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The Effect of Using Seismic Isolation System Under the Top Stories, on the Base Shear Force of Outrigger Braced Structures

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Abstract

Current research is carried out on outrigger braced steel structures with welded connections, illustrating the effect of using Seismic Base Isolation System under the top stories, on the seismic base shear forces of above mentioned structures. For this purpose, ٨ two dimensional ٢٠~٦٠ stories high outrigger braced structures are modeled and designed according to the Iranian ٢٨٠٠ seismic code, due to ١st, ٢nd and ٣rd types of soil specifications and Sa=٠,٢٥g & Sa=٠,٣٥g spectral accelerations. On the next stage, all designed models are equipped with base isolation system under the top one or two stories (based on the height of the structure), to perform as a soft story on the top of the whole structure, demonstrating a Tuned Mass Damper passive control system(TMD) there. After tuning the frequency and the damping ratio for this secondary systems, Time History analysis is carried out for all preliminary and secondary systems due to accelerograms recorded on above mentioned site specifications, normalized to S_a=٠,٢٥g & S_a=٠,٣٥g. Finally, by studying the lateral base shear force of all preliminary and secondary models for all mentioned records, the effects of using base isolation system on the top of outrigger braced structures are discussed.

Keywords: Time History analysis, Sismic Base Isolation, Soft Story, Outrigger Bracing, Tuned Mass Damper

١. Introduction

Previous experience of earthquakes illustrates that many types of structures behave nonlinearly during a severe earthquake. So a huge amount of input energy is mainly dissipated through the form of damping and hysteresis. According to this, the structures are usually designed for much lower lateral forces than those demanded by aseismic design codes in elastic range. The aseismic behaviour analysis and accurate design of structures for severe earthquakes are mainly carried out using Nonlinear Time history Analysis method (NTHA). Using the NTHA method for analysis of somehow simple structures in consulting engineers offices is not appropriate enough, due to the complexity and timetaking behaviour of the method. So according to simplicity and popularity of structural linear analysis techniques, they are mainly proposed in most aseismic design codes using the reduced lateral forces meanwhile. The seismic linear force for structural design purposes is achived from a linear earthquake spectra. The computed lateral force from the spectra is decreased by the means of a reduction factor or modification factor, according to ductility, damping, overstrentgh and so on. This research is carried out to compute the modification factor of " outrigger braced structures". A central core, composed of braced frames or shear walls is included in this types of highrise structures as shown in fig.١. When the structure is subjected to lateral loads, the plannar rotation of core is limitted by compression-tension functioning of the outside columns by the use of outriggers, as shown in fig١. According to the height of outrigger braces, the overall lateral stiffness of the structure is increased, causing the lateral deformation decrease to a great extent. This method is a proper solution for overturning control of highrise buildings ranging from ٤٠ to ٦٠ stories high. It is also a proper solution to construct a highrise building without any additional fee due