Nonlinear Static Pushover Analysis of Steel Frame with Different Type of Bracing: A Review

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Abstract— Steel is by far most useful material for building construction and in last decades steel structure has played an important role in construction industry. Presented in this paper is review of the nonlinear static pushover analysis method. It is necessary to design a structure to perform well under seismic loads. To model the behavior of steel structure analytically in its non-linear zone is difficult. Push over analysis explicitly evaluates how a structure is likely to perform, given the potential hazard it is likely to experience, considering uncertainties response. It is necessary to design a structure to perform well under seismic loads. In this study non-linear analysis is carried out for high rise steel frame building with different bracing configuration. Steel braced frame is one of the structural systems used to resist lateral deflection of the structures. In this project a steel building model is taken, this model is compared in different aspects such as different type of bracing system. Present study is based on the collection of pushover analysis (nonlinear static analysis) of steel structure with different type of Bracing system. In This paper we concentrate on the analysis of different type of Bracings K bracing at corner, X bracing, V and more Concentric and eccentric Bracing with help of SAP2000.

Key words: Nonlinear Static Analysis, Performance Objectives High Rise Steel Frame with Different Types of Bracing, Bracing Pattern

I. Introduction

Nonlinear static pushover analysis gives a better view on the performance of the structures during seismic events. The seismic performance of a multi-story steel frame building is designed according to the provisions of IS 800 2007. Steel buildings are more flexible than RCC building but they display lateral deflection than RCC building. A Bracing is a system that is provided to minimize the lateral deflection of structure. A Braced Frame is a structural system which is designed primarily to resist wind and earthquake forces. Braced frames are classified as concentric braced frames (CBF) or eccentric braced frames (EBF). Concentric braced frames are frames in which the center line of the member that meet at a joint, intersect at a point to form a vertical truss system which resists lateral forces. These frames provide complete truss action with member subjected to the axial forces in elastic range. Concentric braced frames (CBF) are used to resists wind forces. Bracing arranged concentrically in structure pose difficulties in preventing foundation uplift. Because one diagonal of an opposing pair is always in tension, possibility of brittle failure is present.

Eccentric braced frames(EBF) is a framing system in which the forces induced in the braces are transferred either to a column or to another brace through shear and bending in small segment of beam called link. The link in EBF act like structural fuses to dissipates earthquake induced energy in stable manner. EBFs represent an economically effective way of designing steel structure for seismic loading. Due to eccentric bracings there is reduction in the lateral stiffness of the system and improve the energy dissipation capacity. This study includes the structural behavior of steel building for braced frame under static and lateral loading. The main aim of study has been to identify the type of bracing configuration which causes minimum displacement such contributes to greater lateral stiffness to the structure.

This method aims to produce structures with predictable seismic performance. The three key elements of this method are:

1) Capacity: It is a representation of the structures ability to resist the seismic demand.
2) Demand: It is a representation of the earthquake ground motion.
3) Performance: It is an intersection point of capacity spectrum and demand spectrum.

The performances levels as per FEMA, ATC 40 are:

– Immediate occupancy IO: damage is relatively limited; the structure retains a significant portion of its original stiffness and most if not all its strength.
– Life safety LS: substantial damage has occurred to the structure, and it may have lost a significant amount of its original stiffness. However, a substantial margin remains for additional lateral deformation before collapse would occur.
– Collapse prevention CP: at this level the building has experienced extreme damage, if laterally deformed beyond this point; the structure can experience instability and collapse.

