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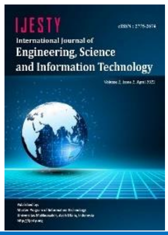

Evaluation of Multi-Function Drainage Channels For Running Water Fish Culture For The Benefit of The Community In Pangururan District

Novdin Manoktong Sianturi

Department of Civil Engineering, Universitas Simalungun, Indonesia
**Corresponding author E-mail: snovdinm@gmail.com*

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Abstract

Pangururan Subdistrict in Samosir Regency requires rearranging its open land functions related to the meaning of the environment. From the civil engineering perspective, landslides can occur suddenly during the rainy season without being noticed by the people around the Pangururan sub-district, Samosir Regency. To realize this program, the community can add the function of the drainage channel into a mobile fish pond around the Pangururan Subdistrict, Samosir Regency, which still has a large area of land/settlements to become a running fish pond drainage channel. This can increase residents' income which is beneficial for the community around the drainage canal. In addition, the problem of overflowing water in the rainy season will be minimized. To implement this program, an analysis should be prepared in advance to evaluate the drainage channel that will function as a fish pond around Pangururan District, Samosir Regency. In line with the government's program in promoting and increasing the income of residents, the existing drainage channels should be utilized. Unproductive drainage channels can become productive drainage channels by cultivating freshwater fish along the drainage channel while simultaneously irrigating rice fields. Therefore, a wet section of the plan is made along 1000 meters where the condition of the drainage channel is planned according to the analysis. The depth of the drainage channel for running water fish ponds is 100 to 170 cm and the width of the top side from 100 cm to 150 cm, and the width of the sides below 100 cm. Based on the calculations, the first process that must be done is to first calculate the maximum planned rainfall, calculate the planned discharge, calculate the dimensions of the channel, and flood discharge (designated discharge), where QT = 0.278 x C x I x A = 6.69 m3/s at a speed of plan average flow. The flow velocity of the drainage channel is installed with a sluice so that the average velocity value is = 1/n R2/3 x S1/2 = 3.8 m/s, the cross-sectional area of a fish pond with a wet cross-section A = a x b = 1.904 m2, the cross-sectional area of the wet plan making fish ponds where the channel design discharge for fish ponds is QS = AS x V = 7.23 m3/s and the calculation of sluice gates with a width of 50 cm and a height of 170 cm for fish pond water with Q = (u x b x a $\sqrt{2.9.z}$) x 3 of 10.8 m/s.

Keywords: *Drainage, Running Water, Velocity, Level, Fish Pond.*

1. Introduction

Drainage channels are crucial for agriculture life, particularly in the fisheries sector. Aside from being the water distribution tool, the role of drainage channels is inevitable for the survival of the living things around [1]. Adequate water availability is important in the process of making drainage channels, where drainage channels can function as running water fish ponds, particularly in the subdistrict of Pangururan, Samosir Regency [2]. The drainage channel area in Pangururan District, Samosir Regency can produce by utilizing drainage channels as mobile water fish cultivation for residents [3]. It can also be an additional tourist attraction if it is well organized, and will be an example for other areas around Samosir Regency [4].

The existing drainage in Pangururan Sub-district, Samosir Regency, needs to be reorganized because most of it is not functioning due to garbage and weeds piled up in the drainage canal [5] [6] [7]. From a civil engineering point of view, this drainage problem can lead to sudden flooding and landslides during the rainy season due to the water limit on the ground and garbage or weeds in the drainage canal. The community is unaware of this potential danger, so it is necessary to carry out socialization and rearrangement of drainage channels around the Toba Samosir Regency [5] [8]. With the rearrangement, the drainage canal can also function as a running water fish pond under the regulations of the local environmental service [9]. Most of the drainage channels are not utilized properly because the drains are full of garbage and weeds [10]. This condition is the potential to cause flooding during the rainy season [11] [12]. Thus, it is necessary to review the drainage system by carrying out a hydraulic system or by analyzing the channel and calculating the water flow. The analysis includes the flow velocity and water demand in the drainage channel when it was utilized as a fish pond [13].

2. Literature Review

Drainage is a water structure, which in its planning and implementation involves various supporting disciplines, such as hydrology, hydraulics, irrigation, river engineering, foundations, soil mechanics, and environmental engineering to analyze the environmental impacts of the drainage development [14] [15].

