

UPLIFT LOAD CARRYING CAPACITY OF PILES IN MULTILAYER OF SOIL

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Abstract - In this chapter, Single pile and Groups of pile is carried out using pile model of circular PVC pipe pile, circular Galvanised iron hollow pipe pile, circular solid concrete pile (M25) and circular solid timber pile. Diameter of pile is 25.4mm and length is 600mm for all piles and groups of pile, L/d ratio is 24 constant. Arrangement of pile groups is 2x1 and 2x2, is anchored with 7mm thick and 150mm x 150mm size of pile cap. Centre to centre spacing between two piles is kept as 5d is constant for all case of pile groups and size of Model Tank is 600mm x 600mm x 700mm. Results of further study is compare with previous paper and also know about the behaviour of piles and group of piles. Know about which material of pile is more economical and preferable for single pile and group of piles.

Key Words : uplift load capacity, single pile, group of piles, circular solid concrete pile (M25), circular timber pile, circular hollow PVC pipe pile, Circular hollow Galvanised Iron pipe pile.

1. INTRODUCTION

Foundations of some structures like transmission towers, mooring systems for ocean surface or submerged platforms, tall chimneys, jetty structures etc. are subjected to uplift loads. These structures need footings, which can anchor these with the competent strata. To study the effect of pile length, pile diameter, shape, surface characteristics and pile tip properties on uplift capacity of piles, laboratory experimental investigation is carried out. When structures are constructed below the ground water table or if they are constructed under water then uplift forces are applied on the basement of the structures.

1.1 Black cotton soil

Black cotton soils are problematic for Civil Engineers, Because of their unconventional behaviour. These soils show large volume changes with respect to variation of seasonal moisture content. These soils when subjected vehicular traffic, road pavement gets heaved and cracked due to swelling and shrinkage.

As plasticity index and linear shrinkage decreased with the increase of lime content, a mixture of both lime and cement is necessary for adequate stabilization of road bases for heavy wheel loads on the black cotton soils. Previously

derived results from African and Indian black cotton soils are also matched with these results.

1.2 Sandy soil

Sandy soils are the result of the weathering and disintegration of a variety of rocks such as granite, limestone and quartz. This type of soil is easy to cultivate but, since it allows for more drainage than needed, it is important to water it regularly, especially during summer days. As sandy soils don't allow the water to pool around the roots, they are a good choice for plants that have a tendency to suffer from root decay.

Soils that are more than 50 percent sand particles are considered to be sandy soils. Soils made up of more than 80 percent sand are simply referred to as sand. Sandy soils tend to be easier to work than clay soils, and sandy soils are well-aerated, which helps to keep plants roots healthy.

2. EXPERIMENTAL INVESTIGATION

Model piles were prepared from 25.4mm diameter solid concrete pile, Timber pile, Hollow PVC and Hollow G.I. pipe piles. Tests of model piles were carried out in a steel tank of size 600mm x 600mm x 700mm. Experimental situation of pile was single 2 x 1 and 2 x2 pile groups. Size of pile cap was 150mm x 150mm x 7mm and L/d ratio was constant kept as 24. Length and spacing of piles were kept as 600mm and 5d respectively. Center to center spacing between to piles were 125mm.

Table -1: Properties of Soil

Properties	Sandy Soil	Black Cotton Soil
Water content (%)	6.98	21.31
Specific gravity (g/cc)	2.62	2.46
Relative density (%)	63.20	49.72
Cohesion (C)	0.23	16.20
Angle of friction (Φ)	30.70	28.80

Experiment was conducted by hydraulic jack seen in figure 1, in this work a fixed channel is support on tank, jack was put on upside of channel and proving ring was hanged below the channel. A plate was rest on jack and rigid connection with pile cap by steel rod.



Fig -1: Set-up of experiment

There were two types of soil; sandy soil and black cotton soil, which were used for experiment. Soil was compacted by layered wise in tank as per it's relative density. Bottom layer of sandy soil and top layer of black cotton soil was 400mm and 300mm respectively.



Fig -2: Dial gauge and Proving ring

Two dial gauges were situated on diagonal sides of pile cap. After all set-up test was performed. By working of jack, compression was generated on proving ring and calculation of applied load is depend on ring constant division.

