CERUCUK
Volume 9 No. 6 2025 (258-267)

PLANNING OF RIVER FLOW CONTROL AND LANDSLIDE CONTROL BUILDINGS IN WALET VILLAGE, NORTH BARITO REGENCY

Nurhaliza Febriyani[1], Hutagamissufardal[2]
Program Studi Teknik Sipil Universitas Lambung Mangkurat
Jl. Jenderal Achmad Yani Km 35,5 Banjarbaru, Kalimantan Selatan – 70714
E-mail: [1]nrhlzfbryn@gmail.com; [2]agamsufardal@ulm.ac.id

ABSTRACT

The landslide at one point on the Walet Village road was caused by the scouring of the Montallat River water. Due to the scouring of river water, the cliff on the shoulder of the road experienced a landslide towards the river. As a result of the cliff landslide, the road slowly erodes at that point.

This planning begins with a literature study by collecting and studying previous literature related to planning. Then proceed with collecting soil investigation data. Continue with calculating the stability of the retaining wall. After that, it was modelled and analyzed using GeoStudio 2018 software to get the safety factor value. Finally, the dimensions of the river basin were calculated.

From the planning results, it is obtained that the Gravity Wall has dimensions of a wall height of 4.2 meters, top wall width of 0.35 meters, wall toe width of 2.94 meters, wall toe height of 0.70 meters, and wall toe width of 0.70 meters. Meanwhile, for the rolling stability of the retaining wall, the value was $2.151 \geq 1.5$, the shear stability of the retaining wall was obtained with a value of $0.593 \leq 2$, the stability of the bearing capacity of the retaining wall was obtained as a value of $1.048 \leq 3$, so it is planned to install piles to increase the bearing capacity with a diameter 0.40 meters, 8 meters long, with a distance between poles of 1 meter. The safety factor value of slope stability after handling is $1.618 > 1.5$, so it is said to be safe. Then, the permeable river crib has large gaps with the dimensions of the crib, namely the length of the stiffening beam is 7.50 meters, the height of the stiffening beam is 0.70 meters, the width of the stiffening beam is 0.50 meters, the diameter of the piles is 0.20 meters, the length of the piles is 10 meters, the distance between 14.00 meters of crib, five cribs, and four piles for each crib.

Keywords: Landslides, Retaining Walls, Slope Stability, Permeable Crib

1. INTRODUCTION

One point of the Walet Village road experienced a landslide caused by the scouring of water from the Montallat River which was next to the road and the road body was slowly eroding.

The design of retaining walls and grouts is expected to be able to withstand ground pressure and the impact of river currents to a certain safety limit. Retaining wall planning must be noted in the choice of shape and dimensions because it affects stability against sliding, overturning and bearing capacity. Crib planning must take into account the shape

of the river, the discharge and speed of river flow, and the number and dimensions of the groin, which are related to the length and distance between the groin to direct the river flow.

In writing this final assignment, we will plan the dimensions for retaining walls, and in the grouting, we will plan the type, dimensions and quantity. This plan is expected to provide a solution for planning suitable retaining walls & groutings on roads that are close to rivers.

2. THEORETICAL STUDY

2.1 Landslide

Landslides are a natural phenomenon in the form of the movement of land masses in search of a new balance due to external disturbances which cause a reduction in soil shear strength and an increase in soil stress. The reduction in soil shear strength parameters is caused by increasing soil water content and decreasing bonds between soil grains (Suryolelono, 2002).

2.2 Soil Retaining Wall

A retaining wall is a structure designed and built to withstand lateral (horizontal) soil pressure when there is a change in ground elevation that exceeds the at-rest angle in the ground. Retaining walls can be grouped into several types, namely gravity type walls, cantilever type walls, *counterfort*, and wall type *butters* (Supriyanto, 2015).

2.3 Crib Building

The crib is a building made from a river cliff in the direction of middle to regulate the direction of river flow, reduce the speed of river flow along river banks, accelerate sedimentation, ensure the safety of embankments or cliffs against scouring, maintain width and depth of water in the river channel (Sosrodarsono, 2009).

2.4 Lateral Soil Pressure

Lateral earth pressure analysis is used for designing retaining walls and other retaining structures, such as bridge bases, sheet piles, tunnels, underground concrete channels. The lateral earth pressure is a burden which is caused by the result of soil thrust behind the soil retaining structure. The amount of lateral pressure is greatly affected by changes in location (displacement) from the retaining wall to the soil properties (Hardiyatmo, 2010).

