Abstracts of Papers in English

STATIC ANALYSIS OF AXISYMMETRIC 3-D LAYERED TRANSVERSELY ISOTROPIC THICK CYLINDRICAL SHELLS BY DISPLACEMENT POTENTIAL FUNCTION

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Abstract

This work considers an effective analytical method based on Displacement Potential Function (DPF) for solving 3-D thick and multi-layered transversely isotropic linearly elastic cylindrical shells (non-homogeneous in radial direction) with simply-supported end boundary conditions. Axisymmetric radial loads are applied on the inner and outer faces of the cylindrical shell. Three-dimensional elasticity equations are simplified using displacement potential function result in one single linear partial differential equation of fourth order as governing differential equation in term of displacement potential function. The governing equation is solved via the separation of variable method with exact satisfaction of two end boundary conditions including stress and displacement boundary conditions, stresses on the inner and outer surfaces of the shell, and the continuity conditions of the displacement and tractions on the interfacial surfaces of the multi-layered cylindrical shell. After determining displacement potential function, all other functions such as stresses and displacements can be obtained at each point of the examined shell. Comparison of the results with existing analytical results

show excellent agreement at different thickness ratios and aspect ratios of the shells. Some practical problems are solved for one-layered and three-layered cylindrical shells. For this purpose, three types of materials are defined for a one-layered cylindrical shell such as composite material (Graphite epoxy), metallic substance (e.g. Zinc), and isotropic material (Aluminum). Also two combinations of materials are considered for three-layered cylindrical shell so that the inner and outer layers of the shell are made of transversely isotropic material (Graphite epoxy), while the middle layer of the isotropic material is made of aluminum and foam. The values of the non-dimensional functions containing stress and displacement components are calculated for these problems to demonstrate the effect of thickness ratio and anisotropy of the shell on the distribution of the stresses and displacements.

Key Words: Displacement potential function, analytical solution, transversely isotropic material, multi-layered cylindrical shell.

EVALUATION OF TEXTILE CONCRETE BEHAVIOR IN THE ACCELERATED SHELTER

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Abstract

Concrete canvas rolls have several unique properties have made it a strategic material. A major property is rapidness of installation that can be considered in the construction of accelerated shelters of protection against threats. The use of concrete canvas in the construction of the shelter is also expanding worldwide due to its economic benefits and the speed of its installation, as experience has shown that a two-person team can build a shelter with an area of 25 square meters of concrete canvas in less than an hour. Increasing attention to this function of concrete canvas requires studying product behavior against incoming loads, and the need for a deep understanding of the material and components of aerated concrete leads to a better understanding of this product and the possibility of improving product quality. Therefore, the properties of two-phase concrete canvas, including fabric and mortar that have structural performance, were studied using Abacus finite element software. The results of finite element simulation on macro and Meso scales were compared with the laboratory results of different samples, showing the accuracy of the study. The results illustrate that the use of fibers with higher tensile strength and high Young's modulus and stiffness has a better performance against the applied loads. The shelter behavior is evaluated against different probable attack scenarios. The designed shelter is capable of withstanding slag up to a height of 70 cm of soil, which also makes it resistant to mortar attacks. The use of a concrete canvas shelter without any slag also makes it resistant to the 5 kg TNT threat at a distance of 3 meters. Using products against larger threats or loads strengthens the shell with appropriate materials or several layers of concrete canvas shells.

Key Words: Concrete canvas, Meso-Scale, ABAQUS finite element software, Four-Point bending.

THEORETICAL MODEL OF BUILT, OPERATE AND TRANSFER CONTRACTS IN A COMPLEX ENVIRONMENT MULTI-CASE STUDY: IRAN FREEWAY PARTNERSHIP AGREEMENTS

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Abstract

Build Operate Transfer (BOT) contracts in Public Private Partnership process have two important features:

large budget and long life cycle. For these two reasons, these contracts are sensitive to the environment and face many problems in complex environments, such as the project environment in Iran. The structure of freeway partnership contracts in Iran does not fit a highly complex environment and so, performance targets are not achieved. The main purpose of this study is to identify the effective environmental factors, challenges, contextual obstacles, strategies, and outcomes in association with freeway partnership contracts. Therefore, with the help of this knowledge, a theoretical model can be developed. Case study strategy, qualitative approach, and data analysis by grounded theory are the main features of the research methodology. The findings of four freeway cases showed that the partnership contracts were developed without considering the long life cycle. Then, in the course of the construction, despite the effort in gathering many different opinions and expertise, satisfactory performance criteria were not established due to weak understanding of contractual obligations and risks. Also, in the operating period, the return on investment remains ambiguous due to increased costs, insufficient revenue, and high environmental complexity. In general, these contracts are defined as immature with dissatisfied parties. Therefore, according to the obtained facts, few investors express interest in public-private partnership contracts and are less desirable to investors. The private sector does not view infrastructure projects as idealistic and task-oriented but rather hunger for economic interests, mainly. Thus, in order to advance its goals, the public sector must have a different view of such investments. Also, the existing contract system, which is based on the employer-contractor experience, in order to fit the complex environment and achieve development goals, must prioritize structural reforms and normative changes in the contracts and strategies of the parties.

