Rowe cell testing to determine peat soil consolidation parameters

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Abstract. Peat soils are characterized by their strong low shear, high water content, large traction, and low carrying capacity. Many constructions that are built on peat soil experienced a ground settlement problem over a long period of time. To better understand this phenomenon, a consolidation testing will be made using rowe cell testing system. The advantages of this rowe cell are its ability to measure the saturation value of the sample soil tested and the water pressure of pores at the beginning and end of each phase of consolidation. The peat soil used in this research was taken from Rawa Pening, Semarang because of the construction of many buildings built in the area. From the results of the research obtained the value of soil ability (Cc) and the coefficient of speed consolidation (Cv). For the Cc value of peat soil is an average of 0.50 and Cv value of 167.99 cm^2 per minute. As for the average cavity of soil pore (e) amounted to 14.81. The value of 14,81 is know the size of the soil cavity and density. This is all to know the parameters and factors that occur at the time of consolidation.

1. Introduction

Rawa Pening is one of the areas in Semarang, Central Java. Rawa Pening is located in the basin of Slope Merbabu's Mountain, Telomoyo's Mountain, and Ungaran's Mountain. The lake is shallow located upstream from the Tuntang's River. The location has peat soil derived from plant roots and as we know from various problems in the field of geotechnics, this type of peat soil has low shear strength, high water content and low carrying capacity.

Based on this, the construction that is built on this land will have ground settlement problem over a long period of time. Therefore, this study will conduct a consolidation test to get soil parameters such as Cv and Cc using Rowe cell testing system. The final result is settlement value of peat soil from the Rowe cell and plate loading test.

2. Literature review

The following literature reviews are related to this experiment:
G Nurly, explain that the results shows that ulization of parameter's drainage has a positive effect on speeding up the primary consolidation process, thus the post-construction estimation of the settlement could be made based only on the secondary compression [1]. Yulindasari, explained that this research comparison between the results of the consolidation test using rowe and oedometer cells show that the

use of rowe cell for the evaluation of the consolidation characteristics of soil exhibiting secondary compression is advantageous because it enables the observation of the large deformation [2]. P K Kolay, H Y Sii and S N L Taib, explained that the laboratory test results revealed that peat has a large void ratio with high water content and undergone large consolidation settlement when applied load [3]. D. Youventharan, B K H Bujang and A Azlan, explained that the results survey of compressibility characters of reinforced fabrious peat samples in this study and literature show, the ground water in peat soil has negative affected on compressibility parameters of reinforced fabrious peat, in comparison of sample curing in pure water [4]. W Aazokhi, H Hasian, R Joko, S Mhd and J K D Agus, explained that the compression peat of seen relatively large, but after given by initial load in 10 kPa, 20 kPa and 40 kPa with times loading each one day, show that settlement peat soil smaller [5]. S O Bartlomiej and P Elzbieta, explained that simultaneous measurements of settlements together with pore water pressure were used for determination of coefficient of consolidation, Cv [6]. T Efan, explained that the result can be increase modulus subgrade reaction (ks) in pressure that reduction of settlement peat soil until plate load test [7]. W Aazokhi, C H Hary, R Ahmad in 2016 explained that the results indicates that the plate reinforced pile able to reduce the settlement of plate. Reduction of settlement is more effective for the pile with a length greater that 25 cm of peat with a thickness of 50 cm.

3. Methodology

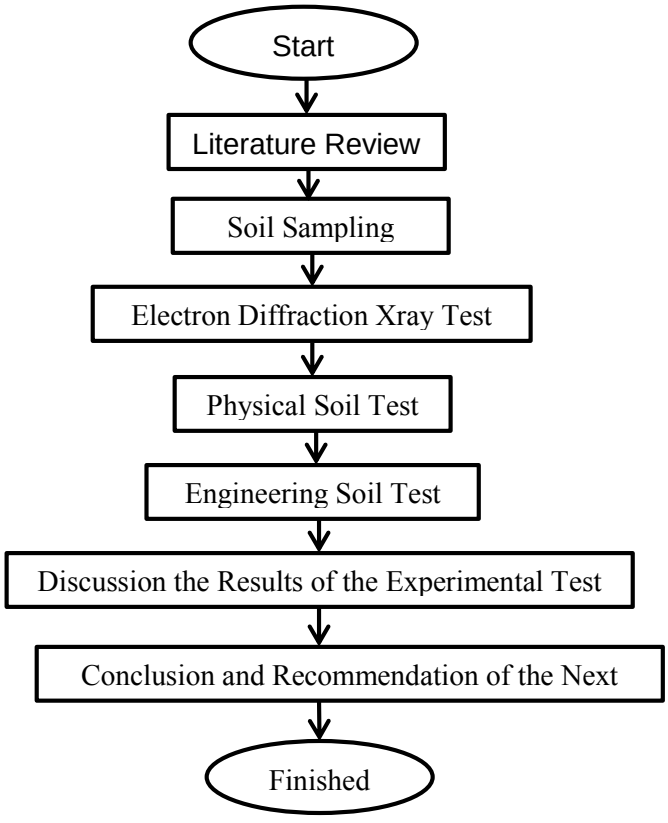

Figure 1. Flow chart of experimental test.

