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Behavior of Soil Peat with Reinforcement of Bamboo Grid

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Abstract: - Type peat soils classified as poorly as the foundation construction, because of the low shear strength, high water content, high compression and low bearing capacity. Using of bamboo grid is an alternative to improve the stability of the construction on the peat soil. Treated system can be made to improve the durability of bamboo. The research was conducted in the laboratory using a test box length 120 cm, width 90 cm, and height 90 cm. The loading plate test with a plate size of 15x15 cm^2 and thickness of 1 cm. Reinforcement material using bamboo grids without and with the treated of which is placed under the foundation plate respectively 1 layer, 2 layers, and 3 layers. Peat soil reinforced of bamboo grid with and without terated generate a significant bearing capacity compared with peat without reinforcement. Generally, the more reinforcement is used, the bearing capacity of the foundation on peat soil will increase. Benefits treated of bamboo grid is not visible on the change in value of the bearing capacity of peat. It can be concluded that the effect was not significant treated of bamboo grid to increase the bearing capacity of a shallow foundation on peat.

Keywords: - *peat, bamboo grid, treated, bearing capacity.*

I. INTRODUCTION

Peat is based on the occurrence of a mixture of fragments of organic material derived from plants that have decayed. Visual observation including color and smell test can help in recognizing peat soil in the field [1]. According to [2] that peat deposits are remnants of decaying plants and fragmented, peat fiber has a hollow structure and mostly occupied by water and very compressible. [3] stated that peat consists of a mixture of organic materials that are still in the process of decomposition respectively.

Peat soil generally has a higher water content than the inorganic soil. Peat showed a unique geotechnical properties compared with inorganic soil like clay and sand which only consists of inorganic particles [4]. [5] state that peat soil denser than the dry sand when the same load is applied to the surface. In addition to high water levels, strong low shear, compression high when receiving a load, peat also has a low bearing capacity, physical properties and geotechnical soil organic matter as the basic foundation of the building is generally the cause of the failure of the foundation ([4]; [6]). [1] states that the peat is one of the most problematic type of soil in the subgrade foundation when implementing civil projects.

[7] Indonesian peatlands covering approximately 20.2 million hectares in Sumatra, Kalimantan, and Papua, with the depth and density is different. Papua has the largest peatland although mostly superficial. Instead, Kalimantan has an area of peat smallest, but relatively deep and very deep. Most peatlands in Sumatra is located in the province of Riau, while in Kalimantan is located in Central Kalimantan. Two in a row the province has 19.4% and 14.9% of the total area of peatlands in Indonesia. While [2], states that the peatlands in Indonesia around 170,000 km^2 or 14% of the total land area and number three largest in the world after Canada and the USA. According to [8] Indonesia has the largest peatland among tropical countries, which is about 21 million ha, spread mainly in Sumatra, Kalimantan, and Papua.

Several types of materials can be used as a reinforcement material. The materials that have been successfully used include steel, concrete, glass fiber, wood, rubber, aluminum and thermoplastic (Jones, 1996). The use of geotextiles as reinforcement embankment over peat soil ([9], [10]), a mattress geocomposite [11], a concrete slab large ([12], [13]), reinforcement geogrid [14], geogrid form biaxial [15], a grid of concrete [16], reinforcement geogrid with a pile of compacted [17], and strengthening geonet [18], all showed a good performance in improving the bearing capacity of reinforced soil.

Natural bamboo material can be used as reinforcement, [19] obtain tensile strength of bamboo grid size of 200 mm x 100 mm in of 106.37 kN/m and initial tangent modulus 7142.85 kN / m. A bamboo strip width of 20 mm and a length of 100 mm produces tensile strength of 87.8 kN m and initial tangent modulus of 38.09 kN/m. While only certain geogrid tensile strength up to 39 kN/m at 15% extension in the direction of the engine maker and 23.5 kN/m at 20% extension in the transverse direction [20]. Results of a review conducted by [21], the use of bamboo as a soil reinforcement can increase the value of the unconfined compressive strength, because of the friction between the ground with the rough surface of the bamboo. In addition to unconfined compressive strength value increases, the decline is reduced and there is no decline is not uniform.

