the nonlinear equilibrium path, it is possible to understand the phenomenon of collapse or buckling, or the total bearing capacity of structures.
Nonlinear equilibrium equations in analysis structures are often solved using the Newton-Raphson method, which is an incremental / iterative procedure. However, the method diverges when it reaches a limit point; therefore, only a part of the curve is obtained. To overcome the difficulties with limit points, displacement control techniques were introduced, and the arc-length method is among those displacement control methods developed in an effort to enable solution algorithms to pass critical points.
The arc-length control method often fails to draw the equilibrium path after passing bifurcation and turning points. This is mostly due to the fact that the corrector steps are not carried out in the proper direction around such points .To overcome this issue, several criteria have been presented to predict the correct direction of the predictor step. Some of these methods have been investigated and discussed by means of numerical experiments; in this research, simple two-dimensional truss structures were chosen in order to keep analysis time short. The criterion recently introduced by Feng, Owen and Peric, showed itself to be insensible to bifurcation and turning points, and, therefore, has been successfully applied to draw entire equilibrium paths containing such points.
In this research, the criteria of the sign of predictor solution methods and the effects of these methods for the arc-length control method were studied and implemented using Matlab software. In addition to existing methods, a new method was proposed, whose verification by these examples is investigated. The choice of a proper scaling parameter, Ψ , was demonstrated to have a great influence on the performance of the arc-length method. In the analyzed problems, the use of $\Psi = 0$ produced the best performance of the method, regarding convergence and computing time.

Key Words: Nonlinear analysis, arc-length method, equilibrium path, the sign of predictor solution methods, scaling parameter.

SEISMIC HAZARD DISAGGREGATION OF ETA IN CONDITIONAL SPECTRA

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Abstract
Selection of appropriate ground motion is a key element within any seismic assessment of structures. Many methodologies have been developed in order to select and scale ground motion records for the purpose of response history analysis. UHS is one of those developments and has been widely used in performance based earthquake engineering. However, implementation of UHS is somewhat conservative when used as a proxy for ground motion selection processes, since it is very unlikely to find a record which has a spectrum as high as the UHS.
Spectral shape indicators, including Epsilon and Eta, have been recently proposed in order to take a wide range of spectra into account. Additionally, conditional mean spectra have been obtained by the mentioned indicators which can be used as the target design spectra, e.g; Conditional Mean Spectrum (CMS) and Eta-based Conditional Mean Spectrum (ECMS).
The Eta indicator uses the conventional epsilon in combination with the peak ground velocity epsilon. As the peak ground velocity epsilon is not convenient in seismic hazard disaggregation, a simple formula was proposed by Mousavi et al. to approximate the target peak ground velocity epsilon based on the conventional epsilon. However, this simple formula needs to be investigated more precisely. Therefore, a comprehensive seismic hazard disaggregation is proposed, in this paper, to explicitly obtain the target peak ground velocity epsilon. An ideal site, with a single linear fault, was assumed in order to obtain the target peak ground velocity epsilon. The results show that the exact target peak ground velocity epsilon is meaningfully different from the simple formula in this issue, and the resulted conditional spectra are sensitive to this refinement in the low period range when using the exact target peak ground velocity epsilon.

Key Words: Seismic hazard analysis, ground motion prediction equation, Eta, epsilon, disaggregation.

be used to analyze and design building frames with concentrically braced. The temperature variation loading method has resulted from the concept of thermal strains and stresses, and is performable by the mentioned analytic software. Actually, instead of force loading, the corresponding temperature variation is assigned to brace members in the appropriate analytic software, and finally, it becomes easy to control the mentioned provisions in the above regulations. The elasticity module of the braces is altered in order to eliminate thermal strains. Without this change, utilizing temperature variation loading is impossible. Another advantage of the temperature variation method is that the corresponding themorature change of tension elements is the same for every stage of the structure, and is independent of section type. This method is more applicable for high-rise structures containing many braced bays, because it needs less accuracy in comparison to the force loading method and also reduces the time of analysis and design of the structure.

Key Words: Special concentrically braced frames, temperature variation loading, seismic provision.

