

Lecture Notes in Civil Engineering

Cuong Ha-Minh · Dong Van Dao ·
Farid Benboudjema ·
Sybil Derrible · Dat Vu Khoa Huynh ·
Anh Minh Tang *Editors*

CIGOS 2019, Innovation for Sustainable Infrastructure

Proceedings of the 5th International
Conference on Geotechnics, Civil
Engineering Works and Structures

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Editors

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Editors

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Cachan, France

Dong Van Dao
University of Transport Technology
Thanh Xuan, Hanoi, Vietnam

Farid Benboudjema
LMT Cachan
University of Paris-Saclay
Cachan, France

Sybil Derrible
University of Illinois at Chicago
Chicago, IL, USA

Dat Vu Khoa Huynh
Norwegian Geotechnical Institute
Oslo, Norway

Anh Minh Tang
Ecole des Ponts ParisTech
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Preface

Following the great success of each of the four previous consecutive events since 2010, CIGOS (*Congrès International de Géotechnique—Ouvrages—Structures*) has firmly established its international reputation and is perceived as an important conference for promoting both academic and high-quality professional exchanges in the fields of **Geotechnics, Civil Engineering Works and Structures**. This, the fifth International Conference—**CIGOS 2019**, held in Hanoi, Vietnam, was co-organized by the Association of Vietnamese Scientists and Experts ([AVSE Global](#)) in collaboration with the University of Transport Technology ([UTT](#)) and in partnership with the Ecole normale supérieure de Paris-Saclay ([ENS Paris-Saclay](#)).

CIGOS 2019 placed particular focus on the theme of **Innovation for Sustainable Infrastructure**, aiming to not only raise awareness of the vital importance of sustainability in infrastructure development but also highlight the essential roles of innovation and technology in helping to plan and build sustainable infrastructure. Having built on the success of CIGOS 2017, this year's conference saw almost double the number of published papers, which covered a broad spectrum within the following topics:

- Advanced Modeling and Characterization of Structures
- Sustainable Construction Materials and Technologies
- Geotechnics for Environment and Energy
- Urban Planning, Transport and Environment
- Data Mining & Machine Learning
- Building Information Modeling

The present CIGOS proceedings contain 201 peer-reviewed papers from 27 different countries, six of which are keynotes presented by internationally outstanding experts in their respective fields. The choice of papers was made on the basis of nearly 380 abstracts accepted. The first keynote presents the author's wide perspective on four decades of computing in civil engineering, which are highly multidisciplinary—crossing computer science, multiple engineering fields, mathematics and medicine. The second, third, fourth, and fifth keynotes address the recent novel technologies and innovations in transportation and construction, which have

been remarkable in helping to plan and build infrastructure that is increasingly more sustainable. The sixth and final keynote emphasizes that society and standards require increasingly more “risk-informed” based decisions, demonstrating that the implementation of reliability and risk-based approaches can not only provide useful complementary information both for design and for re-evaluation during the life-time of the infrastructure but also efficiently assist the preparation of sustainable engineering recommendations and risk-informed decision making.

We wish to acknowledge the wonderful support of the scientific committee and the external reviewers, who provided valuable assistance in the review process and undoubtedly made a tremendous contribution in raising the quality of the proceedings. We are thankful to the keynote speakers, authors and participants for their enthusiastic efforts and time in preparing valuable papers as well as bringing encouragement and inspiration to the conference. Our special thanks also to the organizing committee, without whom it would have been difficult to run this conference.

Last but not least, we would also like to thank all sponsors for their support and generosity in making our CIGOS 2019 such a success.

On behalf of the CIGOS 2019’s committees, we believe that the present proceedings, which include a mixture of contributions from academia and practitioners, will provide valuable up to date knowledge for all those interested in Geotechnics, Civil Engineering Works and Structures.

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VinTech City, a member of Vingroup, was founded with the aim of supporting the Vietnamese ecosystem of tech research and startups, following the success model of Silicon Valley. To realize such mission, VinTech City has identified three fundamental areas of activities: Tech talents, tech products, and an ecosystem of supporting activities. Among these factors, the workforce and tech products with competitive edges have been considered the stepping stones of the development strategy of VinTech City.

