Abstracts of Papers in English

OVERFLOW AND UNDERFLOW WITHIN THE BROAD-CRESTED GABION WEIR IN FREE FLOW WITH SAND BED CONDITIONS

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Abstract

In order to calculate and predict the discharge flow through and over the gabion weir, 33 experimental broad-crested gabion models were carried out through the sand bed condition. The flow conditions through and over the gabion were presented as three classifications which involved partial flow conditions through a gabion, fully gabion flow through a gabion weir, and overflow on a gabion weir. These classifications were considered due to the free flow conditions. Based on the partial and fully gabion flows, an equation was proposed to calculate the gabion flow. Moreover, the flow discharge over the gabion was considered based on the broad-crested weir formula and then, the coefficient discharge of broad-crested gabion weir was proposed based on experimental measurements. Comparison between the proposed values and experimental measurements illustrates that good agreement is between the proposed and experimental flow discharges. Also, the investigation of flow variations through the gabion showed that the error of

gabion equation increased significantly due to overflowing on gabion weir. In order to raise the accuracy of the calculation process of flow discharge through the gabion an equation was proposed based on the geometry and Darcy Wisbech's parameters. The porosity, length, and particle size were defined based on Darcy Wisbech equations. Some math indexes were considered for this equation and by employing the Mathematical software, these parameters were presented based on the non-liner technique. The error was measured based on the experimental and proposed values and the result of the comparison pointed to the suitable agreement between the two groups of values. Finally, the maximum scour hole was measured by point-gauge along the longitudinal section. Based on threshold velocity and geometrical and hydraulic parameters, an equation was proposed to predict the maximum scour hole depth at the downstream of the broad-crested gabion weir.

Key Words: Gabion weir, flow classification, discharge coefficient, free flow, overflow, under flow.

LABORATORY STUDY ON THE EFFECT OF SAWDUST ASH AND ZEOLITE REPLACEMENT ON SANDY SOIL STABILIZED BY CEMENT

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Abstract

Nowadays cement is one of the most common material for construction projects, due to its long time usage it has been handy for engineers. Cement has a lot of deleterious effects on environment from production process to cement itself. So looking for a substitution material is vital for future generation, this research evaluated the effect of zeolite and sawdust ash (SDA) replacement with cement separately and simultaneously. There are some variation parameters: the amount of zeolite and sawdust ash and curing time for each sample. Overall 57 samples were made the amount of cement is 4% by weight of base soil and 0, 0.5, 1, 1.5 percent sawdust ash replaced by cement and 0, 10, 30, 50, 70 percent of zeolite replaced by cement. The curing times are 7, 14, 28 days. According to results by replacement 0.5% sawdust ash with cement the amount of optimum moisture will increased and in higher amounts of sawdust ash it will decrease. Also dry density will decreased. Unconfined compressive strength (UCS) test data shows that optimum amount of zeolite and sawdust ash replacement with cement are 10% and 0.5% respectively. These optimum amounts make compressive strength increased 250.46 and 245.01 percent respectively compared with base soil and 73.9 and 87.42 percent respectively compared with stabilized sandy soil with 4% cement only.

Key Words: Soil stabilization, sand, sawdust ash (SDA), cement, zeolite, UCS test.

INVESTIGATION OF SIMULTANEOUS EFFECT OF THE REMAINING TIME, MOLARITY AND BACTERIAL SOLUTION CONCENTRATION ON SHEAR STRENGTH OF SANDY SOILS STABILIZED BY BIO-CEMENTATION METHOD