EXPERIMENTAL STUDY OF THE EFFECT OF RESERVOIR SHAPE FACTOR ON DAM-BREAK FLOW CHARACTERISTICS

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Abstract

Flooding induced by large dam breaks causes severe and heavy damages to human lives and civil facilities. Knowing the volume and direction of the flood spreading, due to the breaking of a certain dam, in advance, may allow us to specify the areas prone to flood damage and help the institutions in charge to be on full alert before catastrophe occurs. The main aim of this research is to study the influence of the shape factor of a dam reservoir on a flood hydrograph, induced due to a dam break, by means of a physical model in the laboratory. Thus, the sudden dam break phenomenon has been modeled in the hydraulic laboratory of Amirkabir University of Technology. Different tests have been planned and carried out in the laboratory for shape factors ranging from 0.040 to 0.557. Hence, 7 series of reservoir with different dimensions and geometry have been built and tested. To measure the flow velocity and also the variations of water level at different points of the channel, the ADV speed meter and Ultrasonic and Micro sonic sensors were used, respectively. Having the variations of velocity and water level, the flow rate, due to dam break, is calculated and the corresponding hydrograph for each reservoir shape factor is obtained. Finally, the obtained hydrographs are evaluated and compared, and a correlation between the reservoirs shape factor and the Froude Number is developed. The experimental data were compared with those obtained from different actual dam break case histories. Although good agreement between the trends was found, large deviations from actual cases were observed. This may be due to several simplified procedures applied to the physical model developed in the laboratory to study the phenomenon. Thus, more sophisticated models with larger capabilities are needed to reach more accurate and reliable results in future research.

Key Words: Dam break, reservoir shapes factor, physical modeling, ultrasonic sensor, micro sonic sensor, ADV.

INVESTIGATING THE SIGN OF PREDICTOR SOLUTION METHODS IN THE ARC-LENGTH METHOD IN 2-D TRUSS STRUCTURES

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Abstract

The stability analysis of slender structures requires carrying out geometrically nonlinear analysis. Following

COLUMN USING A STEEL LINKAGE ELEMENT UNDER CYCLIC LOADING

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Abstract

One way to construct reinforced concrete structures is by the use of precast technology. Precast structures have different advantages, such as high quality control, economical cost, speed implementation and appropriate seismic behavior. The quality of connection of precast elements to each other is one of the most important parameters in the behavior of a precast structure. Due to the absence of an appropriate precast rigid connection, precast concrete structures are mainly used as a simple frame with a simple connection of beam to column and cast-in-place shear wall. In this study, a reliable system for precast structures to connect beam to column is created and undertaken with steel linkage elements. The connection of steel linkage to a column is performed with bolts, and the beam to this steel linkage is performed with bolts or welding. This method enables creation of concrete structures with higher quality than cast-in-place structures through minimizing in-situ concreting, as well as maximizing the speed of construction and usage of ductile and exchangeable elements in sensible locations. During the last decades, a significant body of research has been conducted on connections in precast structures. The main variables in these studies are the executive details, as well as the location of beam-column connections.

This paper presents the test results of a new rigid connection for precast concrete frames. In this connection, precast concrete beams and columns are connected to each other using a steel linkage element. Two types of bolted and welded connections are compared to monolithic specimens in terms of stiffness, strength, energy dissipation capacity and ductility factor. All specimens satisfied all three criteria of ACI T1.1-01, including; for no cycle, the relative energy dissipation ratio was not less than 12.5%, the secant stiffness from a drift ratio of -3.5% to a drift ratio of +3.5% was not less than 0.05 times the stiffness for the initial drift, and, finally, the ultimate strength recorded for the specimen was not lower than 75% maximum strength.

Key Words: Experimental study, precast concrete structure, rigid connection, hysteresis behavior, steel linkage.

SEISMIC DESIGN OF BUILDING FRAMES IN CONJUNCTION WITH CONCENTRIC BRACES USING THE TEMPERATURE VARIATION METHOD IN BRACED MEMBERS

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Abstract

Progress in our knowledge of seismic systems due to modern research and observations about recent earthquakes, makes it necessary to review building regulations and refine former versions from time to time. Analysis software also needs to be updated according to these changes, to cope with new requirements. In standard "AISC341-10", it is mentioned that beams and columns should be braced in special concentrically braced frames. After structure analysis and design, according to design regulations, first, the braces should be eliminated, and the floors restrained against side movement in order to avoid structural instability. Then, after applying the highest expected tensional and compressional forces along the eliminated braces, structures with gravity loads should be analyzed. Using this new regulation, emergence of plastic hinges in bars and pillars will be avoided as long as possible, and the braces can be used for energy amortization.

