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Feasibility study on a cumulative damage assessment method for a reinforced concrete slab under blast loads

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This study proposes a novel cumulative damage assessment method for a reinforced concrete (RC) slab using an equivalent single degree of freedom (SDOF) model. The proposed method utilizes a structural permanent deformation evaluted from the equivalent SDOF model and its newly constructed resistance function due to initial damage. In order to confirm an applicability and a limitation of the proposed method, a series of numerical simulations and experiments were carreid out. Three consecutive explosions were numerically and experimentally conducted at same detonation points with the same explosive weight for the one-way RC slab and for the two-way RC slab. As a result of comparison between numerical simulaions and experiments, it is sufficiently applicable to assess cumulative damages for a RC slab under blast loads, although the method has some limitation.

Biography

Seung-Hun, Sung has completed his PhD from KAIST. He is the Senior Researcher of the Agency for Defense Develeopment, South Korea. He has published more than 10 papers in reputed journals.

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Deformation and Stresses generated on a Bolted Flange Joint Assembly and Grayloc® Clamp Connector at Elevated Temperatures

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Finite element analyses were performed to investigate the leakage and structural integrity of the bolted flange joint assembly (BFJA) and Grayloc® clamp connector (GCC), when each assembly was subjected to the external loads of bolt preload, internal pressure and thermal loadings. The thermal loadings were of both spatially-uniform and spatially-nonuniform temperatures on the assemblies. The initial bolt preload applied on the BFJA and the GCC was 60,000 N and 6,000 N, respectively. The internal pressure for both assemblies was 27 MPa. The BFJA was found to have satisfactory leakage and structural performance for the thermal loadings expected on the low-temperature (260°C) side of the Carleton Supercritical Water (CSCW) loop. The GCC was found to have satisfactory leakage and structural performance for the thermal loadings expected on the high-temperature (600°C) side of the CSCW loop. The leakage integrity of the GCC was found to remain intact for a temperature difference of 15°C between the inner and outer surfaces of the flange. This was not the case for a temperature difference of 100°C.

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Bamboo - The Wonder Material For Sustainable Built Environment

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Guidance has been provided in NBC 2016 Part 11 'Approach to sustainability'. for making buildings and built environment energy efficient and environmentally compatible. In article 9.2.1.8 it is stated that Bamboo can contribute to sustainable development. Further it is stated that " as a building material, it had been abundantly used in the country for traditional huts and hermitages for long besides as scaffolds. With the understanding of its physical and mechanical properties, it has been recognized as an engineering material with scope of buildings and structures to sustain among others the lateral forces including earthquake forces,etc. Bamboo can be used as structural material in buildings. Bamboo structure shall be designed in accordance with Part6 Structural design, Section 3B Bamboo.Raw bamboo has been used as a structural material for centuries. Traditionally, the bamboo pole is used intact and tethered to adjacent poles to create a structure. The most significant advantage bamboo has over timber is found in its structural properties. All allowable stresses except for compression parallel to the grain are greater for raw bamboo than those of most wood species. This information indicates that raw bamboo poles are a good material for beams, but not necessarily for columns. If bamboo is laminated to form structural components, the material properties become significantly better than those of laminated wood. Laminated bamboo(LBL) is ten times stringer in tension and six times stronger in compression and flexure than laminated timber(LVL).and yet, laminated bamboo is only recently becoming a material of interest to designers. Other advantages of LBL are that it has 15% less embodied energy in processing than wood and is 20% more stable than wood in moisture and temperature changes. The code is silent on structural design using Laminated Bamboo structural components. Modular design, Pre frabricated unit and assembled at site , afordable housing unit with ECO aspects is a successful venture to be adopted in India.The building code shall be strengthned with sufficient design data and construction techniques and skill guidens.

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Discharge modelling in smooth and rough compound channels using genetic programming

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Discharge results observed from the experimental channels for smooth and rough surfaces, along with data from a compound river channel are used in the Genetic Programming. Model equations are derived for estimation of discharge in compound channel for various types of channel surfaces. Five hydraulic parameters are used for developing the model equations. Models derived are tested and compared with other soft computing techniques. Evaluations of all the approaches are carried out using five performance parameters. Finally, the effect of parameters responsible for the flow behaviour is shown through sensitivity analysis. GP is found to give the most promising results. This work aims to benefit the researchers engaged in modelling of discharge using machine learning techniques.

