the cohesive strength of the clay bed caused 34.2% and 15.8% enhancement in the safety factor of the embankment, respectively, through the equivalent strip and area methods. As modeling equivalent strips is a tedious task, especially when the number of columns is high, geotechnical designers prefer to use the equivalent area method. Hence, a reduction factor was proposed here to apply to the safety factor of the equivalent area method. The analyses results show that the reduction factor varies between 0.74 and 0.99. The FS values obtained from the equivalent area method may be adjusted using such reduction factors.

Key Words: Slope stability, soft clay, stone column, equivalent strip and area, plaxis.

THE ASSESSMENT INTERRELATIONSHIP BETWEEN FAR-FIELD AND NEAR-FIELD SEISMIC PARAMETERS USING THE CORRELATION CONCEPT

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Abstract
Ground motions consequent to an earthquake reflect the features of the seismic source, the rupture process, the source-site travel path, and local site conditions. Consequently, the characteristics of ground motion in the vicinity of an active fault can be significantly different from those of the far-field. Recordings from recent earthquakes show that near-field earthquakes have different characteristics than far-field earthquakes. Overall, these characteristics are caused by a directivity effect in near-field earthquakes. This phenomenon causes the fault normal component of the recorded near-fault to have long-period velocity pulses. This paper investigates the relationship between the near-field of seismic parameters, including range, energy and frequency content parameters, and the results are compared with far-field earthquakes. 30 records of far and near-field earthquakes have been used. The data were analyzed by the Pearson correlation coefficient. It is a measure of the linear correlation (dependence) between two variables, X and Y, giving a value between +1 and -1 inclusive, where 1 is total positive correlation, 0 is no correlation, and -1 is total negative correlation. The results show that the correlation between the parameters of the horizontal component of near-field not only has a direct relationship, but that the correlations, on average, are powerful. The results show that maximum velocity of ground motion is better than maximum acceleration in prediction of other seismic parameters in three-components. On the other hand, the relationships between horizontal and vertical components of the parameters of the near-field differ considerably. So, in the horizontal component, no inverse relationship is seen between the parameters.

Key Words: Near-field earthquake, far-field earthquake, seismic parameters, correlation coefficient.

THE SEISMIC PERFORMANCE OF MOMENT FRAMES

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Abstract

Different passive dampers have been presented in order to improve structural performance, and various investigations have been undertaken to find their optimum distribution by different methods. In this paper, optimal distribution of TADAS dampers to improve the performance of a 3-story steel moment frame is investigated. This frame has the same loading condition, mass, geometry, and beam and column material, as the moment resisting frame of a 3-story SAC building located in Los Angeles. The design of the members of the frame does not satisfy ASCE41-06 criteria. A nonlinear static procedure, according to ASCE41-06 instruction, is used to analyze the frame under seismic load.

Based on the concept of the uniform distribution of deformation (UDD) algorithm, in order to obtain optimal design, structural resistance elements should be transferred from strong to weak portions. In this study, a modified UDD algorithm is used to achieve optimal distribution of dampers. This algorithm acquires the optimal stiffness distribution of TADAS dampers, with respect to the demand to capacity ratio (DCR) of the stories. The DCR of each story is equal to the maximum DCR of elements in that story, which is calculated based on ASCE41-06 regulations. First, the proposed algorithm assigns minimum stiffness to all dampers, then, increases TADAS stiffness in stories that have DCR greater than the allowable value, and vice versa. This process continues until uniform distribution for the stories DCR is achieved.

Genetic and PSO algorithms are types of heuristic algorithms. Optimal distribution of dampers using these algorithms is also obtained and their results compare with the UDD algorithm. Heuristic methods utilize a stochastic search to find optimum solution. First, they generate a population of solutions, then, find proper solutions, with regard to the objective function, and in the next steps, attempt to produce better population. Finally, they converge to the optimum design.

The results show that the optimum stiffness distribution of TADAS dampers is obtained when the distribution of stories DCR becomes uniform. Also, the UDD alogorithm acquires optimum distribution of dampers in fewer numbers of analyses in comparison with heuristic methods, because this algorithm uses engineering intelligence instead of stochastic search to find an optimum solution.

Key Words: Optimum distribution, tadas damper, genetic algorithm, pso algorithm, uniform distribution of deformation algorithm, moment frames, nonlinear static analysis.

