LOWWALL SLOPE STABILITY OF PANEL 32 AND PANEL 36 PT. XYZ, SOUTH KALIMANTAN

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ABSTRACT

The research was conducted in the coal mining area of PT. XYZ, South Kalimantan. The goal of the study is create a geological model for each cross-section according to the characteristics of materials and determine of lowwall slope stability. Researcher calculated the slope stability using Morgenstern-Price method with Rocscience Slide2 software. The geological conditions of the study area are composed of alternating sandstones with coal-inserted claystone and coal-inserted claystone from the Warukin Formation. Material properties at the study area are composed of sandstone, claystone, and coal. The lowwall slope panel 32 has a safety factor value of 1.081, according to the results of the slope stability simulation, whereas the slope of lowwall panel 36 has a safety factor value of 1.107.

Keywords : Coal, factor of safety, Morgenstern-Price, slope stability.

INTRODUCTION

Slope stability is the ability of a slope to maintain this stable condition which is influenced by geological conditions, slope geometry, groundwater conditions, climate, and human activities. Disturbed slopes certainly have the potential to cause landslides due to an imbalance of forces on the slopes.

If the slope is in an equilibrium position and gets disturbances, especially those can affect the slope stabilty. It will make the slope condition unbalanced and that the slope will seek a new equilibrium condition with a mechanism in the form of landslides.

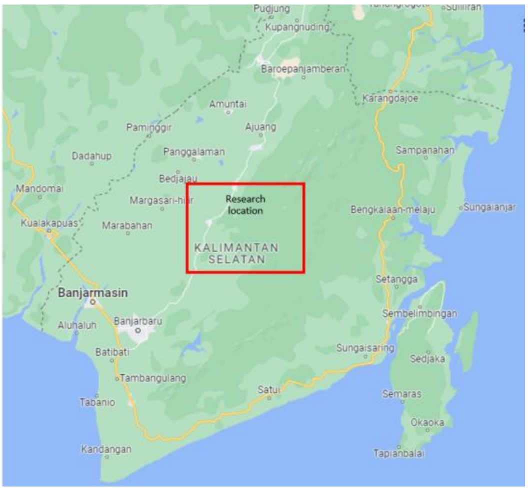

Figure 1. Research location (Google maps, 2023)

Slope stability research was carried out in the PT. XYZ, about 100 kilometers northeast of Banjarmasin. An open pit mining system is used for all mining operations.

RESEARCH METHODS

Research was conducted by simulating the measurement of the actual lowwall slope factor values in the PT. XYZ with simplified limit equilibrium method used in Panels 32 and 36 overlooks the stress-strain relationship on the slopes in favor of static equilibrium conditions. The Morgenstern-Price approach, which takes both vertical and horizontal forces into account when computing slope stability, is used to mimic slope stability.

$$\mathrm{F} = \frac{resisting\ force}{driving\ force} \qquad (2.1)$$

$$\mathrm{F} = \frac{\sum (\mathrm{c}' \,.\, \mathrm{L}) + \tan \phi' + (\mathrm{W} \cos \alpha)}{\sum \mathrm{W} \sin \alpha} \qquad (2.2)$$

with :

F = factor of safety (without units)
c' = effective cohesion (kN/m^2)
L = length of the slip plane segment (m)

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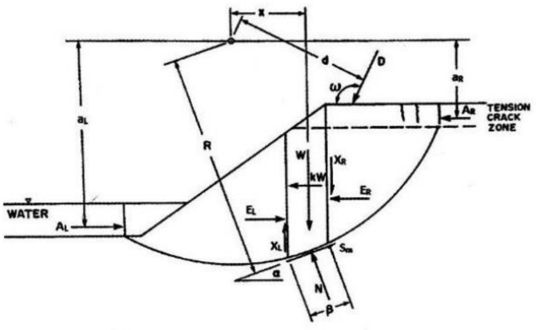
W = weight above the L segment (tons)
ϕ' = effective internal friction angle (°)
α = angle of slip plane (°)



$$F = \frac{\sum_{i=1}^{n}[c'\beta + (N - u\beta)\tan\phi']R}{\sum_{i=1}^{n}[WR\sin\alpha + kW(R\cos\alpha - h_c)] \pm [Dd] \pm [Aa]}$$

Figure 2. Schematic analysis of the slice method at limit equilibrium (Morgenstern & Price, 1965 in Takwin, 2017) Schematic analysis of the slice method at the limit equilibrium, where the resisting forces which can be described as *c, β, N, μ* and *R* are divided by the driving forces involving *W, α,* and *h* (Morgenstern & Price, 1965 in Takwin, 2017)

Material properties figure as input values were obtained from the Department of Mining Operations Engineering Division of PT. XYZ. The analysis was carried out to find how much the lowwall slope safety factor is by making the modeled slope geometry according to the actual conditions in the field. Input material properties data is according to the data and result of analysis that has been obtained.

