Technical note: Risk detection in light steel frame buildings in design, construction and implementation phases

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ABSTRACT

Light Steel Frame System that is briefly called "LSF" is a building system which is used for implying of short-rise and mid-rise buildings (up to five floors). It is a desirable building system for civil engineers (in terms of gravity and lateral load) in developing countries. This system gets significant benefits, although in Iran it is not much used due to the reasons such as: opposite with people's culture, higher price in, lack of specialists, executive problems and etc. So in this article, we are tried to study LSF structures from the design and implementation stage to the operation and identify its risks exactly and finally offer a solution for each risk. Risk detections process is executed with interview technique in the Mashhad city and countryside. Totally, 56 projects are examined in this research. The study projects have been classified here. This classification includes residential buildings, villas, added-storey, schools, administrative, commercial, fastfood, industrial structures and LSF non-load-bearing walls. All the mentioned projects have been implemented in holy city of Mashhad or will be implemented in the future. Designers, administrators and employers are interviewed in person in all the above projects. Because of novelty of this system and its unknown risks, this research can be useful for managers decision making and for executing engineers in the field of choosing the best system for project and adoption of appropriate method for preventing these risks.

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The effect of rebar coating types on bars corrosion of self-compacting concrete

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ABSTRACT

In this paper the effect of different coating types of rebar on bars corrosion and durability of self-compacting concrete structures in Oman Sea (Chabahar port) are investigated. Self-compact concrete samples with three types of coating include 40 and 60 micron of zinc, epoxy and uncoated with 3,5 and 7 cm thickness of concrete cover were made and cured according to the related standards in tidal, submerged and atmospheric conditions for 14 months. Compressive strength test according to Standard BS 1881 part 116, water absorption according to Standard BS 1881 part 122, permeability test under water pressure according to Standard DIN 1048, permeability of chloride ion according to Standard ASTM C1152, electric resistance Cabera and corrosion potential according to ASTM G876 and bar weight loss were performed at different ages of samples. The results of weight loss and corrosion experiments indicate better performance of concrete with epoxy and zinc coated bar comparing to uncoated samples at different conditions. Also, 40 micron zinc coating decreased the weight loss of bars about 10 percent comparing with uncoated bars. The epoxy coating was decreased the weight loss about 4-8% on different samples. It should be noted that the increase of concrete cover from 3 to 5 and 7 cm decreased the weight loss from 34 to 27 and 21%.

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Study on seismic behaviour of integral concrete bridges with different skew angles through fragility curves

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ABSTRACT

Bridges are key elements in urban transportation system and should be designed to sustain earthquake induced damages to be utilized after earthquake. Extensive damages during last earthquakes highlighted the importance of seismic assessment and damage estimation of bridges. Skewness is one of the primary parameters effects on seismic behavior of bridges. Skew bridges are defined as bridges with skew angle piers and abutments. In these bridges, the piers have some degrees of skewness due to construction restrictions, such as those caused by crossing a waterway, railway line or road. This paper aims to investigate seismic behavior of skew concrete bridges using damage criteria and estimate probability of piers damage with fragility curves. To this end, three types of concrete bridges with two, three and four spans and varying skew angles of 0^0 ,10^0, 20^0 and 30^0 are modeled with finite element software. Seismic responses of bridge piers under 10 earthquake ground motion records are calculated using incremental dynamic analysis. Following, damage criteria proposed by Mackie and Stojadinovic are used to define damage limits of bridge piers in four damage states of slight, moderate, extensive and complete and bridge fragility curves are developed. The results show that increasing skew angles increases the probability of damage occurrence, particularly in extensive and complete damage states.

