Load Distribution in Drilled Shafts Socketed in Limestone and Clay Shale

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Abstract

Rock Socketed drilled shafts are increasingly used as foundations for bridges and other transportation structures. Limited information is available on the roughness on the side resistance of dsocketed drilled shafts. In this study, the effect of drilling tools on the drilled shafts socketed in limestone and clay shale was investigated. Based on the results of this study, it was determined that the types of drilling tools produced different socket roughness and they affected on the side resistance of rock socketed drilled shafts.

1. Introduction

The demand for carrying higher loads coupled with the geological conditions has resulted in placing the drilled shafts in rocks. Rock Socketed drilled shafts are increasingly used as foundations for bridges and other transportation structures. Limited information is available on the roughness on the side resistance of dsocketed drilled shafts.

2. Objective

The objective of this study is to identify according to rock type and drilling tools, and investigate the effect of drilling tools on socket roughness and side resistance of rock socketed drilled shafts.

3. Borehole Roughness Profile Device Modification

A borehole roughness profile device (LBRP), which previously developed for pavement profiling using laser technique, was modified by Well Logging Laboratory, Electrical & Computer Engineering, University of Houston, Houston, TX in order to be adapted to operate off the Kelly bar of a drill rig. It recorded depth, and roughness. The LBRP measured the roughness at a speed of 100-kilo samples per second while the Kelly bar moved up from the bottom of the borehole. Four vertical profiling were measured, 90 degrees apart, at 6, 9, 12, and 3 o'clock positions in the borehole. The roughness measurement accuracy was better than 0.5 mm in both the vertical and radial directions (Liang, 2002).

4. Test Sites

Total of three test sockets approximately 0.762 m in diameter were constructed at three test sites [Hampton (HT), Denton Tap (DT), and Rowlett Creek (RC)] in North Central Texas where soft rock formations are upper Cretaceous formations, including the Eagle Ford (clay shale) and Austin (limestone) formations. The test sites were consisted of two clay shale sites (HT and DT) and two limestone site (RC and TS).

5. Test Results

After measuring socket roughness (Summarized in Table 1), the test socket was constructed only for one test hole drilled by the auger at the each site and then load tests were performed using Osterberg Cell after assuring curing of concrete. The results of and effect of roughness on maximum side resistances are summarized in Table 2 (Nam 2004).

6. Conclusions

The roughness caused by drilling tools and its effect on maximum side resistance in clay shale and limestone have been quantified.

7. Acknowledgement

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8. References

Liang, R. (2002), "Development of A Laser Triangulation Distance Measurement Device and Its Application to Borehole Roughness Detection," *MSEE Thesis*, Department of Electrical Engineering, University of Houston, Houston, Texas.

Nam, M. S. (2004), "Improved Design for Drilled Shafts in Rock," *Ph. D. Dissertation*, Department of Civil & Environmental Engineering, University of Houston, Houston, Texas.

Table 1. Socket Roughness Heights (Δr) Based on Cord Lengths (w)

Sites	Rock Type / q_u (MPa)	Δr by Drilling Tools (Auger and Core Barrel)	Δr for corresponding w				Average Values	Overall Average of $\Delta r_{(Core\ Barrel)}/\Delta r_{(Auger)}$
			w = 10 (mm)	w = 30 (mm)	w = 50 (mm)	w = 70 (mm)		
HT	Clay Shale / 1.2	$\Delta r_{(Auger)}$	1.0	2.1	3.2	3.8	2.5	1.3
		$\Delta r_{(Core\ Barrel)}$	1.5	3.3	4.4	5.5	3.7	
		$\Delta r_{(Core\ Barrel)}/\Delta r_{(Auger)}$	1.4	1.6	1.4	1.5	1.5	
DT	Clay Shale / 2.1	$\Delta r_{(Auger)}$	1.4	3.3	4.7	6.0	3.8	
		$\Delta r_{(Core\ Barrel)}$	1.5	3.5	5.2	6.7	4.2	
		$\Delta r_{(Core\ Barrel)}/\Delta r_{(Auger)}$	1.1	1.1	1.1	1.1	1.1	
RC	Limestone / 10.0	$\Delta r_{(Auger)}$	1.2	2.0	2.5	3.1	2.2	
		$\Delta r_{(Core\ Barrel)}$	1.5	3.1	4.2	5.1	3.5	
		$\Delta r_{(Core\ Barrel)}/\Delta r_{(Auger)}$	1.2	1.5	1.7	1.7	1.5	
TS	Limestone / N/A	$\Delta r_{(Auger)}$	1.6	2.8	3.6	4.4	3.1	
		$\Delta r_{(Core\ Barrel)}$	2.1	3.4	4.5	5.3	3.8	
		$\Delta r_{(Core\ Barrel)}/\Delta r_{(Auger)}$	1.3	1.2	1.3	1.2	1.3	

Table 2. Summarized f_{max} Based on Drilling Tools

Sites	$f_{max\ Auger}$ (kPa)	$f_{max\ Core\ Barrel}$ (kPa)	Ratio of $f_{max,\ Core\ Barrel}/f_{max,\ Auger}$
HT	101	126	1.2
DT	405	454	1.1
RC	1403	1614	1.2
Average Ratio			***1.2***