prime Meetings

GMCSEE2022

October 10-12, 2022 | Dubai, UAE

Global Meet on Civil, Structural and Environmental Engineering

Abstract Book

PRIME MEETINGS
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FOREWORD

The Prime Meetings takes the pleasure to invite you to the Global Meet on Civil, Structural and Environmental Engineering (GMCSEE2022) will be held in Dubai, UAE during October 10-12, 2022.

GMCSEE2022, is an annual meeting organized with the intend of being a platform for researchers, engineers, academicians as well as industrial experts from all over the world to present their research results and development activities in Civil, Structural and Environmental Engineering.

The meeting brings together World Class participants and young researchers looking for opportunities for exchanges that cross the traditional discipline boundaries and allows them to resolve multidisciplinary challenging problems that only a venue of this nature can offer. Through this event you will be able to share the state-of-the-art developments and cutting-edge technologies in the broad areas of Civil, Structural and Environmental Engineering.

Effect of Tannin Addition on the Thermo-Mechanical Properties of Tunnel Excavated Earth-Based Plasters

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Abstract

In current environmental and economic conditions, earth construction techniques present an attractive alternative. The use of raw earth in construction has significant environmental and economic benefits. Raw earth comes from a local resource; which reduces transportation problems. It requires little energy for extraction, transformation and production, which makes it an eco-friendly construction material with a very low carbon impact. There are different earthen construction techniques depending on geographical contexts, lifestyles, local customs, climate and available materials such as earth-based mortars, plasters for masonries walls, rammed earth construction, adobe, and earth compressed blocks. This study is particularly focused on the earth-plaster. Earth-based plaster is a blend of clay, fine aggregate, and eventually natural fiber and stabilizers. Earth plasters are generally applied to cover internal and external faces of masonry walls. Earth plaster plays an important role in improving comfort and indoor air quality, regulate the relative humidity, and present a good capacity to adsorb and desorb water vapor. Hence Earth plasters must fulfill requirements of DIN 18947 standard.

This paper aims to valorise the excavated earth (ExE), generated from the tunnel digging works, in order to elaborate excavated earth-based plasters for masonry walls. Low contents of cement are used as stabilizers in ExE-based plasters reinforced with natural hemps fibers. The thermal and mechanical properties of ExE-based coatings comply perfectly with the specifications of DIN 18947. Nevertheless, generalized cracking were observed after 24 hours when 2 cm of ExE-based plaster are applied on concrete and masonry walls.
In order to eliminate the observed cracking in earth-plasters, the Tannin, organic substances, come from lightly toasted French oak, are used as additive (1 and 2% by weight). The cement content was kept at 5% by weight and three contents of natural hemp fibers were tested (0, 0.8 and 1.2% by weight). All mortars were maintained at controlled conditions using a hygrometric chamber, 20 ± 2 °C and 50 ± 5% RH, for 28 days. The earth mortars were tested at fresh and hardened states.

The results show that the tannin addition affects slightly the workability of plasters. As for the mechanical properties, the results obtained indicate that the Tannin increases the compressive and flexural strengths whatever the percentage of hemp fibers. It was found that the thermal conductivity of earth plastering decreased and the volumetric heat capacity increased with the increase of Tannin content, which is a benefit for plasters in terms of thermal properties.

No crack has been observed when the ExE-Tannin-based plasters are tested to plastering concrete or masonry walls. The Tannin product show a great advantage in the reduction of cracking of earth plasters.

Keywords
Tunnel excavated earth, earth plasters, Tannin, hemp fibers

Biography

Elhem GHORBEL has completed his PhD at the age of 27 years in materials science and engineering from the National High Engineering School of Mines - Paris. She is Professor at CY Cergy Paris University in the department of Civil Engineering (IUT) since 2003.
She has several institutional activities and scientific responsibilities at the national and international levels. She has managed several research projects.
Her research interests cover the mix design, the mechanical and fracture behavior of materials (self-compacting, bituminous and resin concretes, composites , polymers), the valorization of inert and industrial wastes in concrete, the repairing and strengthening of concrete by composites, the durability of heterogeneous materials (aging, Chemical attacks, biodegradation and freezing-thawing resistance), …
She has supervised 21 theses supported and 6 in progress at this time.
She has published 71 papers in reputed journals, 100 conference papers, 4 book chapters and was invited to give more than 15 plenary conferences.
She is editorial board member of Advances in Civil Engineering, buildings, ….
She participated in the organization of about ten conferences and is in the scientific committee of about thirty international conferences
She has scientific exchanges with foreign universities in USA, Italy, Bulgaria, UK, Algeria, Tunisia, Morocco, Turkey and Lebanon.
In MINRESCUE, she is the coordinator of the CY Cergy Paris University involved in WP2 (task 2.1) and WP3(tasks 3.1, 3.2 and 3.3).

Multi-Scale Strcutual Homogenisation Methods

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Abstract

In recent years, computational homogenisation techniques for simulating complex materials and structures have evolved to be able to incorporate structural elements and displacement discontinuities in model formulations.However, their extension to scale-bridging between two models each comprised of structural elements remains relatively unexplored. Such an extension requires careful modification of averaging procedures and the microscopic boundary conditions used. This paper presents a structural-to-structural computational homogenisation technique applied to unbonded flexible pipes, where large scale response is dominated by interlaminar sliding. Using a specially developed beam element as the macro-scale model, selection of appropriate boundary conditions for testing each generalized strain state on a nonlinear shell-based detailed model is discussed in the context of the Hill-Mandel macrohomogeneity principle. Aspects of the detailed model and computational issues arising in the detailed model are discussed.

Keywords

Multi-scale structural modelling, Non-linear finite element analysis, Computational Homogenisation

Biography

Hamid Bahai is a Professor of Computational Mechanics at Brunel University London. He received his PhD degree in 1993 in Computational Mechanics from Queen Mary College, University of London. Between 1993 and 1995 he worked as a Senior Research Engineer at T&N Technology where he was involved in research and development work on a number of projects for the automotive and aerospace industries. This was followed by a period at Halliburton Inc during which time he carried out design and analysis of a number of major offshore structures. In 1996 he moved to the aerospace industry by joining Airbus where as a senior scientist he played a leading role in conducting design, mathematical modelling and computational analysis of Euro3000 space craft structures and Ariane launcher / spacecraft adapter. It was during this period that he was made a Fellow of the Institute of Mechanical Engineers for his technical contributions and services to the scientific and engineering communities. In 1998 he returned to academia and joined Brunel University as a lecturer. He was promoted to Senior Lecturer in 2004, Reader in 2005 and Professor in Computational Mechanics in 2009. He has led a number of research projects covering a wide range of topics in the area of Computational Mechanics and has published over 150 papers on various themes in the field. In 2014 Hamid Bahai was appointed as the Head of the Department of Mechanical, Aerospace and Civil Engineering at Brunel University London and in 2019 was appointed as the Director of Brunel's Institute of Materials & Manufacturing. Hamid Bahai's many theoretical and applied contributions include the development of a new type of non-linear shallow shell strain

based finite element and a novel inverse eigenvalue formulation for optimising the vibratory behaviour of structures. His current research interests include development of non-linear finite element formulations and algorithms for fluid-solid interaction and multi-scale continuum-particle numerical simulations. He acted as principal investigator and the chair of government and industrial jointly funded consortiums to work on a high-performance computational fluid-solid coupled structural analysis project. The output of a number of analytical models developed by Hamid Bahai and his co-workers have now become international benchmarks in the scientific community and industry. He has conducted consulting work in the field of structural integrity for many UK and International companies and has given invited talks and courses the world over on various topics in structural computational mechanics. He is the emeritus Editor-in-Chief of the European Journal of Computational Mechanics.

Structural Health Monitoring/Assessment – Opportunities and Challenges

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Abstract

Research activities in health monitoring and assessment of engineered structures have significantly increased in the recent past. The presenter recognized the importance and urgency of the research need in the early nineties. He and his research team members have been conducting analytical and laboratory investigations in the related areas since then.

Since the available financial recourses are very limited, extending the life of existing bridges, buildings and other infrastructures has become a major challenge to the engineering profession worldwide. Structural health just after a natural event (strong earthquakes, high winds, etc.) or a man-made event (explosions, blasts, etc.) or due to normal use has also become a part of the overall health assessment protocol. In the context of nondestructive evaluation, the main thrust has been to locate defects in structures at the local element level and then decide what remedial action would be most appropriate, essentially extending their life. Several advanced theoretical concepts required to detect defects have been proposed. At the same time, improved and smart sensing technologies, high-resolution data acquisition systems, digital communications, and procedures related to noise contamination in measured information and high-performance computational platforms have been developed for implementing these concepts. The general areas are now commonly classified as structural health monitoring (SHM) and structural health assessment (SHA). As the area matures, more new ideas are being proposed to implement the concepts crossing the typical engineering boundaries. The presenter and his team developed several novel concepts in SHM/SHA. He edited 2 books (the most recent one in March, 2022), about 15 book chapters, over 65 referred papers, over 50 conference papers and reports, and made over 31 invited presentations (excluding conference presentations) worldwide on the related topics.

Opportunities and challenges in SHM/SHA will be presented when experimental investigations are conducted to assess structural health. The convergence of most of the iterative theoretical algorithms in the presence of nonlinearities and noises in the measurements used for the assessment purpose is a major hurdle. Some of the overlooked reasons for non-convergence will be identified and how to mitigate them will be discussed. They are expected to increase the interest in the related topics.

In spite of recent developments in analytical and sensor technologies, the implementations of SHM/SHA concepts have been limited for several reasons. An attempt will be made to identify some of the major future opportunities, their merits and demerits, and challenges. The presentation is expected to benefit students (undergraduate and graduate), researchers (university and industrial), and practitioners (government and private).

The presentation will include many emerging areas where the available information is scarce or not yet properly formulated or developed. The discussion is expected to accelerate the development of these areas. It is hoped that the presentation will convey the excitement, advances, promise, and challenges in overall structural health assessment and monitoring.

