7th International Conference on Seismology & Earthquake Engineering
18-21 May 2015
00437-SC
7th International Conference on Seismology & Earthquake Engineering
18-21 May 2015

# COMPARING RESPONSE MODIFICATION FACTORS OF T-SHAPE RESISTANT FRAME WITH ECCENTRICALLY BRACED FRAME

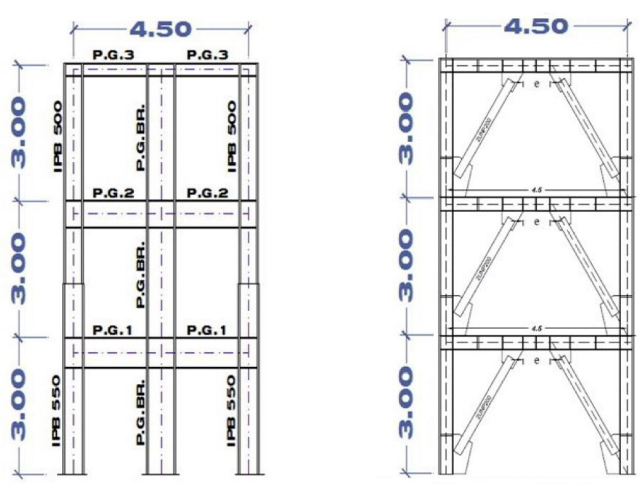
Mostafa GHASSEMI
*M.Sc. Graduate in Structural Engineering, University of Zanjan, Zanjan, Iran*
*m_ghassemi@znu.ac.ir*

Mahdi GORZIN
*M.Sc. Graduate in Structural Engineering, University of Zanjan, Zanjan, Iran*
*mahdigorzin@yahoo.com*

Hossein TAJMIR RIAHI
*Assistant Professor, University of Isfahan, Isfahan, Iran*
*tajmir@eng.ui.ac.ir*

**Keywords:** T-Shape Resistant Frame, Eccentrically Braced Frame, Response Modification Factor, Over Strength Factor, Ductility Factor

Response modification factor is one of the seismic design parameters which considers nonlinear performance of building structures during strong earthquakes. The present paper tries to evaluate response modification factors of a new structural lateral resistant system called ‘T-shape resistant frame’ (TRF) and compares its performance with eccentrically braced frames (EBF). This new form of framing system is constructed through a deep I-shaped steel beam which is vertically placed in the middle of span, connected with two other deep I-shaped beams to the columns at each storey level (Figure 1). The TRF system has been proposed primarily by Ashtari and associates (Ashtari and bandehzadeh, 2010). Past researches have shown that this system has ductile behaviour, high capability of energy dissipation and appropriate response modification factor under sever earthquakes (Ashtari and Gorzin, 2011; Ashtari and Ghassemi, 2011). Most of energy is dissipated due to yeilding of the TRF vertical member web. Comparing of design parameters of structures, such as response modification factor, helps designers to select and utilize the optimum and appropriate lateral resistant systems. Since the response modification factor depends on ductility and over strength, the static nonlinear analysis have been performed on 2D models building including 3, 5, 8 and 12 stories with single bracing bay. The TRF and EBF values for factors such as ductility, over strength and response modification have been evaluated for all the buildings.




A) 3 story TRF System B) 3 story EBF System

Figure 1. TRF and EBF frames: A) 3 story TRF system, B) 3 story EBF system

It can be inferred from the results that in both systems, with increasing in number of stories, stiffness of frames decreases and yeild displacement in pushover curves increases. Response modification, ductility and over strength factors have been compared in Figure 2. According to Figure 2, ductility factors of TRF system except in 3 and 5 stories frames, are further comparing to EBF's. Ductility farctor decreases uniformely with increasing in number of stories in EBF frames. But there is not a considerable change in TRF frames except in 8 story frame. Response modification factors of TRF systems have been obtained 9.8, 9.7, 11.1 and 8.4 for 3, 5, 8 and 12 stories frames respectively, which are more than of EBF's in all models. This parameter for TRF frames alteres from 20 to 126 percent more than EBF's. Maximum and minimum response modification farctor for TRF are accured in 8 and 12 stories, although it is obtained from 5 and 12 stories of EBF system respectively. As can be seen in Figure 2, overstrength factors of TRF which are gained from analyses of taller building are less than shorter ones. Its decrease reduces with increasing in number of stories. This parameter for EBF system does not have a considrable change from 3 to 8 stories, but in 12 stories frame it is decreased 17 percent in accordance with 8 stories frame. It can be concluded from the results that energy dissipation of TFR systems are significant and they are more efficient in sesimic performance than EBF systems.

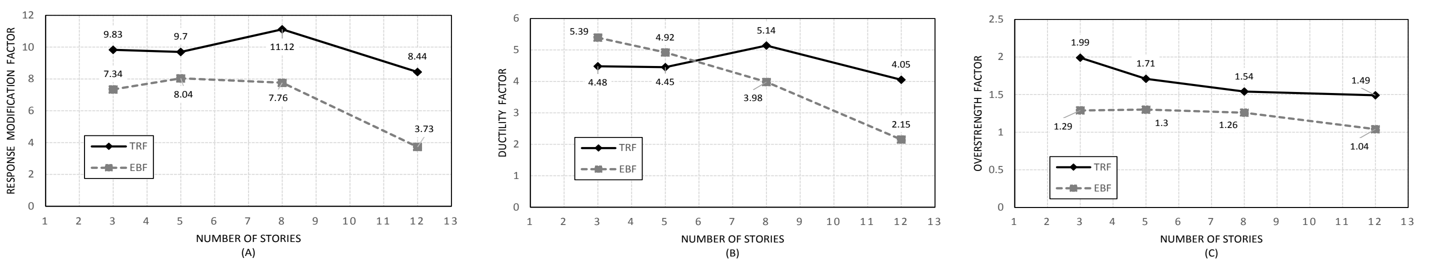



Figure 2. Comparison of TRF and EBF values for factors: A) Response modification factor, B) Ductility factor and C) Overstrength factor

## REFERENCES

Ashtari P and Bandehzadeh M (2010) Seismic evaluation of new crucial beam-column lateral resistant system, *Eighth International Conference of Civil Engineering,* Shiraz, Iran

Ashtari P and Gorzin M (2011) Seismic behavior of innovative T-shape Resistant System, *Sixth International Conference of Seismology and Earthquake Engineering (See6),* Tehran, Iran

Ashtari P and Ghassemi M (2011) Seismic characteristics of a T-shape resistant system, *6th National Congress on Civil Engineering,* Semnan University, Semnan, Iran