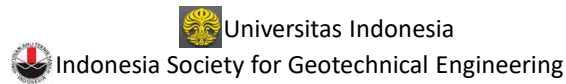


Liquefaction Studies in Indonesia: An Update

**Widjojo A. Prakoso, Masyhur Irsyam,
Mahdi I. Tanjung, Dandung S. Harninto**



GeoTalk XVIII
July 2021

1


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- Siti Prizkanisa
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- Bunyamin Andreatama
- Nurizkatilah
- Irma Yuliyanti
- M. Giezky Natakusumah
- M. Dicky Alamsyah
- Dheyaini Mazaya
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2

28 September 2018 Palu Earthquake : Homework To Do

Widjojo A. Prakoso

 Universitas Indonesia : D.S. Harninto, S. Pramono, E. Bahsan, H.A. Rahmawati

 Universitas Tadulako : Astri Rahayu

 HATTI : Didiek Djarwadi

Pertemuan Ilmiah Tahunan ke XXIII (PIT XXIII)
November 2019

Concluding Remarks

- Ground motion models ?
- Site class effects ? Site class v. Liquefaction?
- Many Known Unknowns:
 - Gumbasa irrigation channel feeding groundwater system ?
 - Water film effect ?
 - Aftershocks nearby ?
 - Fines contents ?
 - Combined effects ?
- Any unknown unknowns ?

Outlines

- Publications
- Laboratory Tests
- Numerical Simulations
- SNI 1726:2019 + “Handbook”

Landslides 17 • (2020)

Recent Landslides

Landslides (2020) 17:1925–1934
 DOI: 10.1007/s10340-020-01314-1
 Received: 24 July 2019
 Accepted: 13 November 2019
 Revised: 03 October 2019
 Published online: 27 February 2020
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The Sibalaya flowslide initiated by the 28 September 2018 M_W 7.5 Palu-Donggala, Indonesia earthquake

Aaron P. Gallant · Jack Montgomery · H. Benjamin Mason · Daniel Hutabarat · A. Nicole Reed · Joseph Wartman · Masyhur Irsyam · Pintor T. Simatupang · Idrus M. Alatas · Widjojo A. Prakoso · Didiek Djarwadi · Rahma Hanifa · Paulus Rahardjo · Lutfi Faizal · Dandung S. Harnanto · Aksan Kawanda · Agus Himawan · Widodo Yasin

Geomorphology 373 (2021) 107–182

Contents lists available at ScienceDirect
Geomorphology
 journal homepage: www.elsevier.com/locate/geomorph

East Palu Valley flowslides induced by the 2018 M_W 7.5 Palu-Donggala earthquake

H. Benjamin Mason ^{a,*}, Jack Montgomery ^b, Aaron P. Gallant ^c, Daniel Hutabarat ^d, A. Nicole Reed ^b, Joseph Wartman ^e, Masyhur Irsyam ^f, Pintor T. Simatupang ^g, Idrus M. Alatas ^h, Widjojo A. Prakoso ⁱ, Didiek Djarwadi ^j, Rahma Hanifa ^k, Paulus Rahardjo ^l, Lutfi Faizal ^m, Dandung S. Harnanto ⁿ, Aksan Kawanda ^o, Agus Himawan ^p, Widodo Yasin ^q

^a Oregon State University, USA
^b Auburn University, USA
^c University of Maine, USA
^d University of California at Berkeley, USA
^e University of Washington, USA
^f Bandung Institute of Technology, Indonesia
^g University of Mercu Buana, Indonesia
^h National Institute of Sciences and Technology, Jakarta, Indonesia
ⁱ University of Indonesia, Indonesia
^j National Research Center for Earthquake Study, Bandung, Indonesia
^k Pontianegara Catholic University, Indonesia
^l Indonesian Society for Geotechnical Engineering, Indonesia
^m University of Trilogi, Indonesia