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Abstract

Soil bio-remediation is one of the developing methods of soil improvement and the reduction of environmental problems due to the injection of chemicals in the soil is one of the superior features of this method compared to

other common methods. It was created by linking the fields of civil engineering, geochemistry, and microbiology. The basis of soil improvement by biological cementation method is based on the microbial production of calcium carbonate precipitation, which is inspired by the formation of sandstone in nature and with the help of bacteria that have precipitation and hydrolysis of urea to enhance the technical specifications of soil. The steps of soil remediation in this method are that in the presence of Bacillus Pasteurii bacteria, crystals are formed which are the result of urea reaction and a source of calcium, which is usually calcium chloride. These crystals are placed in empty spaces of the soil and represent the reason why the adhesion of soil particles increases significantly and its strength increases. In order to manage the consumption of materials used, it is better to obtain optimal values during studies. For this purpose, in this study, the cemented samples were subjected to triaxial tests, permeability, and SEM testing. In consolidated undrained triaxial experiments, the trend of soil resistance over time was investigated by considering different retention times and different molarities. The optimal amount of molarity of the materials used and the concentration of bacteria and the optimal retention time were obtained according to the results of experiments performed in this method. Also, by examining the resistance of cemented samples, an increase in strength in the range of 50% compared to clean sand was observed. Examination of the time parameter pointed to the formation of calcium carbonate precipitation and their final setting up to 30 days. After 30 days, the trend of increasing soil resistance exhibited a constant amount.

Key Words: Biological cementation, shear strength, permeability, triaxial test, retention time.

INTRODUCTION OF A NEW ELLIPTICAL DAMPER FOR SEISMIC ENERGY DISSIPATION OF CIVIL STRUCTURES

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Abstract

In this paper, a new energy dissipative device named elliptical damper was introduced for passive control of structures. In the proposed damper, the energy dissipation capacity is provided by the shear deformation of the elliptical ring. To investigate the behavior of the proposed damper, a sample of this damper was tested experimentally. The results showed that the proposed damper had stable hysteresis loops and good energy absorption. Also, the finite element model was developed by considering nonlinear behavior, large deformation, and material damage. The results of the numerical model were verified through experimental results. The results showed that the numerical analysis could predict the cyclic response and damage location of the experimental sample. A parametric study was performed to investigate the changes in the cyclic behavior of the elliptical damper with its dimensions. Four independent parameters considered for this study are the greater diameter of the elliptical ring, the ratio of its diameters, the ratio of the thickness of the elliptical ring to its greater diameter, and the ratio of the height of the connection area to the greater diameter of the elliptical ring. Among the studied parameters, the thickness of the elliptical ring had the greatest effects, and the height of the connection area had the smallest effects on the cyclic response of the proposed damper. By increasing the thickness of the damper, the maximum strength and energy dissipation capacity increase, but its ductility decreases. The proposed damper has stable hysteresis loops, excellent ductility, and high energy dissipation capacity. The elliptical damper is simple in terms of construction technology and provides excellent energy dissipation capacity for the structure compared to the cost spent for its construction. According to the results, the proposed damper can be used as an appropriate energy dissipation device for passive control of structures.

Key Words: Passive control, elliptical damper, experimental test, numerical model, parametric analysis.

SOURCE APPORTIONMENT OF FINE PARTICULATE MATTER USING COMBINED RECEPTOR MODELS IN TEHRAN

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Abstract

Currently, one of the most important air pollutants in Tehran is fine particulate matter. The composition and sources of these particles are poorly known; therefore, in order to distinguish the status of PM2.5 pollutants from their chemical compounds, 24-hour $PM_{2.5}$ samples were collected at the main residential station (an Air Quality Control Company site, located in Sharif University of Technology) every six days for a full year from February 2014 to February 2015. The samples were analyzed for ions, organic carbon (including water-soluble and insoluble portions), Elemental Carbon (EC), and all detectable elements. Based on the results of chemical analyses including TOT, GCMS, IC, SF-ICPMS, and ROS methods, Organic Matter (OM) is one of the most important compounds in $PM_{2.5}$, which on average constitutes 35% of the mass of fine particulate matter. The contribution of $PM_{2.5}$ sources was determined by the CMB model using the concentration of chemical components of the particles and the profile of possible sources in Tehran. According to previous results, mobile sources (such as gasoline, diesel, and smoking vehicles) as the most important source of particulate matter, accounting for 58% of the total concentration of $PM_{2.5}$. Road dust, the second significant source contribution, was described as the first loading factor, accounting for 49% of the changes in particle concentration extracted by running the PCA model. Combined model (principal component analysis/multiple linear regression chemical mass balance; PCA/MLR+CMB) comprising two stages has been developed for improving the accuracy of identifying $PM_{2.5}$ sources. The results show that the second factor of the PCA model including 17% of PM changes is a composite source, and it is influenced by heavy metals from human resources including industries, car brakes, car tires, and car lubricating oils and, in this factor, combustion. Heavy fuels with an average of 65.10% made the largest contribution to the emission of particulate matter associated to factor 2. The insights regarding fine PM in Tehran provided by the results of this paper could be useful in planning effective control strategies and decision-making in Tehran, Iran.

