EFFECT OF BEDDING PLANES ON SLOPE STABILITY IN COAL OPEN MINE PT. PAMAPERSADA NUSANTARA DISTRICT ASMI, CENTRAL KALIMANTAN

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ABSTRACT

Bedding planes are one of the distinctive features of an open coal mine. The presence of the bedding planes can be a slip surface on a slope that has a dip direction relatively in the same direction as the bedding planes. Kinematic analysis for open pit slopes is one important aspect of the influence of the bedding planes in minimizing the occurrence of landslides. The purpose of this research is to explain the effect of the presence of bedding planes on slope stability. The method used is secondary data collection, field observations, and kinematic analysis. The results showed that the slopes of the study area were composed of sandstone, claystone, siltstone, carbonaceous claystone, and coal. Carbonaceous claystone as a weakly layer. The rock bedding area on this slope has a strike/dip N 288 ° E / 17 °, while the slope of the research has an overall slope 29 ° and a slope dip direction N 15 ° E. The dip direction value that is relatively unidirectional between the bedding planes and the slope of the research with a difference of 3 ° can be the cause of the slip surface and is prone to landslides. Thus, the slopes of the study area have the potential plane failure so that geotechnical engineering is needed in the next mining process to ensure slope stability.

Keyword: bedding planes, kynematic analysis, slope stability

INTRODUCTION

The stability of rock slopes is often significantly influenced by the structural geology of the rock in which the slope is excavated. Structural geology refers to naturally occurring breaks in the rock such as bedding planes, joints and faults, which are generally termed discontinuities (Wyllie and Mah, 2004).

Almost all rock slope stability studies should address the structural geology of the site, and such studies involve two steps as follows. First, determine the properties of the discontinuities, which involves mapping outcrops and existing cuts, if any, and examining diamond drill core, as appropriate for the site conditions. Second, determine the influence of the discontinuities on stability, which involves studying the relationship between the orientation of the discontinuity and the face (Wyllie and Mah, 2004).

Typical plane failure in a rock slope where a block of rock has slid on a single plane dipping out of the face. In order for this type of failure to occur, the following geometrical conditions must be satisfied :

a. The plane on which sliding occurs must strike parallel or nearly parallel (within approximately ±20°) to the slope face.
b. The sliding plane must "daylight" in the slope face, which means that the dip of the plane must be less than the dip of the slope face, that is, $\psi p < \psi f$.
c. The dip of the sliding plane must be greater than the angle of friction of this plane, that is, $\psi p > \varphi$.
d. The upper end of the sliding surface either intersects the upper slope, or terminates in a tension crack.
e. Release surfaces that provide negligible resistance to sliding must be present in the rock mass to define the lateral boundaries of the slide. Alternatively, failure can occur on a sliding plane

E-ISSN : 2579 – 3136

passing through the convex "nose" of a slope (Wyllie and Mah, 2004).

The presence of the bedding planes in the research area in Barunang, Kapuas Tengah District, Kapuas Regency, Central Kalimantan can trigger slope instability so a kinematic analysis is needed to explain the effect of the presence of the bedding planes on slope stability

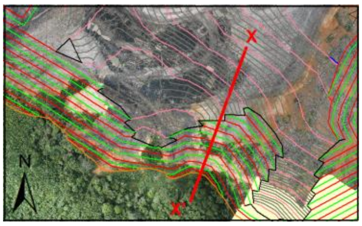

Figure 1. Location Map of Research Slope

RESEARCH METHOD

The method used in this research is the collection of related secondary data such as rock mass properties, field observations by identifying discontinuity plane in the form of bedding planes, and kinematic analysis to explain the effect of the presence of the bedding planes and calculating the percentage of landslides with the help of Dips 6.0 software and based on the results of interpretation by referring to existing theories.

RESULT AND DISCUSSION

Stratigraphy

Stratigraphy is the science of describing rock layers. This stratigraphic data is used as a reference for the rocks that compose a slope and is correlated with the subsurface coal model. The rock slopes of the study are composed of sandstone, claystone, siltstone, carbonaceous claystone, and coal. In general, the rock description is as follows :

a. Sandstone

Sandstones are fresh gray in color, weathered brownish gray, fine - coarse sand grain size, good sorting, matrix supported, hard.

Figure 2. Close-up of Sandstone.

b. Claystone

Claystone is fresh colored blackish gray, weathered brownish gray, the size of the clay grains, soft to brittle.

Figure 3. Close-up of Claystone.

c. Siltstone

Siltstone is fresh gray in color, weathered whitish gray, silt grain size, good sorting, matrix supported, brittle.

