Abstracts of Papers in English

INVESTIGATING THE EFFECT OF SODIUM HYDROXIDE ADDITIVE ON STRENGTH PROPERTIES AND DURABILITY OF SELF-COMPACTING CONCRETE WITH SULFATE AGGREGATES IN SULFATE ENVIRONMENT

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Abstract

Self-Compacting Concrete (SCC) is used even in the complex shapes and can pass through the densest reinforcement without requiring the means of vibration, that is to say, it is recommended that concrete be used in major projects. It uses superplasticizer and stabilizers to significantly increase the ease and rate of flow. Degradation and serious damage of concrete structures triggered by sulfate attack have been widely reported in the saline soil or salty-lake areas all over the world. Sulfate has been claimed to be one of the common corrosive sources in the environments such as soil, groundwater, lakes, or rivers. Many studies revealed that sulfates in the pore solutions could react with cement composition or hydration products to form new phases. Concrete aggregates can include healthy and unhealthy gravel and sand grains. In this study, the effect of unwell aggregates disposed to expand reaction in a simulated destructive environment on the strength and durability of samples is investigated at different ages for compression, tensile and bending samples of self-compacting concrete. Unhealthy materials extract from the exploited gravel and sand mines, which have an impurity rate of more than the allowable value of 0.4% according to Issue 9 of the Iran National Building Code. Sodium hydroxide with three different percentages (2%, 2/5%, 3%) of water weight is used to prevent the destructive effects of sulfate environment. According to a review of past studies and review of similar topics, self-compacting con-

crete was used instead of concrete. Also, in this study, the aggregate sulfate is used in self-compacting concrete. Therefore, the mechanical properties and durability of self-compacting concrete in sulfate environments were investigated. The results of the study show that the addition of sodium hydroxide to the sulfate aggregate in 7 days for self-compacted concrete sample increases the tensile strength up to 84.15% and reduces the permeability and water absorption up to 21.87 and 16.67, respectively.

Key Words: Strength properties and durability of concrete, self-compacting, sodium hydroxide, sulfate environment, compressive strength.

A COMPARATIVE STUDY OF THE PERFORMANCE OF BONDED AND UNBONDED ELASTOMERIC ISOLATORS IN SEISMIC ISOLATION OF ABOVE GROUND LIQUID STORAGE TANKS

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Abstract

One of the most common types of seismic isolators is steel reinforced elastomeric isolators (SREIs) which consist of alternating layers of elastomer and steel reinforcing plates. Unbonded fiber-reinforced elastomeric isolators (UFREI) represent a relatively new type of elastomeric isolators. In this type of isolator, to control lateral strain and provide vertical stiffness, FRP layers are used instead of steel plates. Additionally, to reduce the cost of isolators, the idea of removing the top and bottom connection plates and the unbonded use of isolators has been considered. In UFREIs, due to the rollover deformation and the reduction of the isolator horizontal stiffness, it is expected that the seismic isolation efficiency increases as compared to the bonded isolators. In this research, the performances of UFREIs and conventional SREIs in improving the seismic behavior of liquid storage tanks were evaluated and compared. The isolated water tank was modeled using a mass and spring model of three degrees of freedom with convective mass, impulsive mass, and rigid mass. Time history analyses were performed on the fixed-base storage tank as the benchmark structure and the two base-isolated tanks with steel-reinforced and unbonded fiber-reinforced isolators. The results show that both types of isolators are effective in significantly reducing the demand base shear in the tanks. However, seismic isolation increases the displacement demand in the convective mass. Regarding the comparison of the two types of isolators, it was observed that on average, UFREIs in slender and broad tanks are 33.5% and 23.9%, respectively, more efficient than the SREIs in reducing the maximum base shear forces. Also, there is no significant difference in the maximum displacement of the convective mass in the two isolation systems. The displacement and shear forces developed in the unbonded isolators were found less sensitive to the variations of the Peak Ground Acceleration (PGA) as compared with the conventional bonded isolators.

Key Words: Elastomeric isolators, liquid storage tanks, unbonded fiber-reinforced elastomeric isolators, dynamic spring-mass system, time-history analysis.

