Experimental Study of Various Shaped Isolated Footings under Monotonic Loading on Pond Ash

Rafee Manzoor[1], Zubair Ahmad Lone[2], Mohd. Kashif Khan[3], Syed Mohammad Ashraf Husain[4]
[1, 2, 3, 4] Department of Civil Engineering
[1, 2, 3, 4] Integral University, Lucknow

Abstract- *In the existing study behaviour of four footing specimen when subjected to monotonic loading on pond ash is examined. Four footing specimens rectangular, circular, square and triangular in shape having same surface area (150cm2) with plate thickness equal to 8mm have been used. The loading arrangement consisted of a pond ash filled tank, loading machine, load cell, digital load indicator. A tank of size 45 cm x 45 cm x 45 cm was filled with pond ash. Total height of fill was kept as 30cms. It was divided in three parts and filling was done in three stages also. In each stage pond ash was filled and compacted keeping density of each pond ash equal to the obtained density by compaction test. The intensity – settlement curves for all four footings are plotted under monotonic loading. Based on the test study conducted on various shaped footings under monotonic loading on pond ash, it is determined that for same stratum and footing area under similar loading conditions the performance of footing is highly influenced by shape of footing under the monotonic type of loading. In this case the settlement was recorded lesser in case of square and maximum in triangular footing. The Settlement – Load intensity behaviour improves and plastic deformation reduces with change in shape of footing from triangular shape to square shape footing.*

Keywords- Bearing Capacity, Footing, Pond Ash Settlement.

I. INTRODUCTION

Pond ash, the by-product of thermal power plants is considered as solid waste and its disposal is a major problem from environmental point of view and also it requires large disposal areas. Utilization of pond ash to the maximum possible extent is a worldwide problem. To solve the problem, pond ash can be used as a structural fill for developing low-lying areas to construct civil engineering structures on it. The decreasing availability of good construction sites has led to the increased use of filling low lying areas with pond ash, whose bearing capacity is low.Bearing capacity of soil is one of the typical problems in foundation engineering. Therefore it is necessary to know about the bearing capacity and settlement behaviour of pond ash before going for any construction on the land fill. Hence in the present work various shaped footings are being tested for the same. Footings are used in various fields such as wall foundations, offshore platforms, and machinery foundations. The bearing capacity varies with soil and also the settlement of footing. The settlement of soil also depends upon loading condition such as static loading, cyclic loading, and repeated loading. So far, the studies are limited to square, circular and rectangular footings under monotonic and cyclic loading.

The design of foundation requires sufficient knowledge of settlement of footing. The method of foundation design requires that they must possess sufficient safety against failure and settlement need tokeep within the acceptable limit. These requirements are dependent on the bearing capacity and compressibility of soil. It is commonly believed that the settlement criterion is more critical than the bearing capacity in the designs of shallow foundations. By limiting the total settlements, differential settlements and any subsequent distresses the structure are confirmed to be safe. The shape of footing may also play asignificant role in settlement of footing. Two unlike shaped footing may behave differently on same soil with unlike loading condition. The study is carried out using pond ash as strata. In this test study the density and moisture content of the pond ash were kept same as obtained from compaction test. Settlement – Load intensity curves under monotonic loading are plotted and studied.

II. OBJECTIVES OF THE STUDY

Experimental work is performed to study the following objectives.

a. To determine the suitability of different shaped footings by physical lab tests.
b. To compare the settlements of four various shaped footings under monotonic loading on pond ash.
c. To study the Settlement – Load intensity behaviour of different shaped footing under monotonic loading on pond ash.

III. EXPERIMENTAL PROGRAMME

A. GENERAL

In this experimental work four different shaped footing specimens with same cross sectional area isto be tested under monotonic loading on pond ash.

a. The footing specimens are circular, triangular, rectangular and squarein shape.
b. To account the applied load a load meter and a load cell is used.
c. Settlements were recorded by digital indicator fixed in loading machine.
d. The density and moisture content were kept same as obtained from the compaction test.
e. Load intensity –settlement curves are plotted to study the effect of shape of footing on settlement of pond ash for monotonic loading.

