01 Jan 1989

Cyclic Lateral Loading Of A Large-scale Pile Group

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Recommended Citation

S. Prakash et al., "Cyclic Lateral Loading Of A Large-scale Pile Group," *Journal of Geotechnical Engineering*, vol. 115, no. 5, pp. 747 - 749, American Society of Civil Engineers, Jan 1989.

The definitive version is available at https://doi.org/10.1061/(ASCE)0733-9410(1989)115:5(747)

Cyclic Lateral Loading of a Large-Scale Pile Group[a]

Discussion by Shamsher Prakash,[1] K. Sreerama,[2] and Sally Prakash[3]

The writers have analyzed the test data presented by the authors on the single pile and have predicted the pile group behavior for the group tested by the authors on the basis of the study of model piles (Prakash 1962):

1. The load had been applied 1 ft above the mud line and the deflections have also been measured at the load point (Fig. 6 of the authors). Therefore the following equation will be used to interpret the single pile test data:

$$y = \frac{A_y Q R^3}{EI} + \frac{B_y M T^2}{EI} \quad (5)$$

and Moment, $M = Q \times 1'$ lb-ft. Davisson and Gill (1963) calculated the A and B coefficients for clays as

$$A_y = 1.4 \quad B_y = 1.0 \quad (6)$$

where A_y, B_y = deflection coefficient; Q = applied load; R = relative stiffness factor = $4\sqrt{EI/k}$; k = soil modulus assumed constant with depth; and EI = flexural stiffness of the pile.

2. On the basis of pile tests on groups in sand, Prakash (1962, 1981) and Davisson (1970) had recommended that if the spacing of piles in the direction of load is $3d$, the effective value of $k(k_{eff})$ is $0.25k$, where d = the diameter of the pile.

3. For a spacing of 3-d in the pile group, then from Eq. 1 we obtain

$$y' = \frac{A_y Q R^3}{EI}(2.827) + \frac{B_y M R^2}{EI}(2) \quad (7)$$

where y' = deflection of the pile group at the same load as on single pile.

The values of y' so computed have been listed in Table 2. The predicted and measured load deflection curves are plotted in the attached figure.

Distribution of Loads to the Piles

The question of load distribution on piles was studied by Prakash (1962) in his model tests on piles in sand and the corresponding distribution is shown in Table 3 along with that from Fig. 10 of authors.

Analysis

The full scale pile tests in this paper and the model pile tests of Prakash (1982) differ in the following respects:

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[a]November, 1987, Vol. 113, No. 11, by Dan A. Brown, Lymon C. Reese, and Michael W. O'Neill (Paper 21927).

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TABLE 2. Results of Group Pile Calculations

S.No. (1)	Deflection, (y) in. (2)	Single pile, Q (lb) (3)	y' (4)
1	0.10	4,200.00	0.27
2	0.20	7,200.00	0.54
5	0.40	11,600.00	1.08
7	0.60	14,600.00	1.63
10	0.80	16,800.00	2.18
12	1.00	18,600.00	2.72
15	1.25	20,800.00	3.41

1. The full scale pile tests are in over-consolidated clay, while the model pile tests were in sand.
2. The full scale pile tests were performed with two-directional loading, while the model pile tests were performed with one directional loading.

TABLE 3. Distribution of Total Load in the Front, Middle, and Back Row of Piles

	Front		Middle		Back		
Deflection (1)	Load (kips) (2)	Percent of total (3)	Load (kips) (4)	Percent of total (5)	Load (kips) (6)	Percent of total (7)	Total kips (%) (8)
1 in. (Fig. 10)[a]	13.52	35%	12.95	34%	11.75	31%	38.22 (100%)
2 in. (Fig. 10)[a]	19.09	39%	15.68	32%	14.32	29%	49.09 (100%)
Prakash (1962)	–	40%	–	32%	–	28%	100%
Wen[b] (1955)	–	43%	–	34%	–	23%	100%

[a]Authors' Fig. 10.
[b]Quoted Prakash (1962).

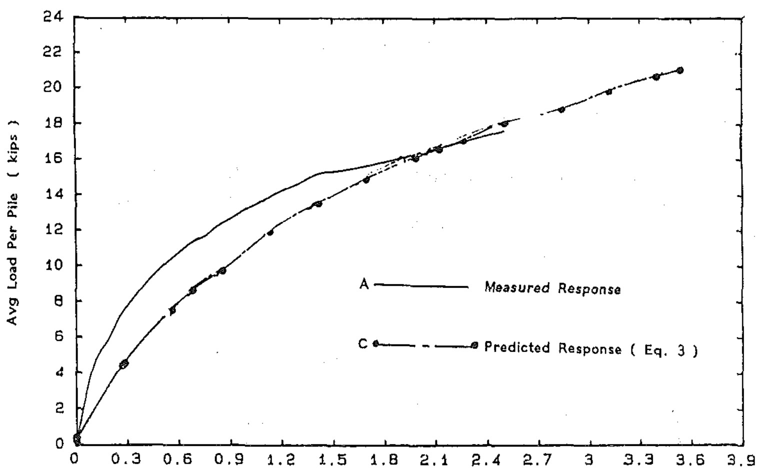

FIG. 15. Measured and Predicted Lateral Load-Deflection Response

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3. The full scale pile tests are performed with complete control of moment at the point of load application ($M = 0$) while in the model tests the rotation of the pile cap had however been monitored, but not controlled.

Despite the above variations in the test conditions, it is extremely interesting to note that (1) The predicted load deflection for full scale pile group agree very well with the measured load-deflection; (2) the results of full scale tests on clays and the model pile tests on sands give almost identical distribution of loads in different piles; (3) the most significant conclusion is that the analysis of single pile and pile groups according to theory of modulus of subgrade reaction predicts the behavior well provided a reasonable value of soil modulus is estimated; and (4) the interaction effects under lateral loads both in sands and clay are of the same order.

Acknowledgments

The draft of this discussion had been commented upon by Dr. M. T. Davisson, to whom the writers express their gratitude.

Appendix. References

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Rate Effects in Pressuremeter Tests in Clays[a]

Discussion by S. Prapaharan,[4] Associate Member, ASCE, and S. Thevanayagam,[5] Senior Member, ASCE

The authors should be commended for their exhaustive experimental and numerical studies of the cavity expansion problem. A few points, however, appear to deserve clarification.

In their numerical analysis of the laboratory specimen, the authors obtained higher limit pressures due to consolidation alone, and since this was not found in the experimental results, they concluded that the effect of creep is significant in the pressuremeter tests. The writers, however, believe that the higher limit pressures were not obtained in the laboratory tests due to

[a]November, 1987, Vol. 113, No. 11, by W. F. Anderson, I. C. Pyrah, and F. H. Ali (Paper 21958)

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