Available online at www.sciencedirect.com

ScienceDirect

Soils and Foundations 60 (2020) 722–735

www.elsevier.com/locate/sandf

Geo-Disaster Report

Overview of long-distance flow-slide caused by the 2018 Sulawesi earthquake, Indonesia

Takashi Kiyota ^{a,*}, Hisashi Furuichi ^b, Risqi Faris Hidayat ^c, Naoto Tada ^d, Hasbullah Nawir ^e

^a Institute of Industrial Science, University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
^b Water Resources Department, National Institute of Advanced Industrial Science and Technology, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8565, Japan
^c Disaster Risk Reduction
^d Department of Civil Engineering, Hokkaido University, 630-8627, Japan

Available online at www.sciencedirect.com

ScienceDirect

Soils and Foundations 60 (2020) 1050–1063

www.elsevier.com/locate/sandf

Geo-Disaster Report

Large-scale flowslide in Sibalaya caused by the 2018 Sulawesi earthquake

Mitsu Okamura ^{a,*}, Kohei Ono ^b, Ardy Arsyad ^b, Utari S. Minaka ^c, Sukiman Nurdin ^c

^a Graduate School of Science and Engineering, Ehime University, Japan
^b Department of Civil Engineering, Kyoto University, Fushimi, Kyoto, Japan
^c IMAGEI Consultant, Tokyo, Japan

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Soils and Foundations 61 (2021) 239–255

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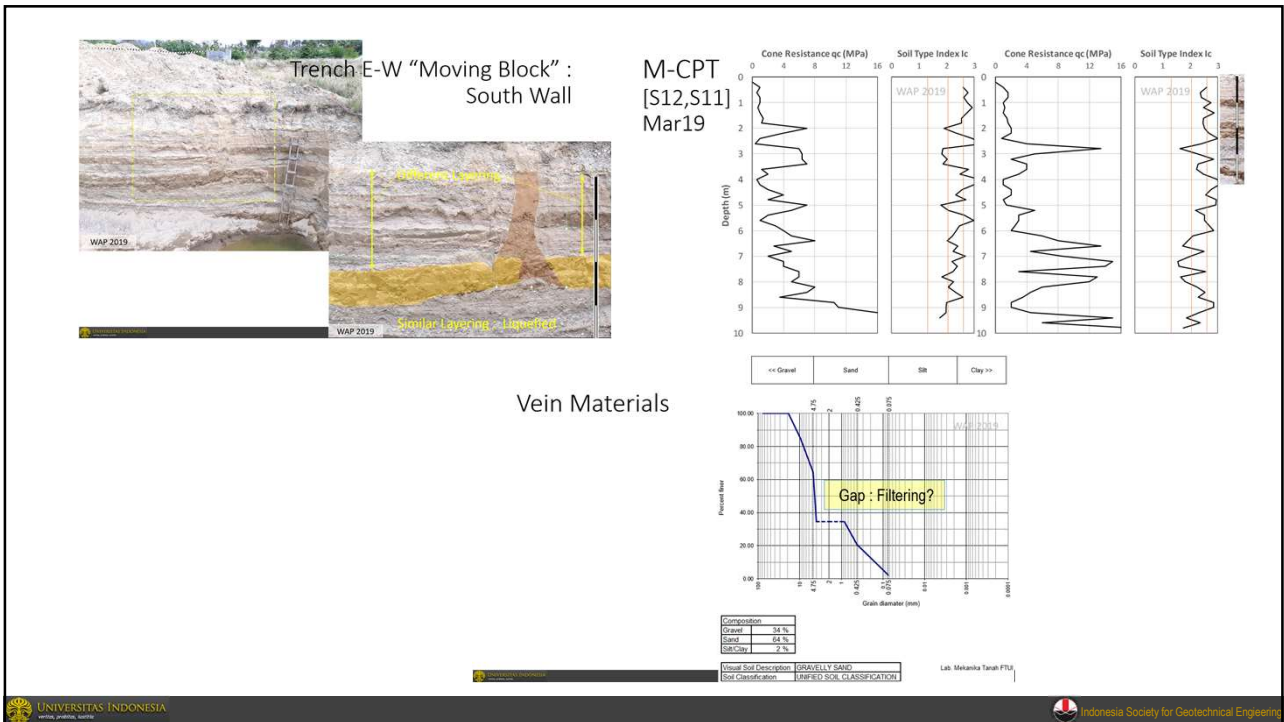
Geo-Disaster Report