Bamboo as a soil reinforcement is better than geotextiles, this can be seen from the results of research [22], the soil soft clay reinforced with a combination of bamboo and geotextile as a separator between soft soil with embankment material, decreased end much better than retrofitting with geotextile, even from the high-tensile strength geotextiles. [23] using bamboo in the form of a grid and the grid of cells called bamboo grid and bamboo cell as the soft soil reinforcement and compared with geogrid and geocell. Bamboo material for soil reinforcement has advantages compared with geocell in antarnya tensile strength of bamboo is about nine times higher than commercial geocell material, bamboo surface roughness is 3.5 times higher than commercial geocell materials. Load-bearing capacity of soft clay increase three to four times with geocells and four to five times with a bamboo cell compared with no reinforcement. Ultimate bearing capacity of clay reinforced with bamboo and grid cell combination of bamboo is 1.2-1.5 times higher than clay reinforced with geocell and geogrid. In addition to increased carrying capacity, also decreased 97% decrease in clay with the insertion of the cell combination of bamboo and bamboo grid compared to clay without reinforcement. Mat bamboo rods facilitates access, provides the basis for rolling and sewing geotextiles, increasing the carrying capacity and significantly reduce sludge wave [24]. Grid bamboo can increase the bearing capacity of a shallow foundation up to 140% for a one layer, 224% for two layers and three layers 279% for the reinforcement of a bamboo grid [25].

Bamboo can be obtained easily, trunk strong, resilient, straight, easy to use, grow throughout Indonesia and grow naturally or are cultivated, but bamboo has other problems, which often faced the attack vulnerability organisms bamboo fungus, wood powder dry and termites, it is necessary for treated of bamboo, so it can improve the strength and long land. Based on this description, then conducted research on the use of the reinforcement of layers of bamboo that has been preserved in peat soil to improve the soil bearing capacity in foundation construction on peat.

II. RESEARCH METHODS

The experiment was conducted using peat soil samples taken from the village of Selingsing, District Medang Kampai, Dumai, Riau Province - Indonesia, the bamboo used is a species of bamboo smear taken from Menteng VII - Medan, North Sumatra - Indonesia. Preliminary test results Selingsing peat consists of 101% water content; gravity of 1.25; wet volume weight 11 kN/m^3; cohesion of 10 kPa; 27% friction angle; ash content of 14%; organic content of 86%, and 25% fiber content. Organic content> 75%, the soil is classified as peat, fiber content> 20%, then this includes peat as fibrous peat soil (Waruwu, 2014).

Research conducted at the Laboratory of Soil Mechanics of Medan Institute of Technology by a foundation model that has a size of 15x15 cm^2 square and 1 cm thick, made of steel is placed in the middle of the surface of a layer of peat. Peat soil has been cleaned is inserted into the test box measuring 120 cm x 90 cm and a height of 90 cm (Fig 2-1). Before it entered into a tub of water given to peat soil and saturated moisture content of close to 200% and then compacted every 15 cm with the roller to the elevation of 90 cm suit research [25]. Peat was ready for loading test then modeled in accordance with a predetermined. Tests on peat soil without reinforcement and with a bamboo grid reinforcement. Number of reinforcement layer one layer, two layers and three layers. Grid bamboo were used by with and without treated. Boucherie-Mourisco treated principles, which include preservative solution of borax with water preservative into the bamboo with air pressure. The tool system circuit of the air pump, air tanks are equipped with a manometer, a preservative fluid tank, air duct pipes, pipelines preservative, air flow regulator valves, flow regulator valves and nozzles for installation preservative that will be treated bamboo (Fig 2-2).