B. TEST SPECIMENS

Four different shaped footing specimens having same surface area (150cm2P) with plate thickness equal to 8 mm have been used. For the study the details of test specimens are given in Table 1.

Table 1: Size of Footings

S.NO	FOOTING SHAPE	SIZE IN CENTIMETERS
1	SQUARE	12.3 cm X 12.3 cm
2	TRIANGULAR	Each Side of 18.16
3	CIRCLE	Dia 13.8 cm
4	RECTANGULAR	15 cm X10 cm

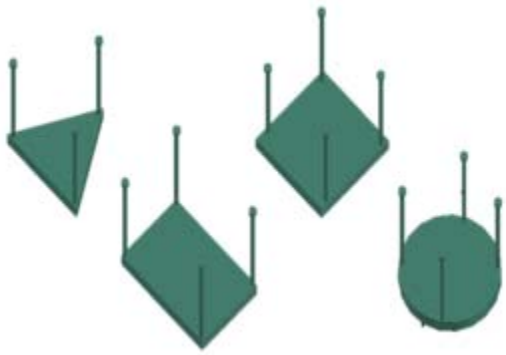


Figure 1: Shape of Footing Models

C. MATERIAL USED

a. Each specimen has been tested on pond ash.
b. Density of pond ash was kept equal to 12.27KN/m3.

D. INSTRUMENTATION

The footing samples are tested under monotonic loading, load was applied axially at centre of footing. A load cell is used to apply load while settlements are measured by digital indicator. The loading arrangement and instrumentation is as follows.

E. LOADING ARRANGEMENT

The loading arrangement consisted of a pond ash filled tank, UTM machine, load cell, digital load indicator. A tank of size 45 cm x 45 cm x 45 cm was filled with pond ash. Total height of fill was kept as 30cms. It was divided in three parts and filling was done in three layers. In each stage pond ash was packed and compacted keeping density equal to 12.27 KN/m3. For loading the footing an automatic Universal Testing Machine (UTM) is used. The UTM was a constant strain rate machine and was capable of constant strain rates in the range of 0.01 mm/min to 500 mm/min. The machine was connected to a computer where the load and settlement was recorded. The load applied to the footing at a constant strain rate of 1.0 mm/min, the settlement and corresponding increase in load was recorded at a settlement interval of 0.1 mm. The setup is shown in Fig. 2-3.

Figure 2: Experimental Setup

Figure 3: Experimental Setup

IV. TEST PROCEDURE

Testing under monotonic loading:

The testing under monotonic loading has been carried out as follows:

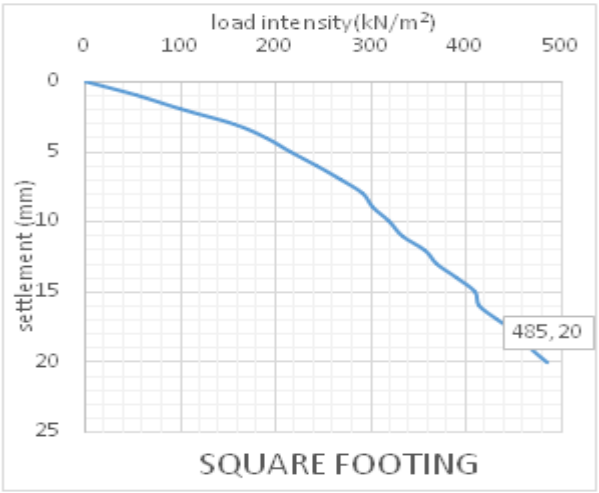
a. The pond ash sample taken from the field was filled up to a height of 10cm and then compacted and again a second layer of 10cm is filled and compacted. Top layer being of 10cm.The compaction was done to achieve required density.
b. The footing specimen was placed centrally and load was applied vertically through loading cell.
c. The load was applied at a constant rate of 1mm/min.
d. Readings of the settlement indicator were noted at each increment of load.
e. After each testing the pond ash was again disturbed and then again compacted for next specimen.
f. The same procedure has been followed for all the four footing specimen.