Specifically, VinTech City has designed programs focusing on tech startups, innovators, researchers, university lecturers and students, in order to support them in creating innovative research and translating them into commercialized products and companies based on applied research. In May 2019, VinTech City has officially announced six such programs, namely: (i) VinTech Fund—a grant for applied research; (ii) Research Laboratory sponsorship; (iii) University-Enterprise Co-operative Semester; (iv) SAP Training; (v) Events, workshops, or seminars sponsorship; and (vi) Tech Startup Student Clubs. Such wide range of support activities and programs demonstrates the comprehensive cooperation between Vingroup and the science and technology universities in Vietnam.

One of the most prominent programs of VinTech City is VinTech Fund—a grant for creating innovative tech products from research, or in another word “bringing lab ideas to market”, which has recently announced the first batch of applied research projects receiving fundings of 86 billions VND in total (equivalent to \$3.7m). Learn more about them on www.vintechcity.com.

In brief, Vietnamese researchers, who works at prestigious research institutes and universities, can contribute to the development of science and technology in

Vietnam through research collaboration, tech product development, and educational activities with domestic universities within the sponsorship framework of VinTech Fund.

We believe that VinTech City can contribute to create a catalyst for “Make in Vietnam” technology products in market and complete the mission of supporting Vietnam startup and technology ecosystem.

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NUCE has undergone over 50 years of formation and development and over 60 years of training. NUCE becomes nowadays a leading centre for training, research, technology transfer and creating high quality human resources for the country in the field of civil engineering. In addition, NUCE was one of the first four universities in Vietnam evaluated and accredited by HCERES (Haut Conseil de l'Evaluation de la Recherche et de l'Enseignement Supérieur)—an international assessment organisation for 5 years, without conditions until May 2022.

Contents

Keynote Lectures

Four Decades of Computing in Civil Engineering	3
Hojjat Adeli	
Industrialized Construction of Medium Span Concrete Bridges Using Movable False Work	13
Jose Turmo	
Using Simulation to Estimate and Forecast Transportation Metrics: Lessons Learned	23
L. R. Rilett	
eHighway – An Infrastructure for Sustainable Road Freight Transport	35
Manfred Boltze	
Innovation Reduces Risk for Sustainable Infrastructure	45
Suzanne Lacasse	
Applying a National BIM Model to Vietnam’s National Implementation of BIM: Lessons Learned from the UK-Vietnam Collaboration for the Industry	57
Adam Matthews and Binh Ta	
Advanced Modeling and Characterization of Structures	
Advanced Analysis Software for Steel Frames	69
Phu-Cuong Nguyen, My Ngoc-Tra Lam, Duc-Duy Pham, Trong-Nghia Nguyen and Phong Thanh Nguyen	
Finite Element Modelling for Axially Loaded Concrete-Filled Steel Circular Tubes	75
Duc-Duy Pham and Phu-Cuong Nguyen	

