Recent Trends in Civil Engineering and Built Environment Vol. 4 No. 1 (2023) 119-131

RTCEBE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rtcebe
e-ISSN :2773-5184

Investigation of Soil Settlement Due to Different Shape of Load Applied on Soft Soil

Muhamad Aidil Fitri Sabrah[1] and Adnan Zainorabidin[1]*

[1]Faculty of Civil Engineering and Built Environment,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/rtcebe.2023.04.01.013
Received 06 January 2022; Accepted 15 January 2023; Available online 01 May 2023

Abstract: Nowadays, in order to accommodate the rising population, rapid structural development such as buildings have occurred and indirectly resulted in the emergence of numerous structures in less desirable sites. Soft soils like peat and soft clay were prone to failure and collapse. Soil settling has caused several structures to crumble. As a result of soil settlement, several buildings have failed. In addition, people nowadays also designed buildings without considering the properties of the soil that they used as a foundation either it strong enough or not to support the structure. The main objective of this study was to analyze the influence of soil settlement due to different shape of loading applied on soil. This study used two type of soft soil which were peat and soft clay. Laboratory testing was conducted in this study to investigate the index properties of soil such as moisture content, liquid limit and plastic limit and to ensure that the soft soil samples that used in this study have the same properties with the soft soil that exists outside there. In this study, laboratory physical model was conducted to determine the behavior of soil settlement due to different loading applied on soil and to analyze the influence of soil settlement due to different shape of loading applied on soil. All the shape of loadings that have been applied in this study were playing role as shallow foundation for a building. According to laboratory testing that have been done, peat have higher value of moisture content and liquid limit compared to soft clay. The study discovered that peat had a greater soil settlement than soft clay after doing physical model testing. The physical model tests also indicated that the increasing amount of loading applied to the soil increased the amount of soil settlement. Furthermore, the findings of physical model testing revealed that the circular shape of loading causes more soil settlement than the square and rectangular shapes of loading.

Keywords: Soft Soil, Peat, Soft Clay, Plate Load Test, Foundation, Soil Settlement

1. Introduction

Nowadays, structures such as buildings are rapidly evolving to accommodate the growing population. Rapid growth would result in numerous projects or developments, such as residential, in less appropriate or risky regions, such as soft soil areas with bad ground due to a shortage of adequate

*Corresponding author: adnanz@uthm.edu.my

land [1]. Soft soil development will have a significant chance of failure and collapse. Soft soil is found in Malaysia in the form of peat and soft clay. People nowadays are unconcerned with the type of soil they choose as a foundation for their structures, despite the fact that peat and soft clay are unsuitable for construction due to stability difficulties. Furthermore, individuals currently plan their buildings without considering the features of soft soil, particularly peat and soft clay soil, that they utilize as a foundation for their structures, such as whether the soil is stable and strong enough to support the loads of their structures. There are 182 cases or 72 percent, of the 252 forensic cases conducted in Malaysia that are connected to the subject of ground settlement [2]. When base or soil that used to develop the building is soft soil such as peat and soft clay that has low strength, settlement of soil could be easily happened when the load of building transferred to the soil. This is because every building have their load and all the load are transferred to the ground.

The aim of this study is to analyze the influence of soil settlement due to different shape of loading applied. The aim of this study can be achieve by conducting laboratory physical model. In laboratory physical model, two type of soft soil samples were used which are peat and soft clay. Laboratory physical model used the same concept as plate load testing but it was conducted in small scale. The soil samples were placed in the physical model at 25 cm to 30 cm height. Then, loadings were applied on the top of soil at middle position. There were different loadings applied such as 0.25kPa, 0.5kPa and 1kPa. In addition, the loadings applied also have different shape such as circular shape, square shape and rectangular shape. In laboratory physical model, the reading of soil settlement were recorded at 0 second, 10 seconds, 20 seconds, 30 seconds, 50 seconds, 1 minute, 2 minutes, 4 minutes, 8 minutes, 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours and 24 hours. The reading of soil settlement for every loadings applied then were plotted into graphs to determine the behavior of the soil settlement due to different loading applied and directly analyze the influence of soil settlement due to different shape of loading applied. To know which type of soft soils were the most problematic and which shape of loadings gave the highest soil settlement, the comparison graph between physical model test for peat and soft clay and comparison graph between circular, square and rectangular have been done. These relations were important to identify the most problematic soft soil and shape of loading that gave higher value of soil settlement.

2. Soft Soil, Peat, Soft Clay, Foundation and Soil Settlement

2.1 Soft soil

Soil that includes between 20% and 70% organic matter by weight is classed as soft soil. There are soft soils all around the planet. High compressibility and moisture content, poor permeability and poor shear strength y are some of their unique characteristics. Besides, soft soil can be classified as soils with substantial percentages of small particles like clayey and silty soils with high moisture content and loose sand layers with high moisture content near or below water table [1]. Peat and soft clay are the examples of soft soils.

2.2 Peat

In terms of engineering, peat is the softest of all soils. Peat and organic soil behavior is usually predicted using inorganic soil principles and techniques. In Malaysia, there is a large amount of low-lying land that has strata that make planning and building challenging because thick clay or peat soils are present. Peat is thickly covered in low-lying marshy regions with 2.0 m average thickness and 10.0 m maximum thickness documented. The most frequent varieties of peat are dark brown spongy amorphous peat and spongy fibrous peat [1]. Peat covers roughly 30,000 km^2 in Malaysia, approximately 8% of the total land area of the nation. Sarawak has the most peat, encompassing 16,500 km^2 and having peat depths of more than 1 m in 89 percent of the areas. Peat deposits in Malaysia ranged in depth from 1 to 20 meters [3]. Figure 1 shows the location of peat swamps in Malaysia.

