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# Identification of Slope Stability Analysis

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***Abstract*— Landslide was natural events that most often occur in Indonesia. South Sumatra Province has a lot of areas susceptible to landslide risk. The aim of this study is to the identification of slope stability analysis. A adjustment in the constancy of a slope can be caused by several factors: geological conditions, high rainfall, and the topography. The research location in Muara Enim regency (Cases: SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja). The results of this research indicated Muara Enim-SP.Sugihwaras-Baturaja was the typology defined in this type of zone C because the area was included in the areas with slope 0 % to 20 %. The zone classification explained some of the caused landslides were natural factors, type of soil, and human activities. Natural factors such as heavy rainfall were 79-82 mm/month. Muara Enim regency conditions were a category of landslide because it was an area that had breccia rock types that were not compact and were weathered and bentonite clay that readily absorbs water. Based on the results of Slope/W analysis, safety factor (SF) in the case of SP. Sugihwaras-Muara Enim was 1.104 and the case of SP. Sugihwaras-Baturaja was 1.186. The value of SF was included in the criteria landslides where the SF less than 1.250.**

***Keywords*— slope stability; landslide; slope/w; safety factor (SF)**

## I. INTRODUCTION

Slope stability can be affected by various factors such as the effect of geological structure, the influence of nature of the rock/soil, water factor, human activities, geometry changes and others [1]. This research studied how far these factors could be affected the stability of the slope so that the landslide that occurred can be minimized.

Stability analysis of slope failure is analyzed by the corresponding method. Soil parameters and shear strength properties can influence the stability analysis. Also, a factor of weather and climate also affects the condition of the slopes due to changes in the degree of saturation and porewater pressure. So that identification of slope stability must be considered a type of slopes [2].

The unrestrained slope is a sloping ground surface at an angle to the horizontal plane [3]. Type slope consisting of natural and man-made slopes. The element of gravity is the cause of the condition of the ground is moving downwards due to the non-horizontal ground surface. If a component of gravity is large enough, slope failure can occur; that is, the soil mass in the zone can slide downward. The driving force overcomes the resistance from the shear strength of the soil along the rupture surface.

Reference [3] classified the slope failures into the following five major categories (Fig. 1). They were: (1) Fall is the detachment of soil and/or rock fragments that fall down a slope; (2) Topple is a forward rotation of soil and/or rock mass about an axis below the center of gravity of mass being displaced; (3) Spread is a form of slide by translation; (4) Flow is a downward movement of soil mass similar to a viscous fluid, and (5) Slide is the downward movement of a soil mass occurring on a surface of rupture.

Based hydrogeomorphology, the investigation area including lowland areas with slope ranging between 0 % - 20 % and with a height of 0 to 200 m above sea level. There are three factors causing the landslide [4] consists of (1) factor of natural conditions, natural conditions are a major factor in the occurrence of landslides; (2) factors type land movement; and (3) factor of human activity, human activities which were not friendly to nature causes a landslide.

Factor of natural conditions such as the slopes are relatively gentle with a slope 0-20%, the slopes of the mountains are composed of thick overburden is less than two (2) m, friable and easily escape the water, the area of the river bends to the slope of the riverbank is more than 40 %, The soil (rock) is generally a downhill slope composing composed of clay, rainfall over 70 mm/month, it often appears water seepage on the slopes, and the vegetation is formed from fibrous roots of plants.

Factors type land movement such as the movement of land that occurs in this area was generally in the form of soil creep resulting in cracks and ground subsidence and the movement was slow to intermediate with a speed of less than 2 m/day.

The factor of human activity, human activities which were not friendly to nature causes a landslide, such as the construction of heavy traffic and the drainage system is inadequate.