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Assessment of aggregates- cement paste border in concretes containing silica fume and fly ash

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ABSTRACT

The bond between aggregate and cement paste, called the interfacial transition zone (ITZ) is an important parameter that effect on the mechanical properties and durability of concrete. Transition zone microstructure and porosity (pores) of cement paste or concrete are affected by the type and properties of materials used which evaluated in this research. On the other hand, the use of efficient, low-cost and reliable method is particularly important for evaluating of concrete performance against the chloride ion penetration and its relationships with transition zone as a suitable index to assess the durability. So far, various methods to approach the electrical Indices are presented. In this research, the effect of pozzolanic materials fly ash (10%, 20% and 30%) and silica fume (5% and 10%) as substitute of cement by weight in binary and ternary mixtures on the fresh and hardened concrete properties were investigated. To determine mechanical properties, the compressive strength, splitting tensile strength and modulus of elasticity tests were performed. Also, water penetration depth, porosity, water sorptivity, specific electrical resistivity, rapid chloride penetration test (RCPT) and rapid chloride migration test (RCMT) tests were applied to evaluate concrete durability. To examine the border of aggregate and cement paste morphology of concrete specimens, scanning electron microscope images (SEM) was used. The fresh concrete results showed that the presence of silica fume in binary and ternary mixtures reduced workability and air content but fly ash increased them. Adding silica fume to mixtures of containing flay ash while increasing mechanical strength reduced the porosity and pores to 18%. The presence of pozzolanic materials in addition to increasing bond quality and uniformity of aggregate-cement matrix border a considerably positive effect on the transport properties of concrete.

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Effect of soil-structure interaction on the seismic behaviour of pedestal-structure system in large dish antennas

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ABSTRACT

Regarding the progressive improvement in the territory of Space Technology in all developed countries and consequently developing countries including Islamic Republic of Iran, the optimization of design and utilization of the communication equipment has been paid more attention today. For instance, considering recent highly innovative methods, specifically in communication field, developed for design, manufacturing and exploiting dish antenna for specific cases, cooperation of other science and technology experts, like civil engineers, is also necessary. In this way, more delicate design procedure in order to satisfy communication requirement, is achieved. So far, no specific investigation about aforementioned subject, especially the effect of soil-structure interaction (SSI) in analysing the seismic behaviour of communication large dish antennas has been conducted in Iran. In this paper, with the aim of investigating the effect of SSI on seismic behavior of pedestal, first an acceptable range for antenna displacement – as the most important parameter in pedestal structure for antenna – in both operational and survival states, has been calculated numerically based on generic formula. Secondly, the modelling of the whole pedestal-structure system has been modelled subjected to the associated loads and other primary conditions. This procedure has been performed once without considering the SSI and once more with it. Comparison of the obtained results shows that considering the SSI would impress the output results with a difference rate more than 50% and 600% respectively at survival and operational condition.

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Nonlinear static analysis of steel frames with semi rigid beam to column connections using cruciform element

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ABSTRACT

In the steel frames, beam-column connections are traditionally assumed to be rigid or pinned, but in the steel frames, most types of beam-column connections are semi-rigid. Recent studies and some new codes, especially EC3 and EC4, include methods and formulas to estimate the resistance and stiffness of the panel zone. Because of weaknesses of EC3 and EC4 in some cases, Bayo et al. proposed a new component-based method (cruciform element method) to model internal and external semi-rigid connections that revived and modified EC methods. The nonlinear modelling of structures plays an important role in the analysis and design of structures and nonlinear static analysis is a rather simple and efficient technique for analysis of structures. This paper presents nonlinear static (pushover) analysis technique by new nonlinearity factor and Bayo et al. model of two types of semi-rigid connections, end plate connection and top and seat angles connection. Two types of lateral loading, uniform and triangular distributions are considered. Results show that the frames with top and seat angles connection have fewer initial stiffness than frames with semi-rigid connection and P-Δ effect more decreases base shear capacity in the case of top and seat angles connection. P-Δ effect in decrease of base shear capacity increases with the increase of number of stories.

