JIT Journal of Innovation and Technology
e-ISSN: 2721-8562; p-ISSN: 2721-8570
Vol. 5, No. 1, April 2024. Page: 1 – 4

Experimental trials to detect the lateral displacement on granular material embankment inserted geosynthetics due to the vertical loads

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Article history
Received: 12.27.2023
Revised: 22.02.2024
Accepted: 27.02.2024

DOI:10.31629/jit.v5i1.7223

Abstract

The usage of geosynthetics to improve the bearing capacity on granular material of embankment construction is worldwide familiar applied. The paper elaborates the lateral displacement of embankment inserted geosynthetics resulted vertical load on the top of embankment. This type of construction is applied like Mechanically Stabilized Earth- Retaining Wall (MSE-RW). Varied distances of inserted geosynthetics with low tensile strength on granular material of embankment for 20, 30, 40, 60 respectively cm installed on totally 140 cm-high of embankment. Each of layer is installed with varied distances with 120 cm -wide must be wrapped in order to avoid loses grains of granular material of embankment. The varied vertical surcharge at the above of embankment started with 19, 34, 49 kg respectively. The result of research indicates that number layer with inserted geosynthetics on granular material of embankment influences the lateral deflections which much more layers of geosynthetics or smaller vertical distance of geosynthetics provides smaller lateral deflection. Beside that increased vertical load implies the lateral deflection is increased.

Keywords: Vertical load, lateral deflection, granular embankment, geosynthetics

1. Introduction

Geosynthetics is familiar used when improving the weak ground and it has already been applied worldwide in the field especially to solve problem on geotechnical engineering and pavement engineering. Some constraints during constructing a roadway, rail way, and other transport infrastructure it is often found a limited terrain or a high cost regarding with available land.

A slender construction but it provides a good performance is needed to solve the technical problem. For instance, mechanically stabilized earth retaining wall (MSE-RW) is a slender construction which it receives the traffic load e.g. vehicles and or trains. To reinforce or stabilize the retaining wall of granular material embankment, it can be applied geosynthetics inserted layer by layer with certain vertical distance between geosynthetics, Das, 1985 [4], Aydogmus et al.,2011 [2].

The challenge for engineers is not only facing the problematic soil, like soft soil, expansive soil, but also constraint of availability land. It must be solved to provide a good performance for some infrastructure especially on sector transportation.

Application of geosynthetics to some infrastructure projects is worldwide used. It is also research regarding with interaction between granular material (non-cohesive material) and geosynthetics. And also research to know interaction between geosynthetics and non-cohesive material are developed in anywhere in the world, Althoff, 2011 [1], Tamascovics et al., 2010 [5]. Some method to elaborate this behavior can be analyzed with statistical approach to conclude interpretation the result, Ang et al.,1975 [3].

2. Installation and Materials

There are four types of trial to be installed related to insertion of geosynthetics on granular material of embankment. To illustrate the scheme of installation, it is shown below.

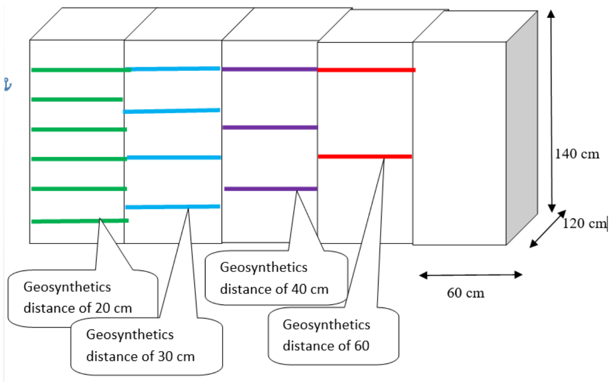

Figure 1. Scheme of geosynthetics insertion

Geosynthetics must be inserted on granular material of embankment with layer by layer and it should be wrapped in order to avoid the loses of grains of material embankment. Overlapping at tip of geosynthetics during wrapping more or less 30 cm long.

On the trial of research, geosynthetics is applied to insert on the granular material embankment with low tensile strength. The tensile strength is between 20 and 30 kN/m. They make the embankment consist of layer by layer after it is inserted the geosynthetics. Material of geosynthetics is made of polyester (PET).

To measure lateral deflection, each of layer is placed a dial gauge at the middle of thickness of layer. Finally, three kinds of surcharge of 19, 34, 49 kg, respectively at the top of embankment. Each vertical load provides value of lateral deflection at each layer.

