An experimental study on mechanical properties of concrete containing steel and polypropylene fibers at high temperatures

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ABSTRACT

The use of fibers in concrete improves strength, ductility and durability of concrete. Concrete has fireproofing properties, but rebars are the most important concern of reinforced concrete structures in the event of fire outbreak. Therefore, one of the recommendations to reduce these risks is the use of alternative materials like fibers. In this paper, the effects of different temperatures on the mechanical properties of concrete with different cement contents containing steel and polypropylene fibers were studied. Although the samples were placed under temperatures of 25, 100, 250, 500 and 700 °C, the results revealed that the effects of fire on concrete containing steel fiber is more damaging, and also the compressive and bending strengths at 25 °C and tensile strength at 250 °C have the maximum values.

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Investigation of the behavior of connection of reduced-beam-section steel beam to reinforced concrete column

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ABSTRACT

After recent earthquakes that caused major damages in beam-column connections, scientists and engineers proposed new types of connections to postpone such brittle failures. One of these new connections is the connection of steel beam to concrete column and connection of reduced-beam-section to steel column. However, these new connections have some defects. The aim of this paper is to investigate the combination of RCS and RBS connection and assess the behavior of new combined connection. In this type of connection, a beam with reduced section at the end is connected to a concrete column. In such a detail, the main defect of RCS and RBS connection disappears. The connection was modeled using Abaqus finite element package and the effect of cut of the flange, cover-plate thickness and stiffener thickness in the new system were investigated and compared with those in RCS connection. The results show that cut of flange has a great influence on compressive damage and tensile damage. Furthermore, cut of flange decreases the stress in the cover-plate, stiffener and reinforcements. Increasing the thickness of cover-plate, reduces stress in cover-plate. The use of reduced-beam-section instead of ordinary connection improves the connection overall performance.

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Probabilistic assessment of steel moment frames incremental collapse (ordinary, intermediate and special) under earthquake

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ABSTRACT

Building collapse is a level of the structure performance in which the amount of financial and life loss is maximized, so this event could be the worst incident in the construction. Regarding to the possibility of destructive earthquakes in different parts of the world, detailed assessment of the structure's collapse has been one of the major challenges of the structural engineering. In this regard, offering models based on laboratory studies, considering the effective parameters and appropriate earthquakes could be a step towards achieving this goal. In this research, a five-story steel structure with a system of ordinary, intermediate and special moment frame (low, intermediate and high ductility) has been designed based on the local regulations. In this study, the effect of resistance and stiffness deterioration of the structural elements based on the results of the laboratory models have been considered and the ductility role in the collapse capacity of steel moment frames has been investigated as probabilistic matter. For this purpose, incremental dynamic analysis has been done under 50 pairs of earthquake records proposing FEMA P695 instruction and fragility curves of various performance levels are developed. Results showed higher collapse capacity of special moment steel frame than the intermediate and ordinary moment frames. In the 50 percent probability level, the collapse capacity of special moment frame increased 34 % compared to the intermediate moment frame and 66 % to the ordinary moment frame. Also, the results showed that for different collapse spectral accelerations, the use of special moment frame instead of intermediate and ordinary moment frames reduces the collapse probability to 30 and 50 % respectively.

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Seismic Microzonation of Tehran based on deterministic seismic hazard analysis and seismic indexes around faults

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ABSTRACT

Tehran has situated over several active faults such as Mosha, North Tehran, North Ray and South Ray faults and has experienced strong earthquakes in its history. It is possible the same earthquake occurs and result to large damages and many casualties. In this paper, seismic hazard analysis of Tehran city has been done with deterministic seismic hazard analysis, using specification of Tehran scenario active faults, soil conditions, average shear wave velocity extracted from several researches on Tehran area. To do this, a credible attenuation relation which considers effects of near source that has appropriate adaptation with Iran records has been used. In the following, deterministic seismic hazard analysis considering earthquake at closest distance to each mesh was done. Then, seismic output such as PGA, PGV, PGD and SA for all meshes of Tehran and their soil condition was done for each fault scenario. Then, maximum of seismic index was calculated for each and all scenarios on GIS and the results were evaluated. One of the main results of this article is calculation of seismic indexes near faults, so spectral acceleration near to North Tehran or Ray Faults with soil types I, II and III predicted as 1.2, 1.5 and 2g corresponding to predominant period of short buildings and it means high damages on areas over or near faults.

