Abstracts of Papers in English

EVALUATION THE EFFECTS OF THE COVID-19 PANDEMIC ON CHOOSING ACTIVE TRAVEL MODES

M. H. Mirnaseri
naserihadi1996@gmail.com
Faculty of Civil Engineering
Architecture and Art, Islamic Azad University
Science and Research Branch
M. H. Dehnad (corresponding author)
m.dehnad@qom.ac.ir
Faculty of Engineering
University of Qom
A. Naderan
naderan@srbiau.ac.ir
Faculty of Civil Engineering
Architecture and Art, Islamic Azad University
Science and Research Branch
DOI:10.24200/J30.2022.58413.2976

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 3-14, Original Article

- Received 4 July 2021; received in revised form 6 April 2022; accepted 15 May 2022.

Abstract

Due to simplicity, economy, and the positive effects on traffic parameters and characteristics related to personal and social health, active travel modes can play an important role in intra-city movements. However, with the outbreak of the Covid-19 virus, people's travel mode choice behavior changed. In other words, some people have changed their travel modes due to concerns about being infected with the virus, which can lead to a change in their travel modes in the long term. As one of the most vulnerable groups in the Covid-19 virus epidemic, students, with a significant share of their travels in intra-city movements, should be given more attention. Therefore, it is necessary to examine how the behavior of students' active travel choices will change as a result of the Covid-19 virus epidemic. To do this, a sample of 267 boys and 546 girls was used based on a study-based questionnaire in Qom in 1399. The results of logit models (choosing and not choosing active travel modes)

by gender (girl and boy) and time position (before and after the Covid-19 virus epidemic) showed that the parameter of the goodness of fit (McFadden) for all models is greater than 0.16 and less than 0.27. In other words, the independent variables in these models can significantly show the changes in the dependent variable. The results showed that the characteristics of the student household, the parents' travel mode on work trips, and the perception of the distance between home and school affect the utility of choosing active travel modes before the Covid-19 virus epidemic. Also, the perceptual variables of the student parents towards the Covid-19 virus epidemic were significant only in the model for boys. Moreover, having a large family is the only variable with a positive effect on the choice of active travel modes and increases the probability of choosing active travel modes by up to 20%. Also, having more than two passenger cars at home has the most negative effect on the dependent variable and reduces the probability of choosing active travel methods by 31%.

Key Words: Active travel mode, gender, Covid19 pandemic, logit model.

SEISMIC RESILIENCE ANALYSIS OF HIGH-RISE DIAGRID STRUCTURES WITH VARIOUS SKELETAL CONFIGURATIONS BASED ON ROBUSTNESS CRITERION

M. Roshani
mahyar_roshani@yahoo.com
A. Meshkat-Dini(corresponding author)
meshkat@khu.ac.ir
A. Massumi
massumi@khu.ac.ir
Faculty of Engineering
Kharazmi University
DOI:10.24200/J30.2022.58867.3012

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 15-28, Original Article

- Received 10 September 2021; received in revised form 18 January 2022; accepted 12 March 2022.

Abstract

Evaluation of the fragility characteristic and its related parameters is an efficient method to assess the seismic performance of structures subjected to earthquake tremors. The probability of exceeding limit state criterions for structural performance associated with a conceptual lemma is usually considered and numerically illustrated as a function of seismic intensity to be used in preparing the fragility curves. By implementing a statistical distribution for preparing the fragility curves, the evaluation process of the vulnerability of structures and its related probable collapse estimation will be available. The concept of resilience is introduced as the ability of structures to reduce the probability of any exceeding performance level over control time. The resilience criterion is an important concept in conjunction with various disaster management processes, in which the structural capability to sustain skeletal stability is determined during strong ground motions. Based on comprehensive researches, there are essential factors that must be considered to establish an effective implementation for the seismic resilience lemma. The aforementioned essential factors are entitled as robustness, resourcefulness, redundancy, and rapidity.

