Literature Review on the Seismic Performance of Multi-Storey Building with Different Locations of Shear Wall and Diagrid

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Abstract: ***As per the previous records of earthquakes, there is an increase in the demand of use of earthquake resisting structures. So it is necessary to design and analyse the structures by considering seismic effect. The present paper gives an overview of different research works to be done regarding the study of multi-storey RC frame structure with lateral load resisting systems such as shear wall and diagrid system. The present work concerned with the comparative study of seismic analysis of multi-storied building with shear wall and bracing, analysis of multi-storey structure of different shear wall locations and heights and proper location of shear wall in the multi-storey building etc. The present paper gives the knowledge about the seismic behavior of structures by using shear wall & diagrid and comparison between them.***

Keywords: Diagrid, Lateral Load resisting System, Multi-storey Building, Seismic Effect, Shear wall, etc

1. Introduction

The rapid growth of urban population and limitation of available land, scarcity and high cost of available land, the taller structures are preferable now days. As the height of structure increases then the consideration of lateral load is very much important. For that the lateral load resisting system becomes more important than the structural system that resists the gravitational loads. The lateral load resisting systems that are widely used are rigid frame, shear wall, diagrid structural system, wall frame, braced tube system, outrigger system and tubular system. Recently shear wall systems and diagrid structural system are the most commonly used lateral load resisting systems. Shear walls have very high in plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. Diagrid structural system is adopted in tall buildings due to its structural efficiency and flexibility in architectural planning. Diagrid– diagonal grid structural systems are widely used for tall buildings due to its structural efficiency and aesthetic potential provided by the unique geometric configuration of the system. Hence the diagrid, for structural effectiveness and aesthetics has generated renewed interest from architectural and structural designers of tall buildings.

2. Research Work of Different Literatures

Kiran.T et al. (2017) **[1]** have performed a comparative study on multi-storey RC frame with shear wall and Hexagrid system. Three models were prepared for study such as 30 storey bare RC building, 30 storey bare RC building with shear wall and 30 storey bare RC building with shear wall and Hexagrid system. These three models have analyzed by using linear dynamic response spectrum method. ETABS V.13 software is used for design and analysis of RC frame. The behavior of the structure is studied based on the maximum displacement, maximum drift, maximum storey shear and maximum overturning moment. The study included the consideration of the effect of base shear and displacement for RC frames with and without Hexagrid bracings and with shear wall. The comparison is made for result parameters such as maximum storey displacement, maximum storey drift, maximum storey shear and maximum overturning moment between various models for zones-III. The present study concluded that the base shear in RC bare frame is least and the displacement is the maximum as compared to other two models and as the number of storey increases the resistance of the structure to base force decreases and as a result displacement increases. The drift values showed the effective behavior of the structure when Hexagrid system of bracing is adopted and the effect of RC bare frame with shear wall and Hexagrid system of bracing is prominent in high seismic zones.

Jayesh Venkolath et al. (2016) **[2]** have performed analysis of 24 storey circular building to find the optimal diagrid angle to minimize the lateral drift and displacement in a high-rise building. The circular plan of 30.7 m diameter is considered with five different types of angles of diagrid that is 36.8°, 56.3°, 66°, 77.5° and 83.6°. The results were tabulated by performing finite element analysis using ETABS software. The comparison of analysis of results in terms of lateral displacement, storey drift, and storey shear and time period. The present study concluded that diagrid angle in the region of 65° to 75° provides more stiffness to the diagrid structural system which reflects the less top storey displacement. The storey drift, storey shear, time period, effect of lateral force to stories are very much lesser in the region of diagrid angle. The optimum angle observed in the region of 65° to 75°.

