



**Vancouver
Geotechnical Society**
A Local Section of the
Canadian Geotechnical
Society

www.v-g-s.ca

2016-17 Executive Committee:

| | | |
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| Chair | - Chris Longley, Stantec | 604-340-5123 |
| Past-Chair | - Ali Amini, NAGL | 778-384-3606 |
| Program Director | - Robyn Barnett, Tetra Tech EBA | 604-685-0275 |
| Treasurer | - Yoshi Tanaka, exp Services | 604-422-2156 |
| Secretary | - Shane Magnusson, BGC | 604-295-8628 |
| Registrar | - Aran Thuraiajah, Golder | 604-296-4200 |
| Web Manager | - Marc Bossé, Thurber | 604-684-4384 |
| CGS Director | - Andrea Lougheed, BGC | 604-684-4384 |
| Member-at-Large | - Mustapha Zergoun | 604-684-4384 |
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| Member-at-Large | - James Woo, Stantec | 604-436-3014 |
| Member-at-Large | - Zahra Pirani, CH2M Hill | 604-439-2331 |

VGS One-Day Short Course on

PM4Sand and Nonlinear Dynamic Modeling of Liquefaction during Earthquakes

by Dr. Ross Boulanger and Dr. Katerina Ziotopoulou

Friday, October 27, 2017

Executive Hotel & Conference Centre, 4201 Lougheed Highway, Burnaby, BC V5C 3Y6

Overview:

The one-day short course covers the constitutive model PM4Sand and its use in nonlinear dynamic analyses of liquefaction during earthquakes. The PM4Sand model is a stress-ratio controlled, critical-state compatible, bounding surface plasticity constitutive model developed by Boulanger and Ziotopoulou (2012 – 2016) for earthquake engineering applications. It is implemented as a user-defined dynamic link library for use in Itasca's FLAC program.

The topics covered include: theoretical background of PM4Sand (formulation and implementation); calibration procedures for engineering applications (single element simulations of various loading paths; capabilities and limitations); hands-on calibration exercises for an engineering application; validation example with focus on recommended practices for evaluating and documenting results of nonlinear dynamic analyses; and general discussion of best practices and modeling details.

The short course is geared toward participants already having some level of familiarity with nonlinear dynamic analyses, nonlinear constitutive models, soil liquefaction during earthquakes, and the computer program FLAC. Coverage of each topic will include a review of background information and underlying fundamentals, but the focus will be more on details and procedures important to using these numerical models in practice. Participants are expected to bring a laptop computer loaded with FLAC 8.0 (a trial version will be sufficient), with the PM4Sand Version 3 dynamic link library, and the calibration drivers for PM4Sand (<https://pm4sand.engr.ucdavis.edu/>) so they can participate in the example exercises.



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Instructors:



Ross W. Boulanger, PhD, PE, NAE.

Professor of Civil & Environmental Engineering

Director, Center for Geotechnical Modeling

University of California, Davis.

Professor Ross W. Boulanger is the Director of the Center for Geotechnical Modeling in the Department of Civil and Environmental Engineering at the University of California, Davis. He received his PhD and MS degrees in Civil Engineering from the University of California at Berkeley, and his BASc degree in Civil Engineering from the University of British Columbia. His research and professional practice are primarily related to liquefaction and its remediation, seismic performance of dams and levees, and seismic soil-pile-structure interaction. His honors include the TK Hsieh Award from the Institution of Civil Engineers, the Ralph B. Peck Award, Norman Medal, Walter L. Huber Civil Engineering Research Prize, and Arthur Casagrande Professional Development Award from the American Society of Civil Engineers (ASCE), and election to the National Academy of Engineering in 2017.



Katerina Ziotopoulou, PhD.

Assistant Professor of Civil & Environmental Engineering

University of California, Davis.