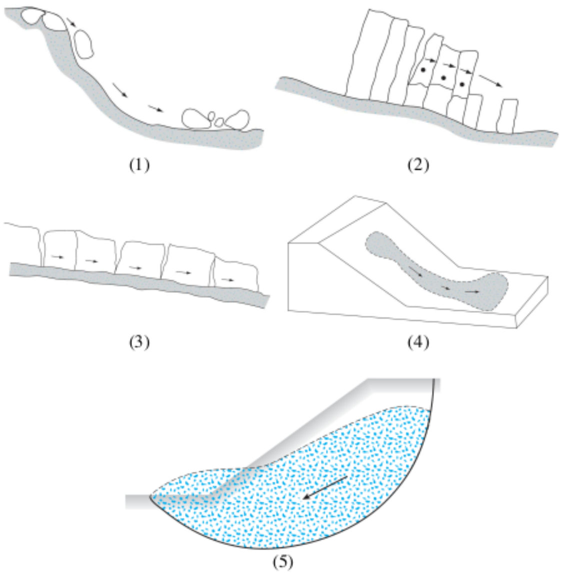


Fig. 1 Type of landslide

The task of the engineer charged with analyzing slope stability is to determine the safety factor (SF). The SF is defined as:

$$FS = \frac{\tau_f}{\tau_d} \tag{1}$$

The shear strength ($\tau_f$) of a soil can be defined as:

$$\tau_f = c' + \sigma' \tan \phi' \tag{2}$$

The safety factor value equal to 1 indicates that the slope is in critical condition. Slope stability design can be used if the safety factor value of 1.5. The safety factor (SF) value of slope stability is shown in Table 1[5].

TABLE I
THE SAFETY FACTOR (SF) VALUE OF SLOPE STABILITY

| SF | Condition |
|---|---|
| SF < 1.07 | unstable |
| 1.07 < SF ≤ 1.25 | critical |
| SF > 1.25 | stable |

Typology of potential landslide zone (Fig. 2) is divided into three parts [a]: Zone A, Zone B, and Zone C. Zone A is zone areas potential to landslide on the slopes of the mountain, mountainside, hillside, hillsides and riverbanks with slope > 40 %, with height above 2000 m above sea level. Zone B is zone area potential to landslide at the foot of the mountain, the foot of the mountains, foothills, foothills and riverbanks with slope ranging between 21-40 %, with a height of 500-2000 m above sea level. Zone C is zone area has the potential landslides in the highlands, low, riverbanks or river valley with slope ranges from 0-20 %, with an altitude of 0-500 m above sea level.

Influence on slope stability was the change of slope geometry as a result [6]. If the degraded material is deposited onto a road construction facility, the factor of safety of traffic could be affected. The shear strength of the slope can be reduced due to the weathering process and the process of disintegration of the material of the slope.

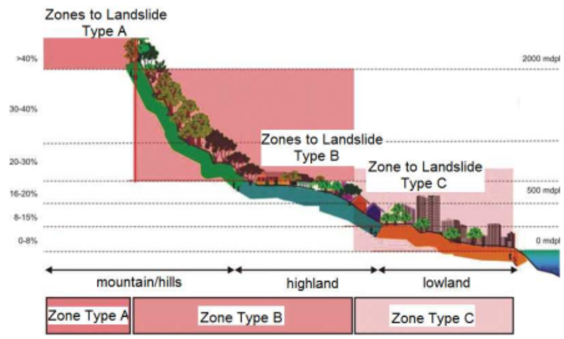


Fig. 2 Typology of the potential landslide zone

Based on [7], there were several methods have been developed for computing safety factor (SF). GEO5 slope stability software was also used to evaluate the stability of the Malin landslide in Pune [12]. Analysis of SLOPE/W 2007 program based on limit equilibrium formulations. However, analysis of finite element method based on finite element computed stresses [8]. The first method of slices formulated is Fellenius or Ordinary method. The Safety Factor (SF) is calculated by dividing the slip surface by gravitational driving forces. The formula of SF (Ordinary method) is:

$$FS = \frac{\sum [c\beta + N \tan \phi]}{\sum W \sin \alpha} = \frac{\sum S_{resistance}}{\sum S_{mobilized}} \tag{3}$$

