abrasion/erosion strength of concrete. But, the abrasion/erosion strength of concrete containing nano silica was greater than fiber concrete. Moreover, the rate of improving abrasion/erosion strength by increasing the amount of nano silica or fiber in the concrete, was reduced. Application of nano silica can improve compressive and abrasion/erosion strength as a linear relation. But, although the use of polypropylene fiber causes better abrasion/erosion strength, it cannot improve compressive strength. In other words, polypropylene fiber can extol the surface properties of concrete. It is shown from the results that application of 1 % nano silica can increase abrasion/erosion strength up to 40%, and usage of 0.5 % polypropylene fiber can improve abrasion/erosion strength up to 30%. These results help to achieve durable concrete in cases where concrete is prone to abrasion/erosion effects, such as wind, flood traffic load and etc.

Key Words: Abrasion/erosion strength, nano silica, polypropylene fiber.

CHALLENGES OF APPLYING THE OVERHEAD COST FACTORS IN BIDDINGS OF CONSTRUCTION PROJECTS

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Abstract

The construction industry is a major player in the economy of a country, generating both employment and wealth, and the main portion of a country's budget is allocated to infrastructure development projects. According to statistics, in Iran, about 373 trillion Irs had been invested in construction projects in the year 2012. Meanwhile, statistics show that a great number of the construction projects failed to be finished. Indeed, many construction projects experience extensive delays and, thereby, exceed initial time and cost estimates. In this regard, government data also indicate that the earning losses due to unfinished projects are over 120 thousand million dollars (about two-thirds of the annual construction budget). There are many reasons why delays occur. They may be due to strikes, rework, poor organization, material shortage, equipment failure and so on. Many contractors justify delays by lack of in time funding and tight budgets. Unfortunately, in most cases, they spend an untold amount of resources on the project; as large as several times the contracted cost. A chief reason for this is that contractors who submit bids are not fully aware of the scale and proportion of the project.

In Many projects, overhead expenses are of considerable importance and are at least 30 percent of the total amount of project cost. As a result, any minor mistakes in calculating project overhead expenses can make the project fail. This paper is mainly a case study in the area of road construction projects, which concerns estimation of overhead factor deficiencies relative to the system expenses status.

The results show that the overhead Cost factors is inversely related to the cost of the project, and with the increasing cost of the project, the factor is decreased. Finally, a linear relation is established to determine the overhead factor relative to contract cost.

Key Words: Overhead costs, cost of project, profit.

the soil nailed walls obtained from full dynamic analysis was used as a reference solution to ascertain the accuracy of the results given by the proposed method. Two soil-nailed structures were considered as case studies. 1940 El Centro and 1989 Loma Prieta were used to excite the models.

A reasonable match was found between the results of the proposed method and fully dynamic analysis of the problem. The proposed method may be used effectively to perform a broad suite of parametric studies at the design stage. The above procedure can also provide a hybrid experimental and numerical tool for earthquake impact assessment of soil-reinforced retaining structures.

Key Words: Soil-reinforced. soil-nailed. dynamic analysis. nonlinear static analysis.

SEISMIC PERFORMANCE OF STEEL-BRAM COUPLED SHEAR WALLS USING THE PBPD METHOD

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Abstract

There are special guidelines for the design of structures resistant to earthquake forces; parameters, such as the conditions and seismicity of the site, and the importance and type of structure, are the main effective factors. Consideration of these parameters in calculation and distribution of earthquake forces is significantly different in various design codes. In most of these design codes, the computation and distribution of earthquake forces are based upon the elastic structural analysis. In this approach, the real behavior of the structure is not considered and consequently it may sustain large displacements and irretrievable damage. Therefore, a new design method has been utilized in this paper, by which, the base shear and its distribution in the height of the structure are calculated according to the plastic behavior of the structure, and which takes advantage of the energy balance. The latter is known as the Performance Based Plastic Design (PBPD) method. In this method, the target drift and yield mechanism are used as performance parameters, which are based on the energy method; in addition, the equilibrium relation between the demanded work for monotonic displacement of the structure to achieve the target drift, and the internal energy obtained by the spectrum response of the equivalent SDOF for the elasto-plastic system, is used to compute the base shear of the structure. This method has been successfully performed on MRF, CBF, EBF and special truss systems. In this paper, the PBPD method has been developed for coupled shear walls with steel link beams. The results of the PBPD method are compared with the results of the ordinary method. It is demonstrated that the plastic hinges, the inter-story drifts and the plastic rotation of links are distributed more uniformly at the height of frames designed by the suggested method compared to those of the ordinary method.

