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Bearing Bapacity of Footings on Sand

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Abstract:- Soil mechanics engineering is one of most important aspects of civil engineering involving the study of soil , its behavior and application as an engineering material. Good soil engineering embodies the use of the best practices in exploration, testing,design and construction control, in addition to the basic idealized theories. with increasing load on soil due to construction of multi storied buildings there is a need to construct footing by conducting a test of their model in laboratory on the soil over which the foundation is to be laid.

Sand is one of the soils over which foundations are laid ,so it is necessary to conduct experiments by placing different model footings over sand and find out their ultimate bearing capacity and based on these values ,it can be incorporated on to the field and foundations can be laid. Square footings of different sizes are taken and model testing of these footings are conducted and the ultimate bearing capacity of different footings are found and on the basis of these values foundations are laid on sandy soils .these values can also be compared with theoretical analysis of Terzaghi and Meyerhof 's to check out the difference in values of ultimate bearing capacity between a theoretical and practical analysis.

Keywords—component, bearing capacity, footing,

I. Introduction

(a)Bearing capacity**:-**The supporting power of a soil or rock id referred to as its bearing capacity. The term bearing capacity is defined after attaching certain qualifying prefixes, as defined below.

Gross pressure intensity (q):The gross pressure intensity q is the total pressure at the base of the footing due to the weight of the superstructure, self-weight of the footing and the weight of the earth fill, if any.

Net pressure intensity (q_n):It is defined as the excess pressure , or the difference in intensities of the structure and the original overburden pressure. The construction of the structure and the effective overburden pressure. if, D is the depth of the footing

$$q_n = q - \gamma d$$

= Average unit weight of soil above the foundation base

Methods of finding out bearing capacity:

There are various methods to find out bearing capacity ,some of the methods are

1. Determination of building capacity by building code method
2. By plate load test
3. Theoretical analysis

Theoretical analysis is done by two methods, they are

1. Terzaghi's analysis.
2. Meyerhof's analysis

II TEST ON A MODEL FOOTING

The bearing plate is square of minimum recommended size 30 cm square and maximum size recommended is 75 cm square. the plate is machined on sides and edges and should have a thickness sufficient to withstand effectively the bending stresses that would be caused by maximum anticipated load. the thickness of steel plate should not be less than 25 mm.

the test pit width is made five times the width of the plate b_p . at the centre of the pit, a small square hole is dug whose size is equal to the size of the plate and the bottom level of which correspond to the level of actual depth formation . the depth d_p of the hole should be such that

A.Plate load test:

the loading to the test plate may be applied with the help of a hydraulic jack. the reaction of the hydraulic jack may be borne either of the following two methods

1. Gravity loading platform method
2. Reaction truss method

Indian standard code (IS: 1888-1962) recommends that the loading of the plate should invariably be borne either by gravity or loading platform or by the reaction truss. The use of the reaction truss is more popular now-a-days since this is simple ,quick and less clumsy

B.Limitations of plate load test:

1. the test reflects only the character of the soil located within a depth less than twice the width of the bearing plate .since the foundations are generally larger the settlement and resistance against shear failure will depend on the properties of a much thicker stratum.
2. it is essentially a short duration test , and hence the test does not give the ultimate settlement ,particularly in case of cohesive soil.
3. another limitation is the effect of size of foundation .for clayey soils the ultimate pressure for a large foundation is the same as that of the test plate .but in dense sandy soils the bearing capacity increases with the

size in foundation and the test on smaller size bearing plates tend to give conservative values.

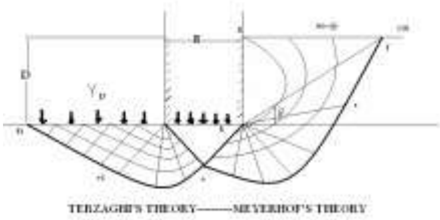
III.BUILDING CODE METHOD

The building codes do not offer any hint regarding the origin of the values,or explaining the meaning of the term “allowable soil pressure” .these omissions have fostered the belief that settlement will be uniform and of no consequence if the pressure on the soil beneath each footing is equal to allowable soil pressure. the size of loaded area and the type of building are considered immaterial. but because of various confusions the engineers assumed that wrong allowable pressures have been selected because the terms used to describe the soil in the field and the building codes did not have the same building . in order to avoid this difficulty ,it gradually became customary to select the soil pressure on the basis of the results of load tests

A.TERZAGHI’S ANALYSIS

an analysis of the condition of complete bearing capacity failure,usually termed general shear failure,can be made by assuming the soil behaves like an ideally plastic material. this concept was first developed by Prandtl and later extended by terzaghi. he considered a footing of width B and subjected to a loading intensity q_f to cause failure.the footing is shallow is equal to or less than width B of the footing. the loading soils fails along the composite surface fede$_1$f$_1$ .this region is divided into three zones zone1 , ,two pairs of zone 2 and two pairs of zone 3. when the base of the footing sinks into the ground ,zone 1 is prevented from undergoing any lateral yield by the fraction and adhesion between the soil and the base of the footing. thus zone 1 remains in the state of elastic equilibrium and it acts as if it were a part of the footing .its boundaries da and db are assumed as plane surfaces $\varphi = \phi$ with the horizontal .zone 2 is called the zone of radial shear .these lines are straight while the lines of the other set are the logarithmic spirals with their located at the outer edges of the base of the footing .zone 3 is called the zone of linear shear,and is

identical with that for rankines passive state .the boundary of zone 3 rise at ($45^o - \frac{\phi}{2}$) with the horizontal the failure zones are assumed not to extend above the horizontal plane through ab of the footing .this implies the shear resistance of the soil above the horizontal plane through the base of the footing is neglected ,and the soil above this



