Abstracts of Papers in English

DEVELOPMENT OF A HYBRID METHOD OF SOCIAL FORCE MODELING AND DISCRETE EVENT SIMULATION TO OPTIMIZE PRODUCTIVITY OF CONSTRUCTION

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Abstract

Optimizing productivity of construction has always been a challenge for project managers and planners. In previous studies, it has been pointed out that productivity is directly related to the number of workers unless the excessive number of workers in the workshop causes congestion. Discrete event simulation is one of the mathematical modeling methods used by researchers to study productivity in construction. Discrete event simulation models the operations considering the flow of resources and the state of entities within the system. In this model, the entities are passive elements that are processed during the work process. Due to the nature of the entities in a discrete event simulation model, it is not possible to investigate the effect of physical interaction of individuals on productivity using this method alone. Social Force Modeling has a great ability to model the movement of people and physical interaction between people and the environment. This study tries to investigate the direct impact of manpower on productivity by modeling the work process and the effect of physical interactions of workers due to the increase in the number of workers and workshop spatial constraints. For this purpose, a hybrid model has been developed that includes a combination of two models. In the first model, the discrete event simulation method is used to simulate the work process. In the second model, the movement and physical interaction of workers are modeled using

the social force modeling method. The proposed hybrid model allows one or more activities to be simulated more accurately. The approach used in this paper is evaluated based on the data from a real project. The results clearly show the reduction in productivity due to overcrowding. The outputs of this work can be used to obtain the optimal number of workers in an activity. The model proposed in this paper gives project managers the chance to have more realistic simulations of work processes.

Key Words: Productivity, spatial constraints, discrete event simulation, social force modeling.

POTENTIAL FUNCTIONS OF THERMOELASTODYNAMIC PROBLEMS FOR TRANSVERSELY ISOTROPIC FUNCTIONAL GRADED MATERIALS

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Abstract

Functionally graded materials are the novel class of advanced composite structures with variable properties in one or more directions. The mechanical properties of Functionally Graded Materials (FGM) such as Poisson's ratio, Young's modulus of elasticity, material density and shear modulus of elasticity undergo changes gradually and continuously between two surfaces in a predetermined manner. FGM structures are often made of a combination of ceramics and metals in which the metal component provides strength and fracture resistance while ceramic component provides thermal resistance. Due to desirable properties, FGM materials are used in various fields of engineering such as optics, electronics, space vehicles, shipbuilding, mechanical, biomechanical and other engineering structures subjected to high thermal and residual stresses. Therefore, the analytical study of thermoelastodynamic problems is of great importance for the functionally graded media. The use of potential functions to analyze three-dimensional elastic problems is one of the most effective methods. This method facilitates solving three-dimensional elastic problems by uncoupling the set of governing differential equations or at least simplifying them. In the present study, the displacement potential functions for solving thermoelastodynamic problems in the transversely isotropic media with functionally graded materials are introduced. For this purpose, first, the three-dimensional kinematic and thermodynamic equations for the functionally graded materials in the transversely isotropic materials are written and then using a systematic method to separate the equations, the displacement potential functions to solve thermoelastodynamic problems are obtained, which can be used further to solve problems of beams, plates, shells, and infinite and semi-infinite media. The obtained potential functions include two scalar functions F and$\mathcal{X}$; the scalar function F satisfies the sixth-order partial differential equation while the $\mathcal{X}$-scalar function satisfies the second-order partial differential equation. In addition, in the present study, the thermal potential functions for the specific state of the isotropic functional graded media are presented.

Key Words: Functional graded materials, transversely isotropic materials, displacement potential functions, exact solution, thermoelastodynamic.

ROBUST-TO-NOISE FEATURE EXTRACTION VIA GENERALIZATION OF CORRELATION RELATIONSHIP IN THE FREQUENCY DOMAIN

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Abstract

Damage diagnosis of a high-dimensional structural signal is a complicated and time-consuming task. In the

worse case, if the signal is measured under noisy ambient loads, the extracted features lead to unreliable results in damage diagnosis. In this study, a robust feature extraction method is presented by using time series analysis and correlation relationship generalized in the frequency domain. At first, a time-series model of the response signal is obtained, and the parameters of the model containing inherent and dynamic characteristics of the signal are separated from the model residual, which is influenced by the noise of ambient loads. Upon measuring the model parameters, the high-dimensional signal is transferred to a space with a lower value in size, and the issues due to high-dimensional data are addressed. By using the obtained parameters, the characteristic function of the signal is calculated in the frequency domain. By utilizing a generalized correlation coefficient relationship in the frequency domain, a 2D damage-sensitive feature being a complex value can be extracted from the characteristic function. Structural damage is detected by investigating the angle of the feature extracted. Moreover, by attending to the real part of the feature, the location of damage can be identified. To investigate the abilities of the new feature in damage diagnosis tasks, a real-world structure, S101 Bridge, is examined. To demonstrate the advantages of the new feature in structural damage diagnosis, the outcomes of this study in different levels of damage diagnosis, i.e., damage detection and damage localization, are compared to some state-of-the-art techniques in the field of Structural Health Monitoring (SHM). The achievements of this study clearly show the abilities of the proposed feature for damage diagnosis of real-world structures, especially in the case of high-dimensional data and noisy ambient excitations. Moreover, in comparison to other techniques, the proposed damage diagnosis algorithm in this paper can detect and localize structural damage with more accuracy.