Keywords
Health Assessment of Structures, Kalman Filter, System Identification, Without Excitation Information

Biography

Dr. Achintya Haldar is active in the areas of structural health assessment and monitoring for over three decades and published extensively. He taught at Illinois Institute of Technology, Georgia Institute of Technology, and now at the University of Arizona. He was a Guest Professor at the University of Tokyo, Visiting Professor at the IISc -Bangalore, IIT – Kanpur, Hong Kong University of Science & Technology, Technical University of Ostrava, Czech Republic, Honorary Distinguished Visiting Professor at BESU. He also worked for Engineers India Ltd, New Delhi and Bechtel Power Corp, Los Angeles. Dr. Haldar has published about 640 technical articles (one of the highest in Civil Engineering in the World), including 11+1 books (including edited; one just published in 2022; one under production), and about 38 book chapters. Dr. Haldar is Distinguished Member of ASCE and a Fellow of SEI. He also received Lifetime Achievement Award from the Society for Reliability and Safety and inducted in to Teaching Excellence Award Wall, Georgia Tech. He received many research awards including a Presidential Award from President Reagan, ASCE's Huber Civil Engineering Research prize, John C. Park Outstanding Civil Engineer Award, an Honorable Diploma from the Czech Society for Mechanics. He received Excellence in Research Journal Award, IGI Global, Certificate of Recognition from Universidad de Cartagena, Colombia, Polis University, Albania, EuroSciCon, France, Euro Congress, London; Certificate of Appreciation, Taishan Academic Forum on Structural Safety and Reliability Assessment, China, and Honorable Recognition Award from ASME. Further details of his activities can be found at his website at haldar.faculty.arizona.edu.

Work Integrated Learning (Wil) Program Enhancing Employability of Graduates in Construction Industry

Faisal Arain

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Abstract

Construction always has been a major player in Canada's economy. In the global economy, construction occupies a still larger position. Around the world this industry accounts for over $8 trillion a year of economic activity or about 15% of the world's GDP. Contemporary construction practices adhere to traditional methods of construction; negative environmental impact during and after construction phase is certainly an area of interest for construction professionals. Technological advancements in the engineering and construction industry is contributing to achieving sustainable construction practices, however industry has been complaining regarding lack of training/education to produce construction professionals with applied training and sustainability competencies.There is a growing need for construction professionals with sustainability skillsets, which are crucial for enhancing sustainability practices, especially given the growing complexity of construction projects and construction-related environmental law. Academic institutions have a responsibility to address this emerging need of the industry to support national economy. The competence of an applied education and WIL program is in imparting to its students the necessary expertise in order to practice professionally in the industry. Work Integrated Learning is becoming increasingly popular as an essential pedagogy for construction education. The study compares the graduate competencies for building and construction education in Makkah, Saudi Arabia and Alberta, Canada. To achieve the study objectives, a comparison of graduate competencies identified by industry for construction management program in both locations is conducted.

The results suggest that the construction acumen, project management and leadership, business acumen, professionalism, and communications were considered as the most important and desirable graduate competencies achieved though WIL. Other important competencies include building techniques, cost management, conflict resolution, ability to learn, contracts management, risk management, teamwork, and technological competency, procurement management. It is recommended that the breadth and depth of the core's syllabi ensure sufficient coverage of fundamental and extended topics on construction, and facilities management. Construction management programs through WIL pedagogy should help to equip our students better to participate in the local and global construction industries that await them. The findings from this study would also be valuable for all academicians and researchers involved in the area of academic development in general.

Keywords

Contratuction; Applied Education, Work Integrated Learning, Sustainability

Biography

Dr. Faisal Manzoor Arain is an experienced academic leader and architect with an MS and PhD in Construction Project Management. He has extensive experience of working at management and leadership positions in industry and academia in Pakistan, Saudi Arabia, Singapore and Canada. Dr. Arain received a certificate from Harvard University, Boston, USA upon completion of the Leadership Development Program. He led the development of Canada's first Bachelor of Science in Construction Project Management at SAIT, Calgary, Alberta. He was appointed by the Saskatchewan Higher Education Quality Assurance Board (Ministry of Education, Saskatchewan) as the Chair of the quality review panel for new program evaluations. Dr. Arain has consulted, researched and published widely in the discipline of Project Management and Design and Construction Management. He has authored over 120 research publications, 2 book chapters, and 13 books. His research interests include leadership, project management, designing educational spaces, design and construction interface issues, and the development and application of knowledge-based systems for management of building projects. Dr. Arain is the recipient of numerous awards including the Donald S. Barrie Award 2005 conferred by Project Management Institute (PMI) USA, and the Idahlynn Karre Exemplary Leadership Award 2016, conferred by the Chair Academy, USA. Dr. Arain serves on editorial boards of several international research journals and also an expert member of the World Association for Sustainable Development, UK.. He is the Editor-in-Chief of the International Journal of Construction Project Management published by Nova Science Publishers Inc., USA.

Dr. Arain worked as Chair, Construction Project Management with Southern Alberta Institute of Technology (SAIT), Calgary, Alberta. He served as the Associate Dean of the School of Sustainable Building and Environmental Management at NAIT, Edmonton, Alberta. He also assisted Saskatchewan Polytechnic, Regina providing educational, administrative and strategic leadership for a new baccalaureate degree program in construction management. Dr. Arain worked as the Senior Principal/Senior Dean, Niagara College (NC) Campuses in KSA. As the Senior Principal/Senior Dean, provided academic quality, administrative and strategic leadership. He recently served as the Vice President, Academic at the Northern Lakes College (NLC), Alberta, Canada.

Dr. Arain is currently the Vice President, Academic & Administration at the KLC College, Ontario and the CEO of AM Management Global Inc, Alberta, Canada.

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Ensuring Durability of Marine Concrete Structures Through On-Site NDT Techniques - Concept And Real Case

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Abstract

Current prescriptive specifications for durability (ACI 318, EN 206), the limitations of which are discussed, are unsuitable to ensure the expected service life of marine structures. A step forward has been made in some countries, that specify limiting values for standard transport tests (permeability, chloride migration), measured in the laboratory on cast specimens. Yet, the results yielded by these tests evaluate just the performance of the concrete producer, ignoring what happens to the mix after sampling, including: transportation, conveying, placement, consolidation, finishing, curing. All these operations exert a strong influence on the quality of the end-product, the quality of which tends to go largely ignored. Some countries (Switzerland, Japan, Argentina) have recognized the relevance of the quality of the surface layers of concrete (Covercrete) in protecting the steel from the rapid penetration of aggressive species (chlorides in the case of marine concrete structures) and, consequently, on their durability, promoting its measurement in situ. For that purpose, they have standardized a non-destructive (ND) test method capable of measuring the coefficient of air-permeability (kT) of the Covercreteon site in up to 6 minutes. In some cases, limiting values of kT have been proposed to ensure a service life of 50 years, for exposures of different aggressiveness. A more advanced use of the test method, in combination with the ND determination of the cover thickness, allows the probabilistic assessment of the service life of structures under risk of steel corrosion, induced by chlorides or carbonation, through the Exp-Ref (Experimental-Reference) approach. This approach was applied to verify the durability of submerged tunnel segments of the emblematic Hong Kong – Zhuhai – Macao (H-Z-M) sea link in P.R. China and of precast dowels of the Port of Miami Tunnel.

This contribution describes the test method, showing the correlation of kT with chloride diffusion and migration tests, as well as details of the standards (moisture compensation, sampling, conformity rules). The H-Z-M real case is presented in detail, comparing the analytical prediction of the service life of the tunnel segments with the more realistic assessment provided by the Exp-Refapproach, discussing the differences between them.

Keywords

Marine Structures; Durability; Air-Permeability; Probabilistic Evaluation

Biography

Civil Eng. (Univ. Buenos Aires) and PhD (Univ. Leeds), has some 50 years' experience as researcher and consultant in the field of Cement, Concrete and Concrete Constructions. He was Director of the Constr. Dept. of the National Inst. of Industrial Technol. and of the Portland Cement Inst. in Argentina. He has been Head of the Concrete Technology and Applications Division of Holcim Technology Ltd. in Switzerland during 20 years. He was also a resident engineer in the construction of Yacyretá Dam (Argentina-Paraguay). Today he is Director of Materials Advanced Services Ltd. (Argentina and Switzerland). He is past-president and honorary president of the Argentine Assoc. of Struct.Concr. (AAHES) and of Concr. Technol. (AATH). He was awarded a Fellowship and became Honorary Member of RILEM, having chaired Committees in RILEM and fib.He is currently a member of ACI, fib and SIA. He has lectured in academic and industrial courses and seminarsall over the world and was Invited Professor at MSc and PhD courses in Spain, Japan, Switzerland and China. He has authored or co-authored some 150 papers in Journals and Conference Proceedings and the recently published book "Concrete Permeability and Durability Performance". He is the inventor of the "Torrent" NDT method to measure the air-permeability of concrete on site. He has served as member of the Editorial Board of Materials & Structures and of Cement & Concrete Research journals.