In this paper, the conceptualization of the structural resilience was assessed for three studied diagrid structural systems. Moreover, there is a basic studied model comprising a full bundled tube skeleton which has been used for performing all numerical comparisons among the seismic response parameters. The effect of the geometrical configuration of the perimeter diagonal beam-column elements on the seismic resilience lemma was evaluated though numerical explanations due to the released fragility curves. The three studied 24-story diagrid structures were considered with uniform geometric configurations and internal bundled flexural cellules, which form a hybrid resistant skeleton. The uniform diagonal angles for diagrid models were considered 49°, 67°, and 74° respectively. Several nonlinear time history (NTHA) and incremental dynamic analyses (IDA) were performed on the four studied 24-story structural models under near-field ground motions with various directivity effects. The probability of the exceeding performance limit states for the studied structures was calculated based on the FEMA provisions. The assumed performance levels in preparing fragility curves included the immediate occupancy (IO), the life safety (LS), the collapse prevention (CP), and the probabilistic global instability (GI) indices. Also, the robustness of seismic resilience for the studied structures was determined according to the proposed formulation of the damage function as reported by MCEER.

The results obtained from conducting nonlinear time history and incremental dynamic analyses indicate that the assumed geometric pattern for the perimeter inclined elements would relatively reduce the maximum inter-story drift and increase the collapse capacity of the diagrid structures. In addition, the definition of large angles for diagonal elements can increase the probability of the seismic performance levels to be higher than the L.S. criterion. The values of the robustness parameter for the studied diagrid structures with skeletal angles of 49°, 67°, 74° and also the studied bundled tube model were obtained as 95.9, 91.7, 88.6, and 85.1, respectively.

Moreover, the evaluation of the related seismic resilience for all the studied structures proved that the diagrid systems had a great ability to resist a specific limit of damage. It is demonstrated that implementing triangular patterns in the external framed panels of the seismic-resistant skeleton would decrease the estimated amount for the qualified deterioration effects in structures after a strong earthquake. In this regard, upon increasing the skeletal angles of inclined elements, the effect of diagonal configuration on controlling the occurrence probability of higher performance limit states would be effectively decreased. This research results indicate that the geometric pattern of diagrid elements is able to increase the value of the skeletal hard resilience component and relatively exceed the capability of structural stability against near-field ground motions.

Key Words: Diagrid structure, fragility curve, incremental dynamic analysis, seismic resilience, robustness.

EVALUATION OF BEHAVIOR OF REINFORCED CONCRETE SHEAR WALL WITH IRREGULAR OPENING DUE TO NEAR-FAULT EARTHQUAKE

A. Arabzadeh(corresponding author)
arabzade@modares.ac.ir
A.P. Gholamrezaie
amirpooya.gh95@gmail.com
Faculty of Civil and Environmental
Tarbiat Modares University
DOI:10.24200/J30.2022.59070.3023

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 29-41, Original Article

- Received 6 November 2021; received in revised form 8 February 2022; accepted 12 March 2022.

Abstract
The increasing need for tall buildings seems to be more prominent than ever with the growth of urbanization and the reduction of urban space. The seismic performance of tall buildings against earthquake and wind forces is known as their main feature. Therefore, these structures should benefit from sufficient strength and rigidity against these forces. Shear wall is recognized as one of the solutions for the stability of the structures against earthquake and wind forces. In this paper, two 5- and 10-story buildings were designed in ETABS software, and shear walls were modeled in Abaqus software to gain a comprehensive understanding of the behavior of shear walls with irregular openings under near-fault earthquakes. The examined structure is built in the city of Tehran with high seismicity. The height of the stories is 3.2 m in both models. The soil type, the design basic acceleration, and the importance factor of the structure were set at types II, 0.35, and 1, respectively. The structure has a system in two directions (medium reinforced concrete bending frame + special reinforced concrete shear wall). The response modification coefficient, deflection amplification factor, and over strength factor are equal to 6.5, 5, and 2.5, respectively. Aguda and Arabzadeh laboratory models were then used for validation. The results of changing the position parameters and the dimensions of openings revealed that the base shear, relative displacement, and absorbed energy increased for both models by increasing the horizontal distance between the two openings. The 10-story model showed more reduction in the base shear than the 5-story model upon creating an opening at the wall base. The base shear of the 5-story model increased by eliminating the opening on the first story, but it barely affected the 10-story model. In the largest opening area, the base shear exhibited a much smaller decrease in the sample with different opening widths than that with different opening heights.

Key Words: Shear wall, irregular opening, near-fault, base shear.