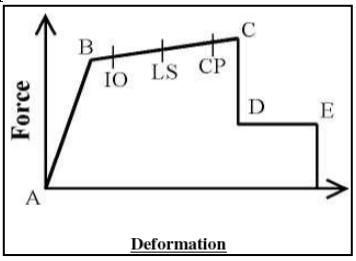

Fig. 1: Deformation

II. Literature Review

Vojko Kilar & peter fajfar (1997) [34] Simple method for the non-linear static analysis of complex building structures subjected to monotonically increasing horizontal loading (push-over analysis) is presented. The method is designed to be a part of new methodologies for the seismic design and evaluation of structures. It is based on the extension of a pseudo-three-dimensional mathematical model of a building structure into the non-linear range. The structure consists of planar microelements. For each planar microelement, a simple bilinear or multi linear base shear–top displacement relationship is assumed. By a step-by-step analysis an approximate relationship between the global base shear and top displacement is computed. During the analysis the development of plastic hinges throughout the building can be monitored. The method has been implemented into a prototype computer program. In the paper the mathematical model, the base shear–top displacement relationships for different types of microelements, and the step-by-step computational procedure are described. The method has been applied for the analysis of a symmetric and an asymmetric variant of a seven-storey reinforced concrete frame–wall building, as well as for the analysis of a complex asymmetric 21-storey reinforced concrete wall building.

A. S. Moghdam and W. K. Tso (2000) [4] a response spectrum based pushover procedure to obtain seismic response estimates of three types of building systems that were asymmetrical was studied. The procedure included some of the 3-D effects caused by the response of torsion. The main features of the procedure were the use of elastic response spectrum analysis of the building to obtain the target displacements and the load distributions used in the pushover analyses.

Ghobarah A. et al., (2001) [10] the control of inter story drift can also be considered as a means to provide uniform ductility over the stories of the building. A story drift may result in the occurrence of a weak story that may cause catastrophic building collapse in a seismic event. Uniform story ductility over all stories for a building is usually desired in seismic design.

R. Hasan and L. Xu, D.E. Grierson (2002) [26] conducted a simple computer-based pushover analysis technique for performance-based design of building frameworks subject to earthquake loading. And found that rigidity-factor for elastic analysis of semi-rigid frames, and the stiffness properties for semi-rigid analysis are directly adopted for pushover analysis.

D C Rai , S C Goel (2003) [8] Many Chevron type “ordinary” steel concentric braced frame (OCBF) structures have suffered extensive damage in recent earthquakes which raises concerns about their performance in future earthquakes. A building in the North Hollywood area, which suffered major damage in the 1994 Northridge earthquake, was selected for detailed study. Response spectrum, nonlinear static (pushover), and nonlinear dynamic (time history) analyses for a ground motion recorded at a nearby site compared well with the observed damage. The state-of-health of the damaged structure was assessed to determine the need and extent of repair. The seismic performance of non-ductile CBFs can be improved by delaying the fracture of braces, e.g., in the case of the tubular braces by filling with plain concrete. Changing the bracing configuration from chevron to 2-story X configuration can avoid the instability and plastic hinging of floor beams. Further improvement can be achieved by redesigning the brace and floor beams to a weak brace and strong beam system, as in Special CBFs. This full upgrading to SCBFs results in excellent hysteretic response and, with inelastic actions confined to ductile braces, exhibits reasonable distribution of damage over the height of the building

B. AKBAS.et.al.(2003) [6] conducted a push over analysis on steel frames to estimate the seismic demands at different performance levels, which requires the consideration of inelastic behavior of the structure.

R. Bento (2004) [25] the performance of a structural system can be evaluated resorting to non-linear static analysis. This involves the estimation of the structural strength and deformation demands and the comparison with the available capacities at desired performance levels. This paper aims at evaluating and comparing the response of two reinforced concrete building systems by the use of different methodologies namely the ones described by the ATC-40 and the FEMA-273 and by the EC8 (Euro code 8) design code using nonlinear static procedures, with described acceptance criteria. Some results are also compared with the nonlinear dynamic analysis. The methodologies are applied to a 4 and 8 storey frames system, both designed as per the Euro codes in the context of Performance Based Seismic Design procedures.

X.-K. Zou (2005) [35] presented an effective technique that incorporates Pushover Analysis together with numerical optimization procedures to automate the Pushover drift performance design of reinforced concrete buildings. PBD using nonlinear pushover analysis, which generally involves tedious computational effort, is highly iterative process needed to meet code requirements.

