were seen depending on the type of device. In order to measure the rebar cross section more accurately, machining has been used to prepare the rebars after corrosion. The results of this research also showed that in 14 mm size rebar, with the progress of corrosion up to 0.68 mm, the amount of force tolerated decreased by 16.7% (from 102 KN to 85 KN). Also, in the next step, with 0.62 mm of corrosion progress, the amount of this force has reached 76.3 KN from 85 KN (i.e., 10.2% reduction). In the third stage, with the progress of 0.96 mm, the amount of force borne by the rebar has reached 69.7 KN from 76.3 KN, which is equivalent to a 2.5% decrease. Finally, considering the economic and various application conditions, suggestions have been made to improve the performance and increase the durability and long-term use of the structures with more confidence.

Key Words: Corrosion of bars, reinforced concrete structures, Half-Cell test, fiber bars, chemical composition of bars.

COMPARING THE TWIST-OFF RESULTS AND THE CEB-FIP MODEL CODE STANDARD TO EVALUATE THE ADHESION OF MORTAR/STEEL AND PROVIDE A CORRECTION COEFFICIENT

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Abstract

In most buildings, concrete and steel are used side by side, and according to the type of loads, various stresses are created at their interface. When the repair layer is in direct contact with the steel or reinforcement, the stresses caused by the shrinkage of the mortars as well as temperature changes have a negative effect on the adhesion between the repair mortar and the steel. According to the CEB-FIP MODEL CODE standard, the shear adhesion between mortar and simple reinforcement is equal to $\tau = 0.3\sqrt{(f_c)}$. But it has not provided conditions to consider the type of implementation. Considering that shrinkage causes shear stresses at the interface of mortar and steel, therefore, in this article, by using the in-situ twist-off test, the shear adhesion strength between mortar and plain steel has been evaluated under different processing conditions. The results of the twist-off test show that the above equation is used if the sample is under processing until the moment of the test, otherwise there will be a big drop in the amount of adhesion, which even reaches 50%. The results of the shear adhesion strength obtained from the twist-off test for the samples that were processed in water until the time of the test, at a young age are almost equal to the equation provided by the CEB-FIP Model Code standard. At older ages, the shear bond strength results from the twist-off test between mortar and steel are on average more than 10% higher than the equation provided by the CEB-FIP Model Code standard. For the samples that were processed for a week and then left in the open space, it is observed that there is a big difference between the shear adhesion strength obtained from the twist-off test and the equation provided by the CEB-FIP Model Code standard. For practical cases where processing is usually done for about seven days, it is suggested that the shear adhesion strength between steel and mortar is measured for samples that have been subjected to wet processing for at least one week and prepared and stored under appropriate conditions. According to the equation, $\tau = 0.15\sqrt{(f_c)}$ should be considered. The amount of 90-day shrinkage for mortar treated in water and left in open space is 0.1083 and 0.2679%, respectively. The amount of shrinkage for mortar processed in water is 59% less than the shrinkage of mortar left in the open space.

Key Words: Adhesion, twist-off test, mortar, steel.

EVALUATION THE EFFECT OF CLAY ON COLLAPSE POTENTIAL OF SOILS IN DIFFERENT WATER INFILTRATION PATTERNS

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Abstract

Collapsible soils are one of the moisture sensitive soils that experience sudden and significant settlements due to wetting. These soils are widely distributed and constitute about 10% of the total land area of the world, which are typically located in arid and semi-arid areas. In foundation engineering, the most important issue in dealing with these soils is to measure their collapse potential with different water infiltration patterns. The effect of parameters such as initial soil conditions, loading conditions and gradation quality on the behavior of these soils has been investigated. The amount of clay in the soil is considered as an important factor in the behavior of the collapsible soils. Water enters the soil from different sources, but the existing devices and tests to measure the collapse potential are not capable of modeling water infiltration patterns. In this study, an apparatus was used that simulates different water infiltration patterns based on the direction of water movement (from top or bottom) and type of water distribution (point or wide). The results show that in oedometer tests and tests with the ability to simulate the water infiltration patterns, with the increase in the amount of clay in the sample, the collapse potential increases, but the amount of increase is not the same in different tests. The amount of increase in collapse potential due to the increase of clay in the sample is greater in single and double oedometer tests than in tests with the ability to simulate the water infiltration patterns, and for a more accurate prediction of the collapse potential, tests with the ability to simulate the water infiltration patterns should be used. Among the different water infiltration patterns in the soil, for the sample with 9.1, clay compared to the sample without clay, the highest increase in collapse potential is related to the top-point water infiltration pattern ($C_p = 4.79$) and the lowest increase is related to the bottom-wide water infiltration pattern ($C_p = 3.69$). But for the sample with 23% clay compared to the sample without clay, the highest increase in collapse potential is related to the top-wide water infiltration pattern ($C_p = 8.62$) and the lowest increase is related to the bottom-wide water infiltration pattern($C_p = 7.8$) .