SMART-PARTICLE APPLICATION FOR DESCRIBING THE PROBABILISTIC PARTICLE TRANSPORT DYNAMICS ABOVE THRESHOLD CONDITIONS

H. Farhadi
farhadi.edu@gmail.com;mailto:shsh70@yahoo.com
K. Esmaili (corresponding author)
esmaili@um.ac.ir
Dept. of Water Science and Engineering
Ferdowsi University of Mashhad
M. Valyrakis
manousos.valyrakis@glasgow.ac.uk
School of Engineering
University of Glasgow, United Kingdom
A. Zahiri
zahiri.areza@gmail.com
Dept. of Water Engineering
Gorgan University of agricultural sciences and natural resources, Gorgan
DOI:10.24200/J30.2022.59457.3050

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 43-53, Original Article

- Received 12 December 2021; received in revised form 12 February 2022; accepted 12 March 2022.

Abstract

Coarse particle motion behavior plays a crucial role in sediment and hydraulic engineering, though its physics is still not fully understood. Disregarding the inherently stochastic nature of the sediment transport leads to various equations for bedload transport which are now being challenged due to their poor results. By applying sensors, like accelerometers and gyroscopes, particle transport physics could be carried out in a more scrutinized approach. In this study, an instrumented synthetic particle ("so-called" the smart particle) was designed and applied (with different densities) in sets of laboratory experiments that covered a hydraulics domain between low transport regime (near- and above-threshold) and higher transport regime (above threshold with a relatively high Reynolds number) conditions. Using the instrumented particle (smart-particle) could bring opportunities to learn more about the physics of the bed particle transport in rivers for different regimes and could bring data in hand for instantaneous particle changes throughout time (hear 0.004 seconds used for data sampling). Therefore, the kinetic energy as a parameter that delivers the behavior of particle energy interaction between the exposed particle and its surroundings (flow and the bed particles) was chosen to be studied. Since the dynamic features of the particle in transport are stochastic, the probability distribution functions, which could describe the particle behavior, were selected (Weibull, Lognormal, Normal, and Gamma distributions). In this case, it was shown that the Weibull distribution best described the particle kinetic energy in lower transport regimes, while for a higher transport regime, the Log-normal distribution worked better. Furthermore, the energy signals of the particle moving throughout the flume for different transport regimes were derived, and it was shown that the average energy gain and loss of the particle decreased exponentially as the particle Reynolds number increased. The presented results here could also be applied in similar hydraulic conditions in eco-hydraulic topics, specifically macro-plastic movement as bedload in river courses and the Aeolian research.

Key Words: Sediment transport, smart-particle, stochastic behavior of particle motion, transport dynamics.

MODELING FACTORS AFFECTING UTILITY TO USE INTERNET TAXI UNDER COVID-19

A. Kheiri
asef_kheyri@modares.ac.ir
A.R. Mamdoohi(corresponding author)
armamdoohi@modares.ac.ir
Faculty of Civil and Environmental Engineering
Tarbiat Modares University
DOI:10.24200/J30.2022.59510.3057

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 55-66, Original Article

- Received 15 December 2021; received in revised form 9 April 2022; accepted 25 April 2022.

Abstract

Given the continuity of Covid-19, the urban transportation system has undergone remarkable changes. Besides, increased risks related to crowded places together with social distancing measures in public and shared transportation probably affect the usual choices of vehicles by passengers. In the present article, by using questionnaire design and online questionnaire in Tehran, attempts have been made to estimate the use of internet taxis by people during the pandemic. To this end, in order to specify the factors affecting the use of internet taxis, ordered and dual logit models were established using 233 data obtained from online inquiries and based on the amount of use and changes in using them before and after Covid-19. The results indicate that Covid-19 pandemic has had a negative effect on the use of internet taxis. Increasing the petrol prices and the lack of parking places at the destination have positively encouraged the use of internet taxis. Moreover, people who own a car use internet taxi less than those who do not. The number of these people not using internet taxis has been also reduced after the pandemic.

Key Words: Covid-19, ride hailing, travel demand, ordered logit model, binary logit model.

BEHAVIORAL MODELING OF THE IMPACT OF INTERNET TAXIS ON THE CAR DEPENDENCY

S.R. Esmaeilzadeh
e_seyyedreza@modares.ac.ir
A.R. Mamdoohi(corresponding author)
armamdoohi@modares.ac.ir
Faculty of Civil and Environmental Engineering
Tarbiat Modares University
DOI:10.24200/J30.2022.59516.3058

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 67-77, Original Article

- Received 15 December 2021; received in revised form 23 February 2022; accepted 12 April 2022.

