SUMMARY REPORT 105-4(S)

DYNAMIC OVERTURNING LOADS ON DRILLED SHAFT FOOTINGS USED FOR MINOR SERVICE STRUCTURES

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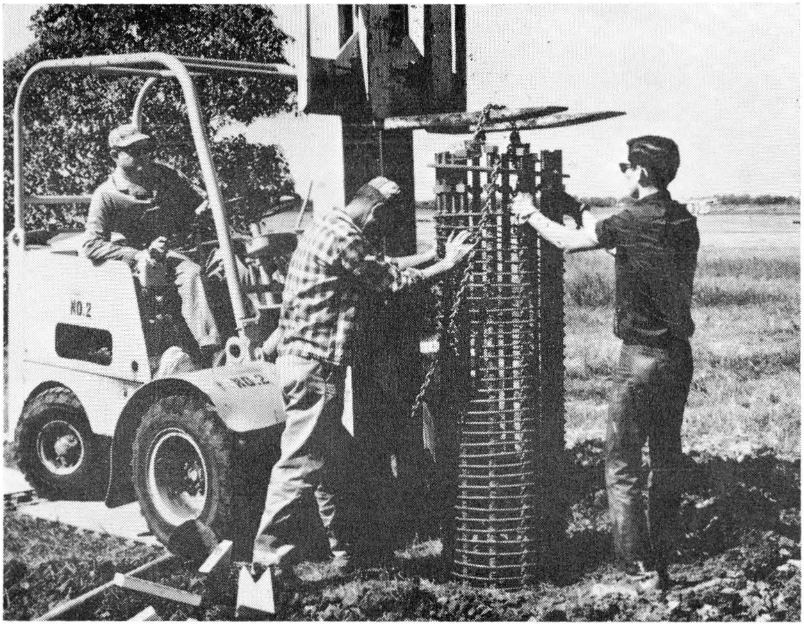

Placing the steel for the footing.

Cooperative Research Program of the
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Dynamic Overturning Loads on Drilled Shaft Footings Used for Minor Service Structures

by

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A theory to predict the ultimate resistance to overturning loads of drilled shaft footings used for minor service structures such as sign boards, strain poles and lighting supports was presented in Research Report 105-1.[1]* The theory was correlated with both model tests[2] and full-scale tests[3] and a tentative design procedure was established.

The purpose of the research presented in Research Report 105-4 was to determine the effect of dynamic overturning forces on footing movements. Current design procedures for minor service structure footings do not treat dynamic forces separately, thus implying that the effect of these forces is the same as the effect of static forces.

To evaluate this aspect several models of drilled shaft footings were subjected to dynamic loads. Compared to the aver-

*Refers to numbers in Selected References.

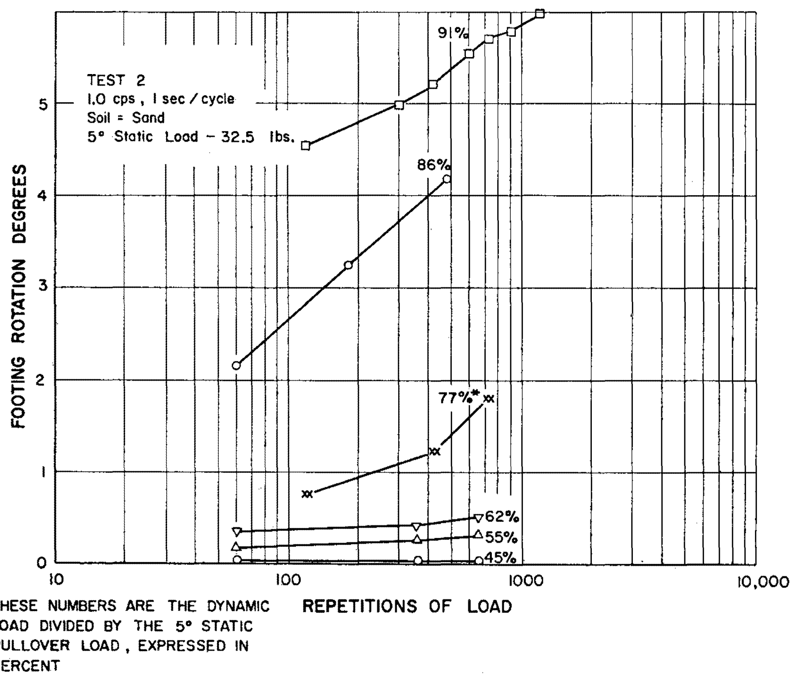

Figure 1.