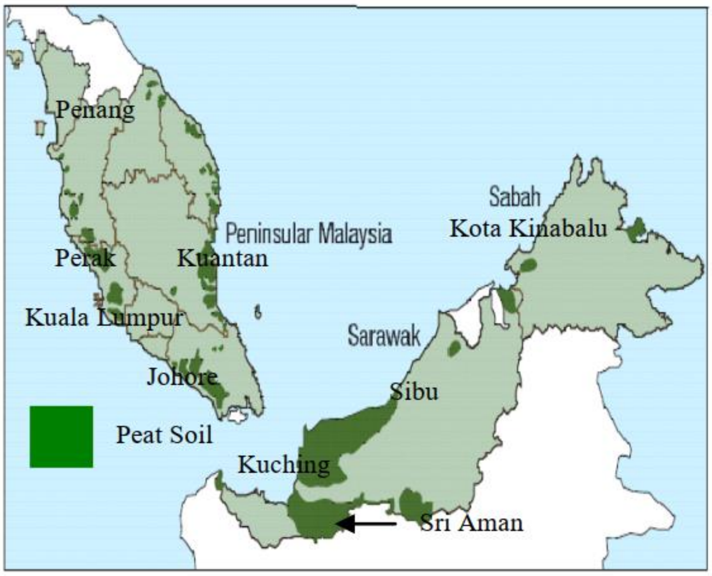

Figure 1: Location of peat swamps in Malaysia [3]

2.3 Soft Clay

Soft clays are hydrous aluminum silicate clays that are pliable or may be shaped with the hands. True soft clays have a different mineral makeup than other types of soils. The particles in soft clays are flaky. Their thickness is small in comparison to their length and width. Almost all soft clay minerals are crystalline minerals, which have a sheet-like structure created by an organized and repetitive arrangement of molecules. Kaolinites, illites, and montmorillonites are the three principal types of soft clay minerals [4]. A fine-grained soil that is prone to settling and instability is known as soft clay. As a result, stability and settling difficulties have long been associated with the construction of buildings, roads, bridges, canals, and trains in soft clay areas. Figure 2 shows Malaysian soft clay distribution map.

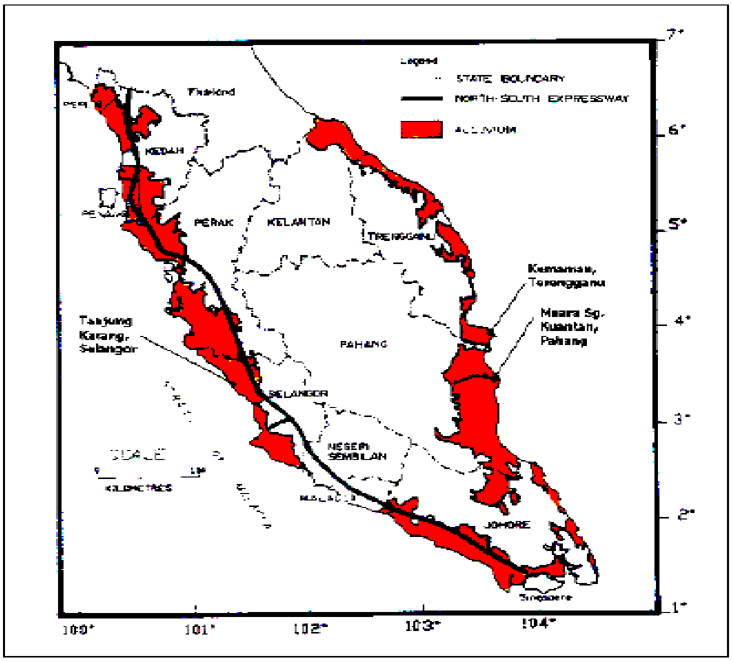

Figure 2: Malaysian soft clay distribution map [4]

2.4 Plate load test

Plate load test is used to determine the soil's strength and vertical deformation by monitoring the amount of penetration and force over time when a rigid plate is pushed into the soil. Without disturbing the sample, the method may be used to evaluate the shear strength, ultimate bearing capacity and soil deformation characteristics beneath the plate. Testing can be done on the ground, in pits, or in trenches. The plate load test is the most often used and appropriate method for its purpose on soils, particularly when the foundation material is such that collecting undisturbed samples for foundation testing is nearly impossible [5]. Plate load tests are the most typical field testing for determining allowed foundation pressures. Plate load test usually was conducted in two ways which are conducting plate load test at field and conducting plate load test at laboratory. For laboratory plate load testing, commonly used a model footing that placed centrally. A consistent surcharge of 5kPa, 10kPa, and 15kPa was used to replace the effect of the soil above the level of the footing. To apply loads to the footing, a manually driven hydraulic jack was employed.[6]. Figure 3 shows the laboratory plate load testing

