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Way Leman River Flood Control in Buru Regency

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***Keywords*— River Flood, BMKG, flood water level.**

Abstract *— Way Leman River is located at the watershed of Way Leman covering with an area of 167.24 Km^2. During the rainy season the Way Leman river flow has the potential to disrupt community activities. Material losses and crop failure are inevitable in the event of a flood. Therefore, it is necessary to identify the cause of the disaster. From the rainfall data usedat the climatology (BMKG) Namlea station for 20 years, namely in 2000 - 2019, statistically with the Gumbel distribution for the 25yearsreturn period, the planned rainfall250.31 mm /year and the Melchior method found a planned flood discharge of 290.85 m^3/sec. From the simulation results of the Way Leman river cross section using the 25-Year Planned Debit with the Melchior Method, it cannot accommodate the flood discharge that occurs because the elevation of the flood water level exceeds the elevation of the river bank. In order to control the flood, the Way Leman river was normalized and made a river reinforcement building with gravity wall type. The results of analysis showed that the selection of the type of structure was permitted.*

I. INTRODUCTION

Flood is an event that overflows water from a container such as rivers, lakes, reservoirs, and so on. Flooding is caused by a large increase in the volume of water which is not balanced by the capacity of the cross-section or containers in the cross-season of the water causing the overflow of water. The Way Leman River whose flow has a large potential for damage. In the rainy season the flow in the Way Leman River is very large and has the potential to disrupt the activities of the farming community in Buru Regency. Material losses and crop failure are inevitable in the event of flooding. Therefore, identification is needed to find out the cause of the disaster. By identifying the cause of flooding, a flood control study can be conducted to reduce the destructive power of the Way Leman River.

II. LIBRARY REVIEW

- **Watershed**

To determine the boundary of the watershed, it is necessary to have a topographic map containing all information about a particular area, whether roads, cities, villages, rivers, types of plants, land use complete with contour lines, a map with a scale of 1:50,000 is considered sufficient. From the map, the highest points around the intended main stream are determined, each point is connected to each other so as to form a solid line that meets the end of the base. The line is the watershed boundary at a certain control point.

- **Rainfall Analysis**

To get an estimation about great forecast of flooding that will happened in a cross-section of the river, the depth of the rain that occurs must also be known. What is needed is the depth of rain that occurs throughout the watershed. So it is not only the amount of rain that occurs in a rain measurement station, but data also on therein depth data from several rain stations scattered throughout the watershed.

- **Parameters Statistics**

Statistical parameters used in the analysis of hydrological data are: arithmetic mean, standard *deviations*, coefficients of variation, *skewness coefficient* and kurtosis coefficients.

The Design of Flood Discharge

The design of flood discharge is the maximum discharge on a river with a certain return period. Sumarauw (2013) stated that flood discharge plans are usually obtained

By several methods, imcluding:

1. Debit Data Available

The method that can be used is the Frequency Analysis Method from the available discharge data, the analysis can use the most appropriate distribution functions such as Normal, Normal Log, Gumbel or Pearson III Log.

2. No Debit Data Available

If discharge data is not available, then the analysis is carried out by calculating the planned rain in advance by entering rainfall data for at least 10 years, after the planned rain is obtained, the results of the planned rain are converted into discharge plans using various methods include:

a. The method of hydrograph unit synthesis, which forms the unit of hydrograph from watershed characteristic data such as river length (L), river length to center of gravity (Lc), watershed slope, and others. This method is usually used if the size of the watershed includes a medium to large watershed.
b. Rational Methods. This method is usually used for small watersheds. In this study, discharge data is available so that frequency analysis method will be used.
c. The Design Flood Method Uses Der-weduwen, Haspers,Melchior with a watershed size greater than 100Km$^{2.}$

▪ **Hydraulic Analysis**

Flow is said to be steady if the speed does not change during a certain interval of time. Natural flow is generally irregular, this is due to the geometric shape ofthe channel, irregular rivers in the field, the presence of plants on the channel cliffs, the presence of water buildings, changes in the base of the channel, and others. Components in this model are used to calculate the water level profile at steady flow conditions. Components in steady flow can model the surface profile of the water face in conditions of subcritical, supercritical and combined flow systems.

