IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Experimental study on cyclic load test on model piles in sand

[1]Dr.Shivamanth Angadi

Associate professor, KLS Gogte Institute of Technology, Khanapur Road, Udyambag, Belagavi- 590 00

[2] Sahana Shivaji Sunagar

B.E, Dept. of Civil Engineering,KLS Gogte Institute of Technology Belagavi, India

[3]Ranjeeta Satyaigol

B.E, Dept. of Civil Engineering, KLS Gogte Institute of Technology Belagavi, India

[4] Basavaraj Katgeri

B.E, Dept. of Civil Engineering,KLS Gogte Institute of Technology Belagavi, India

[5]Ranta Harijan

B.E, Dept. of Civil Engineering,KLS Gogte Institute of Technology Belagavi, India

Abstract: Piles are essential foundation elements designed to transfer load through varying soil layers. Determining their load-carrying capacity is crucial, especially under cyclic loading condition that simulate real-world scenarios. This study investigation the cyclic load behavior of model piles in sand, focusing on elastic and plastic settlement components. Experiments were conducted on piles of varying diameter and length in river sand. The piles were driven using hydraulic jacks, and load-settlement curves were generated to evaluate ultimate capacity. Results indicate that larger pile diameters exhibit higher skin friction in sand, and the load-carrying capacity for cyclic loading differs significantly from direct static loading due to settlement behavior.

Keywords: piles, cyclic load test, model piles, friction

I. Introduction

Piles are widely used as deep foundation elements to transfer loads from superstructures to deeper soil layers with adequate bearing capacity. Their performance is critical in various civil engineering application, especially when subjected to cyclic loading, such as those caused by wind, waves, or repeated vehicle movement. Cyclic loading can induce settlements that differ significantly from static loading condition, making it necessary to assess the behavior of piles under such conditions.

The load-carrying capacity of pile is influence by factors such as soil type, density, pile geometry, and installation methods. While static load test are commonly employed to determine ultimate capacity, cyclic load tests provide a deeper understanding of elastic and plastic settlement, as well as the progressive failure mechanisms under repeated loads.

This study focuses on conducting cyclic load tests on model piles embedded in loose and dense sand. The primary objective is to evaluate the settlement behavior, load transfer mechanisms, and ultimate capacity under varying condition. The finding aim to contribute to the design and optimization of pile foundation in environments where cyclic loading is predominant.

2 APPARATUS AND TEST PRODEDURES

2.1 MODEL PILES

Figure 1 shows a schematic diagram of the model pipe pile used tests. The steel piles has length of 1000mm, outside diameter of 75mm and 45mm.

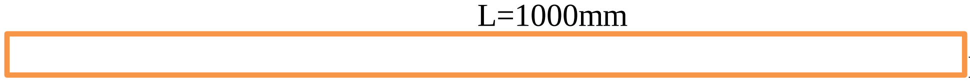

Figure 1: model pile

2.2 SAND PROPERTIES

In this study, oven dried sand was used, with properties noted below: the effective particle size D_{10} of the sand is 0.15mm, with uniformity coefficient C_u of 3.33, and coefficient curvature C_c of 0.20. Sand was discharged into the pit. A falling height of 600mm was chosen to produce a uniform density of 14.87kn/m^3. An angle of internal friction of 46^o was determined from direct shear test.

2.3 PIT AND LOADING SYSTEM

The internal dimension of pit is 3.0m*3.65m*1m, and it's made up with bricks and cement mortar. The size was chosen so that the field conditions can be replicated while conducting the test of model piles. This was far the most complicated thing to do in whole research, the loading arrangement had to be such that it provide concentric loading to the model piles, could withstand the large loads it had to transfer and get easily fixed with the model piles. For this we go for hydraulic jack loading. The arrangement for hydraulic jack loading is show in fig 2.

Fig 2. Loading from hydraulic jack

Fig 3. Pit at initial stage

2.4 TEST PROCEDURE Dry the sand in open for about 2-3days before use. Pour the sand n testing pit from a constant height for each level. In this case we have poured the sand in the testing pit from a constant height 600mm. drive the model pile with loading arrangement in the sand using a standard hammer up to the desired depth. Fix the dial gauge of sensitivity 0.01mm adequately for calculating the settlement in the model pile. Apply the loading on the pile using the hydraulic jack. By then, the pile was ready to be tested under static or cyclic loading. Upon finishing each test, plot the settlement curves for the different piles.

2.5 TEST DETAILS (TABLE 1)

Material	Shape	Diameter(mm)	Length (mm)	Loading type	Load capacity(KN)
Mild steel	circular	75mm(dense)	1000mm	Cyclic	9.4
Mild steel	circular	75mm(loose)	1000mm	Cyclic	6.9
Mild steel	circular	45mm(dense)	1000mm	Cyclic	4.375
Mild steel	circular	45mm(loose)	1000mm	cyclic	1.75

3 TEST RESULS

For different cross section area and same length, load carried by circular section are follow:

During performing cyclic load test we observe that when releasing the load on pile the negative deflection on dial gauge reading occur. The negative settlement is more in case of higher diameter of pile. For 75mm diameter pile in dense ultimate capacity is 1.36 times than in loose sand. And 40mm diameter pile in dense sand ultimate capacity is 2.5 time than in loose sand.

