An Experimental Study of the Dynamic Behavior of Slickensided Surfaces

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Civil Engineering

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January 25, 2006
Blacksburg, Virginia

Keywords: Shear Strength, Clay, Earthquakes, Cyclic Loading,
Slope Stability, Residual Strength

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ABSTRACT

When a clay soil is sheared, clay particles along the shear plane become aligned in the direction of shear, forming "slickensided" surfaces. Slickensided surfaces are often observed along the sliding plane in field landslides. Because the clay particles along a slickensided surface are already aligned in the direction of shear, the available shear resistance is significantly less than that of the surrounding soil.

During an earthquake, ground shaking often causes landslide movement. For existing landslides or repaired landslides that contain slickensided rupture surfaces, it is reasonable to expect that the movement will occur along the existing slickensided surfaces, because they are weaker than the surrounding soil. The amount of movement that occurs is controlled by the dynamic resistance that can be mobilized along the slickensided surfaces.

The objective of this study was to investigate, through laboratory strength tests and centrifuge model tests, the shearing resistance that can be mobilized on slickensided rupture surfaces in clay slopes during earthquakes. A method was developed for preparing slickensided rupture surfaces in the laboratory, and a series of ring shear tests, direct shear tests, and triaxial tests was conducted to study the static and cyclic shear resistance of slickensided surfaces. Two dynamic centrifuge tests were also performed to study the dynamic shear behavior of slickensided clay slopes. Newmark's method was used to back-calculate cyclic strengths from the centrifuge data.

Test results show that the cyclic shear resistance that can be mobilized along slickensided surfaces is higher than the drained shear resistance that is applicable for static loading conditions. These results, coupled with a review of existing literature, provide

justification for using cyclic strengths that are at least 20% larger than the drained residual shear strength for analyses of seismic stability of slickensided clay slopes. This represents a departure from the current state of practice, which is to use the drained residual shear strength as a "first-order approximation of the residual strength friction angle under undrained and rapid loading conditions" (Blake et al., 2002).

ACKNOWLEDGEMENTS

The completion of my doctoral work has been an exceedingly challenging endeavor, one that I could not have accomplished without valuable assistance provided by many.

First and foremost, I would like to thank my advisor, Professor J. Michael Duncan for his guidance and friendship throughout my PhD studies. Working with Professor Duncan has been the highlight of my professional career, and much of what I have learned in my time at Virginia Tech can be attributed to his wise and careful mentoring. His support, encouragement, and love of geotechnical engineering have always been a source of great personal inspiration for me.

Special thanks are also owed to Professor Ross Boulanger, who provided support, guidance, and friendship during my time at UC Davis. As my advisor on the West Coast, Ross taught me much about earthquake engineering and about life in general. His sense of humor and enthusiasm made my time in California extremely enjoyable.

I would also like to recognize the contributions and helpful suggestions provided by my dissertation committee members: Professors Tom Brandon, Marte Gutierrez, Rakesh Kapania, and Jimmy Martin. The regular input and guidance provided by Dr. Brandon in the laboratory is especially appreciated, as is his ability to make the lab a fun place to work.

Funding for this project was provided by the National Science Foundation, the United States Society on Dams, the Virginia Tech Center for Geotechnical Practice and Research, and the Virginia Tech Civil and Environmental Engineering Department (through the Instructorship position).

A number of the laboratory tests described in this research study were performed by other researchers. The aid provided by: Dr. Binod Tiwari, Derek Martowska, Michael Wanger, and Raquel Miller is much appreciated.

The staff at the UC Davis Center for Geotechnical Modeling provided valuable assistance with all aspects of the centrifuge model tests. The author would like to acknowledge the suggestions and assistance of Chad Justice, Dan Wilson, Tom Kohnke,

Tom Coker, Victor Ray, Roger Claremont, Bill Sluis, Lars Pedersen, and Cypress Winters. Thanks also to Dongdong Chang, Umit Gulerce, and Mahadevan Ilankatharan for the training they provided on centrifuge model construction.

Pat Lucia and the staff at GeoSyntec Consultants' Oakland office provided soil for use in the laboratory testing program. Additionally, I am grateful for the friendship and guidance provided by Mike Minch, Hari Sharma, Julie Ryan, Pat Lucia, Chris Hunt, Jeff Dunn, and Krzysztof Jesionek during my West Coast hiatus in 2001.

I am indebted to the Kutter's for their hospitality during my time at UC Davis. I enjoyed being a part of their family, if but for a little while. Thanks also to Laura Pallas for the support she provided during my time in California and during the writing of this dissertation.

I am eternally grateful to all those who have supported me during my studies at Virginia Tech. It is not possible to name here all of those in the geotechnical engineering group that have made my time at Virginia Tech so memorable, but a few people must be noted: Randy Hickman, Brendan Fitzpatrick, Joe Clark, Mark Osowski, Brian Waisnor, Morgan Eddy, Mike Pockoski, Lee Bryant, Kami Deputy, Andy Hill, Youngjin Park, Ming Zhang, Ning Liu, Jianfeng Wang, Jon Rice, Guney Olgun, Miguel Pando, C.J. Smith, and Dave and Jennifer Nevius. Special thanks go to Genevieve Smith, for her support and encouragement during the final push to completion of this dissertation.

Finally, and perhaps most importantly, I would like to express my sincere appreciation to my family, for a lifetime of love and support. This work is dedicated to you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES