human losses and adverse economic, and social effects; and recovery time.

This study aimed to elaborate and evaluate the robustness component of seismic resilience for two types of steel structures with a seismic-resistant frame characterized by panels equipped with a convergent chevron bracing system. This system includes two configurations of "Regular Chevron Bracing" and "Chevron and Inverse Chevron Bracing" in two different classes of low- and mid-rise structures.

First, appropriate modeling was considered to evaluate the inelastic behavior of plastic hinges in structural elements and then, near-field seismic records were selected by considering the seismic directivity effects. Next, Incremental Dynamic Analysis (IDA) was carried out to plot the respective curves that became the basis for the preparation of seismic fragility curves. Finally, the numerical values for the "Drop of Functionality" of the structures were determined, and the robustness component of the seismic resistance for structures under study was evaluated.

A comparison of the obtained results showed the privileges of "Chevron and Inverse Chevron Bracing" and "Regular Chevron Bracing" in low-rise and mid-rise structures, respectively, in terms of configuration performance.

Key Words: Seismic resilience, incremental dynamic analysis, fragility curves, convergent chevron bracing.

STATIONS UNDER STRONG SURFACE EXPLOSION (CASE STUDY OF TEHRAN METRO STATION)

R. Alibaf
ramin.alibaf@modares.ac.ir
A. Komak Panah(corresponding author)
a-panah@modares.ac.ir
Dept. of Civil and Environmental Engineering
Tarbiat Modares University
DOI:10.24200/J30.2021.55049.2698

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 149-158, Research Note

- Received 10 February 2020; received in revised form 5 October 2020; accepted 15 November 2020.

Abstract

The increasing number of worldwide terrorist attacks in recent years and danger of enemy air attacks highlights the significance of the secure design of urban structures and explosion mechanics as the passive defense. Iran is no exception from these external threats considering its position in the Middle East.

Subway stations are considered as the safe and strategic structures during terrorist operations since they provide a safe route for the transfer of power and equipment. Tunnel structures can be exposed to internal or external explosions. The internal explosions are less likely to occur because it is hard to get an explosive material inside a tunnel due to modern security and control systems inside subway tunnels. However, external blasts are more likely to occur due to the difficulty of detecting and preventing their threat.

The present study was carried out in the finite element software LS-DYNA using the ALE (Arbitrary_Lagrangian _Eulerian) technique to simulate and monitor the propagation of the blast pressure waves into the soil. Furthermore, the performance of Tehran metro stations in response to a surface explosion of 11ton TNT, equivalent to the explosive power of the most potent nonnuclear missile, was evaluated. The results from validation model analysis indicated that the pressure waves propagated into the soil as the hemispherical waves as well as the peak pressure values closely matched the predicted values of the technical design manual TM5-855-1. The results also showed that the depths of the crater created by the detonation of 3, 7, and, 11 tons of TNT were 6.5, 9, and 12 m, respectively, for the surface detonation of 11 tons of TNT charge. The affected region of the soil was about 18 m beneath the ground surface, and the duration was almost 0.4 seconds. In addition, although the safety of stations with depths of less than 19 m against the 11-ton explosive charge was not guaranteed, that of the stations deeper than 19 m could be quite ensured.

Key Words: Passive defense, surface explosion, subway station, LS-DYNA.

EVALUATION OF ROBUSTNESS COMPONENT OF SEISMIC RESILIENCE IN LOW- AND MID-RISE BRACED FRAME STRUCTURES IN THE NEAR-FIELD SITE

E. Baghaei Lakeh
baghaei_ehsan@yahoo.com
P. Homami(corresponding author)
homami@khu.ac.ir
A. Meshkat-Dini
meshkat@khu.ac.ir
Dept. of Civil Engineering
Kharazmi University
DOI:10.24200/J30.2020.56543.2839

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 159-171, Research Note

- Received 31 August 2020; received in revised form 8 November 2020; accepted 13 December 2020.

Abstract

Earthquake as one of the most significant types of natural disasters have had considerable influence on human life for a long time and its unpredictable occurrence in terms of time and place has always caused vast human and financial losses. The energy released and the consequent shocks caused by the earthquake cause a lot of damage to natural structures, infrastructures, and buildings. The devastating effects of earthquakes quickly cause human and financial losses spreading to different economic, social, political, and cultural aspects of human society. Given that these different dimensions are closely interrelated, and thus affecting each other, the necessity of an appropriate and coherent multifaceted approach to managing and reducing the destructive effects of disasters gains significance.

Resilience is defined as the ability of a unified system to reduce the chance of shock occurrence, absorption of its energy upon arrival, and quick recovery after a shock; now, in the case of earthquake, there are three stages to take into account to reduce: the probability of failure; consequences of failure such as financial and

the use of the method, the meshes were only concentrated around the interface of the basin. First, the problem is decomposed into two parts including a half-plane Gaussian-shaped feature and a closed filled alluvium. Then, the method was applied to each part to obtain the considered matrices. Finally, by satisfying the boundary/continuity conditions at the interface, the coupled equation was transiently solved to determine the boundary values. All ground surface responses were also obtained in a secondary solution as internal points. After implementing the method in a general algorithm, several practical examples were analyzed to validate the responses. An advanced numerical study was performed to sensitize the surface motion of Gaussian-shaped alluvial valleys with variable shape/impedance ratios as synthetic seismograms and Three-Dimensional (3D) amplification patterns. Moreover, to complete the time-domain results, the transient response of the internal domain of the alluvium as well as the surrounding bed rock was shown by the snapshots views. In the following, the sensitivity analysis was carried out to obtain the seismic amplification pattern of the surface by considering the key parameters including impedance and shape ratios, incident wave angle, and response frequency. Finally, by collecting the maximum amplification of different scenarios and applying linear fit to the obtained values, the results were summarized as a series of linear equations and tables. The results showed that the mentioned factors were very effective in the seismic response of the surface. The results of the present study can be used to complete the accuracy of existing codes around the subject of near-filed site effects.

Key Words: Alluvial valley, gaussian-shaped valley, half-plane BEM, SH-wave, time-domain.

SELECTING THE APPROPRIATE WAVELET FUNCTION IN THE DAMAGE DETECTION OF PRECAST PANEL BUILDING BASED ON EXPERIMENTAL RESULTS AND NUMERICAL METHOD

M. Hanteh
mhenteh@semnan.ac.ir
O. Rezaifar(corresponding author)
orezayfar@semnan.ac.ir
M. Gholhaki
mgholhaki@semnan.ac.ir
Dept. of Civil Engineering
Semnan University

DOI:10.24200/J30.2020.56237.2812

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 131-147, Original Article

- Received 1 July 2020; received in revised form 24 October 2020; accepted 20 December 2020.

Abstract

Most building structures are damaged over time under environmental conditions and external loads. In this regard, the occurrence of damage is common and the detection of damage is the subject of much research. In this regard, wavelet conversion, which is a powerful mathematical tool for signal processing, has attracted the attention of many researchers in the field of health monitoring. In this study, free vibrations of a four-story building with specified boundary conditions and monitored the health of the building based on experimental results using the continuous wavelet analytical method are studied and the damage that may occur in these structures were evaluated and analyzed. The finite element software is used to Model of the Building by the sandwich model. In this four-story building, eight-layer sandwich panel (polystyrene, concrete, steel, concrete) is used symmetrically. The fourteen natural frequencies of the sandwich structure were compared with the experimental model and the main modes of the structure were obtained to influence the health of the structure. An error of less than 2.5% reveals a good match between the results of the two models. Precast panel health monitoring results show that based on the experimental results, the damage location using the coif5 function with scale parameter 8 has been successfully identified and showed a higher perturbation of the coefficients at the damage locations than the other functions. Thus, the relative maximum and minimum jumps in the wavelet coefficients occurred at the location of the damage and considering the maximum or minimum wavelet coefficients generated at the damage location as the center of damage, the damage center can be identified with an error of less than 8%. Also, effects of higher modes are more pronounced in the damage intensity index as in the torsional modes of the structure, the maximum wavelet coefficients are greater and the intensity of the damage more pronounced.