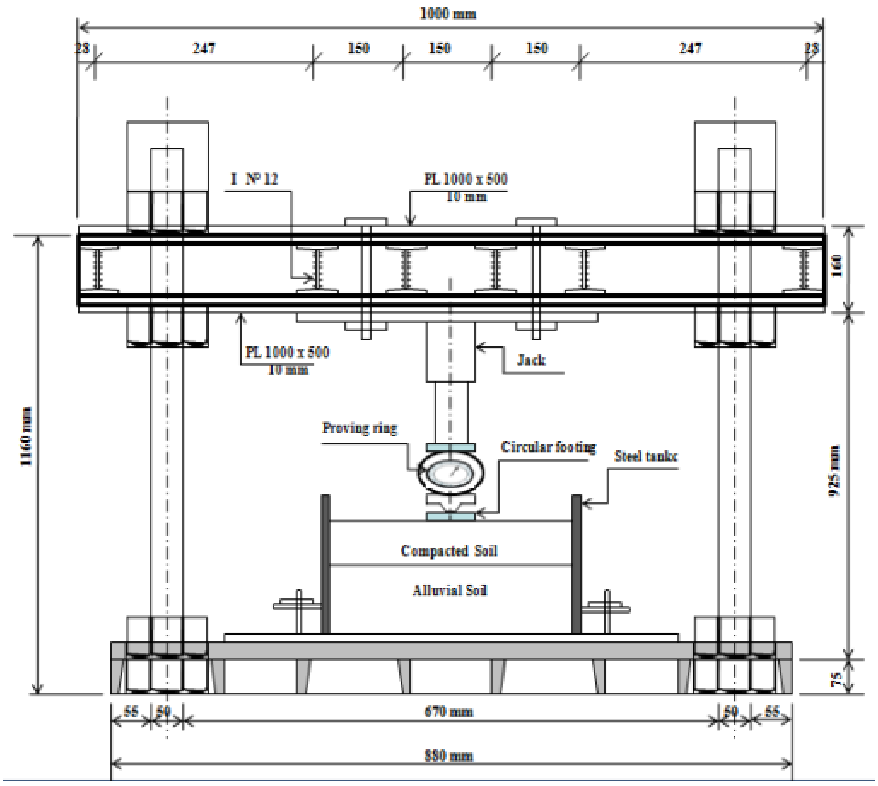

Figure 3: Laboratory plate load testing [6]

2.5 Foundation

Since building structures are connected to the ground, designing and constructing a good foundation is a required step before erecting any superstructure. The purpose of footings is to disperse the weight of the building to the earth. The strength of the soil and its varied qualities are taken into account while designing foundations. The structural plan and the orientation of the columns in the superstructure determine how footings are designed for each individual construction site. It may be made in a variety of forms and orientations, including round, square, and rectangular. Different forms of footing have their own set of advantages and disadvantages. Square and rectangular footings, for example, are unique in terms of simplicity of construction, reinforcement installation, and concrete placement [6].

2.6 Soil settlement

Settlement is a significant consideration in foundation design. To ensure the stability of towers, buildings and other valuable structures, foundation settling must be properly designed. The compressional deformation of the soil is the primary cause of settling. Settlement of soil occurs when the earth's tension changes, causing the soil to shift vertically or downwardly. [7]. Ground settlement is the most common engineering issue faced while building on soft ground or soft soil. Excessive and differential settlement are two typical settlement issues that arose in the majority of the projects. When it comes to needless settlement, this includes rapid soil settling, primary consolidation settling and secondary settling. Meanwhile, differential settling happens when the fill thickness varies abruptly or when compaction process is very difficult [2].

3. Materials and Methods

This study used two type of soft soil which were peat and soft clay. Peat samples were taken from Seri Medan, Batu Pahat while soft clay samples were taken from RECESS UTHM. Both of soil samples were placed in closed container to ensure that the moisture content of soil samples maintained. To achieve the objectives of this study, laboratory testing and laboratory physical model were conducted.

3.1 Laboratory testing

To investigate the index properties of soft soil samples which were peat and soft clay, a few laboratory tests such as moisture content, plastic limit and liquid limit were conducted.

3.1.1 Moisture content test

The moisture content test was designated by ASTM with the ASTM D-2216-90 standard. The aiming of ASTM D-2216-90 was to calculate the water quantity in a given amount of soil when it comes to dry weight. The equipment needed for this moisture content test:

- Soil samples
- Moisture content can
- Temperature-controlled oven
- Electronic scale

For moisture content test procedure, the raw soil samples were prepared. Next, empty can were weighed by using electronic scale and the weight was recorded. Then, raw or moist soil samples were filled in the can and the weight of the can with wet soil were recorded. After that, can that filled with wet soil sample were placed in the oven with temperature 105ºC and kept in the oven for a total of 24 hours. The soil sample was removed from the oven after 24 hours. The container filled with soil sample were weighed and then the data was recorded.

3.1.2 Liquid limit test

One of the tests in the Atterberg limit laboratory test was the liquid limit test. Liquid limit test described in ASTM Standard D4318 to determine the moisture content when the soil contain clay’s behavior transform to liquid from plastic. However, the transition to liquid from plastic behaviour happens gradually across a water concentrations with wide range and the soil’s shear strength at liquid limit does not drop to zero. The equipment needed for this liquid limit test:

- Soil samples
- Moisture content can
- Temperature-controlled oven
- Electronic scale
- Palette knives
- Cone penetration

For liquid limit test procedure, firstly about 300 grams of dirt was prepared and passed a 425 m of sieve test. Secondly, the soil samples were mixed with distilled water with spatula or palette knives for at least 10 minutes. Next, soil samples were placed and pressed into the metal cup. After that, the top of soil samples that have been placed into metal cup were trimmed using palette knives. Then, near the top of its trip, the cone and shaft unit was locked, lowering the supporting assembly. The dial gauge's stem was then lowered until it made touch with the cone shaft's top. Make sure that the cone's tip was only a few millimeters away from the soil's surface in the metal cup. Next, the button was pressed to allow the cone fall and wait for 5 seconds. After that, the dial reading was recorded to the closest 0.1 mm (R1). Then, the cone was removed and thoroughly cleaned. The step was repeated for reading (R2) to get at least 2 point for one soil sample. The dial reading (R2) was then recorded to the closest 0.1 mm for the next step. Took a wet soil sample of around 10g from the location where the cone had punctured the container. The empty can and moisture content can were weighed. The remaining soil samples paste was transferred to the evaporating dish from the metal cup. In the evaporating dish, more water was poured and well mixed into the soil mixture. For tests 2, 3, and 4, all of the stages were repeated. Then, the can with moisture soil sample were dried in oven for 24 hours. Next, the moisture content soil sample after 24 hours dried in oven were weighed and recorded in the table. Finally, the liquid limit graphs were plotted by using the data and liquid limit value for the soil samples were determined.

