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Abstracts

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CONDITION ASSESSMENT OF REINFORCED CONCRETE BRIDGE DECK USING GROUND PENETRATING RADAR

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Catastrophic bridge failure happens due to the lack of inspection, lack of design and extreme events like flooding and earthquake. Bridge Management System (BMS) is utilized to diminish such an accident with proper design and frequent inspection. Visual inspection cannot detect any subsurface defects, so use of Non-Destructive Evaluation (NDE) techniques remove these barriers as far as possible. Among all NDE techniques, Ground Penetrating Radar (GPR) has been proved as a highly effective device for detecting internal defects in reinforced concrete bridge deck. GPR is used for detecting rebar location and rebar corrosion in the reinforced concrete deck. GPR profile is composed of hyperbola series in which sound hyperbola denotes sound rebar and blur hyperbola or signal attenuation shows corroded rebar. Interpretation of GPR images is implemented by numerical analysis or visualization. Researchers recently found that interpretation through visualization is more precise than interpretation through numerical analysis, but visualization is time-consuming and a highly subjective process. Automating the interpretation of GPR image through visualization can solve these problems. After interpretation of all scans of a bridge, condition assessment is conducted based on the generated corrosion map. However, such a condition assessment is not objective and precise. Condition assessment based on structural integrity and strength parameters can make it more objective and precise. The main purpose of this study is to present an automated interpretation method of a reinforced concrete bridge deck through visualization technique. At the end, the combined analysis of the structural condition in a bridge is implemented.

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ULTRA-HIGH PERFORMANCE CONCRETE SHEAR KEYS IN CONCRETE BRIDGE SUPERSTRUCTURE

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This research investigated the use of locally produced ultra-high performance concrete (UHPC) as a grouting material to repair deteriorated shear keys. Shear keys are used in adjacent girder superstructures to produce monolithic behavior and load transfer across the structure. Shear key durability is a concern since shear key degradation can jeopardize the integrity of the structure. Transportation agencies in the United States have reported that 75% of distress in adjacent girder bridges is due to cracking and de-bonding along shear keys. Previous research has shown that locally produced UHPC has excellent mechanical and durability properties. UHPC has also been shown to have good bonding characteristics that are desirable in a potential grouting material. Several tests were conducted to evaluate the potential of UHPC as a shear key grout material. Bond strength between UHPC grout and substrate concrete was evaluated using slant-shear and direct tension tests. Results showed that adequate bond was achieved at seven days. Low strengths at 28 days were observed due to the low strength of the substrate concrete. Shrinkage of UHPC grout was also investigated. Shrinkage at 28 days was less than 600 μ strain which is acceptable for repair practices. Full-scale testing was used to evaluate load-deflection behavior of channel girder assemblages with grouted shear keys. Results showed that UHPC grout and non-shrink grout had similar mechanical performance. Excellent bond was achieved with all grouts, even with minimal surface preparation. In fact, the shear keys remained bonded to the girders even when service load deflections were exceeded and no lateral restraint, such as post-tensioning, was provided. The similar performances of the non-shrink grout and the UHPC grout indicates that UHPC grout does not provide a mechanical benefit over the non-shrink grout.

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EXPERIMENTAL STUDY ON FLY ASH AND GGBS BASED GEO-POLYMER AND ITS COMPARISON WITH COUNTRY BURNT BRICK

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The construction industry currently faces a number of challenges due to the depletion of conventional and non-renewable resources, accessibility and affordability, waste disposal and resulting environmental degradation. Cement is a widely used man-made material and an inevitable component of the industry. The cement manufacturing is both highly energy intensive and resource intensive process and their industry is one of the largest producers of carbon dioxide. The concept of geo-polymer is introduced as an alternative for cement, complying with the notion of sustainability in construction. This demands alternative materials that minimize the environmental impacts as well as utilising waste by products. This paper aims to find a sustainable building material using the concept of geo-polymer which is on par with the conventional bricks in terms of strength and durability. Various proportions of ground granulated blast furnace slag and fly ash was used to form the binder specimens and samples were casted. The samples were then compared with the conventional burnt clay bricks based on their strength characteristics and durability. This research established the potential of fly ash and ground granulated blast furnace slag as a source material for geo-polymer binder to replace cement. In addition, application of geo-polymer in building blocks, as a sustainable alternative to conventional building blocks and it's suitability in structural and sustainable construction was also verified through the study.