Key Words: 3D Panel, wavelet analysis, structural health monitoring, damage detection, signal processing.

NUMERICAL ASSESSMENT OF THE IMPACT RATES OF METRO

critical density and capacity in a heterogeneous condition with limited data. Also, they emphasize that applying this method is quite simple and required pretty few inputs. For the validation purpose, the relative errors of estimated values are calculated. In this measurement, critical densities from daily observation were the actual values, and those from full observations were the expected values.

Key Words: Network fundamental diagram, data fusion, heterogeneity effect.

ASSESSMENT OF SEISMIC COLLAPSE PERFORMANCE OF LOW-RISE PLAN-IRREGULAR REINFORCED CONCRETE BUILDINGS WITH TORSIONALLY-FLEXIBLE BEHAVIOR USING FEMA-P695 FRAMEWORK

I. Torabpour
Isaac.torabpour@gmail.com
R. K.Badri(corresponding author)
ramin.badri@iauazar.ac.ir
Dept. of Civil Engineering
Azarshahr Branch, Islamic Azad University
DOI:10.24200/J30/2020.55900.2790

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 103-113, Original Article

- Received 29 June 2020; received in revised form 5 December 2020; accepted 20 December 2020.

Abstract
A structure is required to show proper performance in regions with a high risk of earthquake, especially when it is an irregular building. In the studies on plan-irregular buildings conducted so far, the seismic collapse performance of torsionally-flexible buildings has not been specifically reported. Generally, a building, which behaves flexibly in torsion, has a fundamental torsional period of vibration that is significantly greater than its fundamental lateral period. However, an adverse situation in terms of vibration periods is observed among the torsionally-stiff types. Compared to the torsionally-flexible buildings, the torsionally-stiff ones show different seismic performance, thus highlighting the necessity of more detailed studies on the torsionally-flexible buildings. The example buildings in the current study were characterized by reinforced concrete special moment-frame systems, including asymmetric stiffness distribution in the plan resulting from changes in the size of the structural elements. The effect of such behavior, i.e., flexibility in torsion, on the collapse performance was then evaluated in different eccentricities. The collapse margin ratio was the proposed performance criteria in this evaluation that quantified how much a building would remain safe during the expected large earthquakes in the area. In this study, OpenSEES software was used to establish and analyze 3D models, and the lumped plastic hinge method was employed to simulate the plastic behavior of elements. According to the results, the plan irregularity corresponding to the asymmetric lateral stiffness distribution had a minor effect on the collapse performance of the torsionally-flexible models. Moreover, the safety margin against the collapse was improved when the mass center displaces on the plan, thus increasing the eccentricity of the studied models. For instance, the safety margin was improved approximately 17 percent when the modeling eccentricity reached 0.3b (b shows the frame spacing). Based on the results, a high plan irregularity did not necessarily mean unfavorable seismic collapse performance in the models with flexible behavior in torsion. In this respect, the code accidental eccentricity provisions were not essential for the proposed building models.

Key Words: Collapse margin ratio, plan-irregularity, torsionally-flexible building, accidental eccentricity, seismic performance.

SEISMIC ANTIPLANE RESPONSE OF GAUSSIAN-SHAPED ALLUVIAL VALLEY

M. Panji(corresponding author)
m.panji@iauz.ac.ir
S. Mojtabazadeh-Hasanlouei
mojtabazadeh@iauz.ac.ir
Dept. of Civil Engineering
Zanjan Branch, Islamic Azad University
DOI:10.24200/J30.2020.56151.2801

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 115-130, Original Article

- Received 29 June 2020; received in revised form 5 September 2020; accepted 20 December 2020.

Abstract
In this study, a direct time-domain numerical approach named the half-plane Boundary Element Method (BEM) is proposed based on the half-space Green's functions for analyzing seismic Gaussian-shaped alluvial valley subjected to propagating obliquely incident SH-waves. In

EFFICIENCY OF AIR BUBBLE CURTAIN SYSTEM ON PREVENTING SALINE WATER INTRUSION IN SURFACE WATER

A. Talebi
akram.talebi@modares.ac.ir
S.A.A. Salehi Neyshabouri(corresponding author)
salehi@modares.ac.ir
Dept. of Civil and Environmental Engineering
Tarbiat Modares University
DOI:10.24200/J30.2020.55273.2717

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 85-94, Original Article

- Received 2 June 2020; received in revised form 13 December 2020; accepted 27 December 2020.

