EVALUATING SUPERPOSITION ERRORS IN BEARING CAPACITY FACTORS FROM SOKOLOVSKI'S METHOD OF CHARACTERISTICS[i)]

Closure by Yoshimichi Tsukamoto[ii)]

The writer would like to acknowledge the thoughtful discussion on this technical note, and would also like to express great respect to the considerable contributions from the early work of Lundgren and Mortensen (1953). This note is primarily aimed at examining superposition errors and interpreting the data on this vein. Since there are some differences in the terminology adopted in this note and the discussion, the parameters addressed in the discussion are first reintroduced hereafter. Since the discussion was limited to cover the "$c=0$" analyses presented in this note, the bearing capacity q is defined as follows,

$$q=\frac{1}{2}B\gamma N_{\gamma q}=\frac{1}{2}B\gamma N_\gamma+q_0N_q, \tag{10}$$

therefore, the following equation holds true,

$$N_{\gamma q}=N_\gamma+\frac{q_0}{\frac{1}{2}B\gamma}N_q. \tag{3}$$

Based on the above Eq. (3), by plotting the parameter $X_o=q_0/(1/2B\gamma)$ against the unified bearing capacity factor $N_{\gamma q}$ and extrapolating such plots with the linear relation, the bearing capacity factors of N_γ and N_q were explicitly determined in this note, which are supposed to be free from any superposition errors. Another parameter $N'_{\gamma q}$ was introduced by the discusser to define the unified bearing capacity factor for unit weight and surcharge contributions as follows,

$$q=\left(\frac{1}{2}B\gamma+q_0\right)N'_{\gamma q}. \tag{8}$$

The writer understood that the significance of introducing the Eq. (8) lies in the fact that by plotting the parameter $X=q_0/(1/2B\gamma+q_0)$ against the unified bearing capacity factor $N'_{\gamma q}$, the bearing capacity factors of N_γ and N_q can be deduced at $X=0$ and 1, respectively. Based on this vein as adopted by the discusser, the data obtained in this note are re-plotted with white round points in Fig. 13. Also shown with dark round points in Fig. 13 are the values of N_γ and N_q, which were derived in this note. It is to note here that combining the Eqs. (10) and (8) leads to the following equation,

$$N'_{\gamma q}=N_\gamma+X(N_q-N_\gamma), \tag{11}$$

which corresponds to the linear interpretation as adopted in this note. It is seen that there is a marked difference in

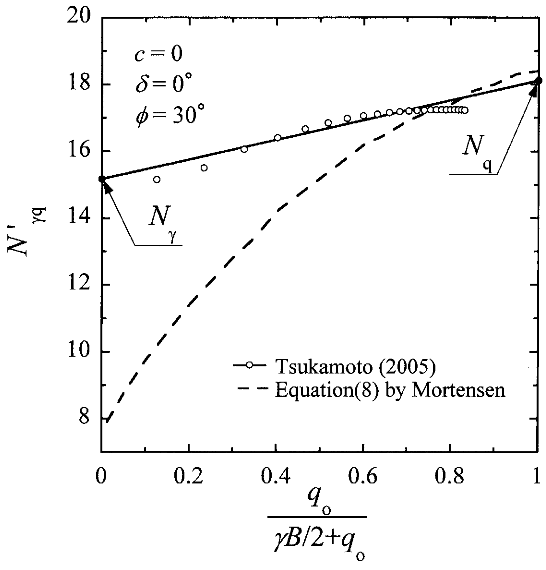

Fig. 13. Comparison of the relations between $q_0/(1/2B\gamma+q_0)$ and $N'_{\gamma q}$

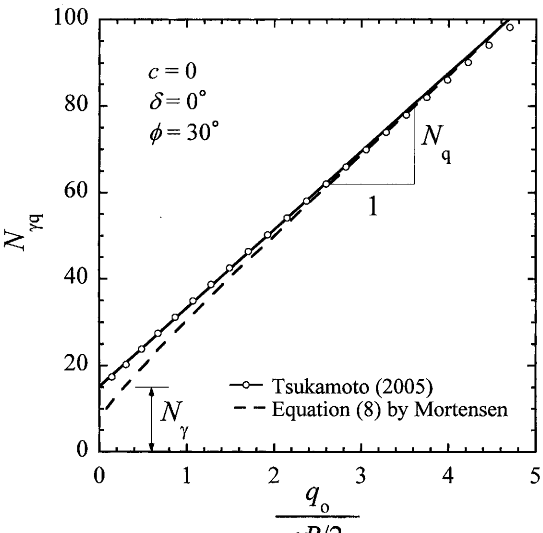

Fig. 14. Comparison of the relations between $q_0/(1/2B\gamma)$ and $N_{\gamma q}$

the values of N_γ, while the values of N_q are similar to each other, as suggested by the discusser. As noted by the discusser, the N_γ-values proposed by Hansen (1970) were based on the condition of $\delta=\phi$, and the present study was based on the condition of $\delta=0$. However, the N_γ-values inferred from the present study seem to be in line with those from Hansen (1970) with a peculiar coincidence.

On the other hand, since the parameters defined in this note and the discussion are related with each other by $X=X_o/(X_o+1)$ and $N'_{\gamma q}=N_{\gamma q}/(X_o+1)$, it is also possible to convert the relation indicated by the discusser as marked with "Eq. (8)" in Fig. 12 of the discussion into

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the plots of $X_o = q_0/(1/2B\gamma)$ against the values of $N_{\gamma q}$, as indicated in Fig. 4 of this note. Such plots are produced as shown in Fig. 14. It is seen that the linear interpolation as adopted by the writer converges with the relation indicated by the discusser, as the parameter $X_o = q_0/(1/2B\gamma)$ increases. It is also seen that from the standpoint of the linear interpretation as adopted by the Eqs. (10) and (3), the data obtained by the writer retain its linearity better and are in line with its principle, while the relation indicated by the discusser loses its linearity at lower values of $X_o = q_0/(1/2B\gamma)$.

However, the reason for the difference in the values of N_γ was not found, as described by the discusser. The discusser shortly discussed the amount of divisions adopted in the two analyses. However, the writer suspects that the influence of the amount of divisions is a minor factor. Rather, it is more related to the differences in the codes of calculation and iteration procedures adopted in the two analyses.

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