Interference of Surface Footings in Sands*

by

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V.L. Agarwal

1. B. Sivaram**

The authors have reported experimental data on model footings in interference, the discusser has following comments to add :

The problem of interference is of greater practical significance apart from those arising from the proximity of construction in urban areas. An example is cited here to illustrate the above. At the rate of 1.5 T/m^2 floor area (live load & dead load) with five meter column spacing, the column load will be of the order of $1.5 \times 5 \times 5 \times 4 = 150T$ for a four storey building. With the I.S. recommended maximum safe bearing capacity of $45T/m^2$ the footing size of 2m × 2m footing to be interference free a column spacing of 12 meters accordingly has not been provided. This suggests that due allowance in bearing capacity and differential settlement should be provided.

The scale effects have been reported to occur in sand by Debeer (1965), Kerisel (1967) and Vesic (1965). For any test to be of practical significance (i.e. for recommendation in Codes) bigger model tests will be required in sands.

The authors have chosen 114×114 cm tank to test the interference effect of pair of footings dimension 7.5 cm. and 10 cm. etc. Whereas the tank becomes inadequate (i.e. the failure surface start interacting with tank wall) as soon as the distance between footings is slightly more than 3 to 3.5 *B*. The trend $N\gamma$ values falling for increasing S/B up to 3.5 *B* is reasonable and confirms the finding of Stuart (1962) and Alam Singh (1973). However, the increase in $N\gamma$ because of S/B greater than 3.5 to 4B in Figure 7 and Figure 8 is quite unique and is result of inadequate tank size. For example footing pair of 10 cm. size for $S/B = 5$ clear spacing of 50 cm. is adopted. Therefore, clearance between footing and tank wall is $(114-50+10+10)/2$ i.e. 22 cm. This is evidently interfering with tank wall. Similar is the case for 7.5 cm footing.

In Figure 8, where the strip footing interference is studied marked lower values of $N\gamma$ compared to Stuart (1962) is result of bulging of perspex tank wall. The inadequacy of transparent perspex model to represent plain strain case like strip footing is established by Debeer Vesic (1950) and Szechy (1967).

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It is noticed that footings in this test have been allowed to rotate freely, the authors are requested to explain why this was chosen and under what conditions the square footings in interference will be free from restraint in building frames.

It is further interesting to note that settlement observation reported by author are in complete contradiction to a similar work by Alam Singh *et. al.* (1973).

The discussor feels that further study in analysis and experimentation must be taken up to remove this contradiction and many other problems of interference.

2. **K. Venugopal*****

The authors in their paper have given three conclusions which are either half-handed or evident from the basic knowledge.

In respect of their first conclusion, the authors have taken the curves drawn for $B = 7.5$ cms and have concluded that the bearing capacity of two interfering footings decreases rapidly with the increase in spacing upto a certain spacing (S = 4.5B) beyond which it increases slowly upto the value of the bearing capacity of isolated footing. On comparing the two sets of curves furnished by the authors for $B = 7.5$ cms & $B = 10$ cms value of 4.5 will not stand. The authors should not say at this stage a value of 4.5 without establishing the same with no. of trials. Generalisation should not be made with one example.

Second conclusion says that settlement of the footings decreases as the spacing between the footings increases. It is quiet evident since settlement depends on intensity of loading keeping the soil condition as the same. Intensity of loading will increase if the spacing between the footing decreases as soon as the mutual effect starts.

With respect to the third that the extent of failure surface decreases with the increase in the spacing, from Table I furnished by the authors for 7.5 cm × 7.5 cm square, the failure surface for isolated case is 11 cm. If two footings are considered at a time then the failure surface for the two will be 2×11=22 cms. If the spacing between the footings is 20 cms the failure surface is also 20 cms, which show that the failure surface of the two footings considered individually or at a spacing of 20 cms is approximately equal. As such the authors conclusion is not correct. It is not known whether the authors have kept spacing distance as between breadth to breadth or length to length (see Figure 12.)