Key Words: Clay percent, collapse potential, water infiltration pattern, experimental apparatus, collapsible soil.

INVESTIGATION OF THE CORROSION OF PARTICULAR BARS IN REINFORCED CONCRETE STRUCTURES

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Abstract

The durability of the rebar used in a concrete structure is very important for the safe and long-term use of that structure, and therefore, the root and the main cause of reducing the life and durability of that structure, which is corrosion, is of great importance. In this study, medium carbon steel bars with a diameter of 14 to 40 mm and a number of epoxy coated and fiber bars have been tested and the effect of simulated corrosion on the samples has been investigated by measuring the mechanical properties. The results obtained from this research can be effective in the field of rebar size selection according to its production method in different conditions. This result has been obtained according to the experiments. Mechanical properties are the main properties of steel rebar affected by corrosion that have been tested in this paper. In the measurement of mechanical properties by universal device, slight changes

a middle plate is proposed in this study to be placed between the two columns to connect them. The plate is butt-welded to both the lower and the upper portions of the column. Although this type of splice has been used occasionally in steel structures, its behavior is mainly unknown and research and code specifications regarding this type of splice are very limited. The current research studied the overall behavior of columns connected by this type of splice and obtained the minimum plate thickness required for typical columns to meet codes provisions. To provide the possibility of filling potential hollow sections with concrete, it is recommended to use a hallow plate in box-shaped columns. This study conducted finite element analysis on box- and H-shaped columns with different upper column depths. The influence of the plate thickness and shape on the strength and stiffness of splice in each combination was studied and minimum plate thickness was obtained. The splice exhibited satisfactory strength and stiffness in regular combinations. In combination with an upper column depth reduction of less than 5cm in box-shaped profiles and less than 7.5cm in the H-shaped profiles, the splice plate with a thickness of 5cm or more meets the criteria for both strength and stiffness. Decreasing the upper column depth increases the demand on the splice plate and a thicker plate is needed. Moreover, the shape of the splice plate, i.e., hollow plate or regular plate, had a large impact on the column behavior as the required thickness was greater in hollow plates. Results of stiffness analysis showed that decreasing the upper column depth and overall height of the column decreases the axial stiffness of the column.

Key Words: Column splice, middle plate, minimum thickness, hollow plate.

MODIFICATION OF SUBSTITUTE FRAME FOR STEEL MOMENT FRAMES WITH IRREGULAR BAY LENGTHS

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Abstract

Mass nonlinear dynamic analysis is unavoidable in many fields of earthquake and structural engineering, such as incremental dynamic analysis, probabilistic performance-based design, and optimization approaches. Using simplified models with fewer degrees of freedom instead of detailed original models to a great extent reduces the computational cost and prevents extremely time-consuming analysis. Among different simplified models for steel moment frames, stick models (such as shear beam models) only use the global story stiffness to estimate the original model responses, which do not consider the structural configuration. The stick models are only suitable for obtaining the general responses of the structure, such as global and interstory drift. However, simplified frame models are the more accurate simplified models that consider the details of the original frame, such as beam and column elements, nonlinear plastic hinge springs, and joint rotations. Substitute Frame is one of these models, which is a one-bay frame that predicts the structural responses for concrete and steel moment frames with very high accuracy. The purpose of this research is to develop a substitute frame model for steel moment frames with unequal bay lengths. For this purpose, the beam stiffness and nonlinear behavior of rotational springs were modified based on linear and nonlinear structural analysis approaches and the proposed model is called Modified Substitute Frame. In the following, to evaluate the accuracy of the proposed model, three types of 12-story buildings with unequal bay lengths were designed using ASCE7-16 and AISC 341-16 criteria and subjected to three different ground motion data sets, i.e., far field, near field with pulse and without pulse ground motions. The nonlinear time history analysis results showed that the Modified Substitute Frame predicts the original frame responses with very high accuracy. Moreover, the Modified Substitute Frame prediction was more precise than the Improved FishBone model which was recently presented for moment frames with unequal bay lengths.

