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REVIEW STUDY OF VARIOUS SHAPED ISOLATED FOOTING UNDER MONOTONIC AND INCREMENTAL CYCLIC LOADING ON B. C. SOIL

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ABSTRACT

Bearing capacity and settlement are the two major criteria for design of foundation. Also it is not always subjected to monotonic loading but it is also subjected to cyclic loading. The examples are lifts, bridges foundation, machine foundation, offshore structure, wind waves to structure etc. The load transmitted to the soil causes the settlement of soil. The method of foundation design requires that they must possess sufficient safety against failure and settlement must be kept within the tolerable limits. These requirements are dependent on the bearing capacity and compressibility of soil. It is considered that the settlement criterion is more critical than the bearing capacity in the designs of shallow foundations. The load settlement behavior of footings of rectangular, circular and square shapes is well known. In the present study a review study has been done for the comparison between various soil test results and load-settlement behavior of rectangular, octagonal, hexagonal, square, triangular and circular footing under monotonic and incremental cyclic loading.

1. INTRODUCTION

The Bearing capacity of Soil plays a major role in design of footings. Every footing has to transfer its load to the underlying soil without failure. As footings are used in a variety of fields such as wall foundations, offshore platforms, bridges, machinery foundations etc. the nature of load transmitted also varies. The load transmitted to the soil causes the settlement of soil. The settlement of footing due to load transmitted to the soil must be within 50mm for structural safety purpose. The settlement of soil varies with nature of loading such as static loading, dynamic loading, cyclic loading, repeated loading etc. When structures are subjected to cyclic loadings, the footing might fail at loads much smaller than the failure load for static condition which in turn will give rise to the collapse of structures. The method of foundation design requires that they must possess sufficient safety against failure and settlement must be kept within the tolerable limits. These requirements are dependent on the bearing capacity and compressibility of soil. It is considered that the settlement criterion is more critical than the bearing capacity in the designs of shallow foundations. The shape of footing also plays an important role in design of footing. Two different shaped footing may show different settlement on same soil subjected to same loading condition. It is an important aspect in the design of foundations to understand the behaviour of underlying soil when they are subjected to cyclic loading condition.

The design of footing should be such that-
[1] The soil below does not fail in shear.
[2] The settlement is within the safe limits.
[3] Free from effect of seasonal volume changes.

A footing may settle due to following reasons:-
[1] Static loading.
[2] Repeated loading.
[3] The vibration produced by machine foundation.
[4] The vibration produced by heavily loaded vehicle.
[5] Liquefaction.

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2. LITERATURE REVIEW

Extensive literature reviews has been carried out in this study related to the following and the out come of different authors has been summarized below.

Amir Shajarati et al.[1] have conducted study to investigate existing research treating the behavior of cohesion less soils subjected to cyclic loading and found to be dependent on the relative density, mean effective stresses prior to cyclic loading, cyclic and average shear stresses and the drainage conditions. The cyclic loading will have an effect on soil properties such as soil stiffness, shear strength, and void ratio.

Bengt H. Fellenius et al [2], investigated the results of finite element analysis of settlement for footings of three sizes placed in two different sand types and conclude that the settlement in sand is a direct function of neither footing size nor soil density, instead, the settlement should be related to the steady state line of the sand and to the upsilon distance of the sand, that is, the initial void ratio distance to the steady state line at equal mean stress and at homologous points.

B.W. Byrne et al [3], establish that there is a relationship between the results of suction caisson foundations subjected to monotonic and cyclic loading. The general approach is equally applicable to other types of offshore and onshore shallow foundations subjected to cyclic loading. It also illustrate the use of a new type of theoretical modeling, named continuous hyper plasticity, which demonstrate that an accurate and concise theory encapsulating cyclic loading is possible.

K.V. Manoj Krishna et. al. [4] described the strength and F O S performance of black cotton soil treated with calcium chloride. It is found that addition of 3% calcium chloride has shown higher factor of safety with higher curing periods for an embankment slope of 1:2.5.

R.K. Tripathi et. al. [5] experimentally studied the bearing capacity of square footing on soft soil stabilized with rice husk ash. From the laboratory test considerable increase in UCS, BCR and reduction in settlements have been observed. 12 % rice husk ash has been observed as optimum dose for stabilizing the soft soil.

G. Gottardi et al [6], investigated the plastic response of circular footings subjected to a variety of combinations of vertical, horizontal and moment loading on dense sand. The tests provide detailed information about the shape of the yield surface, bearing capacity calculations for cases other than purely vertical loading, hardening law and flow rule appropriate for a plasticity model, and the elastic response within the yield surface.