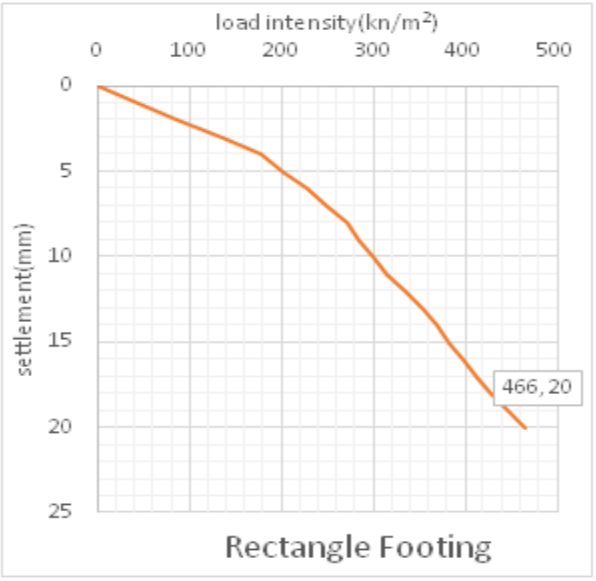
V. TEST RESULT

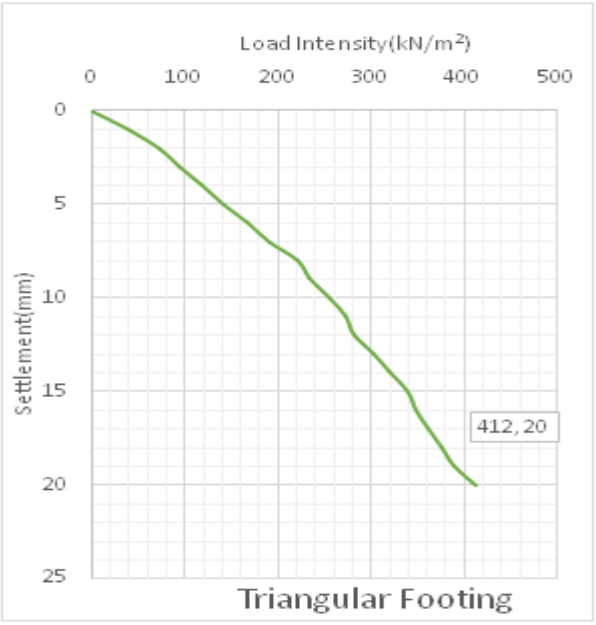
The study was been carried out on four different shaped footing as defined above. The Load Intensity vs Settlement behaviour of these footings achieved under pond ash has been presented in the form Settlement – Load intensity curve under monotonic loading.