Key Words: Built operate transfer (BOT), environmental complexity, case study, grounded theory.

INVESTIGATING THE ROLE OF LATENT INDIVIDUAL COMPONENTS IN THE ACCEPTANCE OF DEMAND MANAGEMENT POLICIES: CASE STUDY OF TEHRAN ODD-EVEN POLICY

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Abstract

Due to the problems caused by personal car use, demand management policies have been developed, which result in reduced use of personal vehicles. It is generally accepted that demand management policies are classified into two types: hard or soft. In the case of soft politics, people tend to be receptive, while being combative to hard policies. In the case of Tehran's odd or even zone, the purpose of the paper is to examine the role of latent components in the acceptance of demand management policies. To address the issue and measure the resistance of individuals to accept the car reduction policy, we designed a stated preference questionnaire and measured the acceptance rate in terms of behavior change. Changes in behavior patterns and the choice of private car mode are methods used to determine acceptance rates. The acceptance of policies can be assessed by identifying their hidden nature via the value-belief-norm theory. In this theory, value influences the norm through belief. So, people who know that they should cut down on the use of the private car are more inclined to accept the use of private cars. Examination of the adoption of private car prohibiting policies under changing behavior in different periods of implementation of a private car is debatable. In this study, more than 500 questionnaires were distributed randomly among Tehran citizens including couples or single individuals considering the scope of the traffic plan traveled by transit vehicles. Using the multiple logit model, this study investigates the changes in people's behavior toward accepting the policies of reducing the use of private cars in two short-term and long-term periods. Results show that individual values and norms are effective factors in changing users' behavior over short- and long-term periods.

Key Words: Value-belief-norm theory, demand management, latent variable, behavior changing.

DEBONDING DAMAGE DETECTION AND ASSESSMENT IN A CFST

COMPOSITE COLUMN USING MODAL DYNAMIC DATA

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Abstract

Structural damage detection is one of the primary goals of structural health monitoring. Minimum safety can be provided upon timely identification of the damaged elements and appropriate decisions (repairing or replacing the damaged elements). Today, the use of concrete-filled steel tube composite columns in the construction industry, especially high-rise buildings, is increasing. In these columns, the concrete core debonding from the steel tube is considered a prevalent type of damage. This study discusses the impact of such debonding on dynamic modal properties (natural frequencies and vibration mode shapes) and the detection of debonding damage area based on wavelet analysis. Debonding to a depth of 3 mm is defined as reduction of concrete stiffness in connection with the steel tube, and the column was subjected to frequency analysis. Modal information, including frequency values and vibration mode shapes, were extracted. Differences in frequency values and Modal Assurance Criterion (MAC) smaller than one were observed between primary and secondary shapes of vibrational modes due to the presence of debonded areas. The results showed that with the addition of a new debonding damaged area, the rate of reduction of frequency values increased. The damage index was proposed based on the detail coefficients obtained from discrete wavelet analysis of primary and secondary shapes of vibration modes to identify the area of detachment damage. The results demonstrated that the relative minimum and maximum values of the damage index for all modes occurred in debonding damaged areas. Moreover, the damage index values for different damaged areas were independent of each other. Indeed, the damage index values for other debonding damage situations did not change when a new debonding damaged area was added. This is a positive point in the damage detection process with multiple debonded areas because in this case, the inability to detect a debonding damaged area cannot affect the detection of other debonding damage situations.

Key Words: Structural health monitoring, debonding damage detection, frequency analysis, modal assurance criterion (MAC), wavelet analysis.

