

Geo-Congress 2023

GSP 340

Geotechnical Characterization

Selected Papers from Geo-Congress 2023
Los Angeles, California • March 26–29, 2023

Edited by
Ellen Rathje, Ph.D., P.E.
Brina M. Montoya, Ph.D., P.E.
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GEOTECHNICAL SPECIAL PUBLICATION NO. 340

GEO-CONGRESS 2023

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American Society of Civil Engineers

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Published by the American Society of Civil Engineers

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4382
www.asce.org/publications | ascelibrary.org

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Errata: **Errata, if any, can be found at https://doi.org/10.1061/9780784484678**

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ISBN 978-0-7844-8467-8 (PDF)
Manufactured in the United States of America.

Preface

This is the third volume of six Geotechnical Special Publications (GSPs) containing papers from the 2023 Geo-Congress: Sustainable Infrastructure Solutions from the Ground Up, held in Los Angeles, California on March 26–29, 2023. These six volumes contain over 350 contributions that span 22 topic areas of the ASCE Geo-Institute's standing technical committee as well as 11 special topics unique to Geo-Congress 2023.

This volume is focused on geotechnical characterization, with contributions related to engineering geology, rock mechanics, site characterization, engineering geophysics, and soil properties/modeling.

This publication culminates two years of effort by the technical planning committee whose focus has been to continue the success of the previous Geo-Congress conference series. Many individuals are responsible for the content of this volume, all of whom served in the efforts to maintain the standard set by previous proceedings. An international call for papers and a rigorous peer review process yielded more than 350 accepted technical papers, that were presented in a wide range of technical sessions, in addition to invited keynote presentations. Papers were reviewed in accordance with ASCE GSP standards. Accordingly, each paper was subjected to technical review by two or more independent peer reviewers. Publication requires concurrence by at least two peer reviewers.

The Editors would like to express their appreciation for having been provided the opportunity to be a part of this Congress' organization, their sincere thanks to the numerous session chairs and reviewers, and we hope that these proceedings will be of use to the geotechnical engineering community for many years to come.

The Editors,

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Acknowledgments

Thanks are due to the authors, primary reviewers, session chairs, and program committee, without whom this publication would not be possible.

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Use of Geostatistical Analyses for Characterizing Mine Tailings as Compared to Geophysics Profiles

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ABSTRACT

Although geostatistical tools have been available for over 50 years, their implementation is uneven across geotechnical industry. One barrier to more widespread use of geostatistics in practice is the difficulty in knowing which realizations, of many error minimizing realizations, are representative of the actual subsurface conditions. When using a set of subsurface explorations, such as CPT, there can be many viable realizations of conditions. For a highly variable mine tailings pile orthogonal 2D MASW profiles showing material variability via shear wave velocity are compared to geostatistical realizations of materials between CPT soundings. Specifically, orthogonal 2D MASW lines were conducted to image the subsurface for soft and stiff locations potentially indicating rubble or debris in the subsurface, while CPT were performed for geotechnical shallow and deep foundation design. In this work the geophysics are used to "truth" the geostatistical analyses. This paper shows that 2D geophysical profiles and geostatistics can both be used to constrain subsurface uncertainties, drive successful foundation design, and control construction phase obstructions.

INTRODUCTION

As large tailing impoundments around the world a closed and site re-development are proposed, a number of impoundments with areas greater than 1,000,000 m^2 will require or are currently requiring subsurface characterization to facilitate site reuse. Mine tailings impoundments are complex depositional environments due to the pond sedimentation nature of the placement. These sedimentation ponds develop alluvial-lacustrine patterns wherein larger granular particles drop out of suspension closer to the effluent pipe, while fine-grained materials settle at the far end of ponds. Ponds are formed by earthen berms, which evolve as needed by site operators to contain ponds. The uncontrolled nature of tailings impoundments means that organic matter including entire trees can be entrained within the tailings mass. Geochemical and biogeochemical reactions in the chemically active environment can result in mineral precipitation in localized and unpredictable areas giving zones of cemented material in an otherwise soft, wet, and liquefiable impoundment. These factors contribute to a nearly random distribution of hard and soft, fine-grained and granular, and dense and loose materials. In contrast to site characterization of natural soils, which follow the laws of natural geologic deposition, mine tailings geotechnical site characterization is particularly difficult. To meet the challenges in geotechnical site characterization thus detailed, geostatistical analyses and advanced use of geophysical surveys are proposed.

The study area for this paper has been described by Parkhill et al. (2019) and (2022). This site was a former copper mine tailings impoundment. Figure 1 shows the site during tailings

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