The equipment used for research are as follows:
1) Rowe Cell Test can be seen on Figure 2.
2) Plate Loading Test can be seen on Figure 3.

Figure 2. Set of rowe cell test.

Figure 3. Set of plate loading test.

The Material used the research is peat soil. Peat soil from Rawa Pening, Semarang – Central Java. The material can be seen on Figure 4. The sample is molded as on Figure 5.

Figure 4. Peat soil.

Figure 5. Moulded of peat soil.

Table 1. Index properties of peat soil.

No.	Index Properties	Symbol	Unit	Sample 1	Sample 2	Sample 3
1	Density	γ	t/m^3	1.080	1.067	1.086
2	Water Content	ω	%	525.25	662.82	729.81
3	Specific of Gravity	Gs	-	2.14	2.10	2.10
	Dry Density	γd	t/m^3	0.17	0.14	0.13
	Void Ratio	e	-	11.39	14.28	15.01
	Porosity	n	-	0.92	0.93	0.94
	Degree of Saturation	Sr	%	98.69	99.20	101.89
4	Grain Size Gravel	G	%	0.39	0.29	0.29
	Sand	S	%	56.75	69.34	69.34
	Silt	M	%	40.94	28.52	27.59
	Clay	C	%	1.92	1.85	2.78

Figure 6 Its an electron microscope scanning test. The test is useful for knowing peat soil structure. The result will be visible shape of the soil is flat, round or long.

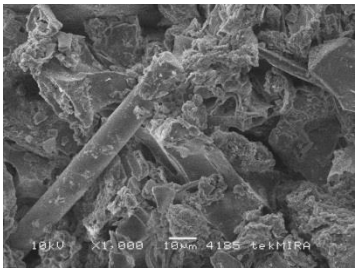

Figure 6. SEM of peat soil.

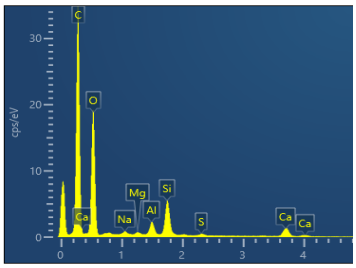

Figure 7. Graph chemical content of peat soil.

Table 2. Chemical content of peat soil.

Element	Weight %	Weight % Sigma	Atomic %
Si	12.28	0.14	8.16
O	70.63	0.26	82.35
Ca	10.54	0.21	4.91
S	0.90	0.08	0.52
Al	4.00	0.10	2.76
Na	0.95	0.08	0.77
Mg	0.70	0.07	0.54
Total	100.00		100.00

The standard testing consolidated Rowe cell is based on ASTM D2435-89 [8]. The consolidated Rowe cell represents of total pressure applied with hydraulic pressure. The tools is useful to know the settlement results of peat soil. The test used sample with size of the ring Rowe Cell. Testing was conducted with 5 times loading, which is 0.25 to 4 bar of the manometer. The testing standard of plate loading is based on ASTM D1196-2012. [9] The plate loading test will determine the carrying capacity. This type of the test is static pressure.

Figure 8. Rowe cell.

Figure 9. Plate loading test.

4. Test result

The test result shows the void ratio (e), Cv value, and the settlement of the experimental test. The void ratio (e) of peat soil has a maximum large 15.10 (on Figure 10). While the cv value have two variation, are Cv t_{90} and Cv_{50}. The Cv value shows that the consolidation peat soil has a large settlement of pressure load in 0.5 kg/cm^2. Because the soil still has a large void. The Cv value is shown on Figure 11 and Figure 12. Peat soil saturates quickly because it can absorb water in a short period of time.

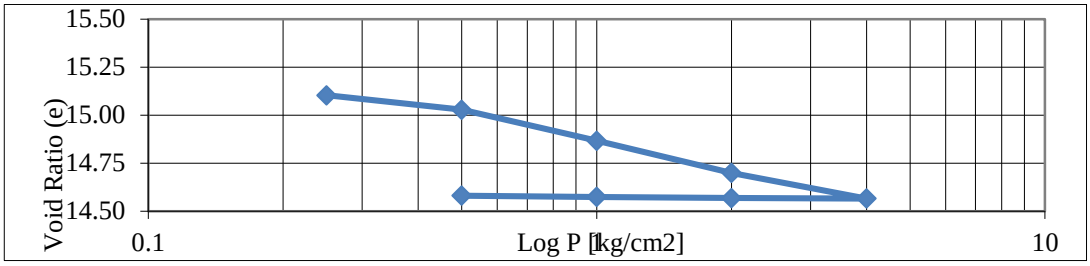

Figure 10. Graph of Cc. Rowe cell consolidation test.

