Abstracts of Papers in English

IMPROVE PLANNING OF GAS PIPELINE CONSTRUCTION PROJECTS

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DOI:10.24200/J30.2021.54796.2680

Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 3-9, Original Article

- Received 29 February 2020; received in revised form 15 November 2020; accepted 16 January 2021.

Abstract

Construction projects in the oil and gas sector require a heavy budget and a long construction time. As construction projects become larger and more complex, new planning methods are needed. The use of traditional planning methods for project management has not been responsive, and most projects face problems such as widespread delays, cost overruns, rework, wastage, and inadequate resource utilization. One of the challenges of oil and gas projects is the issue of delay and inadeqate resource utilization. Traditional planning techniques such as Critical Path Planning or PERT do not meet all linear projects' requirements. Planning for construction projects is often performed in a critical manner. In this way, the impact of resources and machinery is not well understood, and the uncertain nature of construction projects is not applied. In linear projects, similar activities are repeated in different positions. Pipeline construction projects require effective planning to ensure maximum utilization of resources and reduce time outage due to the constant movement of resources and ma-

chinery. Completing projects at a specified cost and time requires proper planning that the project can deliver on time. The current research introduces a framework to improve gas pipeline project planning using modern computer tools such as construction simulation. This framework aims to examine the impact of the number of resources on the project process, estimate realistic project duration, increase resource productivity, carefully evaluate construction operations, and ultimately reduce project time and cost. This framework would enable project employers and contractors to have greater flexibility in planning discussions and increase their supervisory capacity. The framework is presented in collaboration with the Iranian Gas Engineering and Development Company in the form of a case study of the Dehgolan to Miandoab gas transmission pipeline.

Key Words: Gas pipeline, construction, planning, simulation, time, cost, linear project.

DAMAGE DETECTION OF PILES IN A PILE-SUPPORTED WHARF USING THE ENERGY DENSITY FUNCTION OF A SIGNAL

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 11-21, Original Article

- Received 30 June 2020; received in revised form 26 December 2020; accepted 9 January 2021.

Abstract

Marine structures are exposed to harsh sea environments. These structures may suffer physical damages such as collision, explosion, and chemical ones like corrosion during their exploitation. Diagnosis of damages and their repair in these important structures increase their service life. To find the damage to a structural system, it is necessary to consider its effects. According to the theory of structures, the static and dynamic responses of any structure are related to its stiffness. As a result, any sudden change in the stiffness is accompanied by a change in the static and dynamic responses of the structure; thus, it is possible to detect the probable damage in a structural system by changing its responses before and after the damage. Extreme importance of civil structures on the one hand and their expensive maintenance costs on the other hand have led researchers to strive to find more accurate and useful methods for detecting structural damage to their early stages of occurrence. In this regard, wavelet transform, which is a powerful mathematical tool for signal processing, has attracted the attention of many researchers in the field of health monitoring. In this study, based on laboratory and numerical modeling, the damage detection process in the piles of a dolphin wharf was evaluated using wavelet energy that had high sensitivity to minor changes in a vibration signal. Also, without extracting the analytical equation of the damage index, the exact location of the damage is determined directly by calculating the continuous wavelet transform energy density (Scalogram). Evaluation of the results demonstrated that the proposed method in multiple damage simulation scenarios accurately predicted the location of three damages without any additional errors. While estimating the location of damages is accompanied by error in other methods. Comparison between the results obtained from the proposed method and laboratory results demonstrates the capability of the introduced method to detect multiple damages by calculating the continuous wavelet transform energy density.

Key Words: Dolphin wharf, wavelet transform, damage detection, scalogram.

DETERMINING THE OPTIMAL PATH OF WATER DISTRIBUTION SYSTEM USING AHP BASED ON INTEGRATED GIS AND BIM MODEL

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 23-32, Original Article

• Received 9 August 2020; received in revised form 16 January 2021; accepted 7 February 2021.