NUMERICAL INVESTIGATION OF SAND EMBANKMENT STABILITY OVER SOFT CLAYS RETROFITTED WITH STONE COLUMNS

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Abstract

Various techniques have been adopted to enhance the stability of embankments constructed over soft soils. One of the most appropriate methods for this purpose is the application of stone columns. In this study, finite element analyses were carried out using PLAXIS 2D to consider the stability of sandy embankments over a soft clay bed reinforced with stone columns. To estimate the factor of safety (FS) against the deep-seated failure of the embankments, both common approaches of equivalent strip and equivalent area methods were used as a comparative investigation. The numerical analyses were focused on the effects of parameters on embankment stability, such as the diameter as well as the spacing of stone columns, the friction angle of the stone columns, the cohesion of the clay bed, slope height and friction angle. The analyses results show that the enhancement values of the embankment safety factor, due to an increase in the stone friction angle and the cohesive strength of the clay, were more pronounced in comparison to the effects of other parameters. Thus, an increase of 12kPa in

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Abstract

In the present paper, derivation of the yield function of the Hoek-Brown model in stress invariant space is investigated. This model is an empirical model that is defined for estimating the bearing capacity of rocks. The main equations of this model, according to principal stresses and in 3D stress space, are defined here . By defining of the model in the stress invariant space, the yield criterion will be independent from the coordinate directions and the rotation of stress axes in general static loadings. By definition of the Lode angle presented in certain papers and books, basically one cannot derive the relationship between the yield function of the model in the principal stress space and stress invariants space. This problem is because of ignoring the 30 degrees difference between the Lodes angle and the used angle in the definition of the models. After definition of the yield function, the plastic potential function of the model is also investigated. In this study, Hessian matrices are obtained by means of the chain rule in differentiating stress invariants. Basically, any arbitrary constitutive model that is expressed by principal stresses can transform to the stress invariant space via the basic relationships presented here. After this step, by computation of the elasto-plastic constitutive matrix, we can estimate the stress-strain behavior of material using that arbitrary constitutive model. This paper focuses on the elasto-plastic behavior and corresponding elasto-plastic relationships of the Hoek-Brown generalized criterion in three dimensional principal stress space and introduces a simple way to convert these relationships to three dimensional stress invariant space.

Key Words: Hoek-brown model, yield and potential functions, principal stresses, stress invariants, stress conversion, stress-strain relationships, elasto-plastic behavior, hessian matrices, constitutive matrix.

EFFECTS OF SOIL-ATMOSPHERE INTERACTION ON THE PHREATIC SURFACE AND STABILITY OF TAILING DAMS (CASE STUDY: SARCHESHMEH TAILING DAM)

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Abstract

Positioning of the phreatic surface in a dam body plays a critical role in the stability of tailing dams. Soil-atmosphere interaction effects, such as precipitation, runoff, interception, infiltration, and evaporation, on the one hand, and unsaturated soil effects, such as capillary rise, on the other, cause significant changes in the situation of the phreatic surface.

In this paper, first, different mechanisms that affect the phreatic line level in the tailing dams and their corresponding equations are studied, and a computer program is developed for calculating the fluctuations of the phreatic line. Then, for evaluating the usefulness of the program in real time problems, the stability of "Sarcheshmeh" copper mine tailing dam in Rafsanjan city, Iran, has been studied. Plaxis software Ver.8.0 has been used for modeling this tailing dam. Necessary parameters for modeling this dam have been obtained from the results of different laboratory tests on tailing materials, and information available from synoptic stations of the meteorological organization of Iran in the area. After determining the amount of change in the phreatic level for a special period of time, the stability of the dam was studied, based on calculating the factor of safety under different conditions.

The results show that by constructing new dikes, the safety factor decreases. Also, the results show that those parameters that increase the phreatic level reduce the safety factor, and the stability of the tailing dam will be threatened. Among different parameters affecting the phreatic level, capillary rise was found to be the most significant factor in regard to tailing dam stability when constructed in arid areas.

Key Words: Tailing dams, phreatic line, stability, soil-air interaction, capillary effects.