Key Words: Air pollution, fine particulate matters, receptor models, combined model, Tehran.

RANKING AND ANALYZING KEY MOTIVATION FACTORS OF ENGINEERS IN THE CONSTRUCTION INDUSTRY

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Abstract

There is no doubt that human resources have a significant role in running any successful business. The literature indicates that this role is almost neglected in the construction industry. One of the important factors to increase productivity in various industries is to increase the productivity of human resources. Human resource productivity is a function of various factors where motivation is one of the most important factors. Considering the effect of motivation on innovation and the necessity of innovation in construction design firms, studying motivational factors of Architects and Engineers (AE) is of great importance. In this research, the most critical factors affecting Architects' and Engineers' motivation were recognized through literature review. These factors were classified into five main categories including Leadership and management, service compensation system, organizational atmosphere, social status, and job nature (current tasks - immediate situation and job development). Then, the factors were ranked by the industry experts through online questionnaires. Learning opportunity, distributive, procedural & interactional justice, and job promotion opportunity were ranked as the top critical motivational factors. However, it must be noted that important factors may differ considering the demographic properties of the interviewees. As a result, factors were ranked considering demographic factors including gender, marital status, age, educations, years of experience, and profession (civil engineer and architect).

Finally, it should be noted that motivation of engineers and architects depends on several factors that must be considered in the design of human resource subsystems such as job analysis, performance appraisal and service compensation, training systems, and promotion to improve performance and increase productivity. In addition, motivation is one of the most important factors affecting personnel retention. Therefore, human resource management experts are advised to provide necessary grounds to increase the motivation of construction industry employees by designing appropriate human resource systems.

Key Words: Motivation, construction industry, human resource management, AE.

PROBABILISTIC PROGRESSIVE COLLAPSE ANALYSIS OF 3D STEEL MOMENT FRAME USING FRAGILITY CURVES

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Abstract
Previous studies indicate that low-rise buildings are more prone to progressive collapse rather than high-rise ones. In this research, an innovative method of probabilistic analysis of progressive collapse has been applied based on the concept of fragility curves. In order to develop the fragility curves, the column reaction is considered as the Intensity Measure (IM) and the displacement at top of the removed column as the Damage Index (DI). Based on these measures, the fragility curves of a 4-story steel Intermediate Moment Frame (IMF) structure were developed. Six scenarios of progressive collapse including removal of corner, perimeter, and middle columns were investigated. The scenarios were considered in all columns of structural stories. The simulations were conducted in OpenSees software. The structural analyses were performed by the nonlinear time history approach in a three-dimensional framework. The verification of the numerical modeling process was performed using the available experimental data. The results showed that the IDA capacity curve of the upper stories was weaker than the lower stories. According to the results, at every considered DI and assumed performance level, damage to the removed columns occurs at lower axial force on the upper stories than on the lower ones. Furthermore, the potential of the progressive collapse in different columns was investigated. It was shown that the capacity curve of the middle columns was lower than other columns due to the high gravity loads. The probabilities of the fragility of the corner and the perimeter column in the stories were the highest and the lowest, respectively. In order to reach the corner and the perimeter column to CP performance level, 93% axial force and 105% of the axial gravity load in the opposite direction of the column reaction were required. Finally, the overall fragility curves of the structure were investigated. According to the results, upon removing 100% of the column reaction in each column of the considered 4-story structure, the structure exceeded the CP performance level.