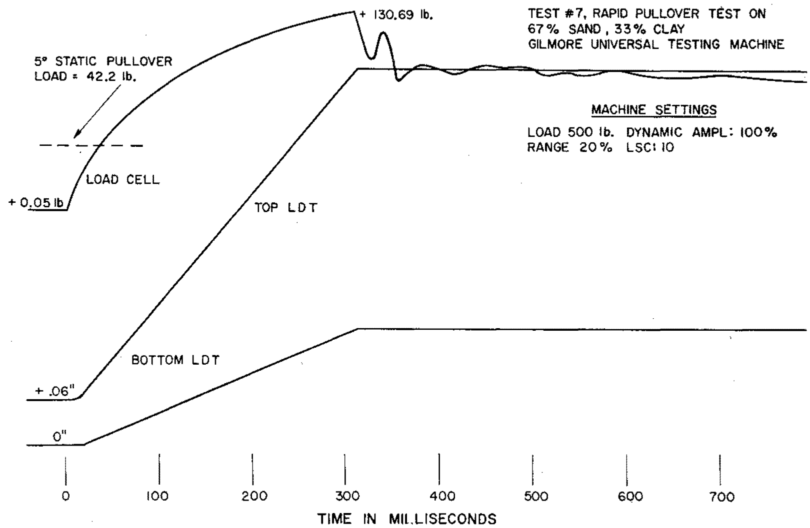

Figure 2. Rapid pullover test, clayey sand.

age size footing used for minor service structures in Texas, the model footings were reduced by a factor of about six. The footing reactions were investigated in a cohesionless sand, a sandy clay, and a clayey sand. Two distinctly different types of tests were performed. In one, repeated dynamic loads were applied at different load levels and load frequency rates. In the other, a single dynamic load of sufficient magnitude to cause failure (defined as a footing rotation of 5°) was applied.

Typical results for a repeated dynamic load test at a loading frequency of 1.0 cycles per second are shown in Figure 1. Under these loading conditions, footing rotations did not exceed 1° for 10,000 dynamic load repetitions, as long as the dynamic loads were less than 50% of the maximum static pullover load.† An exception was a very soft clay in which a footing rotation of 1.2° was observed at load levels of approximately 40% of maximum static pullover load. Thus, some conservatism is warranted in these soils.

Figure 2 shows the results for a single dynamic load application. These results indicate that footing rotations due to single dynamic loads are significantly less than the rotations due to static loads of the same magnitude. Expressed another way, a dynamic load equal to the theoretically predicted static load will produce a footing rotation less than 5°.

In summary, the tests give indications of the type of footing

†The maximum static pullover load is that load obtained using the procedure explained in Research Report 105-3.

movements that can be expected under various dynamic loads and indicate that the "Tentative Design Procedure" developed for the static load condition can provide foundations adequate to resist dynamic loads of the same magnitude. Special consideration should be given to footings subjected to a large number of repetitions of high intensity dynamic loads.

Selected References

1. Ivey, Don L., "Theory, Resistance of a Drilled Shaft Footing to Overturning Loads," Research Report No. 105-1, Texas Transportation Institute, August, 1967.

2. Ivey, Don L., Koch, Kenneth J., and Raba, Carl F., Jr., "Resistance of a Drilled Shaft Footing to Overturning Loads, Model Tests and Correlation with Theory," Research Report No. 105-2, Texas Transportation Institute, August, 1968.

3. Ivey, Don L. and Dunlap, Wayne A., "Design Procedure Compared to Full Scale Tests of Drilled Shaft Footings," Research Report No. 105-3, Texas Transportation Institute, February, 1970.