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A maturity evaluation model for implementing agile management in Iranian building companies with respect to identifications of its challenges

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ABSTRACT

Agile management originally introduced in development of software projects in computer industry but it is applied in different non-software projects because of its success in managing projects. This approach contains some different tools and techniques for working with the dynamic and changeable environment of projects. According to the previous attempts, some investigators believed that the agile management is useful for construction projects and some others do not agree with this statement. The purpose of this paper is, firstly, to identify the challenges of implementing the agile management in the building companies in Iran and the second one is to prepare a model for evaluating the level of the maturity of a company for implementing agile management. The field studies and distributing questionnaires will be applied for the first objective of this paper and for the next purpose, evaluating the maturity level of companies, the authors will use one of the multi-attribute decision making models named TOPSIS. The results show that the level of the maturity of companies should be surveyed separately in each company in three different parts including: engineering, procurement and construction. It means that the level of maturity in these phases is different.

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Estimation of RC columns' response under the effect of lateral blast loading by SDOF method and comparison with FEM

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ABSTRACT

In most of the structural blast-resistant designs and analysis single degree of freedom (SDOF) method is used. Generally, for this method flexural response of the structural members is considered but in axial loaded members, secondary moments (P-δ effects) are also very important. In the case of columns of building structures, which mostly bear significant axial loads, ignoring P-δ effects under lateral blast loading can be very risky. This paper describes a simple way for taking into account P-δ effects and also the effects of high strain rates (which is very important in severe dynamic loading) in SDOF analysis of reinforced concrete columns under simultaneous axial load and lateral blast loading. The resulting responses are compared with explicit finite element analysis using LS-DYNA hydro-code. Proposed SDOF equation of motion is numerically calculated and secondary moment and high strain rate effects are included within the calculation procedure. Secondary moments due to P-δ effects have been considered as equivalent lateral load and strain effects are introduced to the model by dynamic increasing factors for concrete and steel materials. Based on the main results, estimated response of RC column under blast loading using SDOF method has acceptable accuracy compared to LS-DYNA analysis results.

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Simulation of artificial earthquake records compatible with site specific response spectra using time series analysis

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ABSTRACT

Time history analysis of infrastructures like dams, bridges and nuclear power plants is one of the fundamental parts of their design process. But there are not sufficient and suitable site specific earthquake records to do such time history analysis; therefore, generation of artificial accelerograms is required for conducting research works in this area. Using time series analysis, wavelet transforms, artificial neural networks and genetic algorithm, a new method is introduced to produce artificial accelerograms compatible with response spectra for the specified site condition. In the proposed method, first, some recorded accelerograms are selected based on the soil condition at the recording station. The soils in these stations are divided into two groups of soil and rock according to their measured shear wave velocity. These accelerograms are then analyzed using wavelet transform. Next, artificial neural networks ability to produce reverse signal from response spectra is used to produce wavelet coefficients. Furthermore, a genetic algorithm is employed to optimize the network weight and bias matrices by searching in a wide range of values and prevent neural network convergence on local optima. At the end site specific accelerograms are produced. In this paper a number of recorded accelerograms in Iran are employed to test the neural network performances and to demonstrate the effectiveness of the method. It is shown that using synthetic time series analysis, genetic algorithm, neural network and wavelet transform will increase the capabilities of the algorithm and improve its speed and accuracy in generating accelerograms compatible with site specific response spectra for different site conditions.

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Evaluation of composite shear walls behavior (parametric study)

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ABSTRACT

Composite shear walls which are made of a layer of steel plate with a concrete cover in one or both sides of the steel plate, are counted as the third generation of the shear walls. Nowadays, composite shear walls are widely utilized in building new resisting structures as well as rehabilitating of the existing structures in earthquake-prone countries. Despite of its advantages, use of the composite shear walls is not yet prevalent as it demands more detailed appropriate investigation. Serving higher strength, flexibility and better energy absorption, while being more economical are the main advantages of this system which has paved its path to be used in high-rise buildings, structural retrofit and reservoir tanks. In this research, channel shear connectors are utilized to connect the concrete cover to the steel plate. As a key parameter, variation in the distance of shear connectors and their arrangement on the behavior of composite shear walls has been scrutinized. In addition, the shear stiffness, flexibility, out of plane displacement and the energy absorption of the structural system has been explored. For this purpose, several structural models with different shear distances and arrangements have been investigated. The obtained results reveal that with increase in shear connectors' distance, the wall stiffness would reduce while its lateral displacement increases up to eighty percent While the out of plane displacement of the steel plate will reduce up to three times.