Abstract

Nowadays, the issue of internet taxis and, in the general definition of the cooperative economy, has become an essential issue in people's daily lives. Internet taxis effectively affect the choice of daily travel, as they can even be considered a separate mode of transportation. Initially, this system was assumed to reduce the use of private cars, which would reduce traffic, but it was not felt over time in the public, and in the past literature, that has been generally addressed. There were different opinions. The study details the effect of these two modes of transportation, internet taxis, and private cars. This research has been done by designing the data collection process through a questionnaire designed and compiled for this purpose by gathering data. The questionnaire was designed in four sections, and after gathering the questionnaires, which were done online, 681 individuals answered the questionnaire, and after validating those responses, 598 data was used for modeling. A discrete logit model was used to investigate the effect of internet taxis on people's use of private cars. The results show that most people use their personal vehicles more than internet taxis after the advent of it. Another result of this research is that people with less dependence on their private cars use their vehicles more after the appearance of internet taxis. Furthermore, People with a Ph.D. use their vehicles less than others after the advent of Internet taxis. The results also showed that by changing the level of education of individuals from diploma, bachelor, and master's to Ph.D., the probability of choosing internet taxis increases, and the probability of selecting a personal car decreases. This indicates the effect of education on internet taxi choice.

This study helps managers and policymakers to determine and amend the rules according to the presented results and study the type of attitudes of individuals and their impact on the choice of travel method and the impact of internet taxis as an alternative to private vehicles on the car dependency. This study determines the characteristics of people who tend to reduce their car dependency by introducing an alternative method and encouraging them to use an alternative mode of transportation. This helps policymakers make the necessary choices, and thus, it results in a sustainable system.

Key Words: Internet taxis, car dependency, designing the data collection process.

CRACK DETECTION IN CONCRETE MEMBERS USING ENCODER-DECODER MODELS BASED ON DEEP LEARNING

M. Mousavi
mohammad.mousavi@sharif.edu
A. Bakhshi (corresponding author)
bakhshi@sharif.edu
Dept. of Civil Engineering
Sharif University of Technology
DOI:10.24200/J30.2022.59496.3055

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 79-88, Original Article

- Received 18 december 2021; received in revised form 6 April 2022; accepted 12 April 2022.

Abstract

Concrete is one of the major materials used in modern structures. Concrete members are used as the main structural parts of various infrastructures such as dams, tunnels, bridges, and skyscrapers. However, this wide application requires some accurate and efficient inspection system during the structure's life. Cracks are classified as the earliest symptoms of degradation in concrete members. Although manual inspection is a common method in structural health monitoring and crack detection in civil engineering structures, serious limitations caused by implementing human resources degraded the efficiency of the proposed method. In recent years, many studies tried to automate the inspection of these structures by using different sensors such as Ultrasonic and Piezo-electric sensors, seeming to be costly and insufficient in some cases. With recent development in computer vision techniques, especially deep-learning-based methods, there is an opportunity for researchers to come with autonomous visual inspection systems for structural health monitoring of concrete members. This study proposes a deep-learning-based model for automatic crack detection on the concrete surface. The proposed model is an encoder-decoder model that uses ResNet101, a well-known convolutional neural network, as the encoder and the U-Net's expansion path as the decoder. To minimize the training time and maximize the accuracy, we use transfer learning in our approach. The dataset implemented for this study includes 458 images of the cracked surface of concrete members which come with corresponding segmentation label masks. Data augmentation techniques strongly increased the robustness of the proposed model encountering different imaging conditions and noises. The proposed model was trained using the backpropagation algorithm and it achieved 99.39% precision and 84.99% recall, which led to a 91.38% F1 score on the unseen test dataset. The accuracy and speed of the present model outperform the existing methods and different crack types composing the dataset help generalize the

model for prediction of different crack types and different imaging conditions.

Key Words: Structural health monitoring, deep learning, computer vision, machine learning, crack detection.

