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# Evaluate the Lateral Displacement that Occurs in Each Storey of High Rise Buildings by using Staad-Pro Software

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## ABSTRACT

For braces angle section ISA 600mm X 400mm X 60mm is used. There are four trial locations in the building where braces are placed and analyzed for their effect on lateral stiffness. Braces are modeled as axial force members having pinned end connections. Bracings are of X-type modeled throughout the height of the building. Based on results obtained by Staad Pro. Software the following conclusions are drawn: Base shear is same for zone III, zone IV, and zone V. Lateral displacement is minimum for BEC4 for zone III, IV and V. This type of bracing BXY3 is suitable for zone III, IV and V. The minimum axial force found in BX1, BXY3 and BEC4 in zone III, for zone iv BX1, BXY3 and zone VBX1 is economical. The minimum bending moment occurs in zone III, IV and Zone V for BXY3 system. Torsion Increases owing to bracing. The shear force is found out by zone III, IV and Zone V increasing. The maximum bending moment reduces to BX1 frame in zone III, IV in ZONE V it reduces.BX1 Frame is more effective in resisting maximum bending moment and is more economical. However no particular bracing is suitable for zone III, IV, V individual bracing has to be designed for Seismic zone. Also economy in bracing can be found by suitable design. Steel bracings can be utilized as an option in contrast to the next reinforcing or retrofitting methods accessible as the all-out weight on the current structure won't change essentially.

***KEYWORDS:*** *shear force, Multi storey Building (G+14), STAAD PRO, I.S CODES (1893:2016), Response Spectrum Method, Base shear*

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## I. INTRODUCTION

To resist Lateral load such as seismic forces and wind load various structural system are used such as shear wall, braced frame, outriggers but as we increase height of building shear wall become economical and that's why bracing system is preferred over shear wall for high rise building. Building mostly subjected to lateral load, and must be design to fulfill the requirement of strength and stiffness, on implementation of bracing system, seismic performance can be improved along with increase in strength and stiffness. The lateral displacements and drift arises due to the seismic and wind loads must be properly controlled in order to avoid the structural as well as nonstructural damages. For tall building, it has been found that Suitability and economic criteria of shear wall is limited up to some Heights Which leads to a requirement of the structural system which provides adequate stiffness And Strength Against the seismic loading and winds and satisfy economic criteria to a tall building. Bracing system provides better performance in term of the storey drift and storey displacement. With the same amount of material cost, which makes it economical compared to the other structural system, and it is the best option in economic criteria. With the addition of diagonals between floors, which act as truss members, better seismic performance can be achieved effectively. The primary purpose of diagonals is to transfer axial loads to columns and carry lateral loads, which behave as an effective natural structural system.

## II. LITERATURE SURVEY

**Khatib et al. (1988)** analyzed the failure mode observed in special moment resisting braced frame systems with fracture of bracings at the locations of plastic hinges or local buckling. Significant storey drift were observed at a single storey and showed how the failure is concentrated entirely on single floor. The limitations of using moment resisting frames with bracing systems were observed.

**Uriz and Mahin (2004)** supplied a paper on Seismic performance assessment of concentrically braced metal frames. The normal investigation includes systems that utilize traditional braces, buckling constrained braces and braces incorporating viscous damping gadgets. In the primary part the equal reliability framework as used to assess Special Moment Resisting Frame (SMRF) structures all through the FEMA/SAC Steel Project changed into employed to assess the confidence with which Special Concentric Braced Frames (SCBF) and Buckling Restrained Braced Frames (BRBF) may attain the seismic performance anticipated of new SMRF production. In the second one component, a take a look at application to help improve modelling of SCBF systems is described, including the design of a almost massive, - story SCBF take a look at specimen. The self-belief that a 3 tale SCBF designed in keeping with the 1997 NEHRP provisions is capable of achieve the crumble prevention overall performance intention became less than 10% for all definitions capacity and a seismic hazard corresponding to a 2% chance of exceedance in 50 years. A further designed six-story BRBF changed into tested to be lots more reliable. The performance-based totally evaluation method for characterizing and improving the performance of steel braced frames incorporating traditional bracing, buckling confined braces, friction and hysteretic gadgets, and viscous dampers.

