industries, the number of factories, complexes, refineries and oil product transportation lines around cities increases. Hence, in addition to the environmental concerns caused by the leakage and entrance of pollutions into groundwater and their side effects, the soil geotechnical characteristics and bearing capacity of soils contaminated by oil contaminations are subject to change. Accordingly, in the oil-rich regions of the world, a great deal of research is devoted to the study of soil refinement, bearing capacity and instability caused by soil contamination. A numerically study was undertaken to achieve an accurate and realistic response. As a review of the previous research indicated, in recent decades, most studies have focused on the geotechnical properties of contaminated soils and there is only a limited amount of information about the bearing capacity and the foundation settlement behavior. Thus the purpose of this paper is to determine the behavior of strip footings rested on the gasoil and kerosene-contaminated sand slope. After determining the bearing capacity, the effect of petroleum products, including gas oil and kerosene oil, on the bearing capacity of strip footings adjacent to sand slopes was investigated. In this study, variables such as the type and percentage of contamination, slope angle, footing distance to slope crest and the thickness of the contaminated layer have been investigated. The results show that a thicker contaminated layer and a greater degree of contamination and soil slope will decrease the bearing capacity of the strip footing. Furthermore by increasing the footing distance to slope crest, the bearing capacity of strip foundation is increased. The numerical results have been verified for both the load-settlement diagram and the ultimate bearing capacity of the footing, by recent experimental results.

Key Words: Oil contaminated sand slope, bearing capacity, load-settlement curve, strip foundation, numerical analysis.

and management of the COVID-19 crisis in such seasons.

Key Words: COVID-19, air pollution, $PM_{2.5}$, PM_{10}, NO_x.

INVESTIGATION OF THE BEHAVIOR AND PROGRESSIVE COLLAPSE OF MID - RISE STEEL MOMENT-RESISTING FRAMES EXPOSED TO FIRE

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Abstract

This paper investigates the behavior of mid-rise steel moment-resisting frames (MRF) subjected to compartment fire and progressive collapse scenarios due to floor drop and column removal. In this study, initially, a typical 15-story building with a moment- resisting frame system and a story height of 3.2 (m) was designed using relevant chapters of national building code of Iran for conventional gravity and lateral loads. In order to perform thermal analyses, the most critical frame of this structure is modelled using OpenSees software. Then the nonlinear behavior of the frame is studied at elevated temperatures under different scenarios. In these analyses, the structure is subjected to both gravity and thermal loading simultaneously. Moreover, for performing thermal analysis, a standard fire curve (ISO834) is used. Results of this study indicate that beams do not deform significantly until approximately $400°C$; however, after that, vertical displacements of beams increase significantly due to degrading mechanical properties of steel. Moreover; beams deform and collapse at about $500°C$ to $650°C$. In addition, the beam heating initially causes axial forces in the beams due to thermal expansion restraint. Furthermore, Demand to Capacity Ratios of beams increase from early stages of fire and the most increase of DCRnom occurs at about $350°C$ to $400°C$. Demand to Capacity Ratios of columns increase from early stages of fire, causing the columns to reach their linear limit state in early stages. This behavior results from the thermal expansion of heated floor, which induce large horizontal displacement and, consequently, cause additional bending moment in the outer column. Moreover, by one story floor drop, columns survive up to $500°C$. However, at higher temperatures (about $600°C$ to $750°C$), these heated columns lose their strength and buckle. In column removal scenarios, in the first and 7th stories, where beams lose their strength at about $200°C$ and $400°C$, respectively, more damage is observed compared to floor drop scenarios. Fire in lower stories of structures is more critical than that in upper stories since they carry more gravity loads and start to behave nonlinearly at lower temperatures. Moreover, fire in the middle spans produces a more critical situation than that in the end spans, and interior columns are more critical than corner columns.

Key Words: Steel moment resisting frame system, opensees software, nonlinear thermal analysis, fire scenarios, progressive collapse.