ESTIMATION OF THE PEAK RESPONSE OF NONLINEAR SYSTEMS UNDER THE EFFECT OF NEAR-FIELD DESIGN SPECTRUM USING EQUIVALENT LINEARIZATION METHODS

M.R. Salimi(corresponding author)
mr.salimi@uok.ac.ir
M. Baizidi
mehran21day@gmail.com
K. Nobakht Vakili
k.vakili@uok.ac.ir
A. Yazdani
a.yazdani@uok.ac.ir
Dept. of Civil Engineering
University of Kurdistan
DOI:10.2400/J30.2022.59600.3063

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 89-98, Original Article

- Received 1 January 2022; received in revised form 18 April 2022; accepted 15 May 2022.

Abstract

One of the important issues in performance-based earthquake engineering is the accurate estimation of the response statistics of nonlinear systems under seismic excitation. In this study, the near-field effects contained in the building design regulations against earthquakes (Standard No. 2800, fourth edition) are investigated on the nonlinear response of single degree of freedom systems with bilinear hysteretic restoring force characteristics. Near-field effects are presented in the Standard No. 2800 as spectral correction factor "N" in different seismicity regions. In this study, the site is located in a very high-seismicity zone and the ground type is considered as type II. Second- and third-order linearization methods are used to estimate the response of nonlinear systems. These methods are applied to derive equivalent linear properties. To achieve research goals, it is necessary to represent the input excitation as a quasi-stationary stochastic process compatible with target elastic design spectrum. In this regard, an effective numerical method in the field of random vibrations was used to determine the response spectrum compatible power spectra. After calculating the equivalent parameters related to linearization methods, random vibration theory and time history analysis approaches within the linear range were used to calculate the response of equivalent linear systems. In order to validate the results, the response values obtained from equivalent linearization methods for both approaches were compared with the results of nonlinear time history analysis (NTHA). For this purpose, 250 artificial non-stationary records compatible with two modes of the target spectrum were used to provide reasonable estimates of the peak response of the bilinear hysteretic systems. Artificial records were generated using simulation methods in the field of random vibrations by considering specified envelope functions and power spectral density. According to the results of this study, the second-order linearization method has insufficient accuracy in estimating the response of nonlinear systems under severe excitation. As the natural period of the systems increases, the discrepancy between the results of the equivalent linear system and the results of NTHA increases. Moreover, the good agreement between the third-order linearization results and the results of NTHA indicates the high efficiency of this method in estimating the response of nonlinear systems under the near field excitation.

Key Words: Random vibration, near-field effect, equivalent linearization method, power spectrum, bilinear hysteretic .

NUMERICAL STUDY OF A NOVEL BOLTED MOMENT CONNECTION FOR THE BEAM TO COLUMN CONNECTION USING T-SHAPES AND WEB ANGLE SECTIONS

M. Darrehzereshki
m.darrehzereshki@ut.ac.ir
A.R. Ghiami Azad(corresponding author)
rghiami@ut.ac.ir
M. Ghassemieh
m.ghassemieh@ut.ac.ir
School of Civil Engineering
College of Engineering
University of Tehran
DOI:10.24200/J30.2022.59751.3069

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 99-110, Original Article

- Received 5 February 2022; received in revised form 6 April 2022; accepted 15 April 2022.

Abstract

Based on the past experience of engineers, welded connections usually do not perform well during earthquakes. Nevertheless, welding is used in all prequalified moment connections in chapter 10 of the National Building Code of Iran and as a result, there is a need for a fully-bolted prequalified moment connection for use in intermediate moment frames (IMF) and special moment frames (SMF). Thus, in this paper, a novel type of fully-bolted connection was investigated using T-shaped sections and web angles. First, the finite element model of the connection was developed in Abaqus software and validated with respect to experimental results. Next, using the concepts of Eurocode 3, section 1-8, a method for calculating the stiffness and strength of the connection was presented and was validated with the help of several experimental tests and finite element modeling. The results confirmed the proper performance of this method in predicting the stiffness of the connection. Since finite element modeling and experimental tests require a lot of cost and time, the proposed method can be a good option for engineers. Next, with the aim of parametric study on the connection, a large number of connections were designed based on capacity. Based on the component method, the connections stiffness was calculated using supervised machine learning techniques and multiple linear regression learning algorithm. Next, using the data obtained from the design and component method, a parametric study was performed on the connection and a simple formula was presented to calculate the initial stiffness of the connection. The results of this study show excellent regression performance in predicting connection stiffness. In addition, according to the obtained formula, the depth of the beam and diameter of the bolts connecting the T-shape flanges to the column flange have the most impact on the connection stiffness. Finally, the studied connection was classified according to its rigidity. The results showed that the studied connection acted as a fully-restrained connection and can be used in IMF and SMF systems.