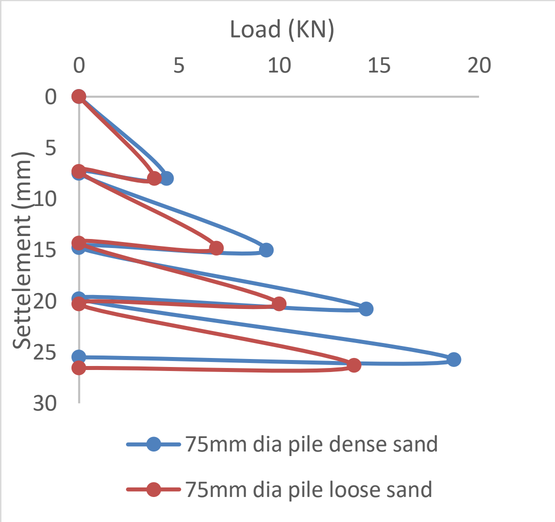

Fig 4. 75mm dia (dense & loose sand)

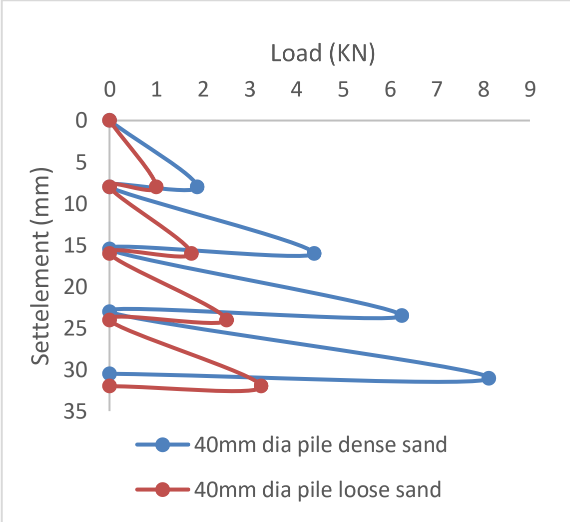

fig 5. 40mm dia (dense &loose sand)

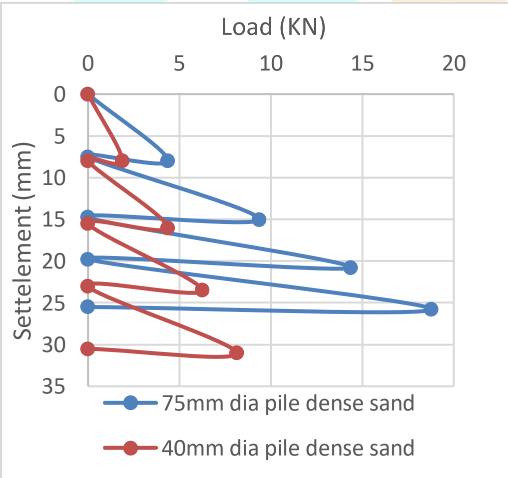

Fig 6. 75mm, 45mm dia (dense sand)

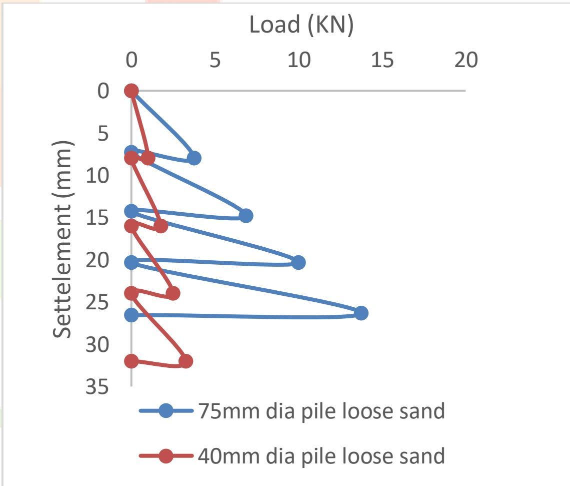

Fig 7. 75mm, 45mm dia (loose sand)

Model piles with a diameter of different diameter behave under cyclic loading n both dense and loose sand. Figure 4 for a pile with a diameter of 75mm, the settlement noticeably smaller in dense sand compared to loose sand for the same load. This show that dense sand provides better support due to stronger particle interaction. Figure 5 in the case of a 40mm diameter pile, settlements are significantly higher in loose sand than in dense sand. This highlights the role of sand density in reducing settlement and improving the piles load-carrying capacity. Figure 6 comparing piles with diameter of 75mm and 45mm in loose sand, the larger pile experience less settlement. This is because a larger pile distributes the load over a greater area, reducing settlement. These observation confirm that both the density of the sand and diameter of the pile significantly affect the settlement and overall performance of piles under cyclic loading. Dense sand and larger-diameter piles provide better resistance to settlement.