Abstract

One of the most important challenges of construction projects is building information modeling (BIM) technology in infrastructure projects such as road projects, water distribution system, power plant projects, etc. The use of BIM in infrastructure projects has been less considered in previous studies. Based on BIM and GIS's advantages, the integrated model of these two technologies can facilitate the decision-making process in the planning, design, and construction phases. The purpose of this paper is to present an algorithm for finding an appropriate pipeline path using the Analytical Hierarchical Process (AHP) and based on integrated GIS and BIM Data in model. In this study, BIM and GIS concepts, combining these two systems in previous research, and their application in infrastructure projects are studied. Then, according to the considered parameters and experts' opinions and the integrated BIM and GIS model, the most appropriate pipeline path in a water distribution system is determined based on the AHP method. The results of this study indicate that the shortest path is not necessarily the best pipeline path. Because different criteria are involved in determining the optimal path and all should be considered in selecting the appropriate pipeline path.

Key Words: BIM, GIS, AHP.

INVESTIGATION THE EFFECT OF TOP STIFFENING RING ON THE BUCKLING CAPACITY OF THIN-WALLED STEEL STORAGE OPENED-TOP TANKS SUBJECTED TO LOCAL SETTLEMENT

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 33-39, Original Article

• Received 26 August 2020; received in revised form 27 December 2020; accepted 16 January 2021.

Abstract

Thin-walled steel storage tanks are used for an extensive array of engineering applications such as urban resource water, petroleum industry, and nuclear power plants for storing variety of liquids, e.g. water, gas, and petrochemicals. The ratio of the radius to the thickness of these tanks is about 5 00to 0000, and the height to radius ratio is about 0.5 to 0.0.The support beneath the tank may lose the bearing capacity in some areas, with the primary reason for this being geometrical misfits, poor soil conditions, ununiformed applied load. Additionally, foundation unevenness, change of ground topology, and foundation subsidence beneath a steel tank can all lead to the development of support settlement of tanks, with tank support settlement being variously categorised as uniform settlement, tilting, and local settlement. After compacting the substrate, these tanks are supported on a concrete foundation using a concrete ring.

Thin-walled steel tanks are used in various industries to store oil and gas condensate. These tanks are supported on a concrete foundation by compacting the substrate. This foundation may lose its load-bearing capacity and settle in a part of the reservoir foundation due to non-uniform geometry or improper soil compaction under the foundation or uneven distribution of load applied to the foundation. Possible settlements are including a uniform, tilt of plan and non-uniform. Non-uniform local settlement is one of the most common and destructive types tanks settlement. In this study, the effect of local settlement on the buckling capacity in the tank with and without stiffening ring was investigated in laboratory and numerical. The results showed that the stiffening ring has an effective role in increasing the parameters of toughness, maximum equivalent load and initial stiffness. It increases the toughness by 98%, the maximum equivalent load by 58% and the initial stiffness by 101%. The presence of stiffening ring also plays a very important role in controlling radial displacements. As by preventing the radial displacement of the upper edge increases the buckling and post-buckling capacity of the tanks.

Key Words: Thin-Walled tanks, local settlement, buckling, stiffening ring, radial displacement.

ESTIMATION OF DAMAGE SEVERITY IN RIGID CONNECTION OF STEEL MOMENT FRAMES USING THE PROPER ORTHOGONAL DECOMPOSITION AND THE PSO OPTIMIZATION ALGORITHM

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 41-50, Original Article

- Received 5 September 2020; received in revised form 2 January 2021; accepted 16 January 2021.

Abstract

One of the most important issues in damage detection is determining the severity of damages. Speed and accuracy in determining the severity of damages depend on the measurement noise. Using the proposed method, damage severity of damaged connections has been calculated in the presence of noise in a faster and more accurate fashion. In the proposed method, instead of using several natural mode shapes, only first proper orthogonal mode shape is used and the damage severity of the rigid connections of moment frames is calculated with acceptable accuracy. Several numerical examples and a laboratory model have been studied to prove the performance of this procedure. The results show that this method has acceptable accuracy and speed to estimate the damage severity in the rigid connections of steel moment frames.

The proposed method is based on the finite element model updating method and the objective function is based on the difference between the proper orthogonal decomposition mode shapes of the intact and damaged structures. In the proposed procedure, the wavelet transform is used to reduce the noise in the displacement history of the structure. An optimized image processing method has been used to record structural displacements in the laboratory sample. To optimize the objective function, the particle swarm optimization method has been used. Two numerical scenarios have been studied using the finite element model of a three-story, three-span steel moment frame structure. Also, three laboratory scenarios have been studied on the three-story one-span steel moment frame laboratory model. In this paper, the exact location of the damaged connections is determined using the optimized mode shape curvature difference method. The effects of noise on the accuracy and efficiency of the proposed method are considered. Numerical scenarios have been studied at three noise levels. The proper orthogonal decomposition mode shapes are calculated using the free vibration of the structure under initial displacement.