PREDICTION OF TIME-DEPENDENT BEARING CAPACITY OF PILE DRIVEN IN COHESIVE SOIL USING GROUP METHOD OF DATA HANDLING

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Abstract

Evaluating the ultimate bearing capacity of piles has been always an important concern for geotechnical engineers. Pile setup is a term which refers to an increase

in bearing capacity of pile after a specific time. This increase is mainly considered relevant to the dissipation of excess pore water pressure created as a result of disturbance of the soil around the pile. Many researches have been centered on the investigation of pile setup and the factors influencing that. Results indicate that soil and pile properties can affect the occurrence and intensity of this phenomenon. The application of artificial intelligence such as artificial neural networks and evolutionary algorithms are considered as efficient and powerful methods for prediction and function finding purposes. Group Method of Data Handling is an intelligent approach that operates in a similar pattern to artificial neural networks. In this system, dual combinations of input variables are created in the form of Kolmogorov-Gabor polynomials. Based on the evaluation criteria such as Root Mean Squared Error (RMSE) and determination coefficient (R^2), the polynomials with higher accuracy are selected and introduced to the next layer as inputs. This repetitive approach is used to reach the best polynomials predicting the target variable of the project. GMDH is a self-organized system in which the number of required layers and neurons are determined during the running process. In this paper, a dataset obtained from the literature review and contains information about 170 test piles derived in clay and mixed soil, is used in which the ultimate bearing capacity is considered as a target, while the other ones are independent variables. It is noticeable that to evaluate the efficiency of the ultimate model, data is randomly divided into training and testing data which the former includes 118 and the latter has used 52 data. The results of this study indicate that the initial bearing capacity of pile (End Of Driving) and undrained shear strength (S_u) have a significant effect on the time-dependent increase in bearing capacity of pile. The ultimate model obtained from the GMDH system with the RMSE of 742.85 and the (R^2) of 0.768 is an acceptable equation that can be used in the process of pile design.

Key Words: Pile setup, time-dependent bearing capacity, artificial intelligence, group method of data handling.

A NUMERICAL STUDY ON COMPOSITE JOINTS COMPRISING PRECAST CONCRETE SLABS AND BOLTED SHEAR CONNECTORS

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Abstract

The use of composite decks (concrete slab and steel beam) has been increasing in recent years due to their high structural efficiency. The connection between the concrete slab and the steel beam is usually made by studs that are welded to the steel beam flange. This type of connection should be completely destroyed at the end of the structure life cycle; or, in case of need to repair the connection, it is not possible to reuse it again. Thus, huge waste materials are then produced at the end of project life cycle which leads to a non-friendly condition for the environment. Therefore, it is recommended that bolted shear joints be employed for connecting the concrete slabs to steel beams. Hence, at the end of the structure life, or in case of damage, members can be easily disassembled and reused. In addition, it is proved that the structural performance of this type of joints against static loads is better than welded joints, i.e., their shear capacity is higher. In this study, the structural behavior of bolted shear connectors is investigated. For this purpose, numerical models were modeled using Abaqus software and then, were verified against the test results. Next, an extensive parametric study was performed considering different structural characteristics including reinforcement ratio, thickness and compressive strength of prefabricated concrete slab, strength, and size of bolts. The results show that the type of bolted shear connector and the concrete slab compressive strength are the most important factors affecting the behavior of the bolt shear force-displacement diagram. Also, in all cases, bolt failure was observed as the main failure mode. This study proves that the composite beam with bolted shear connectors can be a reliable alternative for the welded shear connectors currently in use which not only enhance the connection performance but also reduce the waste materials production at the end of the projects.

Key Words: Steel beam, concrete slab, bolted shear connector, composite connection, structural behavior.

