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A Study on Review of Literature of Asymmetrical Building with Bracings

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Abstract: **An emerging demand for earthquake resistant structure provokes new trends in seismic analysis. In present days a new challenge of constructing asymmetrical building has higher thirst compared with symmetrical buildings. It has been proved for these buildings were able to sustain stiffness and flexibility. Bracings a vital finding enhances the resistances to lateral loads. This paper deals with a study on literatures assembling the need of steel braces over asymmetrical buildings. The author's suggestions were discussed and possible ways to persuade the types of bracing over asymmetric building were framed in this paper. It has been concluded from findings of literatures that initiating the usage of bracings on asymmetric building can effectively reduce the deflection due to lateral loads.**
***Keywords*: Asymmetrical building, Bracing, Lateral loads, Literatures**

I. INTRODUCTION

Considering the recent trends in building design high importance has been seismic design and retrofit. The escalating risk in earthquake paved the way for earthquake resistant structures. For these intentions the steel bracings and braced frames were used abundantly. Bracings have been effectively proved to resist the lateral loads. Bracings have been a very effective upgrades strategy for enhanced stiffness and deformation. Bracings were demanded to decrease the loads caused by earthquakes. Energy dissipated from the structures may safely resist forces and deformations caused by strong ground motions. Types of bracings and frames were been in use due to its aspects in economical and construction. The stiff, strong structures which made them able to resist elastic seismic demands were economically made by using Steel concentrically braced frames (CBFs) [1].For more robust seismic resistance, special concentrically braced frames have been developed. The reduction of lateral stiffness of the system and improve the energy dissipation Capacity were carried out by eccentric bracings. The lateral stiffness of the system depended upon the flexural stiffness. In the beam at the point of connection of eccentric bracings, due to earthquake, concentrated loads caused in the vertical components by the bracing forces. The large axial deformation capacity provided by the buckling restrained braces has high resistance in meeting to seismic design requirements that needed. Yet the rational stiffness, buckling stiffness is to be considered in connection of buckling restrained braces. For both directions of loading an X braced frame were to be considered for bracing arrangements. The V-braced arrangements have large tension yield capacity of the tension brace when compared with buckling capacity of compression brace. The beam column junction might be released either partially or fully in Knee bracings [2]. Depending on the direction of lateral loads applied the knee bracing will be found to be in either compression or in tension.

II. REVIEW OF LITRATURES

Rafael Sabelli et al (2003) studied on Seismic Demands on Steel Braced Frame Buildings with Buckling-Restrained braces. This paper highlighted on the research being conducted in identifying ground motion and structural aspect, that control the feedback of concentrically braced frames, also identified the improved design procedures and code provisions. In this study the author was keened on the seismic response of three and six story concentrically braced frames utilizing buckling-restrained braces. The examined results of the nonlinear dynamic analyses for specific cases as well as statistically for several suites of ground motions to characterize the effect on key response parameters of various structural configurations and proportions [3].
Luigi DI SARNO et al (2004) studied on Bracing systems for seismic retrofitting of steel frames. The seismic performance of steel moment resisting frames (MRFs) retrofitted with different bracing systems were assessed in this study. The three types of braces which have been utilized in this study are special concentrically braces (SCBFs), buckling-restrained braces (BRBFs) and mega-braces (MBFs). The author designed a 9-storey steel perimeter MRF with lateral stiffness insufficient to satisfy code drift limitations in zones with high seismic hazards. The SCBFs, BRBFs and MBFs were been retrofitted with the frame. The executed inelastic analyses demonstrated that MBFs were the most cost persuasive. On an average the reduction of inter story drifts was equal to 70% when compared to original MRF. The author showed that moment resisting frames (MRFs) with insufficient lateral stiffness can be retrofitted with diagonal braces in the present analytical work [4].

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A.Y. Elghazouli et al (2008) studied on seismic design of steel-framed structures to eurocode8. In this paper with emphasis on the provisions of Eurocode8 the fundamental approaches and main procedures adopted in the seismic design of steel frames were assessed. The author studied both the moment-resisting and concentrically-braced frame configurations. The design concepts, behavior factors, ductility considerations and capacity design verifications, in terms of code requirements were examined here in the study. The author has showed that the implications of stability and drift requirements along with some capacity design checks in moment frames and simultaneously with the distribution of inelastic demand in braced frames were the areas of careful consideration required in the process of design.