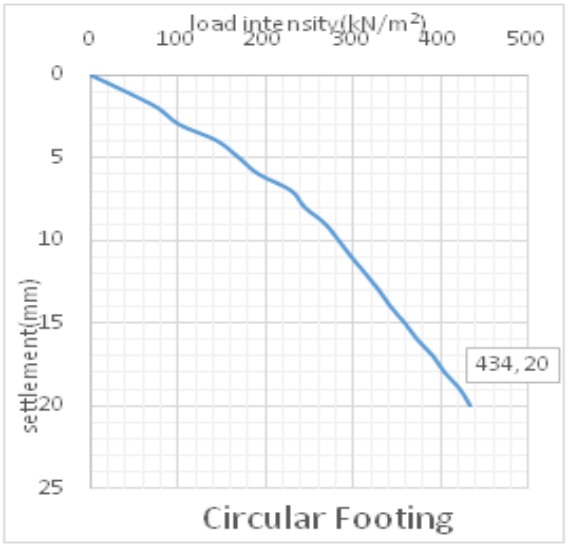
VI. DISCUSSIONS

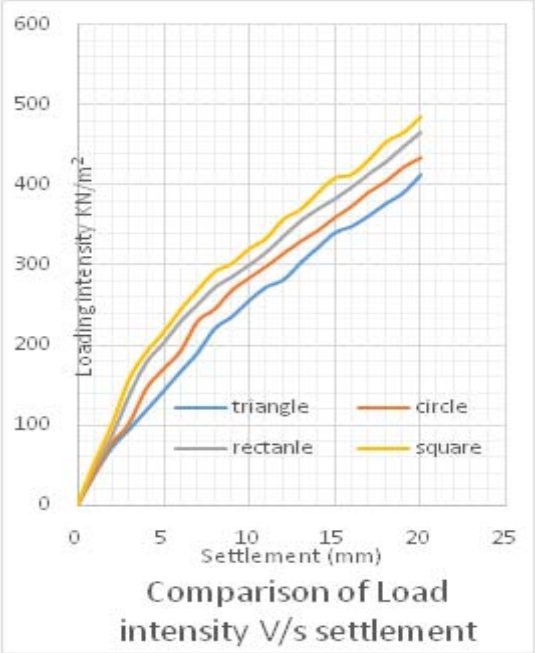
Below Monotonic loading Settlement – Load intensity curve the nature of Settlement – Load intensity curve is similar for all types of footings considered. From graph it can be seen that the settlement for triangular footing is morepronounced than other footings. In pond ash the load recorded for triangular footing at20mm settlementis 412KN/m2 which ismorefor square footing i.e. 485KN/m^2.











VII. CONCLUSION

This experimental program is conducted to relate the behaviour of circular, square, rectangular and triangular shaped footing model when they are subjected to monotonic loading on pond ash as strata. Based on the results obtained from the settlement shown in table2 it can be concluded that triangular footing require lesser load than other footings for the same settlement.

Table 2: Data Obtained

FOOTING	LOAD INTENSITY KN/m^2	SETTLEMENT (mm)
SQUARE	485	20
RECTANGLE	466	20
CIRCLE	434	20
TRIANGLE	412	20

REFERENCES

[1] Dr. Goutam Kumar Pothal, Dr. G. Venkatappa Rao2 "Behaviour of a Strip Footing on Compacted Pond Ash Reinforced with Coir Geotextiles" International Journal of Advanced Technology in Civil Engineering

[2] C. Lavanya, A. Sreerama Rao, N. Darga Kumar, (2013) "Influenc of admixtures on load – settlement behaviour of copper slag – cushioned expansive soil bed." e Proceedings of Indian Geotechnical Conference December 22-24, 2013, Roorkee.

[3] Dr. U.B. Choubey, 2Jagdeshwer Patidar "Experimental Study of Various Shaped Isolated Footings under Monotonic and Incremental Cyclic Loading on Yellow Soil" © 2014 IJEDR

[4] Gottardi G., Houlsbyand G. T., & Butterfield R., (1999) "Plastic Response of Circular Footings on Sandunder General Planar Loading.". Geotechnique 49, No. 4, 453-469.

[5] H.N Ramesh, Dr.L.manjesh, Vijaya Kumar.H.A., (2013) " Effect of Static and Cyclic Loading on Behaviour of Fiber Reinforced Sand" IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719 Vol. 3, Issue 9 (September. 2013), ||V3|| PP 56-63

[6] Nagaraj, T.K. Ullagaddi, P.B., (2010) "Experimental Study on Load Settlement Behaviour of Sand Foundations." Indian Geotechnical Conference – 2010, GEOtrendz December 16–18, 2010

[7] ShajaratiAmir, Sorensen Kris Wessel, Nielsen SorenKjaer & Ibsen Lars Bo, (2012) "Behaviors of Cohesionless Soils during Cyclic Loading." Published 2012 by Aalborg University Department of Civil Engineering Sohngaardsholmsvej 57, DK-9000 Aalborg, Denmark Printed in Aalborg at Aalborg University ISSN 1901-7278 DCE Technical Memorandum No. 14.

[8] Tafreshi S.N. Moghaddas, Zarei S.E., and Soltanpour Y., (2008) "Cyclic Loading On Foundation to Evaluate the Coefficient of Elastic Uniform Compression of Sand." The 14Pth World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.

[9] Tavakoli H.R., Shafiee A., and Jafari M.K., (2008) "Effect of cyclic loading on undrained behaviorof compacted sand/clay mixtures." The 14thP WorldConference on Earthquake Engineering October 12-17, 2008, Beijing, China.

[10] Won Taek Oh, and Sai K. Vanapalli, (2008) "Modeling the Stress versus Settlement behavior of model footings in saturated and unsaturated sandy soils.", The 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG) 1-6 October, 2008 Goa, India.