Dimensioning of Footings on Cohesionless Soils*

by

S. Muthukumaran

N. V. Nayak**

The author should be congratulated for suggesting an approach which aids in selecting most economical sizes of footings. As one, who is working on such problems the writer would like to bring out its limitations. These limitations arise from

(*i*) the assumption that footing depths can easily be varied for a given structure;

(*ii*) soil is homogenous within the effective depth of foundation and

(*iii*) the assumption that the approaches suggested in IS 6403 are acceptable.

For many reasons the foundations for a given structure or a part of the structure may have to be founded at a common depth. In such cases the better approach would be to design the smallest footing to be safe against shear failure and to have total settlement within the permissible limit which could be different than that is specified in relevant Indian standards. The other bigger footings then should be designed to have the same total settlement as the smallest footing. When subsoil is uniform these bigger footings need not be checked against shear failure as they will definitely be safe against shear failure. When different footings are designed for equal total settlement than naturally the resulting differential settlement, between footings would be smaller. The governing criterion in most cases is the differential settlement rather than total settlement, though footings are generally designed based on total settlement. The approach suggested by the writer would allow an acceptance of higher values for total settlement and hence higher intensity of loadings thus economising in foundation sizes.

The author's approach, as is true with many other approaches in soil engineering, assumes soil is homogenous within the effective depth of foundation. In practice such a condition is rarely met. Even if we assume the soil within the effective depth is cohesionless it could be gravelly sand, coarse to medium sand, fine sand, silty sand etc. The author assumes, based on IS 6403, that a single equation, Equation (2) in the author's paper, holds good in predicting allowable bearing pressure, for permissible total settlement of 40 mm, based on N values of standard penetration tests. This is incorrect. This is one of the limitations of I. S. 6403. The writer has recently sent his comments to Indian Standards Institution for necessary

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** Soils Engineer, Tata Consulting Engineers, Bombay.

action. The writer suggests that Equation 2, in author's paper, may be modified as

$$q_a = 0.554 \; I \; (N-3) \; W' \; \left(\frac{B+30}{2B}\right) \quad \ldots \quad (3)$$

where $I =$ a constant dependent on soil type. The values specified are

$I =$ 2.0 for gravelly sands

$=$ 1.5 for coarse to medium sands

$=$ 1.0 for fine sands

$=$ 0.75 for silty sands

The writer has arrived at above values for I after extensive review of recent literature. Interested readers may refer to Bowles (1968); Johnson and Kavanagh (1968); Task Committee for Foundation Design Manual, ASCE (1972); Meyerhof (1956); Peck and Bazara (1969) for selection of appropriate values for I and W'.

There is considerable debate going on whether to take W' as 0.5 for full submergence, as recommended in IS 6403, or to take some other values. Meyerhof suggests that allowable bearing pressure for permissible settlement need not be reduced to half for submergence if standard penetration tests for N values were carried out in submerged condition. However the present thinking appears to take W' as 0.75 rather than 0.5 for full submergence.

The writer is pained to see that even many of the leading soil investigating contractors recommend valuer for allowable bearing pressure mainly based on IS 6403 though cohesionless soil in consideration may be silty sand, gravelly sand and so on. It is believed that this discussion will help in bringing out limitations of applying approach in IS 6403 or author's approach to all types of cohesionless soils.

The author has prepared valuable Figures 2 to 5 for ready reference. These figures can still be used even if soils in consideration may be gravelly sand, silty sand etc. The writer suggests that before using these figures N values may suitably be corrected to account for soil type. The suggested correction is as follows :

$$N \text{ corrected} = IN + 3\,(1 - I). \quad \ldots \quad (4)$$

where I values for different soil types are as stated previovsly varying from 2.0 to 0.75. N is the values from standard penetration test after it is corrected for overburden pressure and submergence, if any. N corrected is the value after it is corrected for soil type.

References

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