Fracture Analysis of Crack Propagation on the Diaphragm of Steel Bridge Structures	81
Tran The Truyen, Nguyen Duc Hieu, Bui Thanh Tung, Doan Bao Quoc and Nguyen Thuong Anh	
A Study on Combination of Two Friction Dampers to Control Stayed-Cable Vibration Under Considering its Bending Stiffness	87
Duy-Thao Nguyen and Duy-Hung Vo	
Design Proposal and Behavior Simulation of Prestressed Concrete Slab Track at Highway-Railway Grade Crossings	93
Pham Van Hung, Tran The Truyen, Tran Anh Dung, Doan Bao Quoc, Le Hai Ha and Nguyen Hong Phong	
Effects of Random Road Roughness on Dynamic Impact Factor of Multi-span Super T Girder Bridge with Link Slab due to Moving Vehicles	99
Xuan-Toan Nguyen and Duy-Thao Nguyen	
Advanced Design Software for Steel Cable-Stayed Bridges Using Nonlinear Inelastic Analysis	105
Viet-Hung Truong and Seung-Eock Kim	
Blind Source Separation Technique for Operational Modal Analysis in Presence of Harmonic Excitation	111
Van-Dong Do, Thien-Phu Le and Alexis Beakou	
Investigation Into The Response Variability of A Higher-Order Beam Resting on A Foundation Using A Stochastic Finite Element Method	117
Ta Duy Hien, Bui Tien Thanh, Nguyen Ngoc Long, Nguyen Van Thuan and Do Thi Hang	
Fatigue Analysis of Jack-up Leg Structures in Transit condition	123
Dinh Quang Cuong and Vu Dan Chinh	
Finite element modeling of the TECCO protection system for rock-fall under impact loading	131
Tran Van Dang, Tran Dong and Dennis Gross	
The study on the behavior of the simply supported beam steel bridge structure without the intermediate bracing system in the construction stage	137
Van Nam Le, Anh Rin Nguyen, Lien Thuc Pham and Ngoc Thi Huynh	
Seismic behaviour of rammed earth walls: a time history analysis	143
Quoc-Bao Bui and Tan-Trung Bui	

Analysis of Two-Directional Seismic Deterioration of Steel Box Columns	149
Tran Tuan Nam	
Numerical analysis of double-layered asphalt pavement behaviour taking into account interface bonding conditions	155
Minh Tu Le, Quang-Huy Nguyen and Mai Lan Nguyen	
Parametric numerical study on a novel energy harvester using iron-gallium alloy and strain response	161
Tuan Minh Ha, Saiji Fukada and Toshiyuki Ueno	
Numerical investigation of derailment loading on composite fibre transoms for implementation in the Sydney Harbour Bridge	167
Olivia Mirza, Maryam Hosseini and Micah Fountain	
Finite Element Analysis of Reinforced Concrete beams subjected to combined actions	173
Tuan-Anh Nguyen, Quang-Huy Nguyen and Hugues Somja	
Resistance of Cross Laminated Timber Members Under Axial Loading—A Review of Current Design Rules	179
Xin Li, Mahmud Ashraf, Mahbube Subhani, Bidur Kafle and Paul Kremer	
A Current-State-of-the-Art on Design Rules Vs Test Resistance of Cross Laminated Timber Members Subjected to Transverse Loading	185
Xin Li, Mahbube Subhani, Mahmud Ashraf, Bidur Kafle and Paul Kremer	
A Further Study on Stay Cable Galloping Under Dry Weather Condition	191
Vo Duy Hung and Nguyen Duy Thao	
Stress-Dependent Permeability of the Fractured Rock Masses: Numerical Simulation Based on the Embedded Fracture Continuum Approach	197
Hong-Lam Dang, Duc-Phi Do and Dashnor Hoxha	
Improved Rigid-Plastic Method for Predicting the Ultimate Strength of Concrete Walls Restrained on Three Sides	203
J. H. Doh, N. M. Ho and T. Peters	
Flexural Capacity Accounting for SBHS500 Steel of Composite Bridge Girders	209
Dang Viet Duc and Yoshiaki Okui	
The Inadequacies of the Existing Structural Health Monitoring Systems for Cable Stayed Bridges in Vietnam	215
Luong Minh Chinh	

