

Geo-Resilience 2023

Proceedings of the Geo-Resilience 2023 Conference

Cardiff University, 28-29th March 2023

Edited by D.G. Toll and M.G. Winter

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Geo-Resilience 2023 was the third in a series of biennial conferences organised by the British Geotechnical Association (BGA). It took place in Cardiff, Wales on 28-29 March 2023.

The climate emergency means we are facing more extreme weather events and, together with other natural and human-induced hazards, these threaten our infrastructure and the natural environment. Floods and landslides are becoming more frequent and of greater magnitude and consequence. Earthquakes pose major hazards in many parts of the world. At the same time, much of our infrastructure is ageing, deteriorating and becoming more fragile. Our built and natural environment needs the ability to withstand extreme shocks and stresses, to be adapted for changing conditions.

Geo-infrastructure comprising earthworks for transport infrastructure, flood embankments and coastal works, drainage systems, foundations and retaining structures are key components in supporting our economy and society. We must also work with our natural environment to reduce the risks from geohazards that threaten people and their activities. The Geo-Resilience 2023 conference was held to address these issues.

The proceedings include 47 papers that were presented at the conference, arranged in 7 themes:

- 1 Resilience of Road Networks
- 2 Resilience of Earthworks
- 3 Wetting & Drying Processes
- 4 Sustainability
- 5 Uncertainty and Probabilistic Processes
- 6 Resilience to Flooding and Coastal Hazards
- 7 Remote Sensing, Data and Monitoring

Four keynote lectures were presented at the conference but are not included in the proceedings:

- Scaling up infrastructure resilience, Savina Carluccio, Executive Director, International Coalition for Sustainable Infrastructure
- **Regulating Resilience**, Rhona Marsland, Railway Planning & Performance (RPP), Office of Rail and Road
- **Resilience of Geosystems using Functional Recovery Frameworks**, Prof. Youssef Hashash, Grainger Distinguished Chair in Engineering and Professor of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, USA
- **Coal Tip Safety**, Sam Deeley, Head of Coal Tip Safety Operations and Reclamation, Welsh Government



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Session 1 - Resilience of Road Networks

- 1.1 <u>A Geotechnical Resilience Assessment Framework for England's Strategic Road Network</u> James CODD; Oliver PRITCHARD; Juliet MIAN
- 1.2 <u>Assessment of the Deterioration of National Highways Geotechnical Assets and their</u> <u>Resilience to a Changing Climate</u>

Christopher M POWER; Verity WADESMITH; Jack RANDALL; Mike G WINTER; Ian NETTLETON; Michelle DUFFY-TURNER; Angus WHEELER

- 1.3 <u>Geotechnical Asset Data to Enhance Road Network Resilience</u> George FIDDES; Tanja WAASER; Mike G WINTER
- 1.4 <u>The Forensic Examination of Critical Special Geotechnical Measures</u> Michelle DUFFY-TURNER; Mike G WINTER; Ian NETTLETON; Gillian BUTLER; Philip LIEW
- 1.5 A40 Brecon Bypass Landslide: investigation, remediation and asset management for climate resilience

Thomas ST JOHN; Hana OLIPHANT; Matt BUTLER

1.6 <u>Protecting Critical Infrastructure through Georesilient Design: A Case Study from the A40</u> <u>near Llanegwad</u>

Edward LUPTON; Jack BLAKE; Stuart ARCHER; Rebecca JONES; Marcus HUBAND; Stuart MORTIMORE; Iain McKENZIE

- 1.7 <u>Development of Rainfall Thresholds for Landslides in Wales and the Application to</u> <u>Geotechnical Risk Management of Transport Infrastructure</u> *Thomas ST JOHN; Hana OLIPHANT; Nia JONES*
- 1.8 <u>A Field Study on the Stability of Road Cut Slopes in Nepal</u> Ellen ROBSON; Samprada PRADHAN; David G TOLL
- 1.9 <u>The Resilience of Critical Infrastructure in Nepal to Earthquake and Monsoon Induced</u> <u>Landslides</u> *Michael R Z WHITWORTH; Joshua JONES; Sarah J BOULTON; Martin STOKES; Georgina BENNETT*
- 1.10 <u>Capillary Barrier Systems for Prevention of Rainfall-induced Slope Instability</u> *Riccardo SCARFONE; Simon J WHEELER*
- 1.11 <u>Modelling Translational Landslides in Strain-softening Soils</u> Wangcheng ZHANG



Session 2 - Resilience of Earthworks

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- 2.2 Improving the Climate Resilience of Railway Earthworks: Case Studies from Southeast England