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Ranking the factors that influence the construction project success: Jordanian perspective

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Project success is what must be done for the project to be acceptable to the client, stakeholders and end-users who will be affected by the project. The study of project success and the critical success factors (CSFs) are the means adopted to improve the effectiveness of the project. This research is conducted to make an attempt to identify which variables influence the success of project implementation. This study has selected, through an extensive literature review and interviews, 83 factors were categorized in to 7 groups that the questionnaire respondents were asked to score. The responses from 66 professionals with an average of 15 years of experience in different types of construction projects in Jordan were collected and analyzed using SPSS and most important factors for various success criteria are presented depending on the relative importance index to rank the categories. The research revealed the significant group of factors which are: client related factors, contractor's related factors, project manager (PM) related factors, and project management related factors. In addition, the top ten sub factors are: assertion of the client towards short time of the project, availability of skilled labor, assertion of the client towards high level of the quality, capability of the client in taking risk, previous experience of the PM in similar projects, previous experience of the contractor in similar projects, decision making by the client/ the client's representative at the right time, assertion of client towards low cost of project, experience in project management in previous projects, and flow of the information among parties. The results would be helpful to construction project professionals in taking proactive measures for successful completion of construction projects in Jordan

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The effect of beam-column connections and soil on the seismic behavior of intermediate steel moment-resisting frames

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Soil structure interaction expresses the difference of structural responses between the actual and theoretical rigid based conditions and depends on the stiffness, mass and damping of soil and structure systems. Nowadays, moment resisting frame is one of the most common structural systems. Ductility of these frames is due to the flexural yielding of beams, columns and the shear yielding of panel zone of columns. The influence of modeling beam column connections and soil-foundation-structure interaction on the seismic responses of 10-story intermediate steel moment resisting frames that located on the two various soil types (II and IV) is studied in this paper. Prequalified welded flange plate connections (WFP) are used in these buildings. For this purpose, several 2D finite element models are developed using OpenSees software by assuming three conditions such as models with considering soil and beam-column connection effects, models with considering soil and without connections, models with fixed based and without considering connections. The maximum responses of the studied frames are calculated and compared with nonlinear time history dynamic analyses under seven far-fault earthquakes. The numerical results show that in the models located on soil type IV, considered connections, SFSI or just soil, the maximum lateral displacement and maximum inter story drift are more, compared to models without connections and with fixed based conditions. In the models rested on soil type II, some of these parameters are reduced. The maximum base shear of structures is reduced in the mentioned models.

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Evaulation of setting time of mortar cured various environmental conditions using electrical resistivity measurement

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The development of various non-destructive measurements involves study on the microstructure evolution of cement based materials. Electrical resistivity measurement is a method that can monitor microstructure evolution due to change in resistivity through hydration products by filling pore space. This study aims to measure electrical resistivity in order to investigate an affect of various environmental conditions. A same mix-proportion mortar samples are prepared to study the effect of curing various temperatures and various humidty ranges. As a result, the rising time, which is the onset of an increase in electrical resistivity, is shortened and the increasing ratio of electrical resistivity is increased at higher curing temperature where various humidity ranges are not significant effec.

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Behavior of continuous or semi-continuous steel-concrete composite beams

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Composite steel-concrete beams have been widely used in the design and construction of modern steel framed buildings. A steel-concrete structural beam consists of a steel structure as the major and concrete as the minor part. It can be achieved by a steel beam overlaid by a concrete slab, in which the connection between steel and concrete is achieved by using mechanical shear connectors (shear studs). Several methods have been introduced to construct steel-concrete composite beams as shown in figure 1 (Uy, 2007). The idea of composite sections refers to the development of shear connectors in the 1950's which has made practicable to connect the concrete slabs to the steel beams (Johnson, 1994). Rae et al., 2011 conduct a study to examine the steel-concrete composite structural frames. Dubai (2007) finds experimentally that shear connectors can be used partially in composite structural beams. Indeed, the composite steel-concrete structural beams should be studied under diverse loading conditions. For analyzing the composite beams under combined bending and shear stress there are not adequate references; even codes and standards do not cover this issue adequately (Liang et al., 2004). There is no doubt that concrete is strong enough in compression and steel in tension. However, regarding the composite steel-concrete beams, in the sagging moment locations where the steel is subjected to compression and concrete subjected to tension, it needs to be investigated conservatively. Mainly, this research investigates the behavior of continuous or semi-continuous beam at the negative moment locations. The loading condition of combined bending and shear will be covered. This work tries to investigate the problem numerically (Finite Element Method) using the computer software ANSYS, and the results will be compared with existing experimental data. FE models will be constructed to investigate the reliability of the simulation of composite steel-concrete structural beams.

