STUDY OF SPECTRAL DYNAMIC ANALYSIS IN RC MID-RISE STRUCTURES WITH SOFT STORY

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Reinforced concrete moment framed structure in recent time has a special feature i.e. the ground story or other story is left open for the purpose of parking, shopping, amphitheatre etc. Such building are often called building with soft story. Soft story system is being adopted in many buildings recently due to the advantage of open space to meet the economical and architectural demands. But these stilt floor used in most severely damaged or, collapsed R.C. buildings, introduced 'severe irregularity of sudden change of stiffness' between the soft story and upper or downer stories since they had the more lateral stiffness of the frame by a factor of three to four times. In such buildings the dynamic ductility demand during probable earthquake gets concentrated in the soft story and the upper story tends to remain elastic. Hence the building is totally collapsed due to soft story effect.

Lateral displacement of a story is a function of stiffness, mass and lateral force distributed on that story. It is also known that the lateral force distribution along the height of a building is directly related to mass and stiffness of each story. If the P-Δ effect is considered to be the main reason for the dynamic collapse of building structures during earthquakes, accurately determined lateral displacements calculated in the elastic design process may provide very important information about the structural behaviour of the system. Therefore dynamic analysis procedure is required in many of the actual codes for accurate distribution of the earthquake forces along the building height, determining modal effects and local ductility demands efficiently. Although some of the current codes define soft story irregularity by stiffness comparison of adjacent floors, displacement based criteria for such irregularity determination is more efficient, since it covers all the mass, stiffness and force distribution concepts.

Spectral dynamic analysis was performed by ETABS 9.7.2. This comprehensive research evaluates how to create soft story with increasing story height and the effect of this increase on story stiffness in the structures. Finally by shifting soft story in story levels, the best level for soft story is suggested and by increasing height of soft story, the effect of this increase on the displacement and drift of the structure is examined. The innovation that introduced in this paper is shifting soft story, which caused by increasing height of story. By shifting soft story in story levels of the structure, the best level for soft story will be determined.

For modelling, a sample RC two dimensional building is selected. 7 and 9 storied RC moment frames with single bay are simulated and checked with the help of software ETABS 9.7.2. The height of all stories except soft story is 3 meters and the height of soft story 4/5, 5 and 5/5 meters is assumed. Every story is kept soft story for different case to get the changing trend. Earthquake effect is assigned by the software which is done by UBC 94. Dead load and live load are taken according to standard practice among the professional designers and engineers. Dynamic analysis of the building models is performed on ETABS. The lateral loads generated by ETABS correspond to the seismic zone III and the 5% damped response spectrum given in 2800 code. The natural period values are calculated by ETABS, by solving the eigenvalue problem of the model. Thus, the total earthquake load generated and its distribution along the height corresponds to the mass and stiffness distribution as modelled by ETABS.

After shifting of soft story in structure levels and analysing 48 models, these results are obtained:
1. By placing soft story in each story, imposed displacement to that story suddenly jumps. By shifting of soft story up to middle height of structure, the imposed displacement to soft story increases. But by shifting of soft story from middle height up to top of the structure, the imposed displacement to soft story decreases. Therefore when soft story places in the middle height of structure, maximum jump is occurred.

