GEOTECHNICAL PRACTICE PUBLICATION NO. 7

GeoChallenges

Rising to the Geotechnical Challenges of Colorado

Edited by
Christoph M. Goss, Ph.D., P.E.
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PROCEEDINGS OF THE 2012 BIENNIAL GEOTECHNICAL SEMINAR

November 9, 2012
Denver, Colorado

SPONSORED BY
The Geo-Institute of the American Society of Civil Engineers

Geo-Institute Chapter of the Colorado Section of the American Society of Civil Engineers

Rocky Mountain Section of the Association of Environmental and Engineering Geologists

Colorado Association of Geotechnical Engineers

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Published by the American Society of Civil Engineers

Cataloging-in-Publication Data on file with the Library of Congress.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4400

www.pubs.asce.org

ISBN 978-0-7844-1263-3
Manufactured in the United States of America.

Preface

As geo-professionals, we are called to provide solutions for the many challenges that our earth presents in the areas we choose to work, play and live. From nature's geological features to our world's aging infrastructure, we are presented with the challenge of developing in areas and in ways that many thought were unbuildable or un-attainable. Yet, through the use of new technologies, modeling methods and visual mapping, geo-professionals have answered these many challenges by providing viable solutions. This book provides examples of how some in our profession have overcome these types of challenges in mining applications, tunneling, geological anomalies, alternative energy resources and infrastructure. This will highlight, again, how the geo-professional community provides solutions to the most challenging applications.

Since 1984, the Geotechnical Institute Chapter of Colorado (formally known as the ASCE Colorado Section's Geotechnical Group) in collaboration with the Rocky Mountain Section of the Association of Environmental and Engineering Geologists and the Colorado Association of Geotechnical Engineers, has organized a biennial series of geotechnical seminars on a wide variety of themes that have been attended by as many as 270 civil/geotechnical engineers, geologists, and other geo-professionals. The geotechnical seminars have been held at area universities or hotels and have offered the opportunity for sharing ideas and experiences among Colorado's diverse geo-disciplines. Since 2004, ASCE's Geo-Institute has published the papers of these seminars in Geotechnical Practice Publications, allowing the experiences to be shared with a worldwide audience.

The GeoChallenges Steering Committee convened in August 2011 and held monthly meetings to plan for the 2012 Biennial Geotechnical Seminar. The Steering Committee members included Joseph Kerrigan (Conference Chair), Dustin Bennetts, Mark Brooks, Robin Dornfest, Darin Duran, Dr. Christoph Goss, Joels Malama, Dr. Bill McCarron, Minal Parekh, Becky Roland, Keith Seaton, Jere Strickland, David Thomas, Mark Vessely Chris Wienecke, and Richard Wiltshire.

Christoph Goss, Jere Strickland, and Richard Wiltshire

Acknowledgments

The GeoChallenges Steering Committee wishes to take this opportunity to thank all of the authors and reviewers of our papers, which are herein presented as Geotechnical Practice Publication No. 7. The authors have spent many hours in preparing and finalizing their papers, which will be presented at the 2012 Biennial Geotechnical Seminar on November 9, 2012. These papers have been reviewed by a volunteer group of Denver area geo-professionals who put in their valuable time and helped make these papers even better. The Geo-Institute's Committee on Technical Publications completed its review of our GeoTrends papers in a very timely manner and their adherence to our aggressive publication schedule is greatly appreciated. We would also like to acknowledge the assistance of Donna Dickert of ASCE's Book Production Department for putting this publication together.

Author List

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Constructing Challenges

Challenges for Debris-Flow Mitigation in Colorado: Helpful Ideas from Recent Research

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ABSTRACT: A large amount of recent research has focused on debris flow analysis, prediction, and mitigation, particularly in burned areas. Ten concepts from this work are especially applicable in Colorado. 1) Debris flows are larger and more likely to occur following wildfire, and the problem is getting worse due to climate change. 2) After wildfire, vegetation often recovers to pre-fire conditions in one to three years. 3) Volume measurement and related volume prediction methods for debris flows have much larger error ranges than is typically assumed. 4) Likewise, measurement and prediction of debris-flow velocities may easily include errors. 5) Impact forces from boulders carried by debris flows are typically overestimated. 6) Flows often occur in surges, probably from creation and breaching of small dams of material. 7) Flow paths on open slopes are unpredictable and may change rapidly following development of these small dams. 8) In burned areas, the occurrence of debris flows depends more on rainfall intensity bursts, with flows often occurring within a few minutes of 10-minute intensities exceeding threshold values, than on total storm rainfall. 9) A corollary is that debris-flow volume, as predicted from multiple-regression datasets, depends more on total rainfall than on shorter intensity ranges. 10) Many flows are comprised more of channel sediment than of materials mobilized from a single slide mass, meaning that they grow substantially in volume in transit.

INTRODUCTION

Debris flows are a common and destructive geologic hazard in Colorado. Recent debris flows have covered Interstate 70 in more than 7m of debris, have affected dozens of flow channels following alpine summer cloudbursts (e.g., Coe et al., 2007; Godt and Coe, 2007), and have influenced zoning and building locations in many mountain communities (such as Aspen, Vail, Glenwood Springs, Telluride, Ouray, and Georgetown). Recent wildfires have created conditions where numerous large and destructive debris-flow events have impacted Durango, Glenwood Springs, and Boulder (e.g., Cannon et al., 2003a; Cannon et al., 2008; Ruddy et al., 2010).