Pull-out test was performed on single pile and group piles. In this investigation load was constantly increase and noted the displacement at constant loading

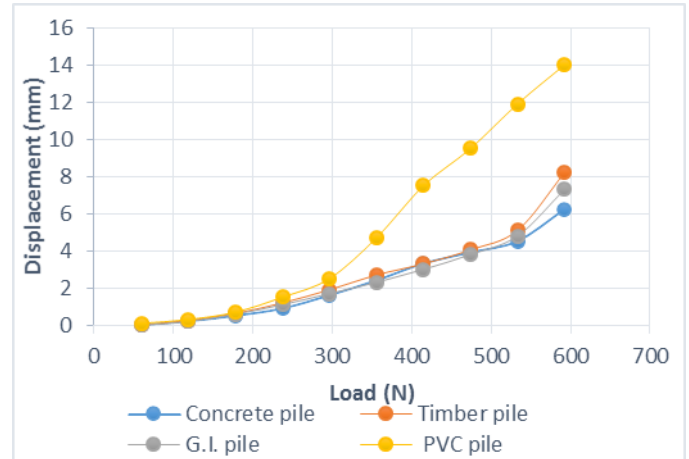


Chart -1: Load Vs. Displacement of single pile

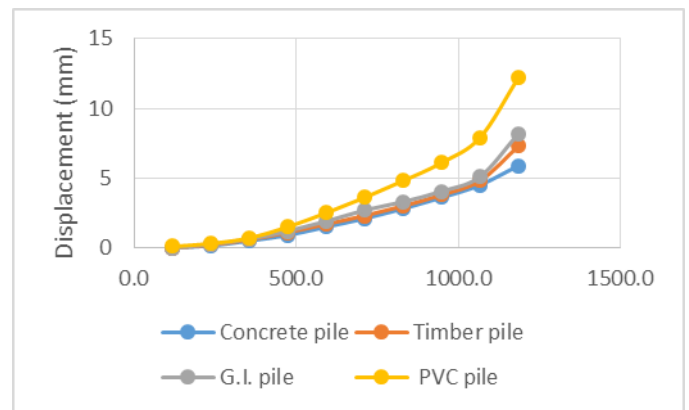


Chart -2: Load Vs. Displacement of group pile (2 x 1)

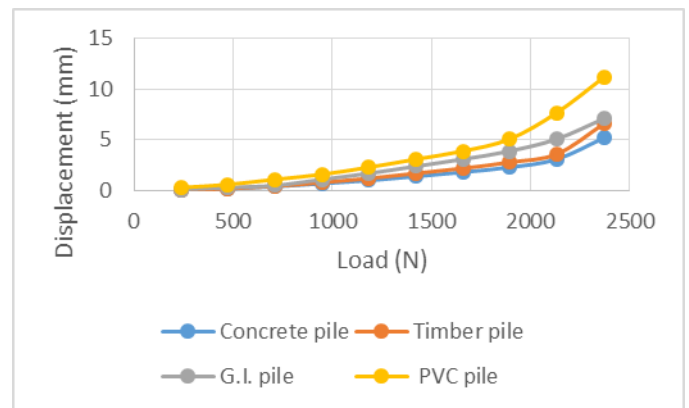


Chart -3: Load Vs. Displacement of group pile (2 x 2)

In all cases of pile, characteristics of ultimate uplift load Vs. uplift displacement was not linear in nature. It is curvilinear with concave upward during initial loading and it turns into fairly straight line, after reaching ultimate load.

3. CONCLUSIONS

For single pile

- Concrete pile resists higher amount of uplift load than G.I. Pipe, timber pile and PVC pipe pile. Due to smoother surface characteristics, PVC piles having least resistance against uplift.
- G.I. Pipe resists higher amount of uplift load than, timber pile and PVC pipe pile.
- By increasing relative density, resist more uplift force.

For group pile

- The ultimate uplift load vs. uplift displacements Characteristics is non-linear in nature.
- Concrete pile resists higher amount of uplift load than other piles.

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REFERENCES

- [1] Chattopadhyay, B.C., and Pise, P.J. (1986). "Uplift capacity of piles in sand", *Journal of Geotechnics Engineering*, Vol.112, No.9, pp. 888-904.
- [2] Das, B.M. (1983). "A procedure of estimation of uplift capacity of rough piles, *Soil and Foundation*", Vol.23, No.3, pp.122-126.
- [3] Kulhawy, F.H., Kozeza, D.W., and Withaim, J.L. (1979). "Uplift Testing of Model Drilled Shafts in Sand", *Journal of Geotechnics and Environmental Engineering*, American Society of Civil Engineers, Vol.105, pp.31-47.
- [4] Downs I, Chieurrazzi R (1966) "Transmission tower foundations". *J Power Div, ASCE*, 92(PO2), Proc Paper4750:91-114.
- [5] Patra NR, Pise PJ (2003) "Uplift capacity of pile groups in sand", *Electronic Journal of Geotechnical Engineering*, EJGE.
- [6] Sharma BVR, Pise PJ (1994) "Uplift capacity of anchor piles in sand under axial pulling loads". *Indian Geotech J* 24(3):181-203.
- [7] Mayerhof GG, Adams JI (1968) "the ultimate uplift capacity of foundations". *Can Geotech J Ottawa* 5(4):225-244.
- [8] Turner EA (1962) "Uplift resistance of transmission tower foundation". *J Power Div, ASCE* 88:17-33.