cost and maximum structure stability. In the next step, sensitivity analysis is carried out on input variables of longitudinal slope and design discharge to understand the effect of variations of these on cost and dimensions of the structure. Further on, sensitivity analysis results are applied for validation of the model.

Model's sensitivity in the longitudinal slope can be applied in the Mountain rivers. These rivers can choose equations such as Meyer-peter and Muller equation, because they reduce costs and increase stability of Bed sills. The results of this study can be used for the prediction of optimized dimensions of Bed sills.

Key Words: Grade control structures, cost, multi-objective optimization, bed sill stability and river stability.

the number of potential conflicts will be reduced before the start of the construction phase; therefore, an optimized schedule is resulted.

Key Words: Time-space conflicts, 4D simulation, labor productivity, building construction projects.

COMPUTER SIMULATION OF THE COLLAPSE OF HIGH-RISE BUILDINGS OF RC MOMENT-RESISTING FRAME

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Abstract

The prediction of the collapse stages of a structure, caused by special explosives, used for controlled demolition, or under any extreme loadings, such as blast has been of interest to designers and structural engineers in recent decades. In this article, the collapse stages of high rise RC buildings with moment resisting frames, due to removal of certain members of the structure, destroyed intentionally or accidentally, has been simulated by the aid of a developed computer program. The computer software, to simulate the process of collapse, is able to carry out sequential analysis, assuming an elasto-plastic behavior for materials. After each analysis, plastic hinges, formed in structural members, are identified. Structural elements which satisfy failure criterion are removed and then the geometry of the structure is updated. The deformed shape of the structure, in each stage of collapse after removing each destroyed members, is visualized. The collapse stages of three selected buildings, introduced in previously published papers, investigated and the computer software is verified. In a different case study the process of the collapse of a 20 story building has been predicted for four scenarios of controlled demolition. It is shown that the software can be used to predict progressive collapse of the structures.

Key Words: Controlled demolition, collapse computer simulation, high-rise buildings, progressive collapse.

OPTIMIZATION MODELING OF GRADE CONTROL STRUCTURES DESIGN TO STABILIZE RIVERS

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Abstract

Due to human activities or natural changes rivers are subject to erosion and sedimentation. One of the best ways to control erosion and sedimentation is through grade control structures. Grade control structures are, in fact, a kind of structures constructed along the river reach to decrease longitudinal bed slope and control erosion. They stabilize the riverbed by increasing resistance to flow shear stress. This research deals with developing an optimization model to design a special type of these structures with the above function, called bed sills. Bed sills are constructed transversely across a cross section with the same level as bed elevation to protect river bed from erosion. In this respect, optimization model is developed as composition of hydraulic and structure modules under objective functions of minimum construction cost and maximum structure stability. The result of model not only consists of optimized dimension of bed sill, which consists of width, height, distance and number, but also the costs of construction implementation and depth of scouring. The model is then calibrated for Dough river. Comparing the obtained results with Bed sills of Dough river shows that the optimization modeling of grade control structures is able to obtain variations of designs for the objectives of minimum construction

mid-rise buildings increased in recent years. The SPSWs control the lateral force response of the building and the building's natural period of vibration. The SPSW with coupling beam (SPSW-WC) system consists of a pair of planes SPSWs linked together with coupling beam at the floor level.

The degree of coupling (DC), which represents the level of interaction between the two piers, is a key parameter in understanding behavior and developing design for the system. Determining the DC is difficult, but necessary. Therefore, this study investigates the relationship between DC and building's natural period of vibration in SPSW-WC structural system.

Some analytical 3-, 6-, and 9-story structures with different lengths of link beams were analyzed for determining first two natural periods and evaluating DC of SPSW-WCs. This study applied a new design technique using orthotropic membrane model proposed in design codes. In this method, after preliminary design of the system, in order to distribute correctly the forces between the wall members, an orthotropic membrane model was developed using ETABS program. Natural period estimations using this method were compared with the finite-element solution, and good agreement is demonstrated. Based on outcomes, an increase in stiffness of coupling beam results in increasing in coupled steel plate shear wall's degree of coupling. On the other hand, an increase in stiffness of coupling beam results in a decrease in structure's first natural periods of vibration. However, if degree of coupling tends to one, then first natural period of structure does not affect stiffness of coupling beam. This paper also presents a model for estimating the DC of SPSW-WC from the first two natural periods of vibration.