Shih-Ho Chao and Subhash C. Goel (2006) [27] presented a paper on performance of a concentric braced frame (CBF) designed by current U.S. practice under seismic excitation. The nonlinear dynamic analysis results showed that CBFs designed by conventional elastic method can suffer early brace fractures and damage in the vicinity of the connection region, which in turn leads to excessive story drift and possible collapse due to P-delta effect. Providing a means to relieve brace-beam-column connections from beam moment, such as by a beam shear splice, is essential to prevent undue damage in that region. On the other hand, behavior of CBFs when designed by the proposed performance-based plastic design (PBPD) methodology can be much better in terms of developing intended yield mechanism, preventing or delaying brace fracture, and controlling the drift within target limits. This indicates that the confidence level of satisfactory CBF performance can be raised by using appropriate performance-base design methodologies, such as the one proposed herein. Further research work for improving the performance of CBFs by using the proposed PBPD approach is currently in progress.

Kadid A. and A. Boumrkik (2008) [13] Pushover analysis was conducted to assess the damage level of a building using Algerian Design code. The load was incrementally applied in the lateral directions. From the capacity or Pushover curve the target displacement at roof level was determined. The level of damage experienced by the structure at this target displacement is considered representative of the damage experienced by the building when subjected to design level ground motions. The seismic loads will result in plastic response of the structure, beyond its elastic limit. The response is dominated by ductile behavior of the structure in terms of plastic hinges

E. Salajegheh,(2008) [9] Earthquake and structural engineering challenge of creating optimized, reliable and cost effective structures leads to the combination of optimization and performance based seismic design theory. The prime goal is to automate the design of the structure on the basis of performance based design and also considering the inherent uncertainties. In this study automating the design process of concentric steel braced frames is performed by use of genetic algorithms. The optimal design of structure minimizes the structural weight subjected to performance constraints on axial deformations of braces and plastic hinge rotation of beam-columns and also the force interactions relationships for them. Nonlinear static analysis (pushover) is implemented by considering the effect of post-buckling in compression brace elements and the performance based criteria is derived from the FEMA-356 (2000). The developed software in this study is capable of automating the design of braced Frames with different spans and stories for a prescribed performance objective, with the limitation of usage for structures in which the first mode is dominant. It is found that a wide range of valid design alternatives exists, from which a decision maker selects the one that balances and optimizes different objectives in the most preferred way.

Chui-Hsin Chen, Jiun-Wei Lai (2008) [7] this paper briefly summarizes the ongoing research about concentrically braced steel frames that are widely used in North America. In the analytic phase, a series of nonlinear dynamic analyses and parameter studies are carried out to improve better understanding of the seismic behavior of concentrically braced frames to identify improved performance based design and analysis procedure. Analytical results of a two-story model building with bracing configuration identical to the test specimen are presented here. In the experimental phase, four large-scale two-story tall special concentrically braced frames and two buckling restrained braced frames are designed and tested in the NEES facility at Berkeley. Test reults and experimental observations of the first two braced frame specimens using square and round hollow structural section as bracing components are presented in this paper.

M. Seifi, J. Noorzaei, M. S. Jaafar and E. Yazdan Panah (2008) [19] in this study nonlinear static pushover (NSP) analysis to nonlinear dynamic time-history analysis was compared and concluded that:

- For estimating the capacity and deformation problems for certain types of structures pushover analysis is a good solution.
- More investigation is required for steel structures, 3D structures and high rise frames.
- NSP method is a well-known method in the society of civil engineers but the conventional code based method has many deficiencies
- Several methods such as MPA (modal pushover analysis), APA, N2, MT, MMC etc. were proposed to overcome the deficiencies of the conventional method in recent decade.

T Hasegawa (2008) [30] A series of earthquake response analyses of these example frames was carried out, and was compared to the results of the proposed method. From the results of the earthquake response analysis, it was found that the maximum inter-story drift and the cumulative ductility demands of members obtained from the proposed method could approximately catch the tendency of results of the earthquake response analysis From the results of the earthquake response analysis, maximum inter-story drift of the proposed method could approximately catch the results of the earthquake response analysis, and the cumulative ductility demands (h) of members obtained from the proposed method could approximately catch the tendency of results of the earthquake response analysis. But the prediction values (h) of panel zones in the frames, and the prediction values of ends of beam connecting to outside columns became smaller than those of the earthquake response analysis.