Bishop method formulated an equation for the normal at the slice base in the 1950's. This method is summing slice forces in the vertical direction. Bishop method was analysis using circular failure surface. This analysis can be used for the analysis of existing slopes. Moreover, also no sign of the slope will landslide [9]. The function of safety factor (SF) based on the Bishop method is that the base average. Bishop method calculated the formula of SF condition no pore water pressure is:

$$FS = \frac{1}{\sum W \sin \alpha} \sum \left[ \frac{c\beta + W \tan \phi - \frac{c\beta}{FS} \sin \alpha \tan \phi}{m_\alpha} \right] \tag{4}$$

$$m_\alpha = \cos\alpha + \frac{\sin\alpha \tan\phi}{FS} \tag{5}$$

Janbu method is identical to the Bishop method. Janbu method was analysis all horizontal force equilibrium, but not all moment equilibrium. This method ignores the effect of shear interlaced so that the value of lambda (λ) is zero. Consequently, the safety factor (SF) based on Janbu method derived from force equilibrium curve where lambda is zero. So Janbu method can be used for all the entire horizontal force equilibrium. Janbu method considers factors of regular interslice forces. However, this method ignores interslice shear forces.

Morgenstern and Price (MP) developed a method similar to the Spencer method in1965. Morgenstern and Price method to analyze a variety of functions for interslice force functions. Such as (a) shear and regular interslice forces; (b) moment and force equilibrium, and (c) variety of user-selected interslice force function.

## II. Material and Method

### A. Literature Study and Data Collection

The data-data collected such as (1) Data of the location landslide; (2) Geological conditions; and (3) Landslide events that have been studied by previous researcher and landslides news from newspapers. Analysis of slope stability by using Slope/W 2007 program.

The research location in the case study: SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja. The location of research was shown in Fig. 3. Soil properties in this research were defined in Table 2.

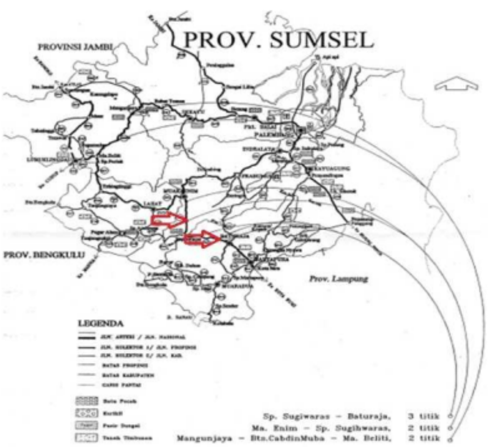


Fig. 3 Landslide location in Muara Enim Regency

TABLE II
SOIL PROPERTIES

| Soil Properties | | Symbol | SP. Sugihwaras-Muara Enim | SP. Sugihwaras-Baturaja |
|---|---|---|---|---|
| Soil | Layer 1 | ($\gamma$, kN/m$^3$) | 16.74 | 16.59 |
| | | (C, kPa) | 2.400 | 17.00 |
| | | ($\phi$, °) | 18.00 | 14.90 |
| | Layer 2 | ($\gamma$,kN/m$^3$) | 16.85 | 16.73 |
| | | (C, kPa) | 2.100 | 9.00 |
| | | ($\phi$, °) | 16.40 | 12.60 |

### B. Data Analysis

Identification of slope stability analysis was essential in this research. Based on the collected data then analyzed the cause of landslide according to [4]. After that, calculation using program Slope/W. The case studies had been used in this research as SP. Sugiwaras-Muara Enim and SP. Sugihwaras-Baturaja in Muara Enim regency, South Sumatra Province. The calculation of slope stability analysis had been done by using Slope/W program due to the factor of water, geometry, and changes in soil properties.

The calculation of safety factor (SF) from slope stability analysis had been done under the factor of the water by using program Slope/W in a case study with three conditions. Condition 1 was the initial condition occur landslides (Ground Water Tabel, GWT layer 1:489 m and the GWT layer: 496 m). Condition 2 (GWT layer 1: 489 m and the GWT layer: 498 m). Condition 3 (GWT layer 1: 491 m and the GWT layer: 500 m).

Analysis of slope stability due to human activity/effect of the geometry also was done in three conditions. Condition 1 is the initial condition landslide. In the second condition occurs cutting the cliff to widen the road. Moreover, the third condition of the slope geometry is converted to a gentle slope.The analysis was calculated using the program Slope/W. This analysis based on the factor of soil properties in four conditions (Table 3 and 4).