Abstract

Water quality is crucial to the development and management of water resources. Therefore, maintaining water quality, especially freshwater, which constitutes the major human consumption for a variety of drinking, agricultural, and industrial uses is important. Water quality is reduced by various natural and anthropogenic factors. One of the most common and important processes that reduces the quality of water resources is the influence of saline sea water on surface water. Seawater infiltration is a natural process due to the difference in the density of seawater from fresh water. Seawater is denser than fresh water because of the presence of minerals such as salt. The higher density of seawater causes it to be submerged under freshwater and, on the contact surface, seawater penetrates into the freshwater wedge. Salt water intrusion of sea toward the river caused a decrease in the quality of fresh water which makes it useless for utilizing in agricultural, industrial, and drinking and led to obliterating this fertilized plain upon its infiltration into the surrounding land. In order to reduce these negative effects through hydraulical control of salt water intrusion, we need to know about the efficacious mechanism of this issue. Thus, this study using ANSYS Fluent for modeling salt water intrusion on the surface water examined influences of changing in the sea water density and the water level of river on the measure of salinity intrusion. Also, air bubble curtain system as an alternative to preventing salt water intrusion was investigated. Results showed that sea water density and the water level of river had direct relationship with salinity intrusion, which means that upon an increase in the sea water density or the water level of river, salt water intrusion will increase, vice versa. Therefore, penetrating salinity increased by 86% with an 0.2% increase in saltwater density and was decreased %45 by decreasing %19 at river water level. Air bubble curtain system by creating impeding bubble between salt and fresh water is an appropriate solution for preventing salt water intrusion.

Key Words: Saltwater intrusion, air bubble curtain, river freshwater level, seawater density.

ESTIMATION OF CAPACITY AND CRITICAL DENSITY NETWORK BY USING RE-SAMPLED NFDs CASE STUDY: A PART OF MASHHAD CITY ROADS NETWORK

S.A. Haghbayan
haghbayanarman@gmail.com
M. Akbarzadeh(corresponding author)
makbarzadeh@iut.ac.ir
Dept. of Transportation Engineering
Isfahan University of Technology
DOI:10.24200/J30.2020.55970.2791

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 95-102, Original Article

- Received 15 June 2020; received in revised form 5 December 2020; accepted 13 December 2020.

Abstract

Network Fundamental Diagram (NFD) can provide an aggregated simple vision of urban traffic networks; thereby, it is a robust tool for measuring traffic flow on the network scale. The NFDs are delineated by different parameters, amongst which the critical density and capacity are vital in the implementation of network-wide traffic control strategies such as pricing and perimeter control. Since heterogeneity effect exists in reality and casts uncertainty about the estimation of the NFD parameters, measuring and reducing the heterogeneity effect would improve the efficiency of network-wide traffic control strategies. In this paper, firstly, the NFD of Mashhad was estimated by fusion of collected data from Inductive loop detectors (ILD), Automatic Vehicle Locating system (AVL), and Automatic Fare Collection system (AFC). As NFD estimation needs data that could directly or indirectly derive average flows and densities/speeds, ILDs have been widely exploited to estimate average flows and AVLs were used to extract average speeds. Going through the current procedure, AFCs were operated for measuring dwell time and cruising bus speed. Eventually, a random re-sampled method was applied to decline the heterogeneity effect and reveal the congestion branch in re-sampled NFDs. The outcomes highlight the application of this method to estimate the