STUDYING THE BEHAVIOR OF STRIP FOUNDATION RESTED ON THE KEROSENE OIL AND GASOIL CONTAMINATED SAND SLOPES

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Abstract

In recent years, due to the increasing use of hydrocarbons by humans, soil contamination has become a concern in environmental and geotechnical engineering fields. In the other words, by the growth and development of

CONNECTIONS WITH TAPERED BEAMS USING THE YIELD LINES THEORY

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Abstract

Ductility is proposed as one of the primary concepts for the structures' plastic and seismic design. Ductility is generally measured in designing with the member's capacity of rotation. In case of a correct designing of the connections and supply of seismic compression to a cross-section of the beam's web and flange, the failures will stem from the occurrence of in- or out-plane plastic buckling. The present study calculates the rotation capacity of the beam-to-column moment connections with tapered beams compressible seismic cross-sections in the web through the use of yield lines theory and the principles of analyzing rigid plasticity originating from the cyclic loading and potential energy minimization. Then, the ductility obtained from the method described above will be compared with the numerical calculations resulting from the finite element analysis. In the end, a laboratory sample will be made for comparing the occurred failure mechanism with the mechanisms obtained from plasticity analysis. The obtained results are indicative of the appropriate match between the ductility rates calculated through the three aforementioned methods as well as meeting of the guidelines' requirements for the use of the aforesaid connections in special moment frames.

Key Words: Tapered beams, ductility, cyclic testing, yields lines, finite element analysis.

A REVIEW OF THE IMPACT OF AIR POLLUTION ON THE INFECTION AND MORTALITY RATES DUE TO COVID-19

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Abstract

In the late February 2020, the first positive cases of the novel coronavirus, COVID-19, were confirmed in Iran, and the World Health Organization updated the status of the global outbreak from epidemic to pandemic in mid-March 2020. The rapid outbreak of the virus intervened a significant portion of socioeconomic activities, leaving behind some serious questions on the main factors intensifying the infection and the morality rates. Although the primary impacts of the outbreak have been extensively explored at the global and regional scales since its emergence, the impacts of the environment on the viral spread are still poorly understood. The goal of this paper is to review the most recent scientific findings on the spatiotemporal correlation between the air pollution and the mortality rate due to COVID-19. These researches are based on statistical analysis of the ground and satellite-based recorded data on PM2.5, PM10, and NOx across the United States, China, Italy, and England. The majority of these studies also consider data on population intensity, meteorological variables, migration rate, age, and health service quality to guarantee the validity of the findings by excluding the possible impacts imposed by these stressors. The results suggest that there exists a significant positive correlation between the concentration of the aforementioned air pollutants and the infection and mortality rates due to COVID-19. While long-term exposure to NOx has been associated with hypertension, heart and cardiovascular diseases, and chronic obstructive pulmonary disease, high concentration of PM2.5 and PM10 pollutants additionally enhances the mortality rate by facilitating the transmit of pathogenic agents through the fine particulate matters in the air. Regarding the drastic air pollution condition during the cold seasons in the most populated cities across Iran, the conclusions of this study can guide policy makers towards an effective planning

models. In this method, the main sample is randomly divided into k sub-samples with the same size. Among k sub-samples, a sub-sample is used as the validation data and the remaining as the test data of the model. Then, the validation process repeats k times (equal to the number of layers) and each of k sub-samples is used exactly once as validation data. In this study, the experimental values obtained by Hussein et al. (2010) and Hussein et al. (2011) are used for validating the results of the numerical models. Their experimental model consisted of a rectangular channel with the length, the width and the height of 9.15m, 0.5m and 0.6m, respectively. They installed the circular and rectangular orifices at a distance of 5m from the inlet of the main channel on the side wall. In the next stage, the most optimized number of hidden neurons was chosen equal to 30 and the results of all activation functions of the extreme learning machine were examined and the sigmoid activation function is selected for simulating the discharge coefficient. Subsequently, two modeling combinations were introduced using the input parameters as well as five different extreme learning machine models were developed. The analysis of the modeling results showed that the model with the shape coefficient has more accuracy. The superior model is a function of all input parameters and reasonably estimates values of the discharge coefficient. For example, the values of R and MAPE for this model are estimated 0.990 and 0.223, respectively. The results of the superior model were also compared with the empirical equations and it was shown that this model has more accuracy. Also, the partial derivative sensitivity analysis (PDSA) was run for all input parameters.

Key Words: Side orifice, discharge coefficient, partial derivative sensitivity analysis, k-fold cross validation, monte carlo simulations.

