Abstracts of Papers in English

EXPERIMENTAL INVESTIGATION OF THE PERFORMANCE OF A REPLACEABLE-RIGID CONNECTION

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Abstract
After the Northridge earthquake, a set of prequalified connections were introduced by international design codes. These connections include reduced beam section (RBS) moment connection, bolted unstiffened and stiffened extended end-plate moment connection, bolted flange plate (BFP) moment connection, welded unreinforced flange-welded web (WUF-W) moment connection, kaiser bolted bracket (KBB) moment connection, conxtech conxl moment connection, side plate moment connection, Simpson strong tie strong frame moment connection, double tee moment connection, slotted web (SW) moment connection. After ensuring the seismic performance of this set during earthquakes, concerns surfaced that forming plastic hinges in beam elements would result in either making repairs impossible or incredibly expensive in the event of a moderate or severe earthquake. Hence, a type of replaceable connection was introduced wherein plastic hinges would be placed in pre-determined elements. Their intuitive replaceability feature would make repairs and reutilization of the structure a much easier task. In this study, the experimental investigations of 4 full-scale samples of a replaceable rigid connection under cyclic loading were carried out. The results of the experiments demonstrated that in the proposed connection, the plastic hinge is formed in the fuse element while the beam and the column maintain their elasticity, allowing the connection to be replaced. Also, taking into account the early buckling of the fuse plates installed on the beam flanges, the moment capacity of the connection is decreased by 22 percent compared to the moment capacity of the fuse. According to the results obtained from the backbone diagrams, the stiffness of the connection after replacing the fuse plates

in the P12 and P15 samples has decreased by 8.61% and 6.14%, respectively; this could be due to slight changes in the holes on the beam web and flanges as well as changes in the pre-tensioning forces of the bolts. Investigations have revealed that the 20% increase in the moment capacity of the fuse (using 15 mm steel plates instead of 12 mm in the fuse plates of the beam flanges) has increased the cumulative energy dissipation of the connection by 12%.

Key Words: Rigid connections, replaceability, fuse, cyclic loading, prequalified connections.

LABORATORY STUDY ON THE SEISMIC ACCELERATION COEFFICIENT USED IN THE PSEUDO-STATIC ANALYSIS OF POLYMETRIC-STRIP REINFORCED-SOIL WALLS ADJACENT TO THE ROCK FOUNDATIONS

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Abstract

In some roadway projects, especially in a mountainous region, the mechanically stabilized earth walls must be constructed in front of stable features such as a rock-face for a variety of reasons, including the construction of new roadways, widening of urban transportation corridors, and reduction of rockfall risk. There has been limited research into the dynamic performance of the MSE wall adjacent to the rock slope; thus, the seismic behavior of this retaining system is still poorly understood. The most common methods for seismic stability analyses of reinforced-soil retaining walls are based on pseudo-static limit-equilibrium approaches, where seismic coefficients are applied to the potential failure soil mass. In the pseudo-static method, the assignment of an appropriate lateral seismic coefficient (Kh) that would be able to simulate the seismic inertial force induced in the sliding wedge has a considerable effect on the accuracy of the analyses. Since earthquake acceleration is the main cause of the inertial force induced in the failure mass, the seismic acceleration coefficient (Kh) is determined mostly based on the peak ground acceleration at the wall base level. The seismic events are transient in nature, and the earthquake-induced forces vary in intensity during vibrations. However, in the pseudo-static method, the seismic force is applied to the failure soil mass indefinitely. Therefore, the use of peak ground acceleration could lead to over-conservative results. To overcome this limitation, the seismic coefficient is usually expressed as a fraction of the peak ground acceleration for design purposes. The value of this fraction has not been clearly defined for reinforced-earth retaining walls. Most of the proposed methods for calculating the seismic acceleration coefficient are based on theoretical assumptions, and the validation of this important parameter has not been evaluated based on an experimental approach. In this study, initially, the seismic behavior of the polymeric-strip reinforced-earth retaining walls built on the rock foundation is investigated using shaking table tests. Then, the assumptions of the pseudo-static approach are simulated by push-back pressure tests. To apply back pressure to a model wall, a special apparatus was designed and made in the Tarbiat Modares University laboratory. Finally, the horizontal seismic coefficient is estimated by comparing and adjusting the result of the shaking table and push-back pressure tests. The results presented are based on the acceptable seismic performance of the retaining wall and are compared with the previously proposed relations and AASHTO design code.

