Surface Friction on Pullout Capacity of Pile in Sandy Soil

P. Dayakar, K. Venkat Raman, R.Venkatakrishnaiah

Abstract: ***At the point when structures are built underneath the ground water table or in the event that they are developed submerged, elevate powers are to be applied on the storm cellar of structures. Likewise on account of transmission line towers, securing frameworks for sea surface or submerged stages, tall stacks and so on are generally exposed to upsetting minutes because of wind, wave weight or ship sway and so forth. These upsetting minutes are moved to structures establishment as pressure on certain components and pullout on others. For establishments in such structures, typically a blend of vertical and hitter heaps is utilized. A huge scale exploratory program utilizing vertical model heaps (Cement Mortar heaps) in sand exposed to pullout loads has been done in a model tank of size 25cm x 25cm x 25cm. Gentle steel of 8 mm measurement is utilized for safe haven reason. PVC funnels of changing breadths, lengths, are utilized for throwing of model heaps. An inadequately reviewed stream sand having explicit gravity G = 2.61, Uniformity coefficient = 3.62, ebb and flow coefficient = 0.91 has been utilized as establishment medium. It is to watch the conduct of sand when heap is exposed to pullout limit. Likewise the pullout limit of heap is resolved with various length to distance across proportions on sand.***

Keywords – Pullout Capacity, Model Piles, Sand bed, Vertical piles, Pile roughness

I. INTRODUCTION

There are many structures which are subjected to uplift, tensile and compressive forces. The structures subjected to these forces include pipeline anchors, radar towers, excavation bracings, suspension bridges, offshore structures, etc[1]-[5]. Many researches have been carried out on piles subjected to pull-out in cohesion-less soil of varying densities.

Various speculations with respect to conduct of heaps under various stacking conditions have been created throughout the years. The dependability of the hypotheses can be exhibited uniquely by correlation of test results on display or field heaps with the hypothetical forecasts[6]-[10]. Full-scale field tests, however profoundly alluring, are commonly costly and hard to perform. Without assets and extent of testing model little scale research center model test led on heaps in establishment medium arranged under controlled condition may fill the need somewhat. Appropriately directed research center tests, with realized parameters influencing the dirt heap reaction under pulling burdens would give data on subjective and quantitative commitments of such parameters on extreme obstruction of heaps without field test results[31]-[34]. Compared to previous studies in this area, this investigation proposes to consider wider range of parameters and their effects on the uplift capacity of piles.

Pile-soil interaction problem is very complicated. The phenomenon is a function of pile material, its surface characteristics, length, diameter, soil-pile friction angle, geometry of group, methods of installation and end conditions, soil characteristics like consistency, compactness, stratification, consolidation, sensitivity, drainage conditions, dissipation of excess pore pressures and shear parameters, location of water table and type of loading. Extensive theoretical and experimental investigations are available on the behavior of piles and pile groups subjected to axial, inclined or lateral compressive loads[11]-[15]. They relate to load carrying capacity of the piles/pile groups, load-displacement response, buckling etc. Consequently the design and analysis of piles under these loading conditions can be done with greater assurance and economy under normal operating conditions.

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II. METHODOLOGY

A. Soil properties

Various tests have been performed on soil, details of which are mentioned as below;

Table 1: Properties of Soil

S.No.	Name of Test	Symbol	State of Soil	Values	Units
1	SPECIFIC GRAVITY OF SOIL	G	LOOSE	2.61	Unitless
2	GRAIN SIZE DISTRIBUTION	C_U C_C	LOOSE	3.16 0.91	Unitless
3	COMPACTION OF SOIL	$\gamma_{d\,max.}$ OMC	DENSE	1.832 11.9	g/ cc %
4	RELATIVE DENSITY	R_d	LOOSE & DENSE	44.44	%
5	DIRECT SHEAR TEST	Φ δ	LOOSE	33.97 37.56	Degrees

B. Casting of shear box specimens

Shear box specimens of size 6cm x 6cm are casted using pile material (cement and sand) in order to determine the exact pile-soil friction angle (delta) which is responsible for load transfer through skin friction when pile is subjected to loading.

