COMPARING NONLINEAR BEHAVIOR OF TRF AND EBF LATERAL RESISTANT SYSTEMS UNDER CYCLIC LOADING

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Improving computers and simulation abilities paved the way for novel ideas analysis in modifying seismic behavior with high precision and less cost. One of the seismic resisting systems which is recently proposed is T-resistant frame (TRF) (Ashtari and bandehzadeh, 2010). This system consists of a vertical member with deep cross section (P.G.BR in Figure 1) which is located in the middle of bay thorough the whole stories and deep beams (P.G.1 in Figure 1) connected to its sides at story levels. Investigations on this system have proved the appropriate performance of it (Ashtari and Gorzin, 2011; Ashtari and Ghassemi, 2011). Comparison of this system with the other seismic lateral resistant systems in the same condition can play an important role in choosing the most appropriate lateral resistant system according to limitations and circumstances of each project. In this paper, behavior of TRF system and eccentrically braced frame (EBF) system which is one of the best known lateral resistant systems is studied in nonlinear domain.

Studied models are one bay one story 2D frames used TRF and EBF systems in the same condition (Figure 1). The frames are simulated and analyzed in ABAQUS finite element software.

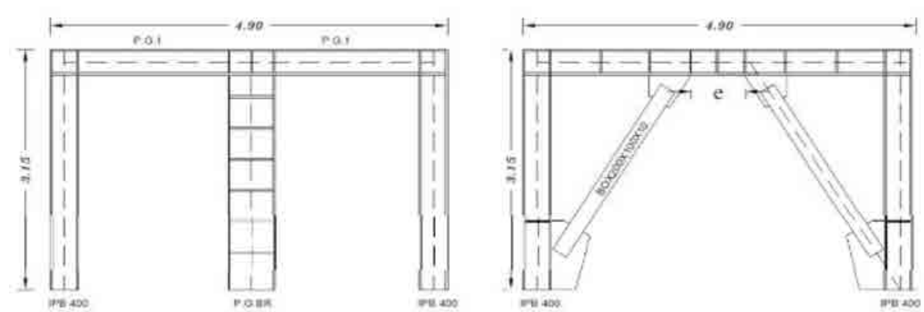

Figure 1. Typical T-shape resistant frame (at left) and eccentrically braced frame (at right)

Proposed cyclic loading protocol in SAC-ATC24 is used as displacement in story level in order to investigate the cyclic behavior of models. Comparison parameters are Vonmises stress distribution, hysteresis curves, dissipated energy, viscous damping ratio and side column axial forces.

In this paper, impact of vertical member stiffness, distance and its web thickness are investigated. Moreover different behaviors of link beam in EBF system are studied considering its length.

As shown in Figure 2, vertical member in TRF systems operates like a fuse as the link beam in EBF systems. It prevents other members from entering nonlinear zone significantly by its yielding. Consequently, global stability of frame is achieved in strong earthquakes. As can be seen in Figure 3, hysteresis curves of studied frames illustrate that both systems have stable curves. Although, hysteretic curves in EBF system are wider than TRF's. It can be inferred by investigating the frames dissipated energy that most of dissipated energy in TRF system is due to yielding of vertical member web which operate as EBF's link beam. Viscous damping ratios are close to each other in two systems so that in EBF system is 40.5 percent and in TRF system is 37.8 percent. Referring to the results of this paper and the other past investigations, it can be concluded that TRF system is a proper supersede of EBF system considering architectural and construction limitations.

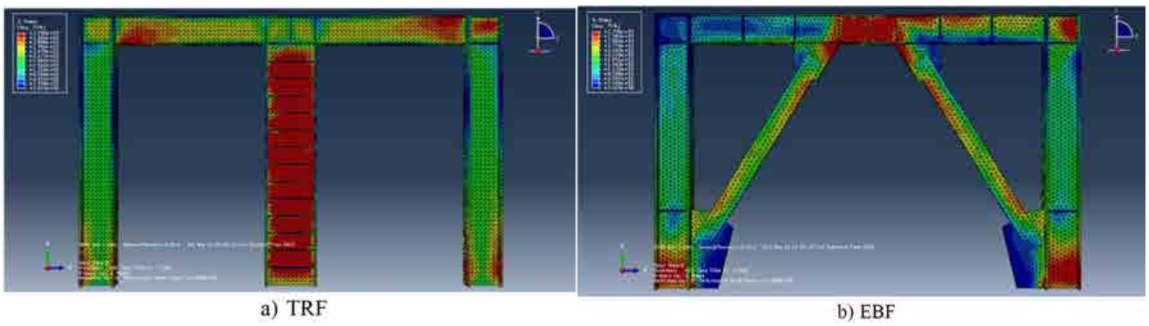

Figure 2. Vonmises stress distribution in a) TRF and b) EBF frames

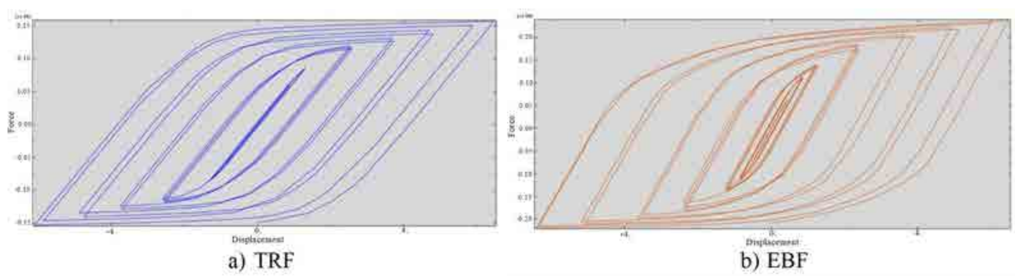

Figure 3. Hysteretic curve of a) TRF and b) EBF frames

Reduction in stiffener spacing of TRF vertical member leads to increase shearing stiffness of the member. Consequently, in connection region of vertical and horizontal parts of the TRF members Vonmises stresses are amplified. Moreover, Results depict that web thickness increase of TRF system vertical member escalate the stress values in three regions namely: a) connection region of vertical and horizontal members of TRF, b) connection between side columns to horizontal member and c) bottom area of the side columns. The probability of Web diagonal buckling of TRF vertical member increases by increase stiffener spacing under shearing stresses. Side column's Axial forces in all studied frames by the writer have higher values in EBF model in comparison with TRF ones. In TRF system, axial forces in side columns are increased due to using more stiffeners and thicker web of the vertical member. Viscous damping of the TRF system is also decreased by making use of thicker web of vertical member.

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