Key Words: Progressive collapse, column removing scenario, probabilistic analysis, nonlinear dynamic analysis, fragility curves.

COMBINED APPROXIMATE ENTROPY MODEL AND ANNs TO PREDICT INFLOW AT GORGANROOD RIVER

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Abstract

Prediction of river inflow along with other parameters such as sediment load, flood magnitude, and so on plays an important role in Water Resources Management planning and reservoir operation program. In this regard, many attempts have been devoted so far by the researchers to predict inflow or flow discharge in the rivers. One of the most important rivers in the Golestan province that highly influences climate changing is Gorganrood river. Assessment of chaotic behavior of time series like inflows of rivers by the entropy measure is an important facility in Water Resources Management projects. In addition, this tool can be employed to extract the number of embedding dimensions to predict time series by models like the ARIMA and ANNs. To this end, this paper employed the capability of Approximate Entropy (ApEn) measure as one of the famous models to capture irregular behavior of a time series. Then, ARIMA and ANNs models are implemented to predict monthly inflows at Gorganrood River as the biggest river in Golestan province. The models are developed by using AQqala and Ghazaghli hydrometric stations gathered data. Final results show that at AQqala and Ghazaghli stations, to have an informative predictor model, the number of embedding dimensions must be set to 12 and 10, respectively. In addition, it is concluded that the developed models are accurate enough to be applied in another period of the times in the studied case. Sensitivity analysis of the ARIMA and ANNs models versus various embedding dimensions proves extracted values of embedding dimensions obtained by the ApEn. In addition, the evaluation of the ApEn curves proves the effect of the constructed dams like Voshmgir, Golestan, and Boustan dams on the environmental process and river behavior. The sensitivity analysis versus embedding dimensions clarifies the effects of these parameters over ARIMA and ANNs models.

Key Words: Predict, gorganrood, inflow, ApEn, ANNs, ARIMA.

SENSITIVITY ANALYSIS OF THE LENGTH OF PLASTIC HINGE REGION IN THE FLANGED REINFORCED CONCRETE SHEAR WALLS

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Abstract

Past earthquakes have shown that properly designed buildings using shear walls have great performance in dissipating a considerable amount of inelastic energy. It is notable that the reduction in seismic input energy occurs in plastic hinge area through inelastic deformation. Plastic hinge development in a RC shear wall in the areas with plastic behavior depends on the ground motions characteristics as well as shear wall details. One of the most generally used forms of structural walls is flanged RC wall. These types of shear walls have large in-plane and out-of-plane stiffnesses through flanges and can tolerate high shear stresses. Several international seismic design codes and guidelines have suggested special detailing to assure ductile response in this region. In this paper, the parameters that affect the length of plastic hinge region in the flanged RC walls were examined and the sensitivity of these parameters was evaluated with respect to the length of the plastic hinge region. Sensitivity analysis was conducted by independently variable parameters with one standard deviation away from their means. To this end, the Monte Carlo simulation, tornado diagram analysis, and first-order second moment method were employed to determine the uncertainties associated with analysis parameters. The results showed that among the considered design variables, the aspect ratio of the flanged RC wall (length to width ratio), length of flange to length of web (lf/lw), and axial load level were the most important design parameters in the plastic hinge region, while the yield strength of transverse reinforcements had the least effect on determining the length of this region.

Key Words: Sensitivity analysis, plastic hinge, flanged RC wall, tornado diagram.