Key Words: Modified substitute frame, simplified models, steel moment frame, nonlinear dynamic analysis.

the stress created in the nails decreases in higher cycles than in lower cycles. Then, the effect of applying three freezing cycles based on a hypothetical critical temperature on the soil nail wall was investigated by comparing the highest stress created in the nails under the mentioned conditions with the rupture threshold Steel, it was concluded that the soil nail wall does not break. In the following, by examining the effect of tension cut-off on the behavior of the soil nail wall, it was found that the soil nail wall experiences an increase in displacement as well as an increase in the stress in the nails.

Key Words: Freezing and thawing cycle-Abaqus-soil nail wall-finite element simulation- field operations.

LABORATORY INVESTIGATION OF DAMAGE DETECTION OF TRUSS BRIDGE JOINTS USING VIBRATION RESPONSES UNDER MOVING LOAD

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Abstract

During operation, a variety of factors, including earthquakes, wind, fatigue, the environment, and many others, can always cause damage to structures and the characteristics of the structure change as a result of the damage. The availability of low-cost methods for detecting damage in truss bridges makes it possible to examine a greater number of operating bridges and ultimately reduces future losses and risks. As a result, researchers' pursuit of suitable methods for detecting damage in structures has grown significantly over time. Bridges have always been the focus of researchers' efforts to comprehend their behavior and develop methods for identifying damage because of their significance as the infrastructure of every nation. In this study, an eight-span truss bridge was subjected to a moving load in a laboratory process, and the vertical displacement response of only one desired point of the truss lower chord is measured, in the damaged and intact condition. On the other hand, the influence line diagrams of all truss members have been extracted during the modeling in finite element software. The efficacy of this method in detecting damage in truss bridge screw connections has been evaluated using fourteen distinct damage scenarios. The results show that if damage occurs in the bridge connections, the difference diagram of displacement responses of two healthy and damaged states and the influence line diagram of the member whose connections are damaged will match in terms of shape and can be an indicator to identify the damage. This method works for all of the truss bridge's members, and it has worked even when more than one member was damaged. Considering that this method has been numerically validated in the previous study, using a more accurate displacement sensor with less noise and using conditions closer to those of the numerical analysis improves the accuracy of the results.

Key Words: Damage detection, displacement response, influence line, truss bridge, connections.

PROPOSING A METHOD FOR SPLICING STEEL COLUMNS TO IMPROVE FORCE PATH AND FACILITATE CONSTRUCTION

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Abstract

Current methods of splicing columns with different depth sizes have a long total load path as well as large and expensive details. These details are sometimes overly complicated and hard to fabricate. To shorten the load path and make fabrication easier and more economical,

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Abstract

The advancement of technology with an increasing population has led to the requirement for high-speed mobility trains. High-speed transportation by trains requires passing through soft soil conditions, which requires stability. High-speed trains are used nowadays in developed countries to reduce travel time. When the train moves at a critical speed, it can significantly increase the dynamic responses of the components on the railway lines. The present study examines the results of 3D numerical modeling, considering the impact of the high-speed train passing through the mechanical earth wall stabilized by plate anchors. Numerical modeling was carried out using Plaxis 3D finite element software. The impact of various factors such as the speed of the train (180, 200 & 250 Km/h), the number of plates (single, double, and triple), and the number of train tracks (1 & 2 tracks) have been investigated. The Hardening soil with small strain model has been used for modeling the behavior of the backfill soil. In this study, the geometrical characteristics of the Thalys high-speed train were used to model the train passing through the walls of 6 meters that were stabilized with plate anchors. From the results, it was concluded that Increasing train speed from 160 to 250 Km/h increases the settlement under the rails by 11% and increases the horizontal displacement of the wall by 13%. It was confirmed that increasing train speed will result in an increase in the settlement under the rails and increases the horizontal displacement of the wall in all investigated cases. Increasing the number of plates along with decreasing their dimensions has a positive effect on the wall's performance with regard to the horizontal displacement of the wall. Also, it should be mentioned that by increasing the number of train tracks from 1 to 2, the settlement under the rails increased by 5%, and the horizontal displacement of the wall increased by 20%.