Chui-Hsin Chen et al (2008) studied on seismic performance assessment of concentrically braced steel frame buildings. The author studied on a 3-story tall, double story X SCBF and BRBF systems were analyzed using Open SEES to identify improved performance-based design and analysis procedures and to improvise the understanding of the behavior of conventionally braced and buckling restrained braced frames. A three-story model building has been designed following 1997 NEHRP and ASCE 7-05 has similar performance with respect to the damage concentration when it is statistically analyzed. The demands on the braces and framing components were reduced along with the tendency to form a soft story when the R value is reduced from 6 to 3. Thus experimented test results were used to rectify the analytical models and validate the seismic performance of SCBF and BRBF.

Massumi et al (2008) studied on strengthening of low ductile reinforced concrete frames using steel X-Bracings with different details**.** In this paper the author experimentally presented the use of steel bracings in concrete framed structures. On a RC model frames, 8, one bay-one story; with 1:2.5 scale a series of test has been conducted. The objective of the tests was done to determine the effectiveness of cross bracings with various details of bracing connections to the concrete frames and to increase the in-plane shear strength of the concrete frames. The author has tested the model frames under constant vertical and cyclic lateral loadings. The ample increase in the lateral strength and displacement ductility of strengthened frames upon bracing details were indicated in the test result.

D. Roke et al (2008) studied on design concepts for damage-free seismic self-centering steel concentrically-braced frames**.** This paper highlighted on the goal of providing the Self-centering concentrically-braced frame (SC-CBF) systems which were being developed with the goal of providing adequate nonlinear drift capacity without significant damage and residual drift under the design basis earthquake. To evaluate the earthquake loading responses the analytical pushover and dynamic analyses were performed on several SC-CBF. Under earthquake loading each SC-CBF was self-centered. To calculate the design demands for the frame members a procedure has been presented which was then validated with analytical results. The design procedure accurately predicted the member force demanded under earthquake loading by the analytical results.

Mahmoud Miri et al (2009) studied on the effects of asymmetric bracing on steel structures under seismic Loads**.** The biographer mentions that the structure is irregular because sometimes mass source and stiffness source were not coincidence due its architectural condition and structure appositeness. The irregular distribution of stiffness and the mass of the structure was also might be asymmetric as an asymmetric bracing in plan and both the condition lead to eccentricity and torsion in the construction. Due to the defect of ordinary code to evaluate the performance of steel structures against earthquake has been caused designing based on performance level to be used. The author mentioned that it is possible to design a structure and its behavior against different earthquakes was anticipating. A 5 story buildings with different percentage of asymmetric which is because of stiffness changes have been designed in this paper. Under three acceleration recording the static and dynamic nonlinear analysis has been done.

Viswanath K.G et al (2010) studied on seismic analysis of steel braced reinforced concrete frames. The author studied, the seismic performance of reinforced concrete (RC) buildings rehabilitated using concentric steel bracing were investigated. For peripheral columns the bracings were provided. A 4 storey building was analyzed for seismic zone IV as per IS 1893: 2002 using STAAD Pro software in this paper. It was examined the effectiveness of various types of steel bracing in rehabilitating a 4 storey building. The seismic performance of the rehabilitated building was studied on the effect of the distribution of the steel bracing along the height of the RC frame. In terms of global and story drifts the performance of the building was evaluated. The downgrading percentage in the lateral displacement was founded out. The author concluded that the X type of steel bracing significantly contributed to the structural stiffness and reduces the maximum inter storey drift of the frames.

Mohammad Eyni Kangavar (2012) studied on Seismic Propensity of Knee Braced Frame (KBF) As Weighed against Concentric Braced Frame (CBF) Utilizing ETABS and OPENSEES. The author studied on the seismic propensity of knee braced frames as weigh against concentric braced frames were investigated which was based on stiffness and ductility. A 1 - bay reinforced concrete frames in two levels which were a 1- story and a 10- story with three modes which were reinforced concrete frame without brace and RC frame with concentric brace system and RC frame with knee brace system were considered. The performance of displacement analysis using the extended 3D Analysis of Building Systems (ETABS) software for investigating stiffness of these systems and pushover analysis were performed through Open System for Earthquake Engineering Simulation (OPENSEES) software for investigating ductility of these systems. For the completion of the investigations the analysis of cyclic loading was carried out by using the software OPENSEES. The outcome of these outputs indicated that the concentric bracing can be provided a stiffer bracing system but reduces the ductility of the reinforced concrete frame. The described ductility level for reinforced concrete frame Knee bracing can be employed to be provided. The author concluded that the use of both concentric bracing and knee bracing systems for both design and to retrofit for a damage-level of earthquake. In defiance of knee bracing was more effective system when designing or retrofitting for a collapse-level earthquake.

