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Keynote lectures

Urban Thermal Modulation – The Limits of Interiorization and Emergence of Atmospheric Security?

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This paper argues that important changes are taking place in how the problematic of excess heat is being understood and addressed in urban contexts. The key shift underway is strategic interest in the thermal modulation of the 'outdoor' environment. This represents an extension of the existing mode of thermal modulation based on 'interiorization' through air conditioned encapsulation to an emerging logic of manipulating the outdoor environment – a form of atmospheric security. The paper explores the key features of this shift and identifies the implications for urban studies.

Keywords: urban thermal modulation, interiorization, atmospheric security

Flexible Blades Wind-Turbines: Giant Installations and System-of-Systems Approach to Optimizing Wind-Energy Farms

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In this work we seek to elaborate a couple of new concepts of off-shore and inland wind-turbines with respect to currently dominant system, which was, to a large extent, developed in Denmark and in Northern Germany. Both of these locations provide near steady winds close to optimal conditions for wind-turbines operation. For any other location, the system is far from optimal performance, mostly sitting idle waiting for optimal wind speed. This new concept to evaluate concerns the wind-turbines with flexible blades, which are easy to start for mild winds, like the leaves on a tree, but more difficult to control for strong winds, with large overall motion of flexible blades. There are multiple main scientific challenges in this work seeking a judicious combination of scientific progress in Mechanics, Control and Stochastics in order to provide the simulation tools for elaboration of such a new concept. In particular, we need to develop detailed models capable of describing the large displacements and rotations of flexible blades (including evaluation of risk to blades failure), the reduced basis approach that can furnish the optimal support for control algorithm of large overall motion of flexible blades and stochastic approach able to quantify the effects of variable wind conditions that can be obtained from measurements of wind-turbine deformations by solving an inverse problem. All these developments will be combined in simulation tools, which will be validated against experimental results and more elaborate predictive computations of underlying multi-physics problems. The main product

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to deliver is to achieve a novel concept of inland wind-turbines, referred to as Perpetual Mobile, which offers the optimal capacity for harvesting energy at large variations of wind speeds and for perfectly adapting to variable conditions inside wind-turbine farms. The side product to deliver concerns the simulation tools to be developed, which will also be of interest for other multi-physics problems.

Keywords: Wind turbine, wind load, energy-conserving scheme, long-term simulation.

Innovation in cements – can we meet future construction needs sustainably?

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There has been an enormous growth in the volume and scope of technical analysis of alternative cements, accompanied by claims of "sustainability", during the past decade. Some of this growth has been accompanied by real-world actions in terms of commercialization, trials, and deployment. However, there are a very large number of lines of investigation – some of which appear extremely promising from environmental and technical perspectives – that have not yet been translated into reality. This presentation will address some of the key drivers for a sustainable future in cement technology, with a particular focus on alkali-activated materials, including comments on the pathways by which some of the evident potential of these materials can be unlocked for the benefit of society.

Keywords: Cement, Concrete, Sustainability.

Strategies for Overcoming Fire Performance Problems in Structures incorporating Fibre Reinforced Polymer.

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In recent years there is a growing interest in the use of fiber reinforced polymers (FRP) for strengthening of concrete structures that are losing their functionality due to aging and corrosion related problems. This is mainly due to high strength, light weight, durability, cost effectiveness and ease of application of FRP which makes it attractive for fixing deteriorating infrastructure. Typically, the capacity of reinforced concrete (RC) columns can be enhanced by wrapping the columns with FRP sheets. Similarly strengthening of beams or slab can be carried out, for enhancing flexural and shear capacity, by applying FRP laminates to the surface of a concrete member and this is designated as externally bonded reinforcing (EB) technique. Alternatively, FRP strips or rods can be inserted into a pre-cut groove(s) on the concrete cover of an RC beam or slab, and then filling the groove(s) with an epoxy adhesive or cementitious grout, and this type of strengthening is referred to as near-surface mounted (NSM) technique.

Fire represents a significant hazard in buildings and thus FRP-strengthened concrete structural members have to meet adequate fire resistance requirements. However, comparatively little is known on the performance of FRP materials and FRP-strengthened concrete members under fire conditions, and this remains a primary factor limiting the widespread application of FRP in building applications.

In the past decade, a number of experimental and analytical studies have been carried out to develop an understanding on the behavior of FRP-strengthened RC beams at ambient conditions. Based on these studies, guidelines have been developed for structural design of FRP-strengthened concrete members. However, there have been only limited experimental and numerical studies on the fire resistance of FRP- strengthened concrete members. Thus, there is very little guidance available in codes and standards for the fire design of FRP-strengthened concrete members.

To overcome some of the current knowledge gaps, a series of experimental and numerical studies have been carried out to evaluate fire response of FRP-strengthened concrete columns and beams. Data generated from fire tests was

utilized to develop a macroscopic finite element for tracing the fire response of FRP- strengthened RC columns and beams under various configurations. The validated model was applied to conduct a set of parametric studies to quantify the influence of critical factors on fire response of FRP strengthened members. Results generated from fire resistance experiments and numerical studies are utilized to develop a rational design methodology for evaluating fire resistance of FRP-strengthened concrete members.

In the presentation, the performance problems associated with FRP-strengthened concrete structures will be illustrated. Data from both material testing and full-scale fire tests will be utilized to discuss fire performance of FRP strengthened concrete members. The various factors influencing fire response of FRP strengthened concrete members will be discussed and the development of a rational design methodology for evaluating fire resistance of FRP-strengthened concrete members will be outlined. Examples of innovative strategies that can be developed for enhancing fire performance of FRP-strengthened concrete structures will be presented. Overall, it is demonstrated that, while currently available FRP strengthening systems are sensitive to the effects of elevated temperatures, appropriately designed and protected FRP-strengthened concrete structures are able to achieve required fire performance needed in buildings and other infrastructure applications.

Green transport development in Vietnam: recent achievements and key challenges

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Transport systems have significant impacts on urban development, economic and environment that might generate threats to the sustainable development. Therefore, the development of green transport is a long-term strategy of many countries internationally. Recently, Vietnamese Government has developed specific policies to enhance green mobility, for instance, the transport plan associated with public transport development, the transition to sustainable energy, the application of advanced materials and technologies. However, green mobility in Vietnam is facing many challenges that links to local characteristics such as a huge travel demand, the unique travel behaviour, the limited investment budget, and legal barriers of public-private partnership mechanism.

This presentation will discuss the long-term demand for green transport development in Vietnam based on scientific approaches and empirical evidence, facilitating an in-depth understanding of transport status for international and local researchers. By indicating key challenges, the presentation confirms the necessity to develop innovative policy recommendations, to further develop models and tools in conjunction with government bodies as inputs into city- and national-level policies and derive practical day-to-day improvement for green transport systems.

Large underground caverns for civil application

Eivind Grøv

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The tunnelling industry has the means to make any “hole in the ground” almost to any size and shape that is requested. The main challenge is to integrate such solutions into long-term development and urban planning. The underground solutions must be cost-effective to compete with surface alternatives and they must be safe and felt to be safe by the users.

Worldwide there is a quest for urban space driven by the increasing urbanisation. According to the ITACUS white paper (2010) more than half of the world’s population lives in urban areas. With regards to industrialised countries the figure is closer to 80%. This increased urbanisation and steadily growing number of “Mega cities” and other congested areas is a consequence of the increasing global population and migration to city areas which may offer jobs, income and improved lifestyle.

Only by ensuring that we are capable of providing safe underground structures will underground infrastructure be perceived to provide a sound internal environment. There is public confidence that the tunnelling industry is capable of producing tunnels and caverns to the satisfaction of the clients.

This presentation discusses the challenges of designing and building large underground caverns needed for further development of the underground infrastructure. Underground caverns excavated in the rock mass require a strict control on a number of design parameters describing the rock mass quality and its ability to host large caverns. Many of these are standard rock mechanical parameters that are identified for any underground excavation. One particular rock mechanics parameter is of utmost importance when designing large underground caverns but to the surprise of the author of this paper it is often ignored and neglected by many, namely the in-situ stress condition which is needed to mobilise frictional forces along joint planes. This paper will particularly shed light on the importance of including in-situ stress conditions in the design tasks, focusing the understanding and utilizing of in-situ rock stresses to materialise such caverns.

The presentation will also present some examples to visualise the beauty of underground rock caverns and their use to serve the public and

thus constituting a major asset to the society including the world largest man made rock caverns, the Gjøvik hall in Norway.

Architecture and Planning for Sustainable Community

Smart Planning and Management Solutions for Smart Mobility

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Due to rapid urbanization, many cities in the world are increasingly confronting urban problems such as inefficient mobility, lack of infrastructure, traffic congestion, and environmental pollution. Against these drawbacks, many governments are working together to find solutions towards smart urban growth. Smart urban growth addresses several domains of urban life to support social needs of residents, among which smart mobility is a vital component. This paper investigates the smart mobility solutions that are prerequisite for smart urban growth, with focus on planning and management instruments. Through the case study of Singapore, the paper attempts to gain knowledge and experiences on smart mobility solutions from the best practices that may be applicable for developing countries. The insights gained from the case study set a foundation for proposals on smart mobility solutions for Hanoi Capital.

Keywords: Smart Mobility, Smart Planning, Smart Urban Growth, Mobility Solution, Sustainable Transport.

Transit-Oriented Development for Hanoi Sustainable Urban Development

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Transit-oriented development (TOD) is urban development near or oriented to public transport facilities. Typically, mixed-use urban development is built around transit stations, surrounded by high density development with progressively lower-density development spreading outward from the center. TOD brings substantial benefits to urban development, including promotion to sustainable urban growth, improvement of connectivity between the city center and outer areas, increase in ridership, decrease in road traffic congestion, and efficient use of the city land. TOD is a fast-growing development strategy and is becoming more popular among city planners and government officials for its potential to promote sustainable urban development. TOD has been using in various developed countries, including Japan, Singapore, and Hong Kong. This paper introduces a number of TOD patterns that have been successfully practiced in international context, analyses the characteristics of transport in a TOD model. In reviewing the current transport situation and initiatives for integration of TOD for Hanoi, the paper identifies challenges in application of TOD model and proposed some key points for successful application of TOD for Hanoi sustainable urban development.

Keywords: Transit-Oriented Development, Public Transport, Integrated Transport, Sustainable Urban Development, Smart Growth.

The typology of the villages in the Red River Delta (Vietnam) - A study for urban planning today

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In general, cities are developed in one of two ways: there are cities that are founded in old towns, such as Rome (Italy), and other cities which have evolved from villages, such as Paris, Beijing, or Hanoi. Despite the fact that village spaces are thought to be spontaneously arranged, it is apparent that there is still order in these places, and some settlements are organized in a regular manner. The authors of this research want to provide a picture of how a typical peri-urban hamlets in the Red River Delta operate. For example, a village's transportation network or "spontaneous" space is advanced: different architectural structures, landscape elements, etc. These characteristics provide evidence for agricultural or non-agricultural society's social, economic, and cultural choices, as well as inherited cultures, in a technological environment with food demand, limitations, and bio-climate measurements. It is also known as an historical stamp of the wet rice civilization. Researching and analyzing traditional village spaces in the Red River Delta's peri-urban zones objectively gives a viewpoint on the challenge to adapt to changing climatic circumstances and indigenous cultures. Especially in today's setting, uncontrolled urbanization around large cities occurs simultaneously to with the negative effects of climate change. These conditions make building and village spatial organization experience increasingly valuable. Today, these qualities might be assessed and used in urban development planning projects.

Keywords: urban development, traditional village, Red River delta.

Temperature changes on land surface in the context of urbanization in Quy Nhon City, Viet Nam

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Quy Nhon city is a grade 1 city situated in Binh Dinh province, in Viet Nam. Its population was 481.110 inhabitants and it had an urbanization rate of 60% in 2019, while Quy nhon population numbered just 260.000 in 2017. In order to evaluate the relationship between urban heat island and land cover, we used Landsat satellite imagery from 1990 to 2020 to classify the land cover by using the Support Vector Machine learning method (SVM). The classified results were evaluated with the test samples from the field survey. The accuracy is above 77%, which is reliable enough for use in research. To create the surface temperature layer, we used band 6 in the Landsat 5 ETM remote sensing imagery and bands 10, 11 in the Landsat 8 imagery. The results were calculated the surface temperature for the study area. The study carried out statistics of surface temperature value with land cover. The results show that Quy Nhon city has become warmer since 2005, which witnessed a significant increase, compared with roughly 4 degrees in 1996 and around 9 degrees in 1990. And the temperature in the urban land area is between 30 and 35 degrees. During this period, the classification results show that urban land has rapidly expanded. Especially from 2005 up to now, Quy Nhon city has witnessed a strong urban expansion, agricultural land, and water surface have been changed into urban land. To determine the area of urban heat islands we used the urban heat index (UHI). The results show that the heat island phenomenon increases with urbanization in the city and tends to increase over the years. This research result is a practical

basis to propose suitable spatial and landscape planning solutions for the city, towards green and sustainable urban development.

Keywords: Quy Nhon; Landsat; Surface temperature; City warming.

Sustainable architectural criteria for shophouse development in Hanoi's new urban areas

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The increasingly notable role of shophouse streets in new urban projects in Hanoi shows great values of this type of housing in the sustainable development of Hanoi architecture. The shophouse development in Hanoi has revealed such architectural-related issues as: a fixed proportion of shophouses in the total number of low-rise buildings will not be suitable for different development stages and scenarios of new urban areas; the strict management of design and construction has not resolved the conflicts between the desire for architectural uniformity and the requirements for diversity which create the attractiveness for the area; the inadequate quality of the outdoor public spaces of shophouse streets and the lack of the possibilities for increasing energy efficiency of shophouses with facade architectural solutions and rooftop renewable energy. In order to find sustainable solutions to the issues as well as to promote the values and potentials of this type of housing, it is necessary to define sustainable architectural criteria for shophouse development in Hanoi's new urban areas and a sociological survey is expected to be made for the study.

Keywords: Shophouse, Townhouse, Sustainable Architecture, Architectural Diversity, Sustainable Architectural Criteria, Hanoi Street

"Living Lab" - an urban design approach with community participation. The case study of Quy Nhon, Vietnam

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In today's ongoing urbanization and 4.0 industry, there is an increasing demand on urban design approach to be innovative and inclusive to handle these emerging issues. As an answer to these challenges, and in order to co-create innovation through the involvement of aware users in a real-life setting, the concept of living labs has emerged. However, to date, the definition of "Living Labs" is different between fields and regions in the world. Some interpret the Living Lab as an approach, others as a single project, and some as a specific place – and some still do not know. In this paper, to better understand this concept and its practical application, we present our overview of previous literature on this topic and then we recount the specific situation in Vietnam through three Living Lab workshops conducted in Quy Nhon city, Binh Dinh province, Vietnam in the last three years. Since then, we have tried to come up with an empirically based definition of a contextual living laboratory concept that is appropriated for Vietnam. We also conclude with a discussion on the role and significance of the living laboratory in implementing urban planning, urban design and landscape projects in Vietnam.

Keywords: Living lab, Vietnam, urban design, community participation, workshop.

Learning from Hanoi city's Ad hoc Architecture for housing design and urban ecologies

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The housing problem of Hanoi shares its similarity with other emerging cities in the region of Southeast Asia as well as other locations throughout Latin America and Africa, in its conflict between formal and informal developments as well as in its absorption of different colonized cultures. Yet it is different from those cities in that the different ideologies are not as clear-cut and are not isolated in separate segments of the city. Instead, the city represents a symbiotic relationship between indigenous knowledge and ideological urban planning processes. As the conventional top-down master plan struggles with urban growth, combined with increasing evidence that informal housing clusters provide advantages in quality of life, bottom-up, self-organizing housing strategies need to be considered. If the spontaneously built structures are synchronized with city planning and in tandem with the requirement of the natural system, then the future of more resilient cities could be secured. The prospective future of this speculation is to turn rigid planning methodologies into parametric, mutable processes, where citizens have freedom to create their own space according to new design guidelines of "kit of parts," by learning from the ad hoc strategies in housing spatial expansion, in a design framework that mimics self-organization in biological systems, where local actions lead to optimal goals of the whole. Moreover, turning the design from plan to process implies a better relationship between clients, designers, and contractors, where the role between them can be shifted and framed in a mass customization of the building industry.

Keywords: Sustainability, Informality, Architecture, Self organization, Ad hoc strategies, urban ecology.

Sustainable management of Vietnamese coastal urban system

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With the rapid growth of the coastal population, predicted to account for 60% of the country's population, Vietnamese coastal cities and towns should not continue developing separately. By systematic thinking and good organization, the coastal cities and towns should link together to establish the costal urban system. This development model will support the economy of scale, level up the efficiency of using coastal infrastructure, and protect national sovereignty. Globally, the megalopolis is an efficient model for managing the coastal urban system. This research will provide international evidences, analyze statistical data of the coastal urban system in the Vietnamese context, and suggest a potential roadmap for applying this coastal urban management model to our management system.

Keywords: Coastal urban, megalopolis, urban system management.

Re-establishing green infrastructure connections in rural construction planning in the Red River Delta

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In this article, the authors aim to identify the connections of green infrastructure in traditional villages in the Red River Delta (RRD) with three case studies from three communes where some of such solutions have been recently applied in several rural planning projects. Thereby it is possible to find out problems in those ongoing projects and then to propose more appropriate planning concept which will help re-establish the fundamental connections in order to achieve the long-awaited green infrastructure system, as well as to secure sustainable development in rural areas, technically, spatially and environmentally considered.

Keywords: Rural planning, Green infrastructure in rural planning, Traditional villages in the Red River Delta.

The participation of community in smart management of neighborhood in parks/playgrounds in Hanoi – The reality and solution

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This paper aims to focus on the participation of community in smart management of neighborhood parks/playgrounds (NPP) in Hanoi. In response to the changing functions and characteristics of public spaces (PS) upon the context of different local communities, this research primarily examines how to smartly manage PS in Hanoi where has been facing increasing challenges of hyper-urbanization. Meanwhile, the term NPP can be referred to as the physical environment and social areas for people, especially elders and children, to relax, exercise and interact. Therefore, it is imperative for NPP to be planned and managed with the participation of local residents who have the best understanding of their needs and expectations, not to mention their interest in improving living standards. Accordingly, this paper began with a review of the reality of NPP management in Hanoi and how participation of community has been taking place. Through a deductive process for the reflection on reality, the paper provided in-depth discussions on the effectiveness of local community involvement in NPP management. Specifically, it came to the conclusion that inclusive stakeholder participation under a strategic partnership can be a key to the success of PS planning and smart management. In an extensive scope, the paper also highlighted how application of digital transformation should be a major driver in NPP management?

Keywords: Neighborhood parks/playgrounds smart management, The participation of community, Digital- transformation, Hanoi.

Classification of public spaces to manage in Hanoi historical inner – toward building a creative city

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According to the Decision No.1259/QD-TTg concerning the general planning of construction in Hanoi Capital to 2030 with a vision to 2050, one of the 15 priorities of urban development is to renovate the Historical Inner-City area of Hanoi for preserving and promoting the historical values of the city. Regardless massive changes of socio-economic conditions, the thousand-year-old public spaces in the Hanoi Historical Inner-City area remain sustaining with a remarkably vigorous vitality, becoming the witness of many historical events. However, hyper-urbanization progress is posing a visible threat to the sustainability of Hanoi Historical Inner, following the challenges of harmonizing the historical heritages in the urban architecture and landscape. One particular problem is poor management of public spaces; for which, classification appears to be a fundamental solution to the existing dilemma. Following that, the appropriate management for each class of public spaces can be developed.

Keyword: Classification; Public space, Manage, Hanoi Historical Inner.

Local Perspectives on Green Resilient Settlements in Pakistan

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The wave of climatic hazards has hampered countries green infrastructure planning. As a countermeasure, Urban Green Infrastructure (UGI) modelling has emerged as an adaptation strategy to enhance the resilience of the urban areas to fight the potential effects of climatic risks. It protects and improves the urban eco-system, human health and wellbeing, like in the Khyber Pakhtunkhwa (KP) province of Pakistan. This research aimed to determine sustainable UGI planning indicators based on local stakeholder's perspectives. It is to develop a UGI indicator-based framework for climate-resilient urbanization. The results of the online expert's survey were based on 172 questionnaires. The relative importance index (RII) and interquartile range technique (IQR) were utilized to examine the data. The result shows a very good level of coefficient alpha (α) value, higher than α = 0.7, which is an acceptable threshold level [1, 2]. Furthermore, in this paper, we acknowledge key green elements, that have achieved RII value ≥ 0.75. This performs a pivotal role in quality improvement and strengthening the health of the respective UGI indicators. This study calls for building a new cultural paradigm in the KP region that supports green growth development to naturally minimize the vulnerability to urban flooding

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hazards and disastrous impacts on the ecosystem functions, and human well-being.

Keywords: climate change, adaptation, green infrastructure; urban eco-system; Pakistan.

Urban Greening and Geo-environmental Safety

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Currently, the city governments of various countries face the urgent issue of adapting the city to climate change. Climate change has become a real threat to urban security. Destructive hurricanes, heavy rains, periods of abnormal temperatures (heat and cold), icy rains and heavy snowfall became more frequent. In addition, the rapid urbanization makes the search for modern solutions to improve urban environment more difficult. The concept of "green city" becomes increasingly popular in the context of global changes in nature and society. Modern megacities place significant emphasis on urban greening as a key component of adaptation for climate change as a necessary condition for comfortable, safe, and healthy living. Moscow takes a leading place in provision of a high rate of green areas per capita among other megacities as reported. Using GIS-based analysis, this paper assessed the distribution of urban green spaces as well as dangerous natural processes (landslides, flooding, and karst-suffusion processes) in Moscow. We showed in one map a high level of heterogeneity in the distribution of natural parks and designed green spaces and spatial distribution of dangerous natural processes. We propose a new scheme to interconnect the existing and future elements of Blu-Green Infrastructure in the single ecological network to minimize the damages of dangerous natural processes. There are three types of design patterns for urban green spaces allocated for geo-environmental safety: conservation, improvement, and redevelopment. New strategy in greenery management is suggested based on the biome concept.

Keywords: Sustainable Cities; Geo-environmental Safety; Urban biomes; Urban Greening

A Generic Framework for Predicting Energy Consumption of Public Building

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With the increase in demand for energy, the energy conservation of the buildings has become important. In this paper, we propose a generic model for predicting the energy consumption of public building. The power usage of the Central Taiwan Industrial Innovation Park (CTIIP) would be used to exemplify the model. The methods of linear regression and various machine learning techniques were applied for the prediction. The experimental results demonstrate that the prediction model is reliable and feasible.

Keywords: Building energy conservation; Public building; Electricity consumption; Machine learning; Deep learning.

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Inventory of Green Roofs within Edinburgh, Scotland

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The integration of Green Roofs (GRs) within urban areas is widely recognised as being crucial for improving urban sustainability. Improvement is largely achieved through the creation of habitats to support urban biodiversity and via the restoration of ecosystem services, which are vital in mediating the impacts of climate change within highly developed areas. Unlike many European countries, Scotland does not currently have a mandatory policy on the inclusion of GRs in urban areas. Consequently, there is a distinct lack of available data on existing GRs in Scotland, which presents issues regarding the monitoring of climate adaptation strategies. The principal aim of this study was to conduct an inventory of GRs within the city of Edinburgh, to provide baseline data, to inform policy. Investigative methods used QGIS with satellite imagery to identify and record GR locations and properties, with findings subject to ground-truthing for verification. To date, survey findings have revealed a total of 83 existing GRs within Edinburgh, which is almost three times as many as reported by a Central Scotland Green Network study previously. The GRs appear to be largely concentrated in the city center where they provide a considerable contribution towards local biodiversity and alleviation of flood risks, as well as several other benefits. The existing GRs are predominantly located on commercial buildings indicating a growing buy-in from local

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businesses. The results of this study will be of use in future policy making in Scotland, as well as for further research on the resilience and ecosystem services provided by urban green infrastructure.