III. RESEARCH METHODOLOGY

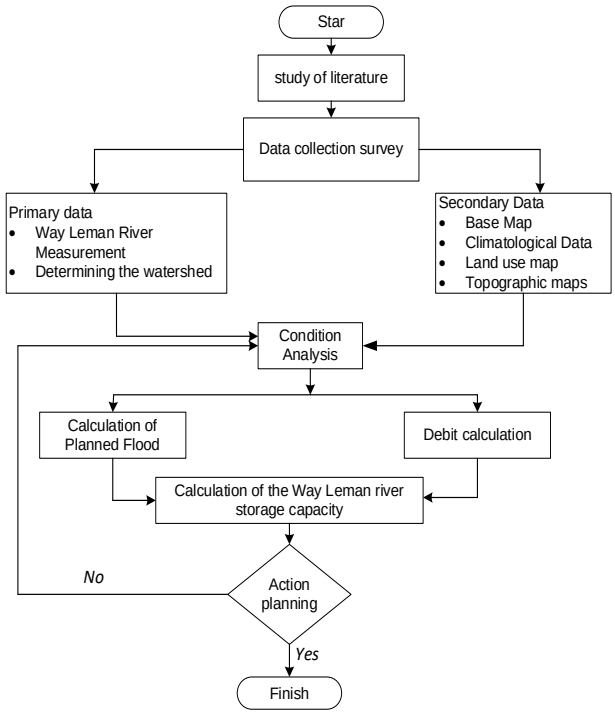


Fig.1. Research flow chart

IV. RESULTS AND DISCUSSIONS

The area of the Way Leman Watershed is 167,24km$^{2.}$

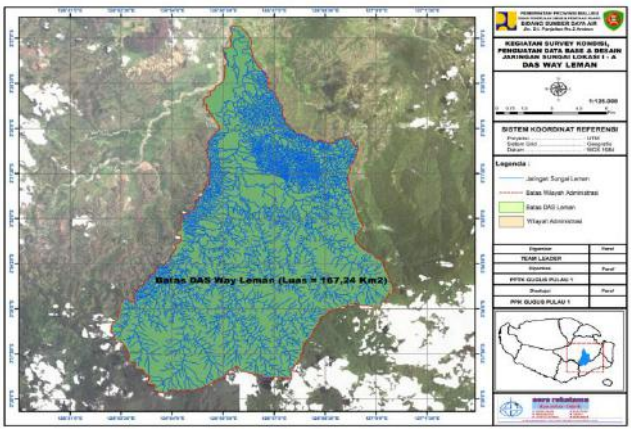


Fig. 2. Way Leman Watershed

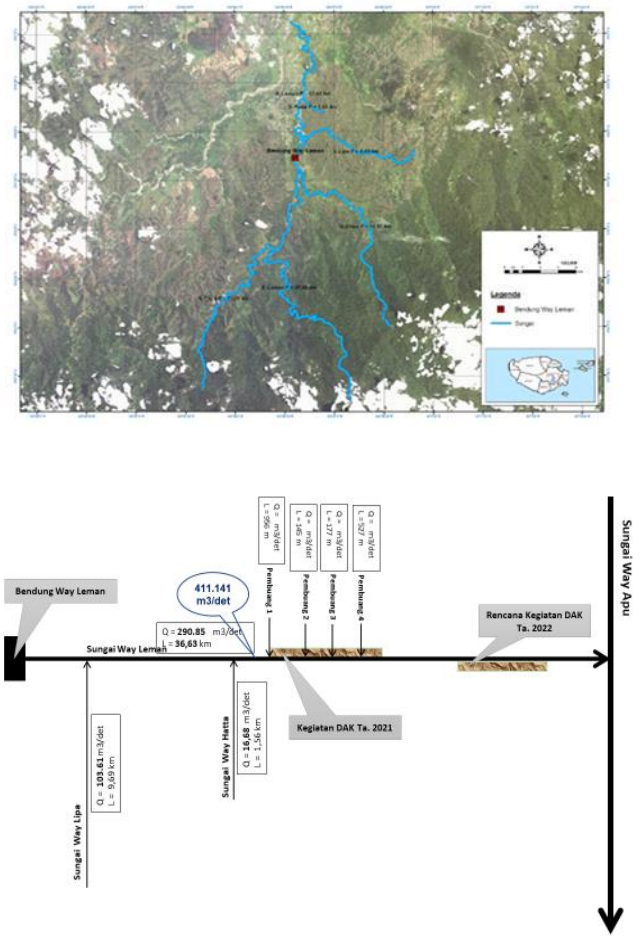


Fig.3. River Way Leman Scheme

Flood Discharge Analysis

Characteristic Parameters of Way Leman's Watershed

Watershed Characteristics	Parameter
Accommodate	Way Leman River
Area (Km2)	167.24
River length (Km)	36.63
Slope	0.0002
Forest type	Forest, shrubs, rice fields
Land use coefficient	0.65 - 0.70

Rainfall data used is monthly rain data at climatology (BMKG) Namlea station for 20 years, namely in 2000 - 2019.

An analysis of rainfall frequency is performed to determine the amount of rainfall designed for a 25-year re-period.

The type of rainfall distribution depends on the value of statistical parameters i.e. average count or mean, standard deviation, coefficient of dissgetation, coefficient of variation and coefficient of kurtosis

No	Distribution type	Condition	Calculation	Conclusion
1	Normal	CS ≤ 0	CS = 0.280	Does not meet the
		CK = 3	CK = 0.372	Does not meet the
2	Log Normal	CS = 1.104	CS = 0.280	Does not meet the
		CV = 5.24	CK = 0.440	Does not meet the
3	Log Pearson III	CS ≠ 0	CS = 0.280	Does not meet the
		CV = 0.3	CV = 0.372	Does not meet the
4	Gumbel	CS ≤ 1.139	CS = 0.280	Approach
		CK ≤ 5.4	CK = 0.440	Does not meet the