2.5 Stability Control

The analysis of the stability of a retaining wall is reviewed on the following matters: The safety factor against shifting and overturning must be sufficient, the pressure that occurs on the base soil of the foundation must not exceed the carrying capacity of the permitted soil, the overall stability of the slope must meet the requirements, If the base soil is an easy compressed, non-uniform settlement that occurs must not be ignored.

3. METHOD

3.1 Preparation Phase

The preparatory stage carried out in this planning is literature study. Literature studies were carried out by collecting and studying literature and reports on the results of previous studies related to the planning of retaining walls and groutings. This aims to provide understanding and can become a strong and accountable basis.

3.2 Data Collection

The activity that will be carried out in this stage is collecting the necessary data. The data required is data obtained directly from the planning location, not data from a different location adjacent to the planning location. The required data collection consists of several data, namely:

1. Location Documentation
2. Location Coordinate Point
3. Soil Research Data
4. Topographic Data

3.3 Data Analysis

Activities to find helpful information that can be used as a basis for making design decisions. The results obtained from data analysis in this planning are soil stratigraphy and data interpretation.

1. Soil Stratigraphy

   Soil stratigraphy is the layers of soil. By knowing the soil layers at the planning location, it can facilitate the subsequent planning process.

2. Data Interpretation

Data interpretation is carried out to interpret the results of tool readings from field tests that have been carried out. The interpretation of this data is then used in the planning process.

3.4 Data Processing and Planning Process

This data processing is the process of processing the data that has been obtained so that it can be used in the planning process. The data that has been processed is then used in the planning process using methods that are in accordance with the literature review in order to obtain accountable planning results.

1. Retaining Wall Planning
2. Crib Planning
3. Stability Analysis
4. Reinforcement

3.5 The Final Result

The final result of the planning for this final project is a typical drawing. A typical drawing is a depiction of the planning results in the form of a cross section retaining walls and groin buildings.

4. RESULTS AND DISCUSSION

4.1 Land Data

Data, such as test data in the field, is needed to support the design. Data collection in the field was in the form of Cone Penetration Test at 2 test points. Point S-1 is on the cliff below the river side and S-2 is on the shoulder of the road on the garden side.

4.2 Data Interpretation

From the results of the CPT, a correlation process was carried out to obtain soil parameter values such as Cu, γ, and ϕ in the following table.

Table 1. Soil Layer Profile Based on CPT S-1 Test

Depth (m)	qc (kg/m^2)	qc avarage (kg/m^2)	Consistency	γ (ton/m^3)	Cu (ton/m^2)	ϕ (˚)
0,00 – 3,00	0 - 5	3.63	Very Soft	1.6	1.81	0
3,00 – 5,60	5 - 10	8.00	Soft	1.6	4.00	0
5,60 – 5,80	15	15.00	A bit stiff	1.8	7.50	0
6,00 – 6,80	10	10.00	A bit stiff	1.8	5.00	0
6,80 – 8,60	20 - 45	29.56	Rigid	2	14.78	0
8,60 – 9,00	75	75.00	Last Half	2	37.50	0

9,20 – 10,60	105-150	118.57	Last Half - Compact	2	59.29	0

4.3 Soil Stratigraphy

Based on the results of soil classification, soil stratigraphy is divided into several layers based on the correlation and interpretation of CPT data.

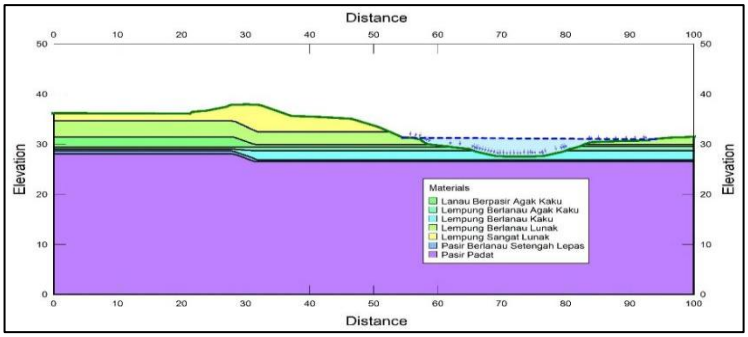

Figure 1. Soil Stratigraphy

4.4 Landfill Data

In designing retaining walls using gabion construction, embankment soil data is used as a substitute for the original soil that was wasted during the construction process. Landfill Data:

- Cohesion c = 0 ton/m^2
- Inner Shear Angel ϕ = 30˚
- Soil Volume Weight γt = 2 ton/m^3

4.5 Retaining Wall Planning

Based on landslide geometric data, it is known that the landslide height (H) varies from 2.06 meters to 3.47 meters. Retaining wall-type gravity wall designed with a height of 4.20 meters. The planning of retaining wall dimensions is guided by SNI 8460-2017 and is planned using maximum provisions. Type of retaining wall planning design, gravity wall seen in Figure 2.