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Damage-Based Fretting Wear Model for Life Prediction of Drawn Wires

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Abstract

This paper presents the refinement and optimization of the developed damage mechanics-based fretting wear model for Hertzian line contact condition. A calibration is conducted to the fretting wear damage model by comparing the wear coefficient between numerical simulation and experimentally measured data. The characteristic degradation of the Young's modulus of drawn steel wires is established through the phenomenological presentation of the interrupted fatigue test data. The samples are given a quasi-static loading followed by a block cyclic loading with various stress amplitudes and ratios. The residual Young's modulus is calculated after each block of cycles. The effect of the different loading condition with the amplitude and mean stress on the measured fatigue life of a single wire is presented using the life parameter, χ. The residual Young's modulus data are presented in terms of normalized quantities. The fitting constants are obtained and the fitted equation is used to describe the degradation of Young's modulus at N number of cycles. The data is applied to the fretting wear damage model and integrated into the user material subroutine (UMAT) of the Abaqus FEA software to predict the fretting wear and fatigue life of the steel wire. The load cycle block method with each block representing 2000 cycles is employed for computational efficiency. The fretting wear quantified using the proposed model is verified by comparing the wear scar size at 50,000 cycles with published experimental results for two wires in contact at the lay angle of 15º, 30º and 45º. The extracted wear coefficients are employed for the fatigue wear model of the steel wire ropes. A scaling factor of 0.0062 is obtained, which accounts for the effect of the wear debris and treated as the coefficient of wear damage. The calibrated fretting wear damage model is then utilized to predict the fretting wear failure between two wires at different contact angles. The damage evolution found to be nonlinear with faster wear rates with increasing number of cycles. Once the element reaches D_c ,the stresses carried by that element are redistributed to the neighboring elements, thus causing faster wear rates. Different shear stress causes fatigue crack to occur faster for bigger contact angle and slower for smaller contact angle. The corresponding contact pressure is also higher for big lay angles as compared to small lay angle. The fatigue life of the two wires in contact is found to be shorter with the increasing lay angles. The outcomes of this study could be used as a guideline in predicting the fatigue life resilience in stranded wire applications under fretting wear failure condition.

Keywords
fretting wear; drawn wires; finite element method; life prediction

Biography

Associate Professor Zaini Ahmad currently serves as the Chair of the School of Mechanical Engineering, Faculty of Engineering, UniversitiTeknologi Malaysia (UTM). He obtained Master of Science in Structures, Impact and Crashworthiness from Cranfield University, United Kingdom and has also been conferred with a Doctor of Philosophy (PhD) from Queensland University of Technology, Brisbane, Australia in the field of energy absorption materials for impact applications. He has published many refereed scientific publications with Elsevier, Springer, SAGE, etc. He serves as editorial member and peer-reviewer for several international high impact research journals. He is active in research collaborations with national and international partners including industries in the field of structural impact and crashworthiness in Malaysia, Indonesia, United Kingdom, India, Turkey, Italy, and Australia. Previously, he led the Applied Mechanics and Consultation Research Group in the School of Mechanical Engineering. As a professional engineer registered with the Institution of Mechanical Engineers (IMechE), United Kingdom and Board of Engineer Malaysia, involvement in consultation and industrial collaboration is part of his interest and goals in disseminating the engineering knowledge to the society. His research interest covers computational solid mechanics, crash analysis, impact mechanics, and light-weight structures.

Waste to Energy through Incineration: Indian Experiences

Babu J. Alappat

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Abstract

Any Solid Waste Management (SWM) scheme includes collection and storage of the waste at the sources, transportation to the treatment facilities, processing of the waste for recovery and the final disposal. In India, waste processing and proper final disposal have not been receiving much attention until recently. This is especially true for the Municipal Solid Waste (MSW). Most of the available funds were spent on the collection, transportation and land-dumping of the MSW rather than its treatment, recovery and safe final disposal. However, presently there has been much emphasize on the proper processing for recovery and safe disposal of the solid waste.

As per the Solid Waste Management Rules, 2016, MSW has to be collected in three different containers segregating the wet waste, dry waste and household hazardous wastes right at the source. The wet waste or green waste to be processed by biological techniques like composting or vermi-composting or bio-methanation preferably in a decentralised way. The dry waste to be processed separating different components like glass, metals, inerts, plastics, leather, rubber, etc The burnable fraction may be used for Refuse Derived Fuel (RDF) production or used directly for incineration and energy recovery. The waste good for nothing, after all possible recovery, goes to engineered landfills based on the dry-tomb concept. This is a kind of ideal situation. Unfortunately, the reality is quite far from this. Raw MSW comes all mixed up. Separation of the different components of the mixed MSW is a costly affair, also, not very reliable. Separation of the raw mixed MSW (to biodegradables, combustibles and other recyclables) has to be done at the municipal facilities.

Waste to Energy through incineration: Since 2010, about eight incineration plants have come up in India generating about 105 MW. Very soon, many more plants shall come up under the Clean India Mission of the Government of India. Although the opportunities and prospects for this technology is substantial in India, there are many challenges and issued to be addressed. From the mixed raw MSW collected, proper separation of the biodegradables and combustibles is the biggest challenge. Air pollution control is another issue as many pollutants may escape the conventional control equipment that targets the conventional pollutants like particulate matter and acidic gases. Carcinogenic emissions like dioxins and furans have to be addressed properly. These pollutants cannot be monitored continuously like the other pollutants that can be monitored using sensors. Separation of chlorinated plastics like PVC is another challenge. Fly ash generated is hazardous. However, the bottom ash generated is not hazardous, but not inert as well. Hence, utilization of the bottom ash needs to be researched in depth. More than all these, public acceptance is a big issue with these plants. Perhaps the only way this is to involve the public right from the beginning (the planning stage) to the commissioning and

operational stage. Integrating these waste management facilities to the existing urban utility services is another challenge.

Keywords
Incineration; Waste to Energy; Waste Management; Solid Waste

Biography

Dr. Babu Alappat holds a Ph.D (Environmental Engineering) from I.I.T Bombay. He has more than 25 years of teaching and research experience in Environmental Engineering. Currently, Dr. Alappat is a Professor of Environmental Engineering in the Department of Civil Engineering, I.I.T Delhi. Also, he is a Visiting Professor in IMT Atlantique, Nantes, France. Prof. Alappat specialises in Environmental Engineering, especially on fluidized bed reactors, solid waste management and thermal treatment techniques. He has published more than 160 research papers in international & national journals and conferences. He is a reviewer of more than 20 international journals. Also, has supervised several Ph.D and M.Tech projects. Prof. Alappat is a consultant to many Govermental and non-Govermental organisations and expert member in several committees. His main contributions in waste management includes: incineration in fluidized bed reactors, waste to energy and environmental indices like incinerability index, leachate pollution index (LPI), etc.

Use of Recycled Construction Waste in Structural Concrete: Pakistani Experience

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Abstract

The rapid increase in construction activities observed during last several decades across the globe has posed a serious threat to the sustainability of natural construction materials such as aggregates.Aggregates, which are excavated from mountainous rocks, is one of the main building material used in reinforced concrete construction, therefore, its global usage (millions of tonnes every year) significantly effects the ecological environment. Consumption of natural aggregates (NA) can be reduced by recycling the construction waste generated from demolition of structures to made concrete which in turn can provide an economical option for construction compared to natural aggregate concrete (NAC) and can also help in sustainable development. Construction industry generates huge amounts of debris and its contribution is estimated at about 31% of the total waste materials in Europe. The natural resources are limited, and recycling is a necessity to reduce natural materials consumption, energy consumption, and pollution. In addition, recycling is becoming mandatory in most countries.A detailed study was carried out at NED University of Engineering & Technology in collaboration with Tongji University, Shanghai, China to investigate behaviour of Structural Concrete made from the construction waste generated from Pakistan biggest construction waste generator, the city of Karachi.In the first phase, concrete waste collected from different sites was characterized to check its potential to be used in structural concrete. Mechanical properties of recycled aggregate concrete were then determined under normal and extreme conditions like exposure to fire, and durability of recycled aggregate concrete. Once established that recycled concrete aggregates can be used in structural concrete, reinforced concrete beams, columns and frames under static and dynamic loadings were tested. Furthermore, life cycle assessment and life cycle cost assessment was carried out to determine environmental sustainability and economic viability of recycled aggregate concrete.Based on the results obtained from the experimental program it was found that recycled concrete aggregates, derived from construction waste, can be used as partial replacement of natural aggregates in structural concrete by adopting careful design procedures to compensate for their low density, greater capacity of water absorption, presence of the cement gangue of old mortar, reduced workability and reduced compressive and tensile strengths as well as the modulus of elasticity. These draw backs can be compensated by the use of supplementary cementitious materials and/or the increase of cement content.

Keywords
Recycled Concrete Aggregate; Structural Concrete; Beams; Columns

Biography

Dr. Asad-ur-Rehman Khan is a Professor in the Department of Civil Engineering at NED University of Engineering & Technology, Karachi, Pakistan. He is also serving as the Dean of Faculty of Civil and Petroleum Engineering in the same University. He did his Bachelors for the same University and completed his Masters and Ph.D. from King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia. Hisresearch interests are Repair and Retrofitting of Reinforced Concrete Structures by Externally bonded CFRP and TRM, Behaviour and design of recycled aggregate concrete structures, Concrete Durability, Computational Modelling, Material Modelling using Damage Mechanics. He has authored or co-authored more than Sixty research papers in International Peer-reviewed Journals and Conferences. He is an active member of American Concrete Institute, American Society of Civil Engineers, International Institute of FRP in Construction, RILEM (Senior Member), Earthquake Engineering Research Institute. He is also member of Technical Committees of RILEM,292-MCC: Mechanical Characterization and Structural design of Textile Reinforced Concrete; 273-RAC:Structural behaviour and innovation of recycled aggregate concrete.He is involved in International Joint Research Projects as a Lead Investigator from the University.

Evaluating Concrete Degradation using Tensile Strength

Prof. Andrew J. Boyd

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Abstract

Most deterioration mechanisms affecting concrete revolve around the development of some form of internal expansive stress that culminates in cracking of the hydrated cement paste. Whether this expansive stress is induced by the expansion of water during freezing, the expansion of alkali-silicate gel during an alkali-silica reaction, or the formation of ettringite during sulfate attack, the mechanical effect is the same. Even reinforcing steel corrosion results in a volume increase that induces stress in the surrounding concrete. Cracking in a brittle material, like concrete, is a tensile phenomenon. Thus, the assessment of mechanical property degradation caused by such deterioration should rely on tensile strength evaluation. However, measuring the tensile strength of a brittle material, particularly concrete, is not easy. Gripping the specimens without inducing additional stresses and localized failure at the contact points is difficult. An alternative technique has been developed that induces an internal pore pressure through a non-contact gas pressure loading approach. This apparatus, deemed the pressure tension test, can generate a true tensile failure from the insideusing the diphase concept of load application. Though the fundamental form of this method for static tensile strength determination has been used for some time, recent modifications to the apparatus have now expanded its capabilities to include long-term sustained loading (creep), cyclic loading, or any other combination of loading and unloading desired. Results from testing various forms of deterioration have shown that the pressure tension test is capable of detecting damage at much lower levels, or at significantly
earlier stages, than other destructive testing techniques currently in use.