Dolce et al. (2005) performed shake table tests on reduced scale RC frames endowed with either steel or superelastic SMA braces. The experimental outcomes showed that the new bracing system based on SMAs may provide performances at least comparable to those provided by currently used devices, also in absence of design criteria and methods specifically addressed to the new technology. With respect to steel braces, the innovative bracing configuration presented excellent fatigue resistance and recentering ability. Due to this property, since the vertical-load-resisting structural system is always restored at its initial shape at the end of the action, it was then possible to allow for great ductility demand in RC members. Accordingly, such approach highlighted the advantage of needing no strengthening of the frame then resulting more attractive from an economic point of view.

**Leon and DesRoches (2006)** has executed a studies paintings on behaviour of Braced Steel Frames with Innovative Bracing Schemes. Conventional bracing structures include traditional diagonal and chevron bracing configurations, in addition to modern concepts which include strut-to-ground and zipper braced frames (Khatib et al. 1988, Bruneau et al. 1998). Seismic rules and guidelines for the seismic layout of CBFs can be observed within the Structural Engineers Association of California (SEAOC) Recommended Lateral Force Requirements (SEAOC 1996), the International Building Code (IBC 2000), the NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings (BSSC 2000), and the AISC Seismic Provisions for Structural Steel Buildings (AISC 2002). Diagonal and chevron structures can provide huge lateral electricity and pressure however do now not provide exquisite ductility as buckling of the diagonals results in speedy loss of power without plenty pressure redistribution (Goel 1992).

**Tremblay et al. (2008)** to compare the Buckling restrained braced frames with self centering energy dissipating frames. The residual deformation of SCED brace frame systems was observed to be negligible under low and moderate hazard levels and wass reduced significantly under MCE or maximum considered earthquake level.

**Ghomi et al. (2008)** Bending and shear deflections are examples of lateral deflections in buildings. Combinations of several sorts of coupled systems can effectively manage bending deflection. However, shear deflection can be reduced by increasing the shear stiffness of structures. The new idea is introduced, and the use of the Easy Going Steel (EGS) theory to improve the behaviour of X-bracing systems is described in this study. The application of this theory to the design of X-Braces can improve building lateral stiffness and reduce lateral displacements.

**Alshamrani (2009)** A 40 storey building of dimension 30m x 30m was supposed to be located in Dammam, Saudia Arabia, was analyzed for comparison of various types of bracing like Diagonal, Eccentric, Cross and Chevron type of bracings. The Lateral Drift was found out in the area of high wind velocity of 145 km/h with almost no significant earthquake recorded. This analysis was done using Staad.Pro 2005. The structure was analyzed for two conditions: the bracings were allowed at two locations, i.e., at the core of the structure and the external parameter. From the study, he concluded that the Chevron bracing and Cross (X) bracing are highly resistive to the lateral loads. However, the Chevron bracings are cost efficient over the expensive cross bracing. Another result concluded was the bracing should be placed at the core instead of the building facade.

**Deulkar et al. (2010)** used five different configurations for their study on the BRB system to help with vibration control. The projects compared the reduction in roof displacements obtained from analyses of different bracing configurations and found that the inverted V-bracing has the least roof displacement of the tested configurations.

**Ozel and Guneyisi (2011)** investigated the seismic reliability of a mid-rise reinforced concrete (R/C) building retrofitted using eccentric steel braces through fragility analysis. As a case study, a six storey mid-rise R/C building was selected. The design of selected sample building was made with reference to 1975 version of the Turkish Seismic Code. The effectiveness of using different types of eccentric steel braces in retrofitting the building was examined. The effect of distributing the steel bracing over the height of the R/C frame on the seismic performance of the retrofitted building was studied. For the strengthening of the original structure, D, K, and V type eccentric bracing systems were utilized and each of these bracing systems was applied with four different spatial distributions in the structure. For fragility analysis, the study employed a set of 200 generated earthquake acceleration records compatible with the elastic code design spectrum. Nonlinear time history analysis was used to analyze the structures subjected to this set of earthquake accelerations generated in terms of peak ground accelerations (PGA), whilst monitoring four performance limit states. The fragility curves were developed in terms of PGA for these limit states; namely: slight, moderate, major, and collapse with lognormal distribution assumption. The improvement of seismic reliability achieved through the use of D, K, and V type eccentric braces was evaluated by comparing the median values of the fragility curves of the existing building before and after retrofits. As a result of this study, the improvement in seismic performance of this type of mid-rise R/C building resulting from retrofits by different types of eccentric steel braces was obtained by formulation of the fragility reduction.