Key Words: Coupled steel plate shear wall, degree of coupling, natural periods of vibration.

DEVELOPMENT OF A SOFTWARE APPROACH TO IDENTIFYING TIME-SPACE CONFLICTS AND ASSESSING THEIR IMPACT ON LABOR PRODUCTIVITY IN BUILDING CONSTRUCTION PROJECTS WITH THE USE OF 4D SIMULATION

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Abstract

Space is considered a significant and effective resource and constraint in building construction projects. In order to execute project activities, other resources, such as labor, machinery, equipment, and material, require space. In other words, each activity needs different types of space. In case the space constraint is neglected, resources allocated to two or more activities, will be obliged to work in a common area during at least a portion of activities duration. Conflict among spatial requirement of activities, can cause serious problems in their execution. Nowadays with the considerable increase in demand for early completion of projects, in many cases the project schedule is compressed. Schedule compression is also used for the purpose of delay compensation. "Fast tracking" or the parallel execution of previously sequential activities, is among the common methods to shorten the project schedule. In case of fast tracking, more activities will be executed concurrently. Therefore, conflict among their spatial requirements will be more likely. Physical conflicts among concurrently executed activities are referred to as "time-space conflicts", and these conflicts are among the most effective factors in labor productivity decrease in building construction projects. They can also seriously impact other performance indexes such as time, cost, quality, and safety. Thus, development of efficient methods and tools for workspace planning can have a significant effect on project performance. In the present research, considering the mentioned necessity, the significance of space as a resource and constraint in building construction projects is studied, and various types of space and space requirements in building construction projects are identified. Furthermore, a 4D-based software approach is developed to identify potential time-space conflicts in the schedule and assess their impact on labor productivity. This approach makes conflict identification and assessment of its effects possible. Through this approach, with the use of proper solutions,

with the combination method of NSM-GFRP and CFRP confinement would reduce, respectively. Thus, the effect of concrete cover on combinatory reinforcing method is higher.

Key Words: Strengthening, CFRP confinements, cyclic load, column, NSM-GFRP.

IMPROVING THE PRODUCTION PROCESS OF BIODIESEL FROM WASTE OIL BY TIO2 CATALYTIC NANOPARTICLES COMPARED WITH CONVENTIONAL CATALYST, SODIUM HYDROXIDE

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Abstract
Due to a huge increase in world energy consumption, the limited traditional fossil energy resources, and increased environmental concerns, a requirement for alternative energy sources has been paid great attention in recent years. Biodiesel is known as a nontoxic, renewable and environmental-friendly biodegradable fuel that is free from sulfur and aromatic compounds. The biodiesel production by transesterification of vegetable oils has the potential to solve the above problems and concerns. Nanocatalysts are considered as important material in chemical processes, energy production and energy savings, and prevent environmental pollution. In this study, the characteristics and performance of TiO2 nanoparticles (TNPs) and one commonly used catalyst for alkaline-catalyzed transesterification, i.e., sodium hydroxide, were evaluated using waste olive oil. The present method affords nontoxic and non-corrosive medium, high yield of biodiesel, clean reaction and simple experimental and isolation procedures. The catalyst can be recycled by simple filtration and reused without any significant reduction in its activity. The process variables that influence the transesterification of triglycerides, such as volume ratio of methanol to waste olive oil, type and loading of catalyst, reaction time and reaction temperature, were investigated. High catalysis activity and a much more specific surface TNPs were found to be more superior to sodium hydroxide under the same conditions. The results showed that TNPs as catalyst can improve the biodiesel production up to 87.8% in the same condition in which the efficiency is 76.4% for sodium hydroxide as a homogeneous catalyst. The effect of biodiesel/diesel blend fuels on engine exhaust emissions in a Robin engine was evaluated. The testing results show that the B20 blend fuel (including 20% and 80% v/v biodiesel and diesel fuel, respectively) reduced (HC) and carbon monoxide (CO) emissions to 28.9 and 20.6% compared to the petroleum diesel fuel, respectively. In addition, in this study, the effective use of biodiesel to reduce air pollutant emissions was approved, although a slight increase in nitrogen oxides emissions than pure diesel fuel was observed that quite what was expected due to increasing combustion temperature.

Key Words: Biodiesel, waste olive oil, TiO2 Nano particles (TNPs), waste management, transesterification.