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Synthesis and shape memory study of amino acid-based polyurethane

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This paper deals with the hysteretic behavior, analysis and stability evaluation of thin-walled steel tubular columns subjected to cyclic multiaxial (axial and bidirectional lateral) loading. Steel columns are very useful in highway bridge pier construction as it offers flexible space requirement and provides speedy construction. Behavior of steel columns under earthquake-induced loads is rather complicated as earthquakes occur in an oblique direction. However, modern seismic design philosophies have been based on the behavior of structures under independent actions of uni-directional loading in orthogonal directions. In this study, inelastic cyclic behavior of steel columns subjected to axial force together with simultaneous bi-directional cyclic lateral loads is investigated using an advanced finite element analyses procedure. Several types of linear and non-linear idealized loading patterns are employed to check the strength and ductility. The effects of important structural parameters and loading history on the behavior of thin-walled steel tubular columns are examined using the proposed procedure. The obtained results from this study confirm the importance of considering behavior of steel columns under multiaxial loading. The multiaxial tests and finite element analysis results showed that the behavior of a tubular column under multiaxial loading becomes complex and exhibits a circular trajectory once local buckling occurs. The local buckling bulge in the multiaxial loading case tends to develop monotonically due to the circular trajectory. As a result, the residual deformation becomes larger. On the contrary, the unidirectional loading test and analysis are likely to underestimate the damage and the residual displacements caused by an earthquake. It is concluded that the effects of multiaxial loading should be considered in ductility evaluation and seismic resistance design of steel structures.

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Technology and innovation applied to the interstate 55 resurfacing project

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This $33 million patching and resurfacing project encompassed more than 100 lane-miles of interstate expressway and related construction work, including bridge deck and joint repairs, drainage improvements, vegetation management, fiber optic installation, and enhancements to the intelligent transportation system. Challenges faced during construction included a demanding completion date, restricted work hours, high traffic volumes, and staging construction through seven full interchanges, including the interstate-to-interstate interchange with I-355. Precise layout of longitudinal paving joints was critical to the proper placement of longitudinal joint sealant and inlaid pavement markings, further adding to the engineering complexity of the construction project. This presentation will demonstrate how innovative practices and applied technology, including mobile LiDAR data with calibrated imagery, GPS measurement and layout, 3D modeling, and high-definition video, were used to respond to challenges faced in the field to complete the project on time and under budget, with considerable improvements to quality and efficiency over traditional methods, while at the same time improving safety and minimizing inconvenience to the motoring public.

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Developing a neutral equilibrium device as dynamic virtual piers for an emergency relief bridge

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Every year, many natural disasters strike Taiwan, destroying bridges and disrupting traffic. To allow shipping of relief provisions and salvage, fabricated steel bridges are often used to construct emergency relief bridges. This kind of bridge must meet strength and functionality requirements. Strength depends on the materials used, while functionality depends on displacement control. These two requirements affect the section design of the bridge deck. In order to quickly build a light-weight bridge for emergency relief with displacement control, a neutral equilibrium mechanism is proposed and developed to control the deflection of an emergency relief bridge. A neutral equilibrium mechanism is a system with an internal control mechanism that can actively change the internal structure. Structural transformation causes the size variation of the action force to respond to continuous changes in bridge deflection. This mechanism can expand the effective span of the bridge, maintain its strength and functionality and increase the convenience of building and mobility. Experimental results reveal that a virtual pier at the center of a bridge with this proposed mechanism installed can control vertical deflection caused by vehicles carrying heavy loads. Test and analysis records also reveal that the vertical displacement at the center of a bridge with the neutral equilibrium mechanism installed is close to zero. The practicality of this neutral equilibrium mechanism has been verified by experiment.

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Behavior of lightweight reinforced concrete beams with openings in shear zones