Key Words: Damage detection, damage severity, proper orthogonal decomposition, particle swarm optimization algorithm, moment frames rigid connection.

INVESTIGATION OF SHEAR AND STATIC PULLOUT BEHAVIOR OF GEOCOMPOSITE EMBEDDED IN TWO-LAYERS SOIL

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 51-62, Original Article

- Received 4 October 2020; received in revised form 13 February 2021; accepted 7 March 2021.

Abstract

Cost-effectiveness, fast performance, and relatively long service life have made geosynthetics widely used in geotechnical structures such as road pavement, retaining walls, slope stabilization and foundations, bridge abutments, embankments or at the boundary between embankments and subgrade to be used. The soil geocomposite used in this research, which is made in Iran under the brand name of GC Soil 40/40, is a combination of geogrid and geotextile and is used in various projects such as embankment bed reinforcement and separation to implement embankment on fine and loose subgrade. In general, in the design of geosynthetics, including soil geocomposites, interaction mechanisms including slip and pullout as well as interaction coefficient between soil and geosynthetic should be considered. Accordingly, to evaluate the soil-geocomposite interaction, direct shear and pullout tests were performed in one-layer soil (sand-geocomposite and gravel-geocomposite) and two-layers soil (sand-geocomposite-gravel) under different vertical stresses. The results of direct shear tests showed that reinforcing the soil with geocomposite reduced the angle of friction and increased soil adhesion. Despite the increase in shear stress and pullout resistance with increasing vertical stress, the interaction coefficients decrease with an increase in the vertical stress. This issue can be related to the nonlinear behavior of pullout force and soil-geocomposite shear stress with vertical stress. Vertical stress is an effective factor to increase the pullout resistance and type of mode geocomposite rupture and also has a significant effect on the displacement at

the maximum pullout resistance. The results showed that under the same loading conditions, the placement of the geocomposite on the common surface of the two layers soil changes the pullout behavior compared to the one-layer soil. In general, it can be stated that the soil-geocomposite interaction, in addition to vertical stress, is sensitive to the type and size of soil particles, one- and two-layers of soil. For sand-geocomposite and gravel-geocomposite interfaces, the average coefficients of interaction (c_i) for direct shear are 0.8 and 0.91, respectively. Also, the average pullout interaction coefficients (f_b) for sandy and gravel soils reinforced with geocomposite (one-layer) are 0.35 and 0.47, respectively, and this coefficient is obtained as the average of 0.51 for sand-geocomposite-gravel (two-layer).

Key Words: Large scale direct shear test, Pullout test, One-layer soil, Two-layers soils, soil-geocomposite interaction.

ULTIMATE SHEAR STRENGTH OF UNSTIFFENED LONG WEB PANELS AT HIGH TEMPERATURES

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 63-73, Original Article

- Received 10 October 2020; received in revised form 23 November 2020; accepted 3 January 2021.

Abstract
Following the collapse of the World Trade Center towers, investigating the building resistance and providing the safety of residents in case of fire have attracted the attention of engineers more than ever. In this regard, similar to buildings, gas and liquid containment structures, vehicles, planes, and vessel fuselages are examples of engineering usage which need to be designed against fire. It was shown that inelastic or elastic buckling of steel plate webs, that experience plastic buckling at normal temperatures, is a possible phenomenon at elevated temperatures owing to the deterioration of mechanical properties, i.e., a change in the failure mode, is to be expected. Therefore, regarding the importance of the issue and its application in the industry, it is necessary to investigate the behavior of the I-shaped plate girders against fire. In this research, shear behaviors of long steel plate girder web panels subjected to pure shear loading are investigated at elevated temperatures by the nonlinear finite element method. Therefore, web panel shear design relationships mentioned in AISC360-16 specification is modified to be used in fire conditions. This is achieved by direct utilization of steel stress-strain reduction factors in EN1993-1-2 at elevated temperatures. It is observed that the adopted equation of AISC360-16 for fire situations yields values that are more non-conservative such that the difference reaches almost 18%. On the other hand, AISC equations are more accurate and in the safe region for compact plates. However, these equations lead to the unsafe condition at higher slenderness values. In this regard, nonlinear finite element analysis results were employed to modify the AISC 360-16 equation for predicting the ultimate shear strength of long steel plate girder web panels by considering the strength degradation caused by high slenderness, high temperature, and initial geometrical imperfections. Comparison of the results corroborated the appropriate accuracy of the proposed equations.

