LIMESTONE OPEN PIT MINING EXCAVATION SLOPE STABILITY ANALYSIS DUE TO DYNAMIC VIBRATION

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ABSTRACT

In the open pit mine limestone, particularly which is managed by the priority, design and slope stability is often not analyzed. However the slope stability problem in an open pit mine is a very important issue because it involves risks of human’s, mining equipment, and other infrastructure safety which is located around the quarry slopes. The dynamic vibration and wetting processes in the rainy season and drying processes in the dry season on rock mining area can lead cracks and crevices of rocks. Moreover, induce the existing discontinuities in the rock thus causing failure in slope excavation. The location of the study will be conducted at the location of limestone mining in the district Madura, Gresik, and Jember.

The research includes the influence of wetting-drying test on physical mechanical, and dynamic characteristics of rock (Unconfined Compressive Strength Test, Suction Test, Bender Element Test, Point Load Test, and Durability test). The analysis was also conducted for the chemical content of rocks in all study sites, where the results of chemical analysis can be used as a preliminary description of the strength of rocks. The results of physical, mechanical, and dynamic characteristics of rock will be used to analyze the stability of the excavation (from safety factor analysis). Furthermore, this analysis also uses a variety of dynamic vibration by modeling vehicle dynamic loads and earthquake dynamic load using Plaxis program.

The obtained results indicate that when viewed in terms of the rock density, the rocks in Jember locations are more solid than the rock at another location. In terms of void ratio, the void ratio of rocks in Jember is smaller than in Madura and Gresik. When viewed from the chemical content, the content of potassium (K), manganese (Mn) and copper (Cu) is only owned by rock in Jember. Most likely, the chemical content causes the strength of rocks in Jember is greater than in other locations. The test results using Bender Element with Dutta equipment, conclude that the average dynamic response of rock in Madura ($G_{\text{maks}} = 35689.14$ kPa) is smaller than the average dynamic response of rock in Gresik ($G_{\text{maks}} = 35714.71$ kPa). From the test results by using rock slaking equipment, it can be concluded that the slaking intensity of the average rock in Madura (Medium High Durability) is higher than the average slaking intensity of the rock in Gresik (Medium Durability). The vehicles in the mining area itself has a total weight of an average of 12,32 tonnes, amplitude of 0.0011, and frequency of 10 Hz. While, the calculations results of the excavation stability site in Gresik, stable condition is achieved when the mining height is 10
meter, maximum excavation angle is 70°; when the mining height is 20 meter, the 
maximum excavation angle is 50° and 30°. In Madura, a stable condition is achieved 
when the mining height is 10 meter and the maximum angle is 50°; when the mining 
height 15 meter, the maximum excavation angle is 30°. For the location of Jember, 
stable condition is achieved for all conditions of the excavation; for the excavation 
height is 5 meter until 45 m and excavation angle of 30° until 90°. The influence of 
wetting and drying processes have a significant impact on the parameters of negative 
pore water pressure in the rock but did not affect the physical and dynamic 
parameters of the rock.

From the results of numerical modeling of the stability of excavation due to a 
combination of dynamic vehicle load and earthquake dynamic loads by using Plaxis 
program, it can be concluded that there is no collapse of the mining of limestone 
quarrying in the three study sites: Jember, Gresik and Madura district (for height 5 
meter until 20 meter height and angle = 50° until angle = 90°)

**Key words:** Slope stability, Open mining, Dynamic load, Wetting-drying, Safety 