EXPERIMENTAL INVESTIGATION OF THE REDUCTION OF LATERAL PRESSURES ON RETAINING WALLS USING EXPANDED POLYSTYRENE GRANULES

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Abstract

Expanded Polystyrene (EPS) is commonly used in construction, especially in geotechnical projects, due to its super lightweight and high compressibility. One of the applications of this material is to use it behind the retaining walls to reduce the lateral earth pressures exerted on the wall by the embankment. In this research, two types of EPS in the form of granules and sheets of EPS are used as interface between the embankment and the wall. In order to carry out this research, an instrumented laboratory model of retaining wall has been used and the effect of using these materials as buffer behind retaining wall has been investigated. The assembly includes a 105 28.5 70 cm sand box, a retaining wall model with 28.3 54.2 cm front dimension, a wall-displacement system for driving the wall, and a data acquisition system (data logger). The lateral pressures are measured by eight load cells attached to 8 equally spaced wall sections. The approximate relative density of the backfill sand was 70%. Experiments included cases in which a sheet of EPS-block or stack of small bags filled with granular EPS was used as a buffer between soil and wall. The results of these two cases were compared with the case in which the backfill was the sand alone. After measuring the lateral forces in the at-rest state, the active and passive states were created by displacing the wall away or toward the backfill. The lateral stresses could be measured in any state of displacement. The results showed that the use of EPS behind the retaining wall as an interface material resulted in a significant reduction in lateral pressures. This was due to the very low stiffness of EPS compared to the soil. It was also observed that the use of bags filled with EPS-granules had a greater effect on the reduction of lateral pressures on the retaining wall compared to using sheets of EPS-block.

Key Words: Expanded polystyrene (EPS), geofoam, geosynthetics, reduction of lateral pressures, retaining wall.

EFFECT OF BASE ISOLATION ON SEISMIC RESPONSE OF CONCRETE ELEVATED TANKS SUBJECTED TO BOTH TRANSLATIONAL AND ROTATIONAL COMPONENTS OF FAR AND NEAR-FIELD EARTHQUAKES

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Abstract

Water storage tanks are one of the vital and essential arteries whose immediate operational performance after an earthquake is of special importance and interruptions in their operation can indirectly increase the damage and losses caused by earthquakes. Due to the significant effect of earthquakes on structures located in the vicinity of faults and, also, the unknown effect of the simultaneous transitional and rotational components of these earthquakes, present study investigated the behavior of concrete elevated tanks with central shaft and lead rubber bearing base isolation, under simultaneous excitation of translational and rotational components of near- and far-field earthquakes using nonlinear time history analysis. Base shear force and normal stress of tanks were determined considering dynamic interaction of water and tank. The corresponding rotational component

of each translational pair of accelerograms was generated using the classic formulation of the theory of elasticity and wave propagation simultaneously, taking into account the frequency-dependency of wave velocity. To model the base isolator in the present study, an equivalent simplified link and combination model, based on 3D model of reference [32], has been suggested and its performance accuracy has been evaluated. The results of dynamic analysis show that the presence of the base isolator in all the studied conditions causes a reduction of about in base shear and in normal stress of the elevated tanks. Increasing the tank volume will reduce the decreasing effect of the isolator on the normal stress of tanks, but will improve the performance of the seismic isolator in reducing the base shear. Also, increasing the angular acceleration of rotational component of near-field earthquakes weakens by about the decreasing effect of the base isolator on the seismic response of elevated-tanks. Thus, neglecting rotational component of the earthquakes in analysis of tanks located near the faults will magnify the decreasing effect of the base isolator on seismic demands and the poor design of structure. Therefore, use of the isolator to reduce the seismic response in these areas will not be economically justified.

Key Words: Concrete elevated tanks, fluid-structure interaction, lead rubber bearing base isolation, far and near field earthquakes, translational and rotational components of earthquake.