2.1 Hydrological Analysis

a. The steps in the analysis of the planned discharge are as follows: 37s 27s
b. Determine the watershed (DAS) along with its area and the STA measuring rain in the vicinity.
c. Determine the area of influence of rain gauge stations.
d. Determine the maximum rainfall each year from the existing rainfall data.
e. Analyzing the planned rainfall with a return period of T years.
f. Calculating the planned flood discharge based on the amount of rainfall planned above in the return period of T years.
g. Calculate the mainstay discharge which is the minimum river flow used for irrigation purposes.
h. Calculate the water needs in the fields needed for plants.
i. Calculating the water balance which is the ratio between the available water discharge and the water required for irrigation purposes

2.2 Synthetic Unit Hydrology (HSS) Gamma I

Synthetic Unit Hydrograph (HSS) Gamma I ordinary used to measure flood discharge with parameters appropriate to the conditions in Indonesia [16] [17]. The parameters are:

a. Source frequency (SN), which is the ratio between the number of shares of first-level rivers with the total shares of rivers of all levels.
b. Width factor (WF), which is the ratio between the width of the watershed measured at a point on the river which is 0.751, with the width of the watershed measured at a point on the river which is 0.251, from the hydrometric station.
c. Source factor (SF), which is the ratio between the total length of the first-level river and the total length of the rivers of all levels.
d. Upstream watershed area (RUA), which is the ratio between the watershed area measured upstream of the line drawn perpendicular to the connecting line between the hydrometric station and the point closest to the center of gravity of the watershed, passing through that point.
e. Number of river confluences (JN), namely the number of river confluences in the watershed
f. Drainage network density (D), which is the total length of the river at all levels per unit area of the watershed.
g. Symmetry factor (SIM), which is the product of the width factor (WF) and the upstream watershed area.

The unit hydrograph is given with four main variables, namely rise time (TR), peak discharge (QP), base time (TB), and storage coefficient (k). The equations used.

2.2 Determination of Planned Flood Discharge

The selection of flood plans for water structures is a problem that relies on a statistical analysis of the sequence of flood events in the form of water discharge in rivers and rain. Selection of an analytical technique, the determination of the flood plan depends on the available data and the type of water structure to be built [18].

2.3 Regional Rainfall

To obtain rainfall data, a measuring tool is needed, namely a rain gauge and a rain recorder. Rainfall data is obtained from stations around the drainage location where the rain stations is included in the watershed [19].

2.4 Water Demand Analysis

According to the type, there are two kinds of understanding of water needs [20], namely:

a. Water needs for plants (consumptive Use)
b. Percolation of water into the soil in a vertically downward direction, from an unsaturated layer. The amount of percolation is influenced by the properties of the soil, the depth of groundwater, and its root system.
c. The magnitude of the crop coefficient.
d. Effective Rainfall (Re)
e. Water Demand for Land Treatment
f. Water Demand For Growth

2.5 Hydraulic Analysis of Drainage and Auxiliary Buildings

The hydraulic analysis of the drainage channel includes the drainage channel itself and the door regulating the water level in the drainage channel and is under the purpose of the existing drainage channel around Pangururan District, Samosir Regency. The analysis starts from the primary channel analysis, Romijn door, and intake channel. Based on the intake channel, the elevation of the intake water level is identified and used as a reference in determining the height of the drainage channel crests around Pangururan District, Samosir Regency [7].

2.6 Selection of Drainage Channels

Factors to consider in selecting the type of drainage are [21]:

a. The nature and strength of the subgrade.
b. The type of material transported by the river.
c. The condition/condition of the watershed in the upstream, middle and downstream areas.
d. The maximum flood water level that has ever occurred.
e. Ease of exploitation and maintenance.

f. Efficiency of implementation costs.

Based on the topography located in hilly areas, the suitable drainage type can be determined for the existing drainage channels. The drainage channel functions during the rainy season and dry season, that flows through the drainage channel while functioning. become a running water fish pond. By the proper analysis, its multi-functions will run successfully [14].
The existing drainage channel around Pangururan District, Samosir Regency can be run, which is a construction building that still functions to raise the water level of the drainage channel to irrigate rice fields or become a running water fish pond [22].

2.7 Selection of Locations for Drainage Channels for Fish Ponds

The determining factors in the selection of drainage locations are [14]:

a. The topography of the area to be irrigated is such that the entire plan area is irrigated by gravity.
b. Placement of the proper location of the drainage channel in terms of hydraulics. The transportation of garbage and wild plants to the intake is not disturbed to ensure the water level in the drainage channel is maintained.
c. To ensure a smooth flow into the intake, one of the conditions is that the drainage channel must be located at the outer bend of the stream or in a straight river section. The placement of drainage in the inner bend of the stream should be avoided.
d. Drainage channels should be placed in a location where the foundation soil is good enough so that the building will be stable.

2.8 Discharge Meter

The parameters in determining the selection of the discharge measuring device are as follows:
The suitability of the building for discharge measurement purposes.

a. Measurement accuracy in the field.
b. Sturdy, simple and economical building.
c. The debit formula is simple and precise.
d. Easy exploitation and reading.
e. Easy and inexpensive maintenance.
f. Suitable for local conditions and acceptable to farmers

2.9 Romijn Measuring Instruments

This gauge is used in front of the intake channel building. This measuring instrument also functions to regulate and measure the discharge as well as the primary channel door [23].