Riding Comfort Assessment of High-Speed Trains Based on Vibration Analysis	221
Van Nguyen Dinh, Ki-Du Kim and Dinh Tuan Hai	
Assessment of methods of riprap size selections as scour countermeasures at bridge abutments and approach embankments	227
Huy Quang Mai and Noi Thi Doan	
A review on protection methods against debris accumulation for bridge in mountain areas	233
Huy Quang Mai and Phong Dang Nguyen	
Numerical modelling of thermo-mechanical performance of small-scale CFRP reinforced concrete specimen using near surface mounted reinforcement method	239
Phi Long Nguyen, Xuan Hong Vu and Emmanuel Ferrier	
Experimental characterization of multi-full-culm bamboo to steel connections	245
Nischal P. N. Pradhan, Themelina S. Paraskeva and Elias G. Dimitrakopoulos	
FE modelling of RC frames with Link Column Frame System under in-plane loading	251
J. Joel Shelton, G. Hemalatha and V. Venkatesh	
Mechanical Behaviour of Four-Leg Base Configuration on Cold-Formed Steel Lattice Column	257
Mohd Syahrul Hisyam Mohd Sani and Fadhluhartini Muftah	
Finite Element Simulation of Member Buckling of Cold-rolled Aluminium Alloy 5052 Channel Columns	263
Ngoc Hieu Pham, Cao Hung Pham and Kim J. R. Rasmussen	
Lateral Buckling Tests of Cold-rolled Aluminium Alloy 5052 Zee Beams	269
Ngoc Hieu Pham, Cao Hung Pham and Kim J. R. Rasmussen	
Elastic Buckling Solution for Perforated Thin-walled Channel Sections in Shear with an Aspect Ratio of 2.0	275
Duy Khanh Pham, Cao Hung Pham and Gregory J. Hancock	
The Behaviour of Cold-formed Channel Sections with Elongated Web Holes in Shear	281
Duy Khanh Pham, Cao Hung Pham, Song Hong Pham and Gregory J. Hancock	

Experimental Investigation of Cold-Rolled Aluminium Alloy 5052 Columns Subjected to Distortional Buckling	287
Le Anh Thi Huynh, Cao Hung Pham and Kim J. R. Rasmussen	
Numerical Simulation of Cold-Rolled Aluminium Alloy 5052 Columns Subjected to Distortional Buckling	293
Le Anh Thi Huynh, Cao Hung Pham and Kim J. R. Rasmussen	
Use of Kriging Metamodels for Seismic Fragility Analysis of Structures	299
Cong-Thuat Dang, Thanh Tran, Duy-My Nguyen, My Pham and Thien-Phu Le	
Application of Weighted Latin Hypercube Sampling in Stochastic Modelling of Shear Strength of RC Beams	305
Ngoc Linh Tran and Khuong Le-Nguyen	
Predicting onset and orientation of localisation bands using a cohesive-frictional model	311
Linh A. Le, Giang D. Nguyen and Ha H. Bui	
Non-linear deformational analysis of reinforced concrete frame	317
Tran Thi Thuy Van and Vu Thi Bich Quyen	
Reliability Evaluation of Eurocode 4 for Concrete-Filled Steel Tubular Columns	323
Huu-Tai Thai and Son Thai	
Sustainable Construction Materials and Technologies	
Preparation of low cement ultra-high performance concrete	331
Norzaireen Mohd Azmee and Nasir Shafiq	
Matrix dependent piezoresistivity responses of high performance fiber-reinforced concretes	337
Duy-Liem Nguyen, Thi-Bich-Nga Vu, Huynh-Tan-Tai Nguyen and Van-Ben Nguyen	
Influence of elastic modulus under uniaxial tension and compression on the first-cracking flexural properties of UHPFRCs	343
Duy-Liem Nguyen and Minh-Thuan Duong	
Investigation on shear resistances of short beams using HPFRC composited normal concrete	349
Duy-Liem Nguyen, Van-Toi Do, Minh-Phung Tran and Luu Mai	
Application of Fluidized Power Coating for Propellers	355
Tuan Phan Anh and Huong Pham Thi Thanh	