ESTIAMTING COUPLED STEEL PLATE SHEAR WALL'S DEGREE OF COUPLING USING NATURAL PERIOD OF VIBRATION

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Abstract
Use of steel plate shear walls (SPSW) as an effective structural system for resisting lateral force in low- to

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Abstract

The skirted foundations can be considered to be as new foundation options of shallow foundations including oil and gas storage tanks, wind turbines, oil drilling platforms, and also pier and deep foundations. Skirted foundations are steel or concrete foundations, which have a top raft and a relatively thin plate beneath the periphery, the so-called skirt. The skirts penetrate into the soil beneath foundation and form an enclosure in which soil is extremely confined. The skirts and confined soil behave as a unit to shift loads to the soil at the level of skirt tip. The benefit of skirted foundations over conventional foundations lies in their ease and short time of installations. To study the skirted foundations behavior and comparison with common shallow foundations in terms of the bearing capacity and settlement, laboratory tests were carried out on circular skirted foundation resting on sand layer using physical modeling. In this study, parameters such as ratio of skirt depth to foundation diameter, foundation size, the relative density of sand, and roughness of skirt surface were investigated. The test results showed the overall improvement of skirted foundations performance compared to surface foundations. The enhancement in the bearing capacity as well as reduction in the settlement of shallow foundation increases with increasing skirt depth and decreasing relative density of sand. Bearing capacity ratio of skirted foundations to surface foundations increased about 2.3 to 5 times. In addition, the settlement value of skirted foundation decreased up to 8% of that a surface foundation. In this paper, based on the obtained results, charts are presented to estimate bearing capacity enhancement and settlement reduction in terms of sand relative density, skirt depth to foundation diameter ratio and roughness. Skirted foundations resting on loose sand are more beneficial than those resting on medium and dense sand.

Key Words: Skirted foundation, bearing capacity, settlement, relative density, physical modeling.

THE CONCRETE COVER CHANGING EFFECT ON THE SEISMIC PARAMETERS OF RC COLUMNS STRENGTHENING WITH FIBER REINFORCED POLYMER SHEETS AND BARS

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Abstract

Reinforced concrete structures are strengthened in different ways. Near surface method (NSM) and FRP confinements are some of these ways. Studies show that the use of FRP for the confinement of columns increases both the load carrying capacity and ductility. Former studies in the field of using FRP bars by applying NSM method show that these bars increase the columns flexural capacity. Despite increasing bending capacity by NSM-FRP bars, this method of strengthening leads to decreasing ductility and energy dissipation capacity of the columns. Besides the aforementioned shortcomings of this method, the lack of complete usage of load-carrying capacity of FRP bar is another deficiency of the aforementioned method in which this deficiency is removed by compounding this method with CFRP confinement. In the experimental part of the study, five specimens of square reinforced concrete column strengthened by the methods of NSM-GFRP and NSM-GFRP in combination with CFRP confinement, the effect of concrete covering on the load-bearing capacity, initial stiffness, ductility and energy dissipation capacity were assessed. Also, hysteresis curves and Load-versus-drift ratio envelope curves were compared with each other. The specimens, under cyclic uniaxial flexure with constant axial load, were tested until failure. The results show that the use of both strengthening methods increases the columns carrying capacity. However, the NSM-GFRP method decreases energy dissipation capacity and ductility of the columns. Contrary to this method, the CFRP confinements in combination with the NSM-GFRP would increase the ductility and energy dissipation capacity, indicating that this is one of the useful methods for strengthening of the structure. Also, the results show that with the increase of the concrete cover from 20 to 40 mm, load-bearing capacity, ductility, and energy dissipation capacity would be reduced in both strengthening methods. With the increase of concrete cover from 20 mm to 40 mm, carrying capacity, ductility, and energy dissipation capacities of 10, 3, and 18% for specimens strengthened by NSM-GFRP method, and of 25, 40, 33 % for specimens strengthened

and a height of story (the inside of the beams) are 3 m. Beams and columns are IPB280 and thickness of web plate is 2 mm.
Finite-element modeling, boundary conditions, and loading procedures were validated by comparing published test results with the corresponding analysis results. Two single stories tested by Sabouri-Ghomi et al. and Valizadeh et al. were modeled using the finite-element program. The material properties reported by the original researchers were used in analyses of finite element models. The results show that there is little difference between the experimental and finite element results.
One of the problems of steel wall with opening is causing stress concentration at the corners. Corners are the first place for cracking. One of the solutions that has been studied in this paper is creating a curvature in corner. In addition, effect of opening position on the period and buckling force and wall resistance is studied. The results indicated that opening on the wall increase time period. Corner opening increases period more than central opening does. Not only opening on the wall decrease buckling force, but also decrease wall resistance. If opening is closer to the wall center, the resistance of steel shear wall will be reduced further.