Key Words: Performance based plastic design, couple shear wall with steel connective beam, seismic performance, base shear, plastic hinge.

EFFECT OF NANO SILICA AND POLYPROPYLENE FIBER ON ABRASION/EROSION STRENGTH OF CONCRETE

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Abstract

Abrasion/erosion strength is an important characteristic of concrete, such as when used in pavements or some hydraulic structures. In these cases, usage of some admixtures can help to improve abrasion/erosion strength. In this study, admixtures using nano silica and polypropylene fiber, which can increase abrasion/erosion strength, are used. Determination of abrasion/erosion strength is measured based on ASTM C1138, which can evaluate the abrasion/erosion strength of concrete under water and steel ball suspension. This test method simulates the abrasive action of waterborne particles, such as silt, sand, gravel, and other solids. The results show that these admixtures can remarkably improve the

HYBRID CONNECTIONS OF STEEL AND CONCRETE STRUCTURAL ELEMENTS

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Abstract

For several years, hybrid structures such as CFT and RCS have been studied and their good performance has been proved. By applying the benefits of concrete and steel together in hybrid systems, a connection with good performance is achieved. Composite structures have been widely used in the construction of buildings due to their excellent static and earthquake resistant properties, such as high strength, high ductility, and large energy dissipation capacity. In this paper, an experimental investigation of the perimeter diaphragm and internal plate effects on a hybrid connection of steel beam to concrete column has been conducted. So, a concrete connection and three composite connections were constructed and tested under cyclic loading. A concrete connection was the standard reference connection and the following three connections were proposed as composite connections of steel beam to concrete column: perimeter diaphragm and internal plates, perimeter diaphragm and inner shearheads, and post tensioned composite. In all these composite connections, the concrete column in the panel zone has been confined with a steel sheath. The perimeter diaphragm makes the plastic hinge form at a distance from the connection bay and column edge, and the connection elements remain in an elastic state. The results indicated that composing the connection created an increase in loading capacity and energy dissipation. An increase in the ductility of composite connections with the perimeter diaphragm in comparison with the reference concrete connection was also observed. By composing the connection, the maximum strength of specimens with a diaphragm and internal plates, the connection with diaphragm and shearheads, and the post tensioned connection, in comparison with the reference specimen, was increased 239,389,156 percent, respectively. Also, the ductility increase of specimens with diaphragm and internal plates, and with shearheads, in comparison with the concrete specimen, was 118.25 percent.

Key Words: Perimeter diaphragm, internal plate, composite connection, panel zone, ductility.

VERIFICATION OF A STATIC NONLINEAR ANALYSIS METHOD FOR ESTIMATION OF SOIL-NAILED RETAINING WALLS SEISMIC DEFORMATIONS

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Abstract

In recent years, due to the growing demand for high-rise structures, the use of soil-nailed walls has become increasingly common, particularly as a basement to provide sufficient parking space. However, the main concern when using soil-nailed cuts in high-seismicity regions is the performance of soil-nailed excavations during seismic loading. It is necessary to study the seismic performance of nailed structures for optimum design and it is useful to study displacement seismic design with a focus on displacement, instead of force, as the direct performance or damage indicator, to achieve these objectives.

A method is proposed to evaluate the seismic deformation of soil reinforced structures using a combination of nonlinear static analysis of MDOF models and dynamic analysis of a 2DOF system. A computer program for dynamic analysis of nonlinear 2DOF systems was developed, in which seismic deformations of soil reinforced structures can be calculated. Two force-displacement relations, obtained from nonlinear static analysis, describe the characteristics of the whole structure and are used as the nonlinear stiffness of the 2DOF springs. Nonlinear static analysis was performed by applying a vertical load pattern behind the reinforced block and on the surface of the multi-degree of freedom model. Contours of the horizontal displacement and plastic strain from static nonlinear analyses are compared with the seismic failure mechanism of soil-nailed structures. Deformation of