Design of a Drinking Water Disinfection Systems using Ultraviolet Irradiation and Electrolysis Cell	361
Tuan Phan Anh and Tan Nguyen Minh	
The effect of mineral admixture on the properties of the binder towards using in making pervious concrete	367
Nguyen Van Dong, Pham Huu Hanh, Nguyen Van Tuan, Phan Quang Minh and Nguyen Viet Phuong	
Horizontal response of base-isolated buildings supported to high damping rubber bearings	373
Nguyen Anh Dung, Le Trung Phong and Tran Minh	
A Study on Behavior of Reinforcement Concrete Beam using the Recycled Concrete	379
Anh-Thang Le, Thanh-Hung Nguyen and Cong-Vu-Duc Phan	
Geochemical modelling for prediction of chloride diffusion in concrete exposed to seawater	385
Hoang Long Nguyen, Van Quan Tran, Long Khanh Nguyen, Tuan Anh Pham, Quoc Trinh Ngo and Van Loi Giap	
Application of Asphalt Concrete using Limestone with Cement & Admixture	391
Nguyen Ba Hoang, Pham Van Hung, Tran Viet Khanh and Nguyen Viet Huy	
Experimental Investigation of a Self-powered Magnetorheological Damper for Seismic Mitigation	397
C Daniel, G Hemalatha, L Sarala, D Tensing, S Sundar Manoharan and Xian-Xu Bai	
Effect of Ground Blast Furnace Slag in Replacement of Cement in Ternary Binder on Performance of Sand Concrete	403
Thanh Sang Nguyen and Long Hai Chu	
Experimental Study on Effect of Ground Granulated Blast Furnace Slag of Strength and Durability of Sand Concrete	409
Nguyen Thanh Sang and Nguyen Tan Khoa	
Mechanical properties of fly ash based geopolymer concrete using only steel slag as aggregate	415
Dong Van Dao and Son Hoang Trinh	
Effect of fly ash on the mechanical properties and drying shrinkage of the cement treated aggregate crushed stone	421
Ho Van Quan, Nguyen Van Tuoi and Chau V. Nguyen	

Strength of Granulated Blast Furnace Slag during Hydration Reaction Process	427
Tran Thanh Nhan, Hiroshi Matsuda, Tran Xuan Thach, Nguyen Dai Vien and Ho Trung Thanh	
Use of Coal Ash of Thermal Power Plant for Highway Embankment Construction	433
Tung Hoang, Viet Phuong Nguyen and Hong Nam Thai	
Impact of the Porosity of Coarse Aggregates on the Structuration of the Paste-Aggregate Interface: Elementary Model Study	441
Tran Duc Long, Cassagnabère Franck and Mouret Michel	
Strength and Engineering Properties of Cementless Paste Produced by GGBFS and MgO	447
Chao-Lung Hwang, Duy-Hai Vo, Khanh-Dung Tran Thi and Mitiku Damtie Yehualaw	
A Non-paraffinic PCM Modified Textile Reinforced Concrete Sand-Wich Panel	453
Zakaria Ilyes Djamai, Amir Si Larbi and Ferdinando Salvatore	
Design Method for Optimizing Geopolymer Concrete Proportions Utilising Entirely Steel Slag Aggregates	459
Dong Van Dao and Son Hoang Trinh	
Experimental Measurement and Modeling of the Complex Poisson's Ratio of Bituminous Mixtures	465
Quang Tuan Nguyen and Thi Thanh Nhan Hoang	
Evaluation of Macro-Synthetic Fibre Reinforced Concrete as a Sustainable Alternative for Railway Sleepers	471
Christophe Camille, Dayani Kahagala Hewage, Olivia Mirza, Fidelis Mashiri, Brendan Kirkland and Todd Clarke	
The Repairing Effects of Lithium Silicate Based Material to the Surface of Hardened Concrete	477
Nguyen Xuan Tung, Ryoma Kitagaki and Yoshiro Yamakita	
Research on Fabricating Flowforms from Ultra-High Performance Concrete with Local Admixtures for Use in Processing Contaminated Water	483
Thi Thuy Ha Ung, Tuan Hung Pham and Tho Bach Leu	
Research on Application of Flowforms in Combination with Planted Constructed Wetland for Improving Water Quality of Urban Polluted Lakes	489
Thi Thuy Ha Ung, Tuan Hung Pham, Tho Bach Leu, Thi Hien Hoa Tran and Hong Nhung Chu	