INVESTIGATION OF THE NATURAL FREQUENCY OF THE STRUCTURE AND EARTHQUAKE FREQUENCIES IN THE FREQUENCY DOMAIN USING A DISCRETE WAVELET

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Abstract

One of the methods of quake frequency investigation is the use of Fourier series and power spectrum. In this paper, the frequency of the major structural modalities in the earthquake is investigated using the power spectrum and the frequency of the earthquake, which has the greatest effect on the structure response. For this purpose, first, using the discrete wavelet theory, the acceleration of the earthquake is filtered up to 5 steps. At each stage of the filter, two waves of approximations and details are obtained. By analyzing the frequency content of approximate waves and details using the power spectrum and the Fourier spectrum, it results that the frequency of the wave is closer to the original wave of the earthquake. For convergence, the effect of frequency due to different frequencies in approximate waves is considered by the frequency effects of different frequencies in the main earthquake hypothesis called the approximation of the approximate wave to the maximum acceleration of the wave of the main earthquake. In order to verify the validity of the hypothesis, again, the Fourier spectrum and the power spectrum should be plotted for new approximation waves. After examining the frequency of the wave of approximations, it is concluded that the hypothesis works well. By studying the frequency content of the new approximation wave, it follows that for dynamic analysis, the frequency range of the power spectrum is more accurate than the Fourier spectrum. For this reason, the power spectrum is used for analytical calculations. Finally, with the investigations carried out in this paper, for the frequency domain analysis, the scalar approximation power spectrum is plotted. Then, several structures of the modal analysis and under the frequency spectrum of earthquake analysis are in the frequency domain. From the frequency response analysis curve and the results of the modal analysis, the frequency of the dominant mode of the structure is predicted. Using the wavelet transform, the number of accelerated earthquake mapping points reaches 1/32 But there was little mistake in estimating the prevailing frequency of the structure.

Key Words: Earthquake, Fourier spectrum, power spectrum, wavelet transform, dominant frequency.

STUDY OF THE BEHAVIOR AND DUCTILITY OF MOMENT

THE STUDY OF RISK MANAGEMENT OF WATER AND WASTEWATER FACILITIES USING COMBINED METHOD AHP AND RAMCAP

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Abstract

Water and wastewater facilities are the key assets and infrastructure of any country, and any service stop and damage to the infrastructure may have social and political problems and endanger the health and life of humans. Therefore, the study of asset valuation of these facilities against potential attacks is necessary to enable decision-makers to reduce potential risks. In the present study, the proposed combination of RAMCAP and Analytical Hierarchy Process (AHP) analysis of the total water and sewage infrastructure in Tehran based on the value of the assets and riskiness was investigated. We used a pairwise matrix method by receiving 42 expert opinions. To analyze the data, the AHP was used by applying RAMCAP guide. Moreover, to keep the paired comparison of each respondent reasonable, the inconsistency ratio was determined. The results of this study indicated that, because of the importance of assets, the Latian Dam with asset value 1 has the highest asset value and, then, Lar Dam with a value of 0.6920 in the second position and the distribution network of water and reservoirs with asset values of 0.0312 and 0.0310 based on three criteria of economic value, functional value, and uniqueness is in the last position of this value, respectively. Furthermore, 12 different threats were evaluated. In the case of chemical, microbial, and nuclear attacks, a number close to 1 is most likely to occur. The greatest vulnerability of the chemical threat, microbial and nuclear attacks belongs to the Latian dam with a vulnerability of 0.9310 and the Amir Kabir dam with 0.8353. Taleghan Dam with a vulnerability of 0.6304 was in the third position.

Key Words: Risk, infrastructure, asset value, vulnerability, RAMCAP; AHP.

SIMULATION OF RECTANGULAR AND CIRCULAR SIDE ORIFICES USING EXTREME LEARNING MACHINE

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Abstract

In this study, the discharge coefficient of rectangular and circular side orifices was estimated using the extreme learning machine method. Furthermore, in this study for evaluating the ability of different ELM models the Monte Carlo simulations are used. The Monte Carlo simulation is a comprehensive classification of computational algorithms which uses the random sampling procedure for calculating numerical results. The main idea of this method is based on solving problems which might be actual in nature using random decision-making processes. The Monte Carlo methods are usually used for simulating physical and mathematical systems not solvable with other methods. The Monte Carlo simulation is generally used by probability distribution to solve various problems such as numerical optimization and numerical integration. The k-fold cross validation method is also used for examining the performance of the above