plane is replaced with a surcharge $q = \gamma d$

B.ASSUMPTIONS IN TERZAGHI’S ANALYSIS

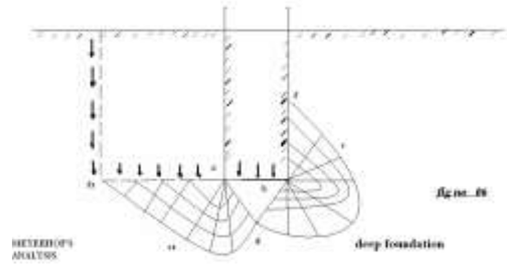
1. The soil is homogenous , isotropic and its shear strength is represented by coulomb’s equation
2. The strip footing has a rough base and the problem is essentially two dimensional.
3. The elastic zones has straight boundaries is inclined at $\varphi = \phi$ to the horizontal and the plastic zones fully develop
4. p_p consists of three components which can be calculated separately and added although the critical surface for these components are not identical.
5. Failure zones do not extend below the horizontal below the base of the footing (i.e) the shear resistance of the soil above base is neglected and the effect of soil around the footing is considered equivalent to a surcharge $\sigma = \gamma d$.

C. Limitations

1. As the soil compresses, ϕ changes slight downward movement of footing may not develop fully the plastic zones
2. The assumption that term p_p consists of three components which can be calculated separately and added although the critical surface for these components are not identical, is small and on the safe side.

D.Meyerhof’s analysis:

Meyerhof extended the analysis of plasic equilibrium of a surface footing to shallow and deep foundations .the below figures show the failure mechanisms for shallow and deep foundations. in this analysis abd is the elastic zone ,bde is the radial shear zone and befg is the zone of mixed shear in which shear varies between radial and plane shear depending upon the depth and roughness of the foundation. the plastic equilibrium in these zones can be established frm the boundary conditions starting from the foundation shift.to simplify this meyerhof established a factor β the angle to define the line bf,joining point b to f where the assumed boundary failure slip intersects the soil surface .the resultant effect of wedge of soil



IV.COHESIVE SOILS

Cohesive soil is one in which the major component of settlement is due to consolidation, which is time dependant. All clays below the water table will undergo consolidation under load irrespective of the actual facility for drainage or the number of drainage faces ,the latter affecting only the time-rate of settlement and not the total settlement due to consolidation .

A.COHESIONLESS SOIL:

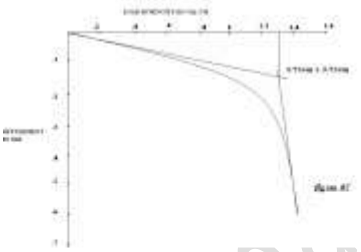
Sandy soils are considered to be cohesion less because their main source of settlement is due to elastic deformation of the soil within the zone of influence under the footing defined arbitrarily as the "bulb of pressure". the sandy soil with which we conducted our experiment was a cohesive soil.

C.Bearing capacity of model footings on sand:

We had done our project thesis on bearing capacity of model footing on sand. In this wehad three different square footings of size (3.75 cm *3.75 cm),(5 cm * 5 cm)and(6.3 cm*6.3 cm) and found out the bearing capacity of these footings on sandy soil. A tank was constructed of size 60 cm * 60 cm * 42 cm. sandy soil was filled in it to a depth of 35 cm. the sandy soil was filled in five layers of depth 7cm.each layer was compacted by giving certain number of blows. the experimental set up of our apparatus is shown below

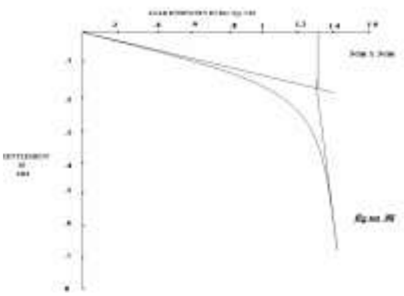
Footing 1:

Size of the footing: 3.75cm * 3.75 cm.



Footing 2:

Size of the footing: 5 cm * 5 cm



V .DIRECT SHEAR TEST

In a strength test of soil, there are two basic stages .first a normal load is applied to the specimen and then failure is induced by applying shear stress .If no water is allowed to escape enter from or enter into specimen either during consolidation or during shearing then it is called undrained test or unconsolidated undrained test (quick test).if specimen is allowed to consolidate under normal load but no drainage of water is allowed during shear it is called consolidated undrained test.if the specimen is consolidated under normal load and sheared under fully drained conditions it is called consolidated drained 0r slow test.undrained tests can be performed in a shear box only on highly impermeable clay.

$$s = c + \sigma \tan \phi$$

VI.CONCLUSION

Bearing capacity increases with the increase in size of model footing(square footing)on sand. The value of ultimate bearing capacity obtained from performing load test on model footings and that obtained from terzaghi's analysis were found to vary slightly. the value obtained by load test on footing was more than that obtained by terzaghi's analysis. It is possible to perform plate load test on model footings on a particular type of soil and these can be incorporated to the field by considering suitable criterias and foundation for the particular system can be laid.

V.REFERENCES

[1] Punmia B.C. , soil mechanics and foundation ,laxmi publications, thirteenthedition.

[2] Gopal ranjan, a text book on soil mechanics, tenth edition

[3] Karl terzaghi., basics of soil mechanics and foundation engg

[4] Braja m das , a text book on soil mechanics

[5] http://www.wikipedia.com/