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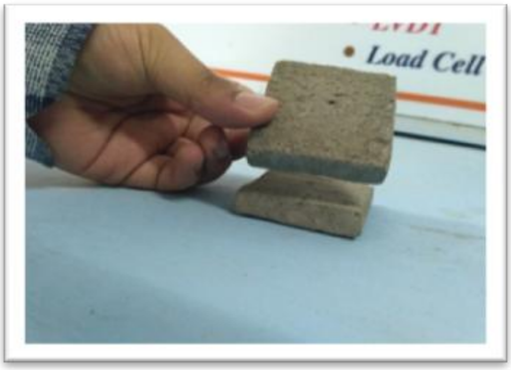


Figure – 1 Casted specimen

Figure – 2 Interface b/w sand and specimen

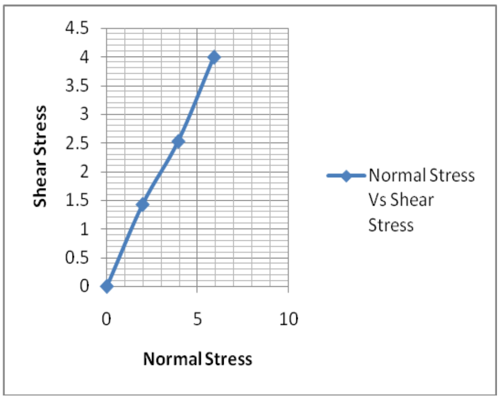


Figure – 3 Determination of φ for sand

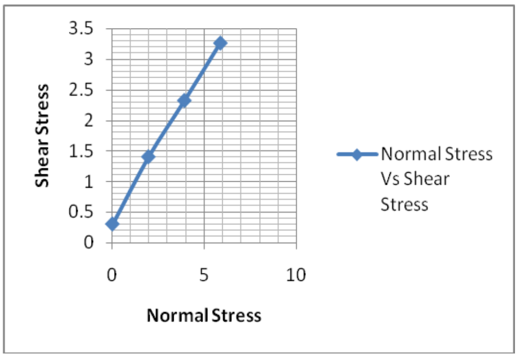


Figure - 4 Determination of friction b/w sand and pile material

i) Internal angle of friction, φ = 33.96
ii) Soil pile friction angle, δ = 37.56

C. Casting of model piles

Cement mortar piles of different lengths are casted using a hollow pipe (PVC pipe). Pipe of required length and diameter is cut. Mosquito net is being used to make the pile surface rough. A 6mm diameter bar is placed in the centre of pipe with sufficient allowance length at the top which is then rigidly fixed with the load cell when pile is subjected to pullout[16]-[20]. To determine the pullout capacity of piles in sandy soils, model piles of different parameters are casted and are mentioned as follows.

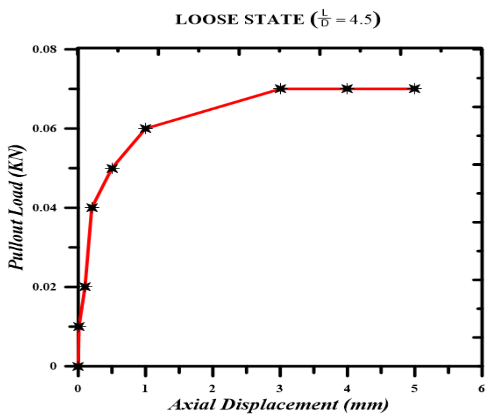
i) Length of pile = 17cm , diameter = 3.75cm, L/D = 4.5
ii) Length of pile = 15cm , diameter = 3.75cm, L/D = 4
iii) Pile with smooth surface
iv) Pile with rough surface

Figure 5- Casted model pile, L/D = 4.5

- Pullout capacity test on model pile in loose state, L/D = 4.0
- Pullout capacity test on model pile in medium dense state, L/D = 4.0
- Pullout capacity test on model pile in dense state, L/D = 4.0
- Pullout capacity test on model smooth pile
- Pullout capacity test on model rough pile[21]-[24]