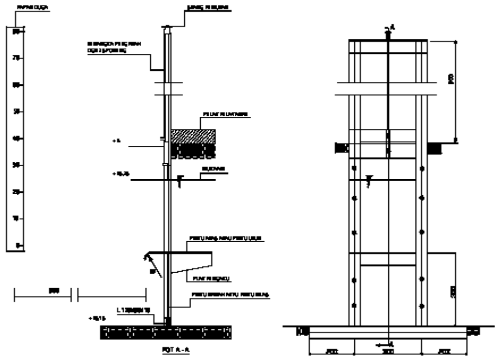


Fig 1. Romijn Measuring Tool

2.10 Water Level Barrier Door

The water level barrier door should not be disturbed as long as the water level remains stable. If there is an overflow, the flow at the door should not sink. The decrease in flow velocity will result in a decrease in water capacity along the drainage channel, so it is necessary to increase the water level in the drainage channel so that the flow does not decrease. Thus, it is necessary to make a slope of the channel that allows for easy water transportation to keep running well [24].

2.11 Preparation phase

The preparation stage is a series of activities before starting data collection and processing. At this early stage, the important things that must be done need to be arranged so that activities are structured, coordinated, and get results as planned.
The stages include:

a. List the agencies that will be used as resource persons.
b. Survey the location to get an overview of conditions in the field.
c. Procurement of administrative requirements.
d. Determine data requirements.
e. Literature study on problems related to drainage and its facilities and irrigation networks.

3. Method

3.1 Data Collection Phase

In the planning process, careful analysis is required. The more complex the problems faced, the more complex the analysis will be. In preparing a good analysis, adequate data, basic concept theory, and tools are needed. The data used as reference material in the implementation and preparation of this final report can be classified into two categories, namely:

a. Secondary Data

Secondary data is supporting data used in the process of making and compiling this Final Project Proposal. This secondary data is obtained from related agencies both from around the activity location and other places that support these activities.

b. Primary Data
Primary data is data obtained from the location of the development plan and survey results that are directly used as a source in building design.

3.2 Data from Literature study

This literature study needs to be considered in carrying out the activities based on existing theories, including problem-solving procedures. The first step that must be carried out is to collect data in the form of notebooks, books from previous studies, and other images that can be used as references in carrying out inventory survey work.

The search on construction drawings (Asbuilt drawings) and building facilities that have been built can be obtained and is available at the Department of Public Works as well as on Projects within the Office in charge of the work location.

3.3 Topographical Data

a. Map of the location of the watershed (DAS)
b. Contour map of Drainage location.

Topographic data is used to determine field conditions around the Gandong watershed. The topographic map used is a topographic map of the location of activities on a scale of 1: 50,000.

3.4 Hydrological Data

a. Maximum and average rainfall data.
b. Flood data.

Hydrological data includes rainfall data, river discharge records, and water balances in areas that influence planning. This data must be homogeneous and independent and representative.

Homogeneous data means that the data comes from the same population, in other words, the data collection station has never been moved and there are no other disturbances that could cause the nature of the data collected to be different.

The data collected is in the form of rainfall data for at least 20 years. This data will be used in analyzing water demand, water availability, and the planned flood discharge.

3.5 Climatological Data

Climatological data consists of:

a. Average relative humidity (%)
b. Average duration of sunshine (%)
c. Average monthly temperature (ºC)
d. Average wind speed (m/sec)

The climatological data used was taken from the station in the Jejeruk Irrigation Area service area. Climatological data is used to calculate water demand and availability (mainstream discharge). By identifying the climatological conditions of the area, the water needs can be determined.

3.6 Soil Mechanics Data

Groundwater level.
Soil porosity.
Soil bearing capacity.
Soil cohesion.

3.7 Additional data:

a. Data on water demand that has been used for planning operations and distribution of water in the Region along the drainage channel concerned.
b. Crop records (planted area) by season, type of crop (second crops, sugarcane, etc.), cropping intensity, and yield for the last five years (Source of data recorded)
c. Other data on current status, constraints, and problems in Operation and Maintenance, as required for System Planning.

3.8 Rainfall Plan Analysis

Determination of rainfall data from the logger or estimator only gets rainfall at a certain point (point rainfall). If the area has several measuring devices or rainfall recorders, the average value should be taken as the area's rainfall value. The rainfall area can be determined by several methods.

3.9 Algebraic Average Method

Calculation method by taking the arithmetic mean of rainfall measurements at rain stations in the area.