Key Words: Special steel plate shear wall, opening, modal analysis, buckling, finite-element method, nonlinear analysis.

APPROPRIATE INTENSITY MEASURES FOR NON-LINEAR BEHAVIOR EVALUATION OF DUAL STEEL SHEAR WALL SYSTEM

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Abstract
In the past decades, the use of steel plate shear wall systems is on the rise in new and existing buildings to resist against lateral forces. Dual steel shear wall system, has many advantages in comparison with the conventional lateral load systems. A four story frame is selected in 4-storey building with a height of 3.5 meters per floor. This building loading is according to 2800 standard and seismic design by AISC360-10 cod and AISC Design Guide 20. To achieve the full range of structural response under earthquake in incremental dynamic analysis, Record intensity is applied to the structure to increase step by step. For this purpose, it is necessary to select the parameters as seismic intensity measure (IM) that can be linked by a scaling factor to the original records. Three four story frame models with different dynamic characteristics are subjected to an ensemble of 20 far-field earthquake ground motion records with a magnitude of 6 to 5.7 on the soil type II. This article is studied based on 25 candidate intensity measures for models in different dynamic characteristics. Accordingly two characteristics of efficiency and sufficiency were determined using regression analysis. Engineering demand parameters, which appropriately characterize the seismic response of the dual steel shear wall system and its related damage, are selected. Different proposed IMs are investigated and classified based on their efficiency and sufficiency in predicting engineering demand parameters. The optimal IMs for estimating dual steel shear wall system response due to seismic excitation are identified based on both efficiency and sufficiency. The results show that the appropriate intensity measure is dependent on the dynamic characteristics of structures. For selecting the models with short period, peak ground velocity is the optimal IMs based on both efficiency and sufficiency; for models with average and big period, the optimal IM is PGV/PGA.

Key Words: Intensity measure; sufficiency; efficiency; dual system; steel shear wall.

EXPERIMENTAL STUDY OF THE BEARING CAPACITY AND SETTLEMENT CIRCULAR SKIRTED FOUNDATIONS RESTING ON THE SAND

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PARAMETRIC STUDY OF CONCRETE-FACE PERFORMANCE IN CFRDs CONSIDERING HARDENING BEHAVIOR OF ROCKFILL MATERIAL

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Abstract

Concrete-faced rockfill dams (CFRDs) have been widely used for multi-purposes over the world. The construction of CFRD involves placing the rockfill in finite thickness layers as a dam body material, and compacting them to reach desired height. A reinforced concrete slab is then constructed at the upstream face of the dam. The concrete face will transfer the water pressure imposed by reservoir to the rockfill and finally to the dam foundation. During impounding of CFRDs reservoir, the upstream concrete face undergoes deformations, resulting in the development of compressive and tensile stresses in the impermeable face. Where, generated stresses exceed allowable values, some cracks would develop in the face and cause deficiencies in the performance of CFRD as a water barrier structure. Regarding the fact that the dam body deformation as a result of reservoir imposed pressure, has a direct effect on concrete face deformation, adopting a suitable constitutive model to simulate rockfill material behaviour, is of particular concern in predicting deformation and developed stresses in the concrete-face of CFRDs. With regard to the previous works on the behavior of rockfill material using large_scale test equipments, the behavior of rockfill is found to be non-linear, inelastic and pressure dependent which clarifies the significance of adoption of a convenient model as dam body material. In this paper, to evaluate the capability of different models to predict the deformation of dam body material and subsequence effect on upstream face, two elasto-plastic constitutive models have been selected and calibrated using triaxial test results. After selection of more proper model based on comparison by measured data in Da'ao dam, the performance assessment of concrete-face in terms of maximum deformation and developed in-slope direction strains, under different conditions was continued. Two-dimensional analyses wereconducted employing Finite Element Analysis (FEA) software, ABAQUS. This software has the ability of simulating multi-step analysis as applied for modeling of dam body in multi layers, placing the concrete face and applying water pressure of reservoir during impoundment, in this study. The analyses results, revealed the importance of rockfill material behavior in the performance of concrete-face, in addition to the remarkable role of dam height and the friction properties of face-rockfill interface.

