Drilled Shaft Foundations for Noise Barrier Walls and Slope Stabilization

FHWA/OH-2002/038

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State Job No. 14705(0)
December 2002

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EXECUTIVE SUMMARY

This research project is focused on two primary objectives. The first objective relates to the development of a methodology for using the SPT (Standard Penetration Test) results to design the laterally loaded drilled shafts. The second objective aims to develop a methodology for design of drilled shafts to stabilize unstable slopes or embankments. The research has resulted in suggestions of two implementation items.

In the course of the research work, a large database has been established to contain a total of 58 lateral load test results and the pertinent soil information at each test site. Among these test data, 32 load tests are from ODOT projects performed by the principal investigator. The drilled shaft sizes range from 10 ft to 90 ft in length, and 16 inch to 72 inch in diameter. Both cohesionless and cohesive soils are present in the test sites.

Correlations between the SPT N values and the pertinent soil parameters needed for p-y curve construction in the COM624 analysis have been developed from the database and statistical comparisons. The predictions of drilled shaft deflections at the load point under different load levels are compared fairly well with the measured data, when these empirical correlations are used.

To aid in the development of a design method for drilled shafts to stabilize an unstable slope, both centrifugal model study and finite element simulation techniques have been used in this research. The measured strains of the model shafts in the centrifuge tests allow for the determination of the deflections of the shafts and the net soil forces applied to the shafts. Soil arching between the adjacent drilled shafts in stabilizing the slope has been quantified from these centrifugal experiments. Specifically, in the sandy slopes, when S/D (S = clear spacing of shafts, and D = Diameter of shafts) is equal to 2, soil arching effect is most pronounced. Similarly, S/D = 1.5 appears to promote most the development of soil arching in cohesive soil slopes.

Finite element analysis of soil arching also confirms that S/D ratio plays the most important role in controlling the development of soil arching in between the drilled shafts. Based on a series of finite element simulation results, the soil arching effect on the net earth forces applied to the drilled shafts has been quantified and summarized in a design table. Also, a slope stability analysis procedure that incorporates the soil arching effect has been developed on the basis of method of slices for any composite shape of failure surface. The method has been validated against other slope stability programs and been used successfully to assist ODOT to design slope stabilization schemes for several slope rehabilitation projects.