at 0.38. In order to investigate and compare the influences of polymer materials on the durability characteristics and mechanical properties, the tests to determine the compressive strength, flexural strength, tensile strength, coefficient of rapid chloride migration (RCM), water sorptivity and water absorption were carried out. The specimens were cured under wet conditions at early ages (7 days) and air cured at later ages (After 7 days until the time of testing). According to the results, the plain calcium aluminate cement mix had high early strengths and appropriate durability characteristics. However, increasing the chloride permeability was observed due to the conversion of the early hydrate products to the stable ones. Despite the lower compressive strenths, modification of the mixtures with polymers led to improvements in the mechanical characteristics such as flexural and tensile strengths, It is also worth noting that the reduced compressive strength of the modified polymer mixes compared to the plain mix was decreased with age, approaching the values observed for the plain mix. Significant influences on reducing the sorptivity rates, rapid chloride migration coefficient and water absorption were also observed for the polymer modified mixes. However, the mixes with Styrene acrylic did not have enhanced performance in the wet curing conditions. It appears that the Styrene butadiene rubber mixes could provide more suitable results compared to the Styrene acrylic ones. Comparing the results at different ages revealed that dry curing period had a significant effect on the strength growth process, mechanical and durability properties of the polymer modified mortars.

Key Words: Calcium aluminate cement, polymer, acrylic-styrene, styrene-butadiene-rubber, mechanical properties, durability.

EXPERIMENTAL EVALUATION OF THE EFFECTS OF INGREDIENTS RATIO, COMBINATION OF SLAG AND ZEOLITE AS PRECURSOR AND EMBOSS FIBER ON THE STRENGTH CHARACTERISTICS OF GEOPOLYMER MORTAR

V. Ghadaki
v.ghadaki@semnan.ac.ir
M.K. Sharbatdar(corresponding author)
msharbatdar@semnan.ac.ir
Dept. of Civil Engineering
Semnan University
DOI:10.24200/J30.2020.55729.2770

Sharif Civil Engineering Journal

Volume 37, Issue 2.2, Page 73-84, Original Article

- Received 2 May 2020; received in revised form 24 October 2020; accepted 15 November 2020.

Abstract

About 7% of the total volume of carbon dioxide produced in the world belongs to cement plants. Therefore, it is necessary to look for suitable alternative materials that their mechanical characteristics are similar to or better than mortars made with OPC and also consider the concept of sustainable development and environmental protection. In this paper, the effects of ingredients ratio, combination of slag and zeolite as Precursor and adding Emboss fiber on the strength characteristics of geopolymer mortar has been investigated experimentally in three separate sections. The different parameters such as weight ratios of sand to slag, sodium silicate to sodium hydroxide in activator solution, concentration of sodium hydroxide solution, different volume percentages of Emboss fiber, and replacing a part of the slag with zeolite were considered and studied in three parts. In the first part, 18 mix designs including 180 specimens were casted to study the effect of ingredients ratios on 7-days and 28-days compressive strength. In the second part, 3 mixes designs were selected from the part 1 and considered as the second group including 105 specimens to measure the compressive strength and modulus of rupture. In the third part, a part of the slag in one of mix designs that was selected from part 1, was replaced with zeolite to study the effect of using combined slag-zeolite as Precursor to investigate 28-days compressive strength and modulus of rupture of the geopolymer mortar. 30 specimens were casted in part 3. Experimental results indicated that the reduction of the sand to slag ratio, the reduction of sodium silicate to sodium hydroxide ratio, the increase of sodium hydroxide molarity, and adding Emboss fiber, respectively, increased the compressive strength by 26, 6, 20, and 14%. The modulus of rupture of fiber specimens was increased up to 38% compared to non-fiber samples. Despite the significant reduction in the strength properties of geopolymer mortar containing zeolite, due to the large number of natural zeolite mines in our country (IRAN) and consequently easy access to this material, using a precursor composed of slag and zeolite could be a good idea.

Key Words: Geopolymer mortar, ground granulated blast furnace slag (GGBFS), zeolite, emboss fiber, mechanical properties.

EFFECT OF FRESHWATER RIVER LEVEL, SEAWATER DENSITY, AND

Key Words: Self-centering concrete rocking walls, unbounded post-tensioned tendon, nonlinear modeling, shake table test, damage estimation.