In the case study landslide initial condition with the data layer 1 c = 2.4 kPa, $\phi$ = 18° and layer 2 c = 2.1 kPa, $\phi$ = 16.4°. On condition two: a data layer 1 c = 4.8 kPa, $\phi$ = 18° and layer 2 c = 2.1 kPa, $\phi$ = 16.4°. While the condition three: a data layer 1 c = 2.4 kPa, $\phi$ = 18° and layer 2 c = 2.1 kPa, $\phi$ = 21°. Landslide condition 4 assumes the value of the friction angle $\phi$ = 0° and in the layers assumes layer 1 c = 2.4 kPa, $\phi$ = 0° and layer 2 c = 2.1 kPa, $\phi$ = 0°.

Beside of that, the case study landslide in SP. Sugihwaras-Baturaja: Condition 1 is the initial condition with the data layer 1 c = 17 kPa, $\phi$ = 14.9° and layer 2 c = 9 kPa, $\phi$ = 12.6°. On two conditions: a data layer 1 c = 19 kPa, $\phi$ = 14.9° and layer 2 c = 14 kPa, $\phi$ = 12.6°.

While the conditions three: a data layer 1 c = 17 kPa, $\phi$ = 17° and layer 2 c = 9 kPa, $\phi$ = 14.6°. Landslide condition 4 assumes the value of the friction angle $\phi$ = 0° and in layers assumes layer 1 c = 17 kPa, $\phi$ = 0° and layer 2 c = 9 kPa, $\phi$ = 0°. Fig. 4 and 5 show the case study using Slope/W.

TABLE III
SOIL PROPERTIES FOR SLOPE STABILITY ANALYSIS
(SLOPE/W) IN SP. SUGIHWARAS-MUARA ENIM

| Case Study SP. Sugihwaras-Muara Enim | | | | | |
|---|---|---|---|---|---|
| Soil | | Condition | | | |
| | | 1 | 2 | 3 | 4 |
| 1 | c (kPa) | 2.4 | 4.8 | 2.4 | 2.4 |
| | $\phi$ ($^0$) | 18.0 | 18 | 18.0 | 0.0 |
| 2 | c (kPa) | 2.1 | 2.1 | 2.1 | 2.1 |
| | $\phi$ ($^0$) | 16.4 | 16.4 | 21.0 | 0.0 |

TABLE IV
SOIL PROPERTIES FOR SLOPE STABILITY ANALYSIS
(SLOPE/W) IN SP. SUGIHWARAS-BATURAJA

| Case Study SP. Sugihwaras-Baturaja | | | | | |
|---|---|---|---|---|---|
| Soil | | Condition | | | |
| | | 1 | 2 | 3 | 4 |
| 1 | c (kPa) | 17.0 | 19.0 | 17.0 | 17.0 |
| | $\phi$ ($^0$) | 14.9 | 14.9 | 17.0 | 0.0 |
| 2 | c (kPa) | 9.0 | 14.0 | 9.0 | 9.0 |
| | $\phi$ ($^0$) | 12.6 | 12.6 | 14.6 | 0.0 |