Due to the inability of current software, like ETABS, SAP2000, to apply loads along brace elements, these forces should be decomposed to horizontal and vertical elements. This method, specifically in high-rise structures containing many braced bays, is too complex, time consuming and prone to error. Also, considering the reciprocal effects of earthquakes, this control should be applied twice in order to design the structure for worst case scenarios .In this paper, the new temperature variation loading method is proposed. This method is more efficient than current force loading methods, and it can

be variable yield acceleration due to the downward-stabilizing movement of the sliding soil mass. In this paper, yield acceleration is modified based upon the changes in the geometry of the sliding surface. An analytical coupled solution is done for a SDOF system with distributed mass and stiffness throughout the system height; whereas sliding displacement and dynamic system response are coupled. Numerical analyses reveal that consideration of the sliding mass rotation and modification of yield acceleration significantly affects the resultant permanent displacement, especially for small slip lengths. It is also shown that period ratio, yield acceleration, and input motion have a significant impact on the results. For better evaluation of the effect of seismic parameters on permanent displacement, a wide-ranging database of earthquake records containing 1363 records from 25 earthquakes, were employed, and permanent displacements were evaluated by the proposed coupled analysis with variable yield acceleration. A regression model is presented to predict permanent displacement, including, as a function of the seismic parameters, slip lengths, period ratio, and yield acceleration. The presented equation is compared with the models proposed by other researchers. The proposed equation is applicable for microzonation of landslide hazard.

Key Words: Earthquake, soil structure, permanent deformation, displacement dependent yield acceleration, sliding block method, coupled analysis.

STUDY OF AIR QUALITY OVER WEST AND SOUTH WEST IRAN USING AEROSOL OPTICAL THICKNESS PRODUCTS OF MODIS

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Abstract

Dust, as an aerosol, significantly impacts air quality in arid and semi arid regions. Dust events in Iran, as a result of the semiarid climate, and its location in the global dust belt neighboring the deserts of Arabian countries, occur frequently. In recent years, the intensity of dust phenomena has increased, most especially in west and southwest Iran. In this study, the Moderate Resolution Imaging Spectroradiometer (MODIS) Aerosols Optical Thickness (AOT) product is applied in order to estimate dust intensity. Since Aerosol Optical Thickness at 550nm has a close relationship with the brightness temperature of MODIS bands 31 and 32, and Normalized Difference Dust Index (NDDI), the calculated AOT is proposed through quantitative analysis of MODIS data for major dust events over west and southwest Iran during years 2000-2009. The proposed calculated AOT matches MODIS AOT very well, with a squared correlation coefficient of 0.740. Moreover, based on MODIS measurements, sequential separation of the dust cloud from the bright underlying surface and water cloud is accomplished through the Brightness Temperature Difference (BTD) of suspended particle matter in 11 and 12 micrometer wavelengths of MODIS, NDDI and refined cloud threshold utilization. By statistical analysis of MODIS measurements, thresholds are determined over west and south west regions of Iran. Validations with ground meteorological observations over the region revealed good agreement of the proposed method in separating dust from the bright surface and cloud, which obviate the deficiency of remote-sensing data products of dust particles near the source as a result of bright surface radiance contributions. In addition, there is considerable correlation between MODIS AOT at 550 nm and Ahwaz station PM10, while there is a negative correlation between calculated AOT and horizontal visibility. The statistical analysis and case studies reveal the accuracy of this method in extracting dust from underlying aerosols, and the usefulness of this technique in dust enhancement optimization.

Key Words: MODIS, dust enhancement, horizontal visibility, AOT.

EXPERIMENTAL STUDY ON A PROPOSED RIGID PRECAST CONNECTION OF BEAM TO

difference level of the reservoirs is approximately 500 meters. Two reversible pump-turbine units are applied in each tunnel, and all four pump-turbines have the same specifications. There are three constraints for this problem: 1) the maximum and minimum water volume of upper and lower reservoirs, 2) the maximum and minimum water flow of the pump-turbine unit and 3) the stationary of exploitation. Based on the international electricity consumption pattern, it is assumed that energy consumption is constant during one hour, while it may change each individual hour. Finally, the solution is estimation of the flow rate into the tunnels over 24 hours.