DESIGN AND CONSTRUCTION OF AN APPARATUS FOR EVALUATION OF DYNAMIC RESPONSE OF MACHINE FOUNDATION AND EQUIVALENT DYNAMIC PROPERTIES OF SUBSOIL BED

R. Zakeri
rzakeri@email.kntu.ac.ir
S.N. Moghaddas Tafreshi(corresponding author)
nas_moghaddas@kntu.ac.ir
Dept. of Civil Engineering
K.N.Toosi University of Technology
DOI:10.24200/J30.2020.55755.2771

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 47-59, Original Article

- Received 16 May 2020; received in revised form 13 December 2020; accepted 27 December 2020.

Abstract

Machine foundations induce a wide range of dynamic shear strains in foundation bed. Dynamic properties of soils including the damping ratio and the dynamic stiffness intensely depend on the level of generated dynamic shear strain. Therefore, considering the appropriate dynamic properties of a foundation bed corresponding to the generated dynamic shear strain is crucial to having a better evaluation of the dynamic response of a machine foundation. This paper presents the design and construction of an apparatus namely "Foundation Model Response Test (FMRT)". This apparatus provides the tests to investigate the dynamic properties of machine foundation and underlying bed in a wide range of dynamic shear strains employing a various range of dynamic excitation forces and static weight (dead weight). The FMRT apparatus could be used in the field to evaluate the dynamic response of the undisturbed bed and on the prepared bed in the laboratory test pit. Two types of steady-state and free vibration tests could be conducted by employing the FMRT apparatus. Steady-state vibration tests induce larger shear strain in bed, whereas free vibration tests induce smaller shear strain. Correlation of the results of these two types of tests, dynamic responses, and dynamic properties of foundation bed in a wide range of dynamic shear strain would be achieved. The accuracy and validity of all FMRT tests are possible to monitor precisely and any unwanted noises and modes of vibration are possible to be controlled by evaluating the Fast Fourier Transform (FFT) of all sensors data when conducting tests. Several steady-state and free vibration tests were conducted to illustrate the performance of the designed apparatus. Moreover, the method of calculation, controlling unwanted vibration, and correlation of free and steady-state example tests were submitted. FMRT tests are inexpensive, repeatable, nondestructive and reliable tests that ensure the dynamic response of machine foundation possible accurately.

Key Words: Dynamic response, machine foundation, steady-state vibration, free vibration, in-situ and laboratory tests.

THE MODIFYING EFFECTS OF STYRENE BUTADIENE RUBBER AND STYRENE ACRYLIC POLYMERS ON THE PROPERTIES OF CEMENTITIOUS MIXTURES WITH CALCIUM ALUMINATE CEMENT

A. Saeedikia
saidikia1993@yahoo.com
S.H. Madani(corresponding author)
h.madani@kgut.ac.ir
Dept. of Civil Engineering and Geodesy
Graduate University of Advanced Technology, Kerman
DOI:10.24200/J30.2020.55584.2754

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 61-71, Original Article

- Received 2 May 2020; received in revised form 22 September 2020; accepted 8 November 2020.

Abstract

In this research, the mechanical characteristics and durability of mixtures containing calcium aluminate cement (CAC) and polymer materials have been evaluated. The investigated polymers were two types of commercial polymers including Styrene butadiene rubber (SBR) and Styrene acrylic. The levels which the polymers have been used were 5, 15 and 25% by weight of cement and the water-cement ratio was kept constant

- Received 25 April 2020; received in revised form 18 October 2020; accepted 8 November 2020.

