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Investigation on Correlation of Earthquake Intensity Parameters with Seismic Response of Reinforced Concrete Structures

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Abstract : Nonlinear dynamic analysis is permitted to be used for structures without any restrictions. The important issue is the selection of the design earthquake to conduct the analyses since quite different response may be obtained using ground motion records at the same general area even resulting from the same earthquake. In seismic design codes, the method requires scaling earthquake records based on site response spectrum to a specified hazard level. Many researches have indicated that this limitation about selection can cause a large scatter in response and other charecteristics of ground motion obtained in different manner may demonstrate better correlation with peak seismic response. For this reason influence of eleven different ground motion parameters on the peak displacement of reinforced concrete systems is examined in this paper. From conducting 7020 nonlinear time history analyses for single degree of freedom systems, the most effective earthquake parameters are given for the range of the initial periods and strength ratios of the structures. In this study, a hysteresis model for reinforced concrete called Q-hyst is used not taken into account strength and stiffness degradation. The post-yielding to elastic stiffness ratio is considered as 0.15. The range of initial period, T is from 0.1s to 0.9s with 0.1s time interval and three different strength ratios for structures are used. The magnitude of 260 earthquake records selected is higher than earthquake magnitude, M=6. The earthquake parameters related to the energy content, duration or peak values of ground motion records are PGA(Peak Ground Acceleration), PGV (Peak Ground Velocity), PGD (Peak Ground Displacement), MIV (Maximum Increamental Velocity), EPA(Effective Peak Acceleration), EPV (Effective Peak Velocity), teff (Effective Duration), A95 (Arias Intensity-based Parameter), SPGA (Significant Peak Ground Acceleration), ID (Damage Factor) and Sa (Spectral Response Spectrum).Observing the correlation coefficients between the ground motion parameters and the peak displacement of structures, different earthquake parameters play role in peak displacement demand related to the ranges formed by the different periods and the strength ratio of a reinforced concrete systems. The influence of the Sa tends to decrease for the high values of strength ratio and T=0.3s-0.6s. The ID and PGD is not evaluated as a measure of earthquake effect since high correlation with displacement demand is not observed. The influence of the A95 is high for T=0.1 but low related to the higher values of T and strength ratio. The correlation of PGA, EPA and SPGA shows the highest correlation for T=0.1s but their effectiveness decreases with high T. Considering all range of structural parameters, the MIV is the most effective parameter.

Keywords : earthquake parameters, earthquake resistant design, nonlinear analysis, reinforced concrete
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