**Gajjar et al. (2011)** Investigated, the design of multi-storeyed steel building is to have great parallel load opposing framework alongside gravity stack framework since it additionally administers the plan. They exhibited to demonstrate the impact of various sorts of supporting frameworks in multi storied steel structures. For this reason the 20 stories steel structures display is utilized with same setup and diverse bracings frameworks, for example, knee support, X prop and V prop is utilize. A business bundle STADD Pro is utilized for the investigation and plan and diverse parameters are analyzed.

**Amini et al. (2012)** studied the effect of bracing arrangement in the seismic behavior of buildings with various concentric bracing by nonlinear static and dynamic analysis. In this study a set of regular multi-story steel building were considered with three kind of x, v and chevron bracing, in two placements of 'two adjacent bays' and 'two non-adjacent bays' along the building height. Results show that in all cases, bracing arrangement in non-adjacent bays leads to lower stiffness but higher strength than in adjacent bays.

**Zandi (2013)** discussed on comparison between thin steel plate shear walls with dual system of steel moment frame and cross bracing or chevron with a design method based on performance levels. The study focused and discuss on the dual system comprising with thin steel plate shear wall and bracings. In addition, it is based on steel moment resisting frames and approach on performance based design has been arrogated in this research.

**Parasiya et al. (2013)** has showed a review on comparative analysis of brace frame with conventional lateral load resisting frame in rc structure using software. It has been represented that the parameters of bracings, locations & stiffness of bracings have notable effect on the performance of a building.

**Siddiqi et al. (2014)** has conducted the comparative study of five different types of bracing systems for the use in tall building in order to provide lateral stiffness and finally the optimized design in terms of lesser structural weight and lesser lateral displacement has been exposed. For this purpose a sixty storey regular shaped building is selected and analyzed for wind and gravity load combinations along both major and minor axes.