3.10 Hydrological Analysis

The hydrological analysis in the implementation of this work is more on the analysis of water availability and water demand. The purpose of this analysis is to determine the characteristics of rain, discharge, or water potential.

3.11 Planned Flood Discharge Calculation

3.11.1 Rainfall Data Analysis

If the rainfall data is used in more than one rain station, there are several methods to calculate the rainfall, including:

a. Thiessen method
b. Isohyet method
c. Algebraic Average Method (Arithmetic Mean Method) The reference station used to fill in the missing data is the adjacent Rain Station and influences the watershed rainfall input.

3.11.2 Dispersion Measurement

Dispersion can not be separated from the magnitude of the degree of the distribution of variance around the average value. The methods for measuring dispersion include:

a. Kurtosis Measurement
b. Coefficient of Variation (CV)
c. Standard Deviation (S)
d. Skewness Coefficient (CS

3.11.3 Selection of Distribution Type

In choosing the type of distribution, there are several types of distribution often used, namely:

a. Gumbel I . distribution
b. Pearson Type III Log Distribution
c. Normal Distribution
d. Normal Log Distribution

3.11.4 Distribution Alignment Test

In this distribution alignment test, the Chi-square test is used to determine whether the probability distribution equation that has been selected represents the statistical distribution of the analyzed data sample.

3.11.5 Rainfall Data Plot

In plotting the data, the frequency distribution in the probability paper aims to match the data series with the selected distribution type, where the match can be seen with the equation of a line that forms a straight line. The plotting results can also be used to estimate a certain value from the new data obtained.

3.12 Planned Flood Discharge Analysis

There are several methods in determining the design flood discharge, namely:

a. Rational Method.
b. Haspers method.
c. The FSR method of Java and Sumatra.

3.13 Selection of Planned Flood Discharge

Choose the design flood discharge from the calculation results. The greatest maximum flood value is taken from various methods with safety considerations [25].

3.14 Water Balance Calculation

Water balance calculations are carried out to check whether the available water is sufficient to meet water needs.
The main elements in the calculation of the water balance are:

a. Water Demand Analysis
   The definition of water needs by type is divided into:
   1. Water needs for plants (Consumptive Use). Evapotranspiration, percolation, crop coefficient (Kc), effective rainfall (Re), water requirement for land cultivation, and water requirement for growth.
   2. The need for water for irrigation.
   Crop patterns, cropping planning, and irrigation efficiency.
b. Mainstay Debit Analysis
   The mainstay discharge calculation aims to determine the area of rice fields to be irrigated. This calculation uses the water balance analysis method from Dr. F.J. Mock is based on data on rainfall, evapotranspiration, water balance on the ground surface, runoff, groundwater storage, and river flow.

4. Results and Discussion

4.1 Drainage Channel Data

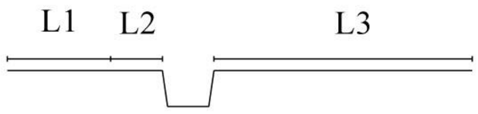
The research drainage channel data were obtained by direct observation and measurement in the field of the drainage channel in Pangururan District, Samosir Regency.

4.2 Drainage location, structure, and length

The field study is carried out in Pangururan District, Samosir Regency. The drainage found at the study site is secondary drainage with various lengths and widths of channels.

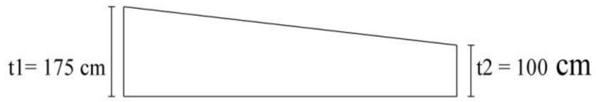
4.3 Surface Condition

Planning the drainage channel into a fish pond is carried out by conducting a direct evaluation in the field. It was found that the width and depth of the drainage channel did not match so it was necessary to carry out a temporary calculation of the channel, as described as follows:

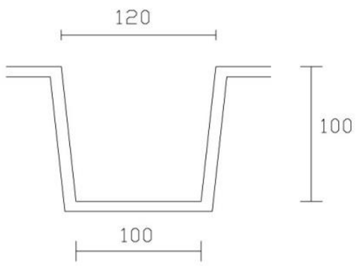


Description:
L1 = Paved road
L2 = Sidewalk
L3 = Open land

4.4 The difference in the height of the channel ground elevation



4.5 Initial channel cross-sectional size



4.6 Hydrological Data Analysis

Average Maximum Daily Rain
Based on the rainfall data in table 1, the average maximum rain (R) is calculated as follows:

$$R = \frac{\sum \overline{xi}}{\sum n}$$

$$= \frac{2211.5}{10} \text{ mm} = 221.15 \text{ mm}$$

Rainfall intensity
Calculation of rainfall intensity using the Mononobe formula, by following these steps. Calculation of standard deviation value. Based on the following table can be determined as follows:

Table 1. Rainfall configuration to determine standard deviation

$$Sd = \sqrt{\frac{\sum_{i=1}^{n}\left(Ri - \overline{R}\right)^2}{n-1}} = \sqrt{\frac{170955{,}22}{9}} = 137{,}82$$

Planned Rain
Rainfall plan (Rr) is calculated by the E.J Gumbel method as follows.
R r = R + k. Sd
Where the value of k is the probability factor for Gumbel's extreme values and is obtained through calculations with the formula:

$$K = \frac{Y_{Tr} - Y_n}{S_n}$$

The values of YTr, Yn and Sn for each period (T) years can be seen from table 1 and table 2. Thus, the Rr value is obtained as shown in the following table.

Table 2. Results of planned rainfall calculation using the E.J Gumbel method:

T	R (mm)	YTR	Y_n	S_n	k	Sd	k.Sd	R_r
5	221,15	1,5004	0,4952	0,9496	1,058	125,662	132,950	354,1
10	221,15	2,2510	0,4952	0,9496	1,849	125,662	232,349	453,5
25	221,15	3,1993	0,4952	0,9496	2,847	125,662	357,759	578,9
50	221,15	3,9028	0,4952	0,9496	3,588	125,662	450,087	671,2
100	221,15	4,6021	0,4952	0,9496	4,324	125,662	543,362	764,5

Since the analyzed channel functions as a secondary channel, a 5 year return period are used, so R5 = 354.1 mm.

Concentration Time

The concentration-timeTc) is calculated by the following formula.

Tc = 0,0133 x L x $i^{-0,6}$

The value of i can be calculated using the equation:

$$i = \frac{\Delta H}{0{,}9L}$$

Δ = difference in elevation of the channel ground level

Δ = t1 – t2

= 175 cm – 100 cm

= 75 cm

Based on the field observation, the length of the channel is:

L = 1000 m

$$\text{where } i = \frac{0.75}{0{,}9\,x 1000}$$

= 0,00083

Thus Tc = 0,0133 x 1 x $0{,}00083^{-0,6}$

Rainfall Intensity

Rainfall intensity is calculated using the Mononobe formula:

$$I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)2/4$$

Table 3. Results of annual rainfall calculations

o	Year of Observation	Rainfall Xi (mm)	(Xi-R)	$(Xi\text{-}R)^2$
	2012	223,5	2,350	5,53
	2013	279,0	57,85	3346,62
	2014	91,0	-	16939,02
	2015	270,0	48,85	2386,32
	2016	203-,0	-	329,43
	2017	158,0	-	3987,92
	2018	98,0	-	15156,92
	2019	214,0	-	48907,32
	2020	500,0	278,8	77757,32
	2021	175,0	-	2129,82
	∑ = 10	∑Xi =		∑ =

Based on the results of previous calculations, the I is obtained as follows:

$$I = \frac{R_{24}}{24}\left(\frac{24}{Tc}\right)2/3$$

$$= \frac{354.1}{24}\left(\frac{24}{0.93843}\right)2/3$$

= 14.754 x 8.680 = 128.066 mm/hour

Temporary Flood Discharge

Calculation of the planned debit is carried out by following the steps:

Determining the Flow Coefficient (C)

Flow coefficient (C) is calculated using the formula:

$$C = \frac{\sum_{i=1}^{n} C_i A_i}{\sum_{i=1}^{n} A_i}$$

Flow coefficient (C) is calculated by determining the flow coefficient (Ci) and drainage area (Ai) prior to the land use. In this case the coefficient is presented in Table 4.

Table 4. Calculation of flow coefficient

N	Types of Land Use	Ci	Ai (km^2)	Ci.Ai
1	Medium density settlement	0,5	0,120600	0,06030
2	Paved road	0,7	0,001407	0,00098
3	Sidewalk	0,7	0,001005	0,00070
∑			0,123012	0,06198

Based on the values contained in the table, the flow coefficient is determined as follows.

$$C = \frac{0.06198}{0.123012} = 0.56$$

Planned Discharge (Flood Discharge)
Based on previeous data, the planned discharge (QT) is calculated using the following method.
QT = 0,789 x C x I x A
= 0,789 x 0,56 x 128,066 x 0,123012
= 6,960 m3/sec

Temporary Channel Data Analysis
Wet cross-sectional area
Based on Figure 1, the wet cross-sectional area channel is calculated as follows:
Cross-section : a = 120cm
b = 100 cm
t = 70%.100 cm = 70

Width A $= \frac{(a+b)\cdot t}{2}$

$= \frac{(120+100)\cdot 7}{2}$

= 7700 cm2
= 0,77 m2

Wet Circumference
Wet circumference of the channel (P) is calculated based on Figure 1:.
Cross-section : P = b + 2S