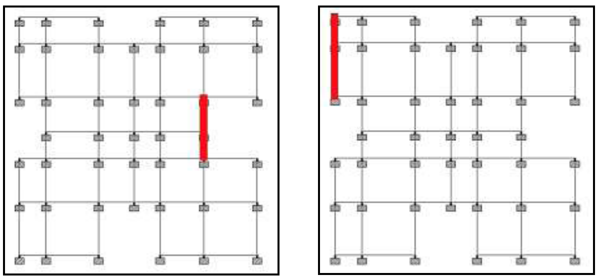
V. Abhinav et al. (2016) **[3]** have performed seismic analysis of multi-storey building with the shear wall using STAAD Pro. an RCC building of 11 floors placed exposed to earthquake loading in zone V is considered and earthquake load has calculated by a seismic coefficient method using IS 1893 (Part I): 2002. The three models of an 11-floor building have been made with the shear wall at corner, shear wall along periphery and shear wall at the middle of the building. The comparative study of deflection of building with and without a shear wall is carried out in X and Z directions. The lateral deflection for building with the shear wall along periphery is reduced in comparison to other models. Hence, it has been concluded that the building with the shear wall along periphery is much more efficient than all other models with a shear wall.

Nandeesh et.al (2016) [**4**] have performed comparative study of 52 storey hyperbolic circular steel diagrid structural system rehabilitated at central core with shear wall and steel braced frames. This work basically comprised of two models with shifting floor zone and centre divider framework. The external fringe comprises of diagrid funnel segment for both models. These models are examined for two distinctive seismic zones (zone II and zone III). All the models and its components are investigated utilizing ETABs programming according to Indian codes. The present work showed the outcomes parameter regarding story drift, story displacement, time period, story shear. It has been concluded that the shear wall shows the better performance under earthquake loading. Shear wall had less top storey displacement, storey drift than steel bracing systems in both seismic zones. The steel bracing system gave better performance against storey shear for both seismic zones than shear walls system. The shear wall systems act as a monolithic structure and it gives the effective performance against all aspects in terms of maximum storey displacement, storey drift and time period.

Md. Samdani Azad et al. (2016) **[5]** have performed a comparative study of seismic analysis of multi-storey buildings with shear walls and bracing systems. This paper contained a numerical approach to show dissimilarity between the shear wall system and steel bracing system. The new approach of this research was strengthening lateral force resisting system by using steel bracing. A gradual process has been done step by step to show comprehensible contrasts between the systems. For implicit results, East Malaysia has considered as the corresponding region. The overall analysis has been carried out using the ETABS9.7 software. Six models have prepared for the comparative study. The First model was having a shear wall at a middle portion, second model was having a shear wall at a side portion, third model was having bracing at a centre, fourth model was having bracing at a side, the fifth model was having floor bracing at middle and sixth model was having floor bracing at a side. It has been concluded from the results that model one was the safest among the six models.

Harshita Tripathi *et al.* (2016) **[6]** have studied the diagrid structural system for framed multi-storey building and also stiffness based design methodology for determining preliminary sizes of R.C.C diagrid structures for tall buildings. A 36m X 36m size regular plan is considered. Modeling, design and analysis of structural members are done by using ETABS 2015 software. Structural members are designed as per IS 456:2000, load combinations of seismic forces as per IS 1893(part I): 2000 and dynamic along wind and across wind are considered for analysis as per IS 875: 1987 (part 3). Dynamic Analysis of 24, 36 and 48 story building with perimeter diagrid with different story module is carried out by Response spectrum method. There are 15 models are prepared with five different types of angles of diagrid i.e. 50.2°, 67.4°, 74.5°, 78.2° and 82.1° for 2 storey, 4 storey, 6 storey, 8 storey, 12 storey diagrid module for 24-storey, 36-storey, 48-storey building. The results of analysis are compared in terms of top storey displacement, storey drift, storey shear, time period, angle of diagrid, spectra acceleration coefficients, base reactions for seismic and wind forces within same storey height for different storey modules and for different storey heights. The present study concluded that for all 15 models storey displacement and storey drifts are within permissible limit. The storey drift, storey displacement, storey shear etc. are less in the region of 65° to 75° diagrid angle. Therefore optimum angle of diagrid is observed in the region of 65° to 75°.

Priyanka Soni *et.al* (2016) **[7]** have analyzed multi-storey building of different shear wall locations and heights and studied the analysis of various research works involved in enhancement of shear walls and their behavior towards lateral loads. Six models of G+10, G+20 and G+ 26 storeys with storey height 3.5m, earthquake zone II are prepared by using STAAD.Pro V8i software and two locations of shear wall are considered. The different parameters such as inter-storey drift, base shear and lateral displacement for all models have studied. From the results, it is concluded that the deflection of the multi-storey building structure of location 2 is more as compare to location 1 for G+10, G+20 and G+26 storey building. Therefore location 1 of shear wall is more efficient than location 2.