Keywords: Green Infrastructure, Ecosystem Services, SuDS, Urban Environment, Sustainable development, Biodiversity, Blue-Green Cities.

E-planning and its potential development in Vietnam urban planning

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Today, terms including e-service, e-business, e-government and e-governance have become ubiquitous. Following this trend, electronic planning or e-planning has gradually gained its traction and become a major development in many developed countries. In Vietnam, e-planning has not been conceptually brought into existence yet. However, with the increasing commitment of the Vietnamese government to e-government transformation and incremental implementation of Information and Communication Technologies (ICTs) in the urban planning industry, switching the traditional mode in urban planning to an electronic mode is inevitable. Therefore, this paper aims to offer an indicative account of e-planning potential development in Vietnam's urban planning industry through critical analysis of the conducive environment that e-government and ICTs implementation have currently provided to a foreseen e-planning transition. Collectively, the paper elicits preliminary recommendations after providing a discussion on the potential benefits and pitfalls that e-planning mode can bring to urban planning in Vietnam.

Keywords: E-planning, E-government, Smart development, Urban planning, Public participation, Open Data.

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Research on the attractiveness of informal public spaces for the youth of Hanoi towards a livable city. Case studies from a university cluster in Hanoi (Vietnam)

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This paper investigates the role and attractiveness of informal public spaces for young people in Vietnamese urban life. In Vietnam, public spaces are officially defined as squares, parks, and flower gardens. The number of these public spaces in most cities in Vietnam, especially in Hanoi, is very limited. However, beside the regulated public spaces mentioned above, there are informal used public spaces (IPSs) that attract a large number young people to participate. It is the vibrant and diverse activities in IPSs that create the vitality, unique characters, and attractiveness of a city. It raises a series of question of "What factors make an IPS to be attractive to the youth? What is the role that an ISP plays in promoting social interaction of the youth of Hanoi city?". The case study was conducted by three large universities in Hanoi. Using observational surveys and interviews with IPS's users, the research has revealed that there are four most important factors that contribute to the attractiveness of IPSs for young people: 1) accessibility and connectivity, 2) a variety functions and meaningful activities, 3) comfort and safety, and 4) sociability. The research has proposed some recomendations for spatial management to improve the quality and attractiveness of IPSs towards the liveable city of Hanoi.

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Keywords: Informal public spaces, Hanoi, the youth, atractiveness

BIGDATA and Data Mining, Digital Transformation and Internet of Things

Development of deep learning neural network for estimating pile bearing capacity

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Accurate determination of bearing capacity is one of the key issues in pile foundation design. However, the estimation of the pile bearing capacity base on in-site test methods showed time-consuming and costly. Thus, the main object of this study is to apply Machine Learning (ML) method, namely Deep Neural Network (DNN) to predict the axial load capacity. A total of 472 static pile load test reports collected from constructions in Ha Nam province were used to build the model in which ten factors and the destructive load on the pile head is considered the single output variable. The original data is divided into three parts, including the training set (60%), the validation set (20%), and the testing set (20%) to build, validate, and test the model respectively. In particular, the best DNN model architecture is determined by a grid search technique. To verify the performance of DNN models, various methods named root mean squared error (RMSE) and R-squared (R2) were used. The results showed that the DNN model of two hidden layers achieved superior performance (average R2 = 0.897, RMSE = 108.515) in the prediction of pile bearing capacity compared to other DNN network architectures. This study can offer pile foundation design engineers an effective tool to quickly predict the axial load capacity of the driven piles.

Keywords: Deep Neural Network; Axial Bearing Capacity of Pile; Grid Search Technique.

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Application of Random Forest model to determine unconfined compressive strength of the soil-cement mixture

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Soil-cement mixture is one of the commonly used ground reinforcement solutions in geotechnical engineering. In this study, the main objective is to apply a Machine Learning (ML) method namely, Random Forest (RF), and an optimization method namely Random search (RS) to predict unconfined compressive strength (UCS) of the soil-cement mixture. A total of 216 soil-cement samples were mixed in the laboratory and compressed to estimate the unconfined compressive strength, in which fourteen input variables, while the UCS of the mixture was considered the output variable. This data is divided into two parts of the training data set (80%) and the testing set (20%) to train and test the model, respectively. To verify the performance of the RF model, various criteria named R-squared (R2), mean absolute error (MAE) and root means squared error (RMSE) was used. The results show that RF is an effective method to predict the UCS of soil-cement mixtures with a performance indicator of R2 = 0.885, MAE = 224.611 (kPa), RMSE = 286.668 (kPa) on the testing set. In addition, feature important analysis showed that the amount of cement is the most important input variable to estimate the UCS of soil-cement mixtures. This study showed the potential of the RS-RF model in developing tools to quickly predict the UCS of the soil-cement mixture.

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Keywords: Random Forest; Unconfined compressive strength; Random search; Cement-soil mixture; Feature important analysis.

Application of XGBoost model for predicting the dynamic response of high-speed railway bridges

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The dynamic response at high speed affects both the vehicles and the structures in a complex manner, especially in the railway infrastructure problems. In this study, we developed a new KD-Railway tool for analyzing the dynamic behavior of high-speed railways by using the finite element method. Then, extreme gradient boosting (XGBoost) was used to predict and better understand the dynamic response of high-speed railway bridges. The model was trained and tested using a dataset including properties and dynamic responses of 10,000 bridges generated by KD-Railway. The input variables were the bridge span length, the flexural rigidity, mass per length of the bridge, the cross-section area of bridge decks, the train speed, the damping ratio, and the HSLM train models.

On the other hand, maximum vertical deflection and maximum acceleration were considered as the output parameters. The coefficients of determination ($R2$) for these two outputs were (0.996, 0.931, 0.977) and (0.987, 0.901, 0.962) for the training, testing, and entire dataset, respectively. The sensitivity analyses were also conducted to evaluate the importance of each input variable on the outcomes.

Keywords: High-Speed Railway Bridges; Extreme gradient boosting (XGBoost); Dynamic response; HSLM train models.

Reliability analysis of structures subjected to seismic excitation using a deep learning-based surrogate model

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Reliability of structures subjected to seismic loading is a persistent and challenging task as it requires performing the dynamic analysis of structures and repeating these analyses multiple times with variables sampled from predefined distributions via the Monte Carlo simulation method. Thus, this study proposed a surrogate model as an alternative for the Finite Element Method in forecasting the structure's response to earthquakes. The proposed method consists of four main steps: i) using experimental data from the literature to calibrate a reliable numerical model, ii) leveraging the numerical model to generate sufficient data for data-driven method, iii) elaborating a deep learning architecture dedicated to forecasting structure's response to earthquake using the lastest advent of Deep Learning in handling time-series data, namely, self-attention mechanisms, and iv) estimating the reliability of the structure of interest. The efficiency and effectiveness of the proposed approach are demonstrated in detail through an example of a 3D steel frame prone to ground motions, showing a reduction up to 180 fold in computational time compared to the plain Monte Carlo simulation using the conventional Finite Element Method, with less than 5% error.

Keywords: Reliability analysis, Earthquake, surrogate model.

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Prediction of Optimal Cross-sectional Areas of Truss Structures Using Artificial Neural Networks

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According to the traditional design process, designers usually design over and over again the same or very similar truss structures. This method is time-consuming and it cannot take advantage of existing designs. In this paper, a machine learning-based method is proposed to determine the optimal design of truss structures. For this purpose, some trusses with various loading and design constraints are optimized using the Differential Evolution algorithm. The values of the applied load, the allowable stress, and the allowable displacement are stored as inputs while the optimized cross-sectional areas of members are collected as outputs of the training data. Then, a neural network model is trained to predict the optimal solution of trusses for new design inputs. The well-known 10-bar truss is used to illustrate the proposed method. The coefficient of determination R-squared is chosen to evaluate the effectiveness of the predictive model. The obtained R-squared value of approximately 1.0 indicates the predicted areas of truss members are very close to the true values.

Keywords: Structural optimization, Differential Evolution, Machine Learning, Neural Networks, Truss structure.

Exploitation of digital data from building information models in virtual reality technology

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This paper proposes a flexible approach to exploit digital data from building information models (BIM) by calling Application Programming Interfaces (APIs) using Representational State Transfer (REST) architectures, from which an application of Virtual Reality (VR) running on mobile devices is built. By adding these techniques, the application can address retrieving information from Common Data Environment (CDE) stored on a server, view the BIM model, and allow users to interact with data associated with each object in a virtual environment. Research results help software developers, engineers, managers to easily exploit M&E data and increase efficiency in the operation and management of the building.

Keywords: virtual reality, building information modelling, REST API.

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GIS-based Logistic Regression Application for Landslide Susceptibility Mapping in Son La Hydropower Reservoir Basin

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Landslide susceptibility map is an important tool for planning and management of landslide prone areas in better way. Logistic Regression (LR) based machine learning model has been successfully applied in many parts of the world for landslide susceptibility mapping. In this study, we have applied the LR model combined with GIS to create landslide susceptibility map of the basin area of Son La hydropower plant catchement, Vietnam. For this, a total of 186 landslide locations identified in the basin area were used to construct landslide inventory. In total, 12 landslide conditioning factors (elevation, aspect, slope, curvature, deep division, fault density, river density, road density,

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weathering crust, rainfall, aquifer and lithology) were used for training and validating the model. Various standard statistical indices including the ROC curve were used to evaluate performance of the LR model. Results show that predictive capability of model performance is very good (AUC=0.832) in accurately mapping landslide susceptibility of the study area. Thus, it can be concluded that the LR model is a great tool in constructing a reliable landslide susceptibility map of the study area, which can be used in better landslide hazard management.

Key words:*Logistic Regression, Landslide susceptibility, ROC, Vietnam, GIS*

An artificial intelligence approach based on Multi-layer Perceptron Neural Network and Random Forest for predicting maximum dry density and optimum moisture content of soil material in Quang Ninh province, Vietnam

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Maximum dry density ($\rho_{d(max)}$) and optimum moisture content (w_{opt}) are two key parameters of embankment fill soil material using in transport construction. To obtain these parameters, Proctor test (ASTM D698 / AASHTO) or Modified Proctor test (ASTM D1557/ AASHTO T180 etc.) is traditionally performed in the laboratory. However, this test takes time and expenses. Moreover, the accuracy of the test depends significantly on the collection of samples, expertize of the testers and quality of the experimental apparatuses. In this study, the main aim is to propose two machine learning approaches named Multi-layer Perceptron Neural Network (ANN-MLP) and Random Forest (RF) for the prediction of $\rho_{d(max)}$ and $w_{opt.}$ Input parameters include silt content(%), clay content (%), liquid limit (%), plastic limit (%), plasticity index (%), specific gravity which have strong correlations with $\rho_{d(max)}$ and w_{opt} were used in the model. Performance of the model was assessed by statistical methods, such as Mean Absolute Error (MAE), Root mean square error (RMSE), and Coefficient of determination (R^2). Results of the models study indicate that the proposed models ANN-MLP and RF has the same predictive capability ($R^2_{average}$ of ANN-MLP is 0.829 and $R^2_{average}$ of RF is 0.827). The results of this study might help in quickly predicting $\rho_{d(max)}$ and w_{opt} of embankment fill soil material.

Keywords: Artificial intelligence, Machine learning, Neural network, Random Forest, Maximum dry density, Optimum moisture content, Proctor test, Soil material, Vietnam.

Development of a BIM-based Master Digital Model using data-driven design for the suspension bridge.

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Long-span cable-supported bridges are increasingly used to bridge a longer distance with a higher clearance than the other bridge types and their impressive aesthetic appearance. However, owing to challenging dynamic engineering practices, the suspension bridges, in particular, require accumulated design and construction technologies. Moreover, as the most distinctive mechanical property of the cable structures, different applied tension generates different lateral stiffness on the main cable. Without an integrated analysis model, the realistic profile of the cable structures cannot be determined. In this regard, this paper proposes a master digital model for a suspension bridge based on the data-driven approach for multiple purposes, including the structural assessment aspect. The Building Information Modeling (BIM) technique is a key factor to creating and federate all the essential engineering knowledge data regarding a suspension bridge. At first, a data schema for the suspension bridge's main structures is created and based on that, the database for each structural member is defined. The BIM authoring using the data-driven design is proposed to generate all the individual structural members then assembly to make the entire initial model for the suspension bridge. Metadata is linked, and any efficient revisions concerning varying situations during the construction process can be easily updated into the digital model through the change of database.

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Finally, an analysis model is integrated into this initial model to create the federated master digital model. The advantage of this master digital model lies in the capability to continuously perform the bridge system's stability analyses at any erection step. Furthermore, it makes the digital representation of the main cable and suspended bridge structures more dynamic, no longer just rigid objects in the general commercial BIM model. A prototyping master digital model was developed for an existing bridge is introduced along with this paper.

Keywords: BIM, data-driven design, master digital model, suspension bridge.

On The Training Algorithms for Artificial Neural Network in Predicting compressive strength of recycled aggregate concrete

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Due to the different difficulties of compressive strength of recycled aggregate concrete (RAC) prediction, this investigation develops a prediction architecture based on machine learning algorithms. The artificial neural networks algorithm and artificial neural networks with a cascade-correlation algorithm using one hidden layer or two hidden layers are proposed to predict the compressive strength of the recycled aggregate concrete. In this research, 112 datasets of recycled aggregate concrete are gathered from the literature with 6 inputs. Moreover, this investigation has predicted the age effect of recycled aggregate age on the compressive strength of recycled aggregate concrete. The reliability of ANN architecture is evaluated by some criteria such as correlation coefficient (R), root mean square error (RMSE) and mean absolute error (MAE). The best ANN architecture could be considered as a new tool for an estimation of the RAC compressive strength.

Keywords: Recycled aggregate concrete (RAC), Compressive strength, Artificial neural networks (ANN), Cascade.

Using Random Forest for predicting compressive strength of self-compacting concrete

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Self-compacting concrete (SCC) is a high-strength and high-efficiency concrete that can get compacted without the need for mechanical vibration. SCC can flow due to the self-weight effect to compact and still ensure uniformity. Thanks to these advantages, self-compacting concrete has been considered an outstanding application in construction. One of the most important properties of self-compacting concrete is compressive strength. In this paper, the application of random forest (RF) to predict the SCC compressive strength has been investigated. Eight RF architectures with different number of trees were fully evaluated in terms of performance and prediction capability over statistical results of 50 simulations for each case. The results showed that a combination of 500 trees performed best and the RF algorithm was a good tool, might be useful for engineers to avoid time-consuming experiments for predicting the compressive strength of SCC. Furthermore, the sensitivity of the input variables was also evaluated in this study.

Keywords: Self-compacting concrete, Compressive strength, Random forest.

Using artificial neural network containing two hidden layers for predicting carbonation depth of concrete

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Carbonation of concrete is one of the main causes of corrosion of reinforced concrete and consequently inducing deterioration of reinforced concrete structures. The carbonation depth of concrete depends on numerous factors including mix design and exposure conditions. Number of models for predicting carbonation depth including mathematical and analytical predictions are proposed in the literature. However, the models seem to not take into account the complexity of carbonation process and effect of mix design and exposure condition on carbonation depth. Therefore, determining the carbonation depth of concrete is a challenge for civil engineers. In this investigation, Artificial neural network (ANN) model is used to predict the carbonation depth. To develop the model, 300 experimental data were collected from the literature. The collected data is randomly divided into 2 groups with 6 inputs such as cement content, fly ash (FA) content, water content, relative humidity, carbonate concentration and time exposure. Performance evaluation of the models was performed and compared on training dataset (70% data) and testing data set (30% to remaining data) by criteria of coefficient of correlation (R^2), root mean square error (RMSE), mean absolute error (MAE). The performance values show that the ANN model can accurately predict the carbonation depth of concrete.

Keywords: Carbonation depth, machine learning, artificial neural network, concrete, fly ash

Investigation of input number effect on performance prediction of soil friction angle using random forest

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The friction angle is one of the most important parameters for analyzing geotechnical properties. The friction angle of soil depends on numerous factors including liquid limit (LL), plasticity index (PI), deviation of the Casagrande ΔPI, clay fraction (CF). Determining the friction angle of soil is a challenge for geotechnical engineers. In this paper, Random Forest (RF) model is used to predict the friction angle. To develop the model, 131 experimental data were collected from the literature. The collected data is randomly classified into 2 groups for training and testing process. Performance evaluation of the RF models was carried and compared on training dataset (70% data) and testing data set (30% to remaining data) by criteria of coefficient of correlation (R^2), root mean square error (RMSE), mean absolute error (MAE). The RF model using 4 inputs gave the best performance. The performance values show that the RF model can accurately predict the friction angle of soil.

Keywords: Friction angle, machine learning, random forest, soil, input number

Estimation of the shear strength of FRP reinforced concrete beams without stirrups using machine learning algorithm

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Predicting the shear strength of Fiber Reinforced Polymer (FRP) reinforced concrete beams is one of the most complex problems in structural engineering applications. The development of accurate and reliable predictive models is essential and could help to reduce costs. The development of an alternative approach is, therefore, crucial for structural engineers. In this study, a database with 307 shear test results is collected from reliable sources to develop an Artificial Neural Network (ANN) model to predict the shear strength of FRP reinforced concrete beams. Four training algorithms, namely Levenberg-Marquardt (ANN-LM), Quasi-Newton method (ANN-QN), Conjugate gradient (ANN-CG), and Gradient descent (ANN-GD) is used to train the ANN models. The evaluation of the models is performed and compared on the training dataset (70% of data) and the testing dataset (the remaining 30% of data), using common statistical criteria. The results show that the ANN-OSS model has the best prediction performance with the correlation coefficient (R) of 0.961, root mean square error (RMSE) of 35.53 and mean absolute error (MAE) of 20.63. These results confirmed the ANN model's effectiveness as a robust algorithm for predicting the shear strength of FRP reinforced concrete beams without stirrups.

Keywords: FRP-RC beams without stirrups, shear strength, machine learning.

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Application of an Artificial Neural Network Model for the Prediction of the bond strength of FRP bars in concrete

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Over the past years, fiber-reinforced polymer (FRP) rebars have been extensively used in the field of construction instead of steel rebars, thanks to their non-corrosive nature and high tensile strength. The bond strength between FRP rebars and concrete is a critical design parameter that controls reinforced concrete members' performance at the serviceability and ultimate limit states. The latter is generally affected by several factors. Unlike steel reinforcement, FRP materials are anisotropic, non-homogeneous, and linearly elastic, resulting in different force transfer mechanisms between the reinforcement and concrete. Therefore, accurate estimation of the bond strength is considered a critical element and might be helpful in many practical applications. In this study, a database including 477 experimental beam results gathered from the available literature is used to develop an artificial neural network (ANN) model to predict the bond strength of FRP bars in concrete. Two ANN models using the Scaled Conjugate Gradient algorithm (SCG) and Variable Learning Rate Backpropagation algorithm (GDX) are constructed and evaluated in terms of bond strength prediction accuracy. The assessment of the models is conducted using statistical measurements, namely the correlation coefficient (R), root mean square error (RMSE), and absolute mean error (MAE). The results show that the proposed ANN model can accurately predict the bond strength of FRP bars in concrete, which appears as an efficient numerical alternative for engineers.

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Keywords: Bond strength, FRP bars, artificial neural network (ANN).

Prediction of the compressive strength of rubberized concrete based on machine learning algorithm

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In recent years, car tires are considered one of the most crucial environmental pollution problems in many countries. Therefore, reusing waste rubber crumbs from recycled tires as aggregates for concrete has attracted increasing attention. Rubberized concrete could also be an economical and environmentally-friendly construction material. Besides, enhancing the ductility, toughness, thermal insulation, and impact resistance are also advantageous while using rubberized concrete. On the contrary, rubberized concrete's mechanical properties are highly dependent on the replacement amount of rubber. Thus, the estimation of the compressive strength of rubberized concrete is crucial for engineering applications. In this study, 162 experimental results collected from the literature are used to construct a database and attempt to predict the compressive strength of rubberized concrete. An artificial neural network (ANN) is developed, using 7 input variables, namely binder, superplasticizer, water, fine aggregate, coarse aggregate, crumb rubber, and chipped rubber. The model performance is evaluated using three performance indicators, such as root mean square error (RMSE), mean absolute error (MAE), the Pearson correlation coefficient (R). The results show that the proposed ANN algorithm exhibits excellent prediction performance and accurately estimated the compressive strength of rubberized concrete. The results in the present research are useful and could provide a reference for engineers in predicting the compressive strength of rubberized concrete.

Keywords: Rubberized concrete, machine learning, compressive strength.

Predicting the compressive strength of recycled aggregate concrete based on artificial neural network

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Recycled aggregate concrete (RAC), where recycled concrete aggregates replace natural ones, has received increased attention over the past decades, and appears as a promising technology for conserving natural resources, reducing the environmental impact of concrete. However, the complexities in the mixture optimization of RAC, due to the variability of recycled aggregates and lack of accuracy in estimating the compressive strength, require novel and sophisticated techniques. This study aims at developing a machine learning model, based on neural networks, to predict the RAC compressive strength. The RAC database in this investigation is constructed from the available literature, divided into two parts, namely the training and testing parts. Well-known statistical indicators, namely the correlation coefficient (R), root mean square error (RMSE), absolute mean error (MAE), and mean absolute percentage error (MAPE) are used to evaluate the performance of the proposed machine learning model. The results indicate that the outputs of the proposed model are in good agreement with the experimental compressive strength values, and may be helpful for engineers to save time, as well as avoiding costly experiments.

Keywords: Recycled Aggregate Concrete, artificial neural network, compressive strength.

Development of Artificial Neural Network Model for Prediction of Marshall Parameters of Stone Mastic Asphalt

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Stone Mastic Asphalt (SMA), firstly introduced in the 1960s, is a durable and rut-resistant asphalt mixture that uses stone-on-stone contact to improve strength, and a rich mortar binder to provide durability. Marshall parameters, such as Marshall Stability (MS) and Marshall Flow (MF) are critical mechanical properties of SMA, representing the performance of asphalt concrete. The two Marshall parameters are widely used for the evaluation of resistance to displacement, distortion, rutting, and shearing stresses of SMA. As the pavement is frequently subjected to traffic loads, it is highly required to find out an optimum manner to determine these Marshall parameters. However, such a procedure is complicated, costly, and time-consuming. The primary aim of the present work is to develop an alternative numerical tool using artificial neural network (ANN) to predict the MS and MF of SMA mixtures. The results show that the ANN algorithm is an excellent predictor based on the excellent values of statistical criteria such as root mean square error, and the Pearson correlation coefficient. This study's results pave the way towards selecting a suitable machine

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learning approach to accurately determine the Marshall parameters of SMA mixtures.

Keywords: Stone Mastic Asphalt (SMA), Marshall parameters, Artificial neural network (ANN).

Using Decision Tree J48 based Machine Learning Algo- rithm for Flood Susceptibility Mapping: A Case Study in Quang Binh province, Vietnam

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Flood is a dangerous natural hazard causing loss of life, property, and infrastructure besides affecting the economy and social life of a country. Vietnam is facing flood hazard problem recurrently mainly due to its topography, hydrology and climatic condition; and dense population. Therefore, it is necessary to develop a n accurate flood susceptibility map to identify the areas likely to be affected by flooding to minimize potential damages of the flood hazard. This study deals with flood-

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susceptibility mapping using machine learning based on J48 decision trees algorithm for identifying in advance flood susceptible areas. In this study, we have used ten important flood affecting factors, namely Elevation, Slope, Curvature, River Density, Distance from River, Geomorphology, Land Use, Flow Accumulation, Flow Direction, and Rainfall, for the model development. Flood inventory of 318 locations was used for randomly splitting dataset in 70:30 ratio for model training (70%) and validation (30%). The model performance was evaluated using standard statistical measures. The results indicated that the decision tree (J48) model has high predictive performance (AUC = 0.97). Therefore, this model can be used to develop a reliable and accurate flood susceptibility map of an area for proper planning, flood risk management, and mitigation.