Large distance flow-slide at Jono-Oge due to the 2018 Sulawesi Earthquake, Indonesia

Hemanta Hazarika ^{a,*}, Divyesh Rohit ^b, Siavash Manafi Khajeh Pasha ^b, Tsubasa Maeda ^c, Irsyam Masyhur ^c, Ardy Arsyad ^d, Sukiman Nurdin ^e

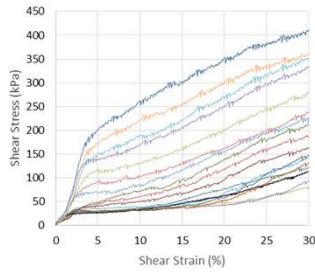
^a Department of Civil Engineering, Kyushu University, Fukuoka, Japan
^b IMAGEI Consultant, Tokyo, Japan
^c Faculty of Civil and Environmental Engineering, Bandung Institute of Technology, Bandung, Indonesia
^d Department of Civil Engineering, Hasanudin University, South Sulawesi, Indonesia
^e Department of Civil Engineering, Tadulako University, Central Sulawesi, Indonesia

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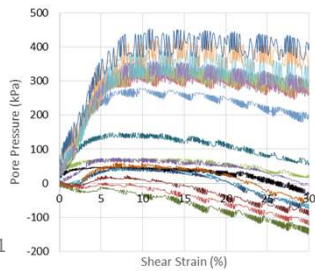


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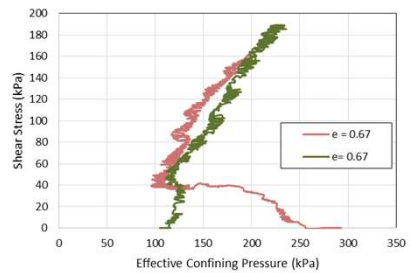
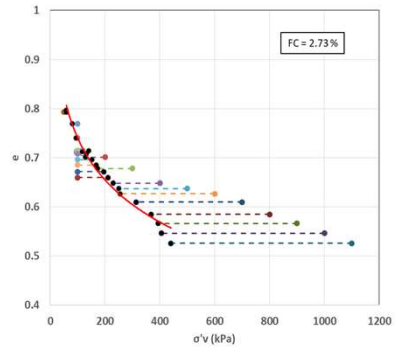
Monotonic DSS Tests



- 100 kPa (e=0.77)A1
- 100 kPa (e=0.74)A2
- 100 kPa (e=0.71)A3
- 100 kPa (e=0.71)A4
- 100 kPa (e=0.70)A5
- 100 kPa (e=0.69)A6
- 100 kPa (e=0.67)A7
- 100 kPa (e=0.66)A8
- 100 kPa (e=0.71)
- 200 kPa (e=0.70)
- 300 kPa (e=0.68)
- 400 kPa (e=0.65)
- 500 kPa (e=0.64)
- 600kPa (e=0.63)
- 700kPa (e=0.61)
- 800kPa (e=0.58)
- 900kPa (e=0.57)
- 1000kPa (e=0.55)
- 1100kPa (e=0.53)