Abstract

This paper presents an experimental study of steel plate shear wall in the concrete moment frame. This study was based on the idea of using steel plate shear walls in precast concrete structures. The steel plate shear wall was bolted to the embedded plates in concrete boundary elements. These plates were embedded at specified intervals, and friction connection was used for the bolted connections. Semi-static cyclic loading was applied to three different specimens according to ACI T1.1-01 code. Lateral load was applied to the top of specimens. The formation of tension field and buckling waves expressed the required behavior of steel shear walls and, also, good performance of connection scheme. In order to illustrate the effects of adding steel shear plate wall to a concrete frame, one of the specimens was considered to be a bare frame. The results showed the placing of steel shear plate wall in the concrete frame, multiplied loading capacity, initial stiffness, dissipated energy, and equivalent damping of the bare frame by three, eight, twelve, and four, respectively. Horizontal and vertical stiffeners decreased the effects of openings. As diagonal opening with horizontal and vertical stiffeners kept initial stiffness the same and increased dissipated energy and equivalent damping by about 15%; however, the lateral capacity decreased by 7%. The results of the strain gauge showed that yielding initiated at a 0.4% drift level. For the simple steel plate shear wall, the yielding started from corners; for the specimen with openings and stiffeners, it started from the bottom solid panel connected to beam and, also, edges of openings. The stress intensity of the bottom solid panel was more than the rest. Moreover, the steel plate initiated tearing at a drift level of 1.75%. According to the strain gauge results, embedded corners plates were critical; however, all of them remained elastic. Moreover, it could be said that dissipated energy was obtained from steel plate shear wall. Small bending and shear cracks occurred at the beam-column connection. All of the specimens failed given hinge supports of columns.

Key Words: Steel shear wall, concrete frame, interaction, bolted connection.

A NEW PLASTIC FLOW RULE FOR MOMENT-SHEAR INTERACTION IN STEEL BEAMS

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Abstract

The interaction of flexural moment and shear force in the eccentrically braced frames with intermediate link length is a major concern of the structural analysis and design. In eccentrically braced frames, if the link length is long, the flexural yielding dominates the inelastic response of the link. In case the link length is short, the shear yielding is dominant. For intermediate link length the inelastic response is controlled by the combination of flexural and shear yielding. Steel frames with intermediate beam length behave Like the links of eccentrically braced frames. Therefore, the interaction of flexural moment and shear force shall be considered in analysis of both intermediate link length and steel frames with intermediate beam length.

For design of steel I-sections with intermediate length, a yield surface considering moment-shear interaction is required for calculating the ultimate capacity. Nevertheless, for capturing the complete force-deformation curve by a nonlinear step-by-step analysis, a plastic flow rule is required in addition to the yield surface. In this paper, to investigate the plastic flow rule for the highly ductile steel I-sections, a study is carried out using nonlinear finite element analysis. The finite element analysis is verified using some available experimental results in the literature. Then, shear and moment deformations are calculated by using Timoshenko beam theory. Investigating the results of finite element analyses, a simple and practical non-associated plastic flow rule is proposed for the highly ductile steel I-sections. Finally, to show the applicability of the proposed plastic flow rule, an incremental (step-by-step) analysis is performed on a beam with intermediate length in which a mixed hinge is formed. This example is solved two times using both the associated and non-associated plastic flow rule. In this example, the load-deflection path resulting from the proposed flow rule is up to 7.5 percent less than the case without interaction. Results of this example indicate that the proposed non-associated flow rule leads to a softer force-deformation path and a larger ultimate deformation prior to the collapse. In general, the effect of flow rule on load-deflection path on structures is different case to case and cannot be ignored in some cases.

Key Words: Moment-Shear interaction, steel I-Sections, eccentrically braced frames, incremental analysis, mixed hinges, plastic flow rule.

indicate that the independence of the method of optimization from random values. Fast convergence, high precision and low computational cost are the advantages of this proposed method to estimate unknown parameters of a multilayer structure, including pavement structure.

Key Words: Differential quadrature method (DQM), harmony search optimization algorithm method, back-calculation, falling weight deflectometer (FWD).