EFFECT OF BOUNDARY CONDITIONS ON BUCKLING OF CYLINDRICAL STEEL TANKS WITH VARIABLE THICKNESSES UNDER LOCAL SETTLEMENT

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Abstract

Cylindrical steel tanks have been used to store various materials and fluids. From a geometrical point of view, steel tanks have a very low thickness compared to the other two dimensions and thus are classified as thin-walled structures. Nowadays, the use of thin-walled structures is very popular. The main reason for this is the low weight and high strength of such structures. In order to reduce the weight and cost of the structure, cylindrical steel tanks can be made with variable thicknesses in height. Changing the thickness of the tank's wall has been considered to reduce weight and economic requirements. Settlement is one of the important issues that must be considered for reservoirs. In general, foundation settlement occurs under the tanks' walls due to special soil properties, which are divided into three general components: Uniform, Tilt, and Local settlement. In the meantime, local settlement has the greatest impact on the tank's shell, although it has the lowest value. This component can cause large radial displacements, shell buckling, and even tank's failure. In this study, 17 steel cylindrical tanks with or without a reinforcing ring on the upper part were modeled in ABAQUS software and placed under local settlement at the edge of their floor. The values of settlement, equivalent buckling load, and their radial deformation were compared to each other. S4R elements (a four-node element with reduced curvature double integral) were used to mesh the tanks. The results of nonlinear analysis indicate that buckling occurs at the lower part of the shell. Moreover, the local settlement causes severe buckling at the site and perpendicular direction of the settlement. Appropriate and acceptable behavior of tanks with variable thickness in comparison with constant thickness and the hardening ring can have positive effects on the buckling behavior of tanks.

Key Words: Variable thickness, cylindrical tanks, finite element software, local settlement, stiffening ring.

FABRICATION AND PERFORMANCE OF NANOFILTRATION MODIFIED MEMBRANES WITH EDTA-GO NANOCOMPOSITE IN SALT-DYE-PB(II) AND CU(II) HEAVY METALS TREATMENT: EVALUATION OF THE EFFECT OF SALT CONCENTRATION ON THE REMOVAL OF ANIONIC CONGO RED DYE FROM THE WASTEWATER

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Abstract

In this study, upon synthesizing GO by Hummer method, EDTA was anchored to the GO surface by covalent band. The obtained nanocomposite was successfully characterized by SEM and FT-IR. Then, GO and EDTA-GO nanocomposites as nanofillers were used in the polyethersulfone nanofiltration membranes matrix. To achieve this purpose, nanofillers were introduced into PES matrix using phase inversion technique. FE-SEM, water contact angle, and overall porosity technique were used to investigate the effect of GO and EDTA-GO nanocomposites on membrane morphology and hydrophilicity. The effects of GO and EDTA-GO nanocomposite on membrane performance were studied in terms of pure water flux, antifouling properties, desalination, and removal efficiency of heavy metal ions Cu^{2+}, Pb^{2+}, and dye (in single-component system) and salt-dye (in binary system) were investigated. With increasing EDTA-GO concentration to 0.25 wt%.
(NFM_3), the contact angle decreased from 76.17° to 54.85° and the overall porosity increased from 61.1% to 75.9%. The water flux in the NFM3 membrane was 13 kg m^{-2} h^{-1} more than that of the NFM0 membrane. FRR, R_t, and R_{ir} values in NFM3 membrane are 63%, 41%, and 33%, respectively, indicating flux recovery and improvement of antifouling properties as a result of nanofiltration membrane modification. The result of desalination tests showed that the highest (55%) and lowest (20%) percentages of desalination were related to Na_2SO_4 and NaCl salts, respectively, in all membranes. By modifying the membrane to 0.25 wt.% EDTA-GO, the removal efficiency rates for Cu^{2+} and Pb^{2+} metal ions in the single-component system increased from 21% to 88% and from 19% to 85% compared to the unmodified NFM_0 membrane, respectively. CR dye removal efficiency for all modified nanofiltration membranes was more than 98%. Increasing the Na_2SO_4 concentration in the dye-salt binary system had no significant effect on the removal percentage of CR. Due to the efficiency of EDTA-GO nanofiller modified membrane in desalination and removal of dye and heavy metals, it can be used as a suitable membrane in wastewater treatment.

Key Words: Nanofiltration membrane, EDTA-GO, heavy metals, wastewater treatment, fouling.