Key Words: Pumped storage plant, power network balance, genetic algorithm, optimization, Siah Bishe plant.

EFFECT OF FILLER THIN STEEL PLATE ON THE BEHAVIOR OF CHEVRON ECCENTRICALLY BRACED FRAMES

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Abstract
Since the seventies, eccentrically braced frames have been considered by researchers because of having both advantages of appropriate ductility and stiffness. Yet, the steel plate sheer wall is still being used for many behavioral benefits in the design and reinforcement of buildings. In this paper, the dual behavior of these two systems, and the behavioral parameters of the systems in three forms, including; side plates, and middle and whole spans with different thicknesses of frame, were studied. The results showed an increase in energy absorption, strength, stiffness, ductility and higher behavior coefficient of the system in comparison with the braced frame. In the rest of the paper, analytical relations for the design of the system are presented. The modeling is done for different positions of the filler plate in eccentrically braced frames, and the models were analyzed. The analyzed models include three positioning forms for the filler plates. Each form was studied and compared for three thicknesses; 0.5, 1, and 2 mm. After analysis and obtaining the results regarding system thickness, the thickest dual system is always related to the form of three panels filled by plates. Finally, we achieve three formula for computing the thickness of the dual systems in all three forms. In the case of ductility between different forms of dual system, regardless of plate thickness, the best ductile system is for two side panels filled by plate. In the other forms, considering plate thickness, the best ductile system is for two side panels filled by 0.5mm plates, whose behavior coefficient is 9.01, while the behavior coefficient of eccentrically braced frames with out plate. In all forms, the ultimate strength of the dual system is greater than the eccentrically braced frame without plate, and most of the time, dual systems have more energy absorption than it does.

Key Words: Eccentrically brace frame, steel plate shear wall, stiffness, behavior factor, energy absorption.

COUPLED SEISMIC PERMANENT DISPLACEMENT OF SOIL SLOPES WITH VARIABLE YIELD ACCELERATION

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Abstract
As a simplified dynamic analysis, the Newmarkian sliding block and decoupled and coupled analyses have received considerable attention among geotechnical practitioners for estimating the earthquake-induced permanent deformation of earth slopes and embankments. However, some conceptual limitations might affect the estimated permanent displacements. Research work still proceeds to modify the basic sliding block approach in order to attain more precise estimates of seismic ground displacement. The original sliding block analogy assumes a constant yielding acceleration, while there must

CLAYEY SAND USING CYCLIC SIMPLE SHEAR TESTS

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Abstract

In this study, the effect of the presence of plastic fines on liquefaction resistance of Firoozkooh sand is investigated. To this end, amounts of 5, 15, and 25 percent of two types of plastic fine (clay), namely, Kaolinite, with a plasticity index (PI) equal to 19, and Bentonite, with a plasticity index equal to 116, were added to Firoozkooh sand, and 68 stress-controlled tests were conducted using Cyclic Simple Shear (CSS) apparatus. Shear load frequency and consolidated vertical effective stress are equal to 0.1 Hz and 100 kPa in all tests, respectively. Initial liquefaction, maximum pore pressure ratio (r_u), or double shear strain amplitude equal to 5%, have been considered as liquefaction criteria. In order to investigate the liquefaction resistance for each soil, at least three tests were conducted at each relative density. In summary, with the addition of plastic fines, fines content, as well as the plasticity of fines, affect liquefaction resistance.

In Koalinite-containing soil, as the amount of fines increases up to 25%, the liquefaction resistance decreases continuously. In these soils, for all fine content less than 25%, the sand skeleton void ratio can be regarded as the effective void ratio. In Bentonite-containing soils, the lowest liquefaction resistance has been observed in soil that contains 5% Bentonite; therefore, 5% fine content is known as limiting Bentonite content. In these soils, fine content less than 5% sand skeleton void ratio, and fine content more than 5interfine void ratio, are considered effective void ratios, respectively.

According to the results, in the case of 5% fines content, the plasticity of fines does not play a major role. In the case of adding fines with different plasticities to one base soil, there exists an amount of fines content at which the plasticity of fines starts to have an increasing effect on liquefaction resistance. According to the results of this study, this threshold value is between 5% and 15%. By more investigation of available literature, we can narrow this range from its lower limit to 10%.

