AN STUDY ON BEARING CAPACITY SAND BED BASED STRUCTURE

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Abstract

Earth reinforcement is an effective and reliable technique for increasing the strength and stability of soils. The technique is used today in a variety of applications ranging from retaining structures and embankments to sub grade stabilization beneath footings and pavements. Reinforcement can vary greatly; either in form (strips, sheets, grids, bars, or fibers), texture (rough or smooth), and relative stiffness (high such as steel or low such as polymeric fabrics). In past practice reinforcements have typically consisted of long, flexible, galvanized steel strips with either a smooth or ribbed surface. Most field research to date on the mechanics of reinforced earth has tended to focus on high modulus, steel strips.

Keywordfiber, foundation, soil, sand

Introduction

The lowest part of a structure is generally referred to as the foundation. Its function is to transfer the load of the structure to the soil on which it is resting. A properly designed foundation transfers the load throughout the soil without overstressing the soil. Overstressing the soil can result in either excessive settlement or shear failure of the soil, both of which cause damage to the structure. Thus, geotechnical and structural engineers who design foundations must evaluate the bearing capacity of soils.A number of equations based on theoretical analysis and experimental investigations are available to determine the ultimate bearing capacity equation.

Terzaghi’s Analysis

Main assumption made by Terzaghi was that the soil behaves like an ideally plastic material (This concept was initially developed by Prandtl). Terzaghianalysed the failure of a shallow continuous footing ($L/B = \infty$) and then suggested modifications for isolated square, rectangular and circular footings. The three cases considered by him are (1) smooth base of a footing resist on an ideal soil surface, (2) Rough base of a footing resting on an ideal soil surface and (3) Rough base of a footing resting at a level below the ground surface. Terzaghi has neglected the shearing resistance of the soil above the base of the footing. The soil above the base of the footing is substituted by an equivalent surcharge (q=γ*Df), where γ = unit weight of soil above the base of the footing. According to Terzaghi, the soil mass above the failure surface consists of three zones:

Zone I: Because of friction and adhesion between the soil and the base of the footing, this zone cannot spread laterally. It moves downward as an elastic wedge and the soil in this zone behaves as if it is a part of the footing. The two sides of the wedge ac and bc make angle Φ with the horizontal.

Zone II: The zones aef and bed are under this zone, which are called zones of radial shear. The soil in this zone is pushed into zone III.

Zone III : These are the two passive Rankine zones, boundaries of which make angles.

Literature review

In comparison to systematically reinforced soils, less information has been reportedon randomly distributed fiber-reinforced soils in the literature. However, anincreasing number of experimental and numerical studies on the subject have beenconducted by several researchers in the past few decades (e.g., Hoare, 1979; GrayandOhashi, 1983; Freitag, 1986; Gray and Al-Refeai, 1986; Maher and Gray, 1990;Ranjan et al., 1996; Bauer and Oancea, 1996; Michalowski and Zhao, 1996; WastiandButun, 1996; Consoli et al., 1998; Kumar et al., 1999; Santoni et al., 2001;Kaniraj and Havanagi, 2001). These previous studies indicate that stress–strain–strength properties of randomly distributed fiber-reinforced soils are also a functionof fiber content, aspect ratio, and fiber-surface friction along with the soil and fiberindex and strength characteristics.

Gray Donald H, OhashiHarukazu.[1983] Direct shear tests were run on a dry sand reinforced with differenttypes of fibers. Both natural and synthetic fibers plus metal wires were tested.Experimental behavior was compared with theoretical predictions based on aforce equilibrium model of a fiber reinforced sand. Test results showed thatfiber reinforcement increased the peak shear strength and limited post peakreductions in shear resistance. The fiber reinforcement model correctly predictedthe influence of various sand-fiber parameters through shear strengthincreases that were: (1) Directly proportional to concentration or area ratio offibers; (2) greatest for initial fiber orientations of 60° with respect to the shearsurface; and (3) approximately the same for a reinforced sand tested in a looseand dense state, respectively. The

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findings of this study are relevant to suchdiverse problems as the contribution of roof reinforcement to the stability ofsandy, coarse textured soils in granitic slopes, dune and beach stabilization bypioneer plants, tillage in root permeated soils, and soil stabilization with lowmodulus, woven fabrics. Wasti Y., Butun M.D., [1996]. A series of laboratory model tests on a strip footing supported by andreinforced by randomly distributed polypropylene fiber and mesh elements wasconducted in order to compare the results with those obtained from unreinforcedand with each other. For conducting the model tests, uniformsand was compacted in the test box at its optimum moisture content andmaximum dry density. Three types of reinforcement, two sizes of meshelements having the same opening size and one size of fiber element cut fromthe meshes, were used in varying amounts in the tests. Results indicated thatreinforcement of sand by randomly distributed inclusions caused an increase inthe ultimate bearing capacity values and the settlement at the ultimate load ingeneral. The effectiveness of discrete reinforcing elements was observed todepend on the quantity as well as the shape of the inclusions. The larger meshsize was found to be superior to other inclusions considering the ultimatebearing capacity values. For the mesh elements there appears to be an optimuminclusion ratio, whereas fibers exhibited a linearly increasing trend onthe basis of an increase in ultimate bearing capacity for the range of reinforcement amounts employed.

Conclusion

This study was undertaken to investigate the effect of fiber content on the bearing capacity of randomly distributed fiber-reinforced sand by measuring load-deformation.The following conclusions can be drawn from the experimental study.

- The bearing capacity of footings on randomly reinforced sand increases due to interference effects.
- Fiber reinforcements showed smaller loss of post-peak strength and changed the brittle behavior of the sand to a somewhat more ductile one. Hence, residual strength increases by adding the fiber reinforcements.

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However, randomly distributed fiber reinforced soils have recently attracted increasing attention in geotechnical engineering. In comparison with systematically reinforced soils, randomly distributed fiber reinforced soils exhibit some advantages. Preparation of randomly distributed fiber reinforced soils represents soil stabilization by admixture. Discrete fibers are simply added and mixed with the soil, much like cement, lime, or other additives. Randomly distributed fibers offer strength isotropy and limit potential planes of weakness that can develop parallel to oriented reinforcement.