Feasibility Study of Pyramidal Shell Foundation of Varying Embedded Depth on Sandy Soil

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***Abstract*— Shell foundations are better alternatives to conventional flat foundations which transmits heavy super structural loads to poor soil. In this paper, Pyramidal shell foundations were designed and compared with flat foundations of same dimensions. A series of reduced scale plate load tests were carried out on sandy soil for investigating the behaviour of Pyramidal shell foundations and flat foundations of varying embedded depth. Four types of foundation models made up of mild steel having same thickness (3 mm) and different embedded depth (25 mm and 35 mm) were used in this study.**

Keywords- Sandy soil; Pyramidal shell foundation; Ultimate bearing capacity

I. INRODUCTION

Due to the vital function of Foundations on the stability of structures, a number of investigators studied the utilization of safer and more economical foundations like shell foundations. Shells can obtain the stability and bearing capacity from their specified geometrical shapes. This characteristics of shells helps them to generate maximum structural efficiency with minimum materials. In geotechnical engineering, the specific behaviour of shell foundations have been directly linked with different geometrical shapes including pyramidal, triangular and conical.

The main aim of this paper is to examine the overall geotechnical performance of pyramidal shell foundation resting on sandy soil. The ultimate load of corresponding foundation models made up of mild steel were obtained by conducting a series of reduced scale plate load tests and the results were compared with traditional flat foundations of same counter parts.

II. OBJECTIVES OF STUDY

A. To examine the behaviour of pyramidal shell foundations on sandy soil
B. To identify the influence of different embedded depth on the performance of foundation models.
C. To compare the pyramidal shell foundation with conventional flat foundation of same dimensions

III. MATERIALS USED

A. Sandy soil

Fig.1. Sandy soil sample

The sandy soil was collected from Achencovil river basin, Kollam district, Kerala at a depth of 5 m from the ground surface. The soil was poorly graded sandy soil.

B. Foundation models

Fig.2. *Foundation models*

The load tests were conducted on pyramidal shell and flat foundation models made up of mild steel having thickness 3 mm. Also, investigated the effect of varying embedded depth (25 mm and 35 mm) of foundation models on the ultimate load.

C. Test tank

Fig.3. Test tank

A test tank made up of mild steel were used in this study for conducting plate load tests. The dimension of the tank was 40 cm x 40 cm x 40 cm.

IV. LABORATORY TESTING

The properties of sandy soil is shown in Table I.

TABLE I. PROPERTIES OF SANDY SOIL

Sl. No.	Property	Dredged Soil
1	Specific Gravity	2.676
2	Moisture Content	0 %
3	Uniformity coefficient, C_u	2.12
4	Coefficient of curvature, C_c	1.14
5	Field density (g/cm^3)	1.433 g/cm^3

The soil sample is classified as poorly graded sandy soil.

A number of load tests were carried out on both pyramidal shell and flat foundation models of different embedded depth such as 25 mm and 35 mm. The ultimate load and settlement of each foundation were obtained from the load versus settlement curve from the load test.

V. RESULTS AND DISCUSSION

The particle size distribution curve of soil sample from sieve analysis is shown in fig 4.