Key Words: CFRD, concrete-face, induced strains, elasto-plastic, hardening, finite element analysis (FEA).

EXAMINATION OF NONLINEAR BEHAVIOR OF SPECIAL STEEL PLATE SHEAR WALL WITH OPENING

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Abstract

Steel shear wall can be reinforced with concrete layer or steel stiffeners. Steel shear wall without stiffeners is named special steel shear wall. Capacity of special steel shear walls before buckling is insignificant because of thin plate or being unreinforced. Several studies have been done on steel shear walls, but because of the confusion that exists in most design codes such as our country code, it is not provided. To eliminate some of the confusion, in this paper focused on the behavior of special steel shear walls. This study, a 10-storey building was designed with special steel shear wall. The upper story of the structure was examined. The models are one span and one story whose length of span (inside into columns)

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Abstract

Today, developed and developing countries try to plan the economic, industrial, and urban developments based on environmental protection due to air pollution and its consequences as a global issue. Air pollution as a potential and permanent risk has gradually threatened human health, especially in large cities. Environmental requirements depend highly on management parameters and play a very important role in the quality of life of citizens. In this study, a series of dose-response functions were applied to analyze the adult mortality due to chronic diseases, the reduced life expectancy as a result of acute and chronic diseases, and the resulting risks for ozone emissions in the city of Mashhad. There are a total of 12 stations in Mashhad which carry out monitoring, measuring, and indexing of the 5 types of pollutants, including CO, NO_2, O_3, $PM_{2.5}$, and SO_2. Information monitored with minimal error, which owned by the year 1393, has been analyzed in this study.

One of the main objectives in the field of analysis and monitoring of air pollution is the determination of dominant or responsible pollutant as influential factors. The prioritizing and comparison of air pollutants can offer important contributions as well as create a management view in the allocation of funds in a specified time period. The major air pollutants were prioritized from the point of view of risk using AHP and ELECTRE methods. The results show a maximum amount of 20.8% in adult mortality and a maximum amount of 8.22 years for men and 8.51 years for women in reduced life expectancy due to chronic diseases which are on the verge of a crisis situation. Statistical investigation conducted over a period of one year (1393) in the city of Mashhad suggests that the main cause of air pollution is particulate matter less than 2.5 microns ($PM_{2.5}$). The results of this research can be used to control pollutants and impose special regulations and restrictions on each contaminant.

Key Words: Air pollution, mortality, life expectancy, dose-response function, AHP, Electre.

USE OF GLASS FIBER POLYMERS (GFRPS) FOR STRENGTHENING OF SEMI-SUPPORTED STEEL SHEAR WALL

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Abstract

During the recent past decade, semi-supported steel shear walls (SSSW) have been introduced as an alternative to the traditional type of steel plate shear walls (SPSW). In this system, the shear wall does not connect directly to the main columns of the building frame; instead, it is connected to a pair of secondary columns that do not carry gravity loads. However, a SSSW system, compared to the corresponding SPSW system in which the infill plate is connected to the main frame columns, has a lower span width (or lower infill plate width) and, thus, lower strength, stiffness and energy dissipation capability. To offset these effects, one effective and practical approach is the use of fiber-reinforced-polymers (GFRPs) for strengthening the steel infill plate. GFRP laminates can be easily attached to one or both sides of the infill plates by the use of adhesive. In this paper, the behavior of semi-supported steel shear walls reinforced by glass-fiber-reinforced-polymers (GFRPs) is studied using the finite-element method and compared with the corresponding systems without the reinforcement. A number of semi-supported steel shear walls with different plate aspect ratios, plate thicknesses, secondary column profiles, and with and without opening of various sizes is considered for this research. Both pushover and cyclic analyses are performed. The adequacy of the finite-element modeling approach for representing the pushover and cyclic responses of SPSWs is verified through comparisons with experimental results. Results show that the use of GFRP laminates, especially for the system with thinner infill plate thickness, can significantly increase the system strength, initial stiffness, and energy dissipation, while it partially decreases the system ductility. In turn, the improvement of the system strength and energy dissipation capability is mainly due to the improvement of the SSSW infill plate behavior. In fact, the use of GFRP laminates does not affect much the hysteresis and pushover behavior of the SSSW frames.