III. RESULTS AND DISCUSSION

1. In loose state with L/D = 4.5



2. In medium dense state with L/D = 4.5

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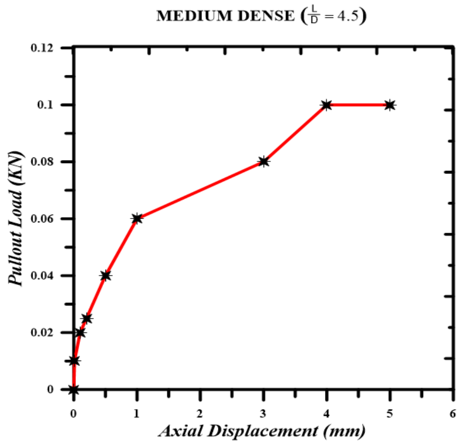
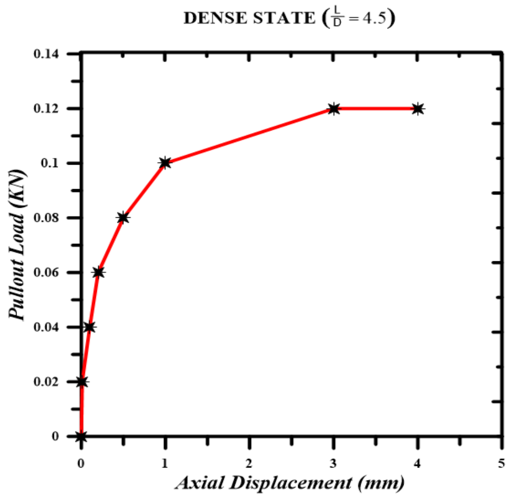
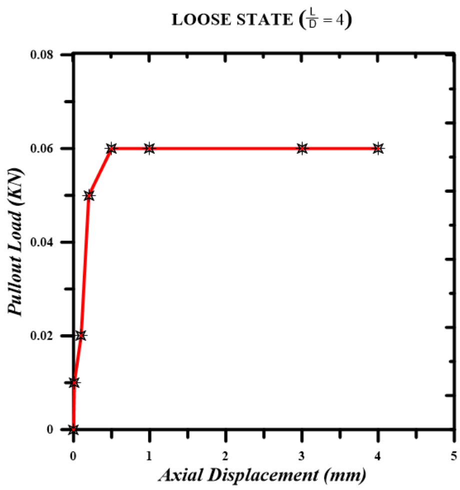