Key Words: Reinforced-earth retaining wall, rock foundation, seismic acceleration coefficient, shaking table test, push-back pressure test.

EXPERIMENTAL INVESTIGATION OF THE DYNAMIC BEHAVIOR OF SLENDER STRUCTURES SUPPORTED ON COMBINED PILE-RAFT FOUNDATION: TOWARDS OF PERFORMANCE-BASED DESIGN

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Abstract

In this research, the experimental investigation of the inertial interaction of soil-pile raft structure has been conducted for slender structures supported by the combined pile-raft foundation with emphasis on the new concept of design method (performance-based design). Most of the former studies based on this concept have focused on the surface foundation, where the surface foundation's rocking motion acts as a source of energy dissipation to protect the superstructure. Meanwhile, less attention has been paid to the surface foundation combined with piles (Combined pile-raft foundation) as an economic support system for high-rise and heavy structures. Mainly, the focus of optimizing these foundations through parametric analysis has been on variables such as pile arrangement and pile length for vertical static loading. When the heavy structures are subjected to the lateral load caused by the earthquake, the foundation experiences significant inertial moments. Thus, the nonlinear behavior of the foundation is not far from expected. The present research intends to examine the rocking behavior of combined pile-raft foundations as the foundation of slender structures. Evaluating the response of the superstructure and its possible benefit from the nonlinear behavior of the foundation is the principal goal of this research. In this regard, using experimental models, some characteristics of combined pile-raft foundations, such as the arrangement of piles and the relative length of the piles, have been investigated on the response of the superstructure. Three physical models were constructed in the laboratory. Each model contained a single degree of freedom superstructure supported by a floating pile raft foundation in sandy soil. Two characteristics were considered for evaluating pile raft characteristics: pile configuration and pile length ratio. The superstructure was identical in all three physical models. An experimental procedure based on forced vibration tests was presented to assess the dynamic response of the models at different levels of foundation nonlinearity. According to the experimental measurements, the nonlinear behavior of the foundation has a significant role in the response of the superstructure. Dynamic demand reduction as well as drift reduction are the two most important factors that benefit the superstructure from foundation nonlinearity. Accordingly, the dynamic behavior of the models is divided into two individual phases. Also, comparing the results of the models showed that the arrangement of piles and the relative length of the piles in the combined pile-raft foundation have a significant impact on superstructure response.

Key Words: Soil-pile-structure interaction, performance-based design, pile-raft foundation, nonlinear response, forced vibration.

WHICH PARENTS ARE ABLE TO COMMENT ON USING AUTONOMOUS VEHICLES FOR THEIR CHILD'S SCHOOL TRIP? (A CASE STUDY OF KERMAN CITY)

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Abstract

Autonomous vehicles are a proper option for children's school trips due to their high potential. Parents are the main decision-makers in choosing their children's school trip mode, and it is essential for policymakers to be aware of their behavior and willingness, especially when technology is not yet available to the public. Previous studies of self-driving cars (SAVs) have focused on the rejection or acceptance of this technology by adult users, while SAVs are an attractive option for students' educational trips. Few studies in this field emphasize the need to do it, but in the current study, unlike previous studies, the factors affecting the behavior of parents who are unable to make a decision in this regard have been investigated using mathematical modeling. The virtual link of the current study questionnaire (in six sections) was uploaded by the school principals in the educational groups of the selected schools with the parents after experimental questioning and correction. Data analysis shows that almost a high percentage of parents (29%) have not been able to give a definite opinion about whether or not their child uses autonomous vehicles. In this article (for the first time), the factors affecting the inability of parents to make decisions are studied. The binary logit model on the May 2021 questionnaire of parents of fourth to ninth-grade students in Kerman schools (1435 cases) has