H.N Ramesh et al [7] evaluate the effect of static and cyclic loading on behavior of fiber reinforced sand and clay using model by conducting plate bearing and cyclic plate load tests circular footing. The results of the tests, evaluated in terms of dynamic response of soil, indicate that the coefficient if elastic uniform compression increases from unreinforced sand to reinforced sand and from BC soil to stabilized BC soil.

H.R. Tavakoli et al [8] investigated the effect of cyclic loading on undrained behavior of compacted medium plasticity sand-clay mixtures. A series of undrained post cyclic triaxial compression tests after cyclic loading were performed on medium plasticity sand/clay mixtures. Testing was performed on isotropically and anisotropically consolidated specimens to investigate the effectiveness of aggregate fraction on the mechanical behavior of the mixtures. In addition, monotonic triaxial compression tests were also performed on the same sand/clay mixtures with the same initial condition. The results show that effect of cyclic loading on post cyclic pore water pressure build-up is significant when pore water pressure build-up is considerably lower than the associated value in monotonic loading. The effect of aggregate content on post cyclic pore water pressure build-up is miner. However, when the aggregate content increases the shear strength increases.

Kartikey Tiwari et. al [9] has deal with the Performance, Problems and Remedial Measures for the Structures Constructed on Expansive Soil in Malwa Region, Madhya Pradesh, India by conducting various tests on expansive soil and explain the phenomenon of swelling . The results of this paper shows that the swelling pressure reduces with increase in bearing capacity of soil by addition of Gypsum.

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Nagaraj, T.K. Ullagaddi, P.B., [10] studied experimentally the effect of shape and size of footing on sand foundation. Using circular, square and rectangular model footing of different area they concluded that square footing shows better load settlement behavior for a given settlement indicating higher load carrying capacity.

S.N. Moghaddas Tafreshi et al.[11], carried out experimental and numerical investigation on circular footing subjected to incremental cyclic loads using sand as footing bed to evaluate the response of footing and also to obtain the value of elastic rebound of the footing corresponding to each cycle of load. The incremental values of intensity of cyclic loads (loading, unloading and reloading) were applied on the footing The effect of sand relative density of 42%, 62%, and 72% and different circular footing area of 25, 50, and 100cm2 were investigated on the value of coefficient of elastic uniform compression of sand (CEUC). The results show that the value of coefficient of elastic uniform compression of sand increases by increasing the sand relative density while with increase in the footing area the value of coefficient of elastic uniform compression of sand was decreases.

S.N. Moghaddas Tafreshi et al [12], carried out experimentation to study and evaluate the coefficient of elastic uniform compression (CEUC) of sand, with different relative densities of 45%, 63% and 78%, under static and cyclic loading on square footing. The various intensity of cyclic load (loading, unloading and reloading) were applied on the square footing to obtain the elastic rebound of the footing corresponding to each loading intensity and to determine the coefficient of elastic uniform compression (CEUC) of sand. The results indicate that with increasing the relative density of soil the value of the coefficient of elastic uniform compression of soil (Cu) increases.

Smita G.M, Vishwanath C.S,[13] used geosynthetic material as ground improvement technique to reduce the settlement and improve bearing capacity of expansive soil.

Sridhanya K.V.et al [14], investigated the Modeling of Degradation of Clayey Soils based on the of concepts of Critical State Soil Mechanics (CSSM) using the modified cam clay model, which was developed based on CSSM, to predict the response of soil under cyclic loading. The Improvements in the predictive capabilities of the proposed modified model, in comparison with an existing cyclic loading model is verified with the published experimental data on natural marine clays. The model is capable of predicting most of the important features of soil behaviour under cyclic loading.

V.K. Sowmya, P. Dilsha,[15] has showed the Effect of rice husk ash on strength and durability of lime stabilized black cotton soil and result indicate that the load - settlement curves showed an increase by 1.8 to 3.0 times as the percentage of cement and lime was increased from 0% to 6%.

Won Taek Oh &Sai K. Vanapalli [16], in their study, proposed a methodology to estimate the bearing capacity and settlement in unsaturated sandy soils by predicting the stress versus settlement behaviour. In addition, finite element analyses were also undertaken using the model footing test results to simulate the stress versus settlement behavior.

3. CONCLUSION

The literature related to bearing capacity and settlement of soil has been studied. Square footing shows better load settlement behaviour for a given settlement indicating higher load carrying capacity. Results of various research concluded that swelling pressure reduces with increase in bearing capacity of soil by addition of Gypsum. The Effect of rice husk ash on strength and durability of lime stabilized black cotton soil and observation indicates that the load bearing - settlement capacity increased. Although large diameter bored piles have been widely used in all kinds of engineering construction, the study of the theory of the large diameter bored piles is not perfect enough, still lags behind compared with the actual application.

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