PERFORMANCE EVALUATION OF PROPOSED TUBE-IN-TUBE BUCKLING RESTRAINED BRACE UNDER CYCLIC LOADING

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Abstract

In this article, a new type of all-steel buckling brace is introduced. The proposed bracing member consists of two tubular members. The inner tube is intended to act as the structural core such that energy can be suitably dissipated by its yielding under cyclic loading. The outer tube is supposed to act as a lateral restraint for the inner one without interfering in the axial load-carrying inner tube, that is, using a gap separating the two tubes, the inner tube should be free to slide inside the outer one under the application of cyclic loading. Hence, axial loads are resisted by the inner core tube and the outer tube may only interfere in axial force resistance through friction at contact points after the core deforms laterally. In this study, while accurately introducing the proposed system, its behavior under cyclic loading has been studied using both experimental tests and numerical modeling. The test specimen was designed based on the parametric study previously done by the authors. In order to investigate the cyclic performance of the proposed BRB member, the displacement loading protocol proposed by the AISC was applied. Numerical modeling was performed using ABAQUS software, taking into account all nonlinear effects, including nonlinear behavior of materials, geometric nonlinearity, and contact. Based on the experimental and numerical results, it was demonstrated that the proposed BRB - if well designed - would be quite competent in accomplishing the intended tasks as a buckling restrained bracing member. Properly designed TiTBRBs can exhibit stable cyclic behavior and satisfactory cumulative plastic ductility capacity so that they can serve as effective hysteretic dampers. At the same time, such all-steel TiTBRBs concreting was eliminated; hence, much lighter members were obtained. This is also associated with ease and speed of fabrication, erection, inspection, replacement, and a more economical and environmentally friendly design.

Key Words: Buckling restrained brace, tube -in-tube member, cyclic loading, FEA.

SPECIMEN SHAPE EFFECT ON THE COMPRESSIVE BEHAVIOR OF PVA FIBER-REINFORCED SELF-CONSOLIDATING CONCRETE

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Abstract

The mechanical properties of concrete are dependent on the specimen size and shape. This phenomenon is caused by the heterogeneous nature of concrete and results in significant dissimilarities between the laboratory-made samples and larger concrete elements in the construction fields. Thus, it is required to develop experimental and numerical models to translate the strength of different concrete specimens with varying sizes and shapes. In this research, the effect of specimen shape is evaluated for PVA fiber-reinforced self-consolidating concrete. To do so, three self-consolidating mix proportions were designed, containing two different dosages of PVA fibers and various sizes of cylindrical and cubic specimens were cast in order to account for the influence of specimen size and geometry. The fresh properties of the designed SCC concretes were assessed using several experiments such as slump flow time and diameter tests, V-funnel flow time test, and L-box test. Also, the 28-day compressive strength of the designed samples was obtained using a pressure jack. The specimen shape and size effect of PVA fiber-reinforced self-consolidating concrete was studied based on specimen geometry and fracture mechanism, and the influence of PVA fiber addition on the compressive strength of samples was presented in the form of linear equations. By analyzing the obtained data, relations were proposed to translate the strength of cylindrical specimens to cubic specimens. Also, for the first time, the experimental coefficients of Bazant's model were achieved for PVA fiber-reinforced SCC, and the Bazant's size effect model became functional for the designed concretes. To do so, non-linear regression analysis was conducted on the obtained experimental data.

According to the achieved results, the addition of 0.08% of PVA fibers increased the transitional size coefficient (D0) of cylindrical and cubic specimens by 170.39% and 105.86%, respectively, reduced the size effect, and enhanced the ductility in the designed self-consolidating concretes.

Key Words: Specimen shape effect, self-consolidating concrete, polyvinyl alcohol fiber, specimen size effect, compressive strength.

INVESTIGATION OF THE EFFECT OF SEISMIC ACCELEROGRAM DATA COMPRESSION ON GEOTECHNICAL EARTHQUAKE ENGINEERING PROBLEMS

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Abstract

Modeling and analyzing various issues in civil engineering, especially in the field of geotechnical earthquake engineering and earthquake engineering, has always been a complex, time-consuming and costly task. Accelerograms recorded by today's seismographs have a large amount of data due to the high accuracy of seismographs and their use in numerical methods and complex models leads to the formation of very large matrices and prolongs the analysis processing time. To reduce computational time, in this research, acceleration time-histories have been compressed using wavelet multi-resolution analysis method and the number of their data has been reduced. The original and compressed versions of accelerograms were used in five different seismic problems. The results demonstrated that one level of compression, which is equivalent to a 50% reduction in accelerograms data, reduced the duration of model analysis by 33% on average, while differential errors in the results are less than 5%.