a correct estimation percentage of 77.1 and a good fit coefficient equal to 0.4. The estimated model shows that the behavioral characteristics and accidental history of parents influence their decisions. In the case of Kerman, parents who have a history of fatal accidents in close relatives and who have a high level of concern about the way they drive and the possibility of a high-traffic accident in public transportation have not been able to decide whether to reject or accept this technology.

Key Words: Autonomous vehicle, school trip, binary logit model, policy making, demand.

ANALYSIS OF BLUE AND GREY WATER FOOTPRINTS OF TRADITIONAL CONSTRUCTION WITH EMPHASIS ON DIFFERENT CLIMATIC REGIONS OF IRAN: A COMPARATIVE STUDY

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Abstract

Traditional patterns could be an effective solution for water consumption and pollution-related problems in the construction industry. However, the water footprint of traditional buildings in Iran has not been investigated. Iran has rich experience in constructing traditional buildings. This paper presents a comprehensive analysis of the grey and blue water footprints of the construction of traditional buildings in Iran with emphasis on different climate zones. The results are compared with modern buildings (concrete and steel). High-quality data related to 11 materials factories and 34 traditional buildings (stone, wood, clay, and brick) are presented. Blue and grey water footprints of building materialization are calculated using the water footprint network and life cycle assessment methods. The focus is on the structures of buildings. The grey and blue water footprints of modern structures are 327 times and 1.5 times larger than the grey and blue water footprints of traditional structures, respectively. Steel and cement production are influential parameters in the greywater footprint of modern structures. Employee meals have the greatest impact on the water footprint of traditional structures. The blue water footprint dominates the water footprint of traditional structures, which is 2.26 times larger than the greywater footprint. Stone structures have a blue water footprint of 0.85 m3/m2, which is dominated by the blue water footprint of employees' food (38.82%) at construction sites. They have a smaller blue water footprint than adobe and brick structures (1.41 - 1.42 m3/m2) and are close to the water footprint of wooden structures. The water footprint of brick structures is mainly influenced by the energy used (57.04%) for brick production. On the other hand, the greywater footprint dominates the blue water footprint of modern structures, which is 99.61 times larger than the blue water footprint. Steel structures have a blue water footprint of 1.86 m3/m2 and a greywater footprint of 208 m3/m2, the main pollutant of which is cadmium. Concrete structures have a blue water footprint of 1.60 m3/m2 and a greywater footprint of 137 m3/m2, with mercury as the main pollutant. From the water footprint viewpoint, it is better to use concrete structures than steel structures if both have suitable properties for the conditions they are used in. According to the results, the non-use of traditional buildings leads to an increase in water consumption and pollution.

Key Words: Blue water footprint, greywater footprint, traditional structures, life cycle assessment.