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EFFECT OF GAS OIL ON GEOTECHNICAL PROPERTIES OF ILLITE SOIL

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Development of the oil industry has increased the possibility of oil spillage into the soil. Oil pollution not only has serious environmental damages, but also it can change the physical, chemical and mechanical properties of soils. Clayey soils have complex behaviour in the presence of petroleum products. In order to better understand the complicated behaviour of oil-contaminated clayey soils, different laboratory tests were conducted on gas oil-contaminated illite soil. The amounts of gas oil were between 0 to 20% by soil dry weight. In this study, standard compaction and one-dimensional consolidation tests were performed to evaluate the effect of gas oil on the compaction and consolidation properties of illite soil. Also, direct shear and unconfined compression tests were done to investigate the strength parameters of contaminated illite. In addition, scanning electron and atomic force microscopes were utilized to study the effect of gas oil on microscopic properties of illite soil. The results showed a decrease in maximum dry density and an increase in optimum fluid content and compressibility of illite in presence of gas oil. The cohesion, internal friction angle and unconfined compressive strength of the soil reduced when it was exposed to the organic fluid. The results revealed that gas oil has adverse impacts on the geotechnical behaviour of illite soil.

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INTEGRATING BIM INTO FACILITY MANAGEMENT OPERATIONS

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Facilities such as residential buildings, office buildings and hospitals house has large density of occupants. Therefore, a low-cost facility management program (FMP) should be used to provide a satisfactory built environment for these occupants. Facility management (FM) has been recently used in building projects as a critical task. It has been effective in reducing operation and maintenance cost of these facilities. Issues of information integration and visualization capabilities are critical for reducing the complexity and cost of FM. Building information modeling (BIM) can be used as a strong visual modeling tool and database in FM. The main objective of this study is to examine the applicability of BIM in the FM process during a building's operational phase. For this purpose, a seven-storey office building is modeled Autodesk Revit software. Authors integrated the cloud-based environment using a visual programming tool, Dynamo, for the purpose of having a real-time cloud-based communication between the facility managers and the participants involved in the project. An appropriate and effective integrated data source and visual model such as BIM can reduce a building's operational and maintenance costs by managing the building life cycle properly.

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EFFECT OF WASTEWATER OF TEXTILE PLANT ON THE BEHAVIOUR OF STEEL BEAMS

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This paper reports the results of an experimental investigation on the behavior of steel I-beam cross sections in wastewater of textile plant. A total of eight beam specimens with a steel I-beam cross sections were tested under three point-loading. The specimens were divided into four groups and each group contains two specimens. The specimens in the first group (Group A) and third group (Group C) were plain without sebaceous resistance corrosion and immerged in the barrel contained normal water. The remaining four specimens in the second (Group B) and fourth (Group D) groups were painted with sebaceous resistance corrosion (Fe2O3) and immerged in the barrel contained wastewater. Before testing, all specimens were immerged for (normal water/ wastewater) more than 380 days. The effect of the wastewater on the performance of the beam specimens was investigated and discussed. The experimental results showed that the use of the sebaceous resistance corrosion provided an improvement in the strength of the beam specimens. In addition, the strength of the beam specimens that were immerged in the wastewater was significantly decreased compared to the beam specimens were immerged in the normal water.

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PUSH OUT TEST OF TIMBER CONCRETE COMPOSITE CONSTRUCTION

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In this study, push out test model is proposed to study the behaviour of shear connector in timber concrete composite beam. Since there is no standard method for determining the strength of connectors, pushout specimens, used for steel concrete composite beams are suggested to study the behaviour of connectors in timber concrete composite beams. Four specimens were tested. Two of these specimens were with one connector per side. The other two were with two connectors per side. The load and slip were recorded during testing. The results showed that the suggested dimensions and properties of pushout tests may be considered as a standard test for connectors in timber concrete composite beams.

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CRACK INDEX METHOD FOR DAMAGE DETECTION IN BUILDINGS

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Structural health monitoring of buildings is of vital importance due to the large number of people inhabiting them. It is important, also, to obtain damage indexes that reflect the real damaged physical state of structural elements. The new Crack Index Method (CIM) is presented to locate and quantify crack-depth in structural elements of buildings. To achieve this, the flexibility matrix of the structure in its damaged state is compared with the undamaged one, a rectangular system of linear equations is solved by means of the pseudo inverse method and singular value decomposition is applied to the so-called crack index matrix, which contains information on the crack-depth associated with each element. The CIM was applied to a three-story frame located in the lake area in Mexico City and to a frame belonging to the Secretariat of Communications and Transportation building damaged during the 1985 earthquake. In both, structures were correctly identified location and length of crack of their damaged structural elements. For these cases, the proposed method yielded excellent accuracy when calculating damage magnitudes with relative error values equal to zero when all vibration modes of the structure are known.

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CONTRIBUTION TO THE STUDY OF CONCRETE SEGREGATION

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Segregation is the unintentional separation of the fresh components of concrete or mortar, which can be caused by bad proportioning, insufficient mixing, or excessive vibration. Segregation can have negative impacts on the mechanical, transport, and durability properties of the cured product. While there are several tests that can measure concrete at the beginning of hardening or in its fully hardened state, these are generally based on the percentage of the coarse aggregates between the top and the bottom of the samples. Consequently, the results do not provide a full description of the state of the material or a basis for its long-term performance. To begin to address this deficit, this paper investigates the potential of using ultrasonic pulse velocity (UPV) as a means to identify and characterize segregation in traditional and self-compacting concrete (SCC), which is known to be particularly prone to segregation, because of its high fluidity level.