Key Words: Thalys high-speed train, retaining wall, plate anchor, numerical modeling, vibration, reinforced soil, finite element method, PLAXIS 3D.

NUMERICAL STUDY OF FREEZING EFFECT ON SOIL NAIL WALL

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Abstract

One of the methods of stabilizing soil slopes or excavated pits is soil nailing. The use of this method is common in different parts of the world and has a history of about four decades. However, the use of this method in cold regions is more limited than other regions with normal temperature conditions due to insufficient studies and lack of necessary information about the response of the soil nail wall under freezing conditions. Therefore, in this study, in order to help better understand the behavior of soil nail wall due to frost activity, using Abacus finite element software, a complete thermal-mechanical analysis coupling on a case soil nail wall in the Brunswick area Located in Maine, USA. In order to validate the numerical model, the results obtained from this simulation are matched with the results of field operations performed by Duchenne (2003) on the same soil nail wall. In the continuation, by applying successive freezing and thawing cycles on the mentioned soil wall, the amount of stress created in the nails strengthening the soil wall in different cycles were compared and the stability or instability of the soil wall was investigated. The results of the study of the amount of stress created in the nails due to the applying of three freezing cycles with normal temperature of the Brunswick region to the soil body show that with increasing the number of cycles,

within the first two days of concreting is approximately 5%. However, as time progresses, the tensile strain capacity decreases to stabilize at a constant value of 3%, a level considerably higher than that of ordinary concrete. Moreover, ECC exhibits exceptional durability in sulfate, chloride, tropical environments, as well as resistance against freeze-thaw cycles. Its significance characteristics, including strain-hardening behavior, multiple cracking, and ductile behavior, distinguish it from the other types of concrete. To produce engineered cementitious composite, special materials such as fly ash and polyvinyl alcohol (PVA) fibers are required, but they are not available in the country. In this research, 13 different engineered cementitious composite mix designs were developed using locally available materials such as slag, limestone powder, industrial pozzolan, silica fume and polypropylene fibers. Then, the mechanical properties of different engineered cementitious composite mix designs, including compressive strength, modulus of rupture, energy absorption, and toughness indices have been investigated. The experimental results showed that optimizing the use of silica fume, and slag at rates of 10% and 28% by weight of cement, respectively, along with the inclusion of industrial pozzolan at a rate of 22% by weight of cement, improves the mechanical properties of engineered cementitious composite. Finally, the best engineering cement composite mix design was reinforced with glass grids (one and three layers) and subjected to a four-point bending and direct tensile tests. According to the results obtained from the four-point bending test of glass grid reinforced engineered cementitious composite panels, it can be concluded that increasing the number of glass grid layers enhances flexural strength, the area under the load-deflection curve, and energy absorption. For instance, the flexural strength of engineered cementitious composite panel reinforced with three layers of glass grid increased by 47.5% and 275%, respectively, compared to the flexural strength of an engineered cementitious composite panel reinforced with one layer of glass grid and an unreinforced engineered cementitious composite panel.

Key Words: Engineered cementitious composite (ECC), micro-silica, industrial pozzolan, mechanical properties.

STUDY ON THE PERFORMANCE OF BLAST WAVE ABSORBER PANEL IN PROTECTING BUILDINGS AND FACILITIES

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Abstract

The retrofitting plan is effective when, in addition to being cost-effective, it minimizes casualties, reduces infrastructure damage, and limits the extent and scope of damages as much as possible. The design and construction of most explosion-resistant barriers in all types of structures are not optimal due to the high cost on the one hand and the low probability of explosion during the life of the structure on the other hand. In this research, the proposal of using the combined method of restraining net along with the blast wave absorber panel as a new model in protecting the building against external explosions has been studied. The rocket is restrained at a certain distance from the main structure by a resistant net and the panel absorbs the wave caused by the explosion. By conducting studies and experiments on various absorbent materials, the selected panel was introduced and its behavior against threats at different distances was evaluated numerically and in the field. The results of the simulations were in good agreement with the field tests, which can be generalized for different amounts of charge.

Key Words: Absorbent panel, concrete fabric, Abaqus, numerical modeling, explosion wave, Absorbing energy.