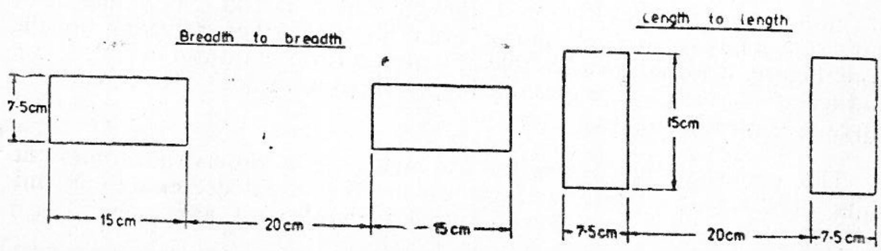

FIGURE 12.

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The author should explain the figures furnished in the table in detail.

3. **M.D. DESAI* and J.M. KATE****

The aim of the present study as given in the last para of introduction is commendable.

The data and the results discussed by the authors give feelings of incompleteness. The paper is silent on the roughness of model footing. The observations for the tilt of footings, as measured by specially designed and fabricated tiltmeter, have not appeared in interpretation and analysis. There is no discussion on the behaviour of footings in two and three dimensional tests, indicating that Figure 6, Figure 7 etc. are common for all tests. This of course, do not sound logical especially, when the sand is in dense state. It should be of interest to discuss the difference between N_γ observed by Stuart and present experiments with respect to its value and trend.

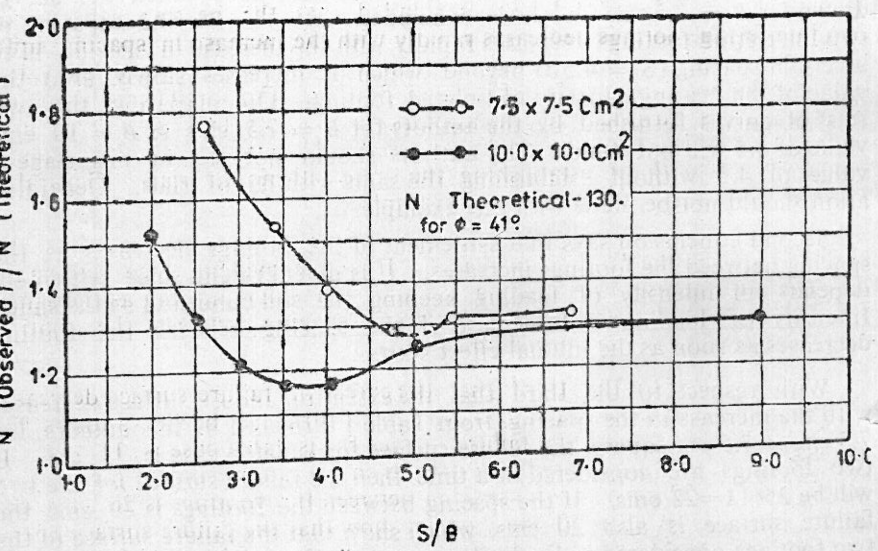

FIGURE 13. Variation of N_γ (observed)/N_γ (theoretical) S/B with

The settlements computed for loads $\frac{q_d}{2}$ and $\frac{q_d}{3}$ for different S/B ratios are not shown in the Figure 9 though stated, in text. It would be of interest to many readers if shown even now. Further, referring to the same Figure, it would be advisable, if readings for S/B ratios of 4.5, 5, 5.5 and 6.0 are verified before generalizing, as there is no logic to extend the curve as shown in Figure.

The conclusions are generalised too much. The observations may be valid only for the dense uniform sand. The rapid decrease in bearing capacity with increase in S/B ratio upto 4.5 should not affect the design

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practice as explained below. In the following Figure 13 the ratio between N_γ observed in the present work and the N_γ theoretical as extrapolated for $\phi = 41°$ (Terzaghi, 1943) are plotted against S/B ratios, for footings of 7.5×7.5 cm² and 10×10 cm². These curves shows :

$$\frac{N_\gamma \text{ (observed)}}{N_\gamma \text{ (theoretical)}} > 1,$$

for the S/B ratios studied in the present work.

The increase in S/B ratio increases the mass under compression below foundation, which is similar to increasing effective width of the footing. De Beer (1965) observed that, if B increases, the settlement at rupture also increases. The actual observations in the present work have shown such a trend only after S/B ratio is more than 4. Explanation of this phenomenon could help the readers realizing the impact of presented work better.

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