OPTIMUM DISTRIBUTION OF TADAS DAMPERS FOR IMPROVING

high energy dissipation and prevents nonlinear behavior in other elements. The hysteresis curves show ductile behavior, enhancing energy dissipation during cyclic loading of the final specimens and postponing the occurrence of buckling in the brace members until lateral displacement at about 2cm. Normal braces buckle in 1cm displacement, leading to brittle behavior. The increase of the frame final displacement between 13-43% and base shear reduction between 19-37% demonstrate the superior seismic behavior of the proposed system. Moreover, equivalent damping ratios in the proposed samples are significant by about 20% The proposed model is relatively easy to implement in a variety of braces, such as X-braces, chevron and diagonal configurations, without too much cost. In this research, by a slight change in the common system and without using complicated devices, energy dissipation is provided. This is one of its distinctive features compared to other research projects. It should be noted that due to the appropriate results obtained in numerical analysis, specimen fabrication and experimental work should be on the agenda to verify the results in the next stage of research.

Key Words: Concentric brace, ductility, perforated gusset plate, nonlinear static and dynamic analysis.

FACTORS EFFECTING THE KINEMATIC BENDING MOMENT IN THE PILES GROUP

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Abstract

Kinematic soil -pile interaction during earthquake motions has received large attention in recent years. In fact, post-earthquake underground field measurement by many researchers proof that bending moments due to kinematic interaction an addition to superstructure inertial effects damaged the pile foundation in recent earthquake. Kinematic forces arise from the passage of seismic waves through the surrounding soil and become significant in the presence of strong discontinuities in stiffness of the soil profile. In this case, the large curvatures imposed to the piles by the vibrating soil in turn generate bending moments; these moments will develop even in the absence of a substructure and are referred to as "kinematic" moments, to be distinguished from moments generated by structural loading at the pile head ("inertial" moments). Kinematic soil - pile interaction is a complex problem involving a number of factors, such as soil profile, soil properties, nonlinear soil behavior, induced pore -pressure and pile properties. Evaluation of the above factors and impact of each on the final response of piles can help engineers to better design. In this paper the results of parametric study of seismic behavior of pile groups embedded in layered soil is evaluated by focusing the attention on the kinematic bending moments induced by the transient motion using the three dimensional finite difference program FLAC3D. Elcentro earthquake excitation that has a low predominant frequency was applied as an acceleration-time history at the base bedrock of the finite difference mesh. Lateral side grids were horizontally fixed for static analysis. In dynamic analyses, lateral boundaries were considered as "Quite Boundaries", a built-in boundary condition in FLAC for dynamic analysis. Analysis is carried out by varying the main parameters governing the dynamic response of piles like the soil properties, the diameter, the spacing between pile and the depth of soft soil layer.The results showed that 1) Kinematic bending moment is increased by increasing the diameter of the pile and increasing the depth of soft soil layer or increase the space between the piles enhance the effect of pile diameter on the bending moment; 2) Increase the space between the piles reduce kinematic bending moments; and 3) Increasing the depth of soft soil layer is increase the kinematic bending moment and by increasing the space between the piles effects of soft soil layer depth on bending moment increases slightly.

Key Words: Numerical analysis, soil -pile interaction, kinematic interaction, piles group, finite difference.

DERIVATION OF YIELD CRITERION FOR GENERALIZED HOEK-BROWN EMPIRICAL MODEL IN STRESS INVARIANTS SPACE: DERIVATION OF SOME PLASTIC THEORY RELATIONSHIPS

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it can be used in nonlinear site response analysis to evaluate liquefaction occurrence.

Key Words: loosely coupled numerical modeling, site response analysis, soil liquefaction, pore water pressure, hyperbolic model.