alginate, which is used a lot in the dentistry industry. It is used extensively as an impression making material in dentistry, prosthetics, life casting and occasionally for creating positives for small scale casting. In addition, alginate is used in the food industry, engineering and construction. This polymer is made in a variety of percentages: 0.5, 1, 1.5 and 2, with different percentages: 1, 1.5 and 2, of resin. The values of w/c in all samples are 0.36. The objective of this study is to investigate the influence of alginate on the fresh, hardened and sulphate resistance properties of SCC. The performance of alginate is established in SCC using fresh concrete tests, such as slump flow, T500 time, J ring and L-box ratio, and by hardened concrete tests, such as compressive strength, flexural strength, water absorption and density in magnesium sulphate solutions. The compressive strength and density of each mix design, over 7, 28, 56, and 90 days, are determined. In addition, prismatic specimens are made to determine the flexural strength at 28 days of curing. Two cubic specimens are made to determine water absorption at 28 days of curing. The results of the fresh concrete show that increasing alginate content negatively affected the blocking ratio, because of viscosity decrease. This reduction is because of diatomaceous earth. The use of alginate increases the strength of the sulphate solutions. The highest flexural strength value is seen in the R1.5A1 sample in the sulphate environment. The R1A1 has the least density compared with other samples. The R2A1.5 sample has a higher compressive strength, over 56 and 90 days, in the sulphate environment rather than the water environment. Results show compressive and flexural strength in upper ages. The R2A2 has the least water absorption compared to the other samples.

Key Words: Self-compacting concrete, polymer, alginate, magnesium sulphate, resin.

INVESTIGATION INTO THE POTENTIAL OF PROGRESSIVE COLLAPSE IN STEEL BUILDINGS WITH A COMPOSITE ROOF

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Abstract
Abnormal load due to natural events, implementation error and some other issues can lead to the occurrence of progressive collapse in structures. In the research undertaken so far, most have involved 2-D models and are based on bare steel frames without consideration of the contribution of the floor systems, which reduces the accuracy of the model. Consideration of the effects of three dimensional and concrete floor slabs can play a crucial role in the progressive collapse response. For this purpose, in this research, a 3-dimensional finite element model of a five story steel building was simulated by Abaqus/CAE 6.11 software; First, with consideration of the slabs, and next, without their consideration. Then, the potential for progressive collapse was simulated. The results of the analysis indicate that the lack of consideration of the slabs during computation can lead to errors in assessing the potential for progressive failure of structures. The following results can be concluded from this study: when a structure is subjected to unusual external loads, such as a motor vehicle collision, explosion of a bomb in a vehicle, etc., the most critical columns are located in the nearest frame to the outer frame of the structure. So, engineers should focus more on resistant design against progressive collapse, as it could be a key factor that has a significant role in reducing the progressive collapse potential. In progressive collapse evaluation, when external columns are removed and the structure is damaged, the closest columns to the external frame are critical. Also, after removing the columns in different modes, the loads are split between the adjacent members; hence, these members must have sufficient ability to withstand the additional forces. Therefore, the distribution of forces in these members, before and after column removal, can be seen by monitoring the axial force values for adjacent members of the removed column. Because all the members are designed to withstand earthquake loads and non-interference of related loads (i.e., earthquake ground motion) with progressive collapse, even by removal of the main load bearing members, other columns still have enough capacity to carry the existing loads.

Key Words: Progressive collapse, intermediate steel moment frame system, composite roofing, abnormal loads.

EXPERIMENTAL INVESTIGATION OF PERIMETER DIAPHRAGM AND INTERNAL PLATE EFFECTS ON

the area of the setback. The seismic responses of geometrically irregular frames, which have a larger effective modal mass ratio for the second and third modes, are large, and the responses increase by a reduction in the area of the setback. The results show that peak seismic responses occur when a setback is in one second, and, then, at one third of the height. At the level of the setback (the level at which the tower is joined to the base) a large jump in drift diagram is observed when compared to the referenced regular frame. Also, enhanced pushover analysis methods can estimate the seismic demands accurately for geometrically irregular frames with setback. The seismic responses of the frames with setbacks and the accuracy of the enhanced pushover analysis methods generally depend on dynamic characteristics and geometrical configuration.

Key Words: Geometrical irregularity in height, setback, dynamic characteristics, seismic behavior, nonlinear dynamic analysis, enhanced pushover analysis.