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Linear and curvature internal heterogeneous boundaries influences on mixed mode crack propagation using level set method

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ABSTRACT

Interactive crack-internal heterogeneous boundaries have been of a great concern to researchers and engineers. Extended finite element method (X-FEM) has recently emerged as an approach to implicitly create a discontinuity based on discontinuous partition of unity enrichment (PUM) of the standard finite element approximation spaces. The extended finite element method (X-FEM) in the combination with level set method (LSM) has been utilized. In this contribution, predefined cracks and internal boundaries are created without meshing the internal boundaries. Soft/hard circular inclusions (interfaces), voids and linear interfaces are considered as internal discontinuities. In addition, the stress intensity factors for mixed mode crack problems are numerically calculated by using interaction integral approach. The interaction integral method is based on the path independent J-integral. The 4-noded rectangular element is considered to discretize the assumed plates. The effects of shape, size and schemes of internal boundary distributions are numerically simulated. The results are shown that the crack paths are attracted to soft internal boundaries and move away from the hard internal boundaries. Also, the influences of internal voids are much more than inclusions. In addition, the linear internal interface has affected the crack growth paths entirely and is created a complicate crack path. All numerical examples are demonstrated the flexibility and capabilities of X-FEM in the applied fracture mechanics.

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Evaluation of bending moment and deflection of cantilever supported excavations

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ABSTRACT

In many conditions, because of several restrictions, cantilever walls are the only way to stabilize the excavations. It is no doubt that one of the most important parameters in design of such walls is wall stiffness. Therefore, in this study, a large number of case histories are collected and the most commonly used range of wall thickness and stiffness are determined based on this database. In addition, validation of limit equilibrium method (LEM) in granular soils showed that this method can only estimate bending moment of rigid walls. Therefore, for more accurate estimating, a new equation is presented for the most commonly used range of wall stiffness and various types of granular soils. Moreover, LEM based equation is replaced with a modified version. The new equation was successfully validated using 70 numerical models and results lied in range of 85% to 115% times the predicted values obtained from FEM. According to the results, in loose and very loose soils, the common cantilever walls can only stabilize the excavations with depth less than 10 m. While if depth is more than 15 m, soil type should be dense or very dense with "E" more than about 70 MPa. The results also show that the effect of wall stiffness is negligible in bending moments less than 2000 kN.m.

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Improving the seismic performance of eccentrically braced frames by using a ductile element

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ABSTRACT

Stability of structures against earthquake is much important to prevent total or partial failure of structures and loss of financial and human investments of people and country. Eccentrically braced frames, as one of the most commonly used earthquake resistant systems, with good ductility and toughness, have different arrangements; one of them is Link beam-to-column connection. This type of connection was considered as bending form before the North Ridge earthquake (1994). But conducted research after the North Ridge Earthquake showed that the link beam-to-column connections were subjected to brittle failure, similar to connections which were located in Moment frames. So, after the North Ridge Earthquake, researchers began looking for ways to improve these types of connections, which indicates necessity of research in this field more than before. In this study, a new type of Energy absorption was introduced. This absorption consists of a ring which increases the ductility and energy absorption of earthquake and a box to increase the bearing capacity which is connected to the ring through connection plates. for evaluating the performance of the proposed elements in steel frames with eccentrically braces, under nonlinear time history analysis, the OpenSees software has been used. The obtained Hysteresis curves suggest that introduced element can act as an energy absorbing member and a fuse to Reducing damage to structures with reduced rotation of link-beam, Cutting base and Relative story displacement in addition to providing the necessary ductility.

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Steel bridges structural health monitoring based on operational modal analysis accommodating evaluation of uncertainty

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ABSTRACT

Structural damage detection is based on that the dynamic response of structure will change because of damage. Hence, it is possible to estimate the location and severity of damage leads to changes in the dynamic response before and after the damage. In this study, the genetic fuzzy system has been used for bridge structural health monitoring. A key objective of using genetic algorithms is to automate the design of fuzzy systems. This method is used for damage detection of a single span railway bridge with steel girders and a concrete bridge. For studying damage detection, the numerical models of these two bridges are built with the measured dynamic characteristics. A three-dimensional finite element model and a single two-dimensional girders model of the bridge have been constructed to study usefulness of the genetic fuzzy system for damage detection and the effectiveness of modeling. After analysis to control the uncertainties, the measured frequencies are contaminated with some noise and the effect of that on the achievement of damage detection method is evaluated. The present study has shown that the natural frequency has appropriate sensitivity to different damage scenarios in the structure. In addition, the natural frequency in comparison with other modal parameters, is less affected by random noise. Increasing the number of measurement modes and using torsional modes, will lead to an accurate damage diagnosis even in symmetrical structures.

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