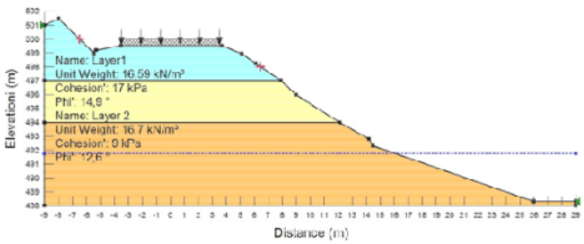


Fig. 4 Cross section in case study SP. Sugihwaras-Baturaja

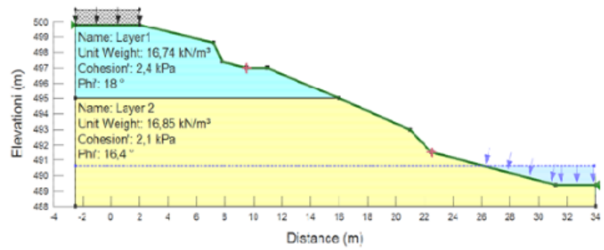


Fig. 5 Cross section in case study SP. Sugihwaras-Muara Enim

Fig. 6 The research location in SP. Sugihwaras-Muara Enim

Fig. 7 The research location in SP. Sugihwaras-Baturaja

TABLE V
IDENTIFICATION OF LANDSLIDE LOCATIONS IN MUARA ENIM REGENCY, SOUTH SUMATRA PROVINCE

| Roads | STA (KM) | Location |
|---|---|---|
| Lahat -Muara Enim | 176 + 300 | Lebak Budi |
| | 195 + 400 | Padangbindu |
| | 189 + 600 | Mangunjaya |
| | 245 + 050 | Bts. Cabdin |
| SP. Sugih Waras-Muara Enim | 257 + 100 | Tanjung Enim |
| | 260 + 200 | Darma |
| | 261 + 200 | Matas |
| | 262 + 100 | Pandaenim |
| | 279 + 900 | Simpang Meo |
| | 189 + 400 | Sugihwaras |
| | 173 + 500 | Sugihwaras |
| | 280 + 000 | Sidodadi |
| SP. Sugih Waras-Baturaja | 281 + 400 | Bunya Mayang |
| | 273 + 700 | Bts. SP. Sugihwaras-Baturaja |
| | 275 + 900 | Bts. SP. Sugihwaras-Baturaja |
| | 280 + 000 | Baturaja Beringin |

TABLE VI
LANDSLIDE LOCATIONS IN MUARA ENIM REGENCY
SOUTH SUMATRA PROVINCE

| No. | Location | Formation |
|---|---|---|
| 1 | Tanjung Enim Village, Lawang Kidul Districts | QTk (Kasai formation) |
| 2 | Darmo Village, Lawang Kidul Districts | QTk (Kasai formation) |
| 3 | Matas Village | Tmpm (Muara Enim formation) |
| 4 | Pandanenim Village, Tanjung Agung Districts | Tma (Benakat water formation) |
| 5 | Simpang Meo Village, Tanjung Agung Districts | Breccia Rock Tuf Volcano(Qhv) |
| 6 | Sugihwaras Village, Rambang Districts | Breccia Rock Tuf Volcano (Qhv) |
| 7 | Sidodadi Village, Tanjung Abang Districts | Breccia Rock Tuf Volcano (Qhv) |

## III. RESULTS AND DISCUSSION

### *A. Identification of Landslide Location*

The landslide was natural events that most often occur in Muara Enim regency, South Sumatra Province. Fig. 6 and 7 show the situation landslides that had been occurred. Table 5 and 6 describes the location of areas landslides in Muara Enim regency, South Sumatra Province.The landslide location in SP. Sugih Waras-Muara Enim such as: Tanjung Enim, Darma, Matas, Pandaenim, Simpang Meo, Sugihwaras, and Sidodadi. Table 6 described that the formation in Sugihwaras was breccia rock.

### *B. Identification Landslide in Case Study (SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja)*

One of the causes of landslides was natural factors such as the influence of geological structure. According to the Department of Mines and Energy, Muara Enim regency was igneous rocks of andesite and bentonite. There were also rocky clay sedimentary rocks and breccia derived from the igneous rock fragment precipitated. Figure 8 showed an example of the breccia lithology at the landslide site.

Fig. 8 Breccia rock

The results of the analysis data of landslide in the case studies described in Table 7, 8, 9, 10, 11, 12 13, and 14. The analysis data using Slope/W program to determined the minimum safety factor (SF) based on a factor of water, geometry, and soil properties.

The value of safety factor (water) in SP. Sugihwaras-Muara Enim: Ordinary method (initial condition, SF=0.779), Bishop method (initial condition, SF=1.104), Janbu method (initial condition, SF=0.790), and Morgenstern-Price (MP) method (initial condition, SF=0.851). A case study in SP. Sugihwaras-Baturaja, the value of safety factor (water): Ordinary method (initial condition, SF=1.076), Bishop method (initial condition, SF=1.186), Janbu method (initial condition, SF=1.102), and Morgenstern-Price (MP) method (initial condition, SF=1.087).