3.1.3 Plastic limit test

One of the tests in the Atterberg limit laboratory test was the plastic limit test. ASTM Standard D4318 was a standard that used to determine plastic limit by rolling a thread of soil on a flat that non-porous surface. When the soil was at moisture level where it acts plastically, this thread will keep its form even when it is cut down to a very small diameter. The test was then repeated after the sample was remolded. When moisture content of the thread diminishes owing to evaporation, at greater diameters, the thread begins to break apart. Plastic limit was referred as moisture level at which a 3 mm diameter thread breaks apart. If a thread could not be rolled out to a thickness of 3 mm, the soil was categorized as non-plastic in any moisture. The equipment needed for this plastic limit test:

- Soil samples
- Moisture content can
- Temperature-controlled oven
- Electronic scale
- Palette knives
- Evaporation dish

For plastic limit test procedure, firstly, 20 gram of soil samples were prepared and spread on the glass mixing plate. Secondly, the soil samples were mixed occasionally with distilled water to avoid local drying out. Thirdly, the soil were shaped into a ball when it was plastic enough when mixing with distilled water. When small cracks formed, the ball was separated into two 10 gramme parts. The ball was then separated into four equal portions, each of which was kept together as a set of four. The ball was then rolled into a thread by applying consistent pressure to the glass plate's surface with one hand's fingers. After five to a total of 10 back-and-forth motions of the hand, the thread diameter was decreased from 6 mm to 3 mm by applying pressure. The soil was then dried by shaping it between the fingers once again. After that, the soil was shaped into a thread as previously. When the thread had been rolled to a diameter of 3mm, the technique was repeated until the thread crumbled. Gauging 3 diameter was done using a metal rod as a reference and plastic limit is the first crushed point. Weighed the empty moisture content container. The moisture content sample was weighed and dried for roughly 24 hours with the container. The dried sample with container after 24 hours was weighed and recorded in the table. Finally, the plastic limit graph was plotted by using the data. Indirectly, the value of plastic index and plastic limit for the soil samples were determined.

3.2 Laboratory physical model

To investigate the soil settlement due to different loading, the physical model need to be prepared. After the physical model was prepared, the plate load testing was conducted to investigate the settlement of soil.

3.2.1 Physical model preparation

Physical model was one of the method that used in this study. This physical model used the same concept as box model for laboratory scale test but in small scale. For box model for laboratory scale made from steel with dimension 150 centimeters length, 30 centimeters wide and 55 centimeters depth. Figure 4 shows the box model for laboratory scale test.

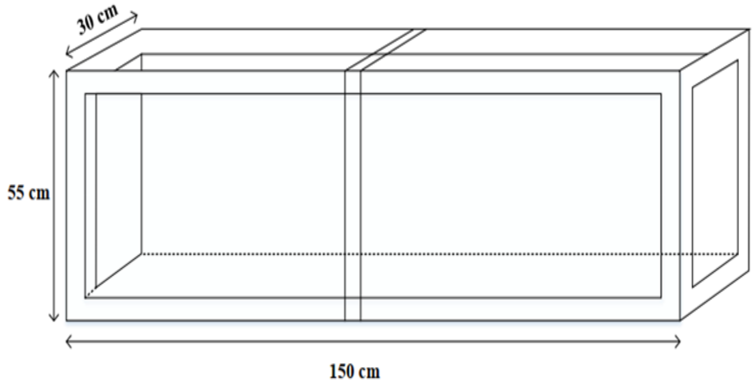

Figure 4: Box model for laboratory scale test

But, in this study, the physical model was made from plywood and wood 2” by 1” with dimension 50 centimeters length, 50 centimeters wide and 50 centimeters depth. The physical model would looked like a formwork that have only one opening at the top. The apparatus needed to prepare physical model are plywood, wood 2’ by 1’, nails, hammer, marker pen, measuring table, grander, varnish and silicon.

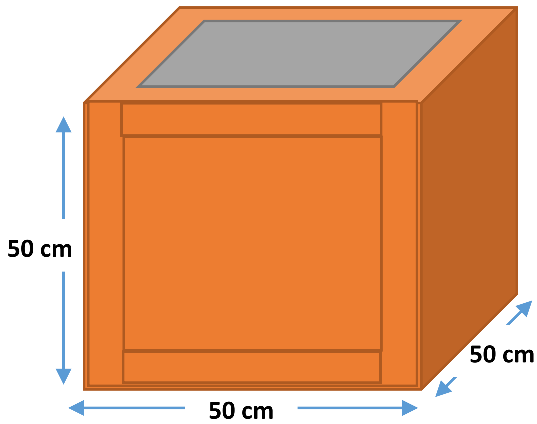

Figure 5: Illustration of the physical model

For physical model preparation procedure, firstly plywood and wood size 2 inches by 1 inche were prepared. Secondly, the dimensions of physical model were marked on the plywoods and woods 2 inches by 1 inche by using marker pen and measuring tape. Thirdly, plywoods and woods 2 inches by 1 inches were cut by using grander. Next, plywoods and woods 2 inches by 1 inche were connected like the illustration of physical model by using nails and hammer. Varnish was applied on the surface of plywoods and woods to prevent water absorption. Then, silicon was applied at the joint between plywoods and woods to prevent water flowed out from the physical model. Finally, two ruler were placed in the physical model in vertical condition as indicator to read the soil settlement during plate load testing.

