

Discussions

Interaction of Different types of Footings on Sand*

by

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Author's Reply

Author is thankful to Shri R.D. Purkayastha, for his interest in the paper and valuable comments. The reply to his comments is as follows.

1. The angle of shearing resistance was determined by the triaxial shear tests.
2. The angle of shearing resistance is not the only governing criteria for determination of bearing capacity factors in recently developed bearing capacity theories, which is clear from the following.

Terzaghi's method has been found to be conservative, and the assumed mechanism of failure usually not in accordance with the observed ground movements (Mayerhof, 1948). The analysis of Mayerhof differs from that of Terzaghi in a number of respects. First the angle of wedge, is not assumed to be ϕ . Instead it is varied to obtain the minimum value of N_1 , with the result that angle of wedge is greater than ϕ and the wedge extends deeper than in the Terzaghi analysis. Second, it is assumed that the shear zone extends above the foundation level. The extent of the zone is largely governed by the shape, roughness and depth of the foundation. Thirdly, the bearing capacity factors depend on the depth and shape of the foundation as well as on ϕ and the roughness of the base. While in Terzaghi analysis the bearing capacity factors depend only on the ϕ and roughness of the foundation base. In case of Balla's theory (Balla 1962), the sliding surface is composed of circular and plane cylinder formed parts. All the bearing capacity factors are determined for the same sliding surface, in contrast to other theories in which these factors belong to two different sliding surfaces. The bearing capacity factors do not depend solely on the angle of shearing resistance but also on other properties of soil (contension, density) and characteristic dimension of the foundation (depth, width).

3. Mayerhof (1961) has pointed out that under strip foundations, the soil is in a state of plane strain and therefore, ϕ should be determined by plane strain compression test at field density and that this is roughly 10% more than that obtained by triaxial tests. On the other hand, the soil under circular or square footing is in a state of axial symmetry.

4. Plane strane conditions may be possible theoretically for strip foundations. But in actual practice, concept of strip with infinite length is not possible. The tests conducted by author were three dimensional

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and on different types of rough based footings that is strip, square, circular and rectangular. For finite shapes of footings (as existing in field) development and maintenance of plane strain conditions does not seem to be practicable.

5. As far as increasing the value of angle of shearing resistance obtained from triaxial shear test is concerned, Ko and Davidson (1973), have stated in conclusion very clearly that firstly the experimental program conducted in study indicates that it is very important to maintain plane strain condition in a two dimensional device and secondly it would be desirable, of course, to develop further the Sokolovski method for the rough footing case until a convenient way of representing the bearing capacity can be found.

It is felt by the author that before taking the decision of changing the values of angle of shearing resistance as obtained from triaxial test, first rational theoretical and experimental investigations are required to be conducted on different types of footing under three dimensional conditions as existing in situ. Once rigours, rational background and solutions are available, then only, concept of change in ϕ may be used. It will also be necessary to evaluate the effect of change in ϕ on different available bearing capacity theories.

6. Terzaghi and Peck (1962) statements, regarding the relation between angle of repose and angle of shearing resistance of a perfectly cohesionless, sand in loose and dense state will have to be checked in light of concept of plane strain. It is felt that the concept of plane strain may increase values of angle of shearing resistance very highly say greater than 70° —which may not be practically correct.

7. In actual practice the group footings be analysed as in a group and the loading is also done in different ways. Further theoretical and experimental investigations are necessary as far as application of plane strain conditions to isolate and interfering footings is concerned, and it is necessary that correlation in field and theoretical values should exist.

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