Key Words: Component method, finite element, machine learning, bolted connection, T-shape sections, initial stiffness.

EXPERIMENTAL INVESTIGATION OF OXY-ACETYLENE WELDING AND ARC WELDING WITH STEEL, BRASS, AND BRONZE ELECTRODES

B. Shervani Tabar(corresponding author)
b.shervani@azaruniv.ac.ir
S. Enteghami Mayan
Shahab.ss349@yahoo.com
A. Sadeghi
a.sadeghi@azaruniv.ac.ir
Faculty of Engineering
Azarbaijan Shahid Madani University, Tabriz
DOI:10.24200/J30.2022.59572.3061

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 111-119, Original Article

- Received 29 December 2021; received in revised form 12 March 2022; accepted 25 April 2022.

Abstract

To consider the importance of avoiding corrosion of weld metal under various environmental conditions, the investigation into the efficiency of different welding methods with different types of electrodes will be inevitable. In this paper, the strength and compatibility of various welding methods were experimentally investigated considering four welding types, including arc welding with phosphor bronze electrode, arc welding with steel electrode, oxy-acetylene welding with bronze electrode, and oxy-acetylene welding with brass electrode. In this regard, first, the material properties of the base metal were determined by tensile testing and then, the behaviors of 46 test samples were examined under three loading conditions of tensile, shear, and bending. Investigation of the experimental results showed that with an acceptable approximation, the strength of arc welding with steel electrode could be considered the same at all thicknesses and the effect of thickness on the tensile strength of the weld could be ignored. while the plate thickness has a remarkable effect on the quality of the oxy-acetylene welding. Also, the results of experiments showed that arc welding with steel electrodes in different types of samples had higher strength than other three types of welding. Then, the strength of arc welding with phosphor bronze electrode was in the second grade.

Key Words: Oxy-acetylene welding, arc welding, bronze electrode, steel electrode, brass electrode.

EVALUATION OF THE STATIC AND MULTISTAGE GEOCELL PULLOUT BEHAVIOR IN COARSE GRAINED SOIL

A. Namaei-Kohal
namaeiali@yahoo.com
A.R. Ardakani(corresponding author)
a.ardakani@eng.ikiu.ac.ir

M. Hassanlou Rad
hassanlou@eng.ikiu.ac.ir
Faculty of Technical and Engineering
Imam Khomeini International University
DOI:10.24200/J30.2022.59660.3065

Sharif Civil Engineering Journal
Volume 38, Issue 2.2, Page 121-130, Original Article

- Received 10 January 2022; received in revised form 12 March 2022; accepted 15 March 2022.

Abstract

Geocell mattresses are one type of three-dimensional honeycomb soil reinforcements that is manufactured from polyethylene sheets using ultrasonically welded joints. This type of geosynthetics is commonly used to stabilize geotechnical problems in which the pullout failure is likely to occur. The present study has been conducted to evaluate the pullout behavior of a geocell by considering the effect of soil grain size. A series of 18 monotonic and 24 multistage geocell pullout tests were performed in sandy and gravely soil. The obtained geocell pullout loads were divided into two components: passive and frictional resistance. A previously made theoretical approach was used to measure the mobilized frictional and passive resistance components to evaluate the contribution of each mechanism. The results obtained from monotonic geocell pullout tests showed that the geocells exhibited hardening pullout behavior and the pullout failure occurred when the geocell material did not have any more pullout capacity to resist external load. Increases in the geocell height and soil grain size had significant effects on the passive component and it was seen that the contribution of geocell height developed passive resistance higher than the soil grain size. Furthermore, the multistage test results indicated that for removal of the geocell, the ultimate post-cyclic pullout load was less than the monotonic pullout load. This was the result of a reciprocating motion from loading caused by the interlock between the geocell infill soil and the surrounding material, which weakened and broke during the cyclic phase. As the coarseness of the soil increased, the interfacial strength increased. The theoretical approach did not single out the passive component between monotonic and multistage tests and the obtained passive resistance values were the same in these calculations. However, the cyclic loading could affect this component. Also, the soil particle size had a significant effect on the cumulative displacement during the cyclic phase.

Key Words: Geocell, pullout behavior, coarse grained soil, static test, dynamic test.