RESULT AND DISCUSSION

This research was conducted on the lowwall slopes of Panel 32 and Panel 36 PT. XYZ, South Kalimantan. In general, the study area is included in the Barito Basin with rock characteristics that generally have a strike direction 160 - 210° and dip 20-35°.

Geological Condition

In general, the study area is composed of alternating sandstone with coal-inserted claystone and coal-inserted claystone originating from the Warukin Formation. This formation was deposited in a shallow marine environment at the beginning of sea shrinkage (regression) during the Tertiary period (Djohor, 2009) which is composed of siltstone, sandstone, and coal. The existence of a regression process in shallow seas allows silt, sand, and coal to be deposited with a laminated structure.

Novita (2016) which states that in the study area, the Warukin Formation was deposited starting from the upper delta plain to vertically changing to a flood plain and then to a lower delta. This is characterized by an increase in the thickness of the coal seams and then the thinning of the coal seams accompanied by the thickening of the sandstones with an intense laminated structure.

a. Alternation of Sandstone and Coal Inserted Claystone

   Based on observations in the field, outcrops are alternating between claystone and coal, the color of the outcrops is yellowish-brown, locally it is gray. The outcrop with a height of 8 meters and a width of approximately 42 meters has a strike direction 204° and a slope of 29°. This grain size approximately fine sand with angular grain shape; good permeability; well sorted, there are laminated structures alternating with claystone with a thickness of 35-40 cm. There are coal inserts in the claystone with a thickness of 25-55 cm. The outcrop has slope 70°.

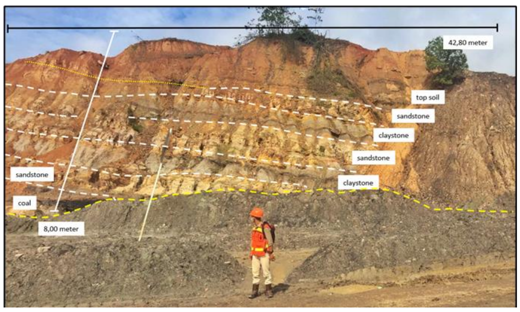


Figure 3. Coal-inserted sandstone and claystone outcrops, azimuth image 280°

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b. Coal-inserted Claystone

Based on observations in the field, outcrops are alternating between claystone and coal, and the color of the outcrops is light to dark gray. The outcrop with a height of 6 meters and width of approximately 52 meters has a strike 192° and dip 20°. The claystone are well sorted, there is a layered layer of coal with a thickness of 20 - 90 cm. The outcrop has a slope of 70°.

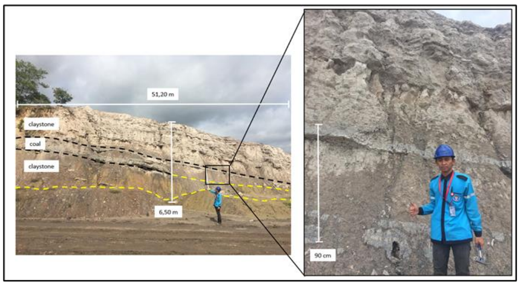

Figure 4. Outcrop of alternating claystone and coal, azimuth image 295°

Characteristics of Mass Properties

Data on rock mass characteristics such as cohesion (c), angle of internal friction (ϕ), and bulk density (γ). The data obtained through a geotechnical drilling and direct shear laboratory tests to determine the rock mass characteristic.

Slope Stability Simulation

From the results of slope stability simulation use Rocscience Slide2 software, factor of safety is carried out by adhering to the regulation of the Decree of the Minister of Energy and Mineral Resources (ESDM) No. 1827 K/30/MEM/2018 concerning Guidelines for the Implementation of Good Mining Practice where the slope studied is the overall slope with medium landslide severity.