Where S $= \sqrt{100^2 + 5^2}$
= 100,12 cm
P = 100 + 2(100.12)
= 300.24 cm

Hydraulics radius
The following formula is used to calculate the hydraulic radius:

$$R = \frac{A}{P}$$

Based on the previous calculations the values of A and P have been obtained. Thus

$$R = \frac{7700}{300.24} = 25.646 \text{ cm}$$

Channel Base Slope
Based on the previous calculation, the slope of the channel base is obtained by S = 0.0057
Average Flow Speed
The average flow velocity in the channel is calculated based on the Manning formula.
Where : V = 1/n R2/3 x S1/2
n = 0,013
Thus, V = 1/0,013 x 0,256462/3 x 0,00571/2
= 2,34 m/sec

Channel Debit
The channel discharge is calculated using the following formula:
QS = AS.V
= 0,77 m2 x 2.34 m/sec
= 1,80 m3/sec

Temporary Calculation Results
After the planned discharge and channel discharge are found, the channel discharge is examined versus the planned discharge. The results of the data analysis reveals:
QT = 0.789 x C x I x x A
= 0,789 x 0,56 x 128,066 x 0,123012
= 6,69 m3/sec.
QS = AS x V
= 0,77 m2 x 2.34 m/sec
= 1.80 m3/sec or QT≥ QS
Furthermore, based on these results, it can be concluded that the existing channel dimensions do not meet the standards. Therefore, the authors plan the dimensions for the channel as follows:

Wet cross-sectional area
The wet cross-sectional area of the channel is calculated as follows:
Cross-section : a = 150cm
b = 170 cm

t = 70% x 170 cm = 119 cm

Width A $= \frac{(a+b)\cdot t}{2}$

$= \frac{(150+170)\cdot 119}{2}$

= 19040 cm^2 = 1,904 m^2

Wet Circumference

The wet circumference of the channel (P) is calculated as follows.

Cross-section : P = b+2S

where S $= \sqrt{119^2 + 5^2}$

= 119,104 cm

Thus, P = 119 + 2(119,104)

= 357,208 cm

Hydraulics radius

The following formula is used to calculate the hydraulic radius,

$$R = \frac{A}{P}$$

Based on the previous calculations the values of A and P have been determined. Thus,

$$R = \frac{19040}{357.208} = 53{,}302 \text{ cm}$$

Channel Base Slope

Based on the previous calculation, the slope of the channel base is obtained by S = 0.0057

Flow Speed Average

The average flow velocity in the channel is calculated based on the Manning formula.

Where : $V = 1/n\ R^{2/3} \times S^{1/2}$

n = 0,013

Thus $V = 1/0{,}013 \times 0{,}53302^{2/3} \times 0{,}0057^{1/2}$

= 3,8 m/sec

Channel Debit

The channel discharge is calculated using the following formula:

QS = AS x V

= 1,904 m^2 x 3,8 m/sec = 7,23 m^3/sec

Final Calculation Results

After the planned discharge and channel discharge are determined, the channel discharge is tested against the planned discharge.

Based on data analysis :

QT = 0,789 x C x I x A

= 0,789 x 0,56 x 128,066 x 0,123012

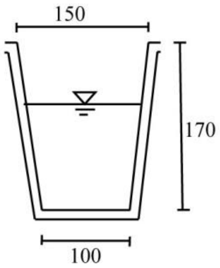
= 6,960 m^3/det

QS = AS x V

= 1,904 m^2 x 3,8 m/sec = 7,23 m^3/sec

= 7,23 m^3/sec or $QT \leq QS$

Therefore, based on results presented above, it can be concluded that the dimensions of the planned channel has met the standards



Pool Gate Calculation Plan

Drainage channels require sluice gates to control the water level of the pond during heavy rains and the dry season. Based on the calculation of the width of the building, the drainage channel can be used as a running water fish pond because the building taps water discharge so that it can meet the needs of drainage channels in the planned area.

The planned door/intake width is calculated based on the maximum capacity of water demand, and the height and intake speed is calculated using an equation with the following calculation example:

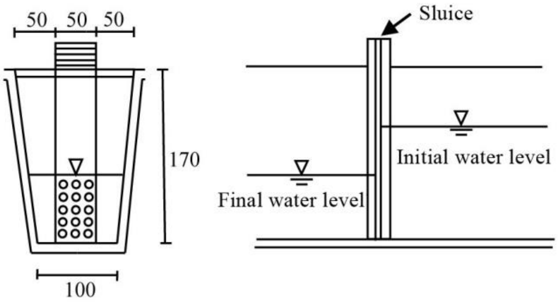
$$Q = \mu \times b \times a \times \sqrt{2gz}$$