Biography

Dr. Boyd obtained a BScEng from the University of New Brunswick (1993), an MASc from the University of Toronto (1995), and a PhD from the University of British Columbia (2001), all in Civil Engineering. He joined the Department of Civil Engineering at McGill University in 2006, following a six-year stint in the University of Florida Department of Civil & Coastal Engineering. He is a registered professional engineer in Canada, was named a Fellow of the American Concrete Institute in 2008, and former chair of the nondestructive testing committees of both ACI and ASTM. Prof. Boyd's research interests lie in the areas of construction materials and sustainability, particularly as they relate to transportation infrastructure. Specific fields of research include durability, nondestructive testing &evaluation, standards & specifications, repair & rehabilitation, recycling, and hazardous waste reduction& mitigation.

Real-time Vision-based Unsafe Action Detection for Mobile Scaffold Usage

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Abstract

Most of accidents in construction site are caused by unsafe actions of a construction worker. Therefore, guiding the behaviour of workers is critical element for the safety management in construction site. However, generally detecting and measuring the unsafe actions of a worker isa difficult problem because of diversity of actions and real-time requirements in application. Recent approaches adopt several expensive hardware equipment for each worker and estimate the safety of actions, but they do not show good enough accuracy for the practical application. In this study, for more practical and less expensive approach, we adopt the state-of the-art vision-based AI methods for real-time unsafe action detection and show its effectiveness in the application of mobile scaffold usage. Our method not only detects and tracks each worker in construction site, but also continuously tracks the temporal state of HOI (Human Object Interaction) to alarm the real-time occurrence of unsafe actions. Even though our approach only relying on a single monocular camera, it successfully detects predefined unsafe actions of workers for mobile scaffold usage.

Keywords

Unsafe action detection; Mobile scaffold usage; Vision-based AI

Acknowledgment: This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No. 2021-0-02068, Artificial Intelligence Innovation Hub).

Biography

Minho Lee received the Ph.D. from Korea Advanced Institute of Science and Technology (KAIST) in 1995, and is currently a head of graduate school of AI, full professor of School of Electronics Engineering and directors for AI Institute of Technology, KNU-LG Electronics Convergence Research Center, Metaverse AI platform Convergence Research Center, Kyungpook National University, Taegu, Korea. He was a visiting scholar for Dept. of Brain and Cognitive Science at MIT from 2006 to 2007. He was president for Asia-Pacific Neural Network Assembly (APNNA) at 2013, and vice president and governing board member for Asia-Pacific Neural Network Society (APNNS) and International Neural Network Society (INNS). He received several awards such as APNNA Excellent Service Award (2014) and Best Industry-Academic Cooperation Award (2014), and best paper awards at international conferences. He has been served for several international journals as an associate editor and also for international conference as general chairs. His research interests include deep neural networks, brain-neuroinformatics and natural language processing (Home page: http://abr.knu.ac.kr).

Development and Characterization of Graphene Oxide (GO) Based Alkali-Activated Concrete

Donkupar Francis Marbaniang, Arkamitra Kar, **Dibyendu Adak**

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Abstract

In concrete, particularly for precast applications, thermal-cured alkali-activated binders (AABs) have the potential to replace conventional Portland Cement (PC). This study addresses the creation of ambient-cured AAB by adding graphene oxide (GO) nanoparticles in an effort to circumvent this energy-intensive regime and promote wider application. For alkali-activated slag (AAS) mortar specimens made with 4 molar (4M), 6 molar (6M), and 8 molar (8M) concentrations of sodium hydroxide in the alkaline activator, the mechanical strength and durability parameters are assessed. The various GO by weight of slag percentages are 0.0%, 0.03%, 0.06%, and 0.09%. Compressive, flexural, and split tensile strength are the mechanical factors that are taken into account. Rapid chloride permeability sorptivity, and acid resistance tests are the durability parameters examined. To assess the impact of GO on the mortar properties, the performance of ambient-cured AAS mortar specimens containing GO is compared to thermal-cured AAS mortar specimens (without any GO inclusions) and control cement mortar (PC). For sodium hydroxide molarities greater than 4M, it has been found that the strength of AAS mortar is stronger both with and without GO inclusions. The mixture with 0.06% GO and a 4M activator is discovered to have the best mechanical and durability properties. According to mineralogical, chemical, and microstructural studies, adding GO to ambient temperature-cured AAS speeds up the rate of hydration even at a lower activator concentration (4M). This is because GO has a high specific surface area, which leads to the development of more nucleation sites. Hence, ambient-cured AAS mortar prepared using 4M sodium hydroxide and 0.06% GO is recommended for practical usage.

Biography

Dibyendu Adak is an Assistant Professor in the Department of Civil Engineering at National Institute of Technology Meghalaya, India. His area of research is the development and characterization of low-cost environment-friendly construction materials. He is an Associate member of ASCE since 2018.

A Topology Optimization Framework for Tall Buildings

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Abstract

The world population is moving towards more urbanized cities. A key element in shaping those cities is tall buildings with their relatively small footprint that accommodate more space. With the increase in the height of those buildings, the construction industry becomes responsible for 40% of carbon emissions contributing to the climate change phenomena facing the world. The design process for those buildings is a pretty complex process that requires cooperation between architects and engineers to achieve the targeted functionality for the building. As a result, topology optimization for tall buildings starts to play an essential role in reducing the amount of materials used in construction. In the last few decades, it proved its efficiency in reducing carbon emissions and the cost of tall buildings. Due to tall buildings' sensitivity to lateral loads, the Lateral Load Resisting System (LLRS) contributes the most to the cost of the whole structure with a great potential of reducing the project's budget by applying modifications to this system. With the aid of artificial intelligence, this paper introduces a novel topology optimization framework for tall buildings against dynamic wind loads. The framework extracts dynamic wind loads time history from a computational fluid dynamic (CFD) model. Then, automated Finite Element Analysis is conducted to prepare a database for surrogate model training. An artificial neural network-based surrogate model is built using the prepared database to form the objective and constraints functions of the optimization problem that can capture the structure response. This model is coupled with a genetic algorithm to identify the optimum layout of LLRS within the predefined architectural and structural constraints.

Keywords

Tall buildings, Topology optimization, Computational Fluid Dynamics (CFD), Finite Element Models

Biography

Dr. Ahmed Elshaer is a structural/wind researcher who participated in many mega-scale projects in Canada and overseas. His research group included 4 Ph.D. students, 5 MSc students and 10 undergraduate research students. He has admirable experience in research related to climate impact on structures and numerical modelling of complex structural and fluid behaviour. He received an NSERC Discovery grant to work on a climate-resilient modular design for indigenous housing. His research has gained both national and international recognition with 15 peer-reviewed journal papers, more than 21 conference papers, and 3 invited keynote speeches. His research program aims at addressing the sustainability and resiliency challenges facing the built environment, which offers great opportunities for the training interns for Canada's infrastructure industry. He has extensive experience with structural dynamics, wind engineering and High-Performance Computing (HPC). His academic activity is recognized by many academic awards including the Alan Davenport Award of Excellence and the Lakehead Merit award. He served as the chair and proceedings editor of the Canadian Society of Civil Engineering (CSCE) structures specialty conference in 2022.

The Architectural Role in Environmental Engineering: Sustainability is Forever

William J Batson Jr., M. Arch

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Abstract

The purpose of our built environment has changed over the millennia. Our first dwellings were designed for theuserand were engineered for human comfort to keep their hosts warm, cool, and dry. These firststructures were built by locals, using local material, it was regionally specific and sustainable. Asbuildings progressed, organic ingenuity and engineering methods gave rise to ample leisuretime necessary to produce artistic engineering i.e., architecture. Withinarchitecture, the freedom to acquire a distinctiveregional, cultural and aestheticbeautyhad arrived. Architecture became in part, an intentional and theoretical exercise. One of these theoretical architects was the Roman Architect Vitruvius, who codified architecturaldesign in three words, firmitas(strength) utilitas(functionality), and venustas(beauty).

In the previous century functionality (utilitas) became a product of form. Wedesigned cubic volumes and tall glass towers without climatic considerations because of our perceivednotion of unlimited resources. In Academia, theoretical notions sometimes overwhelmedour attentionto our environment and logical evolution. Modern architecture developed an international style of form and function that made no conclusive promise to improve our lives or preserve the environment. Much of the modern movement lacked intention and respect forthe culture and regional sensibilities. Engineers simply followed the direction oftheirarchitect's "artistic" aspirations. As the 21-century arrived, the era of experimentation, deviation, architectonics, morphism, and "talkitecture" had passed. Our present task is to sustain our planet. The warning has been sounded loud and clear; sustainability is forever.

Recently and rather suddenly, we introduced"green" and sustainable attributes tothe preplanning and design phase of architecture.As architects accept their role as primary decision makers with environmental engineers,in making places livable and sustainable,it is important that we reconsider all rational design concepts, and vernacular and regional solutionsamenable for modern construction. In particular, vernacular architecture provides a foundation for design solutions that solved problems particular to climate, geography, social, and environmental regions.

The objective of this address is toreveal the pivotal role that architecture must perform as the arbiter of environmental engineeringand the various ways it reestablishes and fostersa sincere focus on sustainability. And lastly, to demonstrate how the architectural profession redefines its primary role professionally and academically, reinforcingsustainability along with,firmitas utilitas and venustas.

"Tradition is the uninterrupted chain of all navigations and beyond that the surest witness of the projection towards the future." -Le Corbusier.

Keywords
Architecture, green, sustainability, Vitruvius, environmental engineering, site, microclimate

Biography

William (Bill) Batson Jr. was born in Cleveland, Ohio, once known as the "best location in the nation." After graduating from Cathedral Latin High School, he attended The Ohio State University and earned three degrees. A BA in Art and BS in Architecture and a Master of Architecture. He is currently a tenured Associate Professor teaching full-time at Prairie View A & M University.