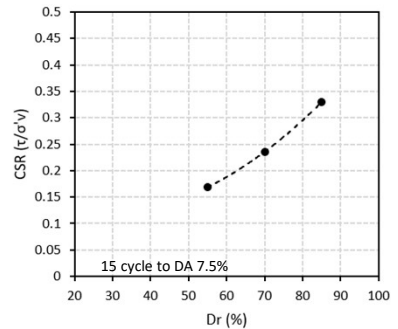
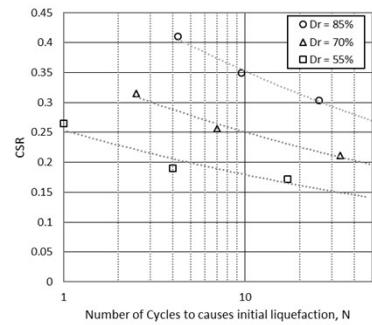
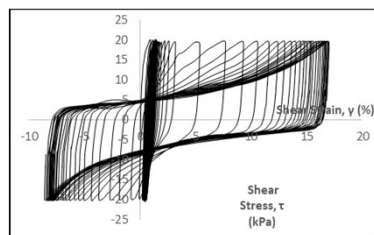
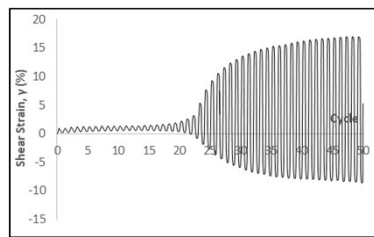


- 100 kPa (e=0.77)A1
- 100 kPa (e=0.74)A2
- 100 kPa (e=0.71)A3
- 100 kPa (e=0.71)A4
- 100 kPa (e=0.70)A5
- 100 kPa (e=0.69)A6
- 100 kPa (e=0.67)A7
- 100 kPa (e=0.66)A8
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- 800kPa (e=0.58)
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- 1000kPa (e=0.55)
- 1100kPa (e=0.53)



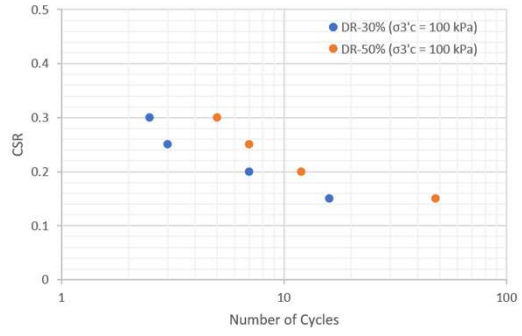
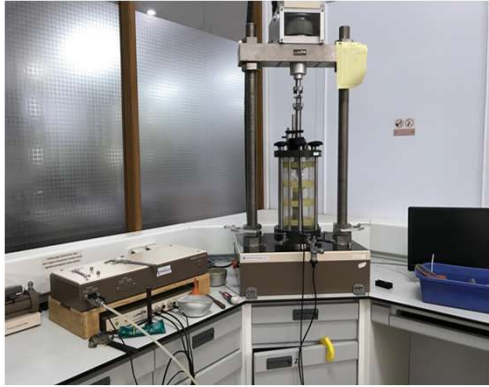
M.I. Tanjung 2021