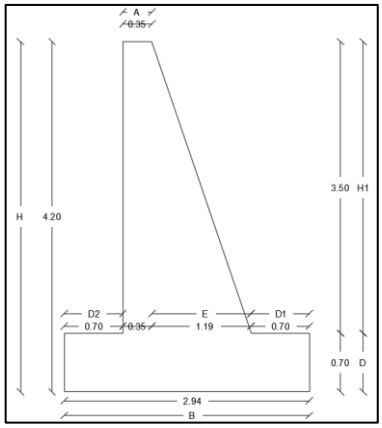

Figure 2. Planning Dimensions of *Gravity Wall*

Table 2. Overturning Moment of Retaining Soil Wall Overview per 1 Meter

No.	Active Soil Pressure Pa (tons)	Moment Arm About Catch Point h (m)	Rollover Moment Mg (tm)
1	3,11	2,10	6,53
2	5,88	1,40	8,23
S	**8,99**		**14,76**

Table 3. Retaining Moment of Soil Retaining Wall Review per 1 Meter

No.	Heavy W (ton)	Load Distance to End of Retaining Wall X (m)	Prisoner Moment Mt (tm)
1	4,58	1,493	6,84
2	2,69	2,065	5,56
3	4,53	1,470	6,66
4	4,90	2,590	12,69
S	**16,70**		**31,75**

Control of Retaining Wall Stability

1. Roll

$$SF_{roll} = \frac{Mt\ total}{Mg\ total} = \frac{31{,}75\ tm}{14{,}76\ tm} = 2{,}151 \geq 1{,}5 \quad \textbf{...OK}$$

2. Shift

$$SF_{shift} = \frac{Rh}{Pa\ total} = \frac{5{,}32\frac{t}{m}}{8{,}99\frac{t}{m}} = 0{,}593 \leq 2 \quad \textbf{...NOT OK}$$

3. Carrying Capacity

$$SF_{carrying\ capacity} = \frac{that}{\sigma max} = \frac{11{,}45\frac{t}{m^2}}{10{,}93\frac{t}{m^2}} = 1{,}048 \leq 3 \quad \textbf{...NOT OK}$$

Calculation of Retaining Wall Piles

1. Vertical Load
   1) Total Vertical Load = 31.71 tons
2. Horizontal Load
   1) Total Horizontal Load = 8,99 ton
   2) Horizontal Load that Works on Piles = 2,996 tons/pillar
3. Bearing Capacity of Piles
   1) Group Pile Permit Capacity, Qag =172,28 ton > Vtotal = 24,304 ton **...OK**
4. Carrying Capacity of Piles Against Lateral Loads

1) Horizontal Load Single Permit, Hi = 5,42 ton > Hk = 2,996 ton **…OK**

5. Pile Deflection

1) Free Pile Deflection = 6,323 mm ≤ 12 mm**…OK**

Calculation of Retaining Wall Reinforcement

1. Main Reinforcement

It is planned that the main reinforcement is installed D10 - 100 mm

2. Shear Reinforcement

It is planned that the main reinforcement is installed D8 - 50 mm

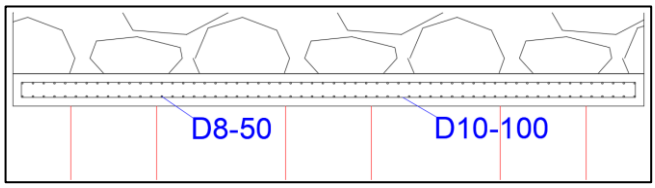

Figure 3. Work Floor Reinforcement Details *Gravity Wall*

4.6 *Overall Stability*

Analysis results in overall *stability* obtained SF value = 1.618 > 1.5. Then install the retaining wall *gravity wall* safe against landslides.