Key Words: Shear strength, fire, plate slenderness, steel plate girder, long web pan.

THE EFFECT OF PRECOMPRESSION ON ADHESION BETWEEN CONCRETE AND FIBER-REINFORCED MORTARS AND ASSESSMENT OF COMPRESSIVE STRENGTH OF MORTARS USING IN-SITU TESTS

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 75-84, Original Article

- Received 24 October 2020; received in revised form 9 January 2021; accepted 14 February 2021.

Abstract
The interface area between substrate concrete and repair mortars is of great importance. Shrinkage and incorrect

compaction of the mortar causes fine cavities, and consequently, the bond strength decreases at the interface area. Therefore, in this paper, the influence of different precompressions on the shear and tensile bond strength between polypropylene fiber-reinforced mortar and substrate concrete has been investigated. Friction-transfer and pull-off tests were applied to measure shear and tensile bond strength, respectively. Furthermore, the effect of polypropylene fibers on shrinkage and bond strength is presented. Subsequently, using photography and analysis by Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) pattern, the effect of polypropylene fibers and precompression on the bond strength between fiber-reinforced mortars and the concrete substrate has been studied. Moreover, the compressive strength of fiber-reinforced mortars was evaluated by using semi-destructive in-situ tests. In addition to determining the correlation coefficient between in-situ tests and laboratory tests, calibration diagrams, and transformation equations of records obtained from semi-destructive tests to the mortar compressive strength, are presented. Finite element software ABAQUS has also been used to model the tests mentioned above and compare the outputs with laboratory results. The gained results reveal a positive effect of precompression on the bond strength between concrete and the repair layer. Polypropylene fibers also reduce the shrinkage of mortars and hence increase adhesion. In the XRD test, it was observed that adding polypropylene fibers to the mortar diminishes calcium hydroxide and thus increases calcium silicate hydrate, which has a positive effect on the properties of the mortar. Besides, the SEM photos reveal that the process of hydration and formation of calcium silicate hydrate (C-S-H) gel in the fibers' vicinity is carried out well and has made a better uniformity to the mortar composition. The results of numerical modeling are highly consistent with laboratory results. Due to the high correlation coefficient between in-situ and laboratory tests, it is possible to evaluate fiber-reinforced mortars' compressive strength by using friction-transfer and pull-off tests.

Key Words: Precompression, in-situ tests, adhesion, fiber.

NEW STRESS FORMULATION IN X-FEM BASED ON NUMERICAL INTEGRATION OF RESTORING FORCES USING EQUIVALENT POLYNOMIAL FUNCTIONS

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 85-98, Original Article

- Received 15 November 2020; received in revised form 21 November 2020; accepted 7 December 2020.

Abstract

In this study, stress formulas in the extended finite element method are investigated. The stress components for the enriched DOFs are developed and conventional stress components of the standard DOFs are modified. The modified stresses for the standard DOFs have a unique value for the whole domain of the cracked element, whereas the stress components for the enriched DOFs have different values at each side of the crack faces. New formulations are obtained by investigating the restoring forces equations. To do so, new polynomial functions are developed by eliminating the element partitioning when the shifted Heaviside function is utilized. The proposed stress formulas are verified by the force convergence criterion. It is shown that the proposed formulations for the standard DOFs are more compatible with the characteristics of the crack propagation within the cracked body and the stress components for the enriched DOFs represent the tractions at the crack faces, although properties of material nonlinear behavior are not considered. It is proven that the internal forces calculated utilizing the proposed formulation are in equilibrium with the external loads.

Key Words: Extended finite element method, material discontinuity, numerical integration, restoring force, stress formula.

DEVELOPMENT OF FRAGILITY CURVES FOR SELF-CENTERING BAE-ROCKING WALLS SUBJECTED TO FAR AND NEAR FIELD GROUND MOTIONS

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 99-110, Original Article

- Received 26 December 2020; received in revised form 6 February 2021; accepted 14 February 2021.