Cyclic Direct Simple Shear Tests



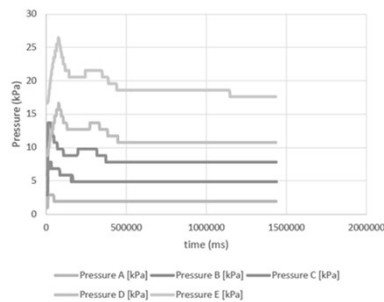
M.I. Tanjung 2021

Cyclic Undrained Triaxial Tests



M.F. Andanawarih 2021

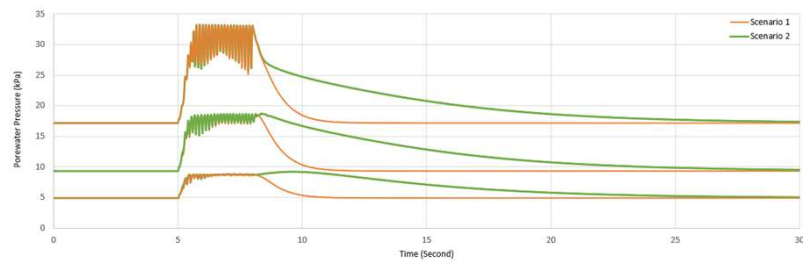
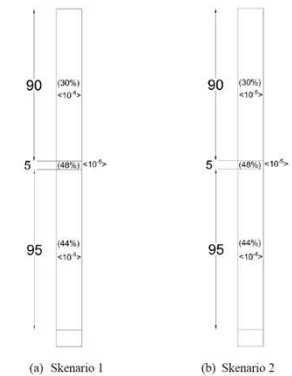
Column Tests



S. Prizkanisa 2021

Numerical Simulations

- Hydromechanical FEA → Effective Stress Analysis
- Time History Analysis
- Constitutive Model : PM4Sand
- Openssees : Liquefaction



D. Mazaya, R.A. Kartika 2021

Numerical Simulations

- Point / Particle-Based Models



B. Andreatama 2021

SNI

Standar Nasional Indonesia

SNI 1726:2019

Tata cara perencanaan ketahanan gempa untuk struktur bangunan gedung dan nongedung

ICS 91.120.25; 91.080.01



SNI 1726 : 2019

7.13.8 Persyaratan untuk fondasi di situs mudah likuifaksi

- Jika laporan investigasi geoteknik disyaratkan pasal 6.7 mengidentifikasi potensi kehilangan kekuatan tanah yang diakibatkan oleh likuifaksi pada gerak gempa, struktur harus didesain untuk mengakomodasi pengaruh likuifaksi sesuai dengan pasal 7.13.8.1 hingga 7.13.8.3.
- Struktur juga harus didesain untuk menahan pengaruh beban gempa dalam pasal 7.4 berdasarkan anggapan tidak terjadi likuifaksi.
- ...

SNI 1726 : 2019

7.13.8.1 Desain fondasi

- Fondasi harus didesain untuk memikul beban-beban gravitasi dan gempa desain berdasarkan kombinasi beban dalam pasal 7.4, menggunakan daya dukung yang direduksi sebagaimana disebutkan dalam laporan investigasi geoteknik yang meninjau pengaruh likuifaksi akibat gerakan gempa MCE_G .
- Pengaruh mitigasi dari rencana perbaikan tanah situs pada serakan lateral, beda penurunan dan desain fondasi diijinkan untuk dimasukkan dalam desain.
- ...

SNI 1726 : 2019

7.13.8.2 Fondasi dangkal

Struktur gedung tidak direkomendasikan untuk dipikul fondasi dangkal pada tanah dengan potensi likuifaksi tinggi. Struktur gedung diizinkan untuk dipikul fondasi dangkal jika fondasi didesain dan didetailkan sesuai 7.13.8.2.1 dan kondisi dalam butir berikut terpenuhi.

- a. Laporan investigasi geoteknik mengindikasikan bahwa perpindahan tanah horizontal permanen akibat dari serakan lateral dari gerak gempa MCE_G tidak melebihi nilai dalam Tabel 21.
- b. ...

SNI 1726 : 2019

7.13.8.3 Fondasi tiang

- Fondasi tiang harus didesain untuk memikul beban-beban vertikal berdasarkan kombinasi beban dalam pasal 7.4 dan dikombinasikan dengan momen dan gaya geser akibat deformasi lateral elemen fondasi tiang respons dari beban-beban inersia lateral.
- Daya dukung aksial fondasi tiang dan tahanan lateral tanah harus direduksi untuk memasukkan pengaruh likuifaksi.
- Fondasi tiang harus memenuhi persyaratan desain dan detailing dalam pasal 7.13.8.3.1 hingga 7.13.8.3.5.
- ...

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Tata cara perencanaan ketahanan gempa untuk struktur bangunan gedung dan nongedung

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