Key Words: Structural health monitoring, damage-sensitive feature, frequency-domain characteristic function, correlation coefficient, noise.

INVESTIGATION OF BUCKLING BEHAVIOR OF FUNCTIONALLY GRADED THIN-WALLED BOX BEAMS UNDER AXIAL LOADING

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Abstract

Recently, the growing needs of the engineering community for smart structures have led to targeted material technology gradually replacing conventional homogeneous and laminated composite materials. Among the sandwich-shaped structures with targeted core, the thin walled closed beam of sandwich box (with functionally graded core), due to having desirable properties such as high flexural stiffness, low density, desirable static and dynamic properties likewise high strength against mechanical loads and stresses have received much attention.

In some specific applications, components of modern structures, such as thin walled functionally graded beams with a closed box geometry, are subjected to axial or concentrated or wide transverse loads. Under these conditions, the choice of loading parameters may lead to lateral or axial buckling, which results in irrecoverable damage to the structure. Buckling of an axially loaded thin-walled functionally Graded sandwich box beam in presence of structural non-homogeneity is studied.

In this study, taking into account the effects of the structural heterogeneity (via power law distribution), porosity and effect of the cross-sections warping by means of Vlasov's beam assumptions and applying the Hamilton's principal the governing equations of the Buckling instability of the thin-walled functionally graded sandwich box porous beam were derived. Then the finite element method was developed to formulate the problem. In following, for the case of various boundary conditions, the related governing eigenvalue problem was derived and solved numerically. The validity of the results was accomplished by comparing the results with those of the literature. In following beside by providing the characteristic buckling curves, the effect of different parameters of the problem, including the beam aspect ratio, mixing volume fraction index, porosity index, core component modulus ratio and ceramic layer thickness on the buckling load were investigated comprehensively. It was observed that different parameters, especially the mixing index and structural porosity index has a considerable influence in determining the buckling boundary.

Key Words: Thin-walled beam, functionally graded box beam, finite element method, mixing volume fraction index, critical buckling force.

DAMAGE DETECTION AND IDENTIFICATION IN A COLUMN UNDER THE EFFECT OF AXIAL LOAD USING MODAL PROPERTIES AND MODE SHAPE-BASED DETECTION INDEX

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Abstract

From the past until now, monitoring the health of structures and identifying different locations of damage to their elements have always been one of the basic requirements of maintaining structures and ensuring the safety of residents. Damage is defined as any modification to the shape or material characteristics of a structure that could impair its overall performance. Irreversible damages to structures can be avoided by promptly identifying, repairing, and replacing any damaged components in early stages. Damage to columns, one of the most vital elements of building structures and bridges, can pose serious concerns about the overall health of the structures compared to damage to other elements. This study proposes a detection index based on the slope and curvature of the mode and explores its usefulness in identifying distinct sites of column damage under axial load. The preliminary findings of this research revealed that as the axial load increases, the value of the natural frequency of all modes drops in both healthy and damaged conditions. Considering that the given columns may buckle and become unstable under the impact of axial load less than the design axial load due to damage, this underlines the necessity of addressing the problem of damage detection in columns under this load. The results also demonstrate that the frequency values of healthy and damaged conditions are different due to damage. Damage detection using the suggested index indicates that it is sensitive to the position of the damage, and that by establishing relative maxima in the damaged area, it is possible to recognize the location of the damage with an error less than one percent. In addition, the findings demonstrated that while the amount of axial load affects frequency values, it does not have any effect on the values of the damage detection index.

Key Words: Structural health monitoring, structural safety, column damage detection, axial load, mode curvature detection index.