Panel 32

From the results of make design of lowwall slope sections in panel 32 with a slope height of 200 meters, it is known that the slope is in the same direction with the seam of coal. The simulation results show that the actual slope is 15° has a safety factor value of 1.081. This slope refers to the regulation of Minister of Energy and Mineral Resources Decree No. 1827 K 30 MEM 2018 included an almost safe slope.

Panel 36

From the results of make design of lowwall slope sections in panel 36 with a slope height of 200 meters, it is known that the slope is in the same direction with the seam of coal. The simulation results show that the actual slope with a slope of 15° has a safety factor value of 1.107. This slope refers to the regulation of Minister of Energy and Mineral Resources Decree No. 1827 K 30 MEM 2018 included an safe slope.

CONCLUSION

Geological conditions of the study area are composed of alternating sandstones with coal-inserted claystone and coal-inserted claystone originating from the Warukin Formation. Material properties at the study site are composed of sandstone, claystone, and coal. The simulation results in panel 32 show that the actual slope with a slope of 15° has a safety factor value of 1.081. Meanwhile, the simulation results on panel 36 show that the actual slope with a slope of 15° has a safety factor value of 1.107.

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REFERENCES

Anonim. (2018). Keputusan Menteri Energi dan Sumber Daya Mineral No. 1827

K/20 MEM/2018 tentang Pedoman Pelaksanaan Kaidah Teknik Pertambangan yang Baik.

Arif, I. (2016). Geoteknik Tambang : Mewujudkan Produksi Tambang yang Berkelanjutan dengan Menjaga Kestabilan Lereng. Gramedia Pustaka Utama.

Chang, Y. M., Lau, C. K. (2008). Slope Stability Analysis and Stabilization New Methods and Insight. Library of Congress Cataloging, China.

Haris, V. T., Lubis, F., Winayati. (2018). Nilai Kohesi dan Sudut Gesek Tanah Pada Akses Gerbang Selatan Universitas Lancang Kuning. SIKLUS : Jurnal Teknik Sipil Vol 4 No. 2 : 123 - 131.

Heryanto, R., Sanyoto, P. (1994). Peta Geologi Lembar Amuntai, Kalimantan. Pusat Penelitian dan Pengembangan Geologi Republik Indonesia. Badan Geologi.

Hoek, E. Bray, J. W. (1981). Rock Slope Engineering 3rd edition. The Institution of Mining and Metallurgy, London.

Martin, D., Stacey, P. (2018). Guidelines for Open Pit Slope Design in Weak Rocks. CRC Press.

Takwin, G. A., Turangan, A. E., Rondonuwu, S. G. (2017). Analisis Kestabilan Lereng Metode Morgenstern-Price : Studi Kasus Diamond Hill Citraland. Jurnal TEKNO Vol. 15 No. 67: 66 – 77.

Zakaria, Z. (2011). Analisis Kestabilan Lereng Tanah. Laboratorium Geologi Teknik, Program Studi Teknik Geologi Universitas Padjadjaran.