3.2.2 Plate load test

Plate load test was a way to find out the ground's ultimate bearing capacity and the potential of settling under a given load. In most cases, this test is performed in-situ and in compliance with BS 1377 Part 9:1990 Standard for Plate Bearing Test. Shallow foundations are typically selected and designed using this test. In this study, there are two different loading applied for plate load test which were different loading for plate load test and different shape of loading for plate load test. Figure 3.9 shows different shape of loading that used in plate load test.

Circular Shape	Square Shape	Rectangular Shape

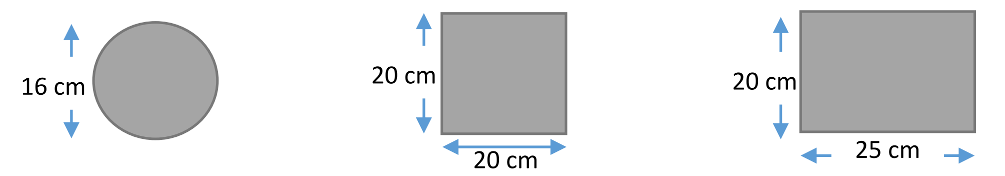

Figure 6: Different shape of loading

The first step that need to be done for plate load testing was preparing the soil sample either peat or soft clay and setup it in the physical model for about 25cm to 30cm height. Next, on top of the soil sample, a 0.25kPa or 6.25kg weight with a circular, rectangular, or square form was applied. The load was placed at the middle to get precise and evenly reading of displacement. A ruler was placed horizontally on the top of load and make sure that it touched the ruler that have been placed vertically in the physical model. This step was important because it make the process of taking reading of soil settlement more easily. Figure 3.11 shows the condition of ruler during the testing.

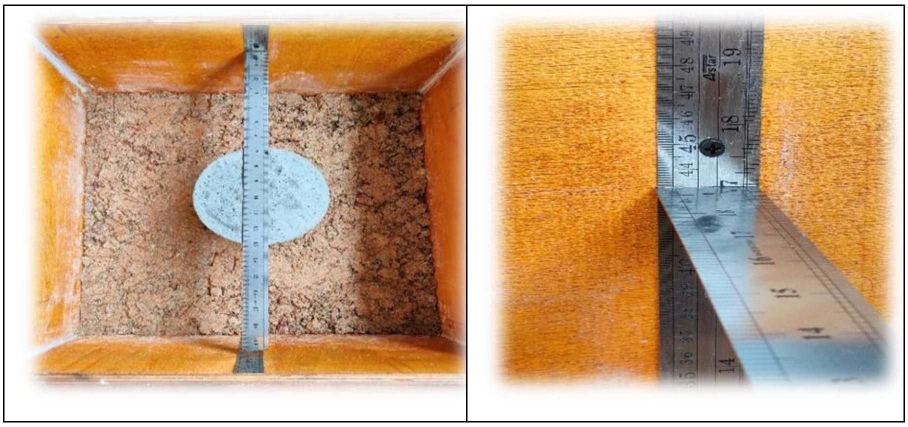

Figure 7: Condition of ruler during the testing

After that, reading of soil settlement were taken at 0 second, 10 seconds, 20 seconds, 30 seconds, 50 seconds, 1 minute, 2 minutes, 4 minutes, 8 minutes, 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours and 24 hours. After finished taking the reading at 24 hours, the soil was loosened up and setup again to give fair reading for other load. The process of plate load testing were repeated again by using different load which were 0.5kPa or 12.5kg and 1kPa or 25kg. After finished repeating with different load by using the same shape of load, the process of plate load testing were repeated again by using different shape of load either circular, rectangular or square. Next, the process of plate load testing were repeated again by using another soil sample either peat or soft clay. At the end of the plate load testing, the result of soil settlement for every shape of load with different loading and different soil sample were changed into graphs to determine the behavior of soil settlement due to different shape of load applied.

4. Results and Discussion

4.1 Index properties

The index properties for peat that taken from Seri Medan were 120.29% for moisture content, 74% for liquid limit, undetermined for plastic limit and plastic index value. Meanwhile, the index properties for soft clay that taken from RECESS UTHM were 55.28% for moisture content, 48% for liquid limit, 27.96% for plastic limit and 20.04% for plastic index. Table 1 shows the summary of index properties for soft clay and peat.

Table 1: Summary of index properties for soft clay and peat

Parameter	Soft Clay	Peat
Moisture Content (%)	55.84	120.29
Liquid Limit (%)	48	74
Plastic Limit (%)	27.96	-
Plastic Index (%)	20.04	-

Peat have higher value of moisture content and liquid limit compared to soft clay. The results shows that because peat have greater moisture content value and causes water contained in organic components and cell of plants. Peat also consists of roots, trees stumps and leave that influenced the liquid limit value. Plastic limit and plastic index for peat cannot be determined due to the presence of fibers in peat that causes Atterberg boundaries difficult to be defined. Table 2 shows the index properties for soft clay and peat from other researchers.

Table 2: Index properties for soft clay and peat from other researchers

Parameter	Soft Clay	Peat
	[4] [8][9] [10]	[10] [11] [12]
Moisture Content (%)	53.95-85	100->1000
Liquid Limit (%)	41-77	69-417
Plastic Limit (%)	19.83-34.28	-
Plastic Index (%)	18.82-46	-

4.2 Physical model

Figure 8 shows the graph result for constant shape of loading versus different loading applied. For circular loading, 0.25kPa loading on peat produced 7.5 mm of soil settlement, 0.5kPa loading produced 15.5 mm of soil settlement and 1kPa loading produced 27.5 mm of soil settlement after 24 hours testing. Meanwhile, 0.25kPa loading on soft clay produced 4.5 mm of soil settlement, 0.5kPa loading produced 7 mm of soil settlement and 1kPa loading produced 14.5 mm of soil settlement after 24 hours testing. From the graph, only 0.25kPa loading on soft clay that remained constant after 8 hours of testing while 0.5kPa and 1kPa loading on soft clay still increased slowly after 8 minutes of testing. Meanwhile, others loadings on peat still increased slowly after 15 minutes until 24 hours of testing.