INVESTIGATING THE EFFECT OF INTENSITY AND LOCATION OF DAMAGE ON MODAL CHARACTERISTICS IN CONCRETE ARCH DAMS

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Abstract

Dams are among the most important and largest engineering structures used to supply potable and agricultural water and hydro-power as well as prevent seasonal floods. Human experience has shown that when damage occurs in these megastructures, there are irreversible financial, environmental, and fatal losses. Therefore, the issue of safety and proper performance of dams is of vital importance both in terms of designing new structures or health monitoring of the old structures. This subject is of more particular importance in the case of concrete arch dams, since in the absence of identification of small and minor damages, with the growth and spread of structural damages, a general failure may occur in these infrastructures with considerable human and financial losses. Nevertheless, concrete arch dams have been less broadly considered in the investigation, and most of the researches have included simple structures with a low-degree-of-freedom. Therefore, the main objective of this paper is to study the effects of structural damages (including the intensity and location) on the modal properties of these engineering systems. For this

purpose, the modal characteristics of the structure, such as the natural frequencies and the shape-modes, are initially computed using finite element model on a concrete arch dam. Considering different scenarios for damage including, nine different locations (on different vertical and horizontal locations) are chosen. The modal characteristics of the system would be then determined before and after the occurrence of damage. In the presented research, the effects of damages at three levels of arch dam body on the modal parameters of the system are investigated. The comparison of the structural modal parameters of the intact and damaged states shows that first, the natural frequencies of the system have lower sensitivity than mode-shapes of the system, and also the damages to the top and middle are more effective than the corner zones on the modal features of the arc-dam body.

Key Words: Health monitoring, concrete arch dam, modal characteristics, intensity and location of damage, natural frequency, mode-shape.

NUMERICAL INVESTIGATION OF THE EFFECT OF CROSS-SECTION SHAPE, MORTAR STRENGTH, AND NUMBER OF TEXTILE LAYERS ON THE CYCLIC BEHAVIOR OF RC COLUMNS

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Abstract

Repairing and strengthening of structures are unavoidable. The main reasons for repairing and strengthening concrete structures are improper design or construction, weakness of the structural elements, changing the usage of the building and damages that happen in structural elements. There are various ways for strengthening the vulnerable structures. In recent years, usage of high strength concrete reinforced with textile meshes (Textile Reinforced Concrete (TRC)) for strengthening the concrete structures has become a proper alternative for retrofitting the buildings. Using reinforced concrete with TRC is one of the new methods for strengthening the concrete structures. This method has become popular in recent years due to its light weight, high strength, no changes in the dimensions of reinforced concrete elements, and ease of use. The aim of this study was to evaluate the efficiency of this method in strengthening concrete columns with a low reinforcement ratio that need reinforcement. In this investigation, after verifying two models simulated by finite element software (ABAQUS) with experimental results, eight models were studied numerically. The models consisted of columns and supporting beams and they were categorized into four groups by different parameters which are effective in strengthening the concrete columns. In this paper, various parameters such as geometry of cross-section, mortar strength, and number of textile layers were investigated. The columns and their connections to supporting beams were strengthened with TRC. Models strengthening were carried out using vertical layers plus horizontal layers of textile meshes in cement mortar. Lateral force capacity, crack, and stress pattern on concrete and mortar surfaces and yielding of rebars in reinforced concrete columns were compared and evaluated. The cyclic behaviors of all TRC strengthened models were improved compared to non-strengthened ones.

Key Words: TRC, Reinforced concrete column, structural rehabilitation, cyclic behavior, finite element method, textile.

A HYBRID MODEL FOR RESERVOIR OPERATION OPTIMIZATION PROBLEM USING INFLOW FORECASTING APPROACH (CASE STUDY:DEZ DAM)

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Abstract

In this paper, a hybrid model is proposed to solve a reservoir operation optimization problem considering uncertain inflow conditions. In this model, the artificial neural network (ANN) and improved particle swarm optimization (IPSO) algorithm are used for inflow forecasting and reservoir operation optimization problem, respectively. The proposed IPSO is developed after applying some useful modifications to the original form of particle swarm optimization (PSO) algorithm. The modifications are proposed in order to reposition the infeasible particles. Two different conditions are considered in order to show the effect of inflow forecasting on reservoir operation optimization problem using ANN. It is worth noting that the ANN model is a powerful data driven model that can be used for real time inflow forecasting. In this research, in the first case, the actual measured inflow values are considered as input data to solve reservoir operation optimization problem. In the second case, the ANN model is used to forecast inflows while considering the effects of previous months inflows on the target month inflow. After determining the inflow, the reservoir operation optimization problem is solved using the forecasted inflows. In addition, in the proposed hybrid model, two different formulations are suggested to solve the optimization problem considering water release and reservoir storage volume as decision variables of the problem. The simple and the hydropower operation problems of Dez dam reservoir are solved for forecasted (5 year) time period considering all formulations and cases and the results are presented and compared with other available results. The results indicate the ability of ANN model to forecast the inflow of the Dez dam with acceptable accuracy. In addition, the improved particle swarm optimization algorithm shows to be an effective algorithm to solve reservoir operation optimization problem in which the results of first formulation is better than the second one.