Keywords: Machine learning; Decision Tree; Flood susceptibility; Quang Binh province; Vietnam.

An artificial intelligence approach to predict the resilient modulus of subgrade pavement or unbound material

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The resilient modulus (M_R) is a crucial parameter, reflecting the dynamic stiffness and structural response of subgrade pavement materials. However, the repeated load triaxial tests to directly measure the M_R are complicated, time-consuming, and expensive. Thus, an alternative manner of calculating such values needs to be constructed. In this paper, the backpropagation algorithm is used to construct an artificial neural network (ANN) model to predict the M_R of unbound materials. The database used in the development phase of ANN consists of 9 input parameters, such as the percentage of particles passing through a 200 sieve, plasticity index, liquid limit, percentage of optimum moisture content, percent of moisture content, soil saturation degree, confining stress, deviator stress, and the unconfined compressive strength. The target of the proposed ANN model is M_R values. The dataset is split into two subsets, namely the training dataset, which accounts for 70% of the total data, and the testing dataset, containing the remaining 30% of data. The results show that the proposed ANN algorithm could successfully predict the values of M_R, based on several performance criteria such as the coefficient of determination (R^2), root mean square error (RMSE). It could thus be concluded that the ANN model is a highly efficient alternative manner for quick estimation of M_R and can be used as an advisory tool for engineers.

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Keywords: Unbound materials, resilient modulus, artificial neural network, backpropagation

Passenger Train Delay Prediction using Linear Regression and Ensemble Learning Methods with and without Ridership and Population Data

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Passenger train delay (PTD) prediction is an effective solution not only for rail operators to plan and solve their operation problems, but also for passengers to better plan or alter their travel schedules. As an endogenous variable, train delay profile or accumulated delay is normally used as a key variable to model train delay. In addition, several exogenous variables, especially ridership or station activities and population seem to influence train delay. This study develops and compares the performance of PTD prediction models using data-driven linear regression and ensemble learning methods with and without exogenous variables; the two exogenous variables examined are ridership and population. Three Amtrak passenger trains with different delay profiles and host-railroad performances from 2008 to 2019 are used as case studies to build the prediction models. The results indicate that the PTD prediction models using ensemble learning methods outperform the ones using linear regression (LR). Moreover, the results also indicate that the two exogenous variables had little to no impact on the prediction models using ensemble learning methods.

Keywords: Train Delay Prediction, Machine Learning, Big Data, Ensemble Learning Method, Random Forest, Exogenous Variables.

Investigation of artificial neural network models for predicting the international roughness index of rigid pavements

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The International Roughness Index (IRI) is the one of the most important roughness indexes to quantify road surface roughness. In this study, the backpropagation (BP) algorithm and conjugate gradient backpropagation algorithm were used to develop artificial neural network (ANN) model for the prediction of the IRI. A total of 913 samples in the case study of the experimental study was the Vietnamese Highway No.5 between Hanoi and Hai Phong, located in the northern part of Vietnam including 6 inputs and 1 output were collected for training and testing the ANN model. The reliability of ANN model is evaluated by some criteria such as correlation coefficient (R), root mean square error (RMSE) and mean absolute error (MAE). The best ANN architecture could be considered as a new tool for accurate prediction of the IRI for evaluation of quality of road surface roughness.

Keywords: International roughness index (IRI), rigid pavements, concrete, artificial neural network, machine learning.

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Construction Economics and Management

Traffic Revenue Risk Identification and Assessment in Build-Operate-Transfer Transport Projects in Vietnam

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The purpose of this paper is to identify and assess the traffic revenue risks in Build-Operate-Transfer (BOT) transport projects in Vietnam. This will assist project participants in managing these risks effectively in their projects. The study used two different data collection phases to do this, including a literature review and a questionnaire survey. The questionnaires were administered to two different primary stakeholder groups comprised public sector authorities (i.e. ministries, department, agencies) and concessionaires involved from conception to operation phase of BOT transport projects in Vietnam. The 15 detected traffic revenue risk indicators were classified into three main components by factor analysis in the study. This study is expected to assist policymakers and other stakeholders in formulating policy recommendations that would favorably impact the development of BOT transport projects in Vietnam and other developing countries.

Keywords: Revenue Risk; Risk Management; Build-Operate-Transfer; Public-Private-Partnership; Transport Projects.

Corporate social responsibility disclosure and financial performance of construction enterprises: evidence from Vietnam

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Currently, Vietnam is increasingly participating in the process of globalization and international integration, issue of corporate social responsibility has not been given adequate attention from both theoretical and practical perspectives in Vietnam. To ensure sustainable development for businesses and society, the issue of corporate social responsibility (*CSR*) is increasingly concerned. In the construction industry, the implementation of *CSR* activities has yielded some results, but there are still some limitations. Based on 135 observations samples from 27 construction companies listed on the Vietnam Stock Exchange during the 2014-2018 period, the study showed a positive relationship between *CSR* disclosure and financial performance, including the positive relationship of product *CSR* disclosure concerning *ROA* (Return on Assets).

Keywords: *CSR* in construction, financial performance, Vietnam.

Public private partnership for transport infrastructure investment: critical success factors and lessons learnt from projects in the context of developing countries

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Public-private partnerships (PPPs) represent an important channel that attracts the participation of private sponsors to invest in transport infrastructure systems in developing countries. PPPs are increasing as an innovative tool to remedy the lack of the dynamics of traditional investment channels of public governments and to stimulate the development of transport infrastructure via the encouragement of participation by private investors. PPP projects are established based on the cooperation rules of public and private sectors on the basic of pursuing common goals; and leveraging their joint resources regarding the competencies and strengths of each actor. However, the poor quality of collaboration mechanisms between public agencies and private organizations is considered to be one of the main causes leading to project delays and the need for unexpected renegotiations, which results in unforeseeable events beyond the control of the contractual parties. Thus, this paper focuses on reviewing the implementation of PPP projects in developing countries to provide a holistic picture of PPP contractual negotiations and identify potential risks and associated consequences during the project stages. A systematic review has been conducted and more than one hundred research papers from 2000 to 2020 have been selected for analysis and synthesis. The initial findings

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of this study show that political support, legal-financial risk allocation, shared authority and responsibility, communication channels, and conflict resolution are critical factors contributing to the success or failure of the collaboration mechanism between parties in PPP projects. These factors should be examined carefully during investment policy development to improve the success rate of PPP projects and attract the participation of private sector investors.

Keywords: Public-Private Partnerships; Transport Infrastructure; Project Risks

Implementation of PPP for Urban Metro System: Critical Issues for Developing Countries

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Rapidly growing urbanization in developing countries has led to high level of traffic demand and vehicle emissions. Consequently, the rail-based transport system is preferred in growing metropolises as an advanced transport mode, potentially resolving mentioned problems. The huge capital requirement of urban metro projects, however, far exceeds the availability of the state or central government funding. To meet the gap in finance, the public sector has implemented public–private partnership (PPP) framework to build the system. This contract form offers valuable benefits, such as *access to finance, appropriate risk allocation, and efficient management ability*. Nevertheless, international experience in metro plans reveals that the successful application of PPP in this transport mode is significantly challenged by various critical issues. Hence, prior to engaging in PPP urban metro projects, key elements justifying the benefits and possible threats, need to be evaluated. This paper, by reviewing international experience, intensively from emerging markets, and by carrying out an in-depth case study, attempts to clarify key issues, and strategy implications to promote successful PPP mechanism for urban metro system in Vietnam.

Keywords: Public – Private Partnership, Urban Metro System, Project Management.

Application of 4D BIM Simulations for Safety and Schedule Integration of a Reconstruction Project for Oxygen Plant in Steel Works in Korea

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Since the duration of the reconstruction project of an oxygen plant to replace the about 40-year aging oxygen plant for the "P" company's steel works in Korea needs substantial schedule acceleration to improve the steel plant's overall production efficiency, the plant owner decided to integrate construction schedule and cost for minimum trial and error by adopting pre-simulations with 4D BIM (building information modeling). This case study presents a model for checking the process plan by providing information on construction duration reality-check compared to the construction schedules of previous similar projects in "P" company history before beginning reconstruction of the oxygen plant. It also helps make decisions by simulating the planned schedule to predict potential construction delays and providing prioritized ranks of activities that need to be shortened to reduce duration economically. The 4D BIM-based simulations with Dassault's Delmia, which combines the 3D modeled with Catia and CPM (Critical Path Method) with Enovia, further reflects the safety factors for the construction workers based on the lessons-learned database from the previous similar projects, enable the visualization and management of hazard elements to the schedule planner and safety manages. The system developed through research will be implemented as a full-scale during the reconstruction of the oxygen plant after a pilot test project reported in this paper. When utilizing the result of this study, it is expected that existing plans can be checked through the 4D BIM simulations in advance through PC and mobiles

(tablets and smartphones) to reduce risks such as construction delays and safety hazards.

Keywords: BIM, Safety, Schedule, Cost, Plant, Simulation, EPC (Engineering, Procurement, Construction), Project Management.

Evaluating the Impact of Interventions in Motorcycle Ownership and Usage in Vietnam Cities

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There is a boom of motorcycle growth through the cities of Vietnam during two decades. The impact of increasing motorcycle ownership and usage, both positive and negative impact, has been particularly apparent in terms of mobility, accessibility, air pollution, and safety. However, there is still very little that cities know about managing such kind of mode. This study aims at assisting practitioners by providing a better understanding of policy options and the likely effectiveness of instruments to achieve urban mobility. A wider range of policy instruments will be reviewed to evaluate which one can be used to better manage the use of motorcycle in cities of Vietnam. To support this task, a choice-based conjoint analysis will be applied to evaluate motorcyclists' preferences. Through analysis, the impact of each policy to customers' decision and some market segments are highlighted.

Keywords: Motorcycle, Policy Intervention, Motorcycle Ownership, Motorcycle Usage.

Capturing the flexibility value of infrastructure: a case example of a road project

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Road infrastructures have high uncertainties due to unique and long-lasting characteristics, and these uncertainties, such as varied market demands, environmental and demographic changes, lead to the obsolescence of infrastructures. This creates the need for modern road infrastructures to be designed and built with a certain level of flexibility. Flexibility refers to the ability to adjust or change with future circumstances. Considering the potential case of road expansion, this paper investigates the viability of incorporating flexibility into road projects. The proposed financial valuation approach of flexible infrastructure is illustrated via the probabilistic cash flow approach of options analysis. This approach is straightforward, requires minimal financial and mathematical knowledge, and offers a practical way to create flexibility for road projects. As a case example of Lo Te – Rach Soi highway project, the paper considers incorporating flexibility on the two-stage development of a road project, adding extra lanes for road expansion. The results, calculated on the case example, show that incorporating flexibility is financially viable. Although this conclusion on the viability of flexible infrastructure cannot be drawn generally due to limitations of a particular given case example, it is shown that the proposed approach is suggestive and applicable to evaluate the flexibility value of built-in flexible infrastructure.

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Keywords: Flexibility, Options analysis, Expansion, Cash flow, Road project.

Factors affecting Public-Private Partnership preference in Vietnam road infrastructure projects

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Private sector plays the vital role in the success of road infrastructure development in the form of public-private partnership (PPP) in Vietnam. However, factors significantly influencing private partners' willingness to participate in road PPP projects remain unclear. The paper aims at studying factors affecting private sector investment decision in road PPP projects. The research has conducted literature reviews and questionnaire surveys concerning the road PPP projects that have been implemented in Vietnam, identifying 26 factors that can be grouped into seven major components using principal component factor analysis. Using the linear regression model and the data from a questionnaire survey, the findings reveal that three variables have a significant coefficient, including lender support, public support, capacity and experience of the private sector. The result can offer suggestions, including a theoretical basis and practical guidance for government to encourage private partners to participate in road PPP projects.

Keywords: PPP, road infrastructure development, road PPP project, public-private partnership preference.

Toward more flexible financial agreements of PPP toll roads: international experiences for Vietnam

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Public-Private Partnership (PPP) is adopted globally in the development of toll road infrastructure projects, and in Vietnam, there is no exception. Within this project delivery, to mitigate revenue-based risk, the public sector authority offers a guarantee or subsidy, as a form of the financial agreement, to the private sector concessionaire. The recent literature provides a great deal of study on introducing managerial flexibilities, embedded with Real Options, in such financial agreements. Those financial agreements that reflect how risk-sharing mechanisms between the two parties, the authority and the concessionaire, can be classified into two groups: one-sided protection and two-sided protection. One-sided revenue protection provides revenue protections to either party to cope with fluctuating revenue, while two-sided revenue protection combines both minimum revenue guarantee and revenue cap to create a band of revenue that benefits both parties. Each of the above protection scenarios is discussed in independent research. The literature lacks a comprehensive review covering all revenue guarantee options available in PPP toll road projects. This paper thus summaries all existing revenue-related guarantee options available in the worldwide literature and analyses international experiences that provide potentials and valuable lessons for developing road infrastructure in Vietnam.

Keywords: PPP, Road projects, Financial agreements, Options.

Design optimization of Fibres Reinforced Concrete Railway Tracks by using Non-Linear Finite Elements Analysis

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Between 2007 and 2014, IFSTTAR, Alstom and other industrials partners have developed a new concept of railways track called New Ballastless Track (NBT). A first numerical study, using a non-linear model was performed to evaluate the possibility of replacement of the original reinforced concrete layer of the track slab by a steel fiber reinforced concrete, to simplify the construction of the NBT track and to take advantage of the redistribution of mechanical stresses on a hyper-static structure. This study led to the conclusion that this replacement was very relevant.
This paper is on the optimization of this Fibres Reinforced Concrete Railway Tracks solution by using the same non-linear numerical model. It is shown that this optimization procedure should lead to reduction of CO_2 emissions compared with the initial one.

Keywords: Railway Tracks, Fibre Reinforced Concrete, Cracking, Carbone Footprint.s

Geotechnics for Environment and Energy Efficiency

Segregation index – a new soil parameter for internal erosion assessment

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Internal erosion is a major cause related to nearly half of dam dysfunctions and failures. This phenomenon occurs when loose soil particles are transported outwards the soil mass by seepage through a series of pores and pore constrictions. As loose particles are usually fine and embedded in the pores formed by the soil primary fabric, traditional methods often correlate the representative sizes of fine and coarse particles to indicate the susceptibility to internal erosion of an assessed soil. These methods are not very accurate because soil particle size distribution can vary widely with several identical key sizes. This paper presents a new indicator for internal erosion assessment using the probability to be transported of loose particles: the segregation index. This index is estimated experimentally and analytically for the correlation with internal erosion test results. The index also has a significant role in the estimation of real effective stress of soils.

Keywords: Segregation, Internal erosion, Assessment, Dam, Soil Characteristics

Experimental study on behaviour of clayey sand reinforced by polypropylene fibre

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In this paper, the author presents the improvements in the mechanical properties of clayey sand soils reinforced by polypropylene (PP) fibres. PP fibres with 3 different lengths of 10mm, 15mm and 20mm were mixed with the soil with content by weight of 0.5%, 1% and 1.5%. Three types of experiments were conducted including 30 compaction tests, 30 direct shear tests and 10 triaxial compression tests. With the same compaction energy, the maximum dry density was achieved with a fibre length of 20 mm and a fibre content of 1%. After determining the optimum water content for each type of fibre length and content, the soil samples in the direct shear and triaxial compression test were prepared by compaction to have the corresponding maximum density. The direct shear test showed that as the fibre content or the fibre length increased, the cohesion c increased whilst the friction angle □ decreased. The cohesion c reached the maximum value with the fibre length of 20 mm and the fibre content of 1%. This value was 9 times greater than that of c of the un-reinforced soil. In the consolidated undrained (CU) triaxial test, the peak deviator stress was significantly improved compared to un-reinforced soil. The maximum values of both cohesion c_{CU} and friction angle $\square_{CU}$ were achieved with a fibre length of 15mm and a fibre content of 1%. The largest value of c_{CU} of the reinforced soil was more than 10 times of the unreinforced soil. However, $\square_{CU}$ did not have much improvement compared to un-reinforced soil.

Keywords: Fibre-reinforced, Triaxial Test, Compaction Test, Polypropylene Fibre

Soft Clay Stiffness Measured in Ho Chi Minh City with Oedometer Tests for Deep Excavation Calculation

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To calculate the stability and deformation of the deep excavation in Ho Chi Minh City (HCMC) in particular and Vietnam in general often use the Finite Element Method (FEM) with Mohr-Coulomb (MC), Hardening Soil (HS) model. The HS model built based on the Hyperbolic model shows more progress than the MC model. The HS model also explains the dependence of the modulus on stress. The degree of dependence of stress is given by the exponent m. To simulate the dependence of the stress according to the logarithmic law, the exponent parameter (m) has different values depending on the soil type, the choice of the exponential parameter makes it difficult for engineers to correlate from experimental expressions because this amplitude is still relatively wide and gives a large difference in calculation results. This paper determines parameter m and the correlation coefficient Eoed/ E50 for soft soil in HCMC is based on the Oedometer test as identified in the HS model to calculate deep excavation.

Keywords: Deep Excavation, Hardening Soil, Stiffness, Oedometer test

Concerns related to modelling land subsidence of Mekong Delta

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Land subsidence due to groundwater extraction is a serious issue in Mekong Delta Vietnam, especially when it combines with the sea level rise. Various models were established to study the problem. Usually, two steps models are used. First, the groundwater models are solved to obtain changes in the water table resulting in changes in effective stress. Then, land subsidence magnitude is calculated based on the one-dimensional consolidation theory. After analyzing carefully land subsidence models for the Mekong Delta, we would like to discuss here some concerns related to the described data and methodologies, which are related to (1) the inconsistency between the compression index and the specific storage, (2) the spatial distribution of parameters, (3) obtained parameters using the parameter estimation tool, (4) comparisons between INSAR data and model results.

Keywords: Models of Land subsidence, Mekong Delta

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Flood risk mapping based on AHP, Fuzzy and Geomatics technology for Lai Giang basin in South-Central Coastal Vietnam

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Flood is one of the most dangerous disasters in Vietnam, the problem of floods is getting more serious and floods have caused great damage to people and property in the context of climate change. In this study, the methodology emphasizes weighting crucial variables using spatial analyst tools, Analytic Hierarchy Process, and fuzzy-based Geomatics for flood disaster risk. The fuzzy contains three input indicators: the hazard factor, the exposure factor, and the vulnerability factor. Hazard factors are obtained using the flooding map was constructed from radar satellite imagery (Sentinel-1). Then, hazard factors, exposure factors, and vulnerability factors are all put into the Geographic Information System (GIS) to accomplish overlay analysis, AHP, and fuzzy matrix calculation. This methodology has been successfully applied to the flood risk map in the Lai Giang river basin, the South Central Coast, Vietnam. Finally, the weights of these variables on the risk of the flood were assigned as 50% for elevation, 40% for distance from Lai Giang river, 5% for Manning's coefficient, and 5% for population density.

Keywords: Flood Risk, Fuzzy, AHP, Geomatics, Lai Giang basin

New structure to reduce settlement of sea dike built on soft soil

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Nowadays, there are two types of sea dike, including vertical wall-typed and sloping ones. The vertical wall-typed sea dike is based on the pile foundation principle. The construction process of this structure is complex, and the sheet pile is high cost. Thus, it is rarely used. Sloping sea dike, based on gravity foundation principle, mainly uses rock and soil as the material. Therefore, this structure is widely used due to its simple construction process and low cost. However, in the case of soft soil, the dike settlement is high, requiring ground improvement, leading to higher construction cost. In order to deal with this problem, the hollow structure (KCR) working based on both pile and gravity foundation principle is proposed. This new structure is compared with the traditional sea dike structure using for the Tien Lang – Hai Phong - Vietnam sea dike project. The calculation is performed with Plaxis 2D in terms of the settlement of the dike. Results show that the settlement of sea dike using hollow structure (KCR) equals 18.7% of the traditional one, thanks to its pile foundation principle. In addition, the construction cost also reduces 40 – 70 %.

Keywords: Hollow structure (KCR), sea dike, vertical wall - type sea dike, sloping sea dike, soft soil, sea dike settlement.

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Prediction of Local Pier Scour under Live-bed Conditions

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This paper presents a formula developed for predicting local scour depth around a bridge pier in cohesionless soil based on field data. The semi-theoretical equation for scour prediction proposed by Nghien [1] is considered and improved by incorporating Froude number into the calculation of the hydrodynamic drag force coefficient C_d. By performing field data-based analysis and comparing the results with ten formulas published in the literature, it is concluded that the proposed formula for predicting local scour depth under live-bed conditions could provide the closest prediction to the measurement and observation data.

Keywords: Local scour depth, Field data, Hydrodynamic force, Live-bed conditions.

Experimental study on pile group efficiency in various types of soil using a small - scale physical model

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A testing program of static pile load was conducted using a small-scale model to investigate some factors influencing pile group efficiency. Natural sandy and clay soils were put into a soil tank. The test piles have a small size with two different lengths. The studied types of soil include sand soil, sand-clay alternating layers' soil, and clay soil. There were a total of thirty-six tests with various spacing to diameter ratios (S/d) and length to diameter ratios (L/d). In sandy soil, the group efficiency η was always greater than 1, in which there was a slight decrease in the group efficiency η when (L/d) increased and η decreased to 1 when (S/d) increased. In clay soil, η was always less than 1; however, when (L/d) increased, η increased significantly. Thus, the effect of the pile length should be considered for pile in clay soil, where η increased when (S/d) increased, which is clearly opposite to that of sandy soil. With the same parameters including the number of piles, pile dimensions, and (S/d) and (L/d) ratios, the order in term group efficiency η was obtained as follows: sand soil, sand-clay soil, and clay soil.

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Keywords: Small-scale Model, Pile Group Efficiency, Static Load Test, Sandy Soil, Clay

Influence of Fabrics on Compression Mechanics of Iron Tailings

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Due to irreparable damages done by the failure of tailing dams to the human, assets and environment which have ultimately resulted in great economic, social and environmental challenges worldwide, investigations into mechanical behaviour of tailings have received some attentions. However, the knowledge and understanding of mechanics of compression behaviour in iron tailings is still limited. This study investigates the mechanical behaviour of tailings in compression considering effects of fabric resulting from sample preparation and the possibility of non-convergent behaviour. This was achieved by conducing series of one-dimensional compression tests in conjunction with index, microstructural, chemical and mineralogical tests. The results show that the effects of fabric resulting from sample preparation is seen. There is presence of parallel and non-unique normal compression lines which is an important feature of transitional mode of behaviour. The behaviour of iron tailings therefore depends on initial specific volume.

Keywords: Tailings, compression, fabrics, geotechnical properties, transitional behaviour.

Investigations into Grading Characteristics of Tailings

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Tailings are by-products of beneficiation processes of run-off mine in order to extract valuable fractions from ore minerals. Studying this material is essential due to importance of its handling and consequent negative impacts on human and environment as well as limited understanding of its mechanics. Grading is one of important aspects of mechanics of behaviour of geomaterials and it is investigated in details in this study. This is achieved by conducting index tests on samples collected at different depths in the pond. Also, comparisons were made with other tailings reported in the literature. The engineering descriptors (mean particle size, coefficient of uniformity, coefficient of curvature, clay fraction and fines content) were considered as grading characteristics. Different grading characteristics were found for the tailings. The grading curves may result from degree of sorting by sedimentation at different points.