Key Words: Liquefaction resistance, sand, plastic fine, plasticity of fines content.

OPTIMIZATION OF SIAH BISHE PUMPED STORAGE POWER PLANT DAILY SCHEDULE USING A GENETIC ALGORITHM MODELING FRAMEWORK

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Abstract

Energy storage is an issue that scientists have been researching for many years. There are several energy storage alternatives, among which the pumped storage system, battery storage, superconducting magnets, flywheels, and compressed air are the most popular. Based on former research, pumped storage is the best method for energy storage. The pumped storage plant is an effective method to balance the difference value between electricity demand and production, which has greatly expanded. The advantages of this system include a considerable capacity to store energy, a short-term response to power network fluctuations, long-term energy storage and etc.

Although there are many pumped storage plants under service, a comprehensive research have yet to be undertaken. The purpose of this research is optimization of daily planning, based on available data of an existing pumped storage plant. To achieve this aim, minimization of the difference value between energy production and demand has been determined. A genetic algorithm was used for optimization. The genetic algorithm is a meta-heuristic algorithm. It is inspired by the genetic evolution of living creatures. This algorithm was used according to binary coding.

The Siah Bishe pumped storage plant in Iran was the research case study. This plant includes two non-leveled reservoirs that are connected by two water tunnels. The

with not much attention paid to the soil mechanics of the critical state of clayey sands. The reason for this neglect might be the misconception that plastic properties in clay prohibit flow behaviour and liquefaction. However, the studies of Northridge 1994, Kokaeli 1999, Chi Chi 1999, and Niigata 2004 earthquakes have indicated that notable settlements occur in soils containing considerable amounts of clay, resulting in great destruction. Researchers have emphasized that more detailed investigation is needed to determine the critical state behaviour of clayey sands.

Following, the possibility of presenting a unique frame work for interpretation of critical state clayey sand behavior is investigated, based on steady state lines and equivalent void ratio.

Triaxial experiments are performed on the sand and its combination with 0 to 25 percent medium plasticity clay, resulting in a new relation used to calculate the b parameters. These are presented based on the fine and sand interaction concept and also steady state lines.

The results have proved that by using the proposed relation, it will be possible to convert the different steady state line of sand, and its combination with clay, into one unique line. Also, it will be possible to attain the steady state lines of sand, and all its combinations with clay, based on only some tests performed on clean sand specimens. In order to generalize the proposed relation, it is verified using other available results.

Key Words: Steady state line, triaxial, equivalent void ratio, b parameter.

BEHAVIOR AND ULTIMATE SHEAR STRENGTH OF COMPOSITE PLATE GIRDER WITH DIAGONAL STIFFENER

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Abstract

The contribution of diagonal stiffeners in the shear capacity of composite plate girders has not been studied so far. In this study, the behavior of diagonally stiffened simply supported composite plate girders is investigated and a theoretical formula is proposed to estimate the ultimate shear strength of such girders. The proposed analytical method considers the tension field action within the plate girder web panel and the shear failure of the concrete slab. Several validated finite element models of the composite plate girders, having different configurations of diagonal stiffeners, are also generated to verify the proposed method by comparing the analytical and numerical outcomes. These three-dimensional finite element models are developed to account for the geometric and material nonlinear behavior of composite girders. The models are first verified by experimental values obtained for girders with no diagonal stiffeners tested by other researchers and afterwards different configurations of diagonal stiffeners are added to the models. A total of four tested specimens are selected from previous studies. Based on the results of finite element analyses, a design method is proposed which incorporates the effects of the concrete slab, the composite action, and the web shear buckling of composite girders. The proposed method is approximate, simple and does not require any complex mathematical operations and can be applied to composite plate girders at the preliminary stages of design. The calculated ultimate shear strengths using the proposed method are in good agreement with both numerical results and experimental values, which indicates that the proposed analytical equations can be applied to predict the ultimate shear strength of girders for design office use. In comparison with un-stiffened girders, it is also observed that diagonal stiffeners are able to reduce the buckling effects of the web steel plate, increase elastic shear buckling strength and therefore the ultimate shear capacity of the girders.

Key Words: Composite plate girder, diagonal stiffeners, shear strength, non-linear finite element analysis, analytical method.

