Study on Braced Building Under Seismic Load: A Review

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Abstract- *Seismic analysis means finding the response due to earthquakes. Many researcher worked on the analysis of multi-storied Reinforced Cement Concrete (RCC) symmetric building frame for various types of bracing system subjected to seismic loads according to IS 1893-2002 (Part-1) using linear and nonlinear analysis on software and identify the suitability of the bracing systems to resist the seismic loads efficiently and also the importance of bracing system of building frame in order to resist the lateral forces such as earthquake and wind as well as to increase the stiffness and stability of structures. Based on the literature paper the structure analyzed with considering infinite number of pattern for giving the optimizing bracing system on structure.*

Keywords- RCC frame, software, steel bracing.

I. INTRODUCTION

1.1 General Information

Earthquake caused not only rupture of geological faults inside earth but also mine blasts, landslide, atomic tests and volcanic movement. Now a day's rapidly increase in population also land stringency increases. Hence, the construction of multi-storey building in residential and urban areas but suddenly occurrence the earthquake so many people die. In last few decades, the earthquake occurred in Gujarat-India on 26th January 2001 at 8:46 A.M. which is also called as Bhuj Earthquake having 7.7 Magnitude. This earthquake killed people 19727 (Including 18 in southeastern Pakistan), also injured 166000 and destroyed approximately 400000 houses. Therefore there was lack of lateral stability in RCC structures.
To improve the stability of RCC structure the various method used in modifying the high rise building such as shear wall, diaphragm and bracing system.

A braced building is the one which is reinforced by steel members which increase the tensile as well as compressive strength of the building. Bracing perhaps happens in the periphery of the building and it's in plane, also it is mainly used in steel structures

Figure 1.1.1 Bhuj Earthquake map

The analysis of building frame under seismic loads using software and finding the effective bracing systems to resist the seismic loads. Generally steel bracing is more economical for resisting seismic load than other material.
The advantages of Braced buildings are:

a. Due to bracing of the buildings, lateral storey displacement, storey drift as well as axial force and bending moment in columns reduces to a remarkable level.
b. Reduction in lateral displacement is a major advantage.
c. Braced frames resist the wind and seismic forces, much more than unbraced buildings.
d. Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness.

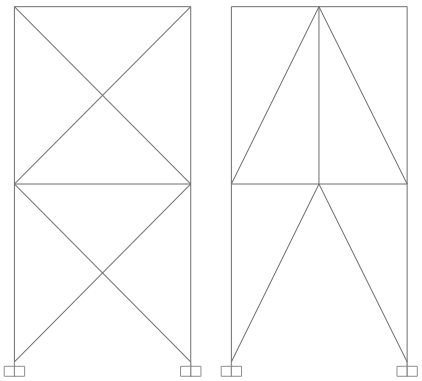
1.2 Bracing System Types

Categorized bracing system provide in frame structure as follows

a. Concentric Bracing
b. Eccentric Bracing
c. Knee Element Bracing

Concentric Bracing

In this types of bracing system the Bracing are connected to beam-column joints. Concentric bracing consists of diagonal braces located in the plane of the frame. Both ends of the brace join at the end points of other framing members to form a truss, creating a stiff frame. Concentric bracing may be arranged in several different configurations – such as X and zipper bracing and the bracing members may be designed to act in tension or compression or both. Balanced diagonal bracing is the most common for medium rise structures because it provides the same strength in both directions.
Efficient energy dissipation is difficult to achieve in concentrically braced frames.



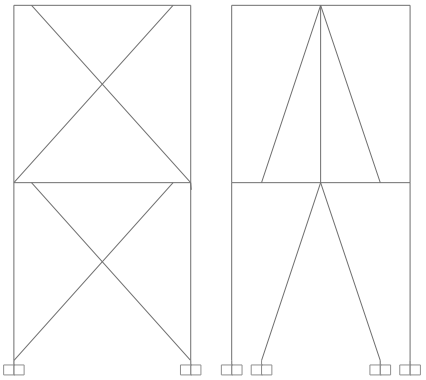
1. X- Bracing ***2. Zipper- Bracing***

Figure 1.2.1 Concentric bracing system

Eccentric Bracing

Eccentric bracing consists of diagonal braces located in the plane of the frame where one or both ends of the brace do not join at the end points of other framing members. The system essentially combines the features of a moment frame and a concentrically braced frame, while minimizing the disadvantages of each system.

The eccentric connection to the frame means an eccentric brace transfers lateral forces via shear either to another brace or to a vertical column.

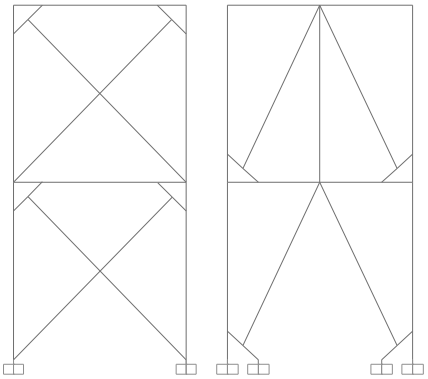


1. X- Bracing ***2. Zipper- Bracing***

Figure 1.2.2 Eccentric bracing system

Knee Bracing

Knee bracing consist of diagonal braced they can act as lateral bracing similar to moment frame connections. Knee element means the extra link connected to beam-column member they can be used to brace beam flanges in compression. For example, if the beam runs over the top of column and puts negative moment in the bottom flange, the knee brace can brace the bottom flange for compression to prevent buckling. The damages occur in knee element due to earthquake can easily replaceable.