Next, for square loading, 0.25kPa loading on peat produced 6.5 mm of soil settlement, 0.5kPa loading produced 12.5 mm of soil settlement and 1kPa loading on peat produced 25 mm of soil settlement after 24 hours testing. Meanwhile, 0.25kPa loading on soft clay produced 3 mm of soil settlement, 0.5kPa loading produced 6 mm of soil settlement and 1kPa loading produced 11.5 mm of soil settlement after 24 hours testing. From the graph, only 0.25kPa loading on soft clay that remained constant after 8 hours of testing. Meanwhile, others loadings on peat still increased slowly after 15 minutes until 24 hours of testing.

Besides, for rectangular loading, 0.25kPa loading on peat produced 5.5 mm of soil settlement, 0.5kPa loading produced 11.5 mm of soil settlement and 1kPa loading produced 22.5 mm of soil settlement after 24 hours testing. Meanwhile, 0.25kPa loading on soft clay produced 2.5 mm of soil settlement, 0.5kPa loading produced 5 mm of soil settlement and 1kPa loading produced 10.5 mm of soil settlement after 24 hours testing. From the graph, only 0.25kPa loading on soft clay that remained constant after 8 hours of testing. Meanwhile, others loadings on peat still increased slowly after 15 minutes until 24 hours of testing.

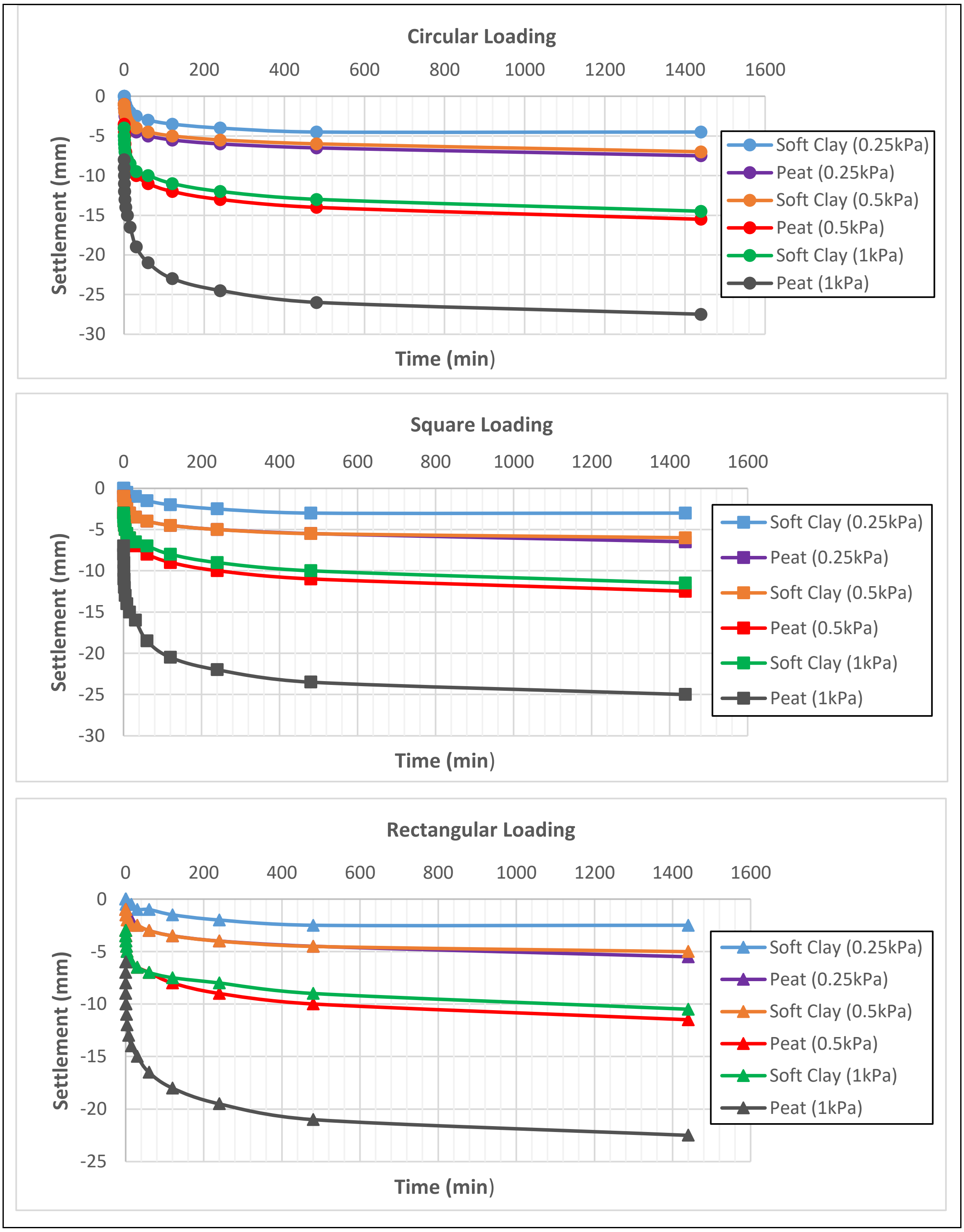

Figure 8: Graph result for constant shape of loading versus different loading applied

Based on the graph result, the soil settlement for peat was more than soil settlement for soft clay even though in this study used different loading such as 0.25kPa, 0.5kPa and 1kPa. The findings were came from all the shape of loading that used in this study which were circular loading, square loading and rectangular loading. From the graph result also, different loading applied on the soil sample give different value of the soil settlement. The soil settling value of the soil sample increased as the loading applied increased. Besides, as the amount of loading applied increase, the soil settlement of the soil sample also increased when the shape of loading used in the testing was constant.