Burçin AVAR; Michael HALIBURTON; Simon SMITH; John-Paul INDOE

- 2.3 <u>The Seasonal Ratcheting of Clay Cut Slopes in Response to Seasonal Weather Cycles</u> Kevin BRIGGS; Yuderka TRINIDAD GONZALEZ; Amr MORSY; Alister SMITH; Ashraf EL-HAMALAWI; Anthony BLAKE; Joel SMETHURST; Peter HELM; Stephanie GLENDINNING
- 2.4 <u>Design-life Based Approach for the Design of Cutting Slopes in Stiff Clay</u> Wenqui HUANG; Fleur LOVERIDGE; Iain JOHNSTON; Peter HELM; Neil DIXON
- 2.5 <u>Resilience of Old British Embankment Dams</u> Nebojsa KOVACEVIC; Kelvin HIGGINS; David POTTS
- 2.6 <u>Developing a New European Standard for Sustainable Earthworks</u> Alan PHEAR; Niall FRASER

Session 3 - Wetting & Drying Processes

- 3.1 <u>Deterioration of Earthworks Due to Changes in Soil Water Retention Behaviour</u> David G TOLL; Guan-shi LIU
- 3.2 <u>Wetting Method to Determine Soil-Water Retention Curves in High Plasticity Clays</u> Ana Sofia DIAS; Paul HUGHES; David G TOLL
- 3.3 <u>Effects of Wet-dry and Intermittent Freeze-thaw Cycles on the Volume Change Behaviour of</u> <u>Some Geomaterials</u> *Snehasis TRIPATHY; Osama Mahdi AL-HUSSAINI; Peter J CLEALL; Stephen W REES; Vinay Kumar GADI*
- 3.4 <u>Study of the Impact of Wetting Processes on Transport Infrastructure Performance</u> Chris WALKER; Ana HEITOR
- 3.5 Insight Into Soil Cyclic Triaxial Testing Using a High Capacity Tensiometer Ashutosh KUMAR; Arash AZIZI; David G TOLL
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Sonu KUMAR; Ashutosh KUMAR



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Terry WINARTA

- 4.2 <u>High Tensile Stainless Steel-Wire Cell with the Inclusions of Stones as Sustainable Approach</u> to Protect the Coast against Natural Hazards and to Mitigate the CO2 – Footprint *Mahan SHEIBANI*
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- 5.2 <u>A Framework for Estimating Impacts on Transportation Infrastructure in a Changing</u> <u>Climate</u>

Mark VESSELY; Scott ANDERSON; Joseph GARTNER

- 5.3 <u>Predicting Changes in Displacement Probability of Slow-Moving Landslides through Markov</u> <u>Chain and Monte Carlo Simulation</u> *Michael PORTER; Mark VESSELY; Scott ANDERSON*
- 5.4 <u>Random Forest and Frequency Ratio: A Comparison of Methods for Landslide Susceptibility</u> <u>Mapping</u> José Maria DOS SANTOS RODRICUES NETO: Natra Brakash BHANDARY

José Maria DOS SANTOS RODRIGUES NETO; Netra Prakash BHANDARY



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- 6.2 <u>Seepage Considerations in the Design of the Leeds Flood Defences</u> Alan WILLONER; Dan BENADA; Lorenzo ALLIEVI
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- 6.4 <u>Numerical Assessment of Sinkhole-induced Damage to Buildings</u> Matteo Oryem CIANTIA
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Session 7 - Remote Sensing, Data and Monitoring

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- 7.2 <u>Application of InSAR for geotechnical asset management on England's Strategic Road</u> <u>Network</u>

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- 7.3 <u>How to Safeguard Critical Infrastructure from Space</u> Jonathan LYNCH
- 7.4 <u>The Growing Risk of Slope Failure to Strategic Infrastructure Risk Mitigation and the Role</u> of Intelligent Monitoring Solutions Simon BRIGHTWELL; Dominic KISZ
- 7.5 <u>Preliminary Analysis of Soil Embedded Fibre Optic Sensors and Particle Image Velocimetry</u> <u>Outputs of Dynamic Soil Deformation for Early Warning System</u> *Maria FERENTINOU; Iacopo CARNACINA; Georgios KAMARIS; Michaela GKANTOU*
- 7.6 <u>Perspectives on Practical Tools, Best Practice and Emerging Technologies in the Application</u> of Geophysics for Enhancing Resilience to Geohazards *Jim WHITELEY; Edward COX; Ady KOE*



7.7 <u>Development of an Acquisition System for High Deformation Barriers using Low-cost IMU</u> <u>Sensors and Image Analysis</u>

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- 7.8 <u>Managing Asset Resilience in Canyon Terrain using Rockfall Hazard Mapping and Modelling</u> Joshua JONES; Scott DAVIDSON; Michael WHITWORTH; Alkis GKOUVALIS; Lucy ANGEL; Jordan WALKER; Alex CONRAD
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- 7.10 <u>Non-intrusive Investigation and Slope Modelling of Compacted Soil in Heritage</u> <u>Geostructures</u>

Phillip WINDSLOW; Ana HEITOR



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