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DYNAMIC BEAM-SOIL INTERACTION BY THE SPECTRAL ELEMENT METHOD

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The structure-elastic medium dynamic interaction is studied by using the spectral element method. The spectral stiffness matrix is formulated in the frequency domain and upon solving the eigenvalue problem, natural frequencies are tabulated for the first three modes of vibration. Obtained results are of multiple objects, (1) the influence of the interaction between the beam and the elastic medium, (2) the influence of medium properties on the dynamic response (3) the influence of non-classical boundary conditions. Finally, the results of above phenomena are obtained and commented.

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MICROSTRUCTURAL INVESTIGATION OF TREATED OIL PALM SHELL LIGHTWEIGHT CONCRETE

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Oil palm shells (OPS) are lightweight and for the purpose of waste utilization from oil palm industries this can be used as coarse aggregate replacing existing granite based aggregate. But the gain of strength depends on bonding characteristics at microstructural level between constituent materials. In addition, oil palm shell absorbs water 24% higher than that of conventional aggregate. Hence, oil palm shell should be treated before use in concrete as aggregate to decrease the water absorption. In this study, microstructural investigation is carried out on lightweight concrete made with treated and untreated oil palm shells. The internal structure of OPS is having pores with sizes ranging from 0.23 µm to 10 µm. When water repellent coating is coated on the surface of the OPS as treatment, water repellent coating acts as hydrophobic layer on the aggregate and fills the pores. Microstructural analysis is carried out for both the treated and non-treated OPS and bonding between aggregate phase and matrix phase is observed in both the cases. For observing the morphology and mineralogical properties of these treated and non-treated OPS aggregates, scanning electron microcopy (SEM), X-ray diffraction (XRD) analysis is carried out.

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SIMPLIFIED NUMERICAL MODELING AND ANALYSIS OF SANDWICH CONCRETE INSULATED PANEL USING SAP2000

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Sandwich Concrete Insulated Panel (SCIP) Technology has been in use since 1960. Its early applications include aerospace applications and refrigerators etc and nowadays they are widely used in building construction. But the main problem with this technology is that there are no analysis and design guides for this technology. This technology has lack of proper analysis and design strategy. Softwares like ANSYS and ABAQUS etc are not much user friendly for typical analysis and design. Researchers have used these software's but they have not interpreted the proper results. Therefore, this thesis has been aimed at developing analysis and design guides for SCIP technology, using commercial software, SAP2000. In the first stage of this research, a typical SCIP panel has been modeled in SAP2000 load applied according to "four points bending method" and then analyzed. The incremental loads have been applied starting from 2.5 KN and displacement corresponding to every incremental load has been recorded. A graph of force and displacement is then developed. Finally, the graph obtained from SAP2000 results is then compared with experimental results of Mr Nouman (MS work). The SAP results show that the graph of SAP is straight and displacement values are near to zero. To match the results, loads are amplified with a constant value for SAP. For amplified load, the SAP result get matched to experimental result up to elastic limit, beyond this limit, there is difference between both results. This is due to the non linear properties of the material which are not defined in SAP2000. It is the limitation of this application SAP2000 make it non preferable software application for the analysis and design of sandwich panels for load at which material get crushed. In the end, we conclude that the buildings having SCIP technology can be modelled and analyzed using SAP2000 up to their linearity limit.

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EVALUATION OF STRENGTHENING LOCALIZED CRACKING OF TUNNEL LINING WITH STRAIN HARDENING CEMENTITIOUS COMPOSITES

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The lining cracking of mountain tunnel has always been a common engineering disease in traffic engineering, and the structural instability and leakage of tunnel caused by lining cracking seriously threaten the safety of tunnel operation. In this article, the strain hardening cementitious composites (SHCCs) characterized by the excellent deformation resistance and large energy absorption capacity is utilized to strengthen the cracked lining. Initially, the details of reinforcing lining process with SHCCs is introduced through a project. Moreover, the reinforcement effect is evaluated with relative stiffness K function based on three parameters: thickness of reinforcement layer h2, concrete damage factor d1, and strain hysteresis factor d2. The results obtained by employing a simplified tunnel reinforcement model show that in the case where the lining damage state d1 is equal, as the thickness of the reinforcement layer h2 increases, the K value also increases. And when the value of d1 decreases, the growth rate of K increases. The strain hysteresis factor d2 also has an important influence on K value, and the results demonstrates that as d2 value increases, however, the K value show an opposite trend. Combining with the project example and evaluation system, it is suggested that the SHCCs can be exploited to strengthen the damaged tunnel lining, and the present engineering experience can provide some reference for similar tunnel lining required to be rehabilitated.

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