Keywords: Grading, tailings, mechanics, engineering descriptors, index properties.

Geophysics technical application in exploring the sand mines in Haiphong area of Vietnam using seismic measuring equipment "Sub-bottom profiling system 3200 – XS"

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In the contemporary life, the exploration of sand mines on the sea has been very interested by investors. In recent years, the demand for backfilling materials by sand in Haiphong estimated to be over 150.000.000 m3 per year [1]. It is projected that from 2020 to 2025, the increase in demand for these products will reach over 20 percent. This research will introduce the sand mine exploration method by the application of sub-bottom seismic equipment in Haiphong City waters and evaluates the effectiveness of the combination of both sand mine drilling methods using a drill boat and Sub bottom seismic device. Indeed, to construct this research, methods of data collection, experimental methods, expert methods, data analysis and evaluation methods have been used to take advantages of applying geophysical techniques in evaluating the current sand mine reserves. After conducting the exploration of sand mines in Haiphong, the results of the sub bottom seismometer device were checked together with the traditional geological drilling results, It was found that the time of using the seismometer was much shorter than the traditional drilling method by many times, it only took about 2 days for 100 Ha to be explored in the field, when the geological drilling method was applied, it could take 15 to 30 days to complete 100 Ha in the field, with the analytical results

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obtained, seismic measurement methods not only save time but also protects the surrounding ecological environment, and it is essential for assessing the project of sand mines reserves.

Keywords: Sub bottom; Geophysics; Seismic; Geological; Sand mines, Boreholes.

Sea Levels and Inundation Mapping for Urban Areas of Vietnam

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Sea level rise is causing a significant increase in the frequency and severity of coastal flooding, natural hazards for coastal populations, infrastructure, constructions or ecosystem. Climate change and weather anomalies are making the more rapid sea level changes. In Vietnam, meanwhile, development of coastal urban areas is a hot trend and of interest to investors. So, it is of necessary to identify the observed and future potential sea level changes. This paper analyses and represents the observed and projected sea level changes for Vietnam. More importantly, inundation mapping is implemented to fully interpret the potential effects of sea level change for urban areas of Vietnam. The data of 10 tide gauges in the whole country and satellite-based from 1986 to 2019 are used to analyse the observation sea level changes for coastal zones of Vietnam. The CMIP5 models are selected for projecting the sea level changes and GIS technology is applied to map for the coastal inundations. The results illustrate an increasing trend of observed sea level up to more than 10 mm per year. Regions affected by sea level rise are significantly large, especially in the Red River Delta to Danang province and Mekong Delta.

Keywords: sea level, inundation, urban, Vietnam, climate change.

A study on the main factors affecting the reinforcement corrosion in mechanically stabilised earth walls and predict the service life of the wall

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In this study, the Principal Component Analysis method is applied to determine the main factors affecting reinforcement corrosion in mechanically stabilised earth (MSE) walls. A response surface model is used to build the correlation function between corrosion and main factors, which is then applied to design a program to predict the service life of the MSE wall constructed using steel reinforcement (MSE-T). The results of MSE-T program are used to simulate the scenarios of steel corrosion of MSE walls by FLAC software, which could show the stress-strain displacement of the walls at the extracted time. The research results could provide a warning of degradation of the MSE wall in the end stage of working period to enhance safety in the operating process and propose the solutions to improve the longevity of the walls.

Keywords: MSE wall, MSE-T program, numerical modelling, corrosion scenario, Principal Component Analysis (PCA), Response surface methodology.

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Emerging Technology for Determining Unsaturated Soil Shear Strength

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In 2019 Fredlund proposed a procedure for the estimation of the unsaturated soil shear strength function. The procedure used the air-entry value, AEV, (as defines by the drying branch of the degree of saturation Soil-Water Characteristic Curve, *S*-SWCC), and residual conditions to define distinct limits for the unsaturated shear strength function. It was suggested that these points formed two "anchor points" (or reference points), along the drying *S*-SWCC. The suitability of these two "anchor points" was verified through comparisons with published laboratory data sets. This paper details a protocol that can be adhered to when using the *S*-SWCC to estimate a suitable unsaturated shear strength function for geotechnical engineering applications.

Keywords: Soil Suction, Unsaturated Shear Strength, Soil-Water Characteristic Curves.

Gellan gum-bentonite mixture as a new vertical hydraulic barrier

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The use of biopolymer, has recently been popularly studied for geo-environmental applications for the past decades. Among the common biopolymers used in laboratory studies, gellan gum has been proved to show effective improvement in the pressurized hydraulic conductivity and the strength of soils. In this study, the application of gellan gum/bentonite grouting for the design of a grout curtain to form a vertical barrier preventing the flow movement has been investigated. Bentonite powder was mixed with hot gellan hydrogel over 100 °C with different gellan gum concentrations (2%, 3%, and 4% to the mass of distilled water). Tests that show the effects of gellan gum on the changes in water durability, viscosity, and flow controllability of bentonite were conducted. The results of this study show that gellan gum enhanced the engineering properties of bentonite, and in turn, suggests a potential material for vertical hydraulic barriers

Keywords: Gellan Gum, Bentonite, Vertical Hydraulic Barrier.

Establishing thresholds for rainfall-induced shallow landslides using fully coupled hydro-mechanical model

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The identification of landslide-triggering rainfall thresholds plays an important role in providing early warning information and implementing emergency remedial actions before landslide occurs. In this study, fully coupled hydro-mechanical model was conducted to establish intensity–duration (I-D) thresholds for shallow landslides upon rainfall. The numerical model was first verified against measurements obtained from a full-scale field test for slope. The simulation result shows good agreement with the experimental results, indicating that the proposed numerical model is appropriate for use in the simulation of unsaturated soil slope behavior subjected to rainfall infiltration. This approach was then used to determine new I-D thresholds for shallow landslides considering the different hydrological conditions. Finally, the critical rainfall threshold curves obtained for the study were compared with shallow landslides historic data. The result revealed that antecedent soil moistures through initial soil suctions is a critical factor affecting the I-D thresholds. The majority of landslide data recorded from literature through case studies located within the proposed thresholds corresponding initial suction of 2 to 10 kPa. The findings of this study can be implemented into the current activities for predicting the occurrence of shallow landslides in the future in Vietnam.

Keywords: Rainfall-triggered landslides, coupled hydro-mechanical model, rainfall thresholds.

Utilization of Site Cut Cohesive Soil for Construction of large platform for Gas Receiving terminal

An environment friendly solution

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This paper presents how an innovative geotechnical solution on utilization of site cut soil to build a large embankment platform for setting up facilities for gas receiving terminal, led to direct positive impact on the environment and significant saving of energy. In fact, the proposed site for the development of gas receiving terminal in Republic of Turkey, is located at hilly area and the initial levels of this proposed site has huge difference between one side to the other all around (North – South and East – West), which has demanded inevitable cutting (352000 m^3) and filling (355000 m^3 soil) to achieve the flat ground to set up the project facilities. However, since the site cut soil is turned to be cohesive in nature, there was a case that all the cut soil to be disposed at 70km away from site and required to import suitable soil from the borrow area located again at about 70km away from site. The roads connecting disposal/borrow areas to site are narrow and passing through villages and forestry areas. This disposal and importing activities would have caused huge impact on the environment for couple of months due to emissions of greenhouse gas -CO_2 from the trucks and other machines required for earthworks. Also, the energy required to operate these trucks/machines is very huge. Therefore, an innovative cut-fill-foundation geotechnical solution was proposed and executed so as to meet both the project engineering requirement as well as to protect the environment and save the energy; where site cut soil was reused with proper compaction and drainage system to build the embankment platform for the project and pile are provided as foundation system to ensure the integrity and performance of the project facilities. As a result,

both disposal and import activities have been drastically reduced and led positive impact on both environment and efficient usage of energy.

Keywords: Innovative solution, cut-fill-foundation, environment, energy, Piles foundations, embankment platform, hilly, disposal and importing.

Study on application of sea sand-cement column in soft soil improvement for Hai Phong-Nam Dinh coastal highway

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The ground structure of the coastal road of Hai Phong - Nam Dinh alignment consists of 10 to 20-m-thickness soft soil layers, lying near the surface, so the deep treatment methods, such as sand column, sand well, prefabricated vertical drain (PVD), soil-cement, etc. will be a reasonable choice. However, each method has pros and cons. In Vietnam, the river sand resource is increasingly scarce and sand exploitation is causing serious environmental problems. It is necessary to study another material to replace the river sand. The paper proposes the soft soil improvement method by sea sand - cement columns. The laboratory experiment tests allow defining the sea sand and soft soil properties, and the sea sand-cement mixture properties. The experimental results show that the influence of cement content on the strength of sea sand - cement samples corresponding to the curing time. Additionally, the four-column physical model in 1:10 small-scale has been set up to investigate the effectiveness of sea sand - cement columns in soft soil improvement. The physical model results indicate that the presence of sand-cement columns in the ground decreases significantly the soft soil and embankment settlements.

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Keywords: sea sand - cement column, soft soil, cement content, physical model, settlement

Hydromechanical behavior of a tuff/bentonite mixture treated with cement

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Sandy soil-clay mixtures are commonly used as a liner/barrier material in various engineering applications, such as construction of hydraulic and waste containment. In this study, the hydromechanical characteristics of tuff-bentonite and tuff-bentonite/cement mixtures are investigated to propose a local barrier ma- terial. A series of free swelling, one-dimensional consolidation and falling head permeability tests for hydraulic characteristics as well as the direct shear test for mechanical characteristics were performed on four different tuff-bentonite mix- tures and two different tuff-bentonite/cement mixtures. Test results show that the compressibility/swelling behavior of the mixtures increases with increasing ben- tonite content. The optimum amount of bentonite to achieve a permeability of less than 10^{-9} m/s, which is a liner/barrier design requirement, was found at 8% and 10%. The results of the strength tests indicate that the apparent cohesion in- creases with the bentonite content, while the apparent angle of friction decreases. Concerning the optimal mix treated with 3% and 5% cement, the test results show that the permeability and compressibility/swelling behavior decrease with the added cement content, while the angle of friction and

cohesion increase. Finally, it was concluded that the 8% bentonite-92% tuff mixture treated with 3% cement is retained as a passive barrier material for landfill sites in arid and semi-arid regions.

Keywords: Bentonite, Tuff, Permeability.

Waste management of disaster affected areas from the zinc-lead enterprise

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The research object of the present work is the Mizur tailing dump located on the territory of North Ossetia-Alania Republic (Russia). The tailings dam has the size – 150 × 280 m and up to 30 m bulk dam high, and situated in the densely populated area. The exploitation of the Unal tailing dump has begun since 1984 with the purpose of warehousing of tails and organization of system of turnaround water supply. During the period of storage all waste undergoes changes caused by the physical and chemical transformations under the influence of external conditions and internal factors. As a result of these pre-rotations significant amounts are formed the neogenic substances being more toxic and mobile, than initial connections. Carried out complex of laboratory and in-situ tests permit to forecast the amount of "technogenic" resources and has formed the basis for alteration of work technique. The high concentrations of As, Sb, Zn, Pb, Cu, Sn are established. Utilization of the buried industrial wastes will allow not only to receive metals necessary for a national economy, building materials, but also will lower negative pressure on an ecological situation of this area and also will reduce degree of risk of emergence the technogenic catastrophes connected with the possible break of a bulk dam of the tailings dam.

Keywords: Tailing Dump, Chemical Composition, Utilization, Concentration.

Reliability analysis of pile foundation using GMDH, GP and MARS

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Risk and reliability are important aspects of geotechnical structures. Soil is highly variable. Pile tests are extremely expensive and labor-intensive. The paper proposes a reliable method to predict the bearing capacity of the pile using AI-based models like Multivariate Adaptive Regression Splines (MARS), Group method of data handling (GMDH) and Genetic programming (GP) using data of pile dynamic tests conducted on various sites in Indonesia. The performance of the model is ascertained using various performance parameters and are compared among themselves using Rank analysis and Taylor diagrams. The reliability indices of each model are calculated and compared. GP and MARS are concluded as robust models for estimating bearing capacity while performance of GMDH is not exciting.

Keywords: Reliability; Piles; MARS; GMDH; GP.

Capillary rise characteristics and saltwater propagation in fine aggregate: toward developing the anti-salinity shallow foundation

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This study is carried out to determine the capillary rise over time of fine aggregate in different saline media. The obtained results showed that the capillary height in fine aggregate is inversely proportional to the salt concentration of the capillary solution. The aggregate that has particle size over 2.0 mm shows the best ability to limit capillary rise. The capillary height of the aggregate gets the highest value when there is no salt in the solution and get the lowest one with the solution at the highest salinity tested, i.e. 33.0 g/L. The obtained results on capillary characteristics lead to an idea of design a shallow foundation that has function of anti-corrosion, anti-salinity proactively and effectively.

Keywords: Capillary rise, Anti-salinity, Anti-capillary, Saline intrusion

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Cyclic Response and Post-cyclic Settlement of Sand Experiencing Repeated Earthquakes

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This study evaluated the cyclic response and re-consolidation volumetric strain (ε^V) of clean sand subjected to repeated earthquakes at non-fully liquefied stage. A series of repeated cyclic direct simple shear tests (CDSS) at various cyclic stress ratios (CSR) and followed re-consolidation phases were performed on loose sand. From the experimental results, CSR, number of applied shear event, shear strain induced by shaking event were factors influencing the cyclic behavior and ε^V. For non-liquefied samples subjected to repeated shear events, two concepts of maximum double amplitude shear strain (γ^{DA}_{max}) and evolution of double amplitude shear strain ($\Delta\gamma^E_{DA}$) in relation to ε^V were examined, in which ($\Delta\gamma^E_{DA}$–ε^V) concept exhibited a better correlation and was suggested as an alternative approach for examining the dynamic response during shaking events induced by earthquakes.

Keywords: Liquefaction, volumetric strain, cyclic shear strain, repeated earthquake.

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Experimental investigation of cement type effect on hydration and strength development of cement-treated soils

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Cement treatment is a popular method to enhance properties of soft soil such as mechanical properties, durability, and physical properties. Compressive strength is known as one of the most important indicators governing the quality of improvement of cement-treated soil. The type of soil and cement greatly affected the compressive strength of cement-stabilized soils. Thus, this paper aims to examine the effects of cement type on hydration and strength development of cement-treated soils. In the experiments, Kasama clay, collected in Kanto loam, and two types of cement, including OPC and HPC, were used to produce the mixtures. The specimens were prepared with optimum water content using cement/soil = 30% and cured under 20, and 30 or 35 °C. The experimental results showed that the temperature generated by hydration of cement-treated soil using HPC was higher and reached the highest peak earlier than that of specimens using OPC. Besides, the strength value of HPC specimens was much higher than that of specimens using OPC at an early and later age. These results suggest that HPC can be used for cement-treated soils as a potential binder to promote the development of compressive strength.

Keywords: Cement-Treated Soil, Cement Types, Cement Hydration, Strength Development.

Green Transport and Environment

Zero-Emission Vehicles Penetration into the ASEAN Market: Challenges and Perspective

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Electric vehicles (EVs) can be considered as zero-emission means of transport. They include battery electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (HFEVs). EVs exhibit several advantages such as high efficiency, suitable torque characteristics, no noise, and no pollution emission in operation. However, the common disadvantages of EVs are related to the low onboard energy density storage, short cruising range, high initial cost, and great investment for charging/fueling infrastructures. Thanks to the development of new technologies and materials, the energy density of the battery has been improved, and the charging time is shortened. The hydrogen storage technology under the form of hydride has also achieved significant progress in recent years. The cost of BEVs and HFEVs drops continuously, and it is predicted that EVs will become cheaper than traditional vehicles in the next decades. The penetration of zero-emission vehicles into the ASEAN market can be forecasted in three phases. In the long-term, with the progress of the hydrogen-based economy, HFEVs may be dominant.

Keywords: Electric vehicles, Zero-emission vehicles, Lithium-ion battery, Hydrogen, Fuel cell

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Performance and Emissions of Motorcycle Engine Fueled with LPG-Ethanol by Port Injection

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The present paper investigates the performance and emission of a retrofitted Honda 110cc motorcycle engine fueled with LPG-ethanol by simulation and experiment. The ethanol and the LPG are injected separately through the two different injectors. A microcontroller is set up connecting with the ECM of the engine for flexible adjustment of the LPG/ethanol ratio based on the gasoline injector control signal. The measurements were conducted on a special engine testing instrument with an automatic load controller. The simulation was performed with the help of the Ansys Fluent Software. The results show that the LPG-ethanol dual injection forms a stratified mixture distribution at the end of the compression process. The relatively LPG-rich area is found around the spark plug while the ethanol-rich area is located near the cylinder wall. With 30% ethanol addition to LPG, the indicative engine cycle work increases by 4.5% while the emissions of NO_x, CO, and HC decrease respectively by 13, 20, and 17% as compared to LPG fueling mode. When the ethanol content is higher than 30%, a special intake manifold design is needed for supporting the evaporation of the liquid fuel.

Keywords: Ethanol; LPG; Alternative fuels; Renewable energy; Port fuel injection.

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Sustainable Rice Supply Chain Management in The Mekong Delta of Vietnam: The Role of Regional Rice Logistics Centre

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The study aims at investigating and assessing the influences of the rice logistics centre on sustainable development of the rice supply chain in the Mekong Delta of Vietnam. In order to achieve these objectives, the current situation of rice logistics including the overall supply chains from production in the Mekong Delta to consumption is described. Potential rice logistics centre in the context the Mekong Delta will be compiled, and the importance of this measure is examined by conducting an expert interview survey based on the Multi-Criteria Assessment (MCA) method. According to the results, the initiative of establishing a rice logistics centre located close to the centralized rice production areas in the Mekong Delta is expected toward more inland waterway use, thereby reducing the number of ton-km for road. In addition to this, the intervention would improve remarkably the social-economic efficiency through reducing total logistics cost and emission cost for the rice industry of Vietnam.

Keywords: Rice supply chain management, impact assessment, multi-criteria assessment method.

Forecasting Logistics Demand on Strategic Transport Corridors Based on VISSUM - Case Study of Hanoi-Lao Cai Transport Corridor of Vietnam

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Logistics demand forecasting on strategic transport corridors is considered as the key step in regional logistics planning aiming at using logistics infrastructure effectively and environmentally. The objective of this study is to forecast logistics demand on Hanoi-Lao Cai strategic transport corridors of Vietnam. The VISSUM model was used to visualise freight movements through the network and logistics chain on this corridor, thereby setting solid ground for the study to propose different logistics centres located in Hanoi, Phu Tho, Yen Bai and Lao Cai. These logistics centers are expected to facilitate freight movement between Vietnam and China and promote economic development of the northwest region of Vietnam in the future.

Keywords: *Logistics demand forecasting, transport corridor, VISSUM.*

Travel Time Attractiveness in Motorcycle Dominated Cities: an Investigation of University Students' Travel Behavior

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Rapid motorisation with high motorcycle volume is a unique traffic situation in Asian developing countries. The travel behaviour in these countries is dominated by motorcycle-traffic-culture in which the convenience of this transport mode is exploited. With the ability to enter small alleys and to serve door-to-door mobility, motorcycles are excellent in accessibility and reducing travel time. As a result, the willingness to shift to bus and urban railway of transport users are limited. In a long term, local government might get difficulties in developing public transport to achieve sustainable transport system. This study aims to examine the travel mode choice of university students in a developing country where motorcycles have been dominating traffic systems. With the data collected from 396 students in five universities in Hanoi, Vietnam, a conditional logit regression model was developed to explore individual and alternative specific variables influencing the mode choice for studying trips. Key finding shows that travel time has significant impact on travel mode choice. Research results are beneficial for transport planners and transport authorities to develop appropriate transport planning and management strategies.

Keywords: Travel Time; Mode Choice; Student Travel Behaviour; Public Transport; Mode Shifting.

Environmental performance evaluation at urban roundabouts

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Transformation toward greener, healthier and safer management of urban mobility demand is needed soon. Smart tools are available to assess the impact of new infrastructural projects and road facilities also from an environmental point of view. In this pilot study pollutant emissions at a sample of urban roundabouts were estimated employing the Vehicle Specific Power methodology which needs second-by-second speed profiles both gathered in the field and simulated in AIMSUN. The versatility of the micro-simulation model for a calibration aimed at improving accuracy of the emissions estimates was tested in order to ensure that second-by-second trajectories experienced in the field properly reflected the simulated speed-time profiles. The results confirmed the feasibility of the smart approach that integrates the use of field-observed and simulated data to estimate emissions at urban roundabouts. It is also revealed friendly in collecting information via smartphone and in the subsequent data analysis, and provided new opportunities for a large-scale data collection through a digital community.

Keywords: Roundabout, VSP methodology, air emissions, AIMSUN.

Impacts of Last Mile Delivery on Environment in Urban Areas: Hanoi Case Study

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Last-mile delivery is increasingly becoming important for retailers in the era of rapidly growing e-commerce when consumers prefer shopping online rather than buy goods at retail stores. However, the last-mile comprises up to 28% of the total delivery cost and is currently regarded as one of the least efficient and most polluting processes in a supply chain. As a part of freight transport, it has been criticized for causing externalities in urban areas such as greenhouse effects, congestion, pollution, and others. Therefore, studies helping to improve the last mile delivery efficiency and reduce externalities are concerns and challenges for many researchers. In this paper, impacts of last-mile delivery on the environment in urban areas, based on the Hanoi metropolitan context, are presented. The paper includes 05 sections. After the general introduction part, the second part describes last-mile delivery's environmental issues. The third section introduces the research methodology to identify characteristics of last-mile delivery and investigate their impacts on the urban environment. Hanoi as a case study will be investigated in the fourth section, and then, conclusions and discussions are presented in the last one. The results reveal that last mile delivery service constitutes about 27% of all circulating vehicles it already contributes to around 13% of emissions.

Keywords: Last mile delivery, Freight Transport, Environment-friendly Transport, E-commerce.

Policy Measure to Promote Electric Mobility in Emerging Cities

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Electric mobility is the key objective for many emerging countries in the context of increasing climate change and environmental pollution. The main reasons for this push are efforts to reduce air and noise pollution thus creating a more attractive cities for residents and tourist whilst also reducing greenhouse gases (GHGs). Transport electrification is one of the popular trends and is a key pillar for achieving decarbonization. In emerging cities, less incentives are considered to examine how they influence consumers' behavior. This article aims at considering the effects of policy measures in terms of financial incentives. A binary regression model was used to evaluate consumer's decision. 700 individuals were invited to participate in the survey to reflect their different preferences and 633 samples were selected for further analysis. The results identified that perception of the government incentives like tax and fees incentives, loan incentives, and electric price reduction can significantly impact electric motorcycle adoption behavior. The results of surveys may serve as initial advance for transport authorities and electric vehicle manufactures in promoting electric mobility in motorcycle (MC) dominated emerging cities.

Keywords: Electric Vehicles, Behavior-based Policy Measures, Financial Incentives, Motorcycle Behavior, Air Pollution.

Assessment of Traffic Performance at Toll Plaza using Microsimulation – a Case in Vietnam

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Toll plaza is considered conventional toll collection, which is manual and the most common toll collection method in Vietnam. This study attempts to analyze the traffic performance of toll plaza by using the microsimulation software VISSIM. At the selected toll plaza, An Suong – An Lac toll plaza, Ho Chi Minh City, traffic data including traffic volume, traffic composition and service time are collected at toll booths for all types of payment. A suggested solution is conducted to enhance the level of service of the selected toll plaza. The output of this study indicates that the best solution for reducing queue length, vehicle day at toll plaza is to change the payment type from manual method to Electric Toll Collection (ETC) method.