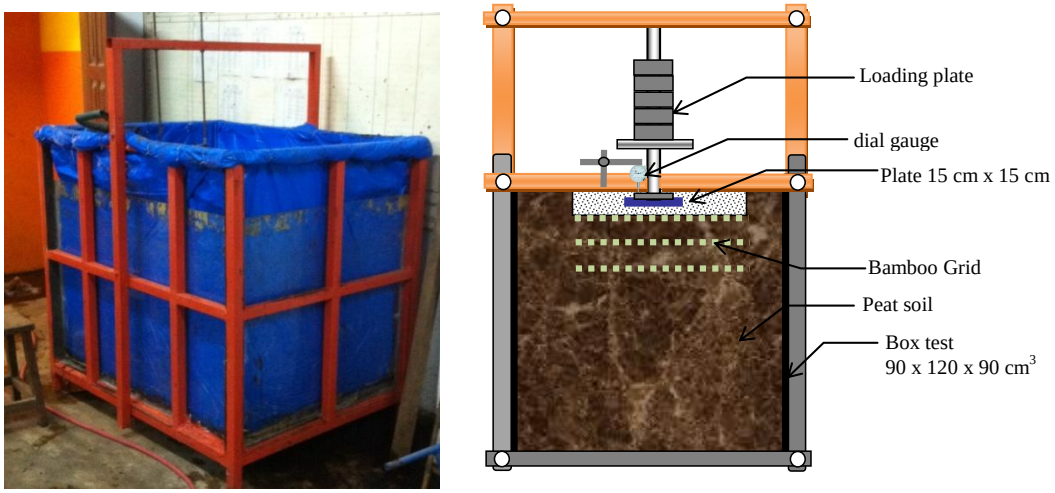

Fig 2-1 Scheme of model test in the laboratory

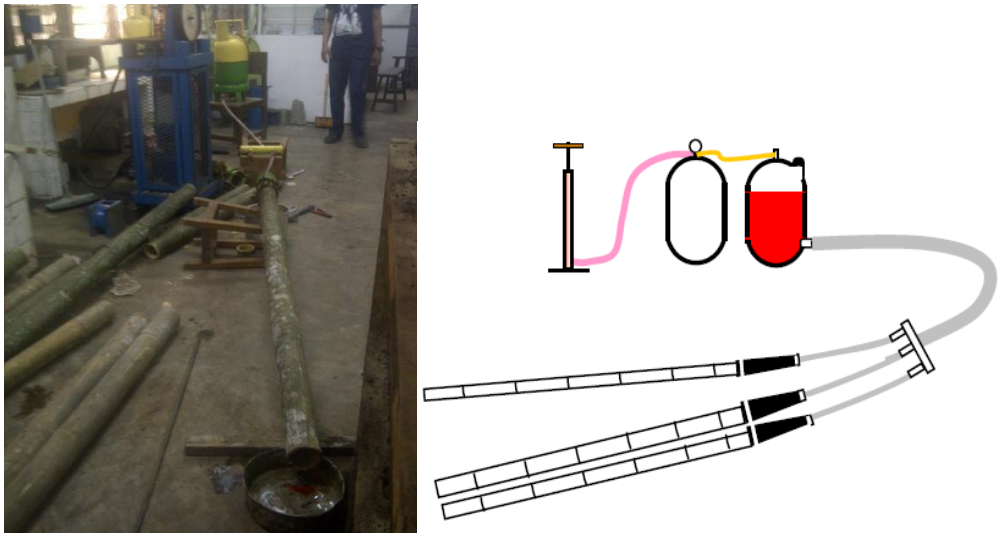

Fig 2-2 System of treated bamboo

III. RESULTS AND DISCUSSION

3.1 Behavior building foundation on the peat soil

The buildings that stand in peatland mostly not able to last long. Bearing capacity of the foundation looks pretty good in the early days of construction, but will not hold up in the long term. This is because for a long time, the peat will decrease secondary consolidation which is the largest component in the compressed peat.