Rainfall analysis plan with the type of spread gumbel selected to planthe flood discharge plan.

Table 1. Rain Plan with each repeat

No	Tr	Xt
1	10.00	221.936
2	25.00	250.308
3	50.00	279.714
4	100.00	295.290

Analysis of Draft Flood Peak Discharge Forecast

One of the final results of the Hydrological analysis is the estimated magnitude of the design flood discharge for a flood amount needed to calculate water buildings. This is expected if there is a flood of such magnitude not to damage the planned building. This flood discharge can be in the form of peak discharge, flood volume, high water level or hydrograph. In order to determine the flood discharge plan, analysis is carried out by several methods, among others; Rational, Der-weduwen, Haspers, Melchior.

No	Debit method	Q25 (m3/det)	Area (Km2)
1	Rasional	290.24	40 -80
2	Der-Weduwen	174.73	< 100
3	Haspers	544.77	< 100
4	Melchior	290.85	> 100
5	HSS Snyder	977.61	Medium Watershed
6	HSS Nakayasu	418.13	Medium Watershed

From the flood method of the plan analyzed, the Melchior method is selected and in accordance with the parameters of the Way Leman Watershed.

High Water Level Simulation with Program

HEC-RAS Computer

The simulation results showed that some cross-sections of the Way Leman River reviewed were unable to accommodate the flood discharge that occurred for a 25year repeat, because the elevation of the flood water level exceeded the elevation of the river cliffs.