Key Words: Inflow forecasting, artificial neural network, improved particle swarm optimization algorithm, optimal operation of reservoir, Dez Dam.

MECHANICAL PROPERTIES OF POLYMER CONCRETE CONTAINING ALUMINUM HYDROXIDE USING ADDITIVES

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Abstract

Corin is a type of artificial stone that is produced without the use of cement and is actually a type of polymer concrete. Unsaturated polyester resin is used as an adhesive and aluminum trihydrate powder is used as a filler to produce artificial stone. This stone is usually composed of 25 wt of unsaturated polyester resin and wt of ATH with a low bulk density. This advantage and others such as non-porous structure result in low water absorption and anti-bacterial properties, Corian artificial stone has many applications.

One of the disadvantages of this type of stone is its high price, which is due to the high price of ATH. Another disadvantage of Corinne is its low compressive strength. In this research, in order to reduce the cost price of Corinne and increase the compressive strength, additional materials such as ceramic tile waste powder, stone powder, gypsum, and cement have been used. The study was divided into 4 phases. In each phase, one of the additives was substituted for by a certain weight. Hardener is a material that is added to the resin as a part of curing. The hardener used in this study is methyl ethyl ketone peroxide of 2% wt resin.

After mixing the resin and hardener, the powder and were added to the mixture and finally, cobalt as catalyst was added to the mixture of 1% wt resin. After mixing and curing at ambient temperature, compressive strength of samples on Days 1,3,7,14 and 28 were measured.
At each stage, one of these materials replaces part of the ATH. Then, the compressive strength of the samples at different ages 1, 3, 7, 14 and 28 was measured. The results showed that by replacing 15% ceramic tile waste, 60% rock powder, 50% gypsum, and 50% cement, compared to the weight of ATH, the compressive strength of the samples increased by 20.9, 16, 18.6 and 312%.

Key Words: Corian, polymer concrete, artificial stone, unsaturated polyester resin.

RELIABILITY ANALYSIS OF CONCRETE ARCH DAM UNDER STAGE CONSTRUCTION AND HYDROSTATIC PRESSURE BY MCS AND RS METHODS

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Abstract
The aim of this paper is to conduct reliability analysis of the Pacoima concrete arch dam considering the construction stage. According to the technical literature and codes, the construction stage should be considered in the structural analysis of the concrete arch dams. Structural analysis was done by taking into account the uncertainties in the physical and mechanical properties of the dam body materials and the reservoir water level. Three parameters of normal reservoir water level, the density of dam body materials, and elasticity modulus of dam body material with coefficients of variation of and with normal distribution function are considered as random variables. Linear elastic behavior is assumed for the constitutive law of concrete material in the finite element model.
Two load combinations are considered. is an unusual static load combination due to dam self-weight that considers the effects of dead load stage construction. load combination results from stage construction and hydrostatic reservoir pressure at a normal water level. and are the unusual static and usual static load combinations without considering the construction stage. The sensitivity analysis of random variables to the maximum tensile stress of the dam body is investigated, and random parameters with more impact are specified. The results showed that the density of concrete was the most effective parameter in response to maximum tensile stress. Reliability analysis based on the load-resistant model was utilized. The evaluation of implicit functions of load and resistance was performed by the finite element method. Monte Carlo method with 20,000 iterations utilized for simulation and the Latin Hypercube method was used for sampling. The maximum tensile stress in the dam body is considered as a limit state. The values of the probability of failure and reliability index are $p_f \simeq 3.75 \times 10^{-9} (\beta \simeq 5.78)$. The results showed that the safety of the Pacoima dam was high and had a very low risk of failure.