Figure 9 shows the graph result for constant loading applied versus different shape of loading. For 0.25kPa loading, circular shape of loading applied on peat produced 7.5 mm of soil settlement and 4.5 mm of soil settlement on soft clay after 24 hours testing. Square shape of loading applied on peat produced 6.5 mm of soil settlement and 3 mm of soil settlement on soft clay. Meanwhile, for rectangular shape of loading applied on peat produced 5.5 mm of soil settlement and 2.5 mm of soil settlement on soft clay after 24 hours testing. From the graph, only loadings that applied on soft clay remained constant after 8 hours until 24 hours of testing. Meanwhile, loadings applied on peat still increased slowly after 15 minutes until 24 hours of testing.

Next, for 0.5kPa loading, circular shape of loading applied on peat produced 15.5 mm of soil settlement and 7 mm of soil settlement on soft clay after 24 hours testing. Square shape of loading applied on peat produced 12.5 mm of soil settlement and 6 mm of soil settlement on soft clay. Meanwhile, for rectangular shape of loading applied on peat produced 11.5 mm of soil settlement and 5 mm of soil settlement on soft clay after 24 hours testing. From the graph, only 0.5kPa of circular loading that applied on soft clay increased slowly after 8 minutes until 24 hours of testing. Meanwhile, others loadings applied on soft clay and peat still increased slowly after 15 minutes until 24 hours of testing.

Besides, for 1kPa loading, circular shape of loading applied on peat produced 27.5 mm of soil settlement and 14.5 mm of soil settlement on soft clay after 24 hours testing. Square shape of loading applied on peat produced 25 mm of soil settlement and 11.5 mm of soil settlement on soft clay. Meanwhile, for rectangular shape of loading applied on peat produced 22.5 mm of soil settlement and 10.5 mm of soil settlement on soft clay after 24 hours testing. From the graph, only 1kPa of circular loading that applied on soft clay increased slowly after 8 minutes until 24 hours of testing. Meanwhile, others loadings applied on soft clay and peat still increased slowly after 15 minutes until 24 hours of testing.

From the graph result for constant loading applied versus different shape of loading, the soil settlement for peat was more than soil settlement for soft clay even though in this study used different shape of loading such as circular shape, square shape and rectangular shape. These findings were came from all the loading applied on the soil that used in this study which are 0.25kPa loading, 0.5kPa loading and 1kPa loading on soft clay and peat. From the graph result also, different shape of loading used in the testing give different value of the soil settlement. The soil settling value increased as the area of the shape of loading applied to the soil sample decreased. Besides, as the area of the shape of loading applied decrease, the soil settlement of the soil sample were increased when the loading applied on the soil sample was constant.