Key Words: Data compression, wavelet multi-resolution analysis, acceleration time-history, earthquake accelerometer.

PERFORMANCE OF AUTOMATIC ELECTRONIC DEVICES IN CONSTRUCTION PROJECTS: AN EMPIRICAL INVESTIGATION

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Abstract

Electronic communications play an important role in assisting construction project managers. Few researchers have addressed the problem of communication technology adoption in the construction industry. This paper explores the quality of communication at construction sites in Iran and evaluates the efficiency of electronic devices. To investigate the quality of communications in construction sites, a field study is conducted on a sample of construction projects in Hamadan province, Iran. In this field study, engineers from the Building Engineering Organization of Hamadan Province are interviewed. Cohen's kappa coefficient is used to determine the percentage of agreement among the research participants. A case study was considered to evaluate the performance of automatic electronic communications in a construction site. The site is related to flour hives located in the west of Hamadan city. Five devices are used including a virtual reality building information model, a smartphone camera, an electronic construction kiosk, a GPS smartphone, and quick response tags. A video is used by the aid of the electronic construction kiosk that shows the risks and injuries for people without helmets. Analytical hierarchy process is employed to assess the relative importance of various electronic hardware used in this study. The results indicate that most communications

in construction sites are traditional (paper-based); slow and ineffective communication, misunderstanding of requirements and agendas, and inadequate communication between personnel are the most important communication problems of construction sites. The results also indicate that prioritizing the importance of electronic communication tools is the electronic kiosk, quick response tags, smartphone camera, and GPS smartphone, respectively. In addition, the results demonstrate the benefit of electronic communications on employee training, project safety, project time, and project cost. Limited research has been conducted on the performance of electronic communications in construction projects. This paper is of interest to those who work in the field of construction project automation.

Key Words: Electronic devices, automation, construction projects.

APPLICATION OF ENDURANCE TIME METHOD IN SEISMIC ASSESSMENT OF STEEL MOMENT FRAME WITH GREEN ROOF

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Abstract

In this study, the capability of using the Endurance Time method in seismic analysis of steel moment frames with green roofs has been investigated. These days, green roofs are welcomed by architects and engineers due to their beautiful architecture and many environmental benefits. In general, this system significantly increases the weight of the structure at the roof level and leads to a change in the dynamic behavior of the structure. There are usually two categories of green roofs. The first category is extensive green roofs with short vegetation (such as grass) and usually low seismic weight. The second category is intensive green roofs with high vegetation (such as trees) and usually high seismic weight. Accurate evaluation of these types of structures has high computational costs. The Endurance Time method is a time history analysis that can seismically evaluate the structure at different levels of excitation intensity with low computational cost. Despite the advantages of this method, its performance in the seismic evaluation of different structures - especially when the seismic behavior of the structure is different from conventional structures - is a challenging issue. In this research, a 5 stories steel intermediate moment frame with ordinary roof, extensive and intensive green roof is modeled in Ansys software. Nonlinear finite element method is used for seismic assessment of these structures in various excitation levels. In this regard, both geometric and material nonlinearities are considered. To evaluate the accuracy of Endurance Time method, 7 earthquake records at different levels of excitation intensity have been used. The results show that the Endurance Time method with different accuracy can evaluate the maximum roof displacement, base shear and maximum interstory drift ratio compared to conventional time history methods. Also, adding a green roof can have a significant impact on the seismic behavior of this structure.

Key Words: Endurance time method, green roof, seismic assessment, nonlinear dynamic analysis.