Key Words: Semi-supported steel shear wall, GFRP, nonlinear analysis, cycle analysis, hysteresis curve.

loads. At the start of modeling, the numerical modeling was verified by the virtue of numerical simulation of a centrifugal modeling experiment. The comparison of results expresses good agreements between the simulations and experiment. In the following steps, a number of numerical models was analyzed by changing soil friction angle as well as the load eccentricity. Finally, attempts were made to find a mathematical expression for the determination of N_gamma factor defined as a function of the ratio of load eccentricity to the footing diameter, ring radii ratio and soil friction angle.

Key Words: Ring footing, numerical simulation, three-dimensional simulation, eccentric loads, bearing capacity factor.

ESTIMATING PARTICULATE MATTER (PM_{10}) CONCENTRATION USING REMOTE SENSING TECHNIQUE AND METEOROLOGICAL PARAMETERS OVER TEHRAN

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Abstract

Determination of particulate matter (PM) levels, as one of the most important pollutants, requires dense monitoring stations network in megacities. Extending monitoring network, especially in regions with sparse monitoring sites, needs a significant economic source and may be rejected due to feasibility considerations. During the last decade, remotely sensed atmospheric data are known as a cost- effective way with appropriate and comprehensive spatial and temporal coverage to estimate ground-based PM concentrations. In this regard, aerosol optical depth (AOD), which represents the amount of aerosol in the column of atmosphere, was used as an independent satellite derived product to predict PM values in monitoring stations. Also, meteorological variables can be used as auxiliary parameters to improve model performance during validation period.

In this study, a statistical model was developed using AOD along with effective meteorological parameters to estimate ground level of PM_{10} (particulate matters with aerodynamic diameter less than 10μm). AOD was extracted from 6 collections 6 of Moderate Resolution Imaging Spectroradiometer (MODIS) by 3 km spatial resolution over Tehran during Marchof 2009. Meteorological variables can specify vertical distributions in atmospheric November column and optical properties of PM, and they are capable to improve AOD and PMs relationship. So, to improve the model performance, model it is developed by meteorological parameters. The meteorological parameters were collected from synoptic stations in Tehran, every 3 hours, during the study period. The linear mixed effect model was fitted into all independent variables to examine their influence on PM_{10} concentrations. The results showed that the proposed model could explain concentration accurately with relative high correlation coefficient of the variation of daily PM_{10} (R^2 = 0.77). Statistical model performance was acceptable during cross validation with 0.88 (R^2 = 0.61). The model had the best performance during correlation coefficient of 0.78 autumn with root mean square error (RMSE) of 15.4$\mu g/m^3$, while the worst one occurred in summer with RMSE of 19.3$\mu g/m^3$.

Key Words: Remote sensing, PM_{10}, AOD, mixed effect model, MODIS.

EVALUATING THE EFFECTS OF AIR POLLUTION ON MORTALITY RATE AND LIFE EXPECTANCY USING DOSE-RESPONSE FUNCTIONS AND PRIORITIZING HAZARDOUS POLLUTANTS (CASE STUDY: MASHHAD, IRAN)

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Abstracts of Papers in English

DETERMINATION OF N_γ BEARING CAPACITY FACTOR FOR RING FOOTINGS OVER GRANULAR SOILS WITH ECCENTRIC LOADS USING THREE-DIMENSIONAL NUMERICAL SIMULATION

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Abstract

Nowadays, ring footings are used widely in the civil engineering projects especially in structures with centric geometry. Among them, Telecommunication towers, water or oil tanks, bridge piers, and on shore structures are some examples. In addition to vertical or gravitational loadings, ring footings are implied by moments imposed by lateral loadings and hence, the ring footings are loaded by eccentric loads. In the literature review of bearing capacity of ring footings, there are many researches in which the vertical bearing capacity of such footings is studied and investigated in numerical, analytical and experimental categories. However, few researches exist for eccentric load of such footings. In the present paper, the N_gamma factor, which is one of the bearing capacity factors is determined by using numerical simulations for the ring footings rested on granular soils. Due to the essence of the problem, three-dimensional analysis is applied using finite difference method. Since a bearing capacity problem was only a function of plastic parameters of the soil including internal soil friction angle and cohesion, the so-called linear elastic- perfectly plastic Mohr-Coulomb model was used in the simulations. Associated flow rule was assumed in the simulations because the variation of soil dilatancy angle was aimed to be ignored and that a rule could be found among the results. These Interface elements were considered in the simulations because the partial uplift of the footing was aimed to be modeled under eccentric