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Shear strength estimation of the concrete beams reinforced with FRP; comparison of artificial neural network and equations of regulations

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ABSTRACT

In recent years, numerous experimental tests were done on the concrete beams reinforced with the fiber-reinforced polymer (FRP). In this way, some equations were proposed to estimate the shear strength of the beams reinforced with FRP. The aim of this study is to explore the feasibility of using a feed-forward artificial neural network (ANN) model to predict the ultimate shear strength of the beams strengthened with FRP composites. For this purpose, a database consists of 304 reinforced FRP concrete beams have been collected from the available articles on the analysis of shear behavior of these beams. The inputs to the ANN model consists of the 11 variables including the geometric dimensions of the section, steel reinforcement amount, FRP amount and the properties of the concrete, steel reinforcement and FRP materials while the output variable is the shear strength of the FRP beam. To assess the performance of the ANN model for estimating the shear strength of the reinforced beams, the outputs of the ANN are compared to those of equations of the Iranian code (Publication No. 345) and the American code (ACI 440). The comparisons between the outputs of Iran and American regulations with those of the proposed model indicates that the predictive power of this model is much better than the experimental codes. Specifically, for under study data, mean absolute relative error (MARE) criteria is 13%, 34% and 39% for the ANN model, the American and the Iranian codes, respectively.

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Probabilistic seismic assessment of RC frame structures in North of Iran using fragility curves

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ABSTRACT

In this article, the fragility curves of RC structures with 3, 5 and 8 stories in Iran have been studied. The structures which have been estimated in this article have the system of RC Intermediate Moment Frame which is designed in accordance with Standard No. 2800 (Third Edition). These models in order to make a non-linear analysis in 3D form, they were modeled in OpenSEES software. The structure analysis was selected of the type of increasing dynamic analysis. In selecting the records of the earthquakes, it was tried that the characteristics of the selected records to be close to the conditions of the construction as much as possible. For this reason, the far-from the fault records of the FEMA P695 Code was used. The selected records were scaled from 0.1g to 1.5g with 0.1g steps and in each step, the structure was analyzed. The IDA curves were drawn for three types of structures under consideration up to structural complete damage. Then using MATLAB software and considering the lognormal probability distribution, the failure probability for each performance level was calculated and the fragility curves for Max Inter Story Drift in different levels of PGA were drawn. The results indicate that in comparing the structure behavior with different heights, it can be said that with the increase of height, the structure reaches to non-linear zone sooner and the structure capacity decreases. In general, with the structure height increase, the structure vulnerability in four specified levels of damage (slight, moderate, extensive and complete) increases but the trend of the increase of damage probability decreases. For the low rise RC structures (Intermediate moment-resisting frame) which have been built in accordance with the Standard No. 2800 (Third Edition), the Probability of extensive and complete damage in earthquakes with PGA's less than 0.4g and 1.0g accordingly is almost insignificant. For the mid and high rise buildings, the probability of extensive and complete damages in earthquakes with PGA's less than 0.3g and 0.7g is almost insignificant.

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Function comparison between moment frame and moment frame with centrically braces in high-rise steel structure under the effect of progressive collapse

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ABSTRACT

Steel moment system and steel moment with centrically braces are two common systems. Many of regulations related to this structures explained in details to design structures against earthquake loads but they didn't mention methods about dynamic load such as blast or car crash. However, the mentioned parameters may cause key member fracture such as column that result total or partial damage. Therefore, investigation about these structures seems necessary. This paper presents a numerical study of 20 story steel building with two different lateral systems and two column removal scenarios using Abaqus. Three dimensional modeling, using the finite element method was developed and investigated to understand the progressive collapse of 20 story buildings with composite steel frames. Numerical result verified with experimental results. The response of the building was studied in detail and results are recommended to mitigate progressive collapse in future designs. The results of this study show that corner column case removal is more critical than side case removal from view point of increasing axial force and moment. Also the results indicated that behavior of different structures systems against progressive collapse is NOT remarkable. To avoid potential progressive collapse, it suggests that the columns were designed and controlled for double of service loads.