Results of this research were the identification of the factors that cause susceptibility to landslides at two case studies (SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja). Identify the caused of the landslide was providing information on areas with the level of category to landslides.

TABLE VII
THE RESULTS OF SAFETY FACTOR (WATER)
IN SP. SUGIHWARAS-MUARA ENIM

| Safety Factor (SF) SP. Sugihwaras-Muara Enim | | | |
|---|---|---|---|
| **Method** | **1** | **2** | **3** |
| Ordinary/Fellenius | 0.779 | 0.768 | 0.737 |
| Bishop | 1.104 | 0.836 | 0.791 |
| Janbu | 0.790 | 0.780 | 0.739 |
| Morgenstern-Price (MP) | 0.851 | 0.835 | 0.790 |

TABLE VIII
THE RESULTS OF SAFETY FACTOR (WATER)
IN SP. SUGIHWARAS-BATURAJA

| Safety Factor (SF) SP. Sugihwaras-Baturaja | | | |
|---|---|---|---|
| **Method** | **1** | **2** | **3** |
| Ordinary/Fellenius | 1.076 | 1.045 | 1.018 |
| Bishop | 1.186 | 1.069 | 1.043 |
| Janbu | 1.102 | 1.081 | 1.054 |
| Morgenstern-Price (MP) | 1.087 | 1.070 | 1.044 |

TABLE IX
THE RESULTS OF SAFETY FACTOR (GEOMETRY)
IN SP. SUGIHWARAS-MUARA ENIM

| Safety Factor (SF) SP. Sugihwaras-Muara Enim | | | |
|---|---|---|---|
| **Method** | **1** | **2** | **3** |
| Ordinary/Fellenius | 0.779 | 0.747 | 1.299 |
| Bishop | 1.104 | 0.818 | 1.456 |
| Janbu | 0.790 | 0.762 | 1.320 |
| Morgenstern-Price (MP) | 0.851 | 0.818 | 1.456 |

TABLE X
THE RESULTS OF SAFETY FACTOR (GEOMETRY)
IN SP. SUGIHWARAS-BATURAJA

| Safety Factor (SF) SP. Sugihwaras-Baturaja | | | |
|---|---|---|---|
| **Method** | **1** | **2** | **3** |
| Ordinary/Fellenius | 1.076 | 1.070 | 1.247 |
| Bishop | 1.186 | 1.154 | 1.315 |
| Janbu | 1.102 | 1.095 | 1.220 |
| Morgenstern-Price (MP) | 1.087 | 1.154 | 1.311 |

TABLE XI
THE RESULTS OF SAFETY FACTOR (SOIL PROPERTIES)
IN SP. SUGIHWARAS-MUARA ENIM

| Safety Factor (SF) SP. Sugihwaras-Muara Enim | | | | |
|---|---|---|---|---|
| **Method** | **1** | **2** | 3 | **4** |
| Ordinary/Fellenius | 0.779 | 1.054 | 0.875 | 0.178 |
| Bishop | 1.104 | 1.127 | 0.959 | 0.178 |
| Janbu | 0.790 | 1.056 | 0.889 | 0.179 |
| Morgenstern-Price (MP) | 0.851 | 1.125 | 0.959 | 0.178 |

TABLE XII
THE RESULTS OF SAFETY FACTOR (SOIL PROPERTIES)
IN SP. SUGIHWARAS-BATURAJA

| Safety Factor (SF) SP. Sugihwaras-Baturaja | | | | |
|---|---|---|---|---|
| **Method** | **1** | **2** | **3** | **4** |
| Ordinary/Fellenius | 1.076 | 1.244 | 1.149 | 0.688 |
| Bishop | 1.186 | 1.260 | 1.166 | 0.688 |
| Janbu | 1.102 | 1.267 | 1.174 | 0.721 |
| Morgenstern-Price (MP) | 1.087 | 1.261 | 1.166 | 1.166 |