Abstract

Due to the growth of energy consumption, air pollution and global warming in the world, the use of renewable energy has become popular in the world due to its variety of resources, lower economic cost and environmental compatibility. One of the unlimited sources of renewable energy, is geothermal energy. Since geothermal energy resources are unlimited and can be exploit in many parts of the world, its application as a reliable source of energy is growing. The use of energy piles as a heat exchanger is one way to exploit this energy. These piles are being used to serve dual purposes: transfer the structural load to the ground and act as heat exchanger elements to extract and inject heat from and to the ground. Energy piles are subjected to daily and seasonal cyclic temperature changes during their life span. These temperature changes (heat cycle) induce cyclic expansion-contraction along the pile-soil interface that may affect interface properties such as shear strength. The pile-soil interface is defined as a thin zone of soil that can be subjected to different boundary conditions with respect to the surrounding soil. Therefore, in order to investigate the influences of temperature on soil-pile interface, a series of direct shear tests is modeled in ABAQUS software. In this modeling the shear strength changes of Illite clay and concrete interface, are investigated under mechanical and thermo-mechanical loading. A series of analysis are conducted with sample temperature of 50° C and the normal stresses of the direct shear analysis are 50, 100 and 150 kPa. This analysis is done at a shearing rate of 0.006 mm/min. In this investigation, it is assumed that the properties of concrete materials are not temperature dependent and their behavior is thermoelastic. In this paper, the main results of modeling show that the shear strength of Illite clay-concrete interface, increases by an average of 20 kPa with increasing in temperature by 50° C.

Key Words: Geothermal energy, energy pile, direct shear test, thermo-hydro-mechanical behavior, soil-pile interface, ABAQUS.

NUMERICAL MODELING OF SEISMIC RESPONSE AND DAMAGE ESTIMATION OF CONCRETE ROCKING WALLS UNDER SEISMIC LOADING

N. Abbasi
n.abbasi@stu.umz.ac.ir
H. Akbarzadeh Bengar(corresponding author)
h.akbarzadeh@umz.ac.ir
Dept. of Civil Engineering
University of Mazandaran, Babolsar
A. Jafari
a_jafari@sjtu.edu.cn
Dept. of of Mechanical Engineering
Shanghai Jiao Tong University, Shanghai, China
M. Nazari
mnazari12@calstatela.edu
Dept. of Civil Engineering
California State University
Los angles, CA, USA
DOI:10.24200/J30.2020.55368.2728

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 35-45, Original Article

- Received 25 April 2020; received in revised form 28 November 2020; accepted 13 December 2020.

Abstract

Application of self-centering rocking walls is now widely accepted as a viable alternative to removal of some of the common seismic defects of conventional shear walls including residual drift and significant damage to the base of walls. Despite the different experimental studies on the seismic performance of rocking walls, few numerical models have been developed to predict the seismic response and damage extent of these walls under seismic loading. The main objective of this study was to present a practical method for numerical modeling and damage estimation for nonlinear behavior of post-tensioned (PT) concrete rocking walls when exposed to earthquake excitations. To this end, PERFORM 3D software was utilized to model self-centering rocking walls. The walls were subjected to a set of seven spectrum compatible ground motions at different intensity levels. To ensure the accuracy of the modeling, the numerical results of the nonlinear analysis were compared with the experimental results, and the results showed that the developed model could predict the behavior of the wall during all ground motions with acceptable accuracy. Moreover, in this study, a damage index was employed to estimate the extent of damage in the developed numerical model. Good agreement between the observed damage in the shake table tests and estimated damage in the developed model was observed. The results of this study indicated that the method for modeling the seismic behavior of the rocking wall could appropriately predict the response and damage extent of these walls under earthquake loading.

on submerged ratio, an equation has been proposed to separate the surface wave regime and deeply submerge regime. The longitudinal velocity has been measured by ADV probe at the downstream broad-crested weir over the longitudinal section. Comparing between measured longitudinal velocity and color injection illustrates that increasing the submergence ratio causes the flow within gabion weir has marginally decreased and this flow is dependent on submergence ratio. The color injection results show the passed the performance of gabion weir in deeply submerged regime is same as broad-crested weir and the flow with in gabion will be negligible over the developed deeply submerged regime.

Key Words: Gabion weir, flow regime classification, discharge coefficient, reduction factor, free flow, submerged flow.

LABORATORY INVESTIGATION OF THE NANOMONTMORILLONITE CLAY EFFECT ON STRENGTH AND PLASTICITY PROPERTIES OF THE CLAYEY SAND

M.E. Hosseini
me.hosseini@modares.ac.ir
M. Oliaei(corresponding author)
m.olyaei@modares.ac.ir
Dept. of Civil and Environmental Engineering
Tarbiat Modares University
H. Heidarzadeh
heidarzadeh@sku.ac.ir
Faculty of Engineering
Shahrekord University
DOI:10.24200/J30.2021.55263.2719

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 13-24, Original Article

- Received 7 March 2020; received in revised form 4 July 2020; accepted 3 January 2021.