NUMERICAL MODELING OF MECHANICALLY EARTH WALLS STABILIZED BY PLATE ANCHORS UNDER THE VIBRATION OF HIGH-SPEED TRAIN

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it was found that adding 1% of polymer resin at the age of 1 day causes a decrease in compressive strength compared to samples without polymer resin. But with increasing age of samples in high sand-cement ratios, an increase in compressive strength is observed. The highest compressive strength at ages 7, 14, 28, 42, 56 and 90 is for the sand-cement ratio of 4.75 and the highest flexural strength was observed at the sand-cement ratio of 4.5.

Key Words: Mortar, mechanical behavior, polymer resin, sand to cement ratio.

A NUMERICAL STUDY ON EFFECTIVE PARAMETERS ON THE THERMAL INTERACTION OF ENERGY PILE GROUP

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Abstract

Global population growth and industrialisation over the past two centuries have been increased the tendency toward increased use of fossil fuels. The rising trend in greenhouse gas emissions brought on by the usage of fossil fuels has contributed to global warming and, as a result, increased environmental hazards. Geothermal energy is a substantial source of clean, sustainable, and renewable energy that is utilized extensively for building heating and cooling and has a big impact on reducing greenhouse gas emissions. Energy piles as a convenient and efficient energy geo-structure receiving a lot of attention worldwide for use in building heating and cooling. Investigating the variables influencing the thermal interaction between the group of energy piles and its impact on reducing the extracted energy from the energy pile group is the goal of this study. The soil porosity, mass flow rate of the circulating fluid, pile diameter, pile length, and pile position have all been investigated using the COMSOL Multiphysics Software. The analysis of the simulation data reveals that as energy piles' diameters increase, so does the amount of extracted energy. The amount of energy extracted is significantly influenced by the soil's porosity, which causes thermal interaction to decrease and energy extraction to increase as porosity increases. It was found that the amount of energy extracted is not significantly affected by the mass flow rate of the fluid circulating in the pipe. If the amount of extracted energy calculated with respect to the pile length, as the length of the pile increases, the average energy extracted per meter of the pile decreases and tends to a constant value. When the pile diameter is kept constant, pile interaction tends to be reduced by increasing the ratio of the pile diameter to the pile spacing (s/D), and as a result, the amount of energy extracted increased. In the group of energy piles, it has also been found that the corner piles are the most and the center piles are the least effective piles.

Key Words: Geothermal energy, energy pile group, extracted energy, interaction, heat transfer in soil, comsol.

MANUFACTURING ENGINEERING CEMENTITIOUS COMPOSITES (ECC) WITH AVAILABLE MATERIALS IN IRAN AND REINFORCING THEM USING GLASS GRIDS

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Abstract

Engineered cementitious composite is a cement-based composite material that exhibits significantly higher flexural, tensile, and compressive strength compared to ordinary concrete. The initial tensile strain capacity of ECC

Abstracts of Papers in English

LABORATORY INVESTIGATION OF MECHANICAL CHARACTERISTICS OF POWDER MORTAR CONTAINING POLYMER RESIN

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Abstract

Mortars are heterogeneous construction materials whose raw materials, manufacturing processes and application conditions have continuously evolved throughout time . Mortars are artificial construction materials that consist of ؛one or more mineral adhesives whose main function is to connect loose grains using different chemical changes in their mass, aggregates that are used to create volume stability on the mortar mass and water that is used to mix the mortar components into a sticky dough. Materials must be carefully measured and mixed to give the desired balance to bring out its essential properties. Therefore, in this research, 11 mixing plans for mortar, which is a kind of reactive powder concrete, with sand to cement ratios of 4.5, 4.75, 5, 5.25, 5.5, 5.75, 6, 25 6.5, 6.5, 6.75, and 7 were made and the effect of increasing the ratio of sand to cement was evaluated, and by analyzing the results of compressive strength, it was observed that the highest compressive strength was at the age of 1, 7, 14, and 28 days of the sample with a sand-cement ratio of 4.75 and at the ages of 42, 56 and 90 days, it corresponds to the sample with a sand-to-cement ratio of 4.5 and by analyzing the flexural strength results, it was also observed that the highest flexural strength is related to the sample with a sand-to-cement ratio of 4.5. Then the effect of adding 1% of polymer resin to 11 sand-cement ratio was investigated. From the analysis of the results,