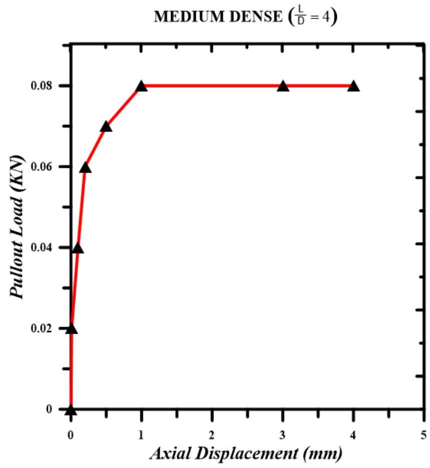
3. In dense state with L/D = 4.5



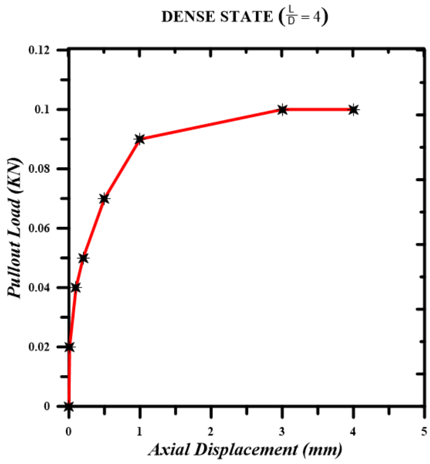
4. In loose state with L/D = 4.0



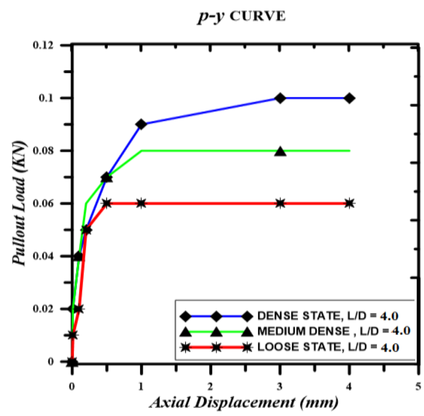
5. In medium dense state, L/D = 4.0

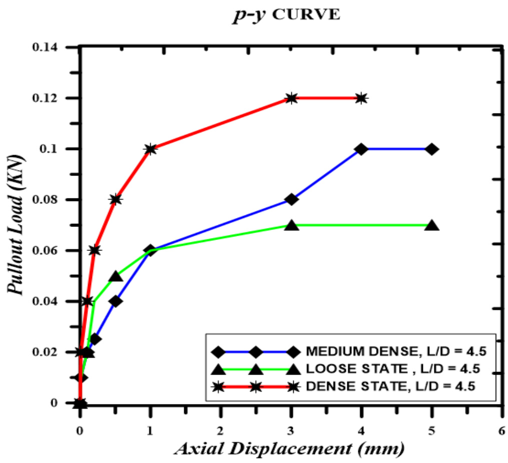


6. In dense state, L/D = 4.0

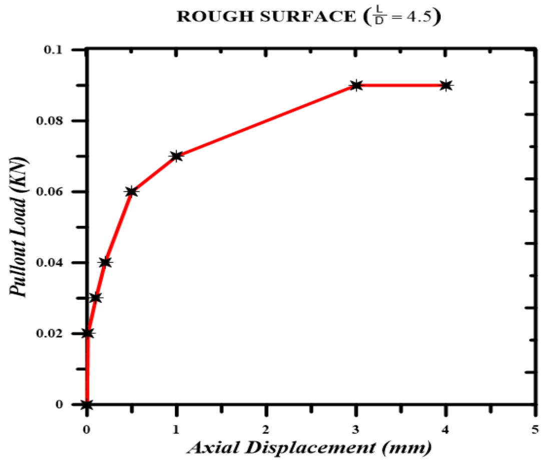


7. Comparison of L/D = 4.5 with L/D = 4.0





L/D = 4.5

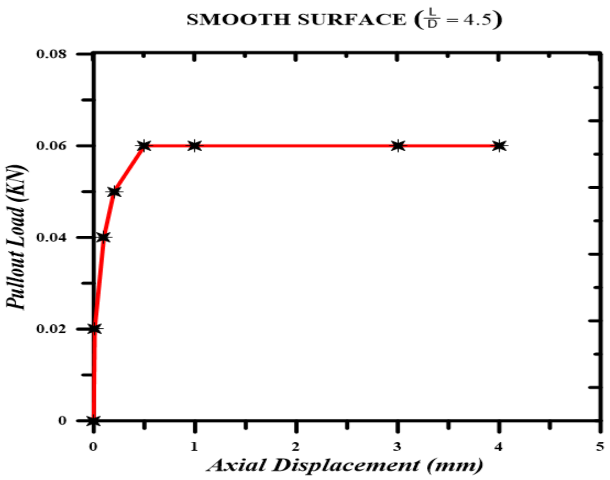


Rough Surface

8. Comparison of pullout capacity of pile in different soil states

	L/D = 4.0			L/D = 4.5		
	LOOSE	MEDIUM	DENSE	LOOSE	MEDIUM	DENSE
PULLOUT LOAD (kN)	0.06	0.08	0.1	0.07	0.1	0.12
%age INCREASE	0	33.33	66.66	0	42.85	71.42

9. Influence of surface characteristics



Smooth Surface

IV. CONCLUSION

From the laboratory investigations that have been carried out, the following conclusions are drawn;

- Axial pullout load versus hub dislodging outlines for vertical heaps are basically straight at starting phases of stacking and non-direct at later stages.
- Pullout limit of heap is seen as additional in thick state contrasted with medium and free state[25]-[30].
- The pullout limit of heap in thick state with L/d = 4.0 is found to have 66.66% expanded contrasted with its free state.
- The pullout limit of heap in thick state with L/d = 4.5 is found to have 71.42% expanded contrasted with its free state.
- The opposition offered by the heap at any pivotal dislodging increments altogether with increment in surface unpleasantness.
- The obstruction offered by the heap at any hub uprooting increments altogether with increment in L/d proportion.

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