He began his career working for several years in the architectural offices and later began a teaching career. Bill started his career with precision hand-drawing, then computer aided drawing (CAD) and presently, using the latest advance in architecture-3D laser scanning technology for historic preservation and archival drawing projects.

Bill Batson shares a passion for architecture, its historical context, and its future, especially as it relates to architectural systems and methods of achieving and maintaining a sustainable planet, a universal determination that we all share.

Performance Evaluation of One-Part Alkali Activated Mortar

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S Beskhyroun (Dr. Sherif Beskhyroun)[2]

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Abstract

The two-part alkali-activated materials (AAMs) have been widely used as an alternative to Portland cement. This product could emit lesser carbon dioxide by utilizing industrial waste products to make this cement binder technology greener and more sustainable. One-part AAMs system was introduced in recent years to overcome the two-part system's shortcomings. This technology, renowned for its 'just add water' concept, was easier and more practical to apply at construction sites. This study was carried out to evaluate the mechanical performance of one-part alkali AAMs in the form of mortar under lab ambient temperature in the tropical climate country of Malaysia. The drying shrinkage measurement of the mortar was also tested to indicate its durability early. The one-part alkali-activated mortar was composed of hybrid aluminosilicate precursors between fly ash (FA), Ground Granulated Blast Furnace Slag (GGBFS) and Portland composite cement (PCC). A low alkaline activator of solid potassium carbonate was used for the geopolymerization process. Three types of solid admixtures were added to complete the composition of the new mix design. According to the results obtained, the mechanical strength of one-part alkali-activated mortar achieved the minimum requirement for Class R3 - concrete structural repair materials as per EN1504-3 specifications. This eco-friendly cement binder has excellent potential for further engineering development, particularly to become a new concrete repair product in the future.

Keywords

Geopolymerization, Mechanical strength, Mortar mix design, Low alkaline activator, Concrete structural repair

Biography

Eddy Yusslee is a Professional Civil Engineer (P.Eng) currently a PhD student working with Assoc.Professor Dr Sherif Beskhyroun and Professor John Tookey at Auckland University of Technology (AUT), New Zealand. Before this, he served for over 12 years as a civil engineer working with an engineering consulting firm and construction company. He was involved in many projects, mainly forensic engineering, and concrete rehabilitation. His research at AUT focuses on developing eco-friendly cementitious materials as an alternative to conventional Portland cement. The cement binder is composed ofindustrial by-products such as fly ash, slag and metakaolin, activated with the alkaline activator to produce Alkali Activated Materials (AAMs), which can be utilized in the form of paste, mortar, and concrete. His research on the hybrid one-part alkali-activated mortar has been selected and awarded the Doctoral Scholarship under The School of Future Environments (SoFE), AUT, for the research on green and sustainable construction materials technology.

Stabilizing Effects of Discrete Deviators on Spatial Stability of Thin-walled Steel Beams Pre-stressed by a Tendon Cable

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2066, Seobu-ro, Jangan-gu, Suwon-si, 16419, South Korea

Abstract

A spatial stability theory of thin-walled beams pre-stressed (PS) by a tendon cable is proposed considering bonded/un-bonded deviators where their cross sections are mono-symmetric. As seen in Figure, it is assumed that simple/cantilever steel beams are subjected to a combined compressive force and bending moment caused by the tendon cable, rigidly connected to discrete deviators. The presented theory is consistently derived based on centroid-centroid formulation and adopting concept of semi-tangential rotations. As a result, total potential energies of the pre-stressed system are newly derived depending on the number of deviators. Buckled equilibrium equations are analytically and numerically solved and compared with FE solutions by Abaqus. Through buckling analysis, stabilizing effects of the deviators are demonstrated on flexural and lateral-torsional buckling strength of mono-symmetric PS steel beams pre-stressed by the tendon cable.

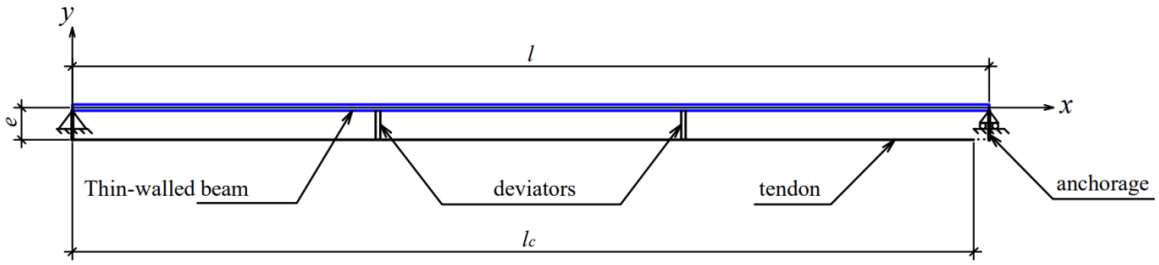

Figure. An initial configuration of a simple beam with two deviators and tendons before pre-stressing

Quite interestingly, critical buckling loads of the present PS system are drastically increased with increase of deviators. This is because intermediate deviators can act as a virtual bracing in the buckled state so that vertical and lateral components of the initial tendon forces can suppress buckling occurrence of the PS system. In consequence, in the case of buckling problems of the PS beams due to initial pre-tension, it is clear that both effective buckling and laterally unsupported lengths can be greatly reduced thanks to stabilizing effects of the deviators. In addition, it is found that in-plane and out-of-plane buckling loads of mono-symmetric simple beams pre-stressed by a single tendon with deviators are identical to those of PS cantilever beams under warping free conditions

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Keywords
Mono-symmetric thin-walled beam, Pre-stressed beam, Un-bonded deviator, LTB

Biography

Professor Moon-Young Kim received his Ph.D. (1987), M.S. (1984), and B.E. (1981) from Seoul National University in Department of Civil Engineering. He started his research career as a post-doctoral researcher (1988) in the same University. After three years, he became assistant professor (1991) at Sungkyunkwan University in Department of Civil Engineering. His research activities have been about stability analysis and design of thin-walled steel beams and bridge engineering. His recent interest is about dynamic interaction analysis of Maglev-guidway structures, initial shaping analysis of cable-stayed and suspension bridges, and spatial stability of pre-stressed steel beams with deviators. As his research results, he has published more 50 peer-reviewed, internationally recognized papers. According to Google Scholar, he has received about 2,000 citations.

Use of Wastewater As Curing Medium And Wastewater Sludge For Lightweight Concrete

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[2]Institute for NanoEngineering Research (INER) and Department of Chemical Metallurgy and Materials Engineering, Tshwane University of Technology, Pretoria, South Africa

Abstract

The search for lightweight materials for construction has led to the use of sludge as a viable replacement for the basic composition of concrete due to its low density. The increasing population have resulted in a higher generation of domestic and industrial wastewater sludge. The sludge ends up as a landfill in designated areas, making the land unusable. The dry sludge collected from Polokwane Waste Water Treatment Works (WWTP) in Limpopo Province was used as a partial replacement for sand in concrete, prepare various concrete cubes that are cured in both wastewater and potable water The investigation is to sample and characterize the wastewater dry sludge for physical, chemical mechanical and microbiological properties, evaluating the differences in organic composition in sludge using a scanning electron microscope (SEM), X-ray diffraction analysis (XRD) and energy dispersive X-ray (EDX) and testing for soluble metal leaching by immersing the concrete sample in iodine water and wastewater for 28, 90 and 140 days. The sludge content in the sand varied from 2.5, 5, 7.5, 10, to 12.5%. The analysis outcomes indicate that the partial replacement of sand with 7.5% dry sludge in the concrete mix is viable and useful and can be used in lightweight structural applications. Also, The blending of aggregates with wastewater sludge led to a significant reduction in leachable heavy metals, reduced environmental pollution, and the leachate heavy metal concentrations were below the USEPA Toxicity Characteristic Leaching Procedure (TCLP) limits and Volume 3 Guidance for wastewater disposal in South Africa (Hermelse, 2006). The EDX analysis of sludge-based concrete reveals a significant decrease in the weight/percentage of metal content when compared to wastewater sludge. The morphology of the sludge was spongy and porous, while the surface morphology of the sludge-based concrete was found to be heterogeneous with christal and gelly elements. The sludge based concrete can be used for minor maintanence of WWTP's structural works and wastewater can be used as medium curing for concret.

Biography

Kobe Samuel Mojapelo has twenty-one years' experience in the Engineering and Built Environment industry,specializing in materials, road structures, structural engineering, rehabilitation of structures and heavy earthworks design. He has extensive experience in project conceptualization, economic, financial analyses, project management, and contract administration in the public and private sectors.

He co-founded SML Projects, a civil engineering consulting firm operating for over a decade. He has been instrumental in the ISO 9001:2015 certification of the firm, working tirelessly to ensure that quality control and quality assurance are- and remain at the forefront of managing and delivering projects. He also served as a Director of Mocha Labs, a civil engineering laboratory which received its South African National Accreditation System (SANAS) certification in 2017.

He is a registered Professional Technologist with the Engineering Council of South Africa (ECSA), holds a master's degree in Civil Engineering and is currently pursuing a PhD in Civil Engineering at Tshwane University of Technology. He aspires to see a radical change in the Engineering and Built Environment and intends to be at its forefront by mentoring research students.

Efforts to Minimize Environmental Pollution in the Construction Industry

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Abstract

Globally, due to climate change, problems such as drought, heat waves, and sea level rise are occurring. One of the major causes of climate change is greenhouse gas, and international regulations on greenhouse gas emission are being strengthened. In addition, building energy plays a key role in the energy sector, as building energy accounts for more than 40% of global energy use and greenhouse gases (GHG) account for 40-50% of global energy. Therefore, the construction industry and building energy are recognized as a major cause of environmental pollution, and it is important to quantify and evaluate building energy and environmental loads. The construction industry was plagued by dependence on conventional methods, interfacing, scheduling, underutilization of space, cost, and quality.The reason is that each factor in the construction industry influences each other and is intricately intertwined. Therefore, it is necessary to make efforts in various aspects to minimize environmental pollution in the construction industry.