EFFECTIVE WIDTH ESTIMATION OF L-SHAPED RC SHEAR WALLS USING EPR ALGORITHM

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Abstract

Effective width is known as an important parameter in the analysis and design of non-rectangular Reinforced Concrete (RC) shear walls. Current design codes, i.e., ACI, CEN, UBC, and BS, propose a constant value for the effective width calculation of flanged sections, which proved to be conservative and ineffective in some cases. Of the conventional non-rectangular RC shear walls, the L-shaped sections have rarely been investigated in the technical literature. As the L-shaped RC shear walls can extensively be employed for structural and architectural reasons, a reliable assessment of the effective width of L-shaped sections is essential. Therefore, this paper attempts to propose applicable formulations for the effective width estimation of L-shaped RC shear walls. In that regard, a number of numerical investigations involving finite element analyses have been conducted in the ABAQUS software in order to evaluate the cyclic

performance of L-shaped RC shear walls. The numerical results including the axial strain and displacement distributions have been attained for 42 L-shaped RC shear walls with three different aspect ratios, at which the shear-lag effects have been taken into consideration. In addition, on the basis of the evolutionary polynomial regression (EPR) analyses, applicable formulations have been established to be utilized for the initial estimation of the effective width of the L-shaped sections. The effectiveness of the proposed expressions has been examined by assessing the R-factor of the estimations. On account of the average R-factor of 0.88, the capability of the proposed expressions has been ascertained in assessing the effective width of L-shaped sections. Moreover, in order to further highlight the unavoidable effects of level of axial loading and drift values on the variation of the effective width, different curves have been presented. Furthermore, calculation of the Mean Absolute Relative Error (MARE) index demonstrates that uniform distribution can well estimate the effective width of L-shaped RC walls.

Key Words: L-shaped RC shear wall, effective width, shear-lag, FE simulation, EPR analysis.

EXPERIMENTAL INVESTIGATION OF STRENGTH AND MICROSTRUCTURAL BEHAVIOR VARIATIONS OF OIL CONTAMINATED CLAY (AREA: MASJEDSOLEYMAN)

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Abstract
Global oil production exceeds two million tons per year, contaminating the soil around oil facilities. Consequently, the soil's geotechnical properties are modified. Since Iran is an oil-rich country with numerous refineries and oil extraction facilities, it is crucial to study the mechanical behavior of contaminated clay soils. This study examines the stabilization of oil-contaminated clay (CH) soils in the Masjedsoleyman contaminated clay soils by adding lime. To this end, laboratory tests were conducted to determine the chemical properties, Atterberg limits, standard compaction, and unconfined compressive strength (UCS) of the soil and conduct a microstructural analysis. As a result, 144 contaminated soil samples (76 mm in height and 38 mm in diameter) containing 0, 4, 7, and 10and 9microstructural analyses after 1, 14, and 28 curing days. The results of the standard compaction test revealed that the optimum moisture content (OMC) of samples with greater oil contamination decreased by 44.4dry density (MDD) increased. The unconfined compressive tests indicated that adding 6other cases. As curing time increased for lime-stabilized samples, the unconfined compressive strength of the samples improved due to the cementation of lime particles with clay soil. The microstructural analysis results demonstrated that the 7discontinuous structure and numerous porous spaces between soil particles. However, longer curing times reduced the porosity and cavities in samples stabilized with different lime percentages. This confirmed the high cation exchange capacity of lime and the presence of pozzolanic reactions, which increased the unconfined compressive strength of the samples. Overall, this study demonstrates the efficacy of adding lime in stabilizing the contaminated clay and the potential use of stabilized contaminated clay as an alternative construction material and practice in the environmental protection of sites.

Key Words: Unconfined compressive strength, microstructural analysis, oil-contaminated clay, stabilization, lime.

EVALUATION OF KEY PERFORMANCE INDICATORS FROM THE PERSPECTIVE OF STAKEHOLDERS IN CONSTRUCTION PROJECTS

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Abstract

In this research, according to the existing gaps and research objectives, at first, a review of the literature on the subject and research background in the field of key performance indicators has been done. According to the results of the research background, a list of frequent indicators was obtained. In the rest of the research, using Q method and related software as well as questionnaires (48 questionnaires completed by 4 groups of stakeholders including employers, contractors, consultants, and project managers) were analyzed by factor analysis. Though this research has been done in the field of residential, office, and commercial buildings, the overall research process can be implemented in all projects and identify the views of different stakeholders. By identifying the different views of stakeholders, their serious similarities and differences were identified and conflicting views analyzed.

The evaluation results show that there are many similarities between the views of one of the identified factors in one stakeholder group, with another factor in another stakeholder group. For instance, the second view of the contractor and the second view of the project manager or the first view of the employer and the third view of the project management are very close.

Generally, the key performance indicators including time, quality, safety, and cost and procurement of construction projects seem to be of great importance and can cover the concerns of many stakeholders. Time and quality indicators were present in the priorities of the first views of all stakeholders.

Finally, the practical project management dashboard should be designed with a small number of metrics that have a significant impact on project success. The results of this research and the introduced priority indicators that were agreed upon by all stakeholders (Like time and quality) can be appropriate indicators for evaluating the performance of the project.

Key Words: Key performance indicators, Q methodology, stakeholders.