International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

A Review on Comparative Study of K Bracing System and X Bracing System for RC Frame Structures

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Abstract-*In this review paper we study some research papers which are relevant to my topic. The paper is related to the comparison between K type and X type bracing systems for a multistoried frame structure. We adopt seismic analysis of the structure for dynamic influences which is according to the IS code 1893 part-1:20002 and 2016 via ETAB software. The main purpose of this review paper is to know the suitability and effectiveness of the bracing systems in RC framed structures. Framed structures constructed as skyscraper building and dynamic loads play an important role in designing and analysis of these buildings. To counteract the effect of dynamic loads on the buildings, steel bracing system is attached in the building. So we have to determine the efficient and economic bracing system for structural design. Hence in this paper we compare the responses of the building derived when various bracing system is attached to the building.*

Key Words:Bracing System, Mode Effects, Seismic Analysis, Time History Analysis, Story Drift, Story displacement.

1.INTRODUCTION

RC frame structures are the structures having the combination of RC beams, RC columns and slabs to resists the static and dynamic loads. These structures are generally used to counteract the heavy moments developed by the applied loads. The major problem in the design of RC frame structure is the effect of lateral and torsional deflections under the action of fluctuating lateral loads. Due to these oscillatory and fluctuating deflections, a wide range of responses induced in the building. To overcome from these deformations and counteract the seismic effect on the structure, steel bracing system is a viable approach for a retrofitting a reinforced concrete frame.

1.1 Steel Bracing System

A steel bracing frame is a structural system commonly used in structures subject to dynamic loads such as wind load and seismic loads. The members in a steel bracing frame are made of structural steel because structural steel can work effectively both in tension and compression loading. In a frame structure, beam and column carry vertical loads and to overcome the lateral loads steel bracing system is adopted. Bracing system is very reliable and economic option to resist wind and seismic loads. Steel bracing framed construction is a new concept in which lateral loads are resisted. Steel braced frame models are effective means to transverse lateral forces caused by earthquake and wind forces in multi-story frame structures. Bracing systems hold the structure stable by distributing the loads.There are various types of Braced Frames such as concentrically braced frames and eccentrically braced frames. These Bracings are arranged in different configuration like X Bracing, V bracing, Inverted V bracing, Single diagonal Bracing.

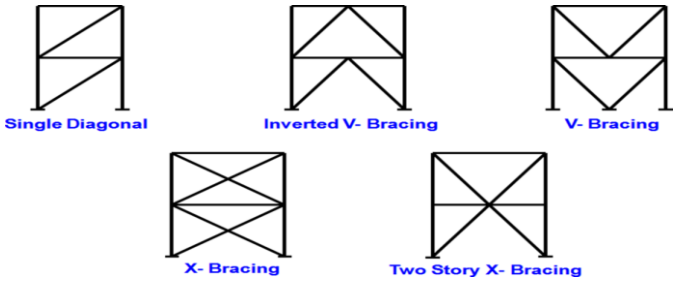

Fig. 1 concentrically braced frames

The above figure shows some concentrically braced frames. Except these, some eccentrically braced frames are given below as:

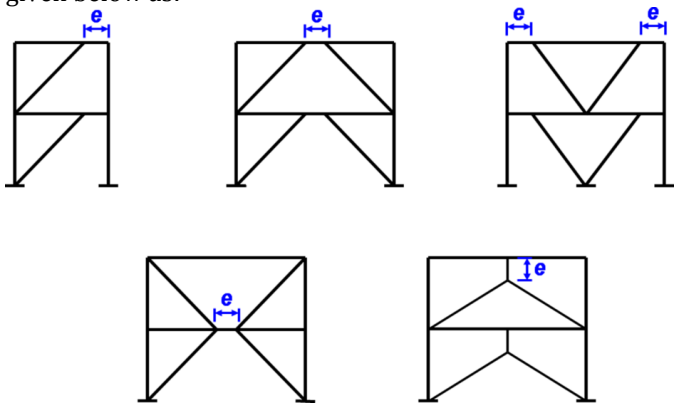

Fig. 2 eccentrically braced frames

2. LITERATURE REVIEW

Revives and conclusions of some research papers related to the study of X and K bracing systems in frame structure are given below:

[1]Dawn LEHMAN (2004)

The title of the research paper written by the author is 'Seismic Performance Of SCBF Gusset Plate Connection'. In this paper he concluded that the researchers proposed an innovative design methods based onsecondary yield mechanism, balancing the control yield mechanism, and critical failure mode to improve seismic performance of gusset plate connection used in concentrically braced frame system. Recommendations were examine for modeling the inelastic and post buckling behavior of the brace for pushover and dynamic time history performance.

[2]Shawn Johnson (2004)

The title of the research paper written by the author is 'Seismic Performance Of SCBF Gusset Plate Connection'. In this paper the author concluded that-

- Seismic response of braced frames largely depended on the response of braces.
- In high seismic zones, two systems were being used at that time; special concentrically braced frames (SCBF) and concentrically braced frames with buckling restrained braces (BRCBF).
- Braces in SCBF systems develop their inelastic action through compressive buckling and tension yielding. Buckling restrained braces (BRB) were encased in an un-bonded, stiff material that restricts brace buckling and they develop their ductility through compression and tension yielding.

Hence on the basis of these facts, the author told that in both types of systems gusset plate connections were used to connect the brace to the framing elements. These different systems place different demands on the connection by the brace depended on the brace type. Braces in SCBF systems place large axial and out-of plane rotational demands on the brace as a result of brace buckling. The stiffness of BRB can result in large in-plane moment and axial force demands. The connection design must account for these different demands.

[3] A.H. Salmanpour (2008)

The title of the research paper written by the author is 'Seismic Reliability of Concentrically Braced Steel Frames'. In this paper the author elaborated that

- The buckling Restrained braced frames (BRBFs) could more readily satisfy the collapse prevention criteria than the special concentrically braced frames (SCBFs) because the collapse prevention probability of BRBF model was less than 2%.
- The immediate occupancy probability of BRBF model was 66% where as the collapse prevention probability was about 43%, a value much higher than 2%.

[4] N.Ozhendekci(2008)

In this paper the author performed numerical investigation to evaluate the effect of the geometry of the eccentrically braced frames. The researcher studied nine eccentrically braced steel frames with various geometries with static pushover analysis. The rotation of load pattern and maximum link rotations pattern were similar and not similar respectively in pushover and inelastic dynamic analysis for EBFs with shear link.

[5] E. M. Hines (2010)

The title of the research paper written by the author is 'Eccentrically Braced Frames System Performance'. In this paper the author concluded that

- The discussions related to the seismic performance of low ductility steel systems designed for moderate seismic regions had generated new interest in the cost effective design of ductile systems for such regions.
- Eccentrically braced frames (EBFs) had a well-established reputation as high-ductility systems and had the potential to offer cost-effective solutions in moderate seismic regions, their system performance had not been widely discussed.
- New performance assessment results for EBFs in moderate seismic regions were compared to previous system studies with the intention of clarifying the nature of EBF system performance including: story drift Capacity, response to higher mode effects, and frame overurning forces.

[6] Jonathan Rozon (2012)

The title of the research paper written by the author is 'Impact of Seismic Response of Outer Beams, Braces and Columns on Global Seismic Behavior of Chevron Type Eccentrically Braced Frames'. In this paper the writer concluded that

- The global seismic response of 3-and 8 story eccentrically braced frames (EBFs) were studied using non-linear time history analysis.
- Analytical models were built in three computer programs. Similar maximum forces were obtained, but the inelastic deformation predictions at the element and global Structural levels showed sensitivity to the modeling employed.
- Current design methods failed to predict inter-story drifts and plastic link rotations, but the study confirmed the strong correlation between the two parameters associated with rigid-plastic behavior.
- It was confirmed that the flexural yielding of outer beams is acceptable for EBFs with short and intermediate links, if the combined flexural strength of the braces and beams was at least equal to the expected end-link moments and the braces can resist the associated axial force-bending moment demand.