Keywords

Construction Industry; Environmental Pollution; Environmental Loads; Energy Use

Biography

Jeeyoung Lim is a research professor at Department of Architectural Engineering, Kyunghee Universityin South Korea. She was a lecturer and a researcher at Department of Architectural Engineering, Pusan National University in South Korea. And she was a lecturer and a researcher at California State University Long Beach, USA from 2019 to 2021.She has teaching experiences at the United States and South Korea for 5 years. She studied Construction Engineering and Management at the department of architectural engineering, Kyunghee University in South Korea. She had joined three Korean construction firms,Iksungtech Co., Ltd, Kunwon Architects & Engineers Corp., Universe Top Engineering Architects.Through the experience of a total of 5 years and 5 months, including a sales engineer at a construction management company and a director of technologies laboratory at a construction panel manufacturer, she has accumulated practical knowledge and achievements. And she participated in the 2016 Hyundai E&C technology competition and received a bronze statue under the theme of 'The System Form for Concrete Casting in the Girder Bridge Slab' to verify technology development capability. She participated in the in-situ production application of precast concrete members at Cheonan. And she had practical knowledge for risk analysis of in-situ production.

Estimation of the FRP Durability Based on Accelerated Tests

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Abstract

It is known that all materials used in the construction industry are subject to the influence of degradation mechanisms. In the context of reinforced concrete elements strengthened with composite materials, it is generally verified that degradation directly affects the most sensitive part of the strengthening system, the bond between the concrete substrate and the FRP composites using epoxy adhesives. Thus, the present work aims to evaluate the long-term behaviour of EBR-CFRP strengthening systems durability using the Accelerated Conditioning Protocol (ACP) presented by ACI 440.9R (2015). Subsequently, the ACP results were compared with those maintained in a laboratory environment and natural weathering. The results showed that epoxy adhesives presented reductions in their mechanical properties, while CFRP composites remain unchanged after being held in a laboratory environment or exposed to accelerated degradation. It was also verified that the use of the strengthening system provides huge increments of the load-carrying capacity and stiffness of the beams. However, it was found that the tests carried out after an accelerated degradation cycle lasting 1,000 h (42 days of exposure) and those carried out after six months of weathering exposure showed a reduction of approximately 10% in the load-carrying capacity of the strengthened elements, indicating a possible degradation of the strengthening system.

Keywords

Reinforced concrete beams; EBR strengthening; CFRP; Accelerated degradation; Natural weathering

Biography

Gláucia Maria Dalfré: She is Adjunct Professor 4 at the Federal University of São Carlos (UFSCar), in Brazil, and a visiting professor at the University of Birmingham (2022), in the UK. She holds an M.Sc. in Structural Engineering from the University of São Paulo (SET/EESC/USP) and a PhD in Civil Engineering from the University of Minho (Uminho/Portugal). She has been teaching various engineering courses at undergraduate and postgraduate levels. Her research topics are strengthening reinforced concrete elements with FRP materials, FRP bars, TRC/TRM composites, and durability tests. She has authored or co-authored 80 papers in Journals and Conference Proceedings and recently published the book “Fiber-reinforced polymers in civil construction: design of strengthening systems and non-metallic reinforcements applied to bend and shear according to ACI standards”, in Portuguese. She is a member of the Brazilian committees IBRACON/ABECE CT 303 - Use of unconventional materials on

structures of concrete, fibres, and fibre reinforced concrete, working in the TG 2 (strengthening of existing concrete structures with unconventional materials) and TG 3 (Concrete structures reinforced with non-conventional materials).

Guilherme Aris Parsekian
BSc in Civil Engineering from the Federal University of São Carlos - UFSCar (1993), MSc (USP, 1996, distinction) and PhD (USP, 2002. He had worked at the University of Calgary as a Postdoctoral Fellow (2006-07) and as Visiting Scholar (2016-17). Prior to his academic career, he worked as a structural engineer designing structural masonry and reinforced concrete buildings. He is currently an Associate Professor at UFSCar, coordinating a group and laboratory dedicated to masonry research and learning. In 2012 he co-chaired the 15 IB2MaC. In 2016, he was awarded “Person of the Year" by the National Clay Industry Association. In 2021 he was appointed to the “Lobo Carneiro Award” by the Brazilian Concrete Institute. He was a guest speaker at the 9 IMC (Portugal, 2014), 12 NAMC (USA, 2015), 50CCMC/13CMS (Canada, 2017), and others. He currently chairs the Brazilian Masonry Standards Committee.

Theoretical Model of Linear and Non- linear Concrete Creep without Empirical Coefficients

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Abstract

Creep is increasing deformations in time under constant stresses at uniaxial compression. Linear and nonlinear creep of concrete elements are investigated theoretically. There are no strong dependences between these two types of creep in existing design codes. When linear creep becomes nonlinear, the concrete modulus of elasticity changes and therefore energy, dissipated by the concrete section at linear and non-linear creep, are different. Accurate values of creep are important for proper design of concrete elements at service and ultimate limit states. The present study analyses linear and non-linear creep and proposes a creep effect algorithm. The methodology is based on Structural phenomenon and new theoretical concepts, using just one empirical coefficient, related to non-linear creep, when the exact lifetime of the structure is unknown. The results of this study can be used to perform more accurate and rather simple design of concrete elements, considering creep.

Keywords

concrete creep; linear and non-linear creep; elastic and elastic-plastic potential of an RC system at creep; Structural Phenomenon

Biography

ProfessorIakov Iskhakov has 60 years of scientific experience, more than 130 publications, 5 monographs and 6 textbooks.

Contribution of the Engineering Community to the Emergency Management System during the 2020 Petrinja Earthquake Response

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Abstract

The Croatian Emergency Management System is in the development phase and one of the greatest potentials for further development is the recognition and the involvement of all potential stakeholders and contributors who primarily work outside the system. One of the mentioned potential stakeholders is the engineering community, which is a recognised and important part of the emergency management system in some countries. In most national systems engineers are primarily involved in the creation of standards and regulations and to bring scientific knowledge and its implementation into the system, but their role in the response activities is getting more recognition.

A great example of this is the 2020 Petrinja earthquake, where engineers were a significant part of the response process at the national level. This event can serve as a case study for the contribution of engineers to the emergency management system response phase, highlighting importance of their role in the response, but also of the general situational use of the volunteers in the emergency management system.

More than a thousand engineers, from the entire country and even from abroad took part in the activities coordinated by the Croatian Centre for Earthquake Engineering, which served as the focal point of the engineering efforts in the response. Engineers volunteered for days, weeks and even months carrying out multiple activities out of which most important one was the building damage and usability assessment. The extent of the contribution of the engineering community can be easily analysed by investigating the other emergency management efforts and even other governmental efforts that relied on the activities carried out by the engineering community, with the database of building damage and usability being the primary source.

The volunteering aspect of the engineering community contribution is crucial. Without the more than a thousand volunteers who were officially not part of the emergency management system, the activities of the Croatian Centre for Earthquake Engineering could not have been completed in a reasonable time. The problems that had risen from engineers volunteering after the 2020 Petrinja Earthquake were related to the lack of awareness from the emergency management system, as well as the engineers themselves, about their potential role. With better preparation of the entire engineering community, their contribution would be much

higher and it is something that has to be improved in the years to come.

This is just one example that efficient Emergency Management Systems have to start recognising the potential stakeholders and focus on using them to secure the development of the system. While engineers have to recognize their potential role in the post-disaster system and prepare for the potential need for their services.

Keywords
Civil Engineering; Volunteers; Emergency Management Systems; Disasters

Biography

Master in Crisis Management from University of Applied Sciences Velika Gorica (Croatia). Currently a PhD candidate in the field of the Security Studies at the Faculty of Faculty of Criminalistics, Criminology and Security Studies University of Sarajevo (Bosnia and Herzegovina).
Employed at the Croatian Centre for Earthquake Engineering (CCEE) at the Faculty of Civil Engineering University of Zagreb on the project of Earthquake Risk Assessment of the City of Zagreb as the project administrator.
One of the founders of Croatian Centre for Earthquake Engineering – Intervention Service (CCEE-IS), an NGO founded for organising participation of engineers in Civil Protection System of Republic of Croatia. At the CCEE-IS serving as the Management Board Member responsible for Operational activities. During the first year responsible for most of the CCEE-IS activities which were mainly directed towards setting up the organisation for future development.
Also, inside the CCEE-IS serving the role of a Coordinator of all the CCEE-IS activities in the disaster struck area following the 2020 Petrinja Earthquake which include assessing the damage and usability of the affected buildings and infrastructure, assessing the need for urgent demolition of most damaged buildings, managing of the building damage and usability database, providing data and expert knowledge to other participants of the Civil Protection System and reconstruction process.
As a Coordinator, regular participant of the meetings of the National Civil Protection Headquarters for mitigating the consequences of the devastating earthquake, where all the strategic decisions are made.

Energy-Efficient Coating Approach For Free-Standing Porous Thin Films

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Abstract

The spin coating technique has been widely used to prepare thin films and coatings. It is easier to use, less time-consuming, less energy-intensive, and provides reproducible results. It is observed that such a user-friendly and quick process has hardly been explored to prepare polyolefin-based free-standing porous or nonporous thin films. The possible reasons could be as follows: In the thin film coating technique, polymers used are dissolved in a good solvent at ambient temperature; thus, the solution remains in a soluble state, which is a requirement of coating. These polymers can be coated on the material of interest, or they can be coated on the solid substrate, and after coating, they can be peeled off using an aqueous or non-aqueous soluble sacrificial layer or without the use of a sacrificial layer. On the other hand, polyolefins, such as polypropylene, a semi-crystalline polymer, cannot be dissolved in any solvent at ambient temperature. Secondly, it is only used for coating a layer on the substrate. The coated layer is not intended to be removed from the substrate. Thirdly, spin-coated polypropylene films do not have sufficient strength to be considered a free-standing thin film, i.e., these films couldn't maintain their integrity without a supporting layer or a substrate. Herein, we report a free-standing thin film of at least 2 µm made from polypropylene which can be used in various applications with minor modifications, such as in coating layers on the solid surface, porous sorbent, filtration membrane, and battery separator.