Based on field observations in the area of peatland, it was found that the building above the peat is not able to withstand the burden of building a house that simple though. Building foundation has decreased while building his house collapsed without physical damage to the building. The building houses just tilted to the side (Fig 3-1), this means that the foundations in peat soils decline is not uniform due to the work load.

(a) (b) (c)

Fig 3-1 The mechanism of failure of the buildings on peat soil: (a) Land compressible, (b) Settlement of foundation, (c) Building collapse

3.2 Peat behavior with bamboo grid reinforcement without treated

The behavior of the foundation bearing on peat soil with a bamboo grid reinforcement without treated is shown in Fig 3-2. The land peat dipekuat with bamboo grid generating significant bearing capacity compared with peat without reinforcement. Bearing capacity of the foundation at the time a 10% reduction in the width of the foundation is increasing in line with the increase in the number of grid reinforcement layer of bamboo. The value of bearing capacity increased significantly after the installation of the reinforcement layer. Increasing the value of the bearing capacity of 0,018 kg/cm^2 to the bearing capacity of 0,048 kg/cm^2 for single-layer grid of bamboo.

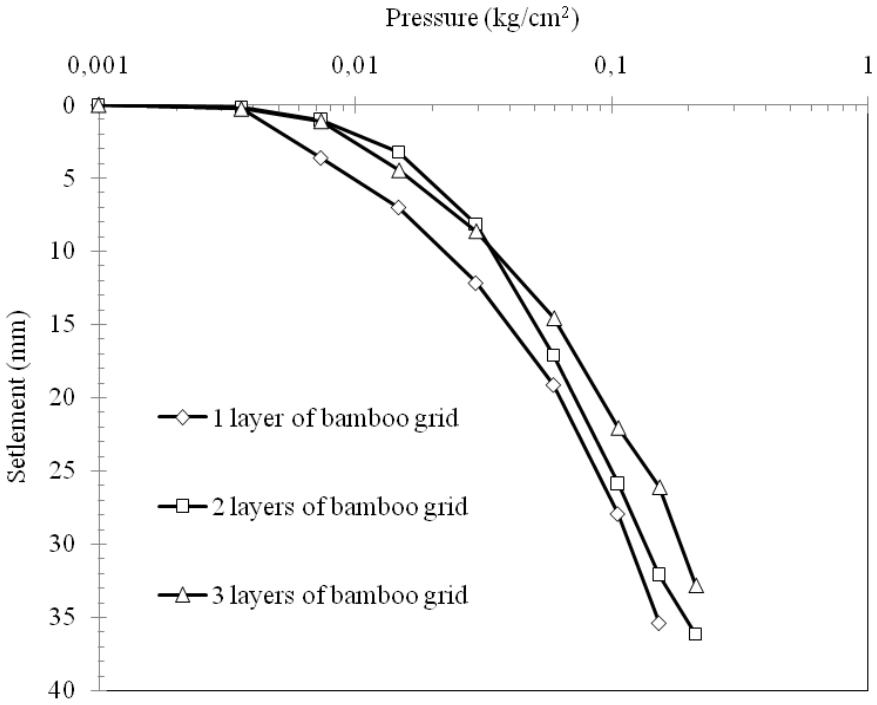

Fig 3-2 Behavior peat with grid bamboo reinforcement

The greater the applied load smaller decline, this means that an increase in load will be very influential in the reduction of peat soil compression. Likewise, the effect of the installation of grid reinforcement bamboo against confinement decline. The more the number of grid reinforcement layer of bamboo mounted, will increasingly reduce the decline. The decline has narrowed, meaning diminishing compression and vice versa peat soil bearing capacity will increase. The amount of reinforcement used greatly affect the increase in the value of the peat soil bearing capacity. Generally, the more reinforcement is used, will further increase the value of the foundation bearing on peat soil.