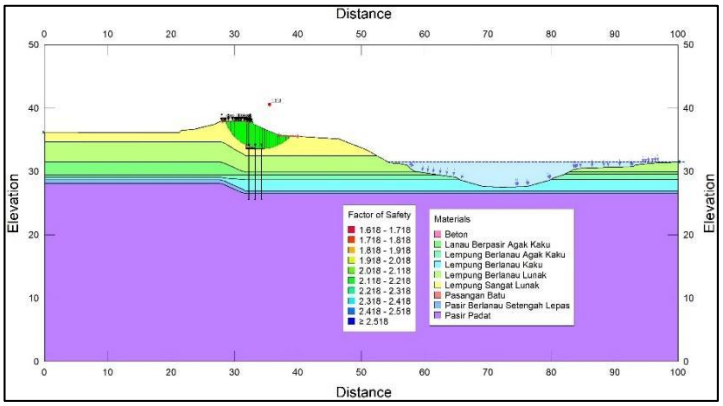

Figure 4. *Overall Stability* Soil Retaining Wall *Gravity Wall*

4.7 Crib Planning

The groin building is planned when the river depth is 6,426 meters with a river width of 47,189 meters. The type of crib planned is a pile crib (crib permeable big gap). Pile cribs consist of stiffening beams made of concrete and piles. The crib is placed on the outside of the river, which is 60 meters long. five curtain rods are installed with a distance of 14 meters between the rods.

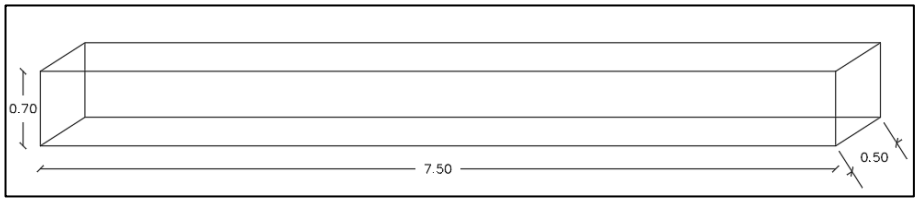

Figure 5. Crib Dimensions

Calculation of Crib Piles

1. Vertical Load
   1) Total Vertical Load = 7.26 ton
2. Horizontal Load
   1) Total Horizontal Load = 1,73 ton
   2) Horizontal Load that Works on Piles = 0.433 tons/pole
3. Bearing Capacity of Piles
   1) Group Pile Permit Capacity, Qag =88,58 ton > Vtotal = 7,26 ton **…OK**
4. Carrying Capacity of Piles Against Lateral Loads
   1) Horizontal Load Single Permit, Hi =1,36 ton > Hk = 0.433 tons**…OK**
5. Pile Deflection
   1) Free Pile Deflection = 4,825 mm ≤ 12 mm**…OK**

4.8 Material Stability

1. Crack Moment
   1) $M_{cr} = 14{,}94\ tm\ > Mg\ total = 14{,}76\ tm$ **… OK**

5. CONCLUSION

5.1 Conclusion

1. The planned retaining wall is type gravity *wall* made of stone masonry. Dimensions Gravity *wall* used is a wall length of 74 meters, a wall height of 4.2 meters, a top wall width of 0.35 meters, a wall footing width of 2.94 meters, a wall footing height of 0.70 meters, and a width of the wall 0.70 meters.
2. Retaining wall stability:
   - Rolling stability of retaining walls: 2,151 ≥ 1,5.
   - Shear stability of retaining walls: 0,593 ≤ 2.
   - Stability of bearing capacity of retaining walls: 1,048 ≤ 3.

So it can be said to be unsafe and it is planned to install piles to increase the carrying capacity with a diameter of 0.40 meters, a length of 8 meters, with a distance between the piles of 1 meter.

3. Safety factor slope after handling use gravity *wall* and analyzed using software GeoStudio 2018 SLOPE/W obtained a value of 1.618 > 1.5 so *gravity wall* safe against landslides.
4. The planned river crib is type permeable with large gaps consisting of stiffening beams made of concrete and piles. The dimensions of the cribs used are the length of the stiffening beam 7.50 meters; the height of the stiffening beam 0.70 meters; the width of the stiffening beam 0.50 meters; the diameter of the piles 0.20 meters; the length of the piles 10 meters, the distance between cribs 14.00 meters, the number of crutches is 5, and the number of piles per crib is 4.

5.2 Suggestion

1. Planning for retaining walls and groutings has been carried out using *cone penetration test* data that is quite accurate. However, it would be better to add completeness to other soil investigation data such as laboratory data.
2. The bearing capacity calculation must be calculated carefully, because it influences the determination of whether the planned retaining walls and grouting walls are safe or not.

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