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P-Delta Effect on Residual Displacement and Collapse Capacity of SDOF Systems during Long and Short Duration Earthquakes

In structural analysis, P-Delta effect refers to the changes in internal forces due to P-Delta moment which can be found by multiplying gravity load (P) by the lateral displacement of structure for earthquake lateral load (Delta). The influence of P-Delta in elastic response of structures is ignorable, but P-Delta effect should be given more attention when the structure responds in inelastic range. On the other hand, the influence of ground motion duration is magnified when P-Delta effect is considered in the structural analysis. In this paper, to consider the simultaneous effect of ground motion duration and P-Delta effect, an algorithm is implemented in MATLAB which employs OPENSEES for linear and nonlinear dynamic analysis of elasto-plastic systems subjected to long- and short-duration records. The analysis results indicate that the frequency of structural collapse for long-duration ground motions is about twice of short-duration ground motions. The frequency of collapse also increases when ductility and stability index increase, but decreases when the period of structure increases. Furthermore, the increase of ground motion duration has no influence on the residual displacement of structures, but nonlinear behavior of structures and gravity load effect increase the residual displacements.

Keywords: P-Delta Effect, Strong Motion Duration, Residual Displacement, Collapse Capacity, Elasto-Plastic System.