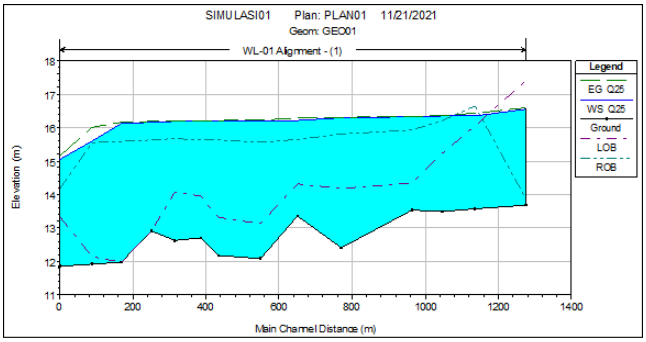


Fig.3 Cross section extending the riverWay Leman

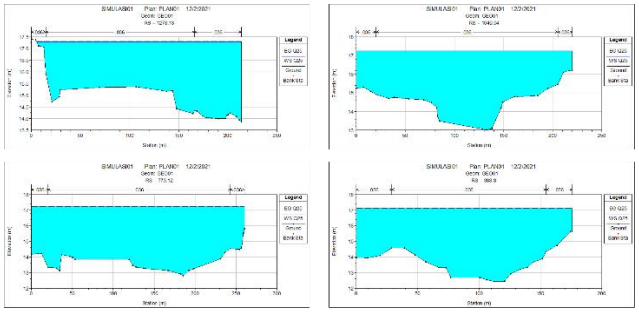


Fig.4 Some cross-sections the river Way Leman.

Flood Control System

In building planning activities, structurally requires the type and number of river construction buildings and their completeness with materials and numbers must be in accordance with their needs. Types of river construction that are reviewed from their usefulness .Common jobs are done including embankments.

Due to changes in the height of the water level that resulted in river flooding, the normalization of the riveris carried out. Handling floods by normalization is carried out on cross-sections of rivers whose capacity has not met the flood discharge that passes through.

After normalizing the conditions and strengthening the normalization condition of the Way Leman river as shown below.

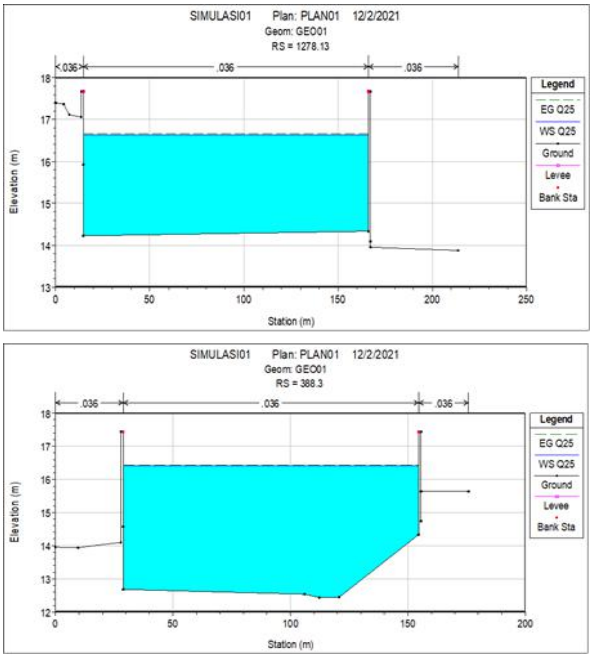


Fig.5 Cross-section of the Way Leman river after normalization

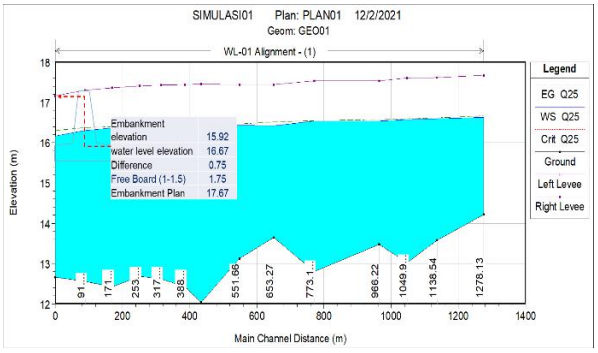


Fig.6 Normalization of rivers and embankment plans

Selection of strengthening type

The selection of slope retrofitting types that match the Way Leman River depends, among others, depending on the dimensions of the river, the speed of water currents, the cross-sectional shape of latitude, the slope of the riverbed, the depth of water, the type of soil to be protected, and the state of the foundation soil. Based on topographic conditions, hydrolysis, and the situation on the banks of the Way Leman River and geotechnical, the strengthening of the cliffs is planned with the Gravity Wall type.