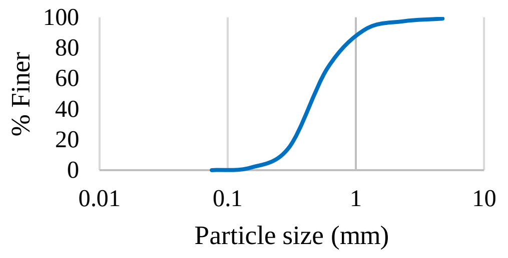

Fig 4. Particle size distribution curve of soil sample

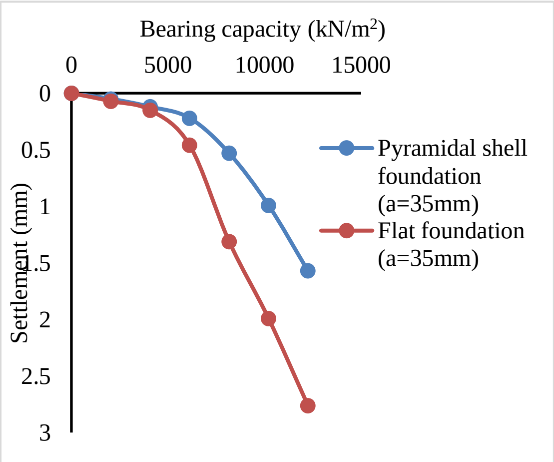

Fig 5. Load - Settlement curve (t = 3mm, a =25 mm)

Fig 5. Shows the load – settlement curve of both pyramidal shell and flat foundation models having equal thickness (t=3mm) and embedded depth (a=25mm). From the figure, the ultimate bearing capacity of pyramidal shell foundation is 6000 kN/m^2 and that of flat foundation is 3500 kN/m^2.

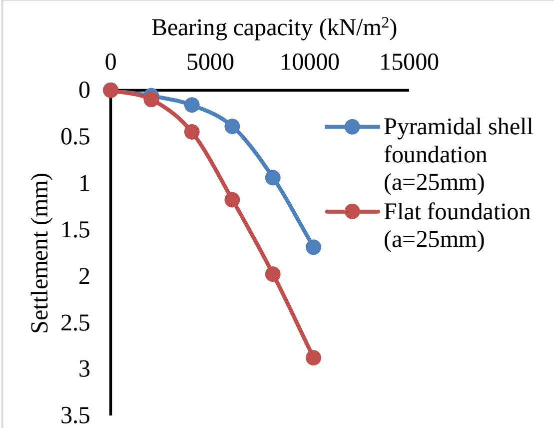

Fig 6. Load - Settlement curve (t = 3mm, a =35 mm)

Fig 6. Shows the load – settlement curve of both pyramidal shell and flat foundation models having equal thickness (t=3mm) and embedded depth (a=35mm). From the figure, the ultimate bearing capacity of pyramidal shell foundation is 7000 kN/m^2 and that of flat foundation is 4500 kN/m^2.

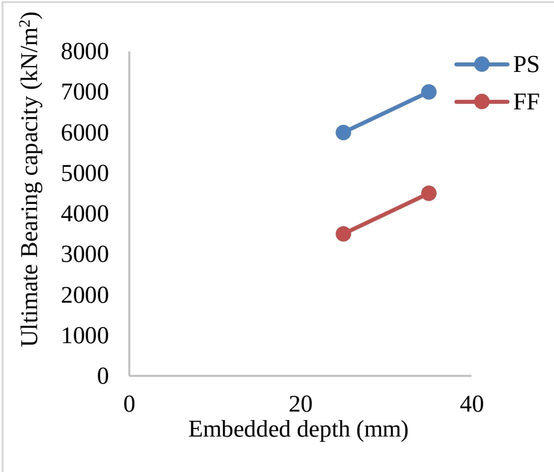

Fig 7. Ultimate Bearing capacity v/s embedded depth

The ultimate bearing capacity of foundation models versus embedded depth is shown in fig 7. From the figure, we can understand that the ultimate bearing capacity increases with increase in embedded depth.

CONCLUSION

The results of this study proves that the pyramidal shell foundation shows better performance than conventional flat foundation of same dimension on sandy soil. The ultimate bearing capacity of pyramidal shell foundation increased by 71.42 % than flat foundation of equal embedded depth. The ultimate bearing capacity increases with increase in embedded depth from 25 mm to 35 mm as in the range of 16.66 % for pyramidal shell foundation and 28.57 % for flat foundation. The settlement decreases with increase in embedded depth as in the range of 25 % for pyramidal shell foundation. Also, the settlement of pyramidal shell foundation decreased in the range of 68 % for embedded depth 25 mm and 50 % for embedded depth 35 mm.

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