INVESTIGATION OF LATERAL LOADED MONO-PILE BEHAVIOR CONSIDERING SOIL AND STRUCTURE INTERACTION

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Abstract
In this paper, the behavior of laterally loaded mono-piles was investigated considering soil and structure interaction, and using numerical modeling. The numerical model was, at first, verified using large scale experimental test results and some analytical methods. Then, some sensitivity analyses were performed and the effects of parameters, such as free to embedded length ratio of the mono-pile, diameter of the pile, soil strength and etc., were investigated. Finally, the response of the laterally loaded mono-pile and soil system was compared with an end fixed column to find an equilibrium length for the column to have the best fit response with the mono-pile and soil system. The verification analysis of numerical modeling showed good compatibility with the large scale tests results and analytical methods. Also, the sensitivity results showed that increasing the free to embedded length ratio and diameter of the mono-pile and reducing soil strength result in the rigid behavior of the mono-pile. Increasing the soil strength, pile diameter and embedded length of the mono-pile increases the mono-pile lateral bearing capacity. However, there is an embedded length, as critical depth, subsequent to which, the mono-pile lateral bearing capacity becomes constant. Comparing the load- displacement response of the mono-pile and soil system with an end fixed column showed that it is possible to replace the mono-pile and soil with a column having an equiblibrium length as its initial length plus a pert embedded length (called depth of fixity). The amount of depth of fixity is suggested to be 6 to 10 times the pile diameter, without considering soil and pile conditions. The depth of fixity depends on the free length and diameter of the mono-pile and soil strength, so that, increasing the free length of the mono-pile results in an increase in the depth of fixity in dense sand soil. However, there is not a specific trend in the loose sand soil.

Key Words: Mono-pile and soil, lateral loading, numerical model, depth of fixity.

EXPERIMENTAL STUDY OF POLYMER SELF-COMPACTING CONCRETE

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Abstract
This paper presents an experimental study on the properties of self-compacting concrete (SCC) using natural polymer (SCC). Fifteen series of mixed proportions were used, which were cured in two environments of magnesium sulphate and by water curing. The polymer used is

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Abstract

A comprehensive closed-form approach is presented to approximately evaluate the probability distribution of displacement of SDOF and MDOF systems subjected to stationary and non-stationary Gaussian excitations. The probability distribution of displacement of a SDOF system is investigated on the basis of statistical relations, and a closed-form method is presented to approximately detect the structural response without any need to perform exact dynamic analysis. Buildings with BW hysteretic behavior can easily be modeled with the aid of the proposed approach. The approximate procedure can significantly facilitate the utilization of non-stationary models in engineering practice, because it avoids computational difficulties. The method is based on the approximation of a non-stationary process by an equivalent stationary process. In this study, six systems with initial periods of 0.4, 0.6, 0.8, 1, 1.2 and 1.4 sec. are considered for the validation of the presented relations. With the aid of the determined linearization coefficients of the system, the target displacement and IDA curves are also determined. The previous investigations into development and evaluation of the coefb03cient method to compute the target displacement used computer models of the buildings; an exhaustive list of references is available in the FEMA-440 report. The "exact" value of the target roof displacement was taken as the peak roof displacement computed by nonlinear response history analysis of the computer model subjected to selected earthquake motion at its base. But, generally, determining the probability distribution of structural demands and the response of structural systems at different confidence levels, based on nonlinear dynamic analysis, can be very time consuming. With regard to this need, developing a simple computational approach that replaces exact methods and the time consuming dynamic analysis of structures is the aim of this research. The computed target displacements for six systems are compared with the target displacement under 300 non-stationary records and from nonlinear static procedure in FEMA-440. In comparison to the exact dynamic analysis procedure, the proposed approach provides an acceptable probabilistic result with less computational time and cost.

Key Words: Target displacement, statistical relations, bouc-Wen model , displacement probability distribution.

INVESTIGATION INTO THE EFFECT OF GEOMETRICAL CONFIGURATION ON THE SEISMIC BEHAVIOR OF GEOMETRICALLY IRREGULAR FRAMES WITH SETBACKS