J R Qian (2008) [11]Pushover analysis has been widely used on earthquake response predication of building structures under severe earthquakes. It needs be studied whether it is applicable for complex large-span steel structures or not. In this paper, pushover analysis of two practical engineering projects, Beijing A380 hangar at Capital Airport and the National Stadium for 2008 Beijing Olympic Games, are introduced. The first mode lateral loading pattern for the hangar structure and twelve cases for the stadium steel structure are adopted to perform the pushover analysis respectively. The pushover analyses results are compared with nonlinear time history analyses results. Results are for complex larger-span steel structures with huge numbersof members, pushover analysis has high efficiency to find out the weak part of the structure, while non-linear time history analysis is time consuming.

K.G.Vishwanath,(2010) [15] presented on "Seismic response of Steel braced reinforced concrete frames" in International journal of civil and structural engineering. A four storey building was taken in seismic zone 4 according to IS 1893: 2002. The performance of the building is evaluated according to story drift. Then the study is extended to eight story and twelve story. X type of steel bracing is found out to be most efficient.

Shahrzad Eghtesadi, Danesh Nourzadeh, Khosrow Bargi (2011) [28] has considered four types of bracing systems including X-bracing, Diagonal bracing, Inverted chevron CBF and Inverted chevron EBF, in four different height levels, were modelled and analyzed. These models were compared in different aspects, such as economical viewpoint with evaluating the weight of the structure, the maximum top story displacement under seismic loading and the energy absorption and concluded that Inverted chevron CBF system has the high energy absorption capacity, the amount of steel used per unit area of the frame and the total weight of the structure was less than other types of bracing systems so applying the inverted chevron concentric bracing system may be proper and economical for the steel braced frames.

Goswami and Murty(2012) : have presented the results of experimental investigations on the performance and failure of seismic connection between I-beam and box column involving different schemes of connection detailing. They have displacement controlled inelastic finite element analysis using ABAQUS software. The results showed that the connection involving externally reinforce inclined rib plate at the column face is the most efficient and economical.

Sejal Dalal & A K Desai (2012) [29] Presented in this paper is the comparison of a steel moment resisting frame designed by the Performance based Plastic design method and conventional elastic design method based on the seismic evaluation done by both nonlinear static (Push over Analysis) and nonlinear dynamic analysis (Time history analysis) under different ground motions using the SAP2000 software. The Performance based Plastic design is a displacement based method which uses pre-selected target drift and yield mechanisms as design criteria whereas the elastic design method is based on the conventional force based limit state method. The nonlinear static pushover analysis shows formation of hinges in columns of the frame designed using elastic design approach leading to collapse. Whereas in the Performance based Plastic design method, formation of hinges is seen in the beams and bottom of base columns. Although the ground motions caused large displacements in the Performance based Plastic design frame as it was seen from the acceleration and displacement responses obtained from the nonlinear time history analysis, the structure did not lose stability. Study of hysteretic energy dissipation results reveals that the Performance based Plastic design method is superior to the elastic design method in terms of the optimum capacity utilization.

Ajay D Goudar (2012) [2] the static pushover analysis is becoming a popular tool for seismic performance evaluation of existing and new structures. The existing building can become seismically deficient since seismic design code requirements are constantly upgraded and advancement in engineering knowledge. Further, Indian buildings built over past two decades are seismically deficient because of lack of awareness regarding seismic behavior of structures. The widespread damage especially to RC buildings during earthquakes around the world generated great demand for developing a simple yet efficiently accurate new method known as "pushover analysis" for seismic evaluation. The expectation is that the "non-linear static analysis" popularly known as "pushover analysis" will provide adequate information on seismic demands imposed by the design ground motion on the structural system and its components and consumes very less time compared to non-linear dynamic analysis.