Abstract

The improvement of soil treatment by additives is one of the most critical issues in geotechnical engineering. Typical additives such as cement, lime, fly ash, and bitumen have been investigated in the past. Nanomaterials have unique features. The application of this type of material has led to a significant development in other branches of engineering. However, in geotechnical engineering, the investigation of the effects of this type of material is a new subject. Hence, in the present research, the effects of nano clay on geotechnical parameters of clayey sand are investigated. The principal purpose of investigation in this scale is the creation of new compounds with changes in ingredients and the detection of a new class of materials with new functions. These types of researches can make an appropriate base for future researches in this context.

The Atterberg limits test and direct shear tests were carried out on different types of clayey sand. Various percentages of nano clay were used in the study. Ball mill was applied for uniform dispersion of nanoparticles. Also, in order to obtain optimum water content and maximum specific weight for prototyping, a standard compaction test was carried out on samples without nano clay particles .

Based on the results, in general trends of tests, liquid limit and plastic limit are increased by increasing nano clay. The plasticity index has decreased when the percentage of the nano clay is increased by up to 1%. The plasticity index has increased again in a higher percentage of nano clays (more than 1%). Also, the shear strength of clayey sand in direct shear tests is improved in a specific percentage of nano clay. The optimum percentage of the nano clay for the friction angle φ is 1% in the direct shear test, and its best percentage for the cohesion C is 4%. Also, nano clay has a negative effect on the shear strength of pure sand. Therefore, according to the results of experiments, nanoparticles can be an acceptable choice for improving the geotechnical properties of clayey sand soils.

Key Words: Soil improvement, nanoclay, atterberg limits, shear strength, direct shear.

NUMERICAL INVESTIGATION OF TEMPERATURE EFFECT ON INTERFACE STRENGTH IN ENERGY PILES

B. Asadi
b.asadi@modares.ac.ir
M. Kiani Fordoei
m_kianifordoei@modares.ac.ir
M. Oliaei(corresponding author)
m.olyaei@modares.ac.ir
Dept. of Civil and Environmental Engineering
Tarbiat Modares University
DOI:10.24200/J30.2020.55583.2750

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 25-33, Original Article

Abstracts of Papers in English

CLASSIFICATION OF SURFACE REGIMES OVER BROAD-CRESTED GABION WEIR

S. Salehi
saeedsalehi100@gmail.com
K. Esmaili(corresponding author)
esmaili@um.ac.ir
A. Parmoodeh
parmude71@gmail.com
Dept. of Civil Engineering
Ferdowsi University Mashhad
DOI:10.24200/J30.2021.55415.2729

Sharif Civil Engineering Journal
Volume 37, Issue 2.2, Page 3-12, Original Article

- Received 22 February 2020; received in revised form 14 September 2020; accepted 15 January 2021.

Abstract

The present study investigate 12 experimental broad-crested gabion models. In order to investigate the flow regimes over this structure, hydraulic characteristics were measured under different submergence conditions. A comparison of coefficient discharge values showed that a significant increase in these values was observed between the broad-crested and broad-crested gabion weirs. It seemed that the passed flows through gabion weir could raise the discharge coefficient values versus the same values with same hydraulic condition for solid broad-crested weir. To predict the discharge values over this weir, reduction factor has been calculated for the experiments in different submerged ratio. By considering the submergence ratio, an equation has been proposed to calculate these values. Three regimes have been introduced to measure the water surface profiles as free flow, (I) surface jump regime, (II) surface wave regime, (III) Deeply submerge regime. Due to increase the tail water height, water surface profile was measured as proposed regimes. The surface jump regime was defined as a downstream hydraulic jump which was developed from downstream location of channel to the weir crest. Additionally, the water surface turn to the series of downward waves which is called surface wave regime. By increasing the submerged ratio, the surface wave regime was vanished as the deeply submerged condition. The submerged ratio 0.18 has been proposed to region the surface jump regime and surface wave regime. Also, based