Keywords

Spin coating; Thin film; Polymeric film; Polymer coating

Biography

Dr. Junaid Saleem obtained his Ph.D. in Chemical & Bimolecular Engineering from Hong Kong University of Science & Technology in 2014. He is a material scientist and currently working at Hamad Bin Khalifa University, Qatar Foundation. His research interests lie in wastewater treatment and advanced material fabrication.

VIRTUAL PRESENTATIONS

A New Foundyn Module in Openfast to Consider Foundation Dynamics of Monopile Supported Wind Turbines Using A Site-Specific Soil Reaction Framework

Lilin Wang [1]

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Abstract

A FounDyn module is created in OpenFAST to consider foundation dynamics, which is an appealing supplement to the current version of OpenFAST. The FounDyn module receives the motions from the SubDyn module and sends the forces back to the SubDyn module. In FounDyn, the soil-monopile interaction is captured using a site-specific soil reaction framework. The soil reaction framework possesses the same configuration of the semi-analytical 1D model to consider effects of large plie diameter and small pile aspect ratio but uses new site-specific soil reaction models. The soil reaction models are nonlinear and hysteretic, which match the desired modulus reduction curve by identifying three parameters in a hyperbolic function and a linear function using genetic algorithm (GA), and the desired damping curve by applying the Ishihara-Yoshida rule that controls the unloading-reloading curves iteratively through three parameters. The FounDyn module is verified by the well-confined OC3 project in terms of modal frequencies, tower top displacement and shear force and moment at the mudline, and reasonable agreements are achieved between them. A series of dynamic analyses of the NREL 5MW wind turbine are performed for normal operation and emergency shutdown using the OpenFAST plus FounDyn module, in which the statistical or time-history responses are evaluated. The results show that the fixed foundation underestimates the moment at the mudline largely while the API p-y curve overestimates that significantly. Neglecting the damping contribution leads to the increase of peak value and cyclic amplitude by 18% and 22%, respectively. The earthquake excitation is found to be the design driving load, prevailing over the wind excitation for the design of wind turbine supporting structures.

Keywords

Wind turbine; Monopile; FounDyn module; Site-specific soil reaction framework; API p-y curveWind turbine; Monopile; FounDyn module; Site-specific soil reaction framework; API p-y curve

Biography

Dr. Wang obtained his master's degree in civil engineering from Tongji University in China in 2016. Later, he obtained his doctoral degree in civil engineering from University of Tokyo in Japan in 2019. He is currently a project assistant professor in University of Tokyo for Laboratory of Joint Program for next generation of energy infrastructure funded by J-POWER, Shimizu Corporation, Toshiba Energy Systems & Solutions Corporation, MHI Vestas Offshore Wind Japan, ClassNK. He has interests in Wind Turbine Engineering, Marine Structural Engineering and Marine Geotechnical Engineering, acting on the following topics: soil-structure interaction, integrated design of offshore wind turbine and smart maintenance of offshore wind turbine.

Corrected Rock Fracture Parameters, Mohr-Coulomb Values And Other Empirical Considerations for Rock Masses of Doha, Qatar

Hrvoje Vučemilović[1]

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Abstract

In this talk we will review some recent progress on the design and nanoengineering of carbon and inorganic nanomaterials for tailored applications. Special emphasis is paid to exploit the synergies of both types of materials by the preparation of nanohybrids with novel or enhanced properties.

The rock formations of the State of Qatar, and in particular those under its capital city of Doha, have seen countless construction projects undertaken over the past couple of decades. But the random nature of their intact rock and rock mass properties has until now been a considerable obstacle in attempts to narrowly scientifically describe them, and unify both small-scale and large-scale observable properties. The rock masses of Doha and Qatar have already been subject of research by other authors with varying degree of scientific scrutiny applied on the subject. With these previous works having revealed some aspects of their nature, this lecture attempts to go a step further.
The objective of this lecture is to provide insights into the intact rock and rock mass properties of the rock formations under the city of Doha, State of Qatar. It is also intended to scientifically clarify these properties by presenting and statistically characterizing the ranges of the parameters, and by discussing the correlations between the parameters with respect to their usage and research potential. The rock quality designation corrected (RQDC) parameter is validated and a new parameter, the fracture index corrected (FIC), is proposed. The significantly improved correlation between RQDC and FIC is demonstrated and their derivation is explained. The lecture demonstrates the correlation between the rock mass estimation parameters obtained through rock face mapping and discusses the applicability of the Hoek–Brown criterion to the studied rock masses, which is found to be relevant. A discussion about how properly performed triaxial tests can directly provide the rock constant mi values for all geological members is presented. Other estimation approaches for mi are also validated and compared with the existing knowledge base. Data for laboratory and field intact rock and rock mass parameters are combined using equations from various authors to obtain narrow ranges for rock mass strength and rock mass elasticity modulus values. Finally, within the framework of previous studies by other authors on the low-end transition range of rocks toward soils, it is shown that only the Rus formation member is sufficiently soft and can be included in the range.

Likewise, among practitioners, designers and researchers, modern-day geotechnical software packages still predominantly use Mohr-Coulomb (MC) input modelling parameters, despite the immense computing power of today's software and hardware. The same applies to this field of work in the State of Qatar. However, because the calculation of MC parameters for Qatari rocks has been inconsistent with varying results, this lecture aims to demonstrate the most appropriate derivation method for MC parameters. To do so, we must first obtain or estimate proper Hoek-Brown (HB) parameters, followed by an appropriate conversion method. Such an approach can remove the uncertainty and high variability of geotechnical estimations and design inputs. The technique demonstrated uses the approach of Hoek and Brown (1997), presented in Appendix C. This method simulates triaxial tests using data-based estimated mi values and is suitable because there are very limited valid triaxial test results for Qatari rocks.

Keywords
Qatar; Rock mechanics; Corrected rock fracture parameters; Mohr-Coulomb values

Biography

Hrvoje Vučemilović is a 45-year-old civil engineering professional with a master of science title, of Croatian nationality. He is a resident of Qatar and an active participant in its' private construction sector on the side of Contractors. He has 15 years of professional experience whereof 10 years he has been active in Qatar. He is currently pursuing a PhD title at his home university in Croatia but his research subject, as is visible from the title, is bound to Qatar and the Gulf. During the course of his PhD efforts, he has produced and published 2 research papers in the Geotechnical and Geological Engineering journal. He is currently finalizing his PhD thesis which he expects to wrap up by end of year 2022. He is a proponent of an idea that institutions of high learning in the Gulf countries should assume initiative for geotechnical research on their home soil and rock masses, which to date has been, for the most part, in hands of their construction sectors.

Use Of Rpas (Drones) For Masonry Arch Bridges Inspection: Quality And Sustainable Work With Preventive Guarantee

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Abstract

Using of remotely piloted aircraft system (RPAS), better known as drones, has spread with multiple and very diverse applications on last years. It includes civil engineering structures inspections. Starting from several real structural inspections of masonry arch bridges, this conference was born. The inspections were conducted by the author experimentally, in order to demonstrate that the aircraft can serve as a quality tool to make this work that is being carried out by qualified personnel and expensive auxiliary means currently. At the end, the author tryes to demonstrate that we can obtain identical or even better quality results, reducing the health and safety risks for the workers who do that work, with time and costs significant savings.

Keywords

Drones, Heritage Buildings, Bridge Inspection, Structure

Biography

Rubén Rodríguez Elizalde is Geologist and Civil Engineer, PhD in Architecture and Heritage and Senior Occupational Health and Safety Degree. On professional level, he is specialized in pathology and structural rehabilitation. In addition, he has carried out preventive management tasks, fundamentally in construction, metal and entertainment sectors for the last fifteen years: he has worked as execution director, health and safety coordinator on project phase and health and safety coordinator on execution phase. In this sense, he has been health and safety coordinator of great renown works in Spain. Currently, he is a professor at various university centers, such as Universitat Oberta de Catalunya (UOC). In addition, he is Member of the National Association of the Technical Inspection of Structures in Spain, member of the Geology Applied to Engineering Spanish Association and member of the International Association for Engineering Geology and the Environment. In addition, he is Technical Director at EIP, company specializing in structural rehabilitation and prevention management in the construction sector. As a final anecdote, it should be noted that Rubén is a Remote Piloted Aircraft (RAP) Pilot and a Pilot Instructor and Examiner. That is why he can talk us about both aspects fusion: he can talk about the application and use of drones for monitoring construction structures.

Decentral Hydrogen

Paul Grunow

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Abstract

Decentral hydrogen is introduced as fast transition path to short and long-term power storage. It circumvents slow infrastructure installments and enables on-site storage and heat coupling in addition to direct use of local electric power. The power-to-gas approach is extended to small combined heat and power devices in buildings that alternately operate fuel cells and electrolysis. While their heat is used to replace existing fossil heaters on-site, the power is either fed into the grid or consumed via heat-coupled electrolysis to balance the grid power at the nearest grid node. In detail, the power demand of Germany is simulated as a snapshot for 2030 with 100% renewable sourcing. The standard load profile is supplemented with additional loads from 100% electric heat pumps, 100% electric cars, and a fully electrified industry. The renewable power is then scaled up to match this demand with historic hourly yield data from 2018/2019. An optimal mix of photovoltaics, wind, biomass and hydropower is calculated in respect to estimated costs in 2030. In most master plans,hydrogen is understood to be a substitute for fossil fuels. This talk focuses on hydrogen as a storage technology in an all-electric system. The target is to model the most cost-effective end-to-end use of local renewable energies, including excess hydrogen for the industry. The on-site heat coupling is the principal argument for decentralization here. Essentially, it flattens the future peak from exclusive usage of electric heat pumps during cold periods. Batteries are tried out as supplementary components for short-term storage, due to their higher round trip efficiencies. Switching the gas net to hydrogen is considered as an alternative to overcome the slow infrastructure expansions. Further decentral measures are examined in respect to system costs.