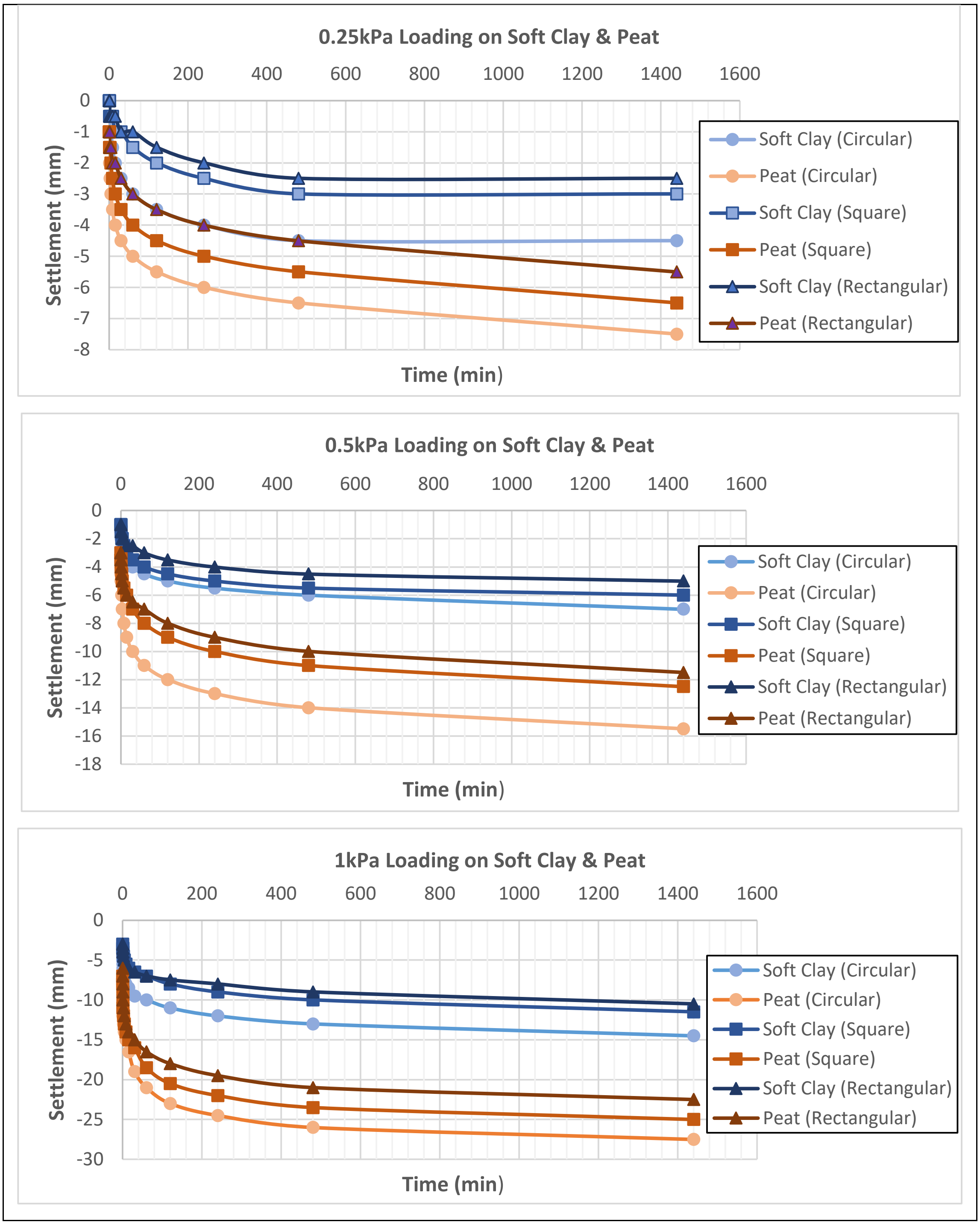

Figure 9: Graph result for constant loading applied versus different shape of loading

5. Conclusion

As a conclusion, based on the result of soil settlement for peat and soft clay, peat was more problematic than soft clay because peat have highest settlement value compared to soft clay. Different loading applied gave different value of settlement and every shape of loading applied gave different settlement. The findings of this study revealed that circular shape of loading have highest soil settlement, followed by square shape of loading and rectangular shape of loading. These was consistent with previous study, which found that at all periods of cyclic stress, the settlement for a square footing was smaller than the one for a circular footing [13]. For recommendation, this study can be improve by using other types of peat and soft clay by taking it from other locations to get more data about this type of soft soil. Next, conduct plate load testing at site to get the real scale data for the soil settlement to improve this study. In addition, use different size of the shape of loading applied during plate load testing to get much data for analyzing the influence of soil settlement due to different shape of load applied.

Acknowledgement

The Authors would like to thank the Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia for their support and facilities.

References

[1] R. C. Omar and R. Jaafar, "The characteristics and engineering properties of soft soil at Cyberjaya," in *Geological Society of Malaysia Annual Geological Conference*, 2000, pp. 313–322.

[2] N. O. Mohamad *et al.*, "Challenges in construction over soft soil - case studies in Malaysia," in *IOP Conference Series: Materials Science and Engineering*, 2016, vol. 136, no. 1, doi: 10.1088/1757-899X/136/1/012002.

[3] A. Zainorabidin and D. C. Wijeyesekera, "Geotechnical challeges with Malaysian peat," in *Advances in Computing and Technology Conference*, 2007, no. December 2017, pp. 252–261, [Online]. Available: http://dx.doi.org/10.1016/j.jada.2010.08.016.

[4] K. N. M. Yusof, L. C. Lun, P. P. Guan, and S. A. A. Tajuddin, "The correlations between chemical and index properties for soft clay of Peninsular Malaysia," in *Technology and Innovation for Sustainable Development Conference (TISD2006)*, 2006, pp. 152–161.

[5] B. Atarigiya and R. Ofori-addo, "Plate load test : getting it right," in *49th Ghana Institution of Engineers (GhIE) Annual Conference*, 2018, pp. 0–7.

[6] S. I. Shalaby, "A comparison between the behavior of laboratory and field plate load tests on collapsing soils," in *International Conference on View Developments in Soil Mechanics and Geo Economic Engineering*, 2016, pp. 283–446.

[7] E. Al-Taie, N. Al-Ansari, and S. Knutsson, "Evaluation of foundation settlement under various added loads in different locations of Iraq using finite element," *Engineering*, vol. 08, no. 05, pp. 257–268, 2016, doi: 10.4236/eng.2016.85022.

[8] A. H. Mat Nor *et al.*, "Stabilization of soft clay by using diapers back sheet layer wastes," in *MATEC Web of Conferences*, 2018, vol. 250, doi: 10.1051/matecconf/201825001015.

[9] M. A. M. Al-Bared, I. S. H. Harahap, and A. Marto, "Sustainable strength improvement of soft clay stabilized with two sizes of recycled additive," *Int. J. Geomate*, vol. 15, no. 51, pp. 39–46, 2018, doi: 10.21660/2018.51.06065.

[10] R. C. Mamat, "Engineering properties of Batu Pahat soft clay stabilized with lime, cement and bentonite for subgrade in road construction," 2013.

[11] P. K. Kolay and S. N. L. Taib, "Physical and geotechnical properties of tropical peat and its stabilization," in *Peat*, IntechOpen, 2018, pp. 93–105.

[12] A. Zainorabidin, M. N. Abdurahman, A. Kassim, M. F. M. D. Azlan, S. N. Razali, and E. S. E. Ab Rahman, "Settlement behaviour of Parit Nipah peat under static embankment," *Int. J. GEOMATE*, vol. 17, no. 60, pp. 151–155, 2019, doi: 10.21660/2019.60.8263.

[13] A. N. Najim, M. Y. Fattah, and M. K. Al-Recaby, "Cyclic settlement of footings of different shapes resting on clayey soil," *Eng. Technol. J.*, vol. 38, no. 3A, pp. 465–477, 2020, doi: 10.30684/etj.v38i3a.483.