Selection of appropriate intensity measure for collapse capacity prediction of low to mid-rise steel special moment resisting frames

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ABSTRACT

A parameter that quantitatively represents the strength of a ground motion is called Intensity Measure (IM). The value of an IM for a given hazard level is the output parameter of Probabilistic Seismic Hazard Analysis (PSHA) which is used in structural seismic analysis. In other words, an intensity measure is a link between PSHA and structural seismic analysis. The main desirable features of an appropriate IM are efficiency and sufficiency. The importance of using an appropriate IM is that the seismic performance assessment of structures can be performed more realistically. In this study, the performance of different scalar IMs to predict the collapse capacity of low to mid-rise steel Special Moment Resisting Frames (SMRFs) was evaluated. For this purpose, 3, 6 and 9-story steel SMRFs designed for the SAC project were simulated by OpenSees and the collapse capacity of these structures were determined by using incremental dynamic analyses under 67 far-field ground motion records. After calculating the collapse capacity values by using scalar IMs existing in the technical literature which are classified into structure and non-structure specific IMs, the performance of IMs including efficiency and sufficiency with respect to magnitude, source-to-site distance, and average shear-wave velocity at the upper 30 m was compared.

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Seismic performance of high rise hybrid structures with moment frame configuration

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ABSTRACT

The seismic design methods should pay special attention to the characteristics of ground motions especially in near fault. Near-field records are generally recognized by the sudden impulsive ground displacements in a short time domain in which contain large amount of kinetic energy. An important consequence of lateral displacement and story drift is the structural and non-structural damage. Many previous studies suggest that the mentioned parameters are sufficient to indicate the correlation between characteristics of the structural response and seismic risk. Framed tube system is one way to limit the movement of stories in high rise buildings. This structural system causes a similar behaviour of the whole resistant skeleton to a hollow tube, so that a significant increase is observed in lateral stiffness of the structure. In this study, the studied models are in the form of 20-story structures that are regular in plan and height. The resistant skeleton of the studied structures is designed according to the fourth edition of Standard No. 2800 as well as topics of the Iranian national building code. Based on the results obtained by conducting the nonlinear dynamic analyses, this study deals with the trend of variations in the target seismic response parameters subjected to the site-specific design spectrum according to the design provisions denoted in the Standard No. 2800. Topics and issues evaluated in this study include the lateral displacement, story drift and effect of the configuration of internal rigid frames in variation rates of the mentioned parameters. Based on the results, the maximum drift usually happened in the middle third of the structure height. Yet, the maximum response parameters of displacement and story drift were individually exposed to relative reduction and increase, regarding to replacement of the resistant skeleton from frame-tube into bundled-tube structure.

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Experimental and analytical study on perpendicular to plane flexural behavior of a new prefabricated wall made by extruded polystyrene

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ABSTRACT

Nowadays softening of non-structural components as well as applying dry-wall systems are one of the efficacious measures to safe constructions against earthquakes. Using rigid and heavy non-structural elements, increase earthquake force and its destructive effects on the structure. Therefore, using flexible and light material in non-structural elements is one of the effective solutions to build light and safe structures against earthquakes. In this study, an experimental and analytical investigation on the behaviour of a new pre-fabricated wall made by extruded polystyrene, gypsum board and cement board has been studied through a comparative analysis that the following conclusions can be drawn. C-C Panels have 35% More resistance and G-G Panels have 37% more Plasticity. Thickness has positive effects on resistance and plasticity. Panels with thickness of 12.5cm have 37% more resistance and 21% more plasticity in comparison with panels with thickness of 7.5 cm.

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Seismic assessment of reinforced concrete buildings using fragility curve

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ABSTRACT

Fragility curves are usually used to determine the vulnerability of structures. But defining failure criteria is of great importance in seismic vulnerability which probability of exceeding from these failure criteria is considered as the basis of probabilistic analysis. In the present study, three types of 3D reinforced concrete buildings having 3, 5 and 8 floors with reinforced concrete moment resisting frame structural system having medium formability designed seismically according to Iranian guideline (seismic regulations of Iranian 2800 code and chapter 9 of National Building Regulations, last edition in 2013) with and without the effect of infill considering structural failure (including low-strength concrete) are analyzed using accelerogram (far source) using OpenSees (Open System for Earthquake Engineering Simulation). Finally, fragility curves of the above-mentioned structures calculated and drawn using Nonlinear Incremental Dynamic Analysis (IDA). The results showed that the infill has an effective role in decreasing lateral stiffness of buildings as much as 20 to 40 percent in proportion to building height.

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Seismic response of cable stayed bridges under multi support excitation

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ABSTRACT

In this Study, the seismic response of cable stayed bridges have been evaluated under multi-support excitations. There are three sources that cause the earthquake wave characteristics change during its propagation path. Local site effect, loss of coherency and wave passage effect are three sources of spatial variation of seismic ground motions. In long span structures, such as cable supported bridges, this phenomenon is more evident and traditional analyzing (uniform excitation) may not be valid and be conservative. Thus, it is necessary to investigate the response of cable stayed bridges under non-uniform excitations. For this purpose, the non-uniform time histories were artificially generated using Kriging method based on a set of known time history in the west support of bridge. Nonlinear time history analysis was performed and cables axial force, deck moment, pylons moment and finally drift ratio of bridge have been examined in order to investigate how non-uniform excitation change the seismic response of bridge compared with uniform excitations. Results show non-uniform excitation in some bridge components increase responses and decreases in the others. In non-uniform excitation, although total time history energy is lesser than uniform excitation, it can significantly change the distribution of the forces and makes differential displacement between cables supports and increase the possibility of failure.

