Review CBR (California Bearing Ratio) value on peat soil
Paya Pinang plantation of sub-district Laut Tador Batubara
Regency

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Abstract. Peat soil is a type of soil that highly consists of organic substance, which is formed from the remains of fully decomposed plants. Peat soil has high water content, high void ratio, and low bearing capacity so that the peat soil is categorized as bad soil for construction. The purposes of this research were to identify the index properties of peat soil, to determine the classification of peat soil, and to determine the subgrade strength of the peat soil from the CBR test. Peat soil Paya Pinang Plantation had high water content ($w$) of 581.721%, specific gravity ($G_s$) of 1.533, void ratio ($e$) of 2.103, moist unit weight ($\gamma_m$) of 0.549 gr/cm$^3$, dry unit weight ($\gamma_d$) of 0.088 gr/cm$^3$. Based on ASTM D4427-92 the peat soil sample had 22.424 % ash content and organic content of 77.576 %, as a result, the peat soil was classified as High Ash Peat. The peat soil had a pH of 6 and was classified Slightly Acidic because of the pH value between 5.5 and 7. The CBR soaked and unsoaked for three days were 1.222% and 1.505% respectively. Based on the Standard Proctor test, the maximum dry density was 0.474 gr/cm$^3$ and the optimum water content was 37.236%.

1. Introduction
Similar to compost, peat is a soil that contains a significant amount of organic substances [1-6]. Peat soil has high water content, high void ratio, and low bearing capacity, so peat soil is categorized as bad soil for construction [7]. Peat soil has chemicals such as Silica (Si), Aluminum (Al), Magnesium (Mg), Ferrum (Fe), Calcium (Ca), Kalium (K), and Nitrogen (N). Peat soil has a high level of soil acidity, where the average of 4.5-7 [8]. Subgrade may be identified by the CBR laboratory test. The California Bearing Ratio (CBR) value is an important soil parameter for the design of flexible pavements and runway of airfields. Besides, the soaked or the unsoaked condition of soil also affects the CBR value. The CBR soaked and the CBR unsoaked of clay soil were 4.410 and 6.230% [9]. While the CBR soaked and the CBR unsoaked of clay soil plus 2% gypsoms were 6.745 and 8.02% [10]. The purposes of this research were to identify the index properties of peat soil, to determine the classification of peat soil, and to determine the strength of the soil from the CBR test.

2. Method
The research used experimental method which was done in the Soil Mechanics Laboratory, Department of Civil Engineering University of Sumatera Utara for index properties, compaction test and California Bearing Ratio test. The research sample is peat soil from the Paya Pinang Plantation...
Sub-district of Laut Tador Batubara Regency. There was one sample to be used for the determination of ash content and organic content based on ASTM D2947-87 [11] and 6 samples for CBR tests. Mineral content tests of peat soil were carried out at the Research and Standardization Office industry of Medan (BARISTAND). Proctor standard test was carried out to obtain the optimum water content and maximum dry density and CBR laboratory test. The index properties of peat were shown in Table 1. All data were analyzed and would be presented in the form of tables, graphs, and explanations. The flow diagram of the research could be seen in Figure 1.

![Flowchart](image)

**Figure 1.** The flowchart of the research.
3. Result and discussion

3.1. Index properties data
Index properties of the peat soil of the Paya Pinang plantation Sub-district Laut Tador Batubara Regency were presented in Table 1.

| No | Test                     | Result  | Index properties       |
|----|--------------------------|---------|------------------------|
| 1  | Water content            | 581.721 | 1100 %-1300 %          |
| 2  | Specific gravity         | 1.533   | 1.250-1.800            |
| 3  | Void ratio               | 2.103   | 5-15                   |
| 4  | Moist unit weight ($\gamma_b$) | 0.549 |                        |
| 5  | Dry unit weight ($\gamma_d$) | 0.088 |                        |

3.2. Classification of peat soil
The result of ash content, organic content, and acidity content (pH) of peat soil were shown in Table 2.

| No | Test               | Result | Peat classification based on ASTM D 4427-92 (2002) |
|----|--------------------|--------|---------------------------------------------------|
| 1  | Ash content        | 22.424 % | >15% high ash-peat                               |
| 2  | Organic content    | 77.576 % |                                                 |
| 3  | pH                 | 6       | Slightly acidic                                   |

3.3. Mineral element of peat soil
Mineral elements of peat soil were displayed in Table 3.

| Mineral element       | Units | Result |
|-----------------------|-------|--------|
| Silica (SiO₂)         | %     | 10.8   |
| Aluminum (Al₂O₃)      | %     | 0.02   |
| Ferrum (Fe₂O₃)        | %     | 3.31   |
| Magnesium (MgO)       | %     | 0.16   |
| Calcium (CaO)         | %     | 0.52   |
| Kalium (K₂O)          | %     | 0.25   |
| Natrium (Na₂O)        | %     | 0.38   |

3.4. Compaction test
1. The standard proctor test result was shown in Figure 2. From the Figure 2, it was obtained that the optimum water content was 37.236 % and the maximum dry unit weight was 0.474 gr/cm³.
3.5. Correlation of water content with California bearing ratio value
The correlation of water content with the CBR was seen in Figure 3. Figure 3 explained that the CBR value would decrease as the water content increased.

3.6. Correlation of moist unit weight with CBR value
The correlation of moist unit weight with the CBR was seen in Figure 4. From the Figure 4, can be inferred that the CBR value decreased as the moist unit weight increased.

3.7. Correlation of water content with the dry unit weight value
The correlation of water content with dry unit weight was seen in Figure 5. Figure 5 showed that the addition of water content caused the dry unit weight decreased.
3.8. Correlation of curing time with swelling
The correlation of the curing time with the swelling was shown in Figure 6. It can be deduced from Figure 6 that the longer the curing time the greater the swelling of peat soil.

3.9. Correlation of curing time with California bearing ratio value
The correlation of the curing time with the California Bearing Ratio value was shown in Figure 7. It was seen in Figure 7 that the longer the curing time the smaller the CBR value.

3.10. Correlation of curing time with void ratio
The correlation of curing time with void ratio was presented in Figure 8. It was seen in Figure 8 that the longer the test material is soaked than the higher the void ratio.
3.1. Correlation of void ratio value with water content
The correlation of water content with void ratio was shown in Figure 9. Figure 9 explained if the water content increased then the void ratio increased.

3.12. Correlation between California bearing ratio and void ratio
The correlation between the CBR and the void ratio was shown in Figure 10. The void ratio increased then the CBR decreased as seen in Figure 10.
4. Conclusion
From the research result, it could be concluded:
1. Peat soil from Paya Pinang Plantation Batubara Regency had high water content \((w)\) of 581.721\%, specific gravity \((G_s)\) of 1.533, void ratio \((e)\) of 2.103, moist unit weight \((\gamma_m)\) of 0.549 gr/cm\(^3\), dry unit weight \((\gamma_d)\) of 0.088 gr/cm\(^3\), ash content of 22.424 \%, organic content of 77.576 \% and acidity / pH is 6.
2. Based on ASTM D4427-92, the peat soil was classified as High Ash Peat with more than 15\% ash.
3. Based on ASTM D4427-92, the peat soil was classified as Slightly Acidic Peat because it had a pH between 5.5 and 7.
4. Based on the Standard Proctor test, the optimum moisture content obtained was 37.236\% and the maximum dry unit weight was 0.474 gr/cm\(^3\).
5. The CBR soaked and the CBR unsoaked was 1.222\% and 1.505\% respectively.

5. References
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