Keywords: Toll plaza, Microsimulation, VISSIM, Traffic performance, Electronic toll collection.

Determinants of bus passengers' loyalty: a multinomial logit regression approach

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Increasing the ridership always receives much attention from public transit agencies. Beside of studies in which researchers focus on determining factors affecting the new customer attraction as well as encouraging customers to shift to public transport (PT) from many other travel modes, transit users' loyalty is considered an emerging approach in order to retain existing customers and attract potential ones. This study used the data conducted from 873 bus users in Viet Nam to identify the factors that affect customers' loyalty in the context of developing countries. A multinomial logit model (MLM) was developed to examine the association passengers' loyalty and affecting factors, including social-economic attributes, trip characteristics and psychological factors. Results revealed that perceived service quality (PSQ) and experience on bus (EXB) play a critical role in transit user loyalty. Other factors such as perceived image (IMA), perceived health benefits (PHB), perceived environmental value (PEV), perceived similarity (SIM) and perceived suitable behavior (SBE), married status and frequency of trips also have significant impacts on passengers' loyalty toward PT system. Whereas, trip purpose, travel time, income and gender have no effect on the user loyalty.

Keywords: User Loyalty; Multinomial Logit Model; Public Transport; Customer Retention; Bus User Behavior.

Impact of congestion charging on traffic and environment in Hanoi: Results from simulation analysis

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Congestion charging is one of the potential measures to control traffic congestion and reduce emissions in urban area, particularly in Hanoi, where both the population and traffic demand are increasing rapidly. This paper í to evaluate the impact of congestion charging on traffic and vehicle emissions in the city based on VISUM macroscopic traffic simulation software. Multiple testing scenarios were developed with assumptions in different sizes of charging zone and charging fee rates. The results showed that congestion charging in Hanoi could reduce the traffic volume in the main road by 10%-25%, potentially reduce CO_2 emission by 10%-27%. The size of the charging zone, charging method, and charging rate are key factors that directly influence congestion charging. This study is supported by Hanoi DOT and is considered as a reference to support the development of Hanoi's congestion charging policies and regulations in the future.

Keywords: Congestion charging; Traffic simulation; Vehicle emissions; CO_2 reduction.

Development of an Emission Inventory Model from Transport Surveys

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Greenhouse gas emission inventory is complicated process because it requires a wide range of input data. The majority of inventories are compiled using registered vehicle fleet statistics and emission factors and by their nature tend to be less accurate as registered vehicle fleet do not reflect normal transport activities. In this paper, a methodology for estimating emissions using transport activity data from transport surveys is described. This methodology is used to calculate emissions in terms of well-to-tank (WTT) and well-to-wheel (WTW) in Hanoi. Transport activity data, which are required on street-by-street basis, is obtained from video records in one week. Based on surveys, role of each transport mode on total transport GHG is considered. They, then support to develop strategies to decrease the ambient concentration of pollutants.

Keywords: Transport Emissions, Transport Activity Data, Emission Model.

Flexible Integrated Transport Systems' Potential to Unleash Net Benefits in Rural Areas

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This contribution presents a flexible integrated transport system which features the combination of anticipated peer-to-peer ridesharing and state-licensed on-demand services, complementing fixed-line scheduled transit. A sequential method of estimating the demand potential of such a collaborative service structure vs. its supply side is formalized and studied by simulating synthetic network models. The workflow is set to support planning, to prove the efficiency of integrated solutions, and to reduce uncertainties for market entrants.

Keywords: Flexible Integrated Transport System, Ridesharing, Mobility on Demand, Mobility as a Service, Demand-Responsive Transport, Demand Model.

Nuclear Power Plants, the Unique Merits of the Floating Option

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The biggest threat to the planet is global warming, rising seas, coastal erosion, caused by the burning of fossil fuels including “clean” natural gas. Neither wind or solar is sufficient to limit the 2°C rise necessary to prevent an irreversible catastrophe.
Nuclear energy is the only carbon-free energy that can keep the planet from overheating. The irrational fear of nuclear power is receding. Innovative safer nuclear technologies are emerging among them, are small modular reactors (SMRs).
The author, a mechanical and marine engineer, taps into decades of experience in the design and construction of shipyards and ships and offshore engineering to offer a concept of lagoon-enclosed floating nuclear power plants which addresses cost, security and environmental concerns relating to nuclear power.

Keywords: Floating, Nuclear, Lagoon.

Calculation of Fuel Baseline and CO2 Emission For Heavy Duty Vehicles in Viet Nam

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Nowadays, the demand for transporting passengers and goods is increasing so the number of trucks and passenger vehicles in Vietnam as well as other countries in the world is continuously increasing to meet such demand. The increase in the number of trucks and passenger vehicles has caused consequences related to environmental pollution, particularly (PM) and CO2 emissions. GFEI's partners agreed with the objective of reducing 35% (referred to as the "35/35 program") of heavy-duty vehicles (HDV) average fuel consumption across the world by 2035. The basis of such reduction is presented by the International Council on Clean Transportation (ICCT) based on a report published in 2016 which assessed the potential for improving fuel savings of HDVs in major markets. The reduction of HDV fuel consumption by 35% in the period of 2015-2035 can be considered as an ambitious target but it is achievable. The paper presents the results of the analysis of the current state of new HDV in Vietnam based on the Global Fuel Economy Initiative (GFEI) Index for the period 2010 to 2019. Results show that if cutting down fuel is currently maintained, by 2035, the CO2 emissions level of heavy-duty trucks and passenger vehicles will be reduced about 32% compared to that of 2015. The calculation results of GFEI and CO2 emissions can be used as a reference for the development of emission index for motorized vehicles and scientific basis for manufactures, assemblers and regulators to reduce fuel consumption and CO2 emissions.

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Keywords: GFEI; CO2 Emission; Electric Vehicles; Vietnam.

Sustainable Logistics System: Principles and Practices in Vietnam

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The overall goal of this study is to gain an in-depth understanding of the sustainable logistics system, especially in the context of Vietnam. For this investigation, policy implication for the sustainability of logistics sector in Vietnam will be formulated. To reach such a goal, the study conducted a comprehensive literature review on sustainable logistics system and its practical application in Vietnam. An attempt has been made to compare and assess different approaches of sustainable logistics system from theoretical to practical perspectives. Based on that, proposed measures that should be pursued for a sustainable development of logistics sector of Vietnam will be discussed in detail. The research described in the paper is expected as the first step to a decision support system for enhancing the sustainable economic development focusing on logistics sector in Vietnam.

Keywords: *logistics, sustainable logistics, green logistics, sustainable development*.

Sustainable Construction Materials and Technologies

Residual Life Assessment (RLA) of cranes and steel structures: Problems and Strategy

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The paper starts with the problem of evaluating residual life of structures and equipment that may have reached or exceeded the end of their design life. In spite that the problem is encountered in many industrial sectors, references available for dealing with it are often limited. The paper presents a general methodology for the assessment and management of residual life of existing equipment and structures that has been developed by CETIM (Technical Institute for Mechanical Industry) and concludes with an example of its application to loading bridges of Calais harbour. The paper also deals with the potential environment thinking in this process, e.g., the advantages of Residual Life Assessment resulting in an extension of the service life that may at final allow to save energy and material versus building a new structure and demolishing the old one.

Keywords: Design life, fatigue life, residual life, evaluation, steel structures, cranes.

Effect of Moist Curing Time on Shrinkage Resistance of Self-Compacting Concrete containing Fly ash

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This paper describes an experimental investigation of the effect of the moist curing time on the degree of shrinkage resistance of self-compacting concrete (SCC). The evaluation for the degree of shrinkage resistance of SCC was based on the restrained ring test (ASTM C1581). Five SCC mixtures with designed compressive strength of 60 MPa were cast with the targeted values of slump flow, T_{500}, and the V-funnel T_V from 650 to 800 mm, 2 to 5 s, and 6 to 12 s, respectively. In these mixtures, fly ash (FA) was used to replace cement with the content of 15%, 25%, 35%, and 50% by weight to evaluate shrinkage resistance under the moist curing condition at 1, 3, and 7 days. The obtained results showed that the moist curing condition and fly ash play a significant effect on improving the shrinkage resistance of SCC mixes. The result further suggested that the use of FA from 25% to 35% replacement of ordinary Portland cement (OPC) and the moist curing for at least 3 days provided a high degree of shrinkage resistance and suitable workability for SCC.

Keywords: Self-compacting concrete, Fly ash, Shrinkage resistance, Moist curing.

Mechanical, acoustic and thermal performances of Australian hempcretes

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This paper is investigating the performance of Australian hemp in hempcrete including unretted and retted hurd and fines for wall and render applications, respectively. The mechanical, thermal and acoustic characteristics of hempcrete are assessed including the effect of retting process. Although the retting process caused about 12% decrease in shiv bulk density, which was attributed to the degradation of hemp and a lower solid volume fraction, hempcrete bulk density, mechanical characteristics, thermal conductivity and acoustic performance are not significantly influenced by the retting process. The thermal conductivity appears to be proportional to the bulk density which is proportional to the hemp content of hempcrete. Acoustic performance of wall mix specimens was outstanding with a maximum sound absorption coefficient around 0.90 for a frequency around 700 Hz. However, the acoustic performance of render mix specimens was extremely poor compared to that of wall mix specimens with a sound absorption coefficient less or equal to 0.13. The combined effects of fine particle size and high binder content is responsible for this drastic drop in sound absorption coefficient. Acoustic performance was much more impacted

than thermal conductivity by the hemp fine particle size and high binder content of the render mix.

Keywords: Hemp concrete, Bio-aggregates, Thermal performance, Acoustic performance, Mechanical characteristics.

Semi-circular bending (SCB) test – modified method and new test parameters

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For several years the crack propagation test data of bituminous mixtures according to CSN EN 12697-44 have been collected and evaluated at CTU in Prague. Over time the standardized test procedure was adapted to the conditions more suitable to be used in the Czech Republic - in terms of test specimen compaction, availability of cutting discs of suitable thickness, diameter of test specimens, loading speed etc. Some of the other conditions of the test were adapted as well as the procedures of data logging and subsequent evaluation of raw data. Over the years it has been identified that the strict focus only on fracture toughness is probably not correct or at least not sufficiently effective. The characteristics of fracture energy have been introduced and further studied. This paper compares the fracture toughness and fracture energy characteristics of selected sets of various types of asphalt mixtures.

Keywords: Asphalt mixtures; semi-circular bending test; SCB test; low temperature properties, fracture toughness, fracture energy, flexibility index.

Abrasive and compressive properties of concrete containing different contents of fine artificial sand

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Using artificial sand to replace natural sand in making concrete is a useful solution for minimizing environmental impact in Southern Vietnam. This investigation focuses the dependence of abrasive and compressive properties of concretes, which is applied for road pavement, upon different contents of fine artificial sand. The contents of fine artificial sand were changed as follows: 0% (Type 1), 5% (Type 2), 10% (Type 3), 15% (Type 4) and 20% total of artificial sand (Type 5). The total of coarse artificial sand (size ≥ 0.14 mm) and fine artificial sand (size < 0.14 mm) in the concrete composition was fixed in weight. The experimental result provides that: Type 3 generated the highest compressive strength and elastic modulus whereas Type 2 produced the lowest abrasion coefficient, i.e., the best performance in abrasive resistance.

Keywords: Artificial Sand, Crushed Stone, Abrasion, Elastic Modulus, Compressive Strength.

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Mechanism analysis and improvement of bacterial bio-mineralization for self-healing concrete using Bacillus subtilis natto immobilized in lightweight aggregate

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Despite many technical improvements, concrete still faces quality degradation problems caused by cracks. Many approaches have been studied more extensively, meeting the criteria and realizing that management should be better than preventing the cracks in concrete. With the ability to be easily cultured and form $CaCO_3$, the potential to use *Bacillus subtilis* natto in full-scale application is promising. Although alkali-tolerant bacteria have been widely studied to maintain enough vegetative cells until the crack formation, their survival is minimal, even when the bacteria were transformed into spores before mixing to concrete. Current works still lack a better understanding of the grave of the factors affecting the fundamental reactions involved, particularly bacterial growth and its bio-mineralization in harsh conditions as concrete. This study clarifies the bio-mineralization of *Bacillus subtilis* natto with the effects of nutrient-low medium to find a suitable way to protect and maintain the self-healing abilities for a long time. The high survival rate of bacteria immobilized in lightweight aggregate

contributes essential information for maintaining self-healing for a long time.

Keywords: Self-healing Concrete, Bacteria, Biomineralization.

Variation in Temperature-Induced Displacement Curvature of Prestressed Concrete Girders Deteriorated by Alkali-Silica Reaction

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For a correct evaluation of structural damage properties, it is vital to recognize structural responses induced by structural damage from alterations due to environmental changes. This study examined the relationship between the ambient temperature variations and the changes in the curvature of displacement curves of full-scale girders, which were periodically experimented on in six months. The alkali-silica reaction (ASR) also deteriorated the girders during the monitoring period. As an outcome, the environmental temperature markedly altered the variations in the displacement curvature of the experimental girders. All curvature values inferred from measured data had positive relations with the environmental temperature. In addition, the regression model explained that the ambient temperature was not the only factor influencing the change in the displacement curvature. Besides, the linear regression line of the ASR-deteriorated girder had a lightly more significant inclination than that of the intact one in all measurements.

Keywords: Fly Ash, PC Girder, Displacement Curvature, Temperature Effect.

Effects of initial conditions on simulations of hygrothermal transfers through a bio-based multi-layered wall subjected to a real climate

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This modeling study investigates the effects of the initial conditions on a bio-based multi-layered wall by hygrothermal simulations. Such a study cannot be found in the relevant literature. In a first step, the work consists in numerically generating different climate histories for the studied wall, using two different real climates: a winter and a spring climate. Then, the wall preloaded with these two different climate histories and therefore different hygric and thermal initial conditions is subjected to several cycle of 18 days of the spring climate. This study highlights the significant effects of the initial conditions on the subsequent simulations: strong differences are predicted about relative humidity and water content. Many cycles of 18 days of the spring climate have to be applied to obtain a hygric convergence of the two simulations, *i.e.*, to erase the wall hygric history. The analytic analysis of the results leads to define characteristic times of hygric dependency of about 35-40 days. It appears that the hygric predictions of the simulations become independent of the initial conditions after about three times these characteristic times, *i.e.*, about 3.5 months. Comparatively, the thermal history takes only a few days to be erased.

Keywords: Bio-based building materials, Hygric history, Modeling.

Influence of calcined clays on workability of low carbon composite cements

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This work highlights that the CO2 footprint of cement can be reduced significantly by blending Portland cement clinker with thermally activated (calcined) clay (CC). Investigations on pure meta phases obtained via calcination of native kaolin, montmorillonite, illite and muscovite reveal that they noticeably increase the water demand and decrease workability of the cement. The effect depends on the fineness and internal porosity of the calcined clay and the chemical composition of the native clay. A comparison of three industrial calcined samples of mixed layer clays originating from natural deposits in Germany, India and China confirmed the increased water demand of composite cements holding up to 40 wt. % of these calcined clays. The increase in water demand correlates with the amorphous part and the meta kaolin content. Also, the particle size and morphology of the calcined clay impact water demand. For one sample holding ~ 50 % meta kaolin, an increase in superplasticizer dosage of ~ 400 % as compared to neat OPC was recorded. Whereas, a high content of meta kaolin proved to be favorable with respect to rapid early strength development as a result of its high pozzolanic reactivity. It can be concluded that calcined clays offer the potential of significant CO2 reduction in cement manufacture, however higher superplasticizer dosages need to be used. Still, because of the low CO2 footprint of superplasticizers a substantial savings in CO2 emission can be realized, and the cement industry can progress into an era of more eco-friendly binders.

Keywords: Cement, CO2 footprint, Clay minerals, Calcined clay, Admixtures, Superplasticizers, Workability.

Experimental investigation of high-strength lightweight concrete using fly ash cenospheres

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Hollow microspheres (cenospheres) from fly ash possess a hollow spherical shape, watertight, with a particle density less than water (< 1 g/cm3). In this study, cenospheres were used as a partial and full replacement of sand as a lightweight aggregate for making high-strength lightweight concrete (HSLWC). Besides, some mechanical properties of the HSLWC including density, compressive strength, flexural strength, water absorption were investigated taken into account the effects of different sand/cenospheres ratios. The experimental results showed that with the density in the range of 1312-1782 kg/m3, the HSLWC attained excellent mechanical properties, i.e. specific strength (ratio of compressive strength to density) of 36-40.8 kPa/kgm-3, compressive strength of 54.3-64.1 MPa, flexural strength of 7.6-9.2 MPa at the age of 28 days.

Keywords: cenospheres, fly ash, high-strength lightweight concrete, mechanical properties, density.

Value-Add Application of Plastic Waste in Porous Asphalt Mixture

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Plastic waste has the highest un-recycled proportion among the solid wastes in Singapore. Given Singapore's densely populated living environment and small land area with limited natural resources, sustainable development is critical to the nation's progress. Utilisation of plastic waste in road pavement construction may become an alternative solution to reduce the amount of plastic waste in the landfill. This study evaluates the utilisation of waste plastic as additive materials in porous asphalt mixture (PAM). PAM is a type of asphalt mixture that possesses high voids content, usually above 18%, hence surface runoff can permeate through the pavement surface. Due to the high voids content, PAM is generally weaker than dense-graded asphalt mixtures. Herein, polypropylene (PP) plastic was added into the mixtures to improve the performance of PAM. Jurong sedimentary rock (JSR) was utilised as aggregates in this study as these materials are abundant in Singapore. PAM containing JSR with three different proportions of PP plastic that are 0%, 5%, and 10%, was fabricated. Meanwhile, PAM containing granite and 0% PP plastic was also produced as a reference mixture. A series of laboratory measurements, including Marshall, moisture susceptibility, resilient modulus, and creep tests, were conducted to assess the properties of PAM. The results indicated that adding PP plastic into the mixtures improves the mechanical properties of PAM, such as higher values of stability and moisture susceptibility, resilient modulus and resistance to deformation. Herein, waste plastic has

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promising feasibility to be utilised as additive materials in porous asphalt mixtures.

Keywords: Waste Plastic, Plastic Polypropylene, Porous Asphalt Mixture, Laboratory Evaluation Tests.

Valorization of local clay by heat treatment for its use in road construction

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The heat treatment of clays constitutes a potential solution for environmental problems and can, possibly, contribute to improving the bearing capacity of road layers. Indeed, heat- treatment modifies the mechanical behavior of fine soils and makes their use very possible in the field of road infrastructure.
In the present work, we propose to investigate the possibility of adding heat treated clay to granular pavement materials (crushed gravel) and to study its influence on the evolution of the bearing capacity of the obtained mixture. The local clay is prepared by heat treatment at two levels of firing, mainly 850 °C and 1150 °C, then added to crushed gravel (0/31,5 mm) as a binder. Several mixtures are prepared at different dosages of treated clay and crushed gravel then subjected to Proctor and CBR (California Bearing ration) tests. The XRD analysis reveals that the firing beyond 850°C induces transformations in the microstructure of the clay. As a result, it was found that the addition of treated clay to crushed gravel at a percentage of 3% to 5% significantly improves the bearing capacity of the mixture compared to untreated granular material. It can be concluded that the addition of treated clay to the crushed gravel considerably improves its bearing capacity by approaching the mechanical performance of cement treatment. It can also be noted that the proposed solution fits very well the sustainable development.

Keywords: Heat Treatment, Clay, Gravel material, Road pavement, CBR.

Influence of rejuvenator on selected characteristics of an asphalt concrete containing 50 % reclaimed asphalt

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The use of reclaimed asphalt has become a common practice and necessity in many developed countries whereas there are several options how to deal with elevated content of such material which is typical for some level of degradation and heterogeneity. Well-developed and widely used are solutions where reclaimed asphalt is cold fed by up to 20 %. Higher portions of reclaimed asphalt are still challenging and need additional focus. Quite common in last few years is use of rejuvenators which are understood as special chemical compounds which help to partly restore the degraded bitumen and secure sufficient performance behavior of asphalt mix containing higher portions of reclaimed asphalt. Recent study focused on use of several market established rejuvenators and some newly developed variants which are predominantly based on renewable materials. A typical asphalt concrete AC16 has been selected and 50 % natural aggregate was replaced by reclaimed asphalt of 0/8 mm grading. Rejuvenators were added in a content of 5-7 % of the bitumen content presented in the reclaimed asphalt. Several tests have been performed focusing on water susceptibility, deformation behavior (stiffness) and resistance to crack propagation. At the same time bitumen extracted from the reclaimed asphalt was mixed with rejuvenator and selected bitumen tests were done to find some relation between binder and asphalt mix behavior.

Keywords: asphalt mixtures, reclaimed asphalt, rejuvenator, recycling.

Influence of constitutive model on the mechanical behavior of a piled embankment

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A piled embankment is a complex system, consisting of the stratum, the soft soil, the rigid pile, and the load transfer platform. Its behavior is also complex, especially, the arching effect within the load transfer platform and the settlements and the negative skin friction around the pile shaft. The selection of constitutive models for soil is one of the important criteria, it decides the accuracy of the results. In the paper, the influence of constitutive models of embankment on the behavior system is investigated. Two models are considered including the Mohr-Coulomb (MC) model and the CYsoil model. The modified Cam clay model is used for the soft soil. The numerical results will compare and evaluate the effectiveness of the two models in simulating the mechanical behavior of a piled embankment in terms of the soil arching effect, the embankment and soft soil settlements and the axial pile force. The numerical results figure out that there is a similarity between the MC and CYsoil numerical results in terms of the arching shape and the stress transmitted down the pile head and the soft soil. The settlement of embankment of MC model is significantly smaller than that of CYsoil model, it is only to two-thirds of that of CYsoil model.

Keywords: constitutive model, piled embankment, mechanical behavior, load transfer platform.

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Some initial results of the research on using recycled polyethylene to modify bitumen

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Asphalt concrete (AC) has long been a popular material used as a pavement texture, however, there are still limitations in the exploitation process. Bitumen has an important role, it has a great influence on the properties of AC, improving bitumen quality is a trend in improving AC quality. Besides some currently used such as rubber additives, sulfur additives, polymer additives, finding new types of additives with easy, cost effective supply, taking advantage of recyclable material is always a matter of necessity. This paper presents some initial results of the research on using recycled polyethylene (RPE) to improve bitumen. This study introduces the mechanism of interaction between polyethylene (PE) and bitumen and conducts experimental studies to evaluate the influence of PE/RPE on the properties of bitumen. PE/RPE with different contents is added to 60/70 bitumen to analyze the parameters of bitumen such as penetration, softening point, ductility, elastic recovery, adhesion to stone, viscosity, storage stability. The results of the study to initially assess the influence of PE/RPE additives on the specifications of the bitumen, it is a premise for other studies in using PE/RPE to create PE improved bitumen (PEMB), RPE modified bitumen (RPEMB), creates new AC with better quality.

Keywords: additives, modified bitumen, polymer modified bitumen, polyethylene, recycle polyethylene.

Impact of surfactant type on performances of gypsum foams

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The production of lightweight materials for the building industry contributes to the sustainable development. To produce such materials, foaming is a process commonly used to trap air bubbles and achieve a range of low densities. A sufficiently low thermal conductivity and an acceptable ability to regulate humidity variations in order to limit overall energy consumption are the sought properties. In this study, a direct foaming method is applied to formulate gypsum foams using a commercial Plaster and biobased foaming agents: an egg white protein (albumin) and a commercial protein. An anionic surfactant α- olefin sulphonate sodium salt is used as a reference surfactant. By varying the mixing time, protein content and water content, gypsum foams were produced with different densities varying from 300 to 750 kg/m^3. The foam volume is measured continuously during the mixing step and the foam homogeneity is controlled. The densities of fresh foams and of the hardened foams are used to identify the links between formulation and foams properties. Use performances as thermal conductivity, Moisture Buffer Value measurements and mechanical performances are performed on a selection of gypsum foams. The results appear directly linked to the porosity and pore connection of the foams. The obtained results highlight the contribution of surfactant type to the performances of gypsum foams.