EXPERIMENTAL INVESTIGATION ON MUD BRICK WALSL WITH MORTAR CONTAINING STRAW FIBERS UNDER DIAGONAL TENSION

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Abstract
This study presents an experimental investigation on mud brick walls with mortar containing straw fibers under diagonal axial compression. The brick size was: 22×22×7 cm (face×*bed*×*end*). The average compressive strength of the bricks was 4.73 MPa. To determine the performance of straw fibers in the mortar of mud brick wall, 12 walls, with size 120×120×22 cm, with various percentages of straw fibers (0/4, 0/6, 0/8, 1 and 1/2), were investigated. For evaluation of failure modes in ultimate diagonal compressive load, types of crack, load capacity and ductility, and energy absorption characteristics, were studied. Cracks in specimens with mortar reinforced by straw fibers have less width than unreinforced mortar. The ultimate load capacities of walls reinforced with various percentages of straw fibers (0/4, 0/6, 0/8, 1 and 1/2), were obtained as 20.3, 21.05, 20.7 and 18.5 kN, respectively. The average load capacitiy was increased about 26.78% compared to the unreinforced mortar wall in the ultimate load. The result shows that energy absorption in reinforced mortar specimens increased about 94.22 percent. Ultimate displacement for the unreinforced walls was 23.1 and for reinforced walls with 0/8% straw fiber in mortar was 34.8mm. It shows that ultimate displacement increased about 51 percent. Test results show that straw fibers can be used for reinforcing the mortar of mud brick walls, which is an advantage both economically and in enhancing structural behavior. In this study, when the straw fibers were increased to 0.8 percent in the mortar, the load carrying capacity was increased more than any other percentage of fiber in the mortar.

Key Words: Brick, diagonal tests, straw fiber, mortar, mud brick wall.

RESEARCH INTO THE EFFECT OF SIZE AND SHAPE IN PERFORATED GUSSET PLATES ON SEISMIC BEHAVIOR OF CBFS

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Abstract
Concentrically braced frames, CBFs, are among common lateral load carrying systems and their relative advantages, such as ease of implementation and lower cost compared to moment resisting frames, has led to their widespread usage. Experiences of past earthquakes indicate that the inherent defects and brittle behavior due to the buckling of compressive braces are the cause of the main damage in structures. In this paper, by making a hole in the gusset plates of diagonal bracing samples, it was endeavored to provide more ductility and improve the seismic performance of CBF through nonlinear static and dynamic analyses using ABAQUS software. For this purpose, holes were designed to have less axial capacity than the brace critical buckling load to help earthquake energy dissipation. The effects of hole shape and dimension and, also, the effect of near and far field earthquakes, were studied. Concentration of inelastic response in the hole neighborhood, results in

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Abstract

In this paper, a semi-active control technique is presented to mitigate the seismic vertical response of suspension bridges using magneto-rheological (MR) dampers and fuzzy logic. Fuzzy logic is a kind of controller that can directly determine the input voltage of an MR damper from the responses of the structure, and MR dampers are semi-active control devices which MR fluid is used in their structure. MR dampers have received significant attention in recent years because they retain the reliability of passive control systems and the advantage of adjustable parameter characteristics of an active control system, simultaneously. The magneto rheological damper is an attractive candidate in semi-active control of structures because of its advantageous features including: no need for a major energy source and high power capacity, adjustable power, fast response, and safe operation in cases of power failure.

To achieve this goal, a large scale MR damper (2200 KN) is used, and the Vincent-Tomas suspension bridge, located in Los Angeles, USA, has been chosen for the numerical example. Installation of the dampers at degrees along the bridge span, far from the towers, should be highlighted as an extremely challenging problem in this study to increase damper efficiency. In order to solve this problem, use of a rigid truss is proposed, and different schemes are also suggested to install MR dampers along the bridge span. The equation of motion of the system, using generalized modal coordinates, is written in the state-space form and the responses of the bridge are calculated under application of 15 major, world-wide earthquake accelerograms. Different inputs and rule bases are proposed for the fuzzy controller in this research. The characteristics of the fuzzy controller, and the number and position of the dampers are optimized by the trial and error method. Finally, three models with optimal position and number of dampers with optimal fuzzy control parameters are proposed.

A comparison between the uncontrolled and controlled responses indicates that the proposed semi-active control technique can effectively suppress the vertical responses of the example bridge.

Key Words: Semi-active control, suspension bridges, mr damper, vertical vibration, fuzzy logic.