3.1 LOAD CARRYING CAPACITY

TABLE 2 (load carrying capacity according to static formulae.)

Dia (mm)	Medium	Length(mm)	Capacity (KN)
75	dense	1000	7.94
40	dense	1000	5.66
75	loose	1000	3.27
40	loose	1000	2.39

TABLE 3 (comparison of pile load test and static load formulae result)

Dia (mm)	Medium	Pile load test (KN)	Static formula (KN)
75	dense	9.4	7.94
40	dense	6.9	5.66
75	loose	4.375	3.27
40	loose	1.75	2.39

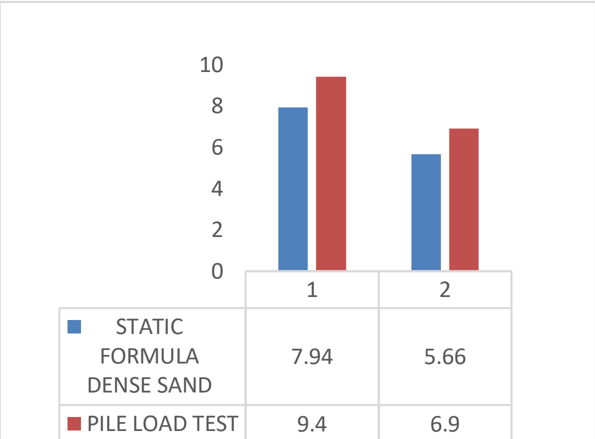

Fig 8. Pile load test vs static formulae (Dense sand)

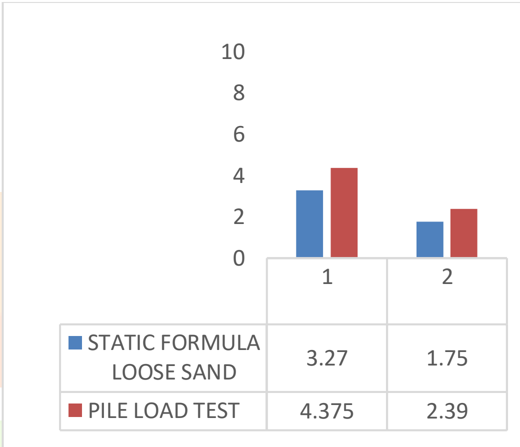

fig 9. Pile load test vs static formulae (Loose sand)

CONCLUSION

Pile load test is conducted on model steel piles in sandy soil having same length but varying cross-sectional area. In this experimental work a testing pit is prepared in which the sand is filled to reach the field condition and hydraulic jack arrangement is made for applying compres12sive loading on piles. The results obtained from cyclic pile load test are also compared with static load formulae. The following conclusion are drown:

- The value obtained by pile load test is higher as compare to static formulae
- For cyclic pile load test for same settlement load requires more as compared to direct pile load test.
- For 75mm dia pile in dense sand pile load test result gives 40% more than static formula
- For 40mm dia pile in dense sand pile load test result gives 93 % more than static formula
- For 75mm dia pile static formula result in dense san gives 36% more than loose sand
- For 40mm dia pile static formula result in dense san gives 150% more than loose sand
- Friction stress decreases with increase in diameter (for 75 dia. 15.39kn/m^2 and 40mm dia 12.15kn/m^2).

REFERENCE

- Sharma, R. K., & Kumar, P. (2017). "Settlement Analysis of Shallow Foundations." Geotechnique, 67(5), 441-453.
- Lehane, B. M., Schneider, J. A. & Xu, X. (2007). CPT-based design of displacement piles in siliceous sands. International Workshop on Recent Advances of Deep Foundations (IWDPF07). Yokosuka, Japan. Taylor & Francis. 1, pp. 69-86.
- Nainan P. Kurian (2006), "Design of Foundation System (Principle and Practice)", Third edition, Narosa Publishing House Pvt.Ltd
- Gopal Ranjan (2000), "Basic and Applied Soil mechanics", 2nd edition, New Age
- International publisher
- Poulos, H.G., (1989). Cyclic Axial Loading Analysis of Piles in Sand. J. Geotech. Eng. ASCE,115 (6): 836-851
- Meyerhof, G.G. (1976), Bearing Capacity and Settlement of Pile Foundations, Journal of Geotechnical Engineering, ASCE, 102(3), pp. 197- 228
- Hansen, J.B., (1970). A Revised and Extended Formula for Bearing Capacity. Danish
- Geotechnical Institute, Copenhagen
- IS-2911 (Part-4), 1985, "Code of Practice for Design and Construction of Pile Foundations, Part 4 Test on Piles". Reaffirmed 2006, Edition 2.1.