Where

Q = Planned wiretapping debit (m^3/s)

M= Discharge coefficient

B = Door opening width (m)
g = Acceleration due to gravity (m/s^2)
z = Energy loss height (m)
a = Opening height (m)



Based on the calculation results, it is identified that excess water discharges in the rainy season and water decreases in the dry season. Therefore, it is necessary to find a way so that the drainage canal can raise and remove excess water flow. An example calculation is presented below:

Pmin = 0,50 m
The taken value are:
z = 0.2
µ = 0.8
Thus :
V = m. (2. g. z)^{0,5}
= 0.8 x (2 x 9.8 x 0.2)^{0,5}
= 1,5 m/sec
If a = 0,76 mb = 3 m
Therefore, Q : = (u x b x a $\sqrt{2.9.z}$) x 3
10,8 = (0,8 x 3 x 0,76 $\sqrt{2.9x8.2}$) x 3
10.8 = 10.8

5. Conclusion

In evaluating multi-function drainage channels, the calculating the highest rainfall in the rainy and dry seasons, calculating the planned discharge, calculating the dimensions of the channel, and flood discharge should be carried out. The result of analysis shows that QT = = 0.789 x C x I x A = 6.69 m^3/sec. The design average flow velocity has been calculated for a 1000 m long drainage channel with sluice gates to control the adequacy of pool water cubication. The average flow velocity is = 1/n R2/3 x S1/2 = 3.8 m/s, where the cross-sectional area for the construction of a fish pond with a wet cross-sectional area for fish pond drainage channels.

$$A = \frac{(a+b)\cdot t}{2} = 1.904 \text{ m2.}$$

The cross-section area of the wet plan for fish ponds has been planned in advance. The channel design discharge for the fish pond is QS = AS x V = 7.23 m3/sec and the calculation of the pond water level gate Q = (u x b x a $\sqrt{2.9.z}$) x 3 is 10.8 m/s was appropriate.

References

[1] Badan Pusat Statistik Kota Pematangsiantar, "Kota Pematangsiantar Dalam Angka 2021," *BPS Kota Pematangsiantar*, vol. 148, 2021.
[2] D. Khadijah, Y. Rouli Siburian, and R. Sinaga, "Hubungan Karateristik Ibu Dengan Sectio Caesarea Di Rumah Sakit TK IV 01.07.001 Kesdam I/BB Pematang Siantar. (2014)," *J. Ilm. PANNMED*, vol. 9, no. 1, 2014.
[3] R. N. Salakory and A. F. Wijaya, "PERENCANAAN STRATEGIS SISTEM INFORMASI MENGGUNAKAN METODE WARD AND PEPPARD PADA DINAS PEKERJAAN UMUM DAN PENATAAN RUANG PROVINSI MALUKU," *Sebatik*, vol. 25, no. 2, 2021, doi: 10.46984/sebatik.v25i2.1441.
[4] V. Awan and M. Hasibuan, "Penggunaan Media Kartu Angka Dalam Upaya Meningkatkan Kemampuan Mengenal Angka Pada Anak Usia Dini," *PAUDIA J. Penelit. dalam Bid. Pendidik. Anak Usia Dini*, vol. 9, no. 2, 2020, doi: 10.26877/paudia.v9i2.6736.
[5] B. O. Y. Marpaung and R. Senders, "The ecological influences in forming waterfront settlements in Pangururan Sub-district, Samosir Regency.," in *IOP Conference Series: Earth and Environmental Science*, 2020, vol. 452, no. 1, doi: 10.1088/1755-1315/452/1/012130.
[6] R. Meixon Siahaan and D. Nirfalini Aulia, "Pelestarian Kearifan Lokal Tempat Suci Tajur di Panguruan," *Talent. Conf. Ser. Energy Eng.*, vol. 2, no. 1, 2019, doi: 10.32734/ee.v2i1.417.
[7] W. Muhammad Tri Yudha and D. Nirfalini Aulia, "Penataan Ruang Tepi Air Untuk Pengembangan Kawasan Ekowisata Di Tano Ponggol," *Talent. Conf. Ser. Energy Eng.*, vol. 2, no. 1, 2019, doi: 10.32734/ee.v2i1.423.
[8] C. I. Erliana, D. Irwansyah, D. Abdullah, M. Zarlis, and E. Elviwani, "ANALISIS TINGKAT KEBISINGAN PADA DEPARTEMENT FIBER LINE DI PT. TOBA PULP LESTARI," *TECHSI - J. Tek. Inform.*, 2018, doi: 10.29103/techsi.v10i2.842.
[9] N. M. Sianturi, M. K. A. Kamarudin, N. A. Wahab, and A. S. Mohd Saudi, "The hydraulic modelling on sediments ponds in binanga aron river, north sumatera indonesia," *Int. J. Recent Technol. Eng.*, vol. 8, no. 2, 2019, doi: 10.35940/ijrte.B1497.078219.
[10] N. M Sianturi, "EVALUASI TERHADAP PENGELOLAAN SAMPAH DALAM MENINGKATKAN PELAYANAN ASET DI KOTA PEMATANGSIANTAR," *J. Tek. Sipil*, vol. 13, no. 3, 2017, doi: 10.24002/jts.v13i3.881.

