PERFORMANCE OF MIDRISE ASYMMETRIC STEEL BUILDINGS WITH PERIMETER MOMENT FRAMES AND INTERNAL BRACED FRAMES AGAINST STRONG GROUND MOTIONS

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Experiences from past earthquakes show the structure torsion as a building damage causes during strong ground motions. Torsion effect can be due to irregularities in the plan, the center of mass, stiffness or distribution of resistance. Asymmetric structures seem more prone to earthquakes damages than symmetric structures, and their vulnerabilities should be considered in design procedures. Furthermore, the usual cause of distortions in the structure during an earthquake is the eccentricity of mass and stiffness centers (Moghadam and Tso, 1996).

Near-field earthquakes have certain characteristics that distinguish them from far-field earthquakes. This kind of strong ground motions recorded at distances less than 10 km to active faults fracture plates have much greater acceleration record and more limited frequency band than that of far-field records. Mapping of the three components of these records, especially when they contain the effects of the progressive direction have long-period pulses with large amplitudes. Generally, the large pulses occur when in the first part of the time history a near-field robust record happens (Moghadam and Tso, 2000).

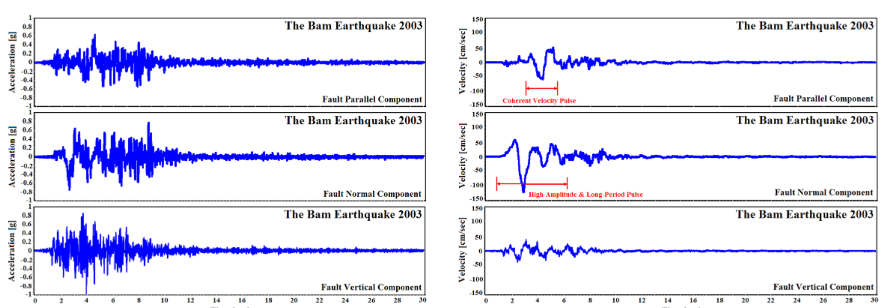

Figure 1. Acceleration and velocity time history record Bam 2003

These characteristics in near-field earthquakes causes the mode state response of structures in which few basic modes with large periods are crucial, and the effects of the dynamic wave response and wave propagation appear larger. Seismic response of mid to high-height buildings would be affected by both modes behavior and the seismic wave propagation effects.

The correlation between dynamic torsion and transitional response of asymmetric buildings leads to increased displacement ductility demand at the soft edges, and the need to ductility on hard edge of the structure. Also, due to changes in the stiffness centers during the severe nonlinear behavior of asymmetric buildings under strong near field earthquake, the prediction of the seismic response is much more complicated relative to those with the elastic behavior (Elnashai and Di Sarno, 2008)

This study focuses on the seismic behavior of a 15-story steel building consisted of moment resisting and braced frames with irregular plan. The seismic response parameters of the structure against an extensive set of earthquake records of near and far fields were evaluated. The records were applied in free field mode. Then, the changes in asymmetric structural parameters were investigated from engineering seismology perspective, and considering the detailed physical specification of robust records of near field. Asymmetric measures were changed by changing in the position of the geometric center of mass of story. Figure 2 illustrates three different positions of the center of mass which were considered.

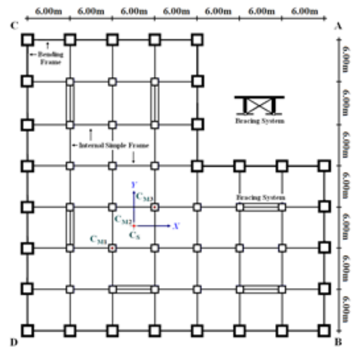

Figure 2. Plan of the structure

Seismic response parameters were studied including maximum drift of stories; maximum displacement of stories, relative velocity of stories, maximum absolute acceleration of stories, as well as the base shear. Above mentioned parameters changes have been monitored in some specific corners of the structure. Figure 3 clearly shows big differences in nonlinear seismic response due to the displacement of the centre of mass of the stories. Maximum drift of stories in x and y directions indicates changes under the effects of near field records.

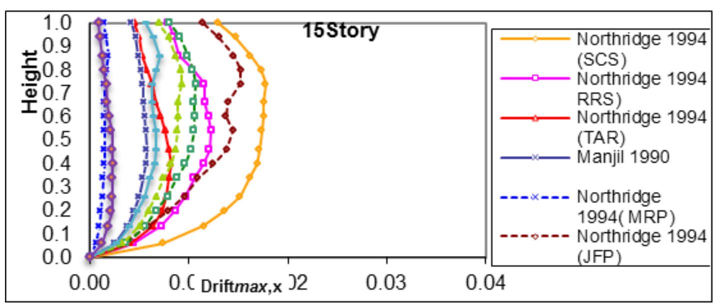

Figure 3. Maximum drift of the classes specified in the plan Drnqth

It is concluded that the difference between maximum relative velocities of stories is an important factor which dominate the increasing and decreasing rate of other seismic response characteristics of the structure.

REFERENCES

Elnashai AS and Di Sarno L (2008) Structural Configuration and systems for Effective Earthquake Resistance Fundamentals of Earthquake Engineering, John Wiley & Sons, ISBN:978-0-470-02483-6

Moghadam AS and Tso WK (1996) Damage assessment of eccentric multistory building using 3D pushover analysis, *11WCEE,* Elsevier Science, Paper No. 997

Moghadam AS and Tso WK (2000) Push over analysis for asymmetric and set-back multistory building, in proceedings, *World Conference on Earthquake Engineering,* Acopulco, PP. 1093