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Abstract

A building with a sudden change in the geometry of the frame over the height is called a setback building, stepped building or vertically geometrically irregular building. This kind of irregularity causes an abrupt discontinuity in the stiffness, strength and mass of the frame, creating complex behavior in the structural system. This paper aims to study the seismic behavior of geometrically irregular buildings with setbacks, the irregularity of which can cause damage during earthquakes. In this study, a total of 20 geometrically irregular steel moment resisting 9-story frames were designed. An eigenvalue analysis was performed to evaluate the dynamic characteristics of the structures. The seismic behavior of the frames was examined by nonlinear time-history analysis using seven ordinary far-field ground motion records. Due to the rapidly increasing use of pushover analysis in recent years, and to account for the effect of higher modes in pushover analysis, enhanced pushover analyses, including modal pushover analysis (MPA), upper bound pushover analysis (UBPA), consecutive modal pushover (CMP) and extended N2 (EN2) methods, were implemented. The results indicate that the effects of higher modes for geometrically irregular frames can be considerable. Also, two basic parameters have an influence on the seismic response of these structures: the position of the setback and the reduction in

into spectral accelerations and displacements is based on the assumption that the dynamic behavior is dominated with only one of the natural vibrational mode shapes which is assumed to be constant and not changing during the (NSP) analysis. Assessing this assumption for horizontally curved bridges shows that the lateral load patterns are effected with combination of modes and are not proportional to one especial mode shape. In this context, mass proportional load pattern is usually used to consider the effects of some special pre-specified mode shapes in (NSP) analysis.
In this research, the (CSM) method is further developed and a method is proposed for determining target displacements using the mass proportional load pattern. In the proposed method, the capacity spectrum is drawn using mass proportional load pattern based on the displacement vector in the linear range instead of some specified mode shapes. Therefore, the developed proposed method is not dependent on some pre-specified modes of vibration and the effects of all modes of vibration are considered simultaneously. The efficiency of the proposed method is proved by determining target displacements of control points on a horizontally curved bridge using the proposed method and then comparing the results with the results of incremental dynamic analysis (IDA).

Key Words: Horizontally curved bridge, capacity spectrum, m load pattern.

INVESTIGATION INTO THE EFFECTIVE PARAMETERS OF COMPRESSIVE AND FLEXURAL STRENGTH OF SOIL CEMENT MATERIALS USING NUMERICAL MODELLING (CASE STUDY: COFFER DAM OF BAKHTIARI DAM)

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Abstract

Soil cement is a mixture of Portland cement, soil and water, the constituents of which, due to the hydration of cement and compaction, bond together and make a dense and durable composition with low permeability and abrasion resistance. According to the definition of ACI 116R, soil cement is a mixture of soil and a certain amount of cement and water which has been compacted to a high density. A more comprehensive definition has been provided in ACI 230 IR, which defines soil cement as a hard material with specific engineering properties that is produced by the mixing, compaction and curing of soil, aggregate, Portland cement, additives and water. They are similar to roller compacted concrete; the main difference between them being, however, the type and size of aggregate particles. Soil cement is principally made of round natural fines, while roller compacted concrete is made of particles with a size of up to 19 mm. The soil cement mixture is usually used as protection for earth embankment slopes, while roller compacted concrete is mostly used in massive elements such as gravity dams. All types of soil can be used in soil cement construction, except organic and plastic soil and reactive sand. The most efficient soils are those containing 5 to 35% of fines, passing sieve 200. However, soil containing more than 2% organic material is strictly unacceptable. Soil cement application in dam and pavement construction has grown. Previous studies have investigated the effects of cement content, water to cement ratio, and compaction level, on the strength of soil cement mixtures. Some other factors affecting the strength of soil cement are pozzolans and chemical additives which are not usually economical for use in large civil projects. In this research, the effects of plasticity index and sand equivalent of soils on unconfined compressive and flexural strength have been investigated. The results show that the compressive and flexural strength of soil cement mixtures is dependent on the plasticity index and sand equivalent. Also, a numerical model developed for the coffer dam of the Bakhtiari dam, and results, show that its structure is stable with soil cement material.

Key Words: Soil cement, unconfined compressive strength, flexural strength, plasticity index, sand equivalent, type of gradation, numerical modeling.

A STOCHASTIC SIMULATION ALGORITHM FOR DETERMINATION OF PROBABILITY DISTRIBUTION AND EXTREME VALUE OF SEISMIC RESPONSE OF DYNAMIC SYSTEMS

(highest bearing capacity with the least cost) are determined in order to reduce the costs as much as possible. Also, a comparison is made between the performance of the 3D geosynthetic reinforcement and planar form with the same mass of used material (as two reinforcing systems with similar materials but different behavior mechanisms) to determine the system with higher efficiency.