Biography

Paul Grunow has completed his Ph.D at the age of 30 years from Technical University Berlin and Helmholtz-Zentrum Berlin and postdoctoral studies from the COPPE/UFRJ in Rio de Janeiro, Brazil. He is the general manager of Trinity Solarbeteiligungen GmbH, an investment company in renewable energies. Before, he co-founded three companies in the area of photovoltaics based in Berlin, i.e. Solon, Q-Cells, PI Photovoltaik-Institut Berlin. He has published more than 12 papers in reputed journals.

Innovative Approaches of the Usage of Wastewater Treatment Plant Biogas in Transportation

Çağrı ÜN[1]

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Abstract

According to 2021 data; in the city of Adana with a population of 2,258,718; a total of 102,396,301 m³ of wastewater was treated in a year. A total of 10,001,480 kWe of electrical energy was produced from a total of 5,394,346 Nm³ of biogas, which was generated as a result of wastewater treatment processes. This generated electrical energy covers the electricity costs of the facilities and also transmitted to the national grid.

At this point, the use of biogas produced from wastewater in transportation has been tried as an innovative step in recent years. Renewable liquefied biogas vehicles will help cities to control their climate goals and reduce their carbon footprints. 100% renewable biogas is an alternative to reduce CO2 emissions. The use of biogas reduces greenhouse gas emissions in the fuel's lifecycle by up to 90% and generates only a small fraction of local emissions compared to conventional fuels, improving urban and regional air quality.

The treatment of wastewater allows the production of green energy. Biogas is a renewable gas that is less polluting than fossil fuel, which can be used to power vehicles and in the generation of heat and electricity.

Wastewater sludge is a important source of biogas. Anaerobic treatment of sludge is able to produce biogas which is a potential renewable energy source. Anaerobic digestion is a sequence of the biological process by which microorganisms convert organic matters into biogas in the absence of oxygen. Biogas is composed of approximately %60 methane (CH4), %40 carbon dioxide (CO2) and trace amounts of other gases.

The invention describes a method of producing biogas for vehicles using highly concentrated organic wastewater and waste residues. One of the methods includes catalytic liquefaction of organic waste residues, fermentation by high performance liquid chromatography, biological anaerobic fermentation, biogas purification and biogas compression steps to obtain biogas for vehicles. One of the other innovative method is aimed at creating a biofuel from treated organic waste, which can then be used to power compressed natural gas (CNG) cars, whose CO_2 emissions would be cut by up to 80 percent. One another system removes nitrogen from the biogas, before it's further cleaned, refined and compressed into CNG for use in vehicles.

It can be seen that such applications will be implemented in urban traffic in the future. And in

this way, significant reductions in carbon emissions will be seen.

Keywords
Biogas; Renewable Energy; Alternative Fuel; Emmission

Biography

Çağrı Ün was born in Adana, Turkey. He graduated from Istanbul University, Department of Chemical Engineering-BS (2008). He completed his MSc (2014) and PhD (2021) degree in Çukurova University. He also graduated from Anadolu University, Business Administration Department (2016).

He has been working at Adana Metropolitan Municipality since November 2010. He has a lot of NGO experiences. In May 2017, he was selected as a Member of International Waste Working Group (IWWG) as a result of his academic and governmental work of waste and environmental management.

Çağrı Ün has many academic scientific publications and many professional certifications (in the fields of waste, environment, innovation, quality and project management). He attended many national, international seminars and panels. He works as Public Officer for Adana Metropolitan Municipality at EU, World Bank and Development Agency projects. He has a National & International Mentorship certificate.

He did scientific and academic studies at USA, Austria, Australia, Belgium, China, France, Iran and Italy. He is married and has two girl.

Fire performance of Prestressed Polypropylene-Fibre-Concrete Bridge Girders

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Abstract

This paper presents an investigation on fire performance of prestressed polypropylene-fibre-concrete (PPFC) bridge girders. Three large-scaled simply supported PPFC test girders with thin web including one box-shape sectional girder and two twin I-shape sectional girders, under localized hydrocarbon fire exposure conditions, were carried out to analyze fire performance of PPFC bridge girders. Taking consideration into load level and section type, temperature in concrete and prestressing strands, mid-span deflection, effective prestress, crack, concrete spalling and fire resistance were attained. The research results show that temperature of each measuring point increases with fire exposure time through fire exposure duration. Evaporation of water within concrete has a significant influence on temperature in concrete when is between 100 and 120 ℃. Temperature of internal concrete and prestressing strands continues to rise when fire is stopped. Temperature in concrete and prestressing strands of box-shape girder is lower than that of twin I-shape girder. Polypropylene fibre added into concrete can significantly enhance spalling resistance of concrete. PPFC bridge girders exposed to localized fire show obvious brittle failure characteristics due to fracture of prestressing strands. Fire resistance of box-shape girder is significantly better than that of twin I-shape girder. Increasing load level can make fire resistance of PC girder decrease significantly.

Keywords

Prestressed polypropylene-fibre-concrete bridge girders; Fire performance; Fuel fire test; Failure mode

Biography

Dr. Gang Zhang is a University Distinguished Professor at Chang'an University (CHD). He serves as Director of Research Center on Bridge Extreme Loading and Protection, and Deputy Director of Bridge Disaster Prevention and Mitigation Research Office and Head of Bridge Structure and Material Fire Laboratory at Chang'an University, and also Deputy Director of Energy-Absorption-Device Technology Innovation Center of Bridge at Hebei Province. He has been "elected" as "Fellow" of the International Association of Advanced Materials and Vebleo-Science, Engineering and Technology.

Prof. Zhang's expertise is on the evaluation and protection of bridge structure and material behavior under extreme fire conditions. His research has focused on the experimental behavior, analytical modeling and numerical prediction of bridge structure under extreme fire exposure conditions, constitutive modelling of material properties at high temperatures, fire-resistant design of bridge structure, and bridge collapsed investigations. He has developed fundamental understanding on the behavior of bridge structure and materials subjected to extreme fire

hazard. His research accomplishments, in the field of bridge fire safety and material at elevated temperatures, has great contribution and major impacts to improve development of disaster prevention and mitigation in transport infrastructure. Prof. Zhang, along with his students and collaborates, has led to over 130 peer-reviewed papers in journals and conferences. The most recent contribution from Zhang is a new text book on “Bridge Structure Fire Theory and Calculation Method” published by China Communications Press.

Autonomous Flight Methods of UAV for Structural Health Monitoring

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Abstract

During last 10 years, computer vision based structural damage identification methods have been proposed, and their integration with advanced deep learning network contributed to significant improvement of quality of damage detection in terms of automation, accuracy, reliability, and robustness. However, to monitor large scale infrastructures, many cameras should be installed, therefore, to tackle this limitation, unmanned aerial vehicles (UAVs) have been actively adopted in structural health monitoring (SHM). All of the UAV applications in this SHM field were relied on manual control of the UAVs which requires very careful flight control that should be done by experts which is expensive and not feasible to monitor numerous numbers of infrastructures. To overcome these critical limitations and facilitate computer vision and UAV based inspection, the authors developed first autonomous UAV system that can be applicable to GPS available and denied areas. Especially beneath bridge deck is the critical location in terms of safety that should be monitored where the GPS is very weak or not available. In this presentation, the author will present state of the art methods in autonomous flight systems of UAV which are carefully integrated with advanced deep learning for SHM.

Keywords

damage detection; autonomous flight; UAV, deep learning

Biography

Professor Young-Jin Cha received his Ph.D. (2008) from Texas A&M University in the Department of Civil and Environmental Engineering. He served as a post-doctoral associate at the Massachusetts Institute of Technology (MIT) until 2014. He then joined the Department of Civil Engineering at the University of Manitoba in 2014. His key scientific contribution is advanced deep learning-based automated structural health monitoring (SHM) with autonomous unmanned aerial vehicles (UAVs). He was reported as top 0.45% and 0.65% cited scientist within Civil Engineering field and top 2% cited scientist in all areas for single year impact in the world in 2020 and 2021 from the Mendeley metadata of citations analyzed by Elsevier and coordinated by Stanford University. He received an IAAM Scientist Award in 2022 and was named to 2005 Who's Who in America,' organized many symposiums in the MIT and Caltech through Engineering Mechanics Institute Conferences with the topics of Deep Learning and Autonomous UAVs for SHM. He is serving as an Associate Editor in Engineering Report, Wiley and International Conference on Patten Recognition, Editorial Board Members, and core peer-reviewers and in many top engineering journals associated with ASCE, Elsevier, IEEE, and Wiley. He is also serving and was severed as Chairman, Co-Chairs and Technical/ Organizing Committee members in many internal conferences in his research discipline such as AI and SHM.

Inverse Problems in Vehicle-Bridge Interaction Dynamics with Application To Bridge Health Monitoring

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Abstract

This talk focuses on two classes of inverse problems arising in vehicle-bridge interaction dynamics. The identification of bridge parameters (damage) and the identification of vehicle parameters are the two typical inverse problems in the field. Specifically, indirect health monitoring strategy for bridges (bridge parameter estimation) using an instrumented vehicle has achieved much interest in recent years. The first part of the talk presents a theoretical framework for damage identification of bridges where one avoids the use of bridge response data (which has practical implementation difficulties along with the high chances of corruption with environmental noises) and utilizes the vehicle response data. The method involves integrating Tikhonov regularization scheme with signal averaging technique to successfully extract the bridge damage components. Numerical results justify our claim that the proposed theoretical framework is capable of detecting the magnitude as well as the location of damage. The second part of the talk briefly presents a novel simultaneous state-input-stiffness estimation framework for nonlinear dynamical systems which is essential for process monitoring and control. The technique unifies an unbiased minimum variance estimator from the data assimilation context with the Moore–Penrose pseudo-inverse to achieve the objective. A few numerical results on prototype problems will be presented to demonstrate the effectiveness of the approach.

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