ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.5

A Study of Lateral Deflection of Pile in Black Cotton Soil

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Abstract:
The behavior of pile under lateral load is studied through laboratory experiments using model and mild steel piles driven into the black cotton soil with density achieved. The load displacement diagrams were drawn to study the effect of pile diameter, pile length, weight of pile, pile material, density of soil on lateral load capacity of pile. It was found that the lateral load capacity of piles increases with increase in length and increase in number of piles. It is also found that lateral load capacity is more when piles used are more that is lateral load capacity is more for three group of piles compared to 2 piles and 1 pile and similar to increase in length that is lateral load capacity is more for 20cm with the 3 group piles compared to 20cm of 2 piles and 20cm of 1 pile. The model used of dimensions 40cm x 40cm x 46cm and the piles were used of different lengths like 1 pile, 2 piles, 3piles of 10cm, 15cm, 20cm respectively and with intervals of 5min for every increment of load. It was found that the ultimate lateral load capacity of 3 piles with 20cm length is the highest compared to all other sets of piles.

Keywords: Black cotton soil, piles, dial gauge.

I. INTRODUCTION

Black cotton soil (BC soil) is a highly clayey soil. The black colour in Black cotton soil (BC soil) is due to the presence of titanium oxide in small concentration. The Black cotton soil (BC soil) has a high percentage of clay, which is predominantly montmorillonite in structure and black or blackish grey in color. Expansive soils are the soils which expand when the moisture content of the soils is increased. The clay mineral montmorillonite is mainly responsible for expansive characteristics of the soil. The expansive soils are also called swelling soils or black cotton soils.

II. PILES

Piles are commonly used to transfer vertical forces, arising primarily from gravity. Examples of structures where piles are commonly used as foundations are tall buildings, bridges, offshore platforms, defense structures, dams and dock structures, transmission towers, earth retaining structures, wharfs and jetties. However, in all these structures, it is not only the axial force that the piles carry; often the piles are subjected to lateral forces and moments. In fact, there are some structures where the primary function of piles is to transfer lateral loads to the ground. Wind gusts are the most common cause of lateral force (and/or moment) that a pile has to support. The other major cause of lateral force is seismic activity. The horizontal shaking of the ground during earthquakes generates lateral forces that the piles have to withstand. Certain buildings are also acted upon by lateral earth pressures, which transmit lateral forces to the foundations.

Objectives

1. Determination of Geo-technical engineering Properties of Black Cotton Soil.
2. Lateral deflection of Pile of different size in Black Cotton Soil.

III. LITERATURE REVIEW

Salini U. and Girish M. S. The behaviour of pile under lateral load is studied through laboratory experiments on model mild steel and aluminum pipe piles driven into dry river sand. The load-displacement diagrams were drawn to study the effect of pile diameter, pile length, weight of pile, pile material, density of sand, and roughness of pile on the lateral load capacity of pile. It was found that the lateral load capacity of piles increases with increase in length, pile diameter, weight of the pile, pile roughness and increase in sand density. It is also found that lateral load capacity is more for steel as compared to that of aluminium

Mohd Raihan Taha A three-dimensional fnite element approach was used to assess the lateral pile and pile group response subjected to pure lateral load. The study evaluated three pile group confgurations with four values of pile spacing. The results of the infu- ence of load intensities, group confguration, pile spacing are discussed in terms of response of load vs. lateral displacement, load vs. soil resistance and corresponding p–y curves. The improved plots can be used for laterally loaded pile design and also to produce the group action design p-multiplier curves and equations. As a result, design curves were developed and applied in the actual case studies and similar expected cases for assessment of pile group behavior using improved p-multiplier. A design equation was derived from predicted design curves to be used in the evaluation of the lateral pile group action. The equation was used with the previous results to predict the expected design curve take in the account diferent source of p-multiplier

IV. MATERIALS AND METHODOLOGY

Black-Cotton Soil

The black-cotton soil involved in this study was brought at Airport road ,Kalaburagi.In India, expansive soils are called as Black Cotton soil. The name “Black Cotton” as an agricultural origin. Most of these soils are black in colour and are good for growing Cotton.

Collection of Soil Sample: The soil is collected from the above mentioned site. First a pit of 0.5m deep is excavated on open ground and then the soil is collected at that level.

Following Test Has Been Conducted For Collected Sample

- Specific Gravity.
- Liquid limit.
- Plastic limit.
- Compaction.
- Unconfined compression test.
- California Bearing Ratio.

Piles

The piles used are of mild steel, we are using 6 number of piles of diameter of 12mm of different lengths i.e 10cm(3 no's),15cm(3 no's), 20cm(3 no's). These piles are used to check the lateral response of cohesive soil for different lengths of piles in three sets using a pair of piles in each set.

Figure.1. Mild Steel Piles

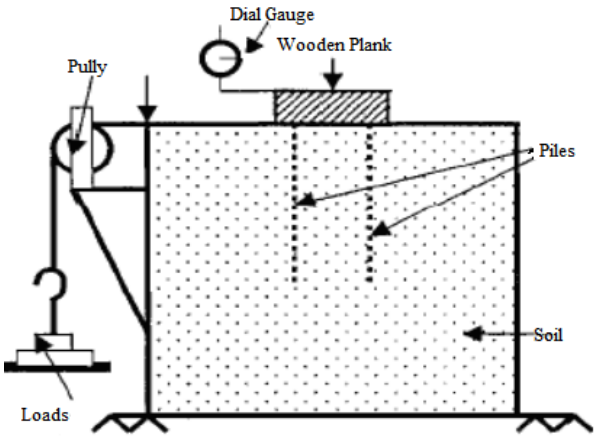

Figure. 2. Test Model

Figure. 3. Model

V. RESULTS AND DISCUSSIONS

The test model of (40cm x 40cm x 46cm) has prepared of pile testing with different sizes. The basic geotechnical properties and lateral deflection of pile has been determined for the black cotton soil.

