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Settlement of Pile Groups in Sand.

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SETTLEMENT OF PILE GROUPS IN SAND

BY

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ABSTRACT:

This article describe the methods for predicting the settlement of pile groups in sand, and a development was done based on (Vesic 1967) and (Berezantzev 1961) taking into account the state of soil, relative density, of sand and method of installation.

The method was used to predicts the settlement of pile groups for actual pile groups of 8 high rise tower in Cairo. Good agreement between the observed and the predicted settlement recommend the use of this method.

INTRODUCTION:

Results from full scale pile tests in sand indicate that the settlement of pile groups more than that of single pile. The larger part of the settlement of pile group first is loaded. The time dependent settlement, which generaly small and negligible is cause by creep in pile material and the soil.

Unless a highly compressible stratum of low parmeability exists some where below the pile tips, the consolidation settlement should not be significant and normaly will not exceed 15% of the total settlement.

Methods of Calculating the Settlement of Pile Groups in Sand:

Analysis of available test date by Skempton, Yassin, Gibbson (1953) indicate that the settlement of a pile group with friction pile increase with increasing size of the pile group.

In Fig. 1 is shown the ratio of the settlement of a pile group and that of a single pile at the same applied load per pile. According to Skempton et al. the settlement of a pile group with a width of for example 20 m will be approximately 12 times larger than that of a single pile.

Meyerhof (1959) indicates that the settlement of large pile groups can be up to 20 times that of a single pile when the pile spacing is large.

Kezdi (1957) indicate that the settlement at a given total load decreased with decreasing pile spacing.

Stuart et al. (1960) found also from model tests in sand that the settlement of a pile group is affected by the pile spacing.

(Berezantzev, Khristoforv and Golubkov, 1961) indicate that the settlement of pile group increases approximately linearly with $\sqrt{A}$ where $\sqrt{A}$ is area of an imaginary surface located at the level of the pile points. They found also that the settlement is not affected by the number of piles in the gruop.

The areas $\sqrt{A_1}$, and $\sqrt{A_2}$ are determined for a single pile and for a pile group as shown in Fig. 2. According to Berezantzev at al. the settlement of a pile group will be $\sqrt{A_2}/\sqrt{A_1}$ times the settlement of a single pile at the same load per pile.

This calculation method is included in the national building codes for Poland and USSR.

Vesic (1967) has suggested on the basis of results from large size mode test and from an analysis of test data repoated by Berezantzev et al. (1961) that the relative settlement of a pile group is proportional to $\sqrt{W/B}$ where W is the width of the pile group and B is the pile diameter.

Present Work:

From the previous study the relative settlement of a pile group in cohesionless soil appears to be influenced by dimensions of the pile groups.

We think that this relative settlement is influenced too by relative density and state of sand around piles which is affected by the method of instillation of piles, in other words:

$$\eta = \frac{1}{N_R} \sqrt{\frac{B}{B^{`}}}$$

where η is relative settlement ratio
B is the width of group
B` is the diameter of pile
N_R is the relative number which is depends on the method of installation and the relative density of sand.

for bored piles
N_R = 0.6 for medium sand
N_R = 0.7 for dense sand

for driven piles
N_R = 0.9 for dense sand
N_R = 0.8 for medium sand.

This equation was used for prediction of settlement under 8 high rise tower in Cairo and the results were good. (Fig. 3, Table 1).

CONCLUSIONS:

This article was describe a new method for prediction of settle ment of pile groups in sand, the method was used for predicte the settlement of piles groups for 8 high rise towers in Cairo. The agreement between the observed and predicated settlement was good. A considerable amount of research, including well-instrumented observations on full size groups is needed in the future.