Abstract

Nowadays, modern lateral-resisting systems capable of reducing residual displacements and post-earthquake costs have gained much more attention. Self-centering lateral load-resisting systems reduce repair costs and allow immediate occupancy by concentrating damages on fuse elements. Self-centering base-rocking concrete shear wall (SC-BRW) is one of the innovative self-centering seismic systems. In the present study, the probabilistic behavior via fragility curve of this system was investigated under three sets of seismic records including 22 Far-Field (FF) ground motions and 28 Near-Field (NF) ground motions half of which are Pulse-like (Pulse). These ground motions were used for nonlinear incremental dynamic analysis of structures with 4, 8, 12, 16, and 20 floors. Numerical modeling was conducted via OpenSEES software in a two-dimensional space. The results of fragility curves showed that short SC-BRWs subjected to NF-Pulse ground motions and tall SC-BRWs subjected to Far-Field (FF) and NF without Pulses (No Pulse) ground motions were more vulnerable. Due to the effects of high modes, the values of moment and shear in the middle of the height than the base of the structure increased with increasing the height of the structures. Increased moments in the middle height compared to the base are observed in tall walls under FF and NF-No Pulse ground motions. Also, increase in the moments is not observed in the case of short and tall SC-BRWs subjected to NF-Pulse at the mid height. The increased moment of the wall of a 20-story SC-BRW subjected to FF and NF-No Pulse ground motions at the level of CP performance is 46 and 39%, respectively. According to the results of the analyses, the residual inter-story drift values for SC-BRWs are negligible. In this respect, the maximum amount of residual inter-story drifts in the 20-story structure under far-field ground motions was about 0.0011 at the CP performance level. Finally, the NF-Pulse ground motions created a greater stress ratio than other seismic records in prestressed tendons.

Key Words: Self-centering system, rocking wall, fragility curve, incremental dynamic analysis, replaceable fuse.

A REVIEW OF DIFFERENT APPROACHES TO ANALYTICAL MODELING OF SOIL-WATER RETENTION CURVES

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 111-123, Review Article

- Received 18 October 2020; received in revised form 10 January 2021; accepted 16 January 2021.

Abstract

Soil-water retention curve describes the relationship between soil suction and soil water content. It has a wide range of applications from the predication of unsaturated shear strength to transient two-phase flow and stability analyses. All physically possible sets of retention curves for a soil with specified state parameters are bounded by the two main drying and wetting curves corresponding to the upper and lower bounds, respectively. As a result, the characterization of these two boundary curves as well as the hydraulic hysteresis is of great importance in problems related to both geo-environmental and hydro-geological fields of research. However, direct measurement of the soil-water retention curve requires advanced laboratory equipment and high expertise. In addition, the experimental output has discrete nature and is usually limited to low suction ranges compared with the theoretical full range. In other words, direct incorporation of experimental data to numerical flow and stability analysis becomes impossible; thus, continuous mathematical modeling is inevitable. Consequently, there has always been great interest in the analytical modeling of soil-water retention curves. No thorough study can be found in the literature so far to collect and revisit the pros and cons of various analytical modeling approaches to simulation of this key hydro-mechanical feature. Therefore, the main objective of the current study is to provide a comprehensive review of all available modeling philosophies with emphasis the capabilities and fundamental limitations of each approach. The paper is especially distinctive in classifying all current approaches under seven categories and in providing insights into the general framework of each one. Eventually, a discussion, highlighting the shortcomings and essential modelling needs, is provided to shed light on potential research directions in future.

Key Words: Soil-water retention curve, drying curve, wetting curve, hydraulic hysteresis, analytical modelling.

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF FRACTURE AND BUCKLING BEHAVIOR OF CHOPPED GFRP CYLINDRICAL SHELLS SUBJECTED TO AXIAL COMPRESSION LOAD

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 125-134, Research Note

- Received 31 August 2020; received in revised form 9 January 2021; accepted 8 January 2021.