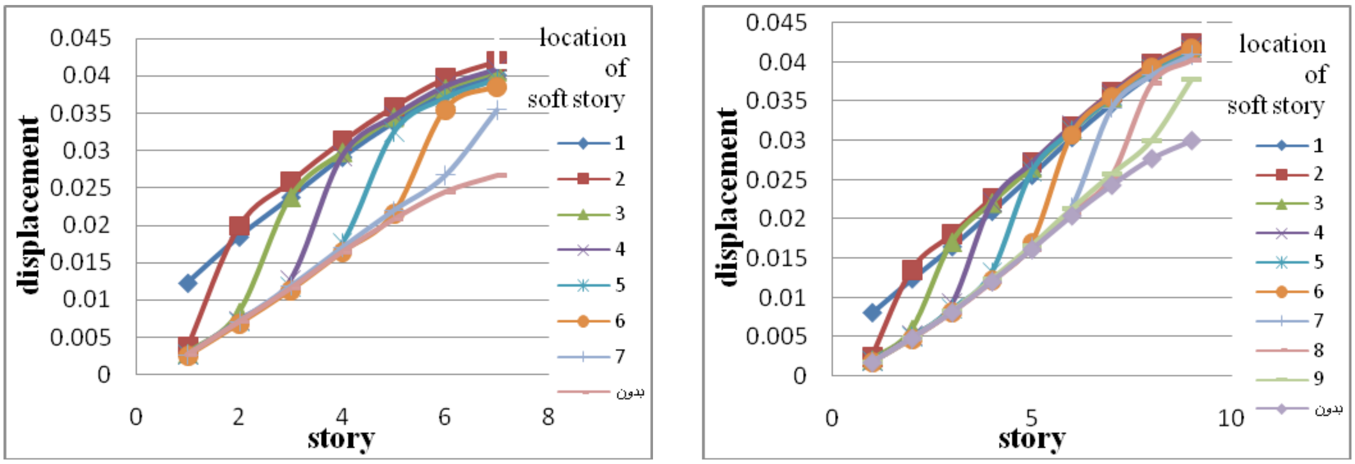

Figure 1. Displacement curves of 7 and 9 stories frame

2. By placing soft story in each story, imposed drift to that story suddenly jumps. By shifting of soft story up to middle height of structure, the imposed drift to soft story increases. But by shifting of soft story from middle height up to top of the structure, the imposed drift to soft story decreases. Therefore when soft story places in the middle height of structure, maximum jump is occurred.

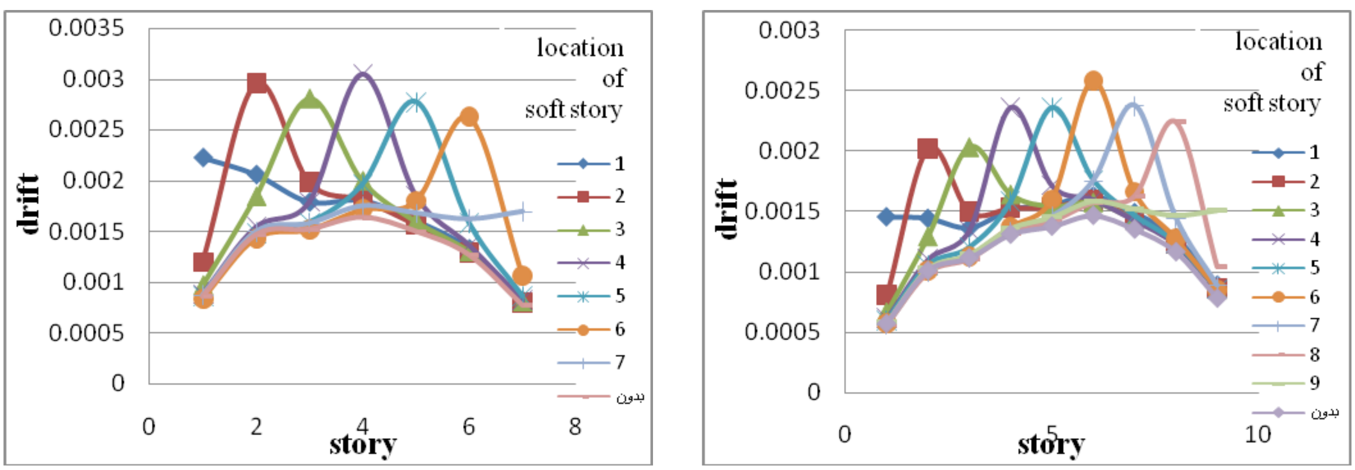

Figure 2. Drift curves of 7 and 9 stories frame

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