Figure 11. Graph of Cv t_{90} rowe cell consolidation test.

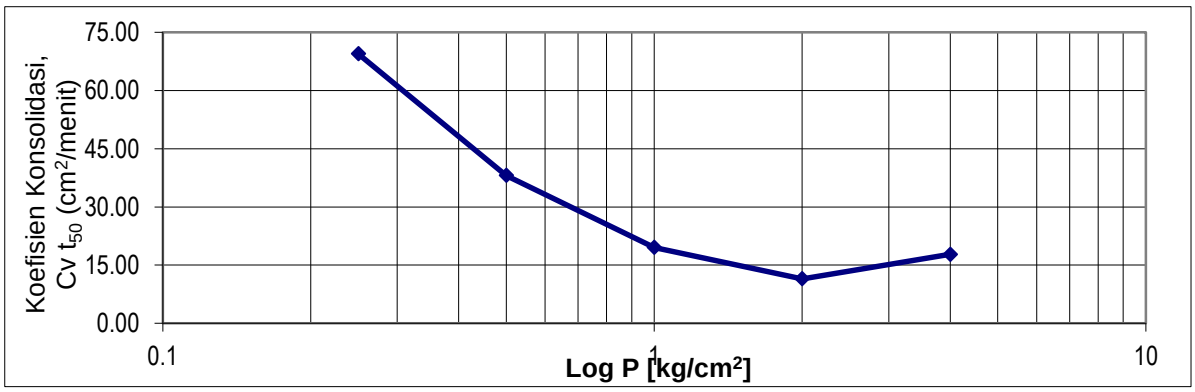

Figure 12. Graph of Cv t_{50} rowe cell consolidation test.

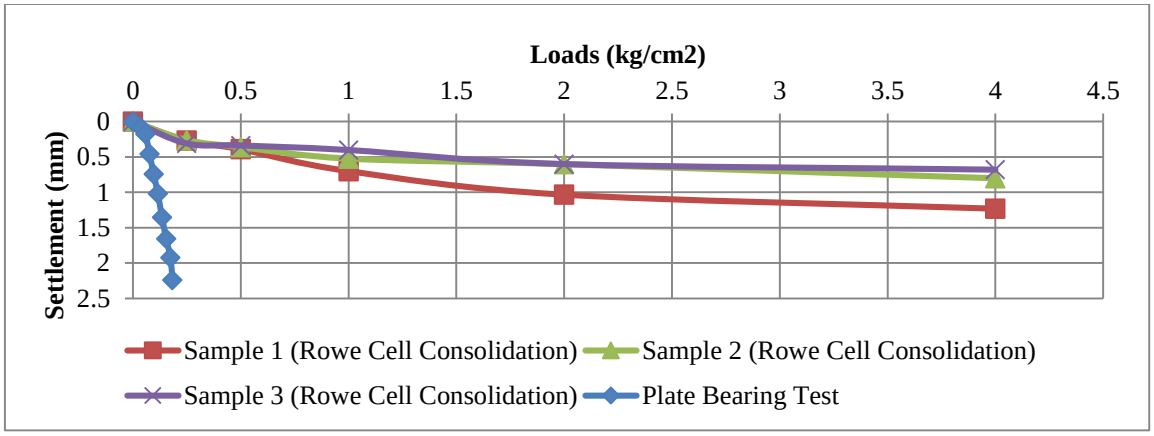

Figure 13. Comparison of consolidation peat soil with rowe cell and plate loading test.

5. Conclusion

Based on the result, it concludes that:

5.1. The result of the Scanning Electron Microscope (SEM) shows that:

- The sample has a large ununiformed grain. The shape of the grain are round, tapered and long shape. The round shape is a form of soil grain, but tapered and long is a formed by fiber and weathering of wood contained in peat soil. For the result of Electron Dispersive X-Ray (EDX) test,
- The type of soil that is the object of this research has a granular composition that dominant in sand and silt or can be called Sandy Clay (USDA classification). While water content obtained more than 100%, this indicates that this type of soil can be said to be peat soil.

5.2. The result of the Electron Dispersive X-Ray (EDX) test shows that the highest contaminant in this sample are oxygen and silica.

5.3. The result of the consolidated testing of Rowe Cell shows that:

- The peat soil compression index in the first sample was 0.96. For a second sample of 0.36. While the third sample amounted to 0.18. All three samples are the same type of soil with different spot sampling.
- For the result of consolidation settlement t_{90}, the value of C_v on the first sample amounted 253.01 cm^2/min. For a second sample of 144.87 cm^2/min. While the third sample 106.09 cm^2/min.
- From the consolidated testing results of the Rowe cell, the soil occur a rapid and constant settlement to the time and load determining.

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