Abstract

Due to their attractive mechanical properties such as higher strength-to-weight and stiffness-to-weight ratios, instead of conventional isotropic materials, Fiber Reinforced Polymer (FRP) cylindrical shells are being increasingly used in various engineering applications such as aerospace, oil tanks, liquid storage vessels, and silos. Cylindrical shells may experience axial compression load due to primary loading conditions. For a shell with a closed roof, axial compression load is caused by the weight of the roof. In addition, many shells under other loading conditions can also induce either symmetrical or unsymmetrical axial compression loads. The buckling and failure analysis of cylindrical shells made of composite materials is a complex task when compared to the cylindrical shells made of isotropic materials. There are two main failure modes in the composite cylindrical shells subjected to axial compression load, one associated with material strength of the cylinder wall and the other with buckling of the cylinder wall. This study deals with the behavior of chopped Glass Fiber Reinforced Polymer (GFRP) cylindrical shells subjected to axial compression load with an experimental and numerical procedure. Three specimens were used with the same R/t ratio. In the laboratory, the axial compression load was applied by a vertical hydraulic jack. In order to measure the deformation of the cylindrical specimens during the loading, four Linear Voltage Differential Transformers (LVDTs) were used. The nonlinear static analysis method (Riks) using the ABAQUS/Standard software has been employed, considering the boundary and geometric imperfections. For modelling the cylindrical specimens shells, the four-node quadrilateral element (S4R) was used. The critical load and failure mode were determined using Hashin's failure criteria. The effects of the L/R ratio on these shells are examined. Results indicate that the failure mode of these specimens was material failure because of high thickness-to-radius ratio. In addition the stiffness of the cylindrical shell specimens decreases with increasing the height. The comparison between the experimental results and Finite Element Analysis (EFA) exhibited acceptable adaptation.

Key Words: Critical compression load, chopped glass fiber, riks analysis, failure mode.

STUDY ON THE EFFECTS OF POLYPROPYLENE FIBERS ON THE SPLITTING STRENGTH, STRAIN CAPACITY AND ENERGY ABSORPTION OF ROLLED COMPACTED SEMI-LIGHTWEIGHT CONCRETE WITH APPLICABILITY IN CONCRETE BLOCKS

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 135-141, Research Note

- Received 27 September 2020; received in revised form 9 January 2021; accepted 31 January 2021.

Abstract

This study aims at improving the tensile behavior of concrete blocks by adding polypropylene fibers to the concrete mixture. For this purpose, 84 cylindrical and cubic specimens were constructed and tested under tensile splitting and compressive force. Three variables of fiber dosage, cement content, and fiber type were taken into account to study the sensitivity of splitting strength, strain capacity, compressive strength, and energy absorption to these variables. The results show that the specimens without fibers experienced a sudden non-ductile failure, whereas this is not the case for the specimens with added fibers. All the considered response parameters were improved thanks to the addition of fibers. Generally, the improvement of specimens with micro fibers was better than that of the corresponding

specimens with macro fibers, especially when larger cement content was included.

Key Words: Polypropylene fibers, splitting strength, fiber dosage, cement content, rolled compacted concrete.

AN ALARMING SYSTEM FOR DANGEROUS PROXIMITY SITUATIONS IN CONSTRUCTION SITES BASED ON WORKERS AND MOBILE EQUIPMENT TRACKING

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Sharif Civil Engineering Journal
Volume 37, Issue 3.1, Page 143-151, Research Note

- Received 5 October 2020; received in revised form 23 January 2021; accepted 7 February 2021.

Abstract

The construction industry and workplaces are known as one of the most adventurous and dangerous industries in the world, incurring more occupational fatalities than any other sectors. This has led researchers to pay greater attention to the use of new technologies, such as the Internet of Things (IoT) technology, to improve safety. The IoT is helping many businesses and consumers to be more efficient and effective in day-to-day operations and tasks. It would only be logical to assume that there must be a way that the IoT could do the same for high-risk industries such as the construction industry. In this study, using a smartphone and fingerprint technique on the Wi-Fi network and the Global Positioning System (GPS), a system has been introduced to detect people approaching dangerous places by tracking them and to provide the necessary warnings. The system consists of three software products the first of which is responsible for performing calculations on the cloud server. The second one is installed on the mobile phones of site managers to record the necessary information in the system database. The third software is installed on the mobile phones of workers and has the task of tracking them and receiving the system warnings. In addition, this system is working in indoors and outdoors areas and has other advantages such as ease of operation, low implementation cost, and higher accuracy than other similar systems. In this study, an average detection error of 1.2 meters has been achieved, which is an acceptable error and indicates the correct operation of the system. Using the proposed IoT system in a construction site's safety management system will provide real-time data on critical safety functions. As a result, it also reduces the accidents of the construction site and the costs around incidents, injuries, and workers' compensation.

Key Words: Safety, construction workplace, internet of things, fingerprint technique, GPS.