Zasiah Tafheem et al (2013) studied on structural behavior of steel building with concentric and eccentric bracing: a comparative study**.** In their study, a 6 storied steel building has been modeled and then analyzed due to lateral earthquake and wind loading, dead and live load. The same steel building has been investigated for different types of bracing system such as concentric (crossed X) bracing and eccentric (V-type) bracing using HSS sections for knowing their performance. The building performance have been evaluated in the terms of lateral storey displacement, total lateral displacement as well as axial force and bending moment in columns at different storey level. It has also been investigated for the effectiveness of various types of steel bracing on the structure. Importantly, the reduction in lateral displacement were been founded out for different types of bracing system in comparison to building with no bracing. The author has been founded that the concentric (X) bracing reduces more lateral displacement which significantly contributes to greater structural stiffness to the structure.

Nauman Mohammed et al (2013) studied on Behavior of Multistory RCC Structure with Different Type of Bracing System (A Software Approach). This paper was to evaluate the response of braced and unbraced structure subjected to seismic loads and to identify the suitable bracing system for resisting the seismic load efficiently was its objective. A G+14 floors building were analyzed using STAAD V8i software for special moment resisting frame situated in zone 4.The RCC G+14 structure was analyzed for both without bracings and with different types of bracings system. For all type of structural systems i.e. braced and unbraced structural system bending moments, shear forces, storey shears, story drifts and axial forces was compared. The author has been concluded that the displacement of the structure decreased after the application of the bracing system. After the application of cross bracing system the maximum reduction in the lateral displacement occurs.

In the columns bracing system reduces bending moments and shear forces. The author achieve that the execution of cross bracing system was better than the other specified bracing systems. To retrofit the existing structure steel bracings were used. Significantly after the application of the bracings, total weight of the existing structure will not be changed.

Mussa Mahmoudi et al (2013) studied on Determination the Response Modification Factors of Buckling Restrained Braced Frames. The author evaluated the response modification factors of buckling restrained braced frames (BRBFs) utilized for rehabilitation of steel frames. The response modification factor which depended on ductility and over strength, the constant nonlinear analysis has been performed on building models including both the single and double bracing arms, multiples of floors and different brace composition (chevron V, invert V). For all the buildings assessment of the BRBFs values for factors such as ductility, over strength, force reduction due to ductility and response modification has been done. The response modification factors for BRBFs have high values in accordance with the result. The number of bracing arms and height of buildings have had greater effect on the response modification factor which has been founded out.

Shrikant Harle (2014) studied on Analysis and Design of Earthquake Resistant Multi-Storied Braced R.C.C. Building using NISA Software. In the authors work the construction of multistoried reinforced concrete building with the help of NISA software was analyzed and designed with steel braces .The behavior of the Reinforced concrete buildings which was subjected to earthquake forces has been obtained. For the better performance of building during and after earthquake has been carried out using the IS 1893:2000 (Part I) for R.C.C. building in zone III. The results have been obtained for the three different cases i.e. normal loading, earthquake loading and earthquake loading applied to braced and unbraced building. The author concluded that in comparison to unbraced building for earthquake loading soft drift decrease by 26.3% for braced building. The distortion of frames was reduced by bracings which lead to reduction in the drift. As compared to unbraced building distortion for braced building is found to be lesser and hence moments were also founded to be less.

Krishnaraj R. Chavan et al (2014) studied on Seismic Response of R C Building with Different Arrangement of Steel Bracing System. The biographer studied the seismic analysis of reinforced concrete (RC) buildings with different types of bracings like Diagonal, V type and inverted V type, X type. For the peripheral columns the bracing was provided for. A 7 storey (G+6) building which was located at seismic zone III was considered. As per IS 1893:2002 using Staad Pro V8i software the building models were analyzed by equivalent static analysis. The main parameters which were considered by the author in this paper to compare the seismic analysis of buildings were lateral displacement, total lateral displacement, axial

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force, base shear. It was founded that the X type of steel bracing significantly contributed to the structural stiffness and reduced the maximum inter storey drift of R.C.C building than other bracing system.

Karoly A. Zalka (2014) studied on Maximum deflection of asymmetric wall-frame buildings under horizontal load. The author presented a new analytical procedure for the determination of the maximum deflection of asymmetrical multi-story buildings braced by frameworks, shear walls and cores. The lateral deflection and rotation were the two phenomenon's which separated the complex response of the building. The results of over one hundred test structures of different bracing system preparations, various stiffness characteristics and different heights ranging from four story's to eighty stories was used to determine the accuracy of the proposed method was demonstrated.