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Seismic behavior of asymmetric structures supported on TCFP bearings subjected to simplified near-fault pulses

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ABSTRACT

In this paper the effects of mass eccentricity of superstructure as well as stiffness eccentricity of isolators on the amplification of seismic responses of base-isolated structures are investigated. Superstructures with 3, 6 and 9 stories and aspect ratios equal to 1, 2 and 3 are mounted on a Triple Concave Friction Pendulum (TCFP) bearing. Three-dimensional linear model of superstructure mounted on nonlinear isolators are subjected to simplified pulses including fling step and forward directivity while various pulse period (T_p) and Peak Ground Velocity (PGV) amounts are scrutinized. Maximum isolator displacement and base shear as well as peak superstructure acceleration and drift are selected as the main engineering demand parameters. The results indicate that the torsional intensification of different demand parameters caused by superstructure mass eccentricity is more significant than isolator stiffness eccentricity. The torsion due to mass eccentricity has intensified the base shear of asymmetric 6-story model 2.55 times comparing to symmetric one. In similar circumstances, the isolator displacement and roof acceleration are increased 1.49 and 2.16 times respectively in the presence of mass eccentricity. Furthermore, it is demonstrated that torsional effects of mass eccentricity can force the drift to reach the allowable limit of ASCE 7 standard in the presence of forward directivity pulses. This aspect should be noted in the design of base-isolated buildings.

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Numerical analysis of effective parameters in response of the nonlinear passive viscous systems

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ABSTRACT

In this article all the effective parameters in response of nonlinear passive viscous systems are investigated. Here, the term response is referred to the maximum inter-story drift and maximum absolute acceleration of the stories. Inter-story drift is known as the structural failure index and maximum absolute acceleration is known as the nonstructural and acceleration sensitive equipment in buildings. Based on the results, the more effective parameters in these systems are initial stiffness and strength of the building, amount of supplemental damping used in the system, stiffness of the braces connecting the dampers to the building and number of the stories. In order to show the effect of each pre-mentioned parameters, many linear and nonlinear passive control systems were analyzed by the time history method. For decreasing the influence of dominant input frequency of the excitation record and also for generalization, two white noise time histories normalized to the 1g were used as the input excitation. The results show that reduction of stiffness and strength are the key parameters in reducing absolute acceleration and also increasing the brace stiffness and supplemental damping are the most effective parameters in reduction of inter-story drift. In other words, if in design of passive control systems, only increasing the damping of the system is considered, the absolute acceleration of the system may be increased and as the result the acceleration sensitive equipment will experience the most failure during the earthquake.

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The behavior of the composite multi-layer cylindrical shells subjected to blast load

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ABSTRACT

Today, with the increasing damages of explosion, it is of great significance to assess the performance of structures against such damages that established by explosive load. Accidental explosions exert great and intense dynamic forces to surrounding structures. Recently, composite shells have been used in structures to protect them against explosion which is due to its high resistance to volume ratio, flexibility and resistance to shock forces. Thus, it is essential to assess how structures protected by such materials behave against these forces. In this paper, we have used Abaqus software to analyze data pertaining the behavior of composite shells against explosive loads. We assessed the various parameters affecting the behavior of CRFP and E-Glass Epoxy and how they were affected by explosive load. Some of the parameters assessed include loading, curving rate, number of layers and size of interior angle. In practice, it is necessary to include openings in the composite shell, thus it is important to evaluate the effect of these openings on the behavior of the composite shell. The survey showed that use of the opening has fallen down shift. The reason for this phenomenon is reduction of area that effected by explosive load in composite shell.

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Influence of fiber geometry on the mechanical properties of structural steel fiber lightweight concrete made with Scoria aggregate

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ABSTRACT

Hardened concrete due to brittleness, have low tensile strength and its strain tolerance is low. Low resistance of this material makes it more brittle. Light weight concrete which contains eager and brittle materials are subject to sudden failure at the time of loading. In order to increase ductility and prevent the spread of micro-cracks as well as appropriate continuity in the concrete, increasing the energy absorption capacity, reducing the structural weight against shock loads, steel fibers can be useful. The purpose of this paper is evaluation of the influences of steel fiber on mechanical characteristic of concrete at the age of 7 and 28 days. Steel fibers used in forms of corrugated shape with length to diameter ratio of 37.5 and smooth-end hook shape with length to diameter ratio of 50. The volume percent in various forms is 1% constant. To calculate the mechanical properties of concrete we used tensile strength tests (Brazilian and direct), and compressive strength tests. The results indicate that they increase flexural strength, especially tensile strength of concrete, but they don't have significant effect on the compressive strength.

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Base level investigation in various buildings and corresponding effective factors

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ABSTRACT

Base level is one of the important parameters in determining the seismic force and preliminary design of structural sections. Base level, according to 2800 seismic regulations, in cases which the basement perimeter is executed with reinforced concrete walls integrated by structure, in addition with surrounding dense soil; set top of basement walls. The critical issue involved in determining base level is horizontal motion of the land. Usually horizontal movement of the Earth is transferred by shear and friction between the edges of the basement walls and foundation, also this process is completed by soil friction between underside of slabs and shallow. Different conditions such as non-same elevated foundations, soil type around building, soil-structure interaction and type of foundation are impressive on location of base level. Other factors including retaining wall openings in basement, basement floors and soil characteristics around the base structures affect base level coordination. As regards there is cleared definition for base level in different regulation all around the world, sometimes engineers cannot comprehend main purpose correctly, or concepts occasionally are interpreted inaccurately. When structure condition is not common, for example, buildings on slope or structures on deep foundation such as piles, often experts are conflicted by finding location of base level in this status. In this paper investigations about base level in the past years expressed and studied. In addition, important issues around them are discussed.

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