THE EFFECT OF WASTE LEACHATE ON THE DYNAMIC PARAMETERS OF CLAY SOILS

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Abstract

Leachate is a hazardous liquid that leads to numerous environmental problems. Soil pollution is one of the most important of these problems caused by poor leachate management facilities and limited land availability. Studies show that soil characteristics change during contamination, and these changes are a function of the type of soil and leachate. Therefore, it is necessary to evaluate the static and dynamic behavior of soils after contamination with leachate. Despite the importance of this issue, studies in this field are limited only to static behavior, and the effect of leachate on the dynamic behavior of soils remains almost unknown. Hence, an experimental effort has been made in this study to evaluate the effect of waste leachate sampled from the Alborz landfill on the dynamic parameters of three different clays under different overburden pressures (6.29, 18.88, and 31.47 kPa). For this purpose, the amount and type of heavy metals in the leachate were first determined using an inductively coupled plasma (ICP) spectrometer. Then, cylindrical soil samples were prepared in three different leachate contents (0%, 6%, and 12.5%) and subjected to a simple dynamic shear test. Moreover, the samples were photographed using an SEM microscope to investigate the effect of leachate on the soil texture. Based on the hysteresis loops obtained from simple shear tests and, subsequently, amounts of shear modulus (G) and damping ratio (D) calculated from them, it was found that pollution and its increase cause an increase in the shear modulus and a decrease in the damping ratio so that the growth of the shear modulus and the decrease in the damping ratio are affected by the type of soil and are more pronounced in soils with a lower paste range. It was also observed that the greatest effect of leachate on improving the shear modulus of the soil can be seen at lower levels of pollution. The increase in the influence of shear modulus and damping ratio of clay from overburden pressure was identified as one of the effects of soil contamination with leachate, which was more evident in clays with high paste range.

Key Words: Waste leachate, shear modulus, damping ratio, clay.

SEISMIC RESPONSE ESTIMATION OF MID-RISE STEEL MOMENT FRAME BUILDINGS USING A NEW ENERGY-BASED METHODOLOGY

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Abstract

Nonlinear Time History Analysis (NTHA) contains a complex and rigorous process for structural seismic evaluation. Nonlinear static (Pushover) analysis can simplify this process. This paper aims to develop an energy-based seismic assessment methodology using pushover analysis. This methodology can estimate the response of mid-rise buildings with much fewer computational operations than NTHA and consider higher mode effects. Other advantages of the proposed procedure include using the capacity curve of Multiple Degrees Of Freedom (MDOF) systems directly instead of the Equivalent Single Degree Of Freedom (ESDOF) and computing the energy demand of the structure based on the mean spectrum corresponding to the desired hazard level instead of the various earthquake record spectrums. The proposed methodology converts the pushover capacity curve to the energy capacity curve for each mode, and the energy demand curve is superimposed on it. The intersection of these two curves is considered the target response. NTHA and Modal Pushover Analysis (MPA) are employed to validate and compare the proposed methodology with other ones. Also, 4, 8, and 9-story steel moment frame buildings are selected, modeled, and analyzed using OpenSEES software. The results show that the proposed methodology can estimate the responses of the building with reasonable accuracy compared to the mean results of the NTHA. Also, the proposed method significantly reduces the error of the responses compared to the MPA. Nevertheless, it can be concluded that the proposed energy-based methodology can be a simple, efficient, and rapid alternative for NTHA.

Key Words: Seismic evaluation, pushover analysis, energy-based methodology, higher mode effects, steel frames.

EXPERIMENTAL INVESTIGATION ON CYCLIC BEHAVIOR OF NON-STRUCTURAL MASONRY WALLS STRENGTHENED WITH BED

JOINT REINFORCEMENT AND TEXTILE-REINFORCED CONCRETE

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Abstract

One of the main damages of the nonstructural masonry walls during an earthquake is its instability and collapse on the combination of deformation at the in-plain direction caused by lateral inter-story drift of structures and out-of-plane inertial forces applied to the wall because of earthquake acceleration. In most of the researches, only one of these actions was investigated, or their interactions were not directly investigated.

In this research, a combination of in-plane and out-of-plane loadings was carried out, and the effect of reinforcing on the nonstructural walls by using fiber mesh reinforced mortar and bed joint rebar has been investigated.

For this purpose, three wall specimens with scale of 1 to 1 were made of Leca blocks. Walls were subjected to a combination of in-plane cyclic loading and out-of-plane loading. The results showed that nonstructural walls, without reinforcement, failed under out-of-plain force in low in-plain drift, and the test process was stopped. On the other hand, strengthening the nonstructural wall with fiber mesh reinforced concrete caused an increase of 15% and 54% in the drift ratio related to the reduction of the wall resistance and the maximum in-plane force compared to the nonstructural wall, which was strengthened with bed joint reinforcement.