III. CONCLUSION

Sustainability of asymmetrical building during seismic is a vital research area. A review of literatures was framed with 15 research papers describing different types of bracings on asymmetrical building. These literatures gave an exposure towards less vertical displacement in view with steel bracings. Some literatures gave an additional study on software analysis leading to a pathway for software analysis for asymmetric buildings. Thus concluding, asymmetric buildings with steel bracings will have higher sustained in seismic lateral system.

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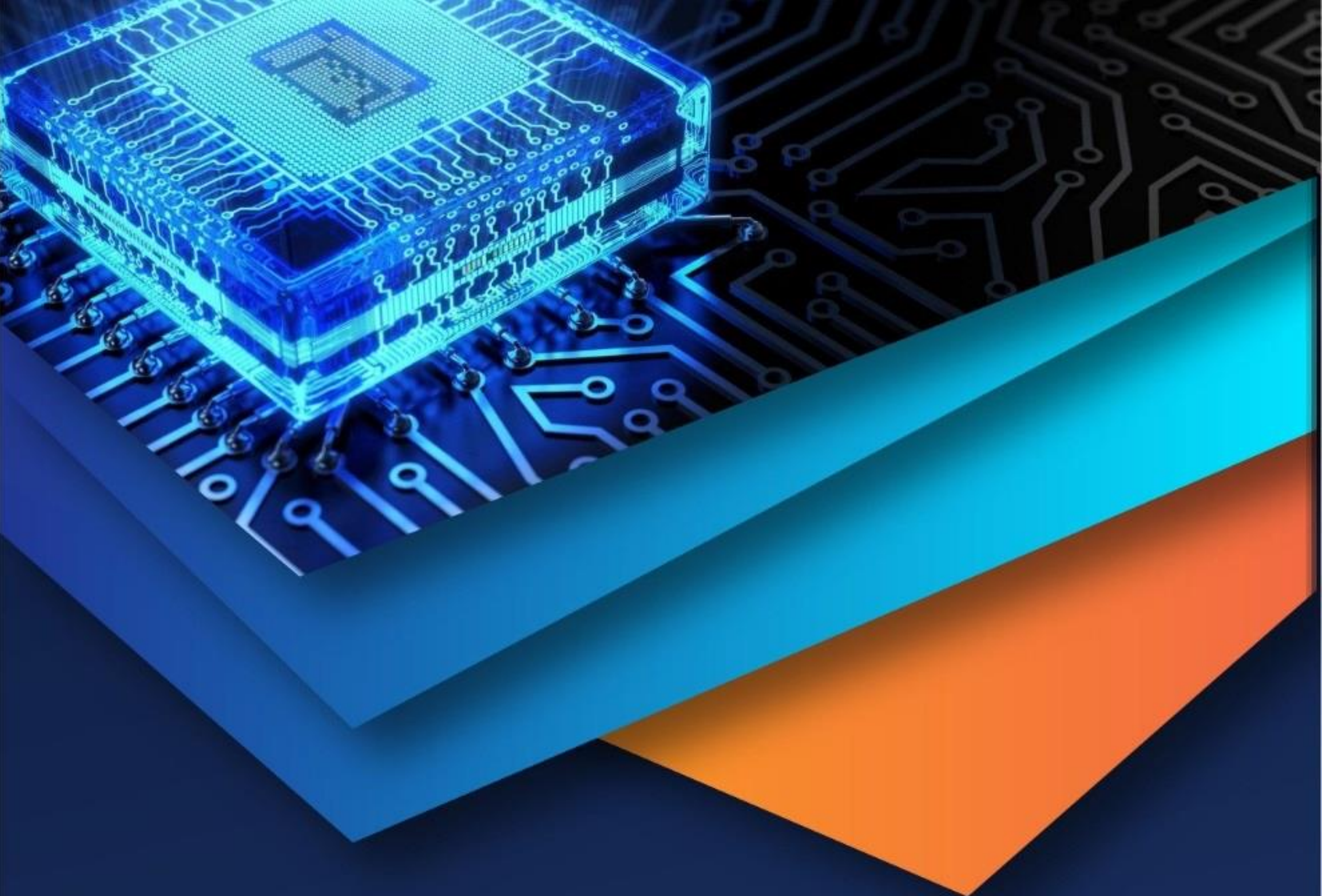

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