Key Words: Stage construction, pacoima concrete dams, reliability index, monte carlo, response surface.

DETERMINATION OF THE ROLE OF RETENTION TIME UNDER DIFFERENT TEMPERATURE CONDITIONS IN THE IMPROVEMENT OF SANDY SOILS BY BIO-CEMENTATION

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Abstract
The mechanical properties of soils often do not fulfill human needs and expectations due to world population

growth. Preventing damage to buildings and infrastructures requires basic measures or ongoing maintenance. For this issue, construction of any structure needs to be on a good soil bed with favorable strength parameters. So far, some improvement methods have been studied and applied. In geotechnical engineering, finding a low-cost and environmentally friendly method is the most improvement challenging problem. Microbial geo-technology is a new branch of geotechnical engineering that deals with the microbiological applications. Microbial sedimentation method (MICP) is a new and emerging method that uses microorganisms in the soil and chemical processes and, thus, the production of calcite sediment increases shear strength and hardness as well as reduces permeability. In this research, we focus on microbial catalysis of urea hydrolysis, which has led to the deposition of calcium carbonate in sand using Bacillus Pasteurii. However, recent researches have not addressed the effects of some parameters such as temperature and material concentration and various bacterial concentrations simultaneously. In this study, under different temperature conditions, different material concentrations, and different bacterial concentrations (different ODs), the reaction completion time is obtained. Significant experimental results show that OD changes have little effect on the result. Also, it is demonstrated that by increasing temperature, the amount of calcium carbonate deposits has also increased. Moreover, the higher the concentration of the material raises, the greater the amount of calcium carbonate deposits, making its formation faster. Also, samples with higher concentrations need a longer time to complete their reaction. High-temperature samples have a higher reaction rate from the earliest hours, but low-temperature samples require more time to precipitate calcium carbonate. Also, with the help of electron scanning, the effect of material concentration on the way of connection bonding and bonding between particles has been investigated.

Key Words: Biological cementation, bacillus pasteurii, completion of retention time, sandy soils.

NUMERICAL STUDY ON THE EFFECT OF GEOMETRICAL PROPERTIES OF GEOCELL ON THE BEARING CAPACITY OF SHALLOW FOUNDATION RESTING ON SATURATED MARL

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Abstract

Shallow foundation construction on soft and loose soils results in unacceptable deformation, high strain, and failure. Therefore, the implementation of shallow foundation on this type of soil can cause problems in terms of bearing capacity and settlement. Therefore, soil improvement is a logical and appropriate way. Geocell is a series of three-dimensional cells and its main application is to reinforce loose soils. Due to the mechanism of geocell interaction with the soil, the use of geocell reinforcement makes it possible to achieve a greater bearing capacity. In this study, using Abaqus finite element software, the effect of geometrical of geocell on the increase of bearing capacity of shallow foundation resting on saturated marl soil has been investigated. Also, using the analysis of the designed numerical models results, a correlation for homogeneity of the improved soil with geocell reinforcement has been presented instead of considering the soil reinforcement relations. The correlation coefficient and the presented diagram illustrate the high capability of the proposed correlation to estimate the equivalent shear strength to the geocell reinforced soil environment. The analysis results show that by increasing the geocell height for greater than , where S and B are the foundation settlement and the foundation diameter, respectively, the effect of the geocell height on increasing the bearing capacity is noticeable and it is more noticeable in looser soils. Moreover, by increasing the geocell pocket size up to 0.2 (m) and the geocell length by twice the foundation diameter, there is an increase in the bearing capacity of the foundation and then, there is no noticeable change in the bearing capacity. With an increase in the length of the geocell, it can be stated that the optimal length of the geocell layer is about twice the diameter of the foundation. In order to produce a correlation for estimating the equivalent shear strength of the soil environment reinforced with geocell, a number of numerical models were designed.

Key Words: Geocell, bearing capacity of shallow foundation, marl, reinforced soil homogenization, numerical study, Abaqus software.