Juan Carlos Vielma, Reyes Herrera (2012) [12] the object of this study is to determine the seismic response of regular high-rise steel buildings with Chevron-braced frames. Mechanics models of three buildings of 14, 18 and 20 stories are studied, all of them with similar geometric characteristics in plan and elevation. These models are realized using prescriptions and parameters from Venezuelan design codes. The seismic action is carried out through varius synthetic design spectrum compatible accelerograms defined by the seismic codes in this study, with three levels of intensity corresponding to three specific Limit States. Dynamic analysis is used to compute parameters of ductility, over strength and maximum displacements. From these results it can be concluded that Chevron-braced frames presented a good overall performance and non V-braced frames show greater damage due to dynamic actions, validating nonlinear dynamic analysis as a very powerful tool to seismic-resistance design and Chevron-braced frames as a very useful choice for improving the response of tall steel structures.

K.K.Sangle,K.M.Bajori,V.Mhalungkar (2012) [16] Has done research work on "Seismic Analysis Of High Rise Steel Frame Building With And With Out Bracing" The Aim of study was to compare the results of seismic analysis of high rise steel building with different pattern of bracing system and without bracing system. By using time history analysis the result of the study shows that bracing element will have very important effect on structural behaviour under earthquake effect.

M.D. Kevadkar, P.B. Kodag (2013) [18] Presented paper on lateral load analysis of RCC building, In this study R.C.C. building is modeled and analyzed in three Parts I) Model without bracing and shear wall II) Model with different shear wall system III) Model with Different bracing system The computer aided analysis is done by using E-TABS to find out the effective lateral load system during earthquake in high seismic areas. The performance of the building is evaluated in terms of Lateral Displacement, Storey Shear and Storey Drifts, Base shear and Demand Capacity (Performance point). It is found that the X type of steel bracing system significantly contributes to the structural stiffness and reduces the maximum inter story drift, lateral displacement and demand capacity (Performance Point) of R.C.C building than the shear wall system.

Baldev D. Prajapati1 & D. R. Pancha (2013) [5] has study that the analysis & design procedure adopted for the calculation of symmetric high rise multi-storey building (G+30) under effect of EQ and Wind forces. The R.C.C., Steel, & Composite building with shear wall is considered to resist lateral forces resisting system.

Mohammed Idrees Khan, Mr.Khalid (2013) [20] Steel is by far most useful material for building construction in the world and in last decades steel structure has played an important role in construction industry. Providing strength, stability and ductility are major purposes of seismic design. It is necessary to design a structure to perform well under seismic loads. In this paper nonlinear push over analysis is carried out for high rise steel frame building with different pattern of bracing system. The shear capacity of the structure can be increased by introducing Steel bracings in the structural system. There are 'n' numbers of possibilities to arrange steel bracings such as Diagonal, X, K, V, Inverted V or chevron and global type concentric bracings. A typical 15th- story regular steel frame building is designed for various types of concentric bracings like Diagonal, V, X, and Exterior X and Performance of each frame is carried out through nonlinear static analysis.

Pundkar R. S, Alandkar P. M(2013) [24] has considered four models with different SPSW locations were analyzed for same geometry and loading. Four models of building frame having (G+19) storey situated in zone III were considered and then compared with moment resisting frame (MRF) and X-braced frame. The analysis of steel plate shear wall building was carried out using Software SAP2000 V15. The main parameter considered to compare the seismic performance of buildings for deflection. The models were analyzed by Response Spectrum analysis and concluded that deflection in case of without SPSW is large as compared with SPSW, due to presence of SPSW total weight of steel in building is reduced than building without SPSWs. Hence steel building with SPSWs is economical compare to without SPSWs. Due to relatively small thickness of SPSW compared to reinforced concrete shear walls and X-braced moment resisting frame, from architectural point of view, steel shear wall occupy much less space.

Zasiah Tafheem, Shovona Khusru(2013) [36] has considered a six storied steel building has been modelled and then analyzed due to lateral earthquake and wind loading, dead and live whole of performance of X braced building better than other types of braced building, also observed that as the size bracing section increases the displacements and storey drifts decreases for the braced buildings.