TABLE XIII
RESULTS OF ANALYSIS DATA
IN SP. SUGIHWARAS-MUARA ENIM

| Safety Factor (SF) SP. Sugihwaras-Muara Enim | | | |
|---|---|---|---|
| **No.** | **Factor of Landslide** | **Category*** | **Criteria** |
| 1 | Natural Factor<br>a. Geometry<br>b. Rainfall<br>c. Geology Structure<br>d. Vegetation | <br>No<br>Yes<br>Yes<br>No | <br>< 25 % is 16,4 %<br>79 mm/month<br>Sediment Rock<br>- |
| 2 | Soil Type | Yes | Silty Clay |
| 3 | Human Activities | Yes | Drainage System Inadequate |

*category: Landslide (Yes); Stable (No)

TABLE XIV
RESULTS OF ANALYSIS DATA
IN SP. SUGIHWARAS-BATURAJA

| Safety Factor (SF) SP. Sugihwaras-Baturaja | | | |
|---|---|---|---|
| **No.** | **Factor of Landslide** | **Category*** | **Criteria** |
| 1 | Natural Factor<br>a. Geometry<br>b. Rainfall<br>c. Geology Structure<br>d. Vegetation | <br>No<br>Yes<br>Yes<br>No | <br>< 25 % is 16,4 %<br>82 mm/month<br>Sediment Rock<br>- |
| 2 | Soil Type | Yes | Silty Clay |
| 3 | Human Activities | Yes | Not Have Drainage System |

*category: Landslide (Yes); Stable (No)

The value of safety factor (SF) of two case studies (SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja) were affected by water, geometry, and soil properties. Several factors caused landslides due to natural factors such as slope and rainfall based on the regulation of the minister of public works No.22/PRT/M/2007 [4].

The slope (ϕ) was 16,4$^{o}$ in SP. Sugihwaras-Muara Enim. Based on [4], the typology of the case study (SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja) defined of zone C because the area was included in the areas with a slope of 0 % to 20 %. Heavy rainfall in November (2012) also causes of the landslide of the case study (SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja). Rainfall reached 79-82 mm/month based on Meteorology Climatology and Geophysics Council (BMKG).

In Nilgiris, heavy rains, steep slope, flooding on the slope and improper land use were significant of landslide [13]. The landslide case in Nilgiris is standard in both the southeast and northeast monsoons. Gentle or steep or slopes, vegetated or not vegetated, are all susceptible to landslide continuous over saturation due to heavy rain.

Beside of that, a case study in [9] described the effect of cutting on an initial slope on its stability. Factors need to be considered in this case study is changes in geometry. Furthermore, changes in shear strength parameters are also analyzed. This analysis correlates with the strain caused by the movement of the slope face.

The case study in [10] from Wollongong region New South Wales Australia. This case study illustrates monitoring data on landslide movements and pore water pressures. The result of this analysis can be used for updating risk and hazard. Effect of rainfall should be analyzed because it can cause landslides. The results of this analysis give much information for the identification of landslides. So landslides that occur can be minimized.

Furthermore, reported 126 factor of safety (FOS) based on Limit Equilibrium Methods (LEM). The calculation used parameters such as unit weight, angle, coefficient of cohesion, internal angle of friction, and height. The results of FOS calculated using a fuzzy logic system. The analysis of this research determined an accurate value of FOS.

## IV. CONCLUSIONS

Identification, the factors of a landslide of the slope stability (case study: SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja), was providing information on areas with the level of the category to landslides.

Factors that caused landslide in Muara Enim (case study: SP. Sugihwaras-Muara Enim and SP. Sugihwaras-Baturaja) was due to the factor of soil/rock, the water factor, geological factors, and human activities. The results of this research indicated that the typology defined in this type of zone C because the area was included in the areas with a slope of 0 % to 20 %.

The primary factor at both locations that caused landslide high rainfall where the SP. Sugihwaras-Muara Enim rainfall up to 79 mm/month and location SP. Sugihwaras-Baturaja reached 82 mm/month.

Conditions Muara Enim regency was a category of landslide because it was in an area that has breccia rock types that were not compact and weathered, and bentonite clay that readily absorbs water.

Results of Slope/W 2007 analysis (Bishop method), safety factor (SF) in the case study of SP. Sugihwaras-Muara Enim was 1.104 and the case study of SP. Sugihwaras-Baturaja was 1.186.

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