Key Words: Reinforced soil, foundation bed, geosynthetic, geocell, FDM, $FLAC^3d$.

EFFECT OF DIFFERENT PARAMETERS ON SHALLOW FOUNDATION SETTLEMENT RESTED ON TWO-LAYERED SOIL SUBJECTED TO EARTHQUAKE LOADING

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Abstract

Settlement and tilt of structures due to the liquefaction of subsoil layers is a major cause of damage during earthquake. Among different soil profile types, two-layered sub soil is very common. The numerical study presented in this research addresses the effects of different parameters that are influential on liquefaction in saturated sand deposits underlying the foundation of structures. In this regard, a 3D finite element model, with a fully coupled dynamic analysis of saturated porous media has been utilized. For the constitutive model, a well-calibrated bounding-surface plasticity model, capable of accounting for the monotonic and cyclic response of saturated sand, in a wide range of densities and confining pressures, has been used. Another main feature of the proposed numerical model is taking the variations of permeability into account during liquefaction. The numerical simulations of this study have been performed using OpenSEES, which is an Open-source software framework. In this research, two 3D u-p elements with novel variable permeability functions have been used, which were implemented in OpenSEES. The numerical model has been verified by simulation of a series of centrifuge experiments performed on models of footing and the analysis results are compared with experimental measurements. After verification of the numerical model, comprehensive parametric studies were conducted and, based on the obtained results the effects of the parameters were reported. The results showed that existance of a liquefiable layer plays a significant role in shallow foundation settlement during earthquake. In two- layered subsoil, if the footing rests on the liquefiable layer, the underlying dense sand can reduce the amount of settlement more effectively.

Key Words: Shallow foundation, liquefaction, parametric study, settlement, numerical model.

DEVELOPMENT OF CAPACITY SPECTRUM METHOD AND DETERMINING TARGET DISPLACEMENT FOR MASS PROPORTIONAL LOAD PATTERN IN HORIZONTALLY CURVED BRIDGES

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Abstract

Considering appropriate lateral load pattern and determining target displacement for bridges in nonlinear static pushover (NSP) analysis have been important issues for researchers. There are two conventional load patterns in the standard codes of practices which are called:1-Mode shape proportional load pattern, 2-Mass proportional load pattern.

Capacity Spectrum Method (CSM) is one of the approaches applied in determining target displacement of structures usually using the first mode proportional load pattern. In conventional (CSM) method for determining the spectrum capacity curve during NSP analysis, the base shear of the multi degrees of freedom system versus displacement of the control point is drawn using the first mode proportional load pattern, and then is converted to spectral displacement and spectral acceleration format. Converting base shears and control point displacements

Abstracts of Papers in English

NUMERICAL ANALYSIS OF GEOCELL REINFORCED FOUNDATION SAND BEDS AND COMPARISON OF CELLULAR AND PLANAR GEOSYNTHETIC REINFORCING SYSTEMS

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Abstract

Geocell is a three-dimensional geosynthetic product which can be used to stabilize foundations by increasing bearing capacity and reducing settlements. Geocells have completely different mechanisms compared to the traditional forms of geosynthetics (planar geosynthetics). Their three dimensional geometry causes extreme lateral confinement for the infilled soil, which leads to an increase in soil strength and stiffness and a decrease in surface permanent-deformation.

Many laboratory and field tests have demonstrated the effectiveness of geocell reinforcement systems in different fields. Due to several advantages, the geocell is in the process of practical development. However, a considerable gap exists between applications and theories for mechanisms of geocell-reinforced foundations. There are relatively extensive laboratory studies in the field of geocell reinforcement, but, because of its complexity, numerical modeling of geocell reinforcement, which is essential for investigating its behavior, has rarely been undertaken.

This paper presents a numerical model of geocell reinforced foundation sand beds. In this numerical study, in order to simulate the three dimensional nature of the geocell accurately, the geocell and soil are simulated separately using the 3D Finite Difference Method (FDM) of FLAC3D. The geocell is simulated using geogrid structural elements, and the elastic-perfectly plastic Mohr-Coulomb model is used for modeling the behavior of soil. In order to verify the modeling, at first, a single geocell reinforced soil is modeled and compared with the equivalent laboratory test presented in the literature. Then, the model is extended to geocell foundation beds.

Finally, in this research, the placement conditions under which the geocell layers have the highest efficiency