Parasia, Ashik S Paresh Nimodia (2013) [22] the structure in high seismic areas may be susceptible to the severe damage. Along with gravity load structure has to withstand to lateral load which can develop high stresses. Now a day, shear wall in R.C. structure and steel bracings in steel structure are most popular system to resist lateral load due to earthquake, wind, blast etc. The shear wall is one of the best lateral load resisting systems which is widely used in construction world but use of bracing will be the viable solution for enhancing earthquake resistance. So there is a need of precise and exact modeling and analysis using software to interpret relation between brace frame parameters and structural behavior with respect to conventional lateral load resisting frame. There are various software's used for analysis of different type of lateral load resisting system such as, E-TABS, SAP2000, STADPRO, etc. In this paper, a few of the past research work has been discussed for modeling and analysis of brace frame RC structure and conventional lateral load resisting frame structures, co-relation of efficiency and various parameters are compared. It is found from the analysis in software, the type of bracing, location of bracing, bracing stiffness and bracing material, etc. have significant effects to the lateral capacity of the structure. In this paper comparative study of RC brace frame structure with conventional lateral load resisting frame has been carried out with different type of bracing, various parameters of bracing and property of bracing by different researchers discussed.

Vaseem Inamdar (2014) [33] Steel bracing is economical, easy to erect, occupies less space and has flexibility to design for meeting the required strength and stiffness. In the present study, pushover analysis of complex steel frame building was investigated. These investigations were based on stiffness and ductility. This paper is intended to compare the performance of structure by using ISMB and ISNB(hollow pipes) steel sections as bracing element on 15-story complex steel frame. Displacement analyses were performed using the Extended3D Analysis of Building Systems (ETABS) software for investigating stiffness of these system and pushover analysis were performed. Base shear obtained from all models using ISNB bracing is lesser then ISMB sections. The lateral displacement of complex steel frame studied is reduced to greater extent by the provision of exterior steel bracing .Stiffness of models increased by an amount of 71.5% using ISMB bracing and 68% using hollow pipes sections.

Mr. A Vijay (2014) [21] The research concentrates on a computer based push-over analysis technique for performance-based design of steel building frame works subjected to earthquake loading. Through the use of a plasticity-factor that measures the degree of plasticization, the standard elastic and geometric stiffness matrices for frame elements (beams, columns, etc.) are progressively modified to account for nonlinear elastic–plastic behavior under constant gravity loads and incrementally increasing lateral loads. The analysis is performed for two steel frameworks of solid and hollow members. This investigation aims to analyze the difference in structural behavior between hollow and solid frames. The technique adopted in this research is based on the conventional displacement method of elastic analysis.

Adithya. M, Swathi rani K.S, Shruthi H K, Dr. Ramesh B.R (2015) [1] has considered a three dimensional structure with 4 horizontal bays of width 4 meters, and 20 stories was taken with storey height of 3m. The beams and columns were designed to withstand dead and live load only. Wind load and Earthquake loads were taken by bracings. The bracings were provided only on the peripheral columns. Maximum of 4 bracings were used in a storey for economic purpose and studied the effects of various types of bracing systems, its position in the building and cost of the bracing system with respect to minimum drift index and inter storey drift and found that as per displacement criteria bracings were good to reduce the displacement and the max reduction of 68.43% was observed in single diagonal braces arranged as diamond shape in 3rd and 4th bay model compared to model without brace, the bending moment and shear force in columns were also reduced in braced models and concluded that the concept of using steel bracing was one of the advantageous concepts which can be used to strengthen or retrofit the existing structures, the lateral storey displacements of the building were greatly reduced by the use of single diagonal bracings arranged as diamond shape in 3rd and 4th bay in comparison to concentric (X) bracing and eccentric (V) bracing system.

Lekhraj Pandit, R. R. Shinde(2015) [17] A Bracing is a system that is provided to minimize the lateral deflection of structure. The members of a braced frame are subjected to tension and compression, so that they are provided to take these forces similar to a truss. Braced frames are always designed of steel members. Use of the braced frames has become very popular in high rise structure and also in seismic design of them. So this paper is aims to investigate the performance of steel Braced Frames for steel frame structure. In these project a steel building model is taken, these model is compared in different aspects such as storey drift, axial force and bending moment in column and story displacement etc. using different section in different locations. Among these numbers of trial which type of bracing at which location is more suitable from the observed results would be selected for the structure.