Katerina Ziotopoulou joined the Department of Civil and Environmental Engineering at University of California at Davis in August of 2016. Prior to this appointment, she was an Assistant Professor at the Charles E. Via Jr. Department of Civil and Environmental Engineering at Virginia Tech for two years. She received her PhD and MS degrees in Civil Engineering from the University of California at Davis, and her undergraduate Diploma degree in Civil Engineering from the National Technical University of Athens, Greece. Currently, her research focuses on the numerical simulation of ground failure due to liquefaction during earthquakes. Her goals are to: (a) improve our understanding of the response of liquefiable soil-structure systems, (b) perform reliable numerical simulations and deliver usable numerical simulation tools, and through these (c) facilitate advances in performance-based design across a range of foundation design and ground improvement methods.



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VGS One-Day Short Course on
PM4Sand and Nonlinear Dynamic Modeling of
Liquefaction during Earthquakes

Friday, October 27, 2017

| <u>Time</u> | <u>Subject</u> | <u>Lead Presenter</u> |
|-------------|---|-----------------------|
| 8:00 a.m. | Welcome and Introduction | All |
| 8:15 a.m. | Theoretical Background – Formulation & Implementation in FLAC | KZ |
| | <i>Break at 9:30 a.m.</i> | |
| 10:00 a.m. | Calibration for Practice – Part I | RWB |
| 11:00 a.m. | Hands-on Calibration Exercises – Part I | All |
| 12:00 noon | <i>Lunch break</i> | |
| 1:00 p.m. | Calibration for Practice – Part II | KZ |
| 1:00 p.m. | Hands-on Calibration Exercises – Part II | All |
| | <i>Break at 2:30 p.m.</i> | |
| 3:00 p.m. | Validation Example & Best Practices for NDAs | RWB |
| 4:30 p.m. | Discussion Session | All |
| 5:00 p.m. | Short Course Adjourn | |



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**VGS One-Day Short Course on
PM4Sand and Nonlinear Dynamic Modeling of
Liquefaction during Earthquakes**
REGISTRATION FORM

Date: Friday, October 27, 2017
Time: 8:00 am to 5:00 pm
Location: Executive Hotel & Conference Centre
4201 Lougheed Highway, Burnaby, BC V5C 3Y6

Lunch will be provided, as will snacks and beverages during the morning and afternoon breaks.

Space is limited to 50 participants, and the deadline for acceptance of mailed registrations is **October 17, 2017**.

Please **MAIL** your completed registration form before the above deadline to the Vancouver Geotechnical Society:

Contact: Aran Thuraiajah, Golder Associates Ltd.
Email: Aran_Thuraiajah@golder.com, Tel: 604-297-4646
Address: 200-2920 Virtual Way, Vancouver, BC V5M 0C4

Please enclose with your registration form a cheque with the appropriate registration sum payable to the "Vancouver Geotechnical Society".

No other forms of registration or payment method will be accepted. Registration will be considered valid only when this form and the cheque for the appropriate registration sum has been received and cleared.

Name: _____ Affiliation: _____

Daytime phone: _____ Email: _____

Cheque enclosed (all in Canadian Dollars):

| <u>Registration Type</u> | <u>Early Bird (before September 26)</u> | <u>Regular</u> |
|--------------------------|---|----------------|
| VGS/CGS Member | \$325 | \$350 |
| Non-Member | \$375 | \$400 |
| Full-Time Student | \$200 | \$225 |

Cancellation of registration will not be accepted after **October 20, 2017**.
Registration fee includes course notes, lunch and beverages during breaks.
The course is credited with 8 hours of professional development.

For additional information or assistance with registration, please contact:
Aran Thuraiajah (Aran_Thuraiajah@golder.com) Phone: 604-297-4646



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| Member-at-Large | - | James Woo, Stantec | 604-436-3014 |
| Member-at-Large | - | Zahra Pirani, CH2M | 604-684-3282 |
| Member-at-Large | - | (Kumar) S. Sriskandakumar, BGC | 604-684-5900 |

Group Registration Form:

| | Name | Affiliation | Phone | Email | Category (VGC/CGS Member, Non-Member or full time Student) | Early Bird or Regular | Registration Fee |
|---|------|-------------|-------|-------|---|-----------------------------|---------------------|
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Cheque Enclosed for the Total Amount of: \$