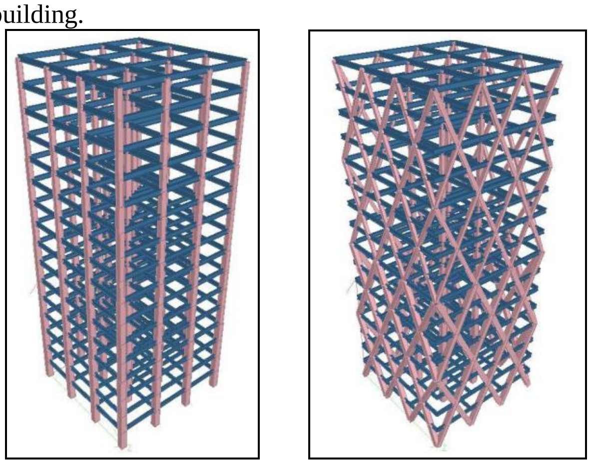
Location 1 of Shear Wall   Location 2 of Shear Wall

Figure 1: Different Locations of Shear Wall

Shubham R. Kasat *et.al* (2016) **[8]** have performed a comparative study of a multi-storey building under the action of a shear wall using ETAB software for achieving economy in reinforced concrete building structures. The design of critical section is carefully done to get reasonable concrete sizes and optimum steel consumption in members. A regular plan of 20 m X 20 m size is considered for 18 storey building with 4 m storey height and 2 m for the base storey. The models of 18 storey building are made with and without shear wall by static analysis method for earthquake zone III. The building is analyzed using ETAB v9.2.0 software. The results are compared in terms of displacement, storey drift, and base shear. It is concluded that buildings with shear wall are economical as compared to without shear wall.

C. V. Alkunte *et al.* (2016) **[9]** have performed seismic analysis of multi-storey building having infill wall, shear wall and bracing. The analysis has been carried out to study different techniques for resisting lateral forces acting on the structure and finding the most suitable method along with the design of a G+25 structure using infill wall, shear wall and bracing. The analysis of building is carried out using analytical methods as well as ETAB'S software. This paper is focused on improving the resistance and stability of high rise building against the different loads and forces it is subjected to during its life time. The parameters of the analysis were a time period, base shear, and joint displacement and these parameters are responsible for the overall stability of any building. It has been concluded from the results that shear wall has proved to be the best alternative for improving the sustainability, force resistance and uniformity of high rise building.

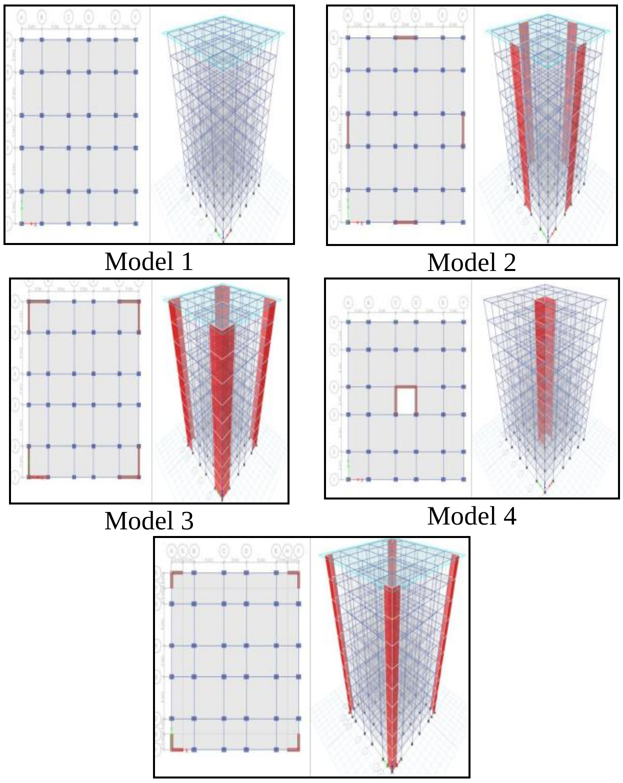
Saket Yadav and Dr. Vivek Garg (2015) **[10]** have studied the advantages of steel diagrid building over conventional building by design and analyses under gravity and seismic loading of a regular G+15 storey steel building with a plan size of 18 m x 18 m, located in a seismic zone V by STAAD Pro. All structural members are designed as per Indian standard for general construction in steel (IS 800:2007) and the seismic forces are considered as per Indian code provision for earthquake resistant design of structure (IS 1893 (Part 1): 2002). The results are compared to evaluate the utility of diagrid. It has been concluded that a significant decrease of bending moment in interior columns of diagrid building is found in comparison to the conventional building. The use of diagrid significantly decreases the maximum shear force and maximum bending moment in internal and perimeter beams. The sign of maximum bending moment also changes in perimeter beams of diagrid building. The diagrid configuration provides a reduction in the span of perimeter beams at alternate floors, hence reducing the beam forces at alternate floors. The sectional requirement of the members has been reduced in diagrid building when compared to the conventional building. This results in an advantage of approximately 12% in weight for diagrid building.