Keywords: Gypsum foams, Mechanical properties, Hygrothermal performance.

Research on the effects of aging asphalt binder 60/70 on Marshall properties of Hot-mix asphalt C12.5 Vietnam

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Aging of asphalt binder (AB), with chemical and physical processes occurring, changes the chemical composition and technical properties of the AB. Change in bitumen characteristics of the AB due to aging have a direct impact to the properties of Hot-mix asphalt (HMA). This study presents experimental properties results of AB and HMA caused by the aging of AB. Research's results show that aging changed the chemical composition of AB, increased viscosity, improved rheological properties of AB, increases Marshall stability, reduces Marshall flow, increased wheel rutting resistance. However, aging of AB maybe reduces the cracking resistance of HMA.

Keywords: Hot mix asphalt, bitumen, aging, Short Term Oven Aging, Marshall stability, Marshall flow.

Experimental study using nanosilica to improve the properties of Asphalt binder and Hot-mix asphalt

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The study evaluated the influence of the content nanosilica (NS) 3%, 5%, 7% and 9% by weight of bitumen on the basic properties of asphalt binder and asphalt concrete. Test results show that the softening temperature of the asphalt binder increases with the NS content up to 65.5^{o}C; Brookfileld viscosity increased from 322 mPa.s up to 765 mPa.s. The results also showed improvements in the technical properties of the Hot Mix Asphalt (HMA) using NS, such as air void, Marshall stability and wheel tracking rutting resistance. The results of the study initially indicated the selection of NS content for HMA in Vietnam.

Keywords: Nanosilica, bitumen, asphalt binder, hot-mix asphalt, Marshall stability, wheel tracking rutting.

Warm mix asphalt with reclaimed asphalt pavement – A solution for sustainable infrastructure development

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While almost all asphalt paving contractors in Vietnam are using virgin, non-renewable materials (i.e., aggregates and bitumen) to produce conventional hot mix asphalt (HMA), most contractors in the United States, Europe and Japan are producing warm mix asphalt (WMA) with reclaimed asphalt pavement (RAP). WMA can be produced and paved at lower temperatures, reducing energy consumption and emissions released during production and paving of asphalt mixtures. Use of RAP can reduce the demand for non-renewable resources. When RAP is used in WMA, their environmental benefits can be combined, making the produced mixture more sustainable. This study presents a life-cycle assessment (LCA) to compare the environmental benefits of WMA with RAP to those of the conventional HMA currently produced by most of the asphalt producers in Vietnam. The WMA mixtures with 20–50% RAP were designed to have performance similar to the conventional HMA in the LCA. Based on this LCA analysis, it was determined that WMA with the addition of from 20–50% RAP provides a reduction of 16.6–27.0% global warming (CO_2-eq) and 17.8–28.7% energy consumption impact of HMA when it is designed to have the same performance as the conventional HMA.

Keywords: Hot mix asphalt, Warm mix asphalt with RAP, Reclaimed Asphalt Pavement, Greenhouse gas emissions, Energy consumption, LCA.

Valorization of treated dredged sediments in light of life cycle assessment

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Nowadays, most researches focus on using alternative materials with growing demand for natural resources and especially in the civil engineering area. One of the alternative materials we can cite the dredged sediments, which are considered as waste according to the European wastes classification directive. In France, the dredging industry generates around 50 million m3 of marine sediments each year. Thus, it becomes an attractive topic to assess its relevance as an alternative material in the civil engineering field. The question, which could be raised is what advantages it can provide as a practical solution in reducing environmental impacts on humans and the environment. So the aim of this study is to assess the valorization life cycle system in order to quantify the environmental impacts, energy usage, and natural resource consumption, and to indicate which material or process contributes to high impacts in order to reduce the valorization system damages improving its efficiency. This paper will summarize the valorization life cycle stages, which will provide an overview for future work and assessment.

Keywords: life cycle assessment, dredged sediments, valorization strategy, environmental evaluation, waste, alternative material.

Developing Statistical Models to Predict Temperature Distribution in Asphalt Concrete in Danang City

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Asphalt concrete (AC) is a commonly used material in road construction; however, its quality is highly dependent on atmosphere temperature. Temperatures can adversely affect AC performance and its service life. This paper presents an empirical model to predict the heat distribution in AC in Danang. A temperature monitoring station has been set up at the University of Danang - University of Science and Technology to monitor heat distribution in the pavement. The monitored AC layer with a thickness of 13 cm was constructed on a 15-cm cement-treated base. Thermocouple sensors were then installed in AC at different depths of 2 cm, 5 cm, 7 cm, 10 cm, and 12 cm from the pavement surface. The temperature was monitored continuously for five days in September, 2020. Climate data, including air temperature and solar radiation intensity, was collected from the Vietnamese National Centre for Hydro-meteorological Forecasting. Statistical models delivered from the collected data to predict the temperature distribution in AC were developed. They were finally compared with previous studies and suited to predict the temperature distribution in AC in Danang city.

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Keywords: Temperature Distribution, Statistical Model, Asphalt Concrete Pavement, Climate Data.

Use of acoustic emission monitoring to follow durability of flax and carbon fibre reinforced polymers under hygrothermal ageing

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Hand lay-up Fibre Reinforced Polymers (FRP), made of either carbon or flax textiles, were considered in this study and were subjected to water immersion at 40°C over 24 weeks. Tensile tests were carried out periodically to assess the mechanical properties of the composites and Acoustic Emission (AE) monitoring was simultaneously realized to characterize the different microstructural damage mechanisms during loading. Maximum force per unit width, stiffness and ultimate strain were determined based on tensile testing data whereas frequency features and number of events were extracted and cumulated from AE signals. The obtained results showed that the mechanical properties of composites were significantly reduced meanwhile a modification of failure mode over 24 weeks was observed. Moreover AE signals analysis allowed a quantification of the level of damage. It also provided a discrimination of the different damage mechanisms and clarified how each mechanism contributed to failure.

Keywords: Hygrothermal ageing, Durability, Carbon fiber reinforced polymer, CFRP, Flax fiber reinforced polymer, FFRP, Acoustic Emission, Tensile behavior, Damage clustering.

Highly environmental-efficient modular houses considering construction and deconstruction aspects

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This paper presents a new concept of modular houses which fulfils the actual requirements of modern construction as optimal insulation, acoustic performance, environmental aspects and modern architecture. A recent literature review [1], shows that modular buildings refer not to a single structure type, but a variety of structural systems or components (1D, 2D, and full volumetric or 3D) and materials (mainly, wood, steel and concrete). In our approach of modular constructions, Prefabricated Finished Volumetric Concrete Construction (PFVCC) was preferred. Then modular houses based on this concept were studied and recently prototypes built. This allows to characterize their mechanical efficiency, to monitor their energy saving, and to qualify all the construction process, including their future deconstruction and reconstruction.

Keywords: Modular buildings, Steel Fiber concrete, Numerical Simulation.

Evaluation of alternative fillers usable for asphalt mixtures

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In this research study, selected fillers originating as stone dust or as back fillers have been used as potential substitutes to normally used limestone filler. They have been analyzed by XRF spectroscopy, density or quality of fine particles. These parameters might influence the effect of used fillers on asphalt mortar properties and mix performance. Two types of aggregates have been selected and alternative fillers have been added to asphalt mix of AC8 type according to modified procedure described by the standard EN 1744-4. For each asphalt mix containing alternative filler stiffness, Marshall stability and resistance to water immersion were determined to indicate the potentials of such substitution to asphalt mix durability and resistance to permanent deformation. From the results it is obvious that the chemical composition might have influence on the asphalt mix stiffness and the resistance to water immersion, similarly the physical properties of fillers will influence the asphalt mortar quality which is crucial for asphalt mix resistance to permanent deformation and moisture susceptibility.

Keywords: Quarry Dust, Backhouse Filler, Asphalt Mix, Water Susceptibility, Stiffness, Loss of Marshall Stability, XRF.

Stress research in hollow core flat slab and applications

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Hollow core flat slab is currently a superior solution compared to traditional reinforced concrete slab in today's construction to help save materials, reduce construction time, thereby saving construction costs significantly while providing a variety of functionality. It brings cool and airy spaces while saving energy in line with the trend of green construction and sustainable energy development in Vietnam and in the world as well. This paper aims to examine the methods of structural calculation and stress analysis of hollow core flat slab through actual cases and then, compare the results of the calculation methods with the measured ones at the actual projects using hollow core flat slab. The finite element method of 3D modeling in commercial Etabs and Ansys software was used to simulate the stresses of the hollow core slab and the column mushroom area. A few simple formulas to calculate the equivalent exchange of flexural stiffness and slab weight were used in analytical methods. The results show that if using Etabs software in the design, the stress and deflection calculated by the wall method are the closest to reality while the slab method gives the biggest error. The achieved results and analytical data of this study can be used as a reference for engineers.

Keywords: Flat slab, Stresses, finite element method, model error.

Effect of tack coat application rate and temperature on interlayer cohesion and friction of double-layer asphalt samples

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Lack of tack coat application will not ensure the bonding and continuity of the asphalt pavement layers. However, excess of its application can reduce the friction at the interlayer causing slipping. On the other hand, bituminous tack coat material is very sensitive to temperature changes. The fluctuations in temperature can change the interface adhesion ability. Therefore, it can be said that the interface shear resistance characteristics including interlayer cohesion and friction depended much on the temperature on the tack coat application rate. The paper presents the experimental results on the influence of temperature (25, 40, 600C) and rate of tack coat CRS-1 (0, 0.2, 0.5, 0.8 l/m2) on the interlayer cohesion and friction between asphalt layers. The results show that the maximum shear resistance is obtained at the rate of 0.2 (l/m2), and the lowest is for the case of 0.8 (l/m2). Besides, the temperature increases, the interlayer cohesion dramatically decreases while increasing the friction coefficient (except for the case of 0.8 (l/m2).

Keywords: Tack coat rate, Temperature, Interlayer, Cohesion, Friction, Shear, Asphalt.

Influence of matrix strength on the pullout behavior of high strength steel fibers

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This study investigates the effects of matrix strength on the pullout behavior of steel fibers by performing single pullout test. Two types of high strength steel fibers, smooth and twisted fiber, were embedded in three different concrete matrices with compressive strengths of 28 MPa (normal concrete), 84 MPa (high-strength concrete), and 180 MPa (ultra-high-strength concrete). The results showed that twisted fibers embedded in both normal concrete and high-strength concrete produced slip hardening behavior while smooth fiber in all concrete matrices generated slip softening behavior. As the matrix strength increased, the pullout resistance of fibers increased if they could maintain pullout mode. However, the pullout resistance of twisted fiber in ultra-high-strength concrete deteriorated immediately after the fiber was broken. Twisted fibers produced higher pullout resistance in normal and high-strength concrete but lower pullout resistance in ultra-high-strength concrete than smooth fibers. Twisted fiber showed the best performance in high-strength concrete whereas smooth fiber did in ultra-high-strength concrete.

Keywords: Pullout behavior, Steel fiber, Ultra-high-strength concrete, Pullout mode, Breakage mode.

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Effect of surface moisture content on the durability of silane-type surface penetration layers during the material application

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The application of silane-type surface penetrants immediately after concrete demolding shortens the construction period to enhance the efficiency of the process. However, a high water content is expected immediately after concrete casting, and the durability is low in the penetrating layer. In this study, specimens are prepared to evaluate the surface water content during the application of silane-type surface penetrants. Then, water absorption and saltwater immersion tests are conducted after the sample are irradiated using a xenon lamp. The ability of specimens with high water content to prevent the invasion of deterioration factors is shown to reduce significantly after the irradiation. Hence, it was the surface moisture content during application can affect the durability of silane-type surface penetration layers.

Keywords: Silane-type surface penetrants, xenon irradiation, surface water content, water absorption, saltwater immersion.

Investigation of hydraulic conductivity of soilcrete specimens made from dredging sand and cement

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The Soil Cement Mixing technology (SCM) has been widely applied for several applications such as soft ground improvement for highway embankments and earth levee embankments, seepage cutoff walls, and so on. The hydraulic conductivity of soilcrete made from clays was primarily studied. The hydraulic conductivity of soilcrete created from sand has limit research data, especially in Vietnam. This study aims at better understanding of the permeability behavior of dredging sand taken in Mekong delta mixing with some cement types at various cement contents of 200, 250, 300, 350 and 400 kg/m3, respectively. Three cement types of the ordinary Portland cement (OPC), Portland cement blended (PCB) and Portland cement slag (PCS) were utilized. All permeability tests followed the ASTM D5084 standard. The results indicate that the hydraulic conductivity of sand soilcrete (ks) was lower 1000 times than that of the compacted sand sample. The ks reduced with increasing in cement contents and in curing time. ks of soilcrete made from the PCS cement was lower than those made from the OPC and PCB cement. The ks varied from 8.07×10-8 m/s to 2.3×10-11 m/s.

Keywords: Hydraulic conductivity, permeability, soilcrete, dredging sand.

Formation of clinker containing copper

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Copper is one of many elements present in secondary raw materials. These coppers containing secondary raw materials can be utilized in the production of ordinary Portland cement (OPC). At laboratory conditions, copper significantly influences the formation of clinker melt and the main clinker phase – alite. For the scope of this research, differential thermal analysis (DTA), powder X-ray diffraction analysis (XRD), optical microscopy (OM), and scanning electron microscopy with electron dispersive spectroscopy (SEM-EDS) methods were used for the investigation of the influence of copper on clinker. It has been confirmed that addition of copper-containing compounds to a raw meal has a significant intensification effect on the clinker melt formation. On the other hand, a decrease in the total alite content in the clinker with increasing CuO content has been observed. Observations were conducted on clinkers with CuO content up to 4 wt. %. The addition of CuO also reduced burning temperatures of alitic clinker from standard industrial burning temperature of 1450 °C to 1250 °C. The decrease of 200 °C in burning temperature has applications for clinker production and reduction of emissions.

Keywords: Copper, Clinker Formation, Phase Composition, Alite.

Establishing the indicators of sustainable building materials

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Sustainable building materials are products with a relatively positive impact on economies, communities and the environment. Understanding the key indicators in developing sustainable building materials, which affect the economic, social and environmental aspects of buildings, is a critical perspective to aid their evolution. Research in sustainable building materials is relatively new, and therefore this study examined the existing literature on sustainable building materials in academic journals with the intent of identifying and clustering key indicators and proposing a conceptual framework for the development of sustainable building materials. This study employed a verifiable and reproducible systematic literature review of building materials, analyzing and scrutinizing 203 academic articles for the co-occurrence of keywords, using a mixed bibliographic and bibliometric method. It emerged from the study that the groups themed "Process", "Material", "Element" and "Technology" contained the greatest number of, and most statistically significant, indicators associated with sustainable building material. It was found that, in developing and evaluating sustainable building materials, sustainability, LCA (Life Cycle Assessment), embodied energy and recycling appear to be the predominant processes used; concrete, bricks, C&D (Construction and Demolition) waste, and fibre are the foremost materials; walls and roofs are the main building components; and composite, 3D printing, nanotechnology and prefabrication are the leading technology features. Also, the results of the analysis of interconnections between indicators revealed that a significant interconnection exists between embodied energy, LCA, concrete, composite and durability to the sustainability of building materials. Based on the taxonomy of indicators and the analysis of their

interconnections, a conceptual framework for developing sustainable building materials was proposed in the paper.

Keywords: Bibliometric analysis, Building element, Building material, Sustainable building materials, Technology.

Stabilize the diaphragm wall by the method of anchoring in the ground in the I-tower project in Quy Nhon city, Binh Dinh province

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The I-Tower commercial building high-level tower is constructed in condition: narrow construction ground and unfavorable but not affecting the traffic of the surrounding streets...Besides, the element with two long, narrow, and deep basements has greatly influenced the optimal construction method and safety. Internal and external risk factors exist, which has set a difficult problem for the foundation design engineer to require savings but absolutely safe and especially not to cause subsidence and damage to adjacent high-rise buildings. This paper presents how to analyze the method of diaphragm wall anchoring in the soil as well as its effectiveness for The I-Tower commercial tower in Quy Nhon City, Binh Dinh Province.

Keywords: Diaphragm wall, anchor in the ground, construction of deep excavation holes, Lower the water table.

Low energy cements prepared from modified SO_3 doped clinkers

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Clinkers doped with optimized combinations of SO_3 and Li_2O or CuO or MgO were synthetized in laboratory furnace at 1350 °C. Clinkers were characterized by light and scanning electron microscopy. Chemical and phase composition of clinkers is discussed with respect to early hydration properties of cements. Hydration of cement pastes was monitored by isothermal calorimetry and reaction kinetics corelated with early strengths. Flexural and compressive strengths of cements were determined after 2, 7, 28, 90 and 365 days of hydration according to EN 196 on mortars. At high CuO contents, Cu-rich phases form inclusions in C_2S. The limited incorporation of MgO into the structure of clinker phases is represented in the form of inclusions in C_3S. Due to formation of $Cu(OH)_2$, hydration slows down significantly, while Li salts accelerate early hydration. For the studied modified SO_3 doped cements, there is a good correlation between heat development during the first 2 days and strength development during 1 year. Proposed four low-energy cements based on SO_3 doped clinkers burned at 100 °C lower temperature meet the requirement for CEM I strengths.

Keywords: Doped clinker, SO_3 activation, Li_2O, CuO, MgO, Microstructure, Hydration heat, Strengths.

Numerical modeling of tensile behaviour of textile-reinforced concrete composite using a cracking model for cementitious matrix: effect of material parameters

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Over the past recent decades, textile-reinforced concrete composite (TRC) has been increasingly and widely applied in the civil engineering field. This paper presents obtained results of numerical modeling for TRC composite using the cracking behaviour model for the cementitious matrix used for TRC. As the results, the TRC composite presented a strain–hardening behaviour with the cracking phase characterizing by the drops in tensile stress on the stress-strain curve. This model also showed the failure mode by the multi-cracking on the surface of TRC specimen. Furthermore, the parametric studies could show the effect of several material parameters on the TRC tensile behaviour such as the reinforcement ratio, the configuration of textile mesh as well as the length and position of the measurement zone. In comparison with experimental results, a good agreement between both numerical and experimental results was found for all cases of this study.

Keywords: Textile reinforced concrete, Numerical modeling, Cracking model, Parametric study, Stress-strain curve.

Preliminary Field and Laboratory Investigation on the Use of Non-Contact Digital Ski Sensor in the South Korea Expressway Network

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In this paper, the effect of using next-generation equipment for pavement smoothness leveling, known as Non-Contact Digital Ski (NCDS), on the smoothness of asphalt pavements and its impact on the low temperature behavior of the paved mixture is evaluated. For this purpose, the International Roughness Index (IRI m/km) was measured on sections paved with and without NCDS. Asphalt mixture cores were then taken from the pavement to be tested with the Bending Beam Rheometer (BBR) and determine thermal stress. Based on simple graphical and statistical comparisons, it was found that the NCDS paving method results in considerably lower IRI coupled with a moderate reduction in thermal stress, suggesting a potential benefit of this technology also on the low temperature behavior of the mixture.

Keywords: Smoothness, Non-Contact Digital Ski (NCDS), International Roughness Index (IRI), Bending Beam Rheometer (BBR) test.

Research on some performance properties of hot mix asphalt using sulfur Dung Quat in Viet Nam

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Sulfur extended asphalt mixture (SEAM) has been studied applied effectively in some countries. However, this topic has not been deeply investigated in Vietnam conditions. This paper presents experimental results on the performance properties of SEAM with sulfur derived from petroleum refinery Dung Quat (Vietnam). Using sulfur for Hot-mix asphalt (HMA) could reduce temperature of mixing procedure and compaction, which also significantly improved Marshall parameters and rutting resistance of HMA over time of crystallization. Though, the results showed that sulfur extended asphalt reduces the crack resistance of HMA.

Keywords: Hot mix asphalt; Wheel tracking test; Dynamic Stability (DS); Rutting Depth (RD), CT index.37

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Design and mechanical experiments on GFRP frame join by bolted connections.

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This research is part of MOOVABAT project aimed at designing a new technological building. In this context, experiments were carried out to assess the feasibility of using Fiber Reinforced Polymer (FRP) for moment-resisting frames. Research focuses on the mechanical behaviour of beam-to-column connections under monotonic and cyclic loading. Specifically highlighted was the need to better understand the mechanical behavior of bolted and screwed connections. Full-scale tests conducted in the laboratory was particularly focused on the beam-to-column connection. Both tested configurations include two T-shaped connections and one portal frame. Cyclic and monotonic tests are performed in order to assess the strength, the stiffness and the energy dissipated. The experimental results allowed to accurately characterize the semi-rigid connections measuring the real deformed shape of the structural frame. In addition, a deformed shape analysis explains why the failure occurs by brittle shearing of self-drilling screws. Finally, the test campaign allow the validation of engineering designs and it seems possible to consider optimization during the entire industrial production phase.

Keywords: GFRP structure, sustainable structure, modular construction.

Investigation on Relationship between Long Term and Short Term Tests of Chloride Diffusion Coefficient

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Generally, in order to determine the chloride diffusion coefficient of concrete, many test methods have been developed; those are divided into two terms: long term tests and short term tests. The long-term test has an advantage that it characterizes the natural penetration in the real environment, however it has also a disadvantage that it takes long time (90 days), while the advantage of short-term test is that it accelerates test so it takes short time (24 hours up to 4 days), but its disadvantage is of not the natural penetration in the actual environment. In this paper, the short term and long term of the chloride diffusion coefficients of the same concretes were evaluated, then the relationship between short-term and long-term test of chloride diffusion coefficient was established. The concrete specimens were casted with water to binder ratio (w/b) as 0.3, 0.4, 0.5 and 0.6. The binder contained Ordinary Portland cement, fly ash, silicafume and granulated blast furnace slag. Results showed that experimental data of short-term test can be converted to those of pounding test that is more reliable. Also, there was a fact that chloride diffusion coefficient from short-term tests, accelerating tests, are always higher than these from long-term test. And, there was a linear relationship between short-term test and long-term test.

Keywords: Chloride diffusion coefficient, Long term test, Mineral admixtures.

Preliminary Study on Bonding Integrity of Tropical Hardwoods Cross Laminated Timber Manufacturing by Vacuum Pressure Method

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Cross laminated timber (CLT) is known as a composite material that possesses high-performance properties. As an engineered timber product, it has been proven that CLT has better properties in terms of its strength compared to solid sawn timber. However, the strength of this product is influenced by its bonding integrity. To date, the production and performance of CLT from tropical hardwood is still less known. A lot more studies need to be explored especially on bonding integrity that contributes to CLT's strength efficiency. High temperature and humidity as well as the uniqueness of the tropical anatomical structure of hardwood significantly affected this bonding integrity. Therefore, preliminary study is conducted under laboratory scale before the manufacturing is executed in industrial scale. In this study, the bonding integrity of the CLT panels from tropical hardwood namely, Light Red Meranti and Keruing are assessed. The CLT panels are manufactured via semi-scale of vacuum press for three and five layers with dimensions of 1.3m length x 1m width in accordance with EN16351. Block shear are carried out in this bonding integrity study. A total number of 189 test

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samples were taken at various locations from these panels to represent the entire CLT panel. Four type of treatments are provided to simulate various service conditions, which are dry, wet, wet + re-dry, and delamination (induced pressure) environments. All designed tests are conducted in accordance with EN16351 and EN14374. The characteristic value of shear strength and wood failure percentage (WFP) were measured. From this study, the bonding performance of Light Red Meranti shows the good bonding performance compared to Keruing.