Figure 4. Close-up of Siltstone.

d. Carbonaceous claystone

Carbonaceous claystone is fresh blackish gray, weathered brown, clay grain size, carbonate, contains organic material, soft to brittle.

E-ISSN : 2579 – 3136

Figure 5. Close-up of Carbonaceous claystone.

Figure 6. Close-up of Coal.

e. Coal

Coal is black in color with a slightly brilliant to brilliant luster (60% - 90%), black scratch, hard, strong resistance to blows, irregular fractions, good sorting, impurities in the form of amber, sandstones, and siltstone.

Discontinuity Plane

The research slope is composed of sedimentary rock so that it has a layered appearance. The bedding planes can act as a discontinuity that triggers slope instability.

Figure 7. Appearance of Bedding Planes

The identification of these bedding planes produces the following strike/dip values :

Table 1. Strike/Dip Bedding Plane

No	Strike	Dip
1	334	22
2	294	13
3	285	18
4	287	17
5	325	15
6	293	24
7	337	23
8	265	14

Characteristics of Rock Mass

In performing the kinematic analysis of a slope, the rock mass value is required, especially the friction angle (φ) of the rock making up the slope. Besides, the UCS value and rock cohesion will affect, especially in terms of slope safety factor analysis. The following is the value of the friction angle (φ), cohesion, and UCS obtained from secondary data from the company's laboratory test results.

Table 2. Rock mass value

Lithology	(φ)	UCS (Mpa)	c (Mpa)
Claystone	9.63	2.25	0.31
Sandstone	17.27	15.74	0.45
Siltstone	15.35	11.93	0.43
Coal	26.98	14.6	0.066
Carbonaceous claystone	15.85	1.15	0.045

E-ISSN : 2579 – 3136

Kynematic Analysis

The kinematic analysis was performed by collecting strike dip data from bedding planes in the field. This is due to the possibility of landslides when slopes are formed according to the yearly design caused by the relatively unidirectional dip direction between the bedding plane and the slope. The location of the collection is at coordinates E 114°22'37,8" and S 1°00'13,1". Measurement of strike dip in the bedding planes is carried out at every contact of the rock bed exposed in the field. Besides, strike and dip direction measurements were made from the yearly design of the PNI Pit slope with a slope height of 53.2 m, strike face of the slope N 285°E, dip direction N 15°E and an overall dip slope of 29°.

Data processing for kinematic analysis using the Dips 6.0 application. Obtained percentage probability of landslide from the slope by entering the value of bedding plane strike dip, friction angle, slope dip, and slope dip direction. The following is the result of the kinematic analysis.

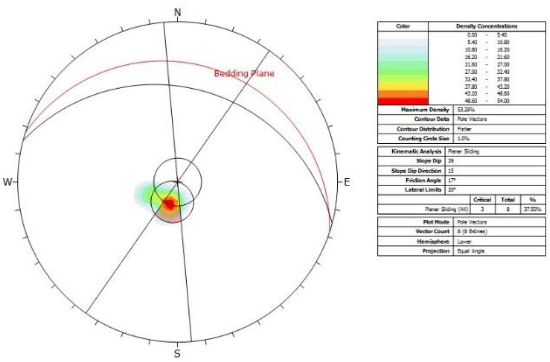

Figure 8. Kinematic Analysis Processing Results

Based on the results of the stereonet projection, it shows that there is one pole pile from the measured bedding planes, while the average strike dip value of the bedding planes area is N 288 ° E / 17 °. The strike dip value of the bedding planes is relatively in line with the strike face of the slope with a difference of 3 °, the dip value of the bedding planes is 17 ° which is smaller than the yearly design dip overall slope which has a value of 29 °. Therefore, it can be interpreted that there is a potential plane failure on this slope (Hoek and Bray, 1981) with the direction of the landslide relative to the north - northeast with a landslide probability of 37.50% of the total 8 strike dip data in the bedding planes. The plane failure can be used as a reference in determining the yearly design and the form of landslides in slope stability analysis.

CONCLUSION

Based on the analysis, the slope of the research has a potential plane failure caused by the presence of the bedding planes which has a dip direction that is relatively in the same direction as the slope. This landslide has greater potential when there is tension crack on the slope surface and it is water-saturated. With the consideration of the results of this analysis, there are two recommendations to minimize the occurrence of plane failure, namely by assuming the overall slope with a dip value equal to that of the bedding planes dip, namely 17 ° or changing the slope design by redesigning the dip direction of the slope from N 15 ° E to N 354 ° E.

ACKNOWLEDGEMENT

Thanks to PT. Pamapersada Nusantara and all those who have helped in this research activity, as well as lecturers of the Faculty of Geological Engineering, Padjadjaran University.

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E-ISSN : 2579 – 3136