Key Words: Masonry wall, TRC, textile reinforced mortar, bed joint reinforcement, hysteresis behavior.

RECOGNIZE ADAPTIVE ECOLOGIES AND THEIR APPLICATIONS IN ARCHITECTURAL STRUCTURES

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Abstract

The understanding of architecture as an ecology of interactive systems moves past limitations and restricted tendencies toward spatial environments that are adaptive, perceptual, and behavioral. In this framework, the environment seeks to build interaction scenarios to activate relationships between components. In this case, architecture moves away from well-known models that always lead to disciplined responses and toward understanding adaptive ecologies that include active particles for communication and exploration. The current research investigated and discussed the design of a system that can replace the current methods of planning the construction of infrastructure units in the future. The result is the simulation of a cellular self-assembly system that can produce and rebuild its structure when needed. Therefore, there is a revolution in construction and a complete revision of architectural standards and construction planning, disremembering demolitions and labori-

ous construction costs. This study aims to explore the function of quorum sensing, a mechanism of intra-species communication that serves as the central regulatory system in the formation and concurrent response to environmental changes. The algorithmic design features of the system's constituent units were also examined. During the assembly process, extracellular matrices act as the milieu in which individual cells interact with one another and the desired environment as constructed building blocks. This allows for parallel assembly and error correction at a general level, both automatically, and has significant implications for the field. The proposed model uses a two-level control system (micro-macro) to ensure that the interactions among the components, on the one hand, and between the components and their environment, on the other hand, are in line with the objectives of the plan and the balance of the whole system. This two-level approach primarily follows a bottom-up process at the scale of the interaction of its constituent particles and subsequently utilizes a top-down process during the overall regulation of the system through the extracellular matrix. Ultimately, the simulation results obtained using Grasshopper3d software were shown in three scales: small (chair), medium (shelter), and large. This approach has been demonstrated to be effective in previous research and offers a promising framework for further investigation in this field. This research can take essential steps in developing simulator machines to build a construction self-assembly system based on sequential configurations and numbers.

Key Words: Adaptive ecologies, self-assembly, living architecture, diffusion limited aggregation, reversible fabrication.

RELIABILITY EVALUATION OF STOCHASTIC SUBSPACE IDENTIFICATION AND FREQUENCY DOMAIN DECOMPOSITION METHODS IN ESTIMATING MODAL PARAMETERS OF A STRUCTURE EXCITED BY THE EARTHQUAKE

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Abstract

One of the most common methods of identifying modal parameters in the field of operational modal testing is the method of identifying sub-random space and frequency domain analysis. Unfortunately, the scope of these methods' application is limited to static signals with a long pick-up time, and if the above conditions are violated, the results will be erroneous; This is in the context that the above two conditions are not met regarding the earthquake signal, and so far the reliability of these methods and their error rate in the face of this group of signals have not been studied. In this regard, in this study, the performance of these methods in earthquake conditions (both conditions are violated) is studied.

For this purpose, an numerical model of two two-dimensional frames with different heights (five and ten floors) is created and stimulated by using 20 earthquake records in the near and far fields. Using the obtained results and comparing them with the results of the numerical model, the error values for the modal parameters are obtained; Also, with the statistical study of the errors in the estimation of the frequency of the structure, the probability distribution function of the error and an estimate of the distance of the error are suggested .The results of the study showed that (a) the method of identifying random subspace has a better performance than the method of frequency domain analysis; (B) The random subspace detection method is not able to detect the first modes and is proposed to identify higher modes; (C) the efficiency of the frequency domain decomposition method decreases with increasing structural height; (D) By optimizing and locating the sensors, the performance of the frequency domain analysis method is dramatically improved. However, in the random subspace detection method, the detectability increases with the number of sensors.

Key Words: Operational modal analysis, frequency domain analysis, identification of random subspace, structural health monitoring.

