SLOPE STABILITY ANALYSIS IN THE SINDANG HEULA MAIN DAM SERANG, BANTEN

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Abstract

A dam construction is called good if it is able to holding back the dammed water rate with stable, which to achieve that condition requires some analysis, one of which is the slope stability analysis where the dam Sindang Heula which has fill dam type will be built later. The parameters that used in the calculation of this analysis are cohesion, the weight of the fill, the internal shear angle, and the water table and lithology. The lithology in the dam slope are dominated by Vithric Tuff and Lithic Tuff from Banten Tuff formation. Wich in that location is not passed by any fault so it is make slope stability analysis easier. Based on the laboratoratory analysis and geological analysis, which is then processed using SLOPE/W Software we found that the value of safety factor is 1.507.

Keywords: Slope of Main Dam, Slope Stability Analysis, Geological Characteristic

1. INTRODUCTION

Slope stability analysis is needed to determine the safety factor value of slope where the dam will be built later, that the safety factor value will be used as a countermeasures parameter in the dam construction, so it can be planned well and strong enough to hold the water. The calculation of security factor can be done by using SLOPE/W application based on Fellenius method to solve the problem in slope design in this application computation through computing that generates the value of the security factor by using algorithm logic Fellenius method run on SLOPE/W program. This feature provides flexibility for use in solving various technical geological problems such as landslide, dam construction, minding and etc. This research is purpose to know the safety factor of the slope as the basis in planning Sindang Heula Main Dam construction.

2. LITERATURE REVIEW

Fill Dam

According to Sosrodarsono (1974) The fill dams or embankment dams is a dam that built by hoarding materials such as stone, crude, gravel, sand, and soil in certain compositions with the function of lifting the water surface contained in the reservoir. While homogeneous fill dams If 80% of all dyestuffs are composed of graded materials and are water-resistant.

Safety Factor

In principle, on a slope there are two kinds of forces, namely: The force that makes the mass of the moving rock (driving force) and the force holding the rock mass (retaining force). A slope will slide if the driving force is greater than its holding force. Mathematically, the stability of a slope can be expressed in the form of a security factor (Fk), in which:
\[ F_k (\text{Safety Factor}) = \frac{\beta (\text{Retaining Force})}{q (\text{Driving Force})} \]

Fk > 1, the slope is considered stable.
Fk = 1, the slope is in equilibrium but will soon slide if it gets a bit of a nuisance.
Fk < 1, the slope is considered unstable.

Based on the research on slope safety factor, it is divided into 3 groups of Safety Factor (Fk) in terms of the intensity of its slide (Bowles, 1989), as shown in Table

<table>
<thead>
<tr>
<th>Safety Factor value</th>
<th>Landslide Intensity</th>
</tr>
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<tbody>
<tr>
<td>Fk &lt; 1,07</td>
<td>Landslide frequently (unstable slopes) Landslides have occurred (critical slopes) Landslides are rare (relatively stable slopes)</td>
</tr>
<tr>
<td>Fk = 1,07 - 1,25</td>
<td></td>
</tr>
<tr>
<td>Fk &gt; 1,25</td>
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**Fellenius Metode**
The Fellenius method is a method introduced by Fellenius (1927) used to analyze slopes on a slip surface that is shaped like a circular arc. This method is very well known in the analysis of slope stability due to the simple calculation, fast and gives the result of calculation of safety factor which enough accurate. This Fellenius method takes into account the component forces (horizontal and vertical) with due regard to the balance on the surface of the slip. The use of this method provides a more appropriate safety factor (SF) than other methods. The equations used in the Fellenius method are as follows:

\[ SF = \text{Safety Factor} \]
\[ W = \text{Content Weight} \]
\[ c' = \text{Cohesion} \]
\[ \phi' = \text{Natural Angle of Repose} \]
\[ \alpha = \text{Angle Slices} \]

![Figure 1. Fellenius Method Scheme](image)
3. METHODOLOGY
The research methods used in this research are:
1. Literature Review
   Literature review done by looking literature for supporting materials. Determining the boundaries of the problem so as not to expand, not out of the existing problems, and the data taken can be utilized effectively, research conducted along the main dam slope.
2. Data Collection
   Secondary Data:
   1) Cohesion
   2) Content Weight
   3) Natural Angle of Repose
   4) Ground Water Level
   5) Geological Data
   The supporty standard used are based on recommendations by Bowles (1989)

4. RESULT AND DISCUSSION
Based on the result of previous researchers analysis of the slope in Sindang Heula main dam is composed by two lithologies :
1) Vitric Tuff
2) Lithic Tuff

Based on the laboratory analysis for parameter in SLOPE/W:
1) Cohesion
   Vitric Tuff 0,1389 kPa and Lithic Tuff 0,2144 kPa, The difference in the value of cohesion between Vitric Tuff and Lithic Tuff results from differences in density and distance between molecules in rocks where Lithic Tuff has a closer molecule compared to Vitri c Tuff so it has a greater Cohesion value.

2) Content Weight
   Vitric Tuff 14,3 kN/m3 and Lithic Tuff 17,2 kN/m3, The difference in the Content weight of Vitric Tuff and Lithic Vitric content is due to the density of rocks where Lithic Tuff is denser than Vitric Tuff so it has a larger weight content value.

3) Natural Angle of Repose
   Vitric Tuff 31,3° and Lithic Tuff 46,8°
   Differences of Natural Angle of Repose In Vitric Tuff and Lithic Tuff result from differences in the resistance of a rock in accepting the external stress applied to the rock which is where the Lithic Tuff has a higher Natural Angle of Repose value because it has a stronger resistance

4) Ground Water Level
   No. Deep/Elevation Referensi
   1  -19,5/102.08 m Data Bor (BD 1)
   2  -9,5/92.92 m Data Bor (BD 2)
   3  0,95/82.85 m Data Bor (BD 3)
   Groundwater values obtained from drill log data on BD-1, BD-2 and BD-3 results from those values are influenced by the lithological differences in the research area in which the Groundwater Level is in the layer between Vitric Tuff and Lithic Tuff.

5) SLOPE/W Analysis
   Then after the inclusion of all laboratory analyzes and data required by SLOPE / W is used as an illustration of the slopes that will be the foundation of the main dam and using the Fellenius method as a parameter, the following security factors are obtained
Figure 2. Safety Factor Value of Sindang Heula Main Dam Slope

Based on the analysis of slope safety factor after insertion of parameter values from the Natural Angle of Repose (phi), Cohesion (c), Ground Water, and Weight of Contents, From the SLOPE / W program obtained a security factor value of 1.507 which is above the safety factor (FK = 1.25 ) according to Bowles (1989). So it can be concluded on the right slope of the main dam is relatively stable.

5. CONCLUSION
From the research that has been done on the slope at Sindang Heula Main Dam of banten province, it can be concluded that:
1. Geological and geotechnical investigation are very important things as parameter for planning the dam construction, it can be determined what type of rock that use as basement for dam construction.
2. Based on the analysis from SLOPE/W, the research area has a security factor value of 1.507, which is above the safety factor (FK=1.25) according to Bowles (1989).
3. Drill log data is very needed in this research that used to get analysis laboratory data.

6. ACKNOWLEDGEMENT
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7. REFERENCES
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