EFFECTIVE STRESS LOOSELY COUPLED ANALYSIS OF SAND LIQUEFACTION BASED ON STRAIN ENERGY

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Abstract

Nonlinear site response analysis gives a more detailed description of soil behavior than the linear elastic or equivalent linear methods, but application of nonlinear codes in practice has been limited because of its greater number of parameters. In addition, there are some difficulties in calibration and adjustment of parameters in nonlinear codes. There are two main approaches for studying the response of soil deposits subjected to earthquake loading, including total stress and effective stress methods. The major deficiency of the total stress method is that it is unable to take into account the progressive stiffness degradation caused by pore pressure buidup in soil. Only the effective stress method can model the gradual loss of soil strength and stiffness due to the build-up of pore water pressure. In this study, a loosely coupled nonlinear model is presented to predict the undrained behavior of sand subjected to cyclic loading. A modified Kondner - Zelasko (MKZ) model, which is coupled with a pore water pressure generation model based on strain energy, is used for effective stress analysis. There are a couple of methods for the effective stress analysis and modeling of liquefaction, but these methods often require many parameters, and their determination requires greater time and cost. The numerical method presented in this paper is simple and needs a few and determinable parameters. It also provides accurate and acceptable predictions in triaxial condition. Although the proposed model is unable to account for the cyclic mobility and fluctuation of pore water pressure during cyclic loading, it accurately predicts peak points of pore pressure history during cyclic loading. Modeling of cyclic undrained triaxial tests conducted on Toyoura and Frazer River sands confirms that the proposed approach predicts the onset of liquefaction very well, and

Over the past four decades, the steel plate shear wall (SPSW) system has been used in a number of buildings in the world as part of the lateral force-resisting system. In today's designs, the SPSW system is designed to buckle elastically, develop a tension field and, ffb01nally, to yield under extreme loading. To increase the elastic buckling capacity, the common practice is to increase the web thickness, or to use horizontal and vertical plate stiffeners. In this paper, an investigation into the seismic behavior of stiffened steel plate shear walls with height is undertaken.
In this research, three FE models of stiffened steel shear walls with rigid connections, with 3, 7 and 15 stories and five spans, under nonlinear dynamic time history analysis, were evaluated. Results show that structural demands in near-fault regions are more than standard 2800 Iran earthquake regulation (v3) criteria. The average of storey shear in 3 storey models in far fault of 8.64% is more than in near fault. This value in 7 and 15 storey model sequences, 4.4 and 4.49 percent, is more than in near fault. The average of drift angle in near fault in 3, 7 and 15 storey model sequences, 46, 192 and 102 percent, is more than in far fault. Structural responses include shear and drift angle, which, in near-fault regions, is more than in far-fault regions. So, that authenticity, from far-fault regions, in the 3-storey model, is transferred to near-fault in models with greater height. The results show a transition zone in the behavior of the 7 storey model from far-fault to near-fault and, with increased height, near-fault effects are remarkable.

Key Words: Stiffened steel plate shear wall, Near fault region, Non-linear dynamic analysis.

INFLUENCE OF THE PROPERTIES OF PORE-FLUID RICH IN HEAVY METAL ON ERRORS ASSOCIATED WITH CONSOLIDATION AND ATTERBERG LIMIT EXPERIMENTS

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Abstract

It is known that engineering judgment and design are significantly a function of experimental results. Due to the importance of the experimental results of geotechnical and geo-environmental engineering projects, determination of the reliability of these experiments is an important factor in the acceptance of experimental investigation. The error associated with these experiments directly influences the reliability of test results. In spite of the importance of determining errors associated with soil mechanics tests, there has been very limited research towards addressing this subject. In addition, most prior research has focused on distilled water as the pore fluid of the soil. Furthermore, no prior research has addressed the influence of heavy metals on the extent of experimental error in soil mechanics experiments. The main objective of this research is to determine the impact of electrolyte properties of soil on the reliability of results of consolidation and Atterberg limit tests. To achieve this objective, a series of consolidation and Atterberg limit experiments, with tens of replicate samples, was performed. In these experiments, bentonite was mixed with different concentrations of heavy metal (lead nitrate). Then, the coefficient of variation of the results was calculated. The results show that the change in the pore fluid properties of soil causes a change in the properties of the soil double layer, which, consequently, affects the error associated with these experiments. For instance, a 30% to 85% change in the COV of the Atterberg limit test and a 4% to 70% change in the COV of the consolidation test were observed once the pore fluid properties of the soil are changed. Finally, it is concluded that the presence of contaminant in different concentrations might increase or decrease experimental error. The results of this research can be used to determine the required replicate samples to achieve specific reliability in consolidation and Atterberg limit tests.

Key Words: Error, coefficient of variation (cov), pore fluid properties, clay mineral, heavy metal contaminant.