3.3 Peat behavior with reinforcement of treated bamboo grid

Before the grid of bamboo is used as a reinforcement in the peat first made of bamboo preservation system. Bamboo that has been treated with a preservation system Boucherie-Morisco, formed in grids of bamboo with a size of 4 times the width of the foundation model. Fig 3-3 is a plate load testing results on peat soil with one, two, and three-layer bamboo grid reinforcement is preserved. Pressure relationship with the decline seen in the burdens of early form linear line. This condition can be interpreted that the behavior of the soil is still in a state of elastic and not collapse. The addition of the load will result in a decrease in the greater. Number of layers of reinforcement will affect the carrying capacity and decline.

An increase in the carrying capacity of the foundation is not directly proportional to the number of layers of reinforcement. This means that the number of layers of reinforcement which continuously increases would not greatly affect behavioral impairment and the carrying capacity of the foundation. Three layers of reinforcement produces increasing the carrying capacity that is not too large. While changes in the carrying capacity of a single layer into two layers retrofitting retrofitting greater than the change in the bearing capacity of two to three layers of reinforcement ply reinforcement. In the early days of loading, carrying foundation with two layers of reinforcement is greater than the carrying capacity of the foundation of three layers of reinforcement. Bearing capacity of the foundation with two layers of reinforcement is almost equal to the three layers of reinforcement, it may mean that increasing the number of layers in the top three layers will not provide significant results

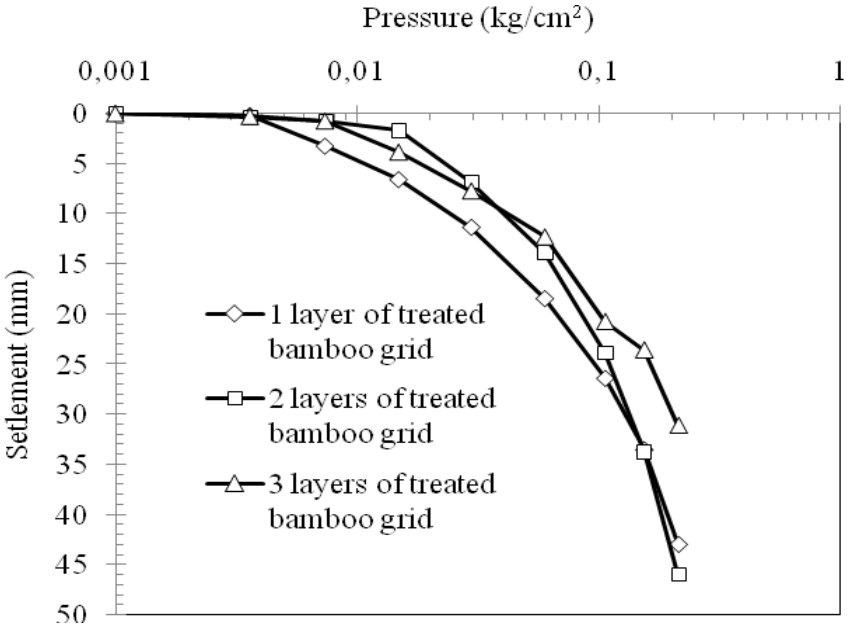

Fig 3-3 Behavior of peat with reinforcement of treated bamboo grid

3.4 Influence of treated bamboo grid toward bearing capacity

Comparison of the use of bamboo grid with and without treated of the respective number of layers of reinforcement, can be said to benefit the treated of the bamboo grid is not visible on changes in the value of the shallow foundation bearing capacity on the ground peat. Behavior and decrease the bearing capacity for the grid of bamboo without treated is similar to bamboo grid with treated for each number of layers of reinforcement. It can be concluded that the effect was not significant treated of bamboo grid to increase the bearing capacity of a shallow foundation on peat. Likewise, the decline that occurred almost equally between bamboo grid without treated and with treated. Treated of bamboo gives little effect on increasing the bearing capacity of the foundation (Fig 3-4). Each of these layers is preserved bamboo reinforcement grid shows the value of bearing capacity greater than the bamboo grid reinforcement that is not preserved. It can be concluded that the treated of bamboo grids for soil reinforcement considered less significant in increasing the value of the bearing capacity of the foundation.