PLASTIC ANALYSIS OPTIMIZATION OF MOMENT FRAMES BY PROPOSING A NEW OPTIMIZATION ALGORITHM, BINARY DOLPHIN ECHOLOCATION

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Abstract

The analysis of structures and, in particular, the determination of their failure mode is an essential requirement in the field of civil engineering. Obtaining this information in high-rise structures or structures with complex irregular layouts is a difficult process, which is very time-consuming even with the use of specialized computer software. In this research, a new optimization algorithm, named Binary Dolphin Echolocation Algorithm, is introduced by modifying the Dolphin Echolocation Optimization Algorithm. In recent years, meta-heuristic algorithms have been used extensively in engineering optimization problems. This research presents an automated approach to assess plastic loads and failure modes of 2D frames. The plastic analysis of moment frames has been optimized using the Binary Dolphin Echolocation Optimization Algorithm. Not only the proposed algorithm is applicable in this specific plastic analysis problem, but also it can be extensively used in any binary optimization problems. The method of elementary mechanism combination in the plastic analysis of moment frames is based on creating the basic collapse mechanisms, which, following their combination, should reach the minimum coefficient of plastic collapse loads. By using virtual work theory, the collapse load factor of each mechanism is achievable. The critical collapse load factor is then the minimum of them among all possible collapse mechanisms. The efficiency of this algorithm is verified using two frame samples with their exact response in the search for minimum load factors and their corresponding collapse mode. A comparison of the results shows that the proposed method provides outstanding results with high precision and speed and demonstrates the structure's failure mechanism. Meanwhile, the modifications made in this method have significantly reduced the volume of calculations. Moreover, applying changes to the Dolphin Echolocation Optimization Algorithm led to the use of this optimization algorithm for binary problems for the first time, ultimately resulting in a good convergence rate.

Key Words: Plastic analysis, kinematic theory, braced frame, optimization, genetic algorithm.

EXPERIMENTAL STUDY OF THE INTERACTION BETWEEN STEEL PLATE SHEAR WALL AND CONCRETE FRAME

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Abstract

Spillways are used in dam projects to convey flood flows and prevent destructive damages of downstream hydraulic systems, while the construction of other types of spillways is restricted, or there is a need to pass great values of flood discharge with a limited head. Siphon spillway is a kind of dam spillways employed in a number of dam reservoirs. This spillway is applied while the space for constructing other types of spillways is restricted, or when there is a need to pass great values of flood discharge with a limited head. One of the most important defects of this spillway is a complicated fluid-structure interaction due to the establishment of different flow regimes inside the spillway. This situation becomes more complicated when the spillway is not connected to the dam, working individually. Despite the importance of the operation of these hydraulic structures, there is a lack of comprehensive research to investigate the hydraulic behavior of these structures and the flow field around and inside them. In the present study, different unsteady flow regimes including sub-atmospheric flow, two-phase flow, and black-water flow and their effects on the hydraulic characteristics of siphon spillways were investigated. For this purpose, ANSYS CFX software was applied to simulate the flow field in such spillways. To validate the obtained flow regimes, via numerical modeling, experimental results of the former studies were used. Results indicated that the pressure fluctuations were mostly greater beneath the inlet and throat of the spillway compared to the other sections.

Key Words: Siphon spillway, fluid-structure interaction, computational fluid dynamics, black-water flow.

BACK-CALCULATION OF PAVEMENT LAYER ELASTIC MODULUS USING THE HYBRID DIFFERENTIAL QUADRATURE METHOD AND HARMONY SEARCH OPTIMIZATION ALGORITHM

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Abstract

The evaluation of pavements being utilized using falling weight deflectometer (FWD) is one of the most important components of the pavement management system in many countries. The computation of pavement layer properties to estimate the remaining life of the pavement and also pavement maintenance has always been of interest to road pavement researchers and engineers. On the other hand, the back-calculation is widely used for the estimation of the pavement layer properties. In most back-calculation methods, the commercial software such as ABAQUS, ANSYS, etc., are used as numerical simulation engine. But it is difficult to integrate them with the optimization engine and consequently, they require the pre-generated artificial analytical data for search space. Subsequently, much computational time due to the large number of iterations is required. In this paper, the differential quadrature method (DQM) is employed to analyze the pavement. By combining this method with harmony search (HS) optimization algorithm, a computationally efficient model is developed for calculation of surface deflections so that it significantly reduces the overall computational time for back-calculation. As an application of the proposed hybrid differential quadrature method and harmony search (DQ-HS) optimization algorithm, a numerical example for back-calculation of elastic modulus of a three-layer pavement structures is presented. The results of this study with different populations show that this method can be used to calculate the elastic modulus of the layers in less than 20 iterations. To demonstrate the efficiency of the optimization algorithm for harmonic search and the convergence independence of optimal solutions, the problem with 10 populations and repetition of 20 is performed 10 times with a series of random numbers. The results