EFFECT OF CONTENT AND PLASTICITY OF FINES ON LIQUEFACTION RESISTANCE OF

prove the behavior of the framed structure.
It is assumed that the same ultimate lateral resistance of structures that causes an increase, to a certain level, in redundancy, can also enhance both the ductility capacity and the inelastic capacity of structures. However, any further increase in the redundancy of that certain level might have a negative effect on the ductility capacity.

Key Words: Redundancy, overstrength, probabilistic overstrength index, deterministic overstrength index, ductility, response modification factor.

EVALUATION OF THE EFFECT OF YIELD SURFACE SHAPE ON STATIC AND DYNAMIC ANALYSES OF GEOTECHNICAL STRUCTURES

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Abstract
In geotechnical engineering, yield surface (criterion) is a subject that has attracted the attention of a large number of researchers in both fields of experimental and constitutive modeling. Various yield surfaces have been introduced by different investigators, of which, Mohr-Coulomb and Drager-Prager criteria are the most famous. Generally, yield criteria are used in constitutive model structures. On the other hand, the final aim is to apply these constitutive models in numerical analyses of geotechnical engineering problems. Therefore, the question which arises here is; how high is the degree of effect of these yielding surfaces on numerical analyses of geotechnical problems, and also, is a more accurate yielding criterion needed or not?
In this paper, two constitutive models of MCH and DPH have been introduced in such a way that they have quite similar structures and the only distinction between them is their supposed yield surfaces. In fact, these models have been originated by a combination of the hyperbola model with Mohr-Coulomb and Drager-Prager criteria, respectively. After calibration of the two constitutive models by experimental data on a specific stress path, their performance on other stress paths were also evaluated using laboratory data. Then, using Fish programming language, the two constitutive models were introduced into the FLAC program to enable investigation of various numerical analyses. In this way, performances of these constitutive models and, consequently, the effect of the yield surfaces on the static and dynamic analyses of geotechnical structures (such as foundation bearing capacity, tunnel and excavation), were evaluated. Therefore, a better insight into the degree of effect of various yield surface shapes on numerical analyses of different geotechnical problems could be obtained for engineers who use different constitutive models for design and numerical investigation, and also for researchers who study constitutive models.

Key Words: Yield surface, constitutive model, different stress paths, static and dynamic numerical analyses.

UNIQUE FRAME WORK FOR INTERPRETATION OF THE CRITICAL STATE BEHAVIOR OF CLAYEY SANDS

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Abstract
The steady state line or critical state line is one of the main factors used in critical state topics. It is used for investigating the variation of liquefaction potential, calculating state parameters and also determining the parameters affecting collapse or state boundary surface shapes. Sand skeleton void ratio, equivalent void ratio and the interaction of sand and fines are main subjects behind research into sand critical state behavior.
Most studies conducted so far have mainly focused on clean sand or its mixtures containing non-plastic fines

Abstracts of Papers in English

EVALUATION OF DETERMINISTIC AND PROBABILISTIC EFFECTS OF REDUNDANCY ON THE RESPONSE MODIFICATION FACTOR FOR RC MOMENT RESISTING FRAMES WITH EQUAL LATERAL RESISTANCE

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Abstract

The general opinion regarding the overstrength capacity of a structure is explained by the process of first local yielding to total failure being due to structural redundancy. Furthermore, results of some research indicate that this part of the overstrength capacity can be introduced as a redundancy reduction factor. On the other hand, some other research showed that an analytical parameter, according to the lines of vertical seismic framing and the theory of structural reliability, can be formulated as the redundancy reduction factor independent of the overstrength reduction factor in the analytical definition of the response modification factor. A general conceptual question is why structural redundancy has been regarded as a desirable property. Is it because making more overstrength capacity or just increasing the number of seismic resistant frames will make the structural behavior more desirable, as well as increasing the reliability of the systems? To answer these questions, six and nine floor three-dimensional reinforced concrete framed structures with the same story area and the same equal lateral resistance were designed. In this research, the essential parameters of the response modification factor for the studied structures were estimated numerically. Furthermore, by considering the strength factor as a random variable, both the deterministic and probabilistic effects of redundancy on the response modification factor were also evaluated. The results of this research illustrated that imposition of an increase in redundancy, where no more overstrength capacity will be made, might not im-