A Model of Local Kinetics of Sorption to Understand the Water Transport in Bio-based Materials	495
N. Reuge, F. Collet, S. Pretot, S. Moissette, M. Bart and C. Lanos	
Air Permeability of Cover Concrete Quality of Precast Box Culverts Affected by Casting Direction	501
May Huu Nguyen, Kenichiro Nakarai and Saeko Kajita	
Effects of Amounts and Moisture States of Clay-Brick Waste as Coarse Aggregate on Slump and Compressive Strength of Concrete	507
Phuong Trinh Bui, Xuan Nam Nguyen, My Ngoc Tang, Yuko Ogawa and Kenji Kawai	
Investigation of the Use of Reclaimed Asphalt Pavement as Aggregates in Roller Compacted Concrete for Road Base Pavement in Vietnam	513
Thi Huong Giang Nguyen, Tien Dung Nguyen, Trung Hieu Tran, Van Dong Dao, Xuan Cay Bui and Mai Lan Nguyen	
Comparison between Critical Path Method (CPM) and Last Planners System (LPS) for Planning and Scheduling METRO Rail Project of Ahmedabad	519
Viraj Parekh, Karan Asnani, Yashraj Bhatt and Rahul Mulchandani	
Study and propose the size of cement concrete slabs for airport road surface in Vietnam conditions	525
Nguyen Duy Dong, Nguyen Vu Viet and Nguyen Quoc Van	
Experimental study of the thermomechanical behavior of the carbon textile reinforced refractory concrete subjected to the constant load and temperature heating	531
Manh Tien Tran, Xuan Hong Vu and Emmanuel Ferrier	
A study on improvement of early - age strength of super sulfated cement using phosphogypsum	537
Nguyen Ngoc Lam	
Effect of calcium sulfate type and dosage on early strength and porosity of self-leveling underlayments	543
Nguyen Ngoc Lam, Elodie Prud'homme and Jean-François Georin	
Heat resistant mortar using Portland cement and waste clay bricks ...	549
Nguyen Ngoc Lam	
Performance of Recycled Coarse Aggregate Concrete with Different Nylon Fiber Content	555
Seungtae Lee, Youngkyu Chu, Sangwook Ha, Yong Kim and Jaehong Jeong	

Air permeability coefficients of expansive concrete confined by rebars	561
Le Anh Van, Kenichiro Nakarai, Nguyen Huu May, Yasutaka Kubori, Toshikazu Matsuyama, Hajime Kawakane and Shintaro Tani	
Application of Six Sigma on METRO Rail Construction Project	567
Viraj Parekh, Kushal Solanki and Nishit Prajapati	
Experimental investigation of loading rate effects on the shear capacity of reinforced concrete deep beams	573
La Vanny, Kenichiro Nakarai, Halwan Alfisa Saifullah and Asuka Mizobe	
Fatigue characterization of conventional and high rutting resistance asphalt mixtures using the cyclic indirect tensile test	579
H. T. Tai Nguyen, Anh Thang Le, Vu Tu Tran and Duy Liem Nguyen	
Sustainable Measures to Achieve Better River-Crossing Access in the Rural Areas of Developing Countries	585
Yoshinori Fukubayashi and Makoto Kimura	
Assessment of Design Guidelines for Fiber-Reinforced Polymer Shear Contribution of Prestressed Concrete Beams Strengthened by Fiber-Reinforced Polymer Sheets	591
Dien Ngoc Vo-Le, Chinh Ho-Huu and Long Nguyen-Minh	
Development of Disaster Resilient and Sustainable University Framework: Case of Bandung Institute of Technology (ITB)	597
Krishna Suryanto Pribad, Rahma Hanifa, Eliya Hanafi and Giovanni Pradipta	
Experimental study on the valorization of poplar by-products in cement-based materials	603
C. Djelal, J. Page, Y. Vanhove and H. Kada	
Horizontal response of base-isolated buildings supported to high damping rubber bearings	609
Nguyen Anh Dung, Le Trung Phong and Tran Minh	
Evaluating the change in the properties of bitumen during production, transport and construction of hot mix asphalt in the conditions of Vietnam	615
K. H. Quang Trinh, T. Nhan Tran and H. T. Tai Nguyen	
Creep behavior and rutting resistance of asphalt pavements by experimental testing and Finite Element modelling	621
Van Bac Nguyen, Chau Phuong Ngo, Ngoc Bay Pham, Thanh Phong Nguyen, Van Phuc Le and Van Hung Nguyen	