SEMI-ACTIVE CONTROL OF VERTICAL VIBRATION OF SUSPENSION BRIDGES SUBJECTED TO EARTHQUAKE EXCITATIONS USING MR DAMPERS AND FUZZY LOGIC

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in a sloping bed, by increasing water depth, the effect of changes in bed slope on the amount of wave force is insignificant. Therefore, for relatively deep water, the seabed slope can be overlooked and then the force can be calculated using the formula for flat seabeds. The results also show that unlike the previous formula, the pressure unbreaking waves at the still water level is also influenced by water depth. Based on our results, breaking waves exert forces up to six times more compared to non-breaking waves.

Key Words: Long waves, caisson breakwaters, wave forces, numerical simulations, tsunami.

INVESTIGATING THE CRITICAL STATE BEHAVIOR OF CLAYEY SAND UNDER STATIC AND CYCLIC LOADING.

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Abstract
Observation of such phenomena as liquefaction and flow behavior generally occurring in loose and saturated sands have stimulated extensive investigation into sands and the parameters involved in their critical state behavior. Most studies conducted so far have mainly focused on clean sand or its mixtures containing non-plastic fines, with not much attention paid to the soil mechanics of the critical state of clayey sands. The reason for this neglect may be the misconception that plastic properties in clay prohibit flow behavior and liquefaction. However, the studies of the Northridge 1994, Kokaeli 1999, Chi Chi 1999, and Niigata 2004 earthquakes have indicated that notable settlements occur in soil containing considerable amounts of clay, resulting in great destruction. Researchers have emphasized that more detailed investigation is needed to determine the critical state behavior of clayey sands.

The critical state behavior of clayey sands has been investigated using cyclic and static triaxial tests. Based on the results, in low fine content, more density will result in a significant increase in steady state strength, while, at high fine content, the effect of density on the steady state strength would be insignificant. Also, increasing fine content results in more instability, but the trend reverses after a threshold value. This threshold value is independent of cyclic or static loading.
Comparing the results of different plasticity fines under similar conditions shows that increasing plasticity leads to more instability under the threshold value, while the effect of plasticity will be more significant with an increase in fine content Firooz-kooh crashed silica sand (sand 161) was used in the experiments due to its desirable properties. Specimens were prepared using the wet tamping method. Having obtained the appropriate blend, it was poured into a special mould and compacted in 6 layers to prepare specimens 50 mm in diameter and 100 mm in height.

Key Words: Cyclic, static, steady state line, triaxial, threshold value.

EVALUATION OF SHEAR AND DRIFT ANGLE OF STIFFENED STEEL PLATE SHEAR WALLS WITH RIGID CONNECTIONS IN NON-LINEAR DYNAMIC ANALYSIS IN FAR AND NEAR FAULT REGIONS

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Abstract
This paper presents research work on earthquake damage, with emphasis on near and far-fault earthquakes. Near-fault region earthquake research is very important regarding the criteria of the current seismic design standard spectrum of Iran (2800 Iran Earthquake regulation), which is based on probabilistic processes and prolonged periods, and describes ground motion in far-fault regions.

Abstracts of Papers in English

NUMERICAL SIMULATION OF LONG WAVES (TSUNAMI) FORCES ON CAISSON BREAKWATERS

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Abstract

In this research, long wave (tsunami) forces on caisson breakwaters have been investigated using numerical modeling. Verifications of the simulation results using experimental data, analytical formula and empirical formula show that numerical model is capable of modeling the aforesaid problem with enough accuracy. Several numerical simulations have been performed in the framework of this thesis to study different parameters affecting the forces induced by long waves on caisson breakwaters. An empirical equation has been introduced to estimate non-breaking long wave forces on caisson breakwaters. Results indicate that the force is a function of water depth and wave period in addition to wave amplitude. By moving the breakwater towards the shoreline, first, the force decreases, then, the force increases, by changing the shape of the wave, and, finally, the force significantly decreases after wave breaking. Results suggest that the wave action time on the breakwater shortens by decreasing water depth. Results show that the amount of exerted force by long wave, in our investigated model, is around 3.5 times more than the amount of force by short wave. Moreover, vertical distribution of long wave forces on the structure is more uniform than that for short waves. By increasing the seabed slope, wave amplitude and speed of horizontal orbitals in the wave crest significantly increase, which further increases wave forces on the structure. Results show that