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Structural behaviour of concrete poles used in electric's power distribution network

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ABSTRACT

Based on a preliminary study on regional electric companies, it is shown that there is no precise structural design on the concrete poles. This leads to uneconomical and overestimated networks' components. Therefore, this study was aimed to investigate the lateral performance of the concrete poles which are employed in electric's power distribution network. This paper presents a numerical study on structural performance of 12 m concrete poles used in electric's power distribution network using Abaqus software. A sensitivity study for mesh size is carried out and concrete damaged plasticity has been employed. The results show that relatively coarse mesh (average) in damaged concrete method gives more reliable result. Some experimental tests based on the Iranian standards were performed in order to make a bench mark for numerical output. Comparison between numerical and experimental results indicates a good agreement between the results. The outcomes also suggest that while the applied lateral load is less than around 400 kg which is assumed as the nominal resistance of the pole, no transverse crack occurs. Based on both experimental and numerical results, one or two transverse cracks are reported when the applied force reaches up to 600 kg. The rate of cracks is amplified by increasing the applied force; and finally, the pole would lose its capacity when the load rises much more than 1200 kg. The study also shows that the poles are very weak when the load direction changes. Also, it can be concluded that the final strength of the pole is higher than what the standards recommend. Finally, seismic behavior factor of the poles around both main axes are evaluated. The estimated seismic resistance factor for the concrete poles indicates that the prescribed R factor for such structure is relatively low; and can be improved at least 20%.

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Estimating the behavior of RC beams strengthened with NSM system using artificial neural networks

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ABSTRACT

In the last decade, conventional materials such as steel and concrete are being replaced by fiber reinforced polymer (FRP) materials for the strengthening of concrete structures. Among the strengthening techniques based on Fiber Reinforced Polymer composites, the use of near-surface mounted (NSM) FRP rods is emerging as a promising technology for increasing flexural and shear strength of deficient concrete, masonry and timber members. An artificial neural network is an information processing tool that is inspired by the way biological nervous systems (such as the brain) process the information. The key element of this tool is the novel structure of the information processing system. In engineering applications, a neural network can be a vector mapper which maps an input vector to an output one. In the present study, a new approach is developed to predict the behavior of strengthened concrete beam using a large number of experimental data by applying artificial neural networks. Having parameters used as input nodes in ANN modeling such as elastic modulus of the FRP reinforcement, the ratio of the steel longitudinal reinforcement, dimensions of the beam section, the ratio of the NSM-FRP reinforcement and characteristics of concrete, the output node was the flexural strength of beams. The idealized neural network was employed to generate empirical charts and equations to be used in design. The aim of this study is to investigate the behavior of strengthened RC beam using artificial neural networks.

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Evaluation of appropriate behavioral models for numerical simulation of new Cu based shape memory alloy

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ABSTRACT

Previous studies on shape memory alloys often related to one of the most usable type called Ni-Ti. However, many researchers are trying to find alternative alloys because of high cost and complex behavior of this alloy due to the high dependence of strain rate. The present study has been evaluated on properties of new alloy Cu-Al-Mn that has been introduced by Japanese researcher Araki. Also, it has been assessed ability of behavioral models for numerical simulation. The alloy with a superelasticity comparable to Ni–Ti alloys has more suitable cost and low dependence of strain rate. Based on properties of this alloy, the ability of three rate-independent model has been evaluated using; Graesser-Cozzarelli, Fugazza, Self-centering for numerical simulation. Despite the higher complexity of Graesser-Cozzarelli model compared to multilinear Fugazza and Self-centering models, Graesser-Cozzarelli model showed a more detailed description of material behaviour especially in points of transformation of two phases, because of the controller parameters. Also constant parameters of the model were developed to describe the behavior of a bar of 14 mm Cu-Al-Mn by trial and error process in MATLAB. The results of numerical simulation of the behavior of Cu-Al-Mn alloy in tension and pseudo-static test by two models Fugazza and self-centering showed that this model with its simplicity and lack of need for complex laboratory parameters has a good conformity with experimental results.

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