under gravity and seismicity loading. The ratio of span's length to the story's height was selected as L/h=0/5 , L/h=1 , L/h=1/5 while three different thickness values (1/5,3 and 4/5mm) were chosen for the steel sheet. As for each specimen, all parts of shear walls were separately designed and controlled by international regulations before conducting numerical evaluations to provide ductility conditions considering the importance of steel shear wall as a ductile system.
The results of limited component analysis indicated that the proposed shear wall consisting of both flat and corrugated sheets showed proper sustainability under loading and significantly improved the seismic performance of unstiffen and corrugated flat walls.

Key Words: Steel shear wall consisting of flat and corrugated sheets (SSW_C_FCS), unstiffen steel shear wall, corrugated steel shear wall, seismic analysis, limited component analysis.

STUDYING THE STRENGTH AND DIFFUSION AND PERMEABILITY COEFFICIENTS OF CONCRETES CONTAINING SILICA FUME, FLY ASH, ZEOLITE AND LIMESTONE POWDER

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Abstract
Permeability is an index, describing the easiness of fluid movement into a porous body, such as concrete. Water containing deleterious substances, such as chloride ions, sulfate ions, aggressive chemicals, etc. can penetrate into concrete and, subsequently, affects its short-term and long-term durability. Therefore, it is of great importance to evaluate the water permeability of concrete. For this purpose, the results of the permeability of the 7-day concrete specimens, containing silica fume, fly ash, zeolite, and limestone powder with replacement levels of 5, 10, 15 and 20 percentage of type II Portland cement mass are presented in this paper. "Cylindrical chamber" method, which was devised and developed by Naderi, was used during this investigation, for permeability measurements. Furthermore, one-dimensional permeability and diffusion coefficients, calculated based on cylindrical chamber test results, were used to evaluate the permeability of the concrete specimens. Percentage of the permeable pore space volume was also measured based on ASTM C642-06. The results tend to show that silica fume increases the compressive strength of the concrete specimen without any admixture (control specimen), while fly ash, zeolite, and limestone powder decrease the compressive strength of the control specimen. Moreover, the permeability and diffusion coefficients of the specimens containing the mentioned admixtures, except limestone powder with a replacement level of 20 percentage, were revealed to be lower than those of the control specimen. The results of the regression approach performed also show that the relationships between the dimensionless coefficients of permeability and diffusion and dimensionless coefficients of the test results (penetrated water depth, penetrated water volume, average water flow rate, and percentage of permeable pore space volume) can be estimated with high accuracy using the regression functions; however, no equation was found to estimate the relationship between the dimensionless coefficients of permeability and diffusion and compressive strength of the studied concrete specimens.

Key Words: Durability, permeability, silica fume, zeolite, fly ash, limestone powder, cylindrical chamber, permeability and diffusion coefficients.

HYDRAULIC CHARACTERISTICS OF FLOW IN SIPHON SPILLWAY BASED ON NUMERICAL MODELING

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Abstracts of Papers in English

EXAMINING THE SEISMIC PERFORMANCE OF NEWLY PROPOSED STEEL SHEAR WALL CONTAINING FLAT AND CORRUGATED SHEETS

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Abstract

Steel shear wall is considered as an effective seismic system due to having various characteristic such as loading capacity, high level of stiffness, ductility and higher level of energy absorption. Most studies focusing on the steel shear walls mainly investigated of stiffened or unstiffened flat steel sheets or corrugated steel sheets. Specific shape and outer stiffness on top of the corrugated steel sheets will create a flat, unstiffened steel shear wall relatively enhancing the limitations of stiffened steel shear walls. It should be mentioned that corrugated steel walls can significantly increase the structures' stiffness. However they exhibit weaker performance regarding sustainability of seismic behavior, ultimate strength and energy dissipation capacity compared to the unstiffened steel shear walls.

In this study, steel shear walls consisting of flat and corrugated steel sheets (SSW_C_FCS) are proposed to improve the performance of the earthquake resistant system. Therefore, considering the frame dimensions and thickness of steel sheets, the seismic performance of unstiffened and corrugated steel shear walls along with the newly proposed steel shear wall consisting of flat and corrugated sheets with horizontal and vertical waves are compared.

The specimen' modeling was implemented for a frame containing 3 stories and 1 span considering a real scale