	179.4
13	11	17.7	1	315.7	48.813	6.468	0.679	214.3

the results that are close to the planned discharge are at an altitude of 9 m with a discharge of 93.7 m3 / s <a planned discharge of 100.137 m2 /s obtained at an elevation of 10 m, so the downstream water level is obtained = 9 + 2 = 11 m. The difference in the height of the upstream downstream (ΔH) = 15,829 - 11 = 4,829 (ΔH) = 15,829 – 11 = 4,829. The calculation results that are close to the planned discharge are at an altitude of 7 m with a discharge of 93.7 m^3 / s <a planned discharge of 100.137 m^2 / s obtained at an elevation of 9 m. so you can get the water level downstream = 9 + 2 = 11 m. The following is a method of calculating the difference in the energy level upstream and downstream (ΔH): The upstream flood water level is 15.829 m, while the downstream flood water level is 11 m.

3.8. Types Mercu of Weir

The shape of the weir lighthouse is planned to use a round type shape with a slope of 1: 1. So that r = 0.8 m can be obtained while the processed pond is obtained from the classification of the energy absorbing pool based on the frounde number 5.34 (Fr), then from the classification of Fr> 4.5 using the Type III

3.9. Seepage of the front floor of the weir

To calculate the length of the line / creep line under the foundation, use the Bligh formula in accordance with the KP 02 (11) requirements regarding stability against underground erosion, following figure 7 longitudinal sections of the weir

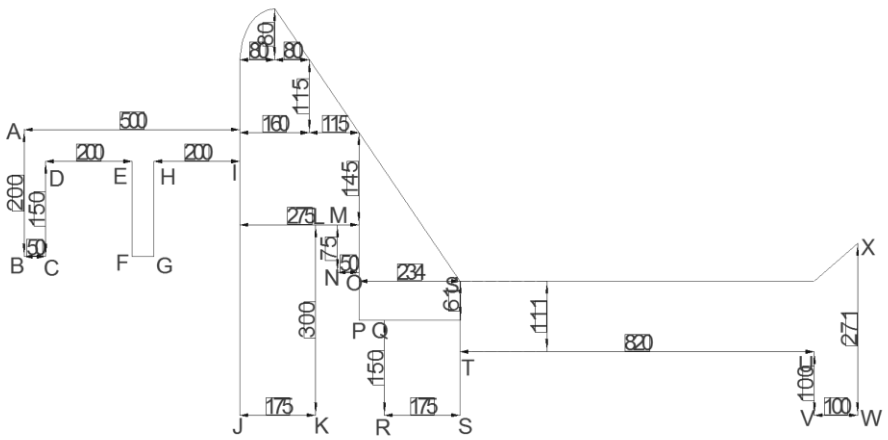

Figure 7 Front Floor Dimensions of the weir

Table 5 Seepage calculation

Point	Garis Line			Seepage length			
				Lv	Lh	1/3 Lh	Lw
A	A	-	B	2			
B	B	-	C		0,5	0,17	2,00
C	C	-	D	1,5			2,17

D	D	-	E		2	0,67	3,67
E	E	-	F	1,5			4,33
F	F	-	G		0,5	0,17	5,83
G	G	-	H	1,5			6,00
H	H	-	I		2	0,67	7,50
I	I	-	J	4			8,17
J	J	-	K		1,75	0,58	12,17
K	K	-	L	3			12,75
L	L	-	M		0,5	0,17	15,75
M	M	-	N	0,75			15,92
N	N	-	O		0,5	0,17	16,67
O	O	-	P	0,75			16,83
P	P	-	Q		0,59	0,2	17,58
Q	Q	-	R	1,5			17,78
R	R	-	S		1,75	0,58	19,28
S	S	-	T	1			20,86
T	T	-	U		8,2	2,73	19,86
U	U	-	V	1			23,60
V	V	-	W		1		24,60
W	W	-	X	1,71			24,93
X							27,64
Amount				21,21	19,29	6,43	

3.10. Local Scour Calculation (Rip-rap)

To secure the downstream part of the building floor from possible scouring, 3.5 layers of rip - rap (bare stone) are installed where each layer = 2 x material diameter = 2 x 0.50 = 1.00 m. So that the depth of the layer is 2.1 x 1.00 = 2.1 m. Length of the rip-rap pair = 4 x 2.1 = 8.40 m

3.11. Calculation of Forces Acting on Weirs

Table 6 Recapitulation of Force and Moment in Normal Conditions

No	Style	RH	RV	Moment	
				H	V
1	Own Weight		41,97		86,74
2	Earthquake	-10,03		-26,51	
3	Active Ground	8,173		10,45925	
4	pressure	-25,2378		-22,732	
5	Passive Ground	1,805		9,266	
6	Pressure	0,855		4,392	
7	Hydrostatic	7,371	-14,922	15,935	-
	Mud Pressure				31,081
	Uplift				
	Amount	-17,06	27,05	-9,19	55,66

Table 7 Recapitulation of forces and moments in flood conditions

No	Style	RH	RV	Moment	
				H	V
1	Own Weight		41,97		86,74
2	Earthquake	-10,03		-26,51	
3	Active Ground pressure	8,173		10,45925	
4	Passive Ground Pressure	-25,2378		-22,732	
5	Hydrostatic	11,243	12,620	90,817	22,785
6	Mud Pressure	0,855		4,392	
7	*Uplift*	6,288	-34,452	-3,325	-22,120
	Amount	-8,71	20,13	53,09	87,42

a. Weir Stability Control Normal Water Front Conditions

Control Against bolster

Terms : Sf = 6,054 ≥ fs = 1,50 (Qualify)

- Control Against sliding

  Terms: Sf = 1,58 ≥ 1,25 (Qualify)

- Control Against sliding Eccentricity Control

  Terms : E = 0,82 ≤ 0,84 (Qualify)

- Soil bearing capacity

  σijin = QA = 20,533 ton/m^2

b. Control of Weir Stability, Flood Water Front Conditions

- Against the bolster

  Terms : Sf = 1,64 ≥ fs = 1,50 (Qualify)

- Control Against sliding

  Terms: Sf = 2,311 ≥ 1,25 (Qualify)

- Control Against sliding Eccentricity Control

  Terms : E = 0,839 ≤ 0,84 (Qualify)

- Soil bearing capacity

  σijin = QA = 20,533 ton/m^2

4. Conclusions

Planning for the construction of the Jeruk Gulung Weir in Troso Village, Pecangaan District, Jepara Regency with the hydrological analysis in the 100.1347 m^3 /sec flood discharge, whereas based on the results of the hydraulic analysis, the weir height was 1.9 m, the flood water level was 3. , 92 m, the width of the weir is 19.2 m with an effective width of 17.7 m and a width of 1 m for rinsing, the radius of the round threshold-type weir is 0.8 m, the type of refined pond is USBR Type III because of this type in accordance with the data and the results of previous calculations

Based on the results of the analysis of the stability of the weir construction, the weir construction is safe against the rolling, shear and the carrying capacity of the soil against the up lift, both in terms of normal water conditions without and flood water conditions in accordance with the provisions (SF)> 1.

Acknowledgements

With the planning of the Jeruk Gulung Dam, it will increase the flow of water supplied to the Troso Village irrigation area which has so far experienced a lack of water discharge. Therefore it is hoped that the participation of the local community is to protect and maintain for its benefits and sustainability

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