DEVELOPMENT OF THE MULTIQUADRIC MESH-LESS METHOD FOR ANALYZING THE DYNAMIC INTERACTION OF DAM-RESERVOIR-FOUNDATION PROBLEMS

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Abstract

The Multiquadric Radial Basis Function (MQ-RBF) method, despite its advantages, has not yet been developed to be used for Dam-Reservoir-Foundation Interaction (DRFI) problems. In this study, this meshless method was developed for solving the DRFI systems in the frequency domain. A new domain decomposition technique was also used for analyzing dynamic interaction problems for the first time in MQ-RBF. In this regard, the computational domain is divided into dam, reservoir, and foundation subdomains. Then, the MQ-RBF method is separately applied to each subdomain. For applying the dynamic interaction between two adjacent subdomains, two Multiquadric shape functions must be considered for each computational center on their interaction boundary. Besides, each shape function is also defined using the computational centers in the subdomain. One of the important challenging issues in RBFs is the determination of the Optimal Shape Parameter (OSP). Thereafter, some new relations in terms of the earthquake frequencies are proposed for the OSPs

in different cases of the interaction systems. In this regard, a few frequency magnitudes were considered and, consequently, different relations were presented for all frequencies using the obtained OSPs. It is found that, the OSP does not depend on the shear modulus of neither the dam nor the foundation. Moreover, the OSP value are not sensitive to the fluid compressibility and do not depend on the number of subdomains. Apparently, these properties reduce the computational costs and facilitate the MQ-RBF application. In order to validate the capabilities of the approach, nine numerical examples are solved in which the Roots Mean Square Error (RMSE) criterion has been evaluated for comparing the results with those of the exact and FD methods. Results show that the proposed method is of acceptable accuracy, i.e. more accurate than FD even with much more FD computational nodes. Also, it is shown that the errors increase by increasing the earthquake frequency value while the FD errors seem to be unacceptable in frequency values close to the resonance frequency, unlike those of the MQ-RBF.

Key Words: Radial basis functions, multiquadric method, mesh-less method, shape parameter, dam-reservoir-foundation interaction.

INVESTIGATING AND COPMARING THE MOST EFFECTIVE METHODS TO IMPROVE POST-FIRE PERFORMANCE OF STEEL SHORT COLUMNS WITH VERTICAL AND HORIZONTAL DEFECTS

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Abstract

In this paper, the performance of box steel columns with corrosion is investigated. Thus the steel columns are made with different defect locations (6 modes) and are subjected to temperatures of $20°C$ and $700°C$. Then, two retrofitted methods (CFRP composites and steel plates) are used in the defect area in order to improve the performance of columns. Afterwards, bearing capacity of all column specimens (38 specimens) has been obtained. The results indicate a decrease in the bearing capacity of the columns and weakness in their performance due to the two factors of defect and heat so that the greatest decrease in the column compression strength is about 32% and 35% due to defect and high temperature, respectively. Also, the comparison of retrofitting methods indicates that the use of composite is more effective in improving the performance of steel columns. Finally, For further investigation, 5 specimens are modeled in ABAQUS finite element software and the results are compared with similar experimental results.

Key Words: Steel columns, defect, fire, CFRP composites, bearing capacity.

RELIABILITY ANALYSIS OF FRP-TIMBER SYSTEM

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Abstract

Wood is one of the oldest materials that has always been known as a construction material. Despite its widespread application and unique properties, it has weaknesses such as relatively brittle behavior, especially in bending. In order to improve its performance and boost its features or strengthen wooden structural members, one solution is to employ FRP component, which is widely used as a rehabilitation tool. The lightness and ease of application for different materials such as concrete, wood, and steel have made it possible to increase the strength and ductility of structural elements. In this study, the few models that were available for the wood-FRP system were collected, and the uncertainty of six variables, as the most effective parameters in the strength of this system, was selected for reliability analysis. Also, during the steps, three live to dead load ratios equal to 0.75, 1, and 1.25 were assumed as the design loads. What was achieved during this research was that during the design process of wood-FRP, uncertainties had a significant impact on the reliability of existing models. Some models could be reliable enough to be applied for design purposes; however, uncertainties seriously affect the reliability of some models. Accordingly, the average reliability index of all six available models decreased from 4.88 in case one fails to consider uncertainties to 2.71 with uncertainties of the models. Among the five existing models presented in previous studies, the Palizi and Toufigh model with an average reliability index of 3.61 was the best-proposed model, which is in good agreement with the acceptable index of existing structural design criteria. It is worth noting that various variables affect the reliability of this system. However, in this study, only the uncertainty of the six variables of modulus of elasticity, thickness, length, and width of FRP, along with wood width and its compressive strength, was considered. Other sources of uncertainties may be considered while analyzing this system in future studies.

Key Words: Reliability, strengthening, wood, FRP, finite element model.