[7] P.SAIRAJ(2014)

In this paper it was concluded that an economic aspects of G+4 multi-storey building designed by using braced frame composite construction. For the ductile performance over all displacement and inter story drift can be effectively controlled by adopting braced frame model. This concept was very useful for retrofitting of and seismic up gradation of existing multi-storied building.

[8]Gunjali Butani (2017)

The title of the paper, written by this author is "Comparative Study of Different Bracing Systems On G+29 Steel frame building". The main concept behind this research paper is as:

- The concept of using steel bracing system is one of the advantageous concepts which may use to strengthen the existing structures.
- Through the analysis, it is clear that diagonal bracing is more effective in most of the cases comparatively.
- Displacement produced by the lateral loads can be reduced up to 93% by using single diagonal bracing.

[9]Jonty Choudhary(2018)

The title of Research paper which written by this author "Comparative Study and Analysis of Un-braced RCC Framed Structures with Steel Braced RCC Framed Structures Using Response Spectrum Method" and conclusion is given below:

- 64.40% reduction in maximum story displacement in X-direction and 83.18% reduction in Y-direction comparatively when X-braced frames are used.
- 78.27% reduction in maximum story drift in X-direction and 105.99% reduction in Y-direction comparatively when X-braced frames are used.
- 17.5% reduction in base shear in X-direction and 29.54% reduction in Y-direction comparatively when X-braced frames are used.

[10] Rong Chen (2019)

The title of the paper written by the author is "Seismic Response Analysis of Multi-Story Steel Frames Using BRB and SCB Hybrid Bracing System" and key features of this paper are as follows:

- When the SCBs were installed to replace BRBs at certain stories, the global energy dissipation capacity will be deteriorated while the re-centering capability was enhanced, according to the cyclic pushover results.
- The hybrid bracing configurations that use SCBs and BRBs in alternative stories were suggested, and considering such a placement reduced the maximum and residual story drift ratios by approximately 2% and 65%, respectively, compared with the pure BRBF.

3. CONCLUSIONS

After study all research paper which is given in the literature review, the following conclusion come out:

- On the basis of above papers, it is concluded that concentrically braced frames had high ductility performance.
- Concentrically bracing system can easily retrofitted with framed structures and can effectively control the various responses of the buildings such as story drift, displacement etc.
- The geometry and shape of the bracing system directly influence the behavior of the structure against the seismic loading.
- Performance assessment results of concentrically braced frames in moderate seismic regions including story drift capacity, response to higher mode effects and overturning effects, are depend upon the geometry of the braced frame.

REFERENCES

[1] Dawn Lehman& Shawn Johnson "Seismic response of SCBF Gusset plate connection" 2004.

[2] A. H. Salmanpour "Seismic Reliability of Concentrically Braced Steel Frames" 2008.
[3] E. M. Hines "Eccentrically Braced Frames System Performance", 2010.
[4] Jonathan Rozon "Impact of Seismic Response of Outer Beams, Braces and Columns on Global Seismic sBehavior of Chevron Type Eccentrically Braced Frames", 2012.
[5] Gunjali Butani "Comparative Study of Different Bracing Systems On G+29 Steel frame building" 2017, International Journal of Advance Engineering and Development (IJAERD) Vol 4 Issue 3, March,2017.
[6] Jonty Choudhary "Comparative Study and Analysis of Unbraced RCC Framed Structures With Steel Braced RCC Framed Structures Using Response Spectrum Method" 2018, International Journal of Engineering Research and Technology(IJERT) Vol. 07 Issue 08, Aug. 2018.
[7] Rong Chen "Seismic Response Analysis of Multi-Story SteelFrames Using BRB and SCB Hybrid Bracing System" 2020,Appl. Sci. 2020, 10, 284;journal homepage: www.mdpi.com/journal/applsci.
[8] IS 1893 part i:2002 and 2016.