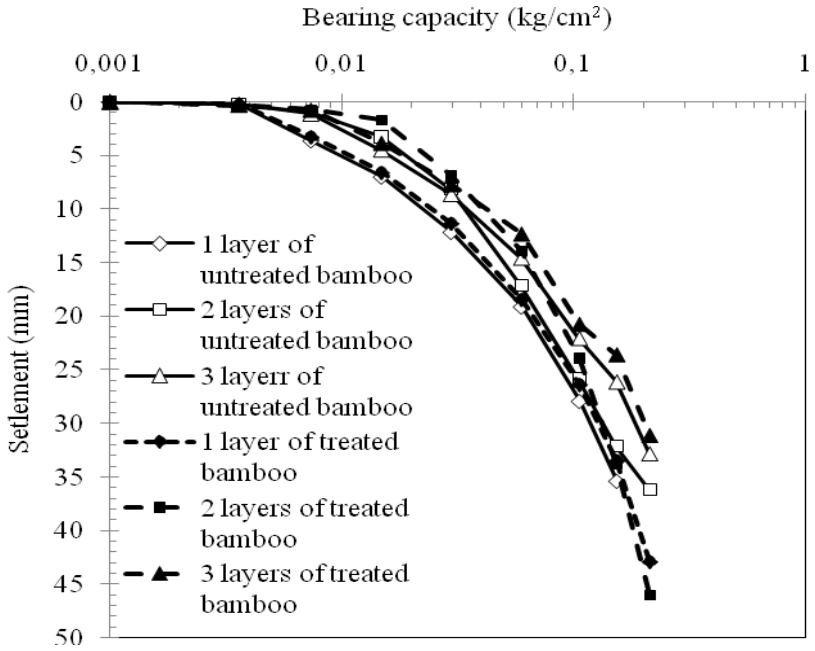

Fig 3-4 Behavior of peat soil with treated and without treated bamboo grid

This is similar to the results of research and Sitharam Hegde (2014) on the use of a grid of bamboo and bamboo without the treated of cells. With pickling, the surface roughness was found reduced to 20%. Bamboo behavior in terms of capacity tensile strength and bearing capacity of clay found reduced 15-20% after pickling. Relationship carrying capacity and a decrease in various test by [23] shows that the bearing capacity of the ground with a grid of bamboo and bamboo cell that has been treated is smaller than the grid of bamboo and bamboo cells were not treated.

Bamboo preservation invisible influences affect the bearing capacity of the foundation on peat soil. The preservation of this relates to the durability of the bamboo, while the bearing capacity related to the tensile strength of the bamboo so as to increase the bearing capacity of the soil, reducing deformation laterial and a vertical drop so that the stability of the foundation can be increased. Based on these results and the reference learned it can be concluded bamboo preservation are not significant on a grid of bamboo as reinforcement.

In Fig 3-5 is shown a decrease in the ratio relationship (S) to the width of the foundation (B) with an emphasis on strengthening the foundation to get the effect of a bamboo grid with and without preserving the bearing capacity of the foundation on peat soil compared with the bearing capacity of the foundation on peat soil without reinforcement. Decrease the value taken from the results of the third test foundation model. The results showed that the foundation bearing on peat soil will semakian increased with increasing number of layers of reinforcement, but the preservation of bamboo as reinforcement does not give significant results in an increase in the bearing capacity of the foundation on peat soil. Bearing capacity with bamboo reinforcement is preserved with the uncured almost the same, where the bamboo grid reinforcement without treated is marked with a full line and a dotted line for retrofitting with preservation of bamboo grid (Fig 3-5). Treated bamboo does not show an increase in the strength of bamboo as a soil reinforcement, this can be due to the benefits of preservation is still not visible in the early moments after curing. Thus it takes longer after harvesting and after pickling to see the behavior of bamboo as reinforcement to increase the bearing capacity of foundation on peat soil.