Influence of High Temperature on Non-Silicate Based Activated Blast Furnace Slag	627
Virendra Kumar, Amit Kumar and B. K. Prasad	
Influence of Linz Donawitz slag aggregates on strength development of concrete	633
Brajkishor Prasad, Virendra Kumar and Prince Singh	
Investigation of the effect of γ irradiations on the mechanical and physico-chemical properties of cementitious materials: from the nanoscale to mortars'scale	639
Maxime Robira, Benoît Hilloulin, Ahmed Loukili, Gildas Potin, Xavier Bourbon and Abdessalam Abdelouas	
Geotechnics for Environment and Energy	
Evaluation of the At-Rest Lateral Earth Pressure Coefficient of Fibre Reinforced Load Transfer Platform and Columns Supported Embankments	647
Cong Chi Dang and Liet Chi Dang	
Nonlinear Behavior Analysis of SFRC Foundation Considering Homogeneous and Inhomogeneous Soil Interactions	653
Tran-Trung Nguyen, Radim Cajka, Phu-Cuong Nguyen and Thanh-Tuan Tran	
Analyses on drainage capacity and sliding resistance of large diameter vertical wells for deep-seated landslide stabilization	659
Ba Thao Vu, Van Minh Pham, Quoc Dung Nguyen, Huy Vuong Nguyen and Thi Thanh Huong Ngo	
Shape effects in the dynamical response of flints/boulders during pile driving – a numerical study	665
Emilio Nicolini and Ivan Terribile	
The failure envelope of a new shaped cross-plates foundation for deep-water soft soils	673
Emilio Nicolini, Alessandro Alberio and Matteo Castelletti	
Enhanced Oil Production in the lower Miocene reservoir by Multistage Fracturing, Offshore Viet Nam	679
Huu Truong Nguyen, W. Bae and Van Hung Nguyen	
Properties of geopolymer modified sludge generated in landslide area designed by Taguchi method	685
Minh Chien Vu, Tomoaki Satomi and Hiroshi Takahashi	

Granular flows through a model-scale forest: Influence of tree density and implications for landslide mitigation	691
H. T. Luong, J. Baker and I. Einav	
Dynamic properties of loose sand using numerical analysis-A case at Hong Thai Tay coal transportation road project (Vietnam).	697
Nguyen Phi Hung, Nguyen Van Dung and Tan Do	
Application of Box-Behnken Design in Optimization of Fracture Treatment Design for Lower Oligocene Reservoir, Offshore Viet Nam	703
Huu Truong Nguyen, W. Bae and Van Hung Nguyen	
Experimental and numerical assessments of seepage effect on embankment behaviours by the time	709
Thanh Quang Nguyen, Truong Linh Chau and The Hung Nguyen	
A numerical homogenized law using discrete element method for continuum modelling of boundary value problems	715
Trung Kien Nguyen, Jacques Desrues, Gaël Combe and Duc Hanh Nguyen	
Influence of heterogeneous fractured fault damage zones on shear failure onset during fluid injection	721
Trung Kien Nguyen, Jeremy Rohmer and Ba Thao Vu	
Influence of Compaction Factor on the mechanical behavior of the soils used for the earth dams in the North Central region, Vietnam	727
Van Toan Tran and Van Hien Tran	
Enhanced oil recovery: A selection technique for the energy and recovery of Bach Ho field in Vietnam	733
Nguyen Van Hung, Nguyen Minh Quy, Hoang Long, Le Quoc Trung and Le Vu Quan	
Overview of Geomechanics and its applications to petroleum industry – a case study for minimum overbalance pressure calculation	739
Nguyen Van Hung	
Numerical model of hydro–mechanical coupling DEM–PFV and application for simulation of settlement of soil saturated in embankment due to static loading	745
Anh Tuan Tong and Nguyen Hoang Phuong Luong	
Abnormal pore pressure and fracture pressure prediction for Miocene reservoir rock, field X in Vietnam	751
Nguyen Van Hung	