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The construction of modern buildings requires many pipes and ducts to accommodate necessary services such as air conditioning, electricity, telephone, and computer network. Passing the required service through web openings in these beams is more desirable than passing it underneath the beams to keep of building aesthetics, also decrease the total height of building as well as decreases the total construction cost. Many researches were prepared to investigate the effect of openings on strength and stiffness of the reinforced concrete beams under different conditions to get suitable solutions to avoid or reduce these effects. Also, this research has been prepared to study the effect of a rectangular opening on the behavior of simply-supported lightweight, mixed and normal reinforced concrete beams with rectangular cross section using a nonlinear finite element program (ANSYS 17.2). For this purpose, a set of fifty one beams were analyzed to study the behavior of beam with opening under different conditions. All tested beams were simply supported beams with 4050 mm long, 3750 mm span, and cross section of (200 mm width and 500 mm total depth). Main parameters were: opening length ( ), opening height ( ), position of the opening along the beam axis (X), type of concrete, ultimate compressive strength ( ) and reinforcement arrangement around opening. The wide range for these parameters was taken as follows: W=(0.42 d, 0.65 d, 0.85 d and 1.30 d), where d is the beam effective depth; h=(0.28 d, 0.45 d, 0.56 d, and 0.67 d); X=(0.50 d, 0.75 d, 1.0 d, and 1.25 d); fcu = 21 MPa for Lightweight, 41 MPa for normal weight, and 26 MPa for mixed concrete. The reinforcement arrangement around the opening at top and bottom chord As1= (0.64 As, 0.36 As, 0.12 As, and without RFT) where As is the main longitudinal reinforcement of the beam. Spacing between main stirrups equal to 200 mm and spacing between stirrups around opening equal to 50 mm. Based on these conditions the study revealed that, provision of openings in lightweight reinforced concrete beams at shear zone changes the behavior of beam. The ratio of reduction in ultimate load increased from 8% to 23%, when the ratio of opening depth to beam effective depth (h⁄d) increased from (0.28 to 0.67). While it increased from 5% to 18%, when the opening length to beam effective depth ratio (W⁄d) increased from 0.42 to 1.30. The effect of opening location becomes more significant when opening is located close to support or at a distance equals to half beam depth. When the opening is located at a distance equal to half beam depth, the cracking load and the ultimate load were reduced by 16%, and 13%, respectively. Also, when the opening is located at a distance equals to beam depth, the cracking load and the ultimate loads were reduced by only 9%, and 7%, respectively. Increasing the ultimate compressive strength from 21 to 41 MPa decreases deflection and increases cracking and ultimate loads by 36%, 33%, and 37%, respectively. In addition to, increasing the reinforcement around the opening with certain arrangement helps to recover the loss in ultimate load of beam with openings.

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Utilisation of olive mill waste and coal ashes in normal concrete mixes

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The main objective of this research investigation is to study the effect of Olive Mill Waste (OMW) ash and Normal Coal (NC) ash on some engineering properties of normal strength concrete such as workability and compressive strength and hopefully select a better alternative for the concrete mix utilising such wastes. Thus, this will lead to reach a clear environment and reduce the overall cost of concrete mix by reducing the amount of cement content, as a result of replacing these wastes in the concrete mix. Overall, there are numerous benefits associated with the recycling of such waste products for the provision of a substitute concrete mix. Firstly, replacing a certain amount of cement with OMW and NC ash would reduce the overall cost of the concrete mix. Additionally, restoring theses wastes would decrease the levels of pollution which would otherwise increase the spread of pests and negatively impact the health of the population. As well as aiding the achievement of providing a cleaner environment, regenerating these wastes for the purpose of creating a concrete mix would eliminate the costs of their disposal. In order to achieve this goal, different percentages e.g. 10, 20, 30 and 40% of both OMW ash and NC ash were used as an additive and/or replacement in the production of normal concrete strength mixes to obtain a concrete grade of 40 MPa. Four sets of concrete mixes were cast to test the workability and the compressive strength based on the changes of the percentage of OMW and NC ashes by weight of cement. The slump test results ranged from 58 to 110 mm with the addition and/or replacement of OMW and NC ashes. Moreover, the compressive strength is decreased as the percentage of adding and/or replacement of OMW and NC ashes is increased.

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Performance enhancement with eco-friendly materials for design

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Currently, civil infra-structural designs need a new dimension different from conventional strength and reliability approaches in which they are less energy intensive and ecologically sustainable. This brought in the use of other materials and admixtures into concrete preparation and in this study, role of fly ash and nylon fibers for replacing cement and improving performance in terms of stiffness and flexibility is shown with testing and design emphasis. Beams with normal concrete, termed as CC, with fly ash termed as CCF and with fly ash and nylon fibers termed as CCFN are cast and tested for performance under service at ultimate and failure conditions and results clearly indicate improvements in rotational flexibility at ultimate and failure conditions. Compressive strength enhancements are shown in Figure (1), while load deflection characteristics of beams tested are shown in Figure (2). Using these as basis, section designs are made with less energy and more eco-friendly properties for the required ultimate or service load, resulting in 15 to 20% savings and carbon emission.

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