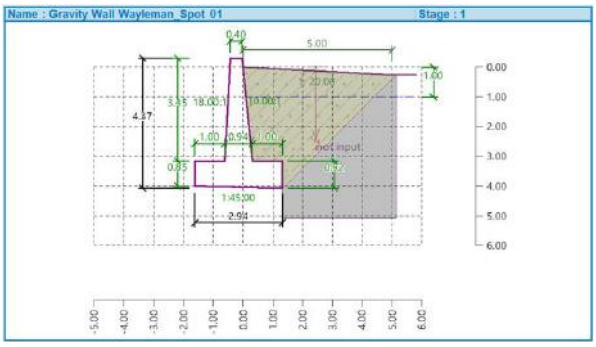
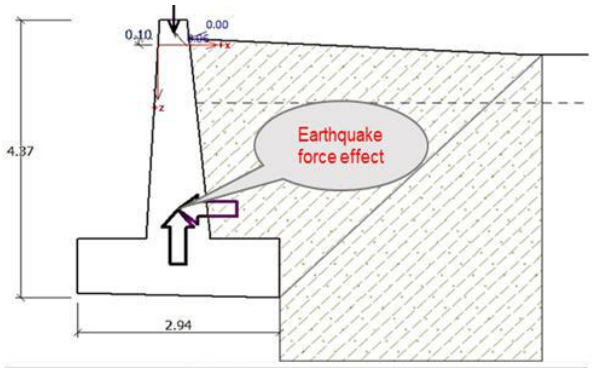
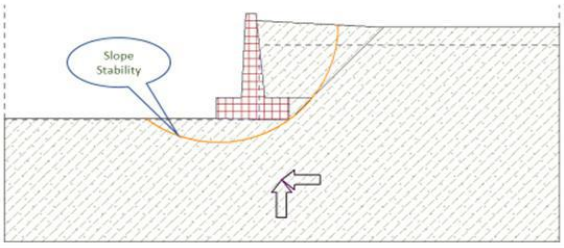


Fig.7 Gravity Wall Dimensions



Force	F_x [kN/m]	F_z [kN/m]	Applic. point x [m]	z [m]
Weight - wall	0.00	4.13	0.23	-0.19
Earthq.- constr.	-0.04	-0.04	0.23	-0.19
Active pressure	0.00	0.00	0.45	-0.10
Water pressure	0.00	0.00	0.45	-0.10
Earthq.- act.pressure	0.00	0.00	0.45	-0.10

Fig.8 Gravity Wall Dimension Review of Earthquake Load



Slope stability verification (Bishop)
Sum of active forces : F_a = 191.52 kN/m
Sum of passive forces : F_p = 231.92 kN/m
Sliding moment : M_a = 926.97 kNm/m
Resisting moment : M_p = 1020.46 kNm/m
Utilization : 90.8 %
Slope stability ACCEPTABLE

Fig.9 Gravity Wall Dimensions review of slopes.

V. CONCLUSION

1) From the results of cross-sectional simulation of the Way Leman river that uses the 25-Year Debit Plan with the Melchior Method, it can not accommodate the flood discharge that occurs because the elevation of the flood water level exceeds the elevation of the river bank.
2) In order to control the flood, the Way Leman river was normalized and made a river reinforcement building with a gravity wall type.
3) In addition to flood control with a structure, it can also be carried out in a non-structure such as watershed management, controlling erosion and sedimentation, regulation and the role of community

REFERENCES

[1] Queen Sukma Slat Tiny Mananoma, Jeffry S. F. Sumarauw., analysis of flood discharge and high water level of pinateduan river in the village of tatelu north Minahasadistrict. 2020
[2] Mohammad Bagus Ansori, Dian Ayu Ratnasari, and Bambang Sarwono. The Kalidawir River Flood Control Study 2015
[3] Koerner, M.K., "Construction and Geotechnical Methods in Foundation Engineering", McGraw-Hill. 1985
[4] Ministry of PUPR Directorate General of SDA BBWS Pemali Juana. 2016.
[5] Sam Yoel, Tivri Manthiq, Sriyana, Hari Nugroho., normalization of murky rivers and plompong bridge value techniques, brebesregency. 2017.
[6] Tutorial Manual HEC-RAS Version 5.0.7, www.hec.usace.army.mil, 2019.