Scheme of installation for the embankment, insertion of geosynthetics, dial gauge, and surcharge is descripted as below.

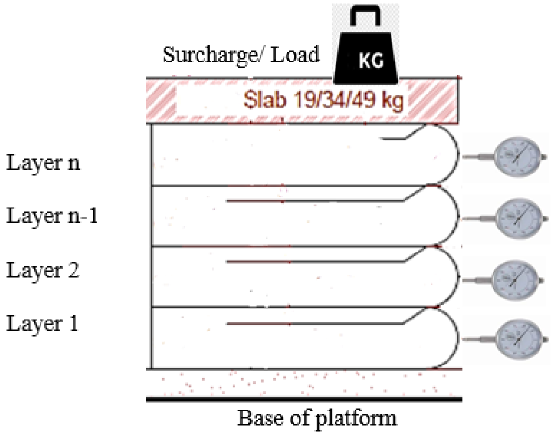

Figure 2. Geosynthetics insertion, deflection measurement, and Surcharge

3. Discussion and Result

Embankment with insertion of geosynthtics on the field comprises a stack of wrapped granular material as shown below.

Figure 3. Embankment with insertion of geosynthetics

Measurement of lateral deflection for each layer and each loading provides values depend of number of layer and size of loading as summarized on table below.

Table 1. Measurement of lateral deflection

Distance of Geosintetis (cm)	Layer i^th	Lateral deflection (mm)		
		Load 19 kg	Load 34 kg	Load 49 kg
60	2	0,13	0,24	0,31
	1	0,05	0,11	0,14
40	3	0,09	0,14	0,22
	2	0,07	0,1	0,13
	1	0,02	0,04	0,05
30	4	0,06	0,09	0,12
	3	0,04	0,08	0,11
	2	0,02	0,03	0,04
	1	0,02	0,02	0,02
20	7	0,05	0,06	0,08
	6	0,05	0,06	0,08
	5	0,04	0,04	0,06
	4	0,02	0,02	0,03
	3	0,02	0,02	0,02
	2	0,01	0,01	0,01
	1	0,01	0,01	0,01

Based on Table 1 above regarding with values of lateral deflection as a result of measurement use digital dial gauge on each layer can be illustrated with figures as below.

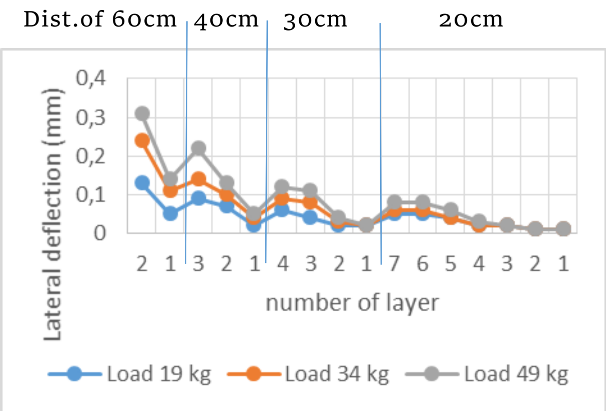

Figure 4. Lateral deflection at varied layers

From Figure 4 shows that lateral deflection is influenced by distance of between geosyntjetics layers. More close the distance between geosynthetics each other result in smaller lateral deflection and vice versa. Besides that, it is proportionally that more higher load at the top of surface embankment will provide bigger value of lateral deflection.

When we incpect indetail that the vertical distance for geosynthetic layer for granular material for 20 cm to 30 cm provide the small deflection. It means that we consider for application purpose that the vertical distance must be max. 30 cm in distance not more.

4. Conclusion

Some results can be summarized from the trial for granular material of embankment inserted geosynthetics and loaded a varied surcharge at the top of embankment. Firstly, smaller distance of inserted geosynthetics provides smaller lateral deflection. Secondly, it is clear proportionally that bigger vertical load at the top of embankment will imply higher lateral deflection.

Then, it is compared to result using vertical distance 40 cm and 60 cm, it provide the lateral deflection near twice even more if compared to 20, and 30 cm, respectively.

Finally that the subjected stress at surface influence the horizontal stress. More bigger load it will give the bigger lateral deflection. It is a proportional based on load subjected over embankment inserted geosynthetics layer.

Acknowledgement

We would like to special thanks to the faculty (Engineering Faculty of the Universitas Tanjungpura) that provide Research Grand of Financial Year 2023 that probable the research have been carried out.

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