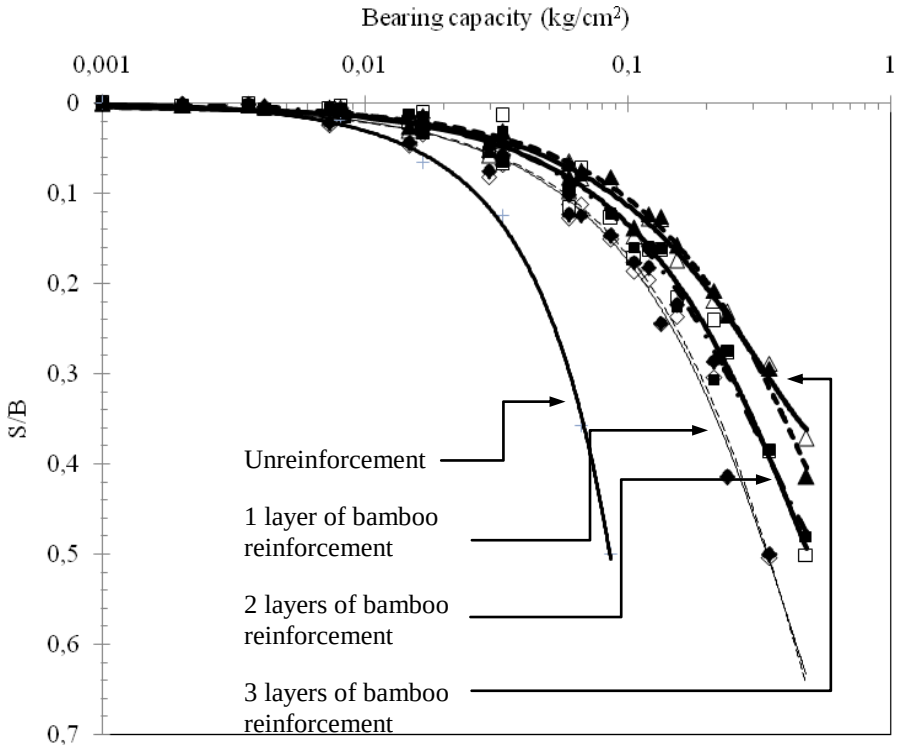

Fig 3-5 Relationship of ratios settlement with the pressure on peat with the bamboo grid without and with treated

IV. CONCLUSION

The conclusion from this study include is the building on peat is not able to withstand the burden of building a house that simple though. Building foundation has decreased while building his house collapsed without physical damage to the building. The building houses just tilted to the side, this means that the foundations in peat soils decline is not uniform due to the work load. Land peat dipekuat with bamboo grid generating significant bearing capacity compared with peat without reinforcement. Bearing capacity of the foundation at the time a 10% reduction in the width of the foundation is increasing in line with the increase in the number of grid bamboo reinforcement. The value of bearing capacity increased significantly after the

installation of the reinforcement layer. Generally, the more reinforcement is used, will further increase the value of the foundation bearing on peat soil. The same is obtained obtained on bamboo grid reinforcement is treated. Comparison of the use of bamboo grid with and without treated of the respective number of layers of reinforcement, can be said to benefit the treated of the bamboo grid is not visible on changes in the value of the shallow foundation bearing capacity on the ground peat. Behavior and decrease the bearing capacity for the grid of bamboo without treated is similar to bamboo grid with treated for each number of layers of reinforcement. It can be concluded that the effect was not significant treated of bamboo grid to increase the bearing capacity of a shallow foundation on peat. Likewise, the decline that occurred almost equally between bamboo grid without treated and treated. Treated of bamboo gives little effect on increasing the bearing capacity of the foundation.

V. ACKNOWLEDGEMENTS

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