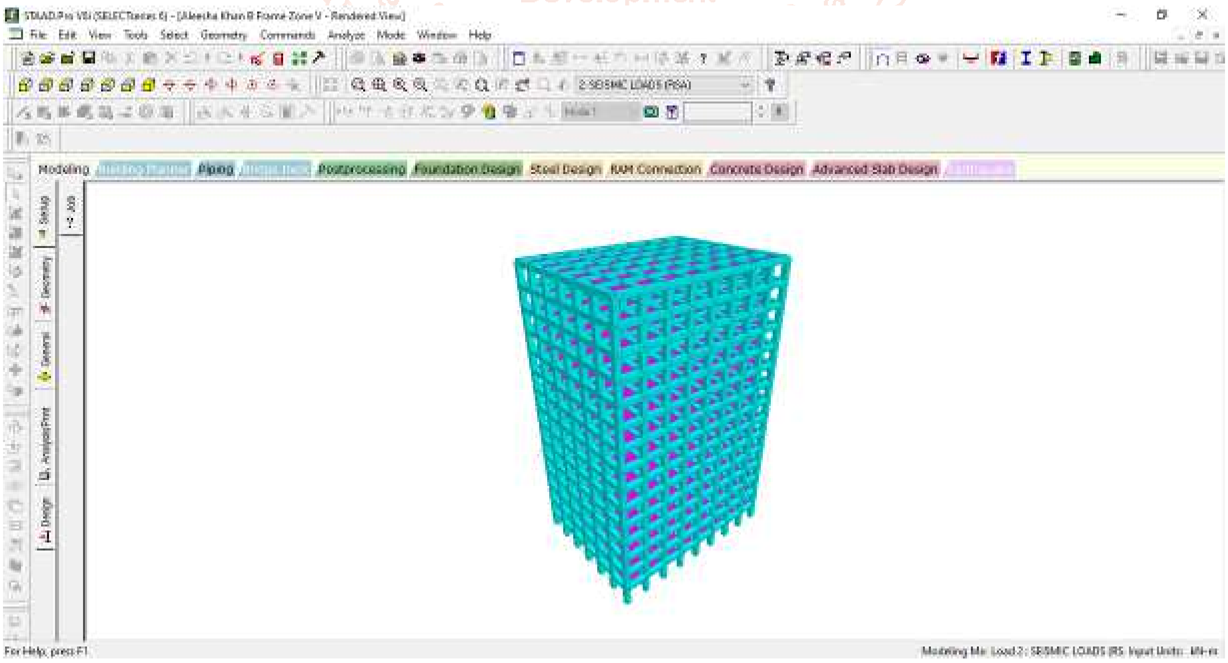
**Rishi et al. (2014)** In this study, seismic analysis of high-rise RC building frames has been carried out considering different types of bracing systems. Bracing systems is very efficient and unyielding lateral load resisting system. Bracing systems serves as one of the components in RC buildings for increasing stiffness and strength to guard buildings from the incidence caused by natural forces like earthquake force. In proposed problem G+ 10 story building frame is analyzed for different bracing system under seismic loading. STADD-Pro software is used for analysis purpose. The results of various bracing systems (X Bracing, V Bracing, K Bracing, Inverted V Bracing, and Inverted K Bracing) are compared with bare frame model analysis to evaluate the effectiveness of a particular type of bracing system in order to control the lateral displacement and member forces in the frame. It is found that all the bracing systems control the lateral displacement of frame very effectively. However Inverted V bracing is found to be most economical. Salient conclusions of the study are, the concept of using steel bracing is advantageous to resist the seismic forces. The bracing system effectively reduces the lateral displacement (up to 80%) of the structure compared to bare frame. Steel bracings the number of forces in members significantly reduces. Bracing system proves as an effective member to control the story drift (up to 56%) in structures as compare to Bare frames. After using bracing member as a resistive member margin of safety against collapse increased.

## III. Structural modeling

The present study is an effort towards analysis of the structure during the earthquake. G+14 stories residential building is considered. To analyze a multi-storeyed RC framed building considering different earthquake intensities IV and V Zone by response spectra method and find the base shear value for different structures. Seismic analysis of RC frame with bare and different position of braced frame is carried out using linear static analysis method as per IS 1893 (Part I): 2016 by using STAAD-PRO software. For this analysis different types of models are considered and comparison of seismic performance is carried out. The bracing system of multistorey building were modeled using plate elements available in structural analysis program STAAD. Pro V8i to obtain the stiffness/rigidities of bracing system using finite element method (FEM). To study the effect of floor slab in high rise building on seismic responses of buildings, three dimensional (3D) geometric models of the buildings were developed in software. Beams and columns were modeled as beam elements. The loads of slab, periphery wall and parapet wall were incorporated in the modeling of structure. Due to time limitations, it was impossible to account accurately for all aspects of behavior of all the components and materials even if their sizes and properties were known. Thus, for simplicity, following assumptions were made for the structural modelling. Analysis performs on the basis of behaviour of the structure, external action, structural material and the type of selected structural model.

## IV. Methodology

G +14 Simple Building model In STAAD PRO software. With beam size 300 X 400 mm and column size 400 X 500 mm this reinforced concrete building having M30 grade of Concrete and Fe415 high density steel. To study the response of building with and without bracing system.



## V. CONCLUSIONS

- However no particular bracing is suitable for zone III, IV, V individual bracing has to be designed for Seismic zone. Also economy in bracing can be found by suitable design.
- Steel bracings can be utilized as an option in contrast to the next reinforcing or retrofitting methods accessible as the all-out weight on the current structure won't change essentially.

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