Keywords: Bonding Integrity, Cross Laminated Timber, Tropical Hardwoods, Vacuum Pressure Method.

An overview: Modern countermeasures against local scour at bridge piers - Applicability in Vietnam

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Local scour is a complex phenomenon consisting of three-dimensional flow structures that often develop around piers and abutments founded in movable river beds. Major damage occurs to bridges during flood, mainly because of scour at bridge foundation, particularly the piers and abutments. In Vietnam, every year there are many serious damages to bridges caused involving local scour. In this article some modern countermeasures against local scour at bridge piers from National Cooperative Highway Research Program (NCHRP) Project were considered, including riprap, articulating concrete blocks, gabion mattresses, rigid and flexible grout filled mattresses. The applicability of each method to bridge structures in Vietnamese conditions was also presented in detail. The results of analyzing the advantages and disadvantages of the four methods of erosion control above show that the riprap method is quite suitable in the conditions of Vietnam.

Keywords: local scour, bridge pier, countermeasure, Vietnam condition.

Smart Technologies for Big Construction Projects

A novel solution structure to decrease elevation of seadike crest level

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Nowadays, there are two main types of sea dike: sloping dikes working based on pile foundation principle and vertical wall-typed dikes working based on gravity principle. Vertical wall-typed dikes are not widely used because of their complicated structure, construction and high cost. Sloping dikes were applied more widely than vertical wall-typed dikes because of their simple structure, construction and low cost. However, the cross-section of a sloping dike lets the wave run-up on the slope. Therefore, the wave run-up height has been higher than the wave height in front of the structure. It leads to an increase of thecrest level of sea dike. In many cases of designing, the wave overtopping was accepted to decrease construction cost. In this paper, the authors have applied a new structure: hollow structure (KCR), which works on both gravity principle and pile foundation principle by KCR sidestep shape dike. Authors also have used ANSYS software to simulate interaction of wave run-up and three sea dike structures: Tien Lang sea dike, outer revetment of Lach Huyen port and sloping dikes in the same environmental condition. Results have proved that the wave run-up height has decreased from 43.96% ÷ 77.76%, crest level of the dike has decreased from 1.01m ÷ 5.07m, especially, a construction cost has reduced to 40% ÷ 70%. Those results have indicated that KCR will be ahigher quality and effective investment of sea dike.

Keywords: Hollow structure (KCR), sloping dikes, vertical wall-typed dikes, sidestep shape dike, dike crest level.

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New structural engineering for reducing seadike incident during construction and operation time

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There are two mainly types of coastal structure engineering: rubble mound slopes and vertical structures. Vertical structure is not widely used because of complex structure, hardly construction and high cost. Rubble mound slope uses more widely than vertical structure because of simplfication structure, construction and low cost. However, rubble mound structure formed by soil or rock core and armours layer consisting of large rock; concrete slab; concrete units... Therefore, seadike core is usually got to incident during construction time and armour layer is destroyed due to seadike core and foundation settement incident during operation time. Papers suggested new structural engineering (KCR), which works based on principle of gravity foundation and pile foundation and step cross- section structure for seadike. These structures will be safe in storm time because of working based on principle of pile foundation, that lead to its settlement is ***18.70***% in comparasion with typical rubble mound slope structure. KCR not only reduce seadike incident during construction and operation time but also reduce percent construction cost up to ***65÷70***. Therefore, KCR need to be applying for protecting costal line.

Keywords: Hollow structural engineering (KCR), seadike, verticall wall, rubble mound slope, step cross section seadike, seadike incident.

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Application of GSM technology for automatic tide monitoring combined with multi-beam measuring equipment to make the bathymetric maps for big construction projects in Vietnam

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In the modern life, marine structures such as projects for exploiting inland waterways, navigational channels, and different types of port facilities are developing more and more, the research of survey technology for these pro-jects is not only fast but also requires high precision. With the urgent require-ments in researching and applying the modern technology for the survey, the author has researched GSM [1] technology applied to automatic tidal data transmission combined with the bathymetric technical by Multibeam Echo Sounder ES3PT-M [2], [3], Hypack software [4] in order to make depth maps for marine constructions. To do this research, the author installed the automatic tidal monitoring station, researched how to use automatic monitoring stations, how to transmit data by SMS waves via mobile phones, how to use multi-beam measuring equipment and conducted the experiment at EURO Jetty port project, Haiphong city. With the initial experimental studies, the combination between the two devices above assists survey engineers not to waste time in reading the water level manually as before, which easily leads to errors due to the reader's eyes. In addition, when measuring with the multi-beam instrument, it was found that the measurement spectrum was wide and covered the surface layer below the measuring area. This is a remarkable advantage of the multi-beam measuring device because it shows the entire bottom depth surface of the

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investigation area with a shorter measuring time compared to traditional measuring devices by about 1/10 times.

Keywords: Multibeam; GSM technology; Hypack; Survey; Tidal; Data transmission.

Waterproofing for underground structures without basement drainage system: assessing the robustness of a negative-side waterproofing solution

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The underground spaces are more than more exploited for constructions, especially in the big cities. One of the problems to be treated for underground structures is the waterproofing. The current technique today for underground levels is using the peripheric reinforced concrete (RC) diaphragm walls and disposes a basement drainage system to evacuate the water penetrating through the diaphragm walls. The basement drainage system composes of drainage channel with pipes and at least two pumps to evacuate the water from the underground levels to the water evacuation systems. Then, a secondary wall is usually built to hide the drainage channel and the diaphragm wall. Therefore, this current technique is expensive for the maintenance and consumes the spaces of the underground levels. This paper presents a direct technique which directly appliques a waterproofing mortar on the negative-side of the diaphragm wall. The direct method has several advantages, not only because it is cheaper than the conventional method but also because it prevents the flux through the diaphragm concrete walls and so decreases the internal erosion of the concrete which can deteriorate the concrete quality. The robustness of the direct negative-side waterproofing method is discussed and assessed in the present study, from laboratory tests to in-situ tests. The technique works also for positive-side waterproofing and has shown the robustness after more than 20 years on in-situ structures.

Keywords: waterproofing; diaphragm wall; cement-based waterproofing; internal corrosion.

Deep Insights into the Self-Compacting Concrete with Hybrid Fibres

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This review article focuses on the mix design data in terms of the constituents used and their proportions in the mix design of Self-Compacting Concrete (SCC) reinforced with fibres. The design mix theory for SCC reinforced with fibres specifically hybrid fibres are rare in the available literature. The attempt is made to collect the mixed design data on SCC with hybrid fibres from last 4 years. It includes the type of cement, mineral admixture, chemical admixture, fine and coarse aggregates used, fibres and powder content of the mix are analyzed and reviewed. The combination of mineral admixtures used with cement by different researchers is also reviewed. The effect of content fibres on the fresh state properties of SCC such as slump value (Diameter and flow time) and L-box test is also summarized. The literature indicates the use of steel fibres (straight, hooked end and crimped) and polypropylene (PP) fibres are widely used. This study shows the increase in the fibre content adversely affect the slump value and other fresh state properties. It also shows the usage of different fibres and their combination in hybridization. Also, based on reviewed articles, 5 trials are performed to achieve the SCC. Fresh state properties results show the designed concrete has met the qualifying criteria for the SCC specified by European guidelines.

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Keywords: Self-Compacting Concrete (SCC), Hybrid Fibres, Mineral admixtures, Fresh State Properties.

ANN Model for Joint Shear Strength of RC Interior Beam-Column Joint

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In the present study ANN model is developed to anticipate the Joint shear strength of interior Beam-Column joints. As there are many factors and parameters that influence the joint strength, it is challenging to determine the joint shear strength of joint. The current research aims to predict the Joint shear strength of the Beam-Column joint with the help of Artificial Intelligence. ANN models have recently gained popularity in Civil and Structural Engineering and have solved many non liner engineering problems. In the present research, ANN Model is constructed and the model is trained, tested and validated. Performance of the ANN model is measured by statistical relations. Error analysis is carried out to find out the deviation from experimental values. As the mean square error is less and correlation is nearly 95-100%, it has been concluded that the Present ANN model can accurately predict the Joint shear strength. The proposed ANN model is compared with design equations proposed by design code and found out that the ANN model shows more stability and accuracy.

Keywords: ANN, Joint shear strength, Beam-Column Joint.

Sub sea tunneling in hard rock environment in Scandinavia

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The paper reviews the experience from Nordic sub sea tunnel benchmark projects, with emphasis on sub sea road tunnels excavated in hard rock conditions. More than 35 such tunnels have been built in the Nordic countries with the majority of the projects located in Norway. However, a total of 4 such projects have been initiated in the Faroe Islands, one in Iceland and one project is under discussions in Åland, a part of Finland. All these tunnels have been excavated by conventional drill and blast. Important issues concerning investigation, planning, design and construction are described, and important lessons learned from these projects are discussed.

Keywords: Sub sea tunnel, investigation, planning, design, construction.

Deep Insights into the Self-Compacting Concrete with Hybrid Fibres

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This review article focuses on the mix design data in terms of the constituents used and their proportions in the mix design of Self-Compacting Concrete (SCC) reinforced with fibres. The design mix theory for SCC reinforced with fibres specifically hybrid fibres are rare in the available literature. The attempt is made to collect the mixed design data on SCC with hybrid fibres from last 4 years. It includes the type of cement, mineral admixture, chemical admixture, fine and coarse aggregates used, fibres and powder content of the mix are analyzed and reviewed. The combination of mineral admixtures used with cement by different researchers is also reviewed. The effect of content fibres on the fresh state properties of SCC such as slump value (Diameter and flow time) and L-box test is also summarized. The literature indicates the use of steel fibres (straight, hooked end and crimped) and polypropylene (PP) fibres are widely used. This study shows the increase in the fibre content adversely affect the slump value and other fresh state properties. It also shows the usage of different fibres and their combination in hybridization. Also, based on reviewed articles, 5 trials are performed to achieve the SCC. Fresh state properties results show the designed concrete has met the qualifying criteria for the SCC specified by European guidelines.

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Keywords: Self-Compacting Concrete (SCC), Hybrid Fibres, Mineral admixtures, Fresh State Properties.

Advanced Modeling and Characterization of Structures

Design optimization of Fibres Reinforced Concrete Railway Tracks by using Non-Linear Finite Elements Analysis

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Between 2007 and 2014, IFSTTAR, Alstom and other industrials partners have developed a new concept of railways track called New Ballastless Track (NBT). A first numerical study, using a non-linear model was performed to evaluate the possibility of replacement of the original reinforced concrete layer of the track slab by a steel fiber reinforced concrete, to simplify the construction of the NBT track and to take advantage of the redistribution of mechanical stresses on a hyper-static structure. This study led to the conclusion that this replacement was very relevant.
This paper is on the optimization of this Fibres Reinforced Concrete Railway Tracks solution by using the same non-linear numerical model. It is shown that this optimization procedure should lead to reduction of CO_2 emissions compared with the initial one.

Keywords: Railway Tracks, Fibre Reinforced Concrete, Cracking, Carbone Footprint.

Numerical Investigation on the Boiling Stability of Sheet Piles Supported Excavations in Cohesionless Soil

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This paper presents the findings of numerical investigations on the boiling stability against seepage failure of a sheet piled cofferdam supported excavation in cohesionless soil. A numerical analysis based on the finite element method using both plane strain and three-dimensional model was conducted to investigate the influence of seepage force on the stability of supported excavation. The results of this numerical analysis were validated with the report data of a case study on seepage force induced boiling failure inside a sheet pile cofferdam in support of deep excavations. Subsequently, a parametric study was undertaken to evaluate further the influence of different design parameters, including size of excavations against excavated level and penetration depths, on the boiling stability by seepage force of sheet piled-cofferdam supported excavations in sand. The numerical results demonstrated that the cofferdam stability against seepage failure significantly improved with an increase in the cofferdam size. Meanwhile, shallower sheet-pile penetration and deeper excavation level in the cofferdam base were found to have a substantial influence on the excavation base stability when the size effect of cofferdam was taken into consideration. Consequently, possible and practical solutions to improve the boiling stability of sheet pile-supported excavations are also proposed in this investigation.

Keywords: Deep excavation; Numerical modeling, Boiling failure; Seepage

Behavior of Steel-UHPC Composite Column under Axial and Flexural Loading

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The most important and most frequently encountered combination of construction materials is that of steel and concrete, with applications in multi-story buildings and constructions. The combination of concrete and steel utilizes the compressive strength of concrete and tensile capacity of steel and the resulting composite members offer many structural as well as economic benefits. The recent development of concrete technology resulting in a new type of concrete with many advanced properties, it is called in common name Ultra High Performance Concrete (UHPC). By substituting UHPC to Normal Concrete, the resistance of concrete materials could be reached the resistance capacity of steel and consequently, obtaining optimal load caring of each contribution material. The replacement does not only increase the stiffness and overall ultimate strength but also reduces the cross-section of the composite beams. Furthermore, the need for economical alternatives for steel-normal concrete composite structure and faster construction processes during the erection of structures, boost the investigation in the domain of steel- UHPC composite construction. This study presents a numerical simulation to investigate the structural performance of steel-UHPC Composite Column under axial and flexural loading. Non-linear finite element analysis was conducted, which uses the Concrete Damaged Plasticity (CDP) model. The numerical results of the proposed model showed a good agreement with the experimental result to capture the behavior of steel-UHPC composite column under axial force and bending moment.

Keywords: Ultra High Performance Concrete (UHPC), composite column, simulation model, Concrete Damaged Plasticity (CDP).

Hybrid Systems in Modelling of Flood Protection Embankments Using a Real-Scale Experimental Set-Up in the Hydraulic Engineering Laboratory of TU Dresden

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The unique large-scale test facility for dam and levee models in the hydraulic engineering laboratory of the TU Dresden has already proven itself methodically in several research projects and has been continuously developed and optimized. Complex issues of dam and levee protection combined with high-performance measuring and control systems for different flood scenarios were addressed in order to develop a profound understanding of the correlations between geohydraulics, geophysics and soil mechanics of such structures under in-situ-related conditions. Furthermore, new technologies (e.g. soil sensors for determining the water content, non-destructive methods for dike monitoring or image recognition) can be tested under laboratory conditions deducing recommendations for practical application. The hybrid approach supports the validation of mathematical-numerical models and keeps the focus on practical issues.

Keywords: Flood Protection, Hybrid Modelling, Levee, Dam.

A study on behavior of RC beams strengthened with three-surface-steel cover

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This paper studied on the behaviors of RC beams strengthened with three-surface-steel cover. All tested beams were prepared with their dimensions of 150x150x900 mm and experimented under three-point bend test. There were two types of concrete used: M200 with its compressive strength of 20.53 MPa and M300 with its compressive strength of 31.55 MPa. For each concrete type, the beams were strengthened by three-surface-steel cover at three levels of thickness: 0 mm (no cover), 1.2 mm and 2.0 mm. The experimental result revealed that the load carrying capacities of the tested beams were clearly enhanced with increasing of the steel cover thickness. In comparing to the beam with no steel cover, the load carrying capacities of the beams using M300 increased 2.18 times and 3.07 times with steel cover thickness of 1.2 mm and 2.0 mm, respectively, while those using M200 increased 2.51 times and 3.89 times with steel cover thickness of 1.2 mm and 2.0 mm, respectively. The prediction of flexural resistance was also performed though sectional analyses.

Keywords: Strengthening; Steel cover; Load carrying capacity; Sectional analysis

Evaluation of applicability of seismic base isolation for bridges according to Vietnamese codes

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Seismic base isolation (SBI) has been increasingly used to enhance the seismic performance of important structures. However, this technique was primarily developed for constructions located in high seismic areas and it is still rarely adopted as common isolation systems in moderate seismic areas. This paper attempts to investigate the seismic performance of SBI and its applicability for bridges located in moderate seismic regions such as Vietnam. The bilinear model is used for addressing the seismic behaviour of isolators. Seismically isolated-bridge analyses are conducted essentially based on the nonlinear time history analysis method (NLTHA). A parametric study is conducted on equivalent simplified models, subjected to ground motions according to the Vietnamese code (TCVN 9386-2012), to investigate the seismic responses of isolated-bridges and the SBIs efficiencies. The applicability of SBI for bridges in such regions is drawn on the evaluation of appropriate seismic responses in force, displacement, and residual displacement. The obtained results indicate that SBIs with moderate characteristic strength (Q_d) and high post-elastic stiffness (K_d) show the best performance for bridges in such seismic regions.

Keywords: Seismic isolation, Hysteresis behaviour, Seismically isolated-bridge design, Moderate seismic regions.

Comparative Analysis of Predicted End Bearing Resistances of Drilled Shafts in Soft Rocks

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Interrelationships of seven representative end-bearing resistance prediction models normalized by an interpreted end bearing resistance were compared. A database containing the results of field load tests of drilled shafts socketed into soft rocks was established for this study. Soft rocks are defined as rocks with unconfined compressive strengths of less than 5 MPa. Results of the comparative analysis showed that normalized end bearing resistances of various prediction models range from 0.55 to 1.02. Design recommendations regarding lower and upper bounds of normalized resistances were provided. Mean displacements for predicted resistances ranged from 21.98 mm to 50.56 mm. Furthermore, a normalized end bearing resistance with displacement curve was developed on the basis of the analysis results to provide a graphical representation of the location of each prediction model in the established curve. Statistical analysis was also applied to compare the results of the prediction models and interpreted values.

Keywords: drilled shafts, end bearing capacity, soft rocks, load tests, prediction models.

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Local mesh refinement for displacement-based and equilibrium-based finite elements

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In this paper, a local mesh refinement algorithm for the computation of elastoplastic structures is presented. The elastoplastic computation is performed using a dual analysis combining two approaches: displacement-based and equilibrium-based finite elements. The remeshing scheme is applied to 3D structures discretized with three-dimensional tetrahedral meshes.
Thanks to the dual approach, it is possible to assess a global error term that quantifies the distance between the displacement-based solution and the equilibrium solution. The local mesh refinement is based on the evaluation of the contribution of each element to this global error. This process is repeated as long as the distance between the two dual solutions doesn't respect an accepted tolerance. The method is illustrated on a real project steel assembly.

Keywords: local mesh refinement, error assessment, equilibrium finite elements, elastoplastic.

Effect of Structural Wall Plan Density on Performance of RC Shear Wall Buildings Designed as per Indian Standards

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Reinforced Concrete (RC) shear wall buildings are the most common construction practice in moderate to high seismic zones. Shear walls provide high strength, stiffness to the building system. However, the performance of RC shear wall buildings depends on various parameters like the location of shear walls, the aspect ratio of the shear wall, and the structural wall plan density. The revised Indian standards for earthquake-resistant design of structures states that RC structural wall plan density shall be at least 2% for buildings with open storeys, and for regular buildings it can be at least 2% along each principal direction. This manuscript aims to check the efficacy of the minimum structural plan density recommended in the revised Indian standard by evaluating the impact of varying structural wall density on the seismic performance of high-rise regular RC shear wall buildings located in the high seismic zone. The seismic performance of shear wall buildings with varying structural wall density is evaluated in terms of peak displacements, peak accelerations, and maximum inter-story drift by performing the time history analysis with different ground motion records. The effect of structural wall plan density on the dynamic properties of the buildings is also studied.

Keywords: Reinforced concrete shear walls, Wall plan density, Nonlinear analysis, Seismic performance.

Effect of Torsional Eccentricity on Twisting Behavior of a Steel Building Tested on Shaking-Table

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Based on shaking experiment results of a full-scale 4-story steel building conducted on E-Defense – the world largest shaking-table in Japan, characterization of twisting behavior can be achieved. Exploration on twisting motion of the specimen building is presented in this paper, addressing global rotational responses in varying excitation levels. Study results show that the torsion movement of the building is mainly due to story torsional eccentricity. On the other hand, the shaking-table also causes considerable influence on the building twisting response. Some justifications for stiffness of non-structural components are also presented, through which we can get a more precise basis to determine stiffness contribution of each component.

Keywords: Shaking Experiment, Twisting Behavior, Torsional Eccentricity.

Global sensitivity analysis for bridge crane system by surrogate modeling

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As key equipment for lifting and transporting duties, cranes are used in various industrial fields in modern productions. Thus, the dynamic problem of such crane system is commonly encountered in the design process. This paper presents a Monte Carlo-based global sensitivity analysis of the dynamic model of a bridge crane system using the surrogate model technique. To this regard, physical modeling and differential equation motion of a coupled crane system is first derived using the Lagrange equation. Then, the numerical solution is offered by using the Newmark-β integral method for characterizing dynamic responses of the crane system involving bridge beam, trolley, and payload. In order to compute Sobol sensitivity indices, the input-output correlation is formulated by a neural network-surrogate model formed from the numerical solutions. Finally, for the considered configuration, the importance levels of input variables with the corresponding estimated values of the first and total order sensitivity functions are demonstrated.

Keywords: Overhead crane, dynamic response, global sensitivity, uncertainty, Monte Carlo simulation, neural network-based surrogate.

Analysis of crack characteristics of reinforced concrete bridge deck under the effect of static wheel load

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The reinforced concrete slab members are widely used in construction in general. For bridges, the reinforced concrete deck slab which is supported by main girders is responsible for making the way on bridge. In operation, the impact zone of the wheel load just is a small area in comparison with the whole area of the deck slab. In the working with superstructure depend on forms of structures, deck slab plays the role of both a member subjected to the local loads and a part taking part in the bending capacity of main beams.
During the operation of the deck slab, which deteriorates faster than other parts such as the supporting, abutments. Cracks appeared on the original deck, which could be caused by a variety of reasons including heavy trucks. Under the effect of heavy trucks with large traffic, the deck slab deteriorates rapidly, leading to repair or replacement.
The investigations proposed ideally simplified models for designing and calculating deck slab in which an equivalent strip is a form of these models. In this investigation, the authors numerically simulated a reinforced concrete slab with two edges being born on the pinned boundary condition and under the influence of static load on the corresponding area of the tread. The numerically non-linear analysis results would be compared with experimental results to propose a reliably simulated model. The cracking characteristics of the deck slab were also investigated by simulated instruments. Simultaneously, a suitable calculation model of deck slab and rationally operating condition would be recommended helping reduce maintenance and repairment costs for deck slab in fact.

Keywords: Crack; crack characteristics; reinforced concrete; non-linear analysis; the wheel load.

Reliability assessment of cold-formed steel roof truss according to random factors in Vietnam

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In Vietnam, the cold-formed steel (CFS) trusses are increasingly popular used due to their advantages. However, there have been problems with the CFS roof truss projects. This study deals with the use of probabilistic methods in assessing the reliability of the CFS roof truss. Random design parameters (loads, materials ...) were used in the Monte Carlo simulation. The reliability of the CFS truss was determined based on the reliability of each element. The results show the influence of random factors on the safety of the CFS truss. The above study has a certain reference meaning for the design and analysis of the CFS truss.

Keywords: cold-formed steel, truss, reliability, probabilistic methods, Vietnam

Discrete Truss Optimization Using Rao Algorithms

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Rao algorithms are known as simple, parameter-free metaheuristics that have shown good performance and are quite competitive in solving engineering optimization problems. Although Rao algorithms are quite new, they gain increasing attention from researchers. This paper freshly explores the applicability of Rao algorithms in solving discrete truss optimization problems. Furthermore, a novel adaptive scheme is proposed to balance the global exploration and the local exploitation of these algorithms and a composite Rao algorithm is established. Three benchmark truss structures are used to test the performance of the original and the new algorithms. The effect of the population size, the only required parameter, is investigated, and some remarks are drawn from the numerical results.