1. X- Bracing ***2. Zipper- Bracing***

Figure 1.2.3 Knee element bracing system

II. RECENT RESEARCH WORK

The literature work carried out on the different types of bracing system. This literature paper studied the concentric bracing system, eccentric bracing system and knee element bracing system. All research paper considering as recent research work only.

Waghmare et.al [1] analysed high rise symmetric steel framed by considering earthquake load. In this study a thirty-one storey building with various braces analysed for zone III as per IS 1893:2002 using STAAD-Pro. The Concentric bracing, eccentric bracing and knee element bracing system considering for this study. The material selected for this particular study was M25 grade of concrete and fe250 mild steel and the whole structure analysed by response spectra analysis. This studied not considered alternate method such as time history method and limited for zone III. **Anitha et.al [2]** studied on seismic behaviour of knee braced frame & eccentric braced frame and their comparison. Analysed the single storied steel framed by nonlinear static analysis and nonlinear time history analysis. Lateral stiffness will increased by increasing length of knee element but ductility value reduces with further increase in length of knee element. In this study the effective length of knee element was carried out by comparing the lateral stiffness (b=h=700mm length of knee element), displacement and also compared the double knee braced with eccentric braced frame. The researcher not goes for high rise building response. **Shreeshma et.al [3]** performed assessment of different types of eccentric braced Systems considered two different height such as (G + 9) and (G + 5) steel building analysed by ETAB 2015 and obtained the variation of performance with changed in link of beam and column length, height. Decrease the time period with increasing the stiffness. Eccentric brace frame shows less time period as compare to concentric bracing. **Priyanka et.al [4]** analysed unsymmetrical twenty storeys RCC frame building. Considering regular shape, C shape, L shape and U shape for soft soil zone IV with different bracing analysed by ETABS software and found that the percentage reduction of time period was nearly same for different shapes of building performance of X-bracing will be best for all shape of building as compare to V and K.

Dinil et.al [5] studied on both concentric and eccentric type of bracing based on performance seismic analysis of steel structure fifteen storey steel building for zone IV with different types of bracing studied and found that the parameter such as Base shear, Joint Displacement and Storey Drift, overall the X -bracing was best. The researcher limited bracing system and zone of earthquake. **Bhosle et.al [6]** analysed RCC frame thirteen storey residential building with compare the concrete and steel bracing for zone III analysed using ETAB software and found that reduction of displacement of two parallel side of bracing was more effective than all side significantly. Hence minimize the bracing number. Base shear was more for concrete-X bracing. **Mohd Mubeen et.al [7]** analysed the steel frames with eccentric bracings using pushover analysis ten storey steel frames building in is analysed by using ETABS 2013 and found that bracing provided in both the directions, the base shear and maximum displacement occurred in inverted V bracing. However ISA section reduces more displacement as compared to ISMB section for similar type of bracing. **Adithya et.al [8]** studied on effective bracing systems for high rise steel structures (G + 19) storey steel structure analysed by ETABS software and found that the beams and columns are designed to with stand dead and live load only. Wind load and Earthquake loads are taken by bracings The lateral storey displacements of the building are greatly reduced by the use of single diagonal bracings arranged as diamond shape in comparison to concentric (X) bracing and eccentric (V) bracing system.

Shachindra et.al [9] determined the most effective steel brace by considering (G + 14) RCC building for zone IV analysed by STAAD pro V8i and found that the bending moment and shear force also node displacements and storey drifts best result for inverted V braced frame as compared to V braced frame. **Amol et.al [10]** studied inelastic behaviour of eccentrically braced frames under Non Linear Range (G + 3) and (G + 7) storey in zone II analysed by ETABS 2013 and found that the Eccentric Diagonal bracing system was better because of its good performance. The Eccentric Inverted-V was the best. **Musmar et.al [11]** studied on effect of link on eccentrically braced frames double storey frames analysed by SAP2000 with four types of bracing system and found that Structure with reduced section link having the proper section and length which would satisfy the capacity design requirement that the link yields while the larger beam section remains elastic. All eccentrically braced frame system adopted in this study with shorter links exhibited more stiffness than in case of flexural links; this behaviour was beneficial in terms of drift control.

III. CONCLUDING REMARKS

After the detailed study on literature paper the following concluding remarks are drawn.

1. The lateral stiffness increases and displacement reduces using bracing system.
2. Base shear increases by applying bracing system.
3. The selected bracing system types and arrangement gives the best result for example X-bracing, V-bracing and Inverted V-bracing.
4. Study carried out by using different height of frame with bracing system.
5. To analyze the structure for various arrangement for optimizing the bracing system.
6. To study the effects of various types of bracing systems, its position in the building and cost of the bracing system.

7. Study carried out by using various section of braced steel.

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