[11] N. M. Sianturi, “Evaluasi Terhadap Pengelolaan Sampah Dalam,” *J. Tek. Sipil*, vol. 13, no. 3, 2015.
[12] N. M. Sianturi, “Evaluasi Terhadap Pengelolaan Sampah Dalam Meningkatkan Pelayanan Aset di Kota Pematangsiantar,” *J. Tek. Sipil*, vol. 13, no. 3, 2015.
[13] M. Ikhsan and R. Rinaldy, “Estimated Flood Discharge in Downstream Krueng Meureubo of Pasi Pinang Section West Aceh Regency,” *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 1, 2021, doi: 10.52088/ijesty.v1i1.41.
[14] I. C. Willis, C. D. Fitzsimmons, K. Melvold, L. M. Andreassen, and R. H. Giesen, “Structure, morphology and water flux of a subglacial drainage system, Midtdalsbreen, Norway,” *Hydrol. Process.*, vol. 26, no. 25, 2012, doi: 10.1002/hyp.8431.
[15] D. Xue, T. Liu, H. Chen, J. Liu, J. Hu, and L. Liu, “Fungi are more sensitive than bacteria to drainage in the peatlands of the Zoige Plateau,” *Ecol. Indic.*, vol. 124, 2021, doi: 10.1016/j.ecolind.2021.107367.
[16] A. Wałega, A. Rutkowska, and A. Policht-Latawiec, “Sensitivity of beta and Weibull synthetic unit hydrographs to input parameter changes,” *Polish J. Environ. Stud.*, vol. 23, no. 1, 2014.
[17] D. Kamila, L. M. Limantara, M. Bisri, and W. Soetopo, “The limiting physical parameter of Nakayasu synthetic unit hydrograph,” *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, no. 6 C2, 2019.
[18] N. M. Sianturi, “Kajian Terhadap Sistem Jalan Merdeka dan HOS Cokroaminoto Kecamatan Siantar Utara Pematang Siantar,” *J. Tek. Sipil*, vol. 9, no. 2, 2019, doi: 10.28932/jts.v9i2.1377.
[19] G. R. Zhang, L. L. Shen, P. Schmatz, K. Krois, and B. J. M. Etzold, “Cathodic activated stainless steel mesh as a highly active electrocatalyst for the oxygen evolution reaction with self-healing possibility,” *J. Energy Chem.*, vol. 49, 2020, doi: 10.1016/j.jechem.2020.01.025.
[20] J. Swanata and M. ikhsan Setiawan, “Evaluation of Reservoir performance Clean Water Distribution in Putat Gede Graha Family,” *J. World Conf.*, vol. 2, no. 1, 2019, doi: 10.29138/prd.v2i1.121.
[21] N. M. Sianturi *et al.*, “Assessment of environmental management in Lake Toba, Samosir Regency, North Sumatera Province, Indonesia,” *Int. J. Eng. Technol.*, vol. 7, no. 3.14 Special Issue 14, 2018.
[22] T. Gupta and T. N. Singh, “Geo-hydrological Stability Analysis of Fly Ash Stabilised Overburden Dump Slopes in Opencast Coal Mines Using Finite Element Analysis,” *Int. J. Adv. Sci. Eng. Inf. Technol.*, 2018, doi: 10.18517/ijaseit.8.2.3449.
[23] M. Klenk, H. Nussbaumer, Y. Veschetti, R. Kopecek, R. Kreiter, and H. Hildebrandt, “Bifacial PV systems and yield data (bifacial gain),” *Bifacial photovoltaics Technol. Appl. Econ.*, 2018.
[24] Nuraini, Iqbal, and Sabhan, “Analisis Logam Berat dalam Air Minum Isi Ulang (AMIU) dengan Menggunakan Spektrofotometri Serapan Atom (SSA),” *Gravitasi*, 2015.
[25] S. Romadhona, F. Kurniawan, and J. Tistogondo, “Project Scheduling Analysis Using the Precedence Diagram Method (PDM) Case Study: Surabaya’s City Outer East Ring Road Construction Project (Segment 1),” *Int. J. Eng. Sci. Inf. Technol.*, vol. 1, no. 2, 2021, doi: 10.52088/ijesty.v1i2.56.