INVESTIGATING THE UNDRAINED SHEAR BEHAVIOR OF SAND CEMENTED WITH PAYTEX NL25

POLYMER AND REINFORCED WITH TIRE THREAD WASTE FIBERS

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Abstract

Improving the soil shear resistance of problematic soils is always one of the challenges for civil engineers. Uniform and incompressible sands are one of these soils. Nowadays, focusing on environmental issues, economic issues, and the reuse of waste materials in civil engineering and choosing soil remediation methods is very necessary. In this article, the shear behavior of Neka sand with uniform granulation, which is stabilized using a polymer liquid called PAYTEX NL25 (with low environmental consequences) and reinforced with the waste fibers of tire thread, is investigated by conducting a series of Consolidated Undrained (CU) Triaxial Test. The percentage of polymer liquid was zero, 1, 2, 3, and 4 percent by weight, and fiber was added to it by 2 percent of dry soil weight. Triaxial tests were performed under confining pressures of 100, 200, and 400 kPa. The samples were made at the maximum density and optimum moisture obtained from the standard proctor compaction test and were cured at 23 degrees Celsius for up to 270 days. In general, the results of the tests showed that the aforementioned polymer liquid has a good potential to stabilize granular soils, and as a result of stabilization, the resistance parameters and hardness of the soil are improved several times. So, adding 4% polymer to sandy soil increases its cohesion from nearly zero up to 1350 kPa for the sample without fiber and 900 kPa for the fiber-reinforced sample. However, the behavior of the stabilized samples is brittle, and they generally break at strains less than 3 percent and undergo a lot of softening after the breaking point. The presence of fibers slightly increases the breaking point strain but significantly makes the behavior of the sample more flexible after the breaking point and prevents the rapid drop in shear strength. Although the presence of fibers reduces the stiffness of the stabilized sample, the reinforced stabilized sample is still much harder and more resistant than the empty sand.

Key Words: Waste fibers of tire, uniform neka sand, PAYTEX NL25 polymer, Consolidated Undrained (CU) triaxial test.

NUMERICAL STUDY OF THE LIQUEFIABLE SAND-PILE BEHAVIOR UNDER THE EFFECT OF NEAR-FIELD GROUND MOTIONS

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Abstract

Three-dimensional analyses are conducted to study the effects of ground motion and the presence of velocity pulse on the pile responses in liquefiable soils. Liquefaction of soils is an important issue in geotechnical engineering. Soil liquefaction occurs when saturated or partially saturated soil substantially loses strength and stiffness in response to applied stress, such as shaking during an earthquake or other sudden changes in stress conditions. The forward directivity effect, which includes a large velocity pulse at the beginning of the velocity time history of the ground motion and contains most of the seismic energy from the rupture, is the most damaging phenomenon observed in near-field ground motions. To investigate the effect of near-field ground motions on the seismic response of a soil-pile system, a three-dimensional model consisting of the two-layered soil and the pile is constructed. Modeling is conducted by using the FLAC 3D software. The P2PSand model is applied for the modeling of sandy soil. P2PSand model refers to a Practical TWO-surface Plastic SAND constitutive model for general 3D geotechnical earthquake engineering applications aimed at capturing essential soil dynamic characteristics. The model is a modified extension of the fabric-dilatancy-related sand plasticity DM04 model developed by Dafalias and Manzari. The Dafalias-Manzari two-surface model (DM04) is a critical-state compatible and state parameter-related plasticity model developed in the framework of Bounding Surface theory, which has been widely implemented

and studied. Dynamic analyses are conducted for the soil-pile system under the excitations of four selected ground-motion suites that were recorded on the rock. The results show that near-field velocity pulses have a considerable effect on the behavior of the system and cause sudden large displacement demands on the piles and soil. The pulse in the record of near-field ground motion has caused the pore water pressure coefficient (Ru) to increase and liquefaction in the upper soil layer.

Key Words: Liquefaction, FLAC 3D, seismic response, soil-pile interaction, pulse-like ground motion.