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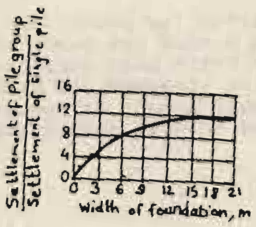


Fig. 1

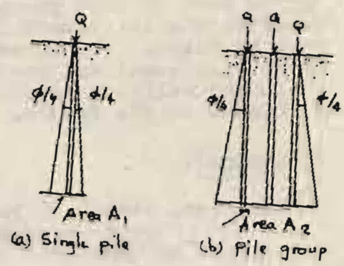


Fig. 2

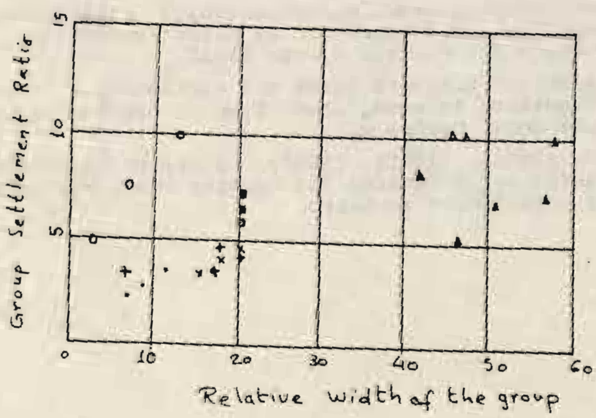


Fig.3

▲ Feagin 1948

o Meyerhof 1960

· Golubkov 1969

■ Zamalik Tower Bahloul 1981

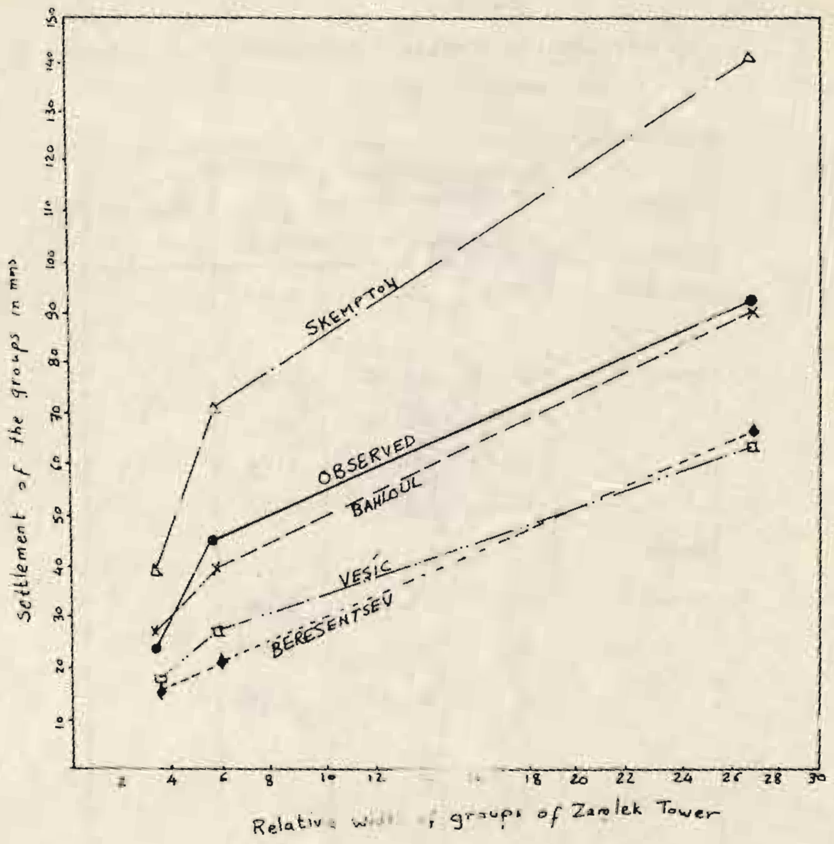
+ Agakhan Towers 1982

x Maadi Towers Bahloul 1982

Table 1

Comparisson of predicted and observed settlement for Towers in Cairo

Tower	Max. Settlement		Observed to pred. ratio	Remarks
	predicted	observed		
Zamalik	89.9	78.24	0.87	
Agakhan				
Tower 1	47.27	45.20	0.96	
2	42.68	41.50	0,97	
3	37.56	39.20	1.04	
4	74	52	0.70	
Maadi				
Tower A	51	44.75	0.88	
B	47	47.2	1.004	
C	45	41.8	0.93	


SKEMPTON
OBSERVED
BAHLOUL
VESIC
BERESENTSEV
Settlement of the groups in mm