Table .1. Properties of soil

Sl No.	Soil characteristics	Description
1	Maximum dry density	1.6 g/cc
2	Optimum moisture content	12.5%
3	Specific gravity	2.2
4	CBR (Unsoaked)	1.08
5	Liquid limit	61%
6	Plastic limit	24%
7	Plasticity index	37%

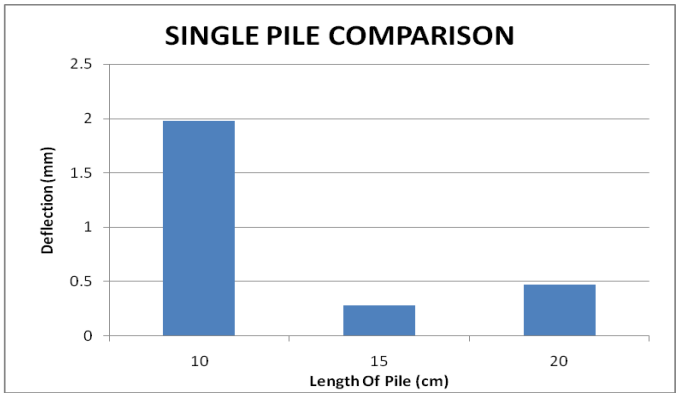

Figure.4. Comparison of Single Piles Of Different Lengths

It has been observed that the single pile having length 10cm gives the minimum deflection of 0.28mm compared to single pile having length 15cm has deflection 0.29 mm and the maximum deflection of 0.31mm occurs in single pile having a length of 20cm. Hence pile of 15cm gives the optimum deflection.

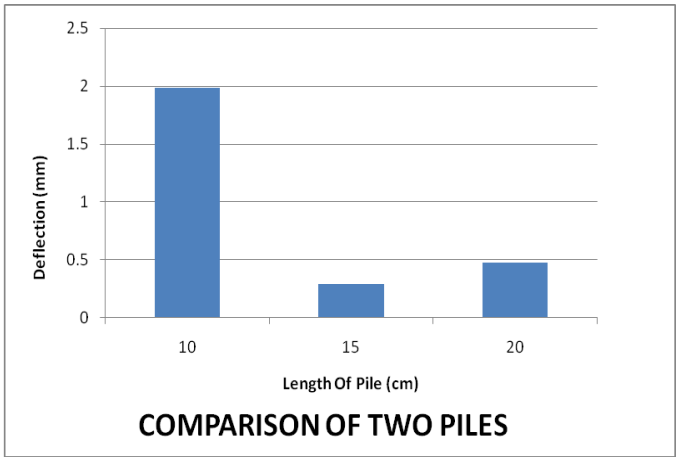

Figure. 5. Comparison of Two Piles of Different Lengths

It has been observed that the two pile having length 10cm gives the deflection of 1.98mm and two pile having length 15cm having deflection 0.2844mm and two pile having length 20cm gives the deflection of 0.47mm.as compared to single pile the deflection is less in two piles. It can also be concluded that due to increase in pile length the deflection has also increased.

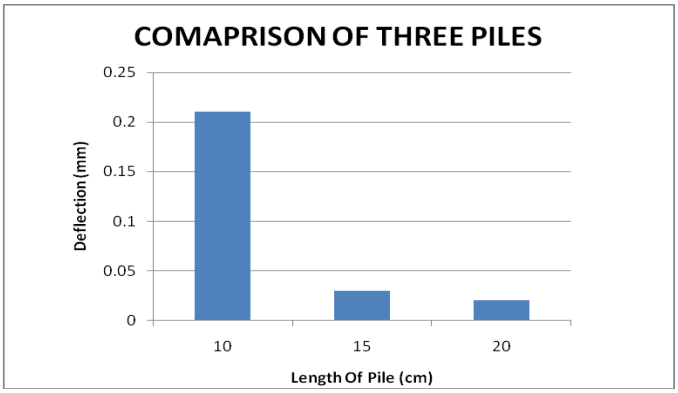

Figure.6. Comparison of Three Piles of Different Lengths

Figure 6 shows that the three pile having length 10cm gives the deflection of 0.21mm and three pile having length 15cm having deflection 0.029mm and three pile having length 20cm gives the deflection of 0.02mm. the deflection in three pile is less as compared to two piles and single piles. It can be concluded that in the three group of piles for 20cm and 15cm length has the lower deflection as compared to 10cm length of pile.

VI. CONCLUSIONS

1. The lateral load capacity of pile increases with increase in length for same diameter since pile stiffness (EI), increases with increase in moment of inertia (I) which depends on the diameter of pile.
2. The lateral load capacity of 3piles with 10cm length is greater than group of 2piles and single pile.
3. The lateral load capacity of 3piles with 15cm length is greater than group of 2piles and single pile of 15cm.
4. The lateral load capacity of 3piles with 20cm length is greater than group of 2piles and single pile of 20cm.
5. Since it can be concluded that 3pile group of different length is having lower deflection compared to other piles.
6. In a three pile group as the length of pile increased the deflection has been decreased.

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