Parlobh S Gaikwad (2015) [23] The important objective of earthquake engineers is to design and build a structure in such a way that damage to the structure and its structural component during the earthquake is minimize. The paper aims towards the dynamic analysis of RCC and Steel building with unsymmetrical configuration. For the analysis purpose models of G +9 stories of RCC and Steel with unsymmetrical floor plan is consider. The analysis is by carried by using F.E based software E TABS. Various parameter such as lateral force, base shear, story drift, story shear can be determined .For dynamic analysis time history method or response spectra method is used. Dynamic analysis should be performed for symmetrical as well as unsymmetrical building. Dynamic analysis can be in the form of full nonlinear dynamic time history analysis. If the RCC and Steel building are unsymmetrical, Torsional effect will be produce in both the building and thus are compared with each other to determine the efficient building under the effect of torsion.

V.A. Choudhari, Dr. T. K. Nagaraj (2015) [32] The study shows that modeling of the G+4 steel bare frame with various bracings (X, V, inverted V, and Knee bracing) by pushover analysis results are obtained Comparison between the seismic parameters such as base shear, roof displacement, time period, story drift, for steel bare frame with different bracing patterns are studied. It is found that the X type of steel bracings significantly contributes to the structural stiffness and reduces the maximum drift of steel building than other bracing systems.

Kalugotla naga bhushanam (2015) [14] presented on "optimized modeling and design of steel frames in different seismic zones using etabs software". In the Present analysis, a steel framed building with 15 floors (each story is 4m height) is analyzed and designed in all seismic zones by using software "ETABS" an engineering software product that caters to multi story building analysis and design. The project consists of design based on a set of user specified load combinations. The design involves calculating story drift, story shear, displacements in all seismic zones and comparing the results.

Vaibhao V Maind, S Sahezad (2015) [31] All natural hazard, earthquake is one of the most dangerous. For safety of the buildings, it is essential that structures should have adequate lateral stability, strength, and sufficient ductility. For construction normally we use materials as concrete and steel to build up buildings. But for the high rise structures we cannot go only by using these two components i.e. concrete and steel. We have to choose some different alternatives or different systems to construct the high rising structures therefore we can see system like Steel plate Shear Wall and Steel Braced System. This paper consists of review on the analysis of multistoried steel building with and without Steel Plate Shear Wall (SPSW) and with different types of bracing system. The aim of the project is to analyze steel frame building by using steel plate shear wall at different locations and with different bracing system for same geometry and loading. The analysis will carried out using Software ETABS 2015 and the models will analyzed by Equivalent Static Analysis and Response Spectrum analysis as per IS 1893:2002.

A. K. Chopra, and F. McKenna (2016) [3] The earthquake engineering profession has been moving away from traditional code procedures to performance-based procedures for evaluating existing buildings and proposed designs of new buildings. Although nonlinear static (or pushover) analysis continues to be used for estimating seismic demands, nonlinear response history analysis (RHA) is now being increasingly employed. In the latter approach, engineering demand parameters (EDPs)—floor displacements, story drifts, member forces, member deformations, etc.—are determined by nonlinear RHA of a computer model of the building for an ensemble of multi-component ground motions. Fraught with several challenging issues, selection and scaling of ground motions necessary for nonlinear RHA remains a subject of much research in recent years.

III. Conclusion

Many guidelines are reviewed for linear, non-linear analysis and the seismic evaluations of the structures are also discussed. Most of the researchers have reviewed that the buildings were assumed to be placed in various zones of India and carried out the investigation on the non-linear analysis (pushover analysis) and compared the performance of the building components, maximum base shear capacity and displacement of the structures located in the various zones. Many papers considered different amount of masonry infill walls to investigate the effect of infill walls on earthquake in response to the structures. SAP2000, ETABS and IDARC-2D software's were mainly used to find out the seismic evaluation and performance of the structures. All these studies require further research not based on assumptions, but in real terms it is essential to consider existing reinforced concrete structures under seismic evaluation.

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