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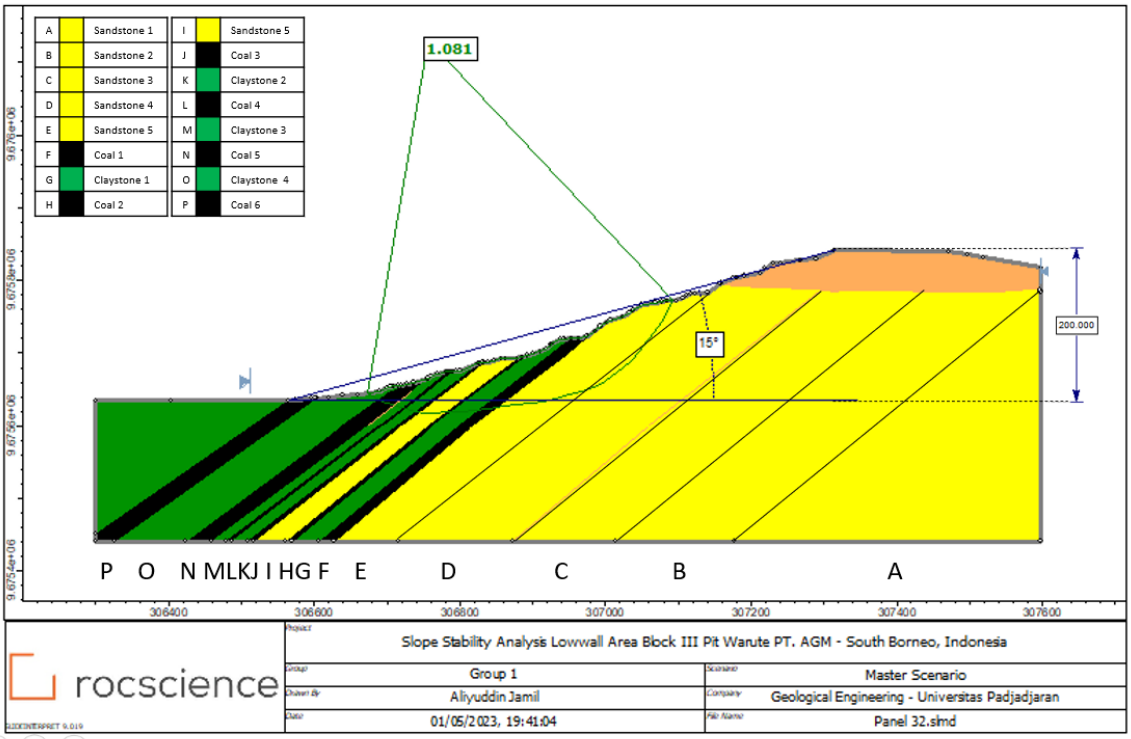
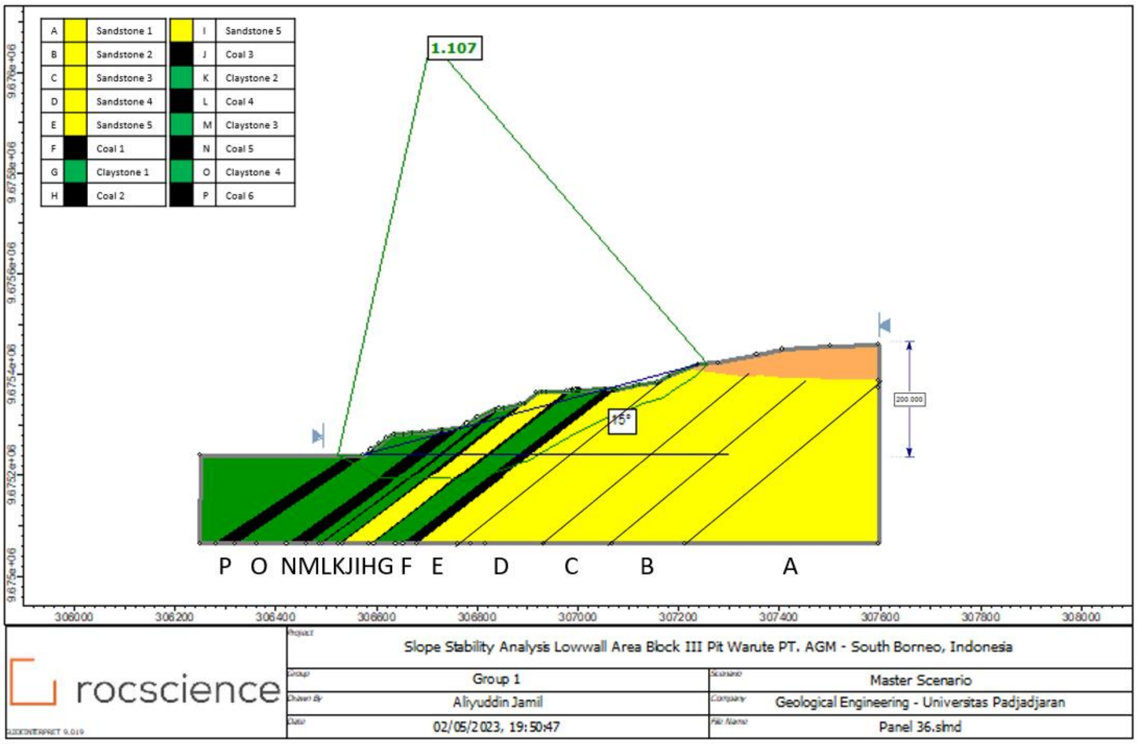
Appendix



Lowwall slope stability simulation results of panel 32, factor of safety is 1.081



Lowwall slope stability simulation results of panel 36, factor of safety is 1.107

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