Keywords: Rao algorithm, truss structure, discrete optimization.

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Jaya-based Fuzzy Structural Analysis

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In this paper, a novel fuzzy structural analysis procedure based on the Jaya algorithm is presented. The Jaya algorithm is a simple, parameter-less optimization technique that is applicable for various kinds of optimization problems. Therefore, Jaya has gained significant attention from researchers. However, the applicability of Jaya in the domain of fuzzy structural analysis has not been addressed. The present study integrates Jaya in the α-cut level procedure to accurately capture the fuzzy response of a structural system. Moreover, two techniques, including the α-level subspace and the nearest neighbor comparison, are introduced to Jaya for reducing the computation burden. Some examples having non-monotonic behavior and a relatively large number of fuzzy parameters are employed to demonstrate the effectiveness of the Jaya-based fuzzy strategy.

Keywords: Jaya algorithm, fuzzy structural analysis, α-level optimization

Large deflection bending analysis of FG-GPLRC doubly curved thin shallow shells stiffened by oblique stiffeners

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In the present paper, by using the Donnell shell theory and the relationship between strain and displacement of von Karman, the bending behaviors of the functionally graded graphene platelet-reinforced composite (FG-GPLRC) doubly curved shallow shells subjected to external pressure are presented and analyzed in detail. Aiming to heighten the structure's bearing capability, the FG-GPLRC stiffener system in the longitudinal, transverse and/or oblique directions is arranged at the bottom surface of FG-GPLRC doubly curve shallow shells. The improved smeared stiffener technique is used for FG-GPLRC stiffeners, and the equilibrium equation system is obtained, after that, these equations can be solved by applying Galerkin's procedure, and the expressions of large deflection bending in the explicit forms are achieved. The influences of material properties, stiffener system, and geometrical characteristics of doubly curved shallow shells on bending behavior are also considered and investigated.

Keywords: Functionally graded graphene platelet reinforced composite, Large deflection bending, Doubly curved shallow shell, Donnell shell theory.

Effect of auxetic core on the nonlinear buckling analysis of sandwich Graphene-reinforced composite plates

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In this paper, the nonlinear buckling behavior of sandwich functionally graded graphene-reinforced composite laminated plates with the auxetic core layer subjected to mechanic loads is analytically analyzed. The formulations are based on the first order shear deformation theory considering the von Kármán geometric nonlinearities. A homogenization technique of auxetic structures used for auxetic core layer is presented in the paper. The Galerkin procedure is presented to achieve the equation system in the nonlinear algebraic form, then, the explicit expressions of critical buckling loads and postbuckling load–deflection curve can be obtained. Numerical examinations indicate the effects of auxetic core layer, geometrical and material parameters on the linear and nonlinear buckling behavior of sandwich plates.

Keywords: Nonlinear buckling; Functionally graded graphene-reinforced composite; Auxetic core layer; Sandwich plate; First order shear deformation plate theory.

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Nonlinear large amplitude vibration of lattice core CNTRC cylindrical panels resting on elastic foundation

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In this paper, a new design of sandwich cylindrical panels is proposed with two functionally graded carbon nanotube reinforced composite (FG-CNTRC) face sheets and lattice core. The lattice core layer is modeled by improving the novel smeared technique for stiffener according to the first-order shear deformation theory (FSDT). Nonlinear vibration behavior of first-order shear deformable cylindrical panels with the geometric nonlinearities is analyzed in present paper.The stress function is considered and the Galerkin method is used to formulate the nonlinear motion equation system. Nonlinear dynamic responses of panels can be achieved by using the fourth order Runge-Kutta method. Numerical investigations can show the very large effects of lattice core layer, volume fraction of carbon nanotube, type of carbon nanotube distribution on the nonlinear vibration behavior of sandwich FG-CNTRC cylindrical panels.

Keywords: Functionally graded carbon nanotube reinforced composite (FG-CNTRC), Nonlinear vibration, Cylindrical panel, Lattice core.

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Postbuckling analysis of core-corrugated sandwich FG-GRC laminated cylindrical shells subjected to external pressure

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An analytical approximation for nonlinear stability analysis of core-corrugated sandwich graphene-reinforced cylindrical shells is presented in this paper. A homogenization model for corrugated structures is used for corrugated core layer and the governing equation system for cylindrical shells are formulated considering the von Kármán-Donnell nonlinear theory. Three-term solution form of deflection is chosen, and the nonlinear postbuckling relation can be formulated by applying the Galerkin procedure. The result of examinations validates the effects of the corrugated core layer, graphene volume fraction and graphene distributions with different geometric ratios on the nonlinear stability behaviors of corrugated cylindrical shells.

Keywords: Functionally graded graphene-reinforced composite; Nonlinear buckling; Sandwich Cylindrical shell; External pressure.

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Nonlinear axisymmetric vibration of sandwich FGM shallow spherical caps with lightweight porous core

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This paper presents the axisymmetric vibration responses of sandwich Functionally graded material (FGM) shallow spherical caps with lightweight porous core subjected to uniformly external loads and shell-foundation Pasternak interaction. Based on the first-order shear deformation theory (FSDT) with von Kármán geometrical nonlinearity, the governing equations are established. By using the Galerkin method and the Runge–Kutta method, the fundamental frequencies and the nonlinear dynamic responses of the shell are obtained. The effects of porosity coefficient, geometrical parameters, and foundation are considered.

Keywords: Nonlinear vibration; sandwich FGM; shallow spherical caps; Lightweight porous structures.

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Experimental study on the bond strength between reinforcement bars and concrete as a function of concrete strength and confinement effect

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This paper presents the results of the experimental investigations on the influence of concrete strength, and confinement effect of different arrangements of hoops on the bond-slip relationship between reinforcing steel bars and concrete. The Pull-out tests according to the recommendations of RILEM CEB RC6 were conducted to determine the bond strength-slips relationship. A set of 27 specimens were prepared for the testing with two main parameters, including concrete strength and stirrup spacing. Based on the current test results, the effects of such variable of interest on the behavior of RC structural elements are discussed

Keywords: bond strength, confinement effect, Pull-out tests.

Numerical simulation in the assessment fatigue life of prestressed concrete sleeper on the urban railway

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In this study, the train and sleeper are simulated with three-dimensional (3D) models. A railway superstructure is modeled with the beam on elastic bearings. Stresses of prestressed steels in the sleeper were determined under the effect of dynamic load by using numerical simulation technique. The purpose of this study is to predict the fatigue life of the prestressed concrete sleeper (PCS) on the urban railway in Vietnam. Simulation calculations are conducted by SIMPACK software to determine the dynamic load of the train. The train and the track structure are considered interacting in a unified. MIDAS FEA software was used to calculate the stress of prestressed steels in the PCS. The fatigue life was calculated for PCS on Ben Thanh – Suoi Tien urban railway line based on the S-N curve. Both the proposed simulation and the solution technique are 3D models, and the results are suitable with other authors. The effects of rail, rail pad, sleeper, vibration sleeper box, and vehicle speed on the dynamic response of the train are considered in detail. The numerical simulation results provide the fatigue life value for PCS is 101,502,519 cycles equal to 38.62 years. Fatigue life can be used to optimize the design and maintenance process for the urban railway.

Keywords Fatigue life, Urban railway, Prestressed concrete sleeper, Dynamic load, S-N curve.

Experimental Study on CFRP Strengthening of Cracked Reinforced Concrete Beams

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This article presents an experimental study on the effectiveness of CFRP strengthening method on the flexural behaviour of Reinforced Concrete beams. Six identical RC beams with dimensions of 80 × 140 × 1100 mm are cast and statically loaded to complete flexural failure in this study. The specimens are divided in three categories, including: Two beams without strengthening as control specimens (Group 1), two intact beams strengthened with CFRP sheets (Group 2), and two pre-cracked beams strengthened using CFRP sheets (Group 3). The strengthening effects on the stiffness and ultimate strength, together with flexural behavior of test beams are discussed in detail based on the test results.

Keywords: CFRP sheets, Strengthening, RC beam, Cracking

Effect of Revised Seismic Design Provisions on Seismic Performance of RC Frame Buildings with and without Infills

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Indian Standard for seismic design of Reinforced Concrete (RC) frame buildings with Un-Reinforced Masonry (URM) Infills have undergone significant revisions in 2016 compared to its older version in 2002 and 1993, respectively. Two of the major revisions of BIS 13920-2016 are the inclusion of capacity design criteria to ensure strong-column weak-beam and selection of column dimension based on largest longitudinal beam rebar. The revised seismic design standard also recommends modeling guidelines for Un-Reinforced Masonry (URM) infill using the equivalent diagonal strut to take into account the complex infill-frame interaction. Under lateral loading, infills contribution to global strength and stiffness is often ignored for being treated as non-structural elements in general design practice. The present study attempts to evaluate the comparative seismic response of Special Moment Resisting Frame (SMRF) RC buildings with and without infills, designed with revised and older versions of Indian seismic standards. Capacity curves have been developed through nonlinear static pushover analysis. It has been observed that revised code provisions improve the structural performance in terms of stiffness, strength, inelastic displacement capacity, and eventually results in the desired ductile failure mechanism of the RC frames. However, considering the effect of infills as per the revised Indian standard has led to reduced inter-storey drift and ultimate inelastic deformation compared to the bare frame and the general design practice. It has been observed that the infill-frame interaction plays a key role in the overall performance as well as govern the failure mechanism of the structure as a whole.

Keywords: Infilled RC frame buildings, Nonlinear analysis, Seismic design code, Seismic performance.

Fire Resistance Performance of Glass Fiber Reinforced Concrete Columns

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The behavior of the reinforced concrete material can be modified by adding a percentage of glass fibers which depend on their characteristics such as type, shape, volume, or weight content. These fibers are characterized by high tensile strength, perfect elasticity, high tightness, good thermal stability and thermal insulation. In this paper, the behavior of glass fiber reinforced concrete (GFRC) columns with varying glass fiber volume content (1% and 1.5%) under elevated temperatures and axial compressive loading is numerically studied in order to evaluate the effect of adding glass fibers on the behavior of RC columns under elevated temperatures. A reinforced concrete (RC) column without fibers is used as a control sample. The study is carried out using the ANSYS software where the temperatures due to the fire are applied according to the standard ISO834 fire model. In evaluating the fire behavior of the columns, geometric and material nonlinearities are considered. The results show when glass fiber is added to reinforced column, the load carrying capacity and displacement of reinforced column increase. Adding glass fibers to reinforced concrete columns provides better protection to rebar under elevated temperatures. The percentages of

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decreasing the ultimate load under elevated temperature were considerably less in GFRC columns compared to that in RC columns.

Keywords: Elevated temperature, Glass Fiber Reinforced Concrete, Concrete Columns, Finite Element Method.

Optimized design of tuned liquid damper for mitigating seismic induced vibration in case of high-rise building

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In high-rise building conception, seismic load becomes more and more a big issue because seismic induced displacement (e.g. displacement or inter-stories shift) is very important. Tuned Liquid Damper (TLD) is considered as one promising solution thank to its efficacity and cheap installation cost. However, lack of standard or design code may conduct earthquake engineers to some difficulties during the conception phase of high-rise building. In this paper, the optimization of TLD parameters, such as geometry, water level are conducted through a systematic analyses of simplified models, representing a various range of TLD parameters, undergoing an input signal recorded during 1940's El Centro earthquake. As highlighted result, the effectiveness of TLD can be clearly asset through non-dimensional frequency equal to the ratio between first sloshing frequency and first eigen-frequency. The optimized design of TLD is reached when the non-dimensional frequency is close to the unity.

Keywords: Tuned Liquid Damper; Structural dynamics, Seismic load

Enhanced Rao algorithm-based optimization method for nonlinear inelastic steel frames

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Metaheuristics have been increasingly applied in structural design optimization due to their efficiency in finding the global optimal solutions. Several metaheuristic techniques have been proposed for the optimal design of structures. However, the performance of each method depends on the characteristic of the considered problem. Moreover, many metaheuristics require different control parameters to be tuned for their effectiveness. In this paper, we present a parameter-free metaheuristic based on the Rao algorithms to optimize steel frames. Direct analysis based on nonlinear inelastic analysis is utilized to capture the nonlinearity of material and structural geometry. The Rao algorithm, which is enhanced by an effective scheme to skip unpromising candidates without performing time-consumed nonlinear inelastic analyses, is used as the optimizer for the optimization. A two-story space steel frame is studied to show the effectiveness of the proposed method.

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Keywords: Optimization, Rao algorithm, Nonlinear inelastic analysis, Advanced analysis, Steel frame.

Experimental study on shear strength and failure mechanisms of concrete dowel in shallow-hollow composite beam

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Recently, many types of the composite shallow beam have been developed in order to minimize the depth of floor-beam structures and to save the cost of headed-shear studs. In this new type of composite structure, the shallow-hollow composite beam consists of web openings, filled with in-situ concrete (concrete dowel). This article presents an experimental study to investigate shear strength and shear transferring mechanism of the concrete dowel with trapezoid shape. A series of static push-out tests have been conducted. The tested results provide information on the behavior and shear performance of the specimen. Shear transferring of concrete-filled web opening connectors reveals that the concrete dowel behavior could be divided into crushing, compression, and tension zones.

Keywords: Concrete dowel, shallow-hollow composite beam, push-out test.

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Effects of travel distance to Acoustic Emission parameters in cement-based materials

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By definition, Acoustic Emission (AE) signals are elastic waves emitted from any internal sources (micro-cracks, interfacial damage, phase transformation) and which propagate to the sensors. In most cases, the waveforms are attenuated and deformed on their travelling path. Thus, parameters characterizing the waveforms (such as Amplitude, Duration, Rise-time) are also strongly influenced. This effect is stronger when the propagation distance increases as indicated in some recent studies. This result is related to the different of velocities of the wave types (p-wave and s-wave) during the propagation of the wave, then the delay between the second and first wave increases. This creates a longer waveform, with higher Rise-time and Duration. The general result is that sensors which have longer distance from the AE source will produce lower Amplitude and higher RA (Rise-time per Amplitude) value signals. This means that the propagation distance should be incorporated in any damage classification.
This study concluded that the RA values increase when the signals propagate through heterogeneous material may lead to a wrong conclusion when using damage classification namely RA method which has been indicated in RILEM TC 212-ACD.

Keywords: Acoustic Emission, concrete, mortar, damage classification, mode I, mode II, distance, propagation, RA value.

Numerical models of locally corroded mooring chain system of floating offshore structures and an application in Vietnamese conditions

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In recent times, floating offshore platforms have become mainstream in Vietnam's oil & gas industry. The platforms are usually kept by mooring line systems. In the shallow water conditions of Vietnam, the mooring lines are mainly made up of chains. For existing floating offshore platforms, the mooring lines' strength is reduced due to local corrosion after a period of operation. In this paper, a numerical investigation of the locally corroded mooring chain system in Vietnamese conditions is conducted to evaluate its strength. The research results could be used as a reference for re-evaluation of mooring system strength for renewal and reuse of floating offshore structures in Vietnamese conditions.

Keywords: Numerical models, Locally corroded mooring chain system, Vietnamese conditions.

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Effects of Random Road Roughness on Dynamic Impact Factor of Cable-stayed Bridge subjected to Moving Vehicle

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In this study, a two-dimensional vehicle-bridge dynamic interaction model is presented to analyze the dynamic impact factor of a cable-stayed bridge in service by considering the effect of the random road surface roughness. The bridge system including girder, towers, and cables is discretized by using the finite element method. The common model of random road roughness vertical profiles is applied in the form of a stationary and ergodic Gaussian process in space. Random samples of road roughness vertical profiles are generated with the Monte-Carlo simulation method. A two-dimension vehicle model with 4 degrees of freedom is adopted. Based on the d'Alembert's principle, the coupled equation of motion of cable-stayed bridge and vehicle are established by combining both the bridge and vehicle using the interaction force relationship at the contact point. Solutions of the coupled equation of motion in the time domain are solved using the Runge-Kutta-Merson method. The accuracy of numerical results is validated by field test results of the Pho Nam cable-stayed bridge at Danang city, Vietnam. Additionally, the influences of random road roughness on the dynamic impact factor of the bridge were discussed in detail. The results of the dynamic impact factor study show that bridge design codes currently underestimate the dynamic response of the bridge for moving vehicles under different road surface conditions. The findings of this study can be utilized for future design.

Keywords: Dynamic impact factor (DIF), cable-stayed bridge, moving vehicle, road roughness, vehicle-bridge interaction (VBI), finite element method.

Rock engineering toolbox for the Follobanen tunnels under existing Ekeberg tunnels in Oslo, Norway

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Just south of Oslo Central Station the new high-speed Follo Line railway tunnels pass beneath the existing Ekeberg road tunnels. This paper presents the numerical model, and monitoring program used to evaluate the stability of the E6 road tunnels during the excavation of the Follo Line tunnels at only less than 4 metres below. The construction of the Follo Line was approved subject to three conditions: (1) There should be no negative effect on the stability of the Ekeberg tunnels, (2) The traffic flow in the Ekeberg tunnels must be maintained at all times and (3) Any risk of instability in the existing tunnels must be detected beforehand so that necessary precautionary action could be taken in good time.
In order to deal with the challenges, SINTEF has developed a comprehensive rock engineering toolbox, combining Investigation – Numerical model – Monitoring. The tool has been used successfully in this project to provide adequate information for excavation planning and control the situation to detect any unexpected situation.

Keywords: metro tunnel, numerical model, tunnel monitoring.

Investigation of a Semi-FE Approach to Prediction of Floor Response to Walking

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Contemporary guidelines for evaluation of human-induced floor vibrations normally introduce simplified hand calculation methods for prediction of dynamic characteristics and response of floor systems. On the other hand, finite element (FE) modeling is more suitable for analysis of floors with complex geometry and irregular framing layouts. Vibration prediction using the FE approach usually involves both a modal analysis and a time history analysis that requires modeling of the time dependent walking force for calculation of the resultant floor response. The present paper investigates the efficiency of a semi-FE approach to predicting the vibration response due to walking of a real office floor. This method combines the modal properties calculated via an FE model with manual equations established by two widely recognized design guides to obtain the floor response. The contribution of multiple vibration modes and multiple harmonic components of the footstep frequency to the total response is considered. The response calculated using the semi-FE approach is found to compare well with that obtained from the time history analysis for a practical range of pacing rates covering both resonance and off-resonance conditions. In addition, the predicted response is reasonably conservative when compared with the response level measured on the test floor.

Keywords: Floor Vibrations, Walking Excitation, Finite Element; Design Guides.

Relocation of Walking Path to Resolve Vibration Problems in a Lightweight Floor

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Annoying vibrations caused by walking traffic were detected on a lightweight floor in an office environment where the measured vibration level was twice the suggested threshold for human comfort. The floor was fully furnished and consisted of chipboard flooring supported on steel beams. The present research discusses a possible solution to lessen the floor vibration by relocation of the long walking path which originally passed the floor's midspan. A finite element (FE) model of the case study floor was created and calibrated against experimental findings. In particular, the fundamental frequency value obtained from physical heel drop tests performed on the floor was used as a yardstick to modify the FE model. Also, the measured damping ratio was utilized in the FE time history analysis to predict the floor response level. A walking event was simulated by a series of time-dependent point loads with arrival times shifted by a footstep period. These single footstep forces were applied to the FE model on the locations where the walker hit the floor. It was found that shortening the length of the original walking path was ineffective as maximum response build-up occurred just after 6 footsteps hitting the lightweight yet highly-damped floor. On the other hand, locating the walking path closer to the bay edges in addition to limiting the path's length appeared to help reduce the vibration level by a factor of up to 2.5. The floor whose critical walking path was properly relocated would hence be much less responsive and deemed acceptable from a human comfort perspective.

Keywords: Lightweight Floor, Footfall Induced Vibration, Relocation.

Energy Consumption Prediction of Residential Buildings using Machine Learning: A Study on Energy Benchmarking Datasets of Selected Cities across the United States

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Energy consumption around the globe has been rising for many decades. A significant portion of this consumption occurs in residential buildings. Developing reliable methods to understand and predict energy use is essential in the global effort to become more sustainable. Many cities across the U.S. have mandatory energy benchmarking programs requiring large buildings to track and report their energy use. These openly available datasets have encouraged many researchers to study energy use and develop energy use prediction models. In this study, we employ Extreme Gradient Boosting, Random Forest, and Artificial Neural Network as three common Machine Learning methods to predict building energy use in eight U.S. metropolitan areas. By examining the models' performance, we also evaluate and compare the datasets provided by the benchmarking programs and we investigate whether the openly available datasets provide adequate input variables for energy use prediction. Based on the results, suggestions are provided to enhance the datasets and further improve building energy use research.

Keywords: Energy Consumption, Residential Buildings, Benchmarking Programs, Prediction Models, Machine Learning.

Experimental and numerical studies of temperature prediction in mass concrete foundation

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The prediction of temperature rise in massive concrete structures has been a very important problem. In this study, a wind turbine foundation with thicknesses varying from 3.2 m in the center section down to 0.8 m at the edge was considered. According to National and Vietnamese standards, this foundation falls in the mass concrete category. For studying, a three-dimensional finite element program for thermal analysis of hydration heat Midas Gen was developed. There is a flow chart that was carried out steps of studying the massive concrete problem with different experimental tests and full-size foundation analysis. The predicted results were compared with the measured data from experimental tests and real foundation. The predicted results from modeling showed good agreements with the site measured data.

Keywords: Mass concrete, thermal analysis, heat of hydration, monitoring of temperature

Impact of fine mineral fraction properties on the fatigue performance of asphalt mastic

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This research investigates the influence of fines quality on the fatigue performance of asphalt mastic by laboratory testing since mastic is the primary binding component in asphalt mixes. We examined six different mineral fines (grain size smaller than 125µm) regarding their true density for this study and carried out a sieve analysis down to 0.002mm. Furthermore, the BET-surface, the Rigden void, and the grain shape through dynamic image analysis of the fines were determined. Twelve different asphalt mastics were prepared with unmodified and modified asphalt binders and the six fines to explore these parameters' influence on fatigue performance. The fatigue performance of the asphalt mastic was tested with a dynamic shear rheometer (DSR). We selected a stress-controlled time sweep test with hyperbolic specimen shape for fatigue tests on DSR. From the data obtained, it can be concluded that the BET-surface and the Rigden void impact the fatigue performance of asphalt mastic, deduced by a simple linear regression model. A correlation between the other tested parameters and fatigue performance of asphalt mastic could not be established.

Keywords: Fatigue, DSR, asphalt mastic, material properties

Combination of cement deep mixing (CDM) and steel sheet piles for the cofferdam used in construction of deep foundation pit in soft ground in the Mekong Delta Coast

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Cofferdam foundation is defined as a temporary structure which is used to prevent soil erosion in the construction area as well as to prevent water from entering the excavated area when excavation is to be done by digging deeper along the river bank or coast. Most of the works such as dams, locks, bridge footings and water intakes of thermal power plants have deep and wide foundation pits leading to very large cofferdam. In fact, the cofferdam for such works are usually made of specialized steel sheet piles and combined with shoring frames.
The specialized steel sheet piles are not popular in the market meanwhile the shoring frame reduces the work space and increases the complication of construction works. Based on research and experience from projects in the Mekong Delta, the cofferdam for the deep and wide foundation pits made by combining between soil cement columns with common steel sheet piles is the reasonable solution. This solution not only does not need specialized steel sheet piles but also takes advantage of local materials, moreover, increasing the work space because it does not need a shoring frame. This paper is going to present the cofferdam used in construction of deep and wide foundation pits under the soft soil of the Song Hau thermal power plant by combining cement deep mixing (CDM) with common steel sheet piles.

Keywords: cofferdam; deep and wide foundation pit; soft soil; CDM.

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