Conventional Building　　Diagrid Building

Figure 2: Isometric Views of Conventional and Diagrid Building

Anil Baral et.al (2015) **[11]** have performed seismic analysis of RC framed building for the different positions of shear wall. The response of building with different positioning of shear wall using both equivalent static method (seismic coefficient method) and response spectrum analysis. For analysis, G + 9 storey's with storey height 3m in all floor including the ground floor and plan area 17m X 17m which is located in zone V is considered. Five different Models of RCC building, one with no shear wall and other four models with different position of shear wall which is subjected to earthquake load in zone V has been studied .This study also incorporates how the bending moment, shear force for beam and axial Force for column vary with change in positioning of RC shear wall. Building are modeled and analyzed using standard package ETABS 2013. It has been concluded that from both equivalent static analysis and response spectrum analysis displacement, storey drift were lower in case of model 3 as compared to other models. Higher values of Bending moment and shear force was observed in model 3 for the beams in storey 9 as compared to all other Models. Minimum value of axial force was observed in model 3 for C13 column in all the storey of the building compared to other models. Proper positioning of shear wall results in effective and efficient performance of building during earthquakes. Proper positioning of shear wall results in effective and efficient performance of building during earthquakes. Among the five models, model 3 having shear wall along the four corners displayed better result compared to other models.



Model 5

Figure 3: Models with Different locations of Shear Wall

Suchita Tuppad *et al.* (2015) **[12]** have analyzed multi-storey building subjected to seismic behavior to found out optimum location of shear wall by using genetic algorithm. The building is analyzed for various positioning of reinforced concrete walls (shear walls) and found the constraints such as lateral displacement using equivalent static method which are carried out as per IS: 1893 (part 1)-2002 using finite element analysis software ETABS2015 for earthquake zone V in India and MATLAB for Genetic Algorithm. Six models are prepared, first model has the building without shear wall and remaining five models have the buildings with shear wall at different locations. It has been concluded that by providing shear wall to the high rise buildings, Structural seismic behavior will be affected to a great extent and also the stiffness and the strength of the buildings will be increased.

Mohd Atif et al. (2015) **[13]** have performed comparative study on seismic analysis of G+15 storey building stiffened with bracing and shear wall. The performance of the building is analyzed in Zone II, Zone III, Zone IV, and Zone V. The analyzed structure is symmetrical, G+15, Ordinary RC moment-resting frame (OMRF). Modeling of the structure is done as per STAAD.Pro.V8i software. Time period of the structure in both the direction is retrieve from the software and as per IS 1893(part1): 2002 seismic analysis has undergone. The lateral seismic forces of RC frame are carried out using linear static method as per IS 1893(part 1): 2002 for different earthquake zones. Results are compared in terms of base shear, displacement, axial load, moments in Y and Z direction in columns and shear forces, maximum bending moments, max Torsion in beams. From the results it has been concluded that shear wall elements are very much efficient in reducing lateral displacement of frame as a drift and horizontal deflection in shear wall frame are much less than that induced in braced frame and plane frame. The location of shear wall and braced members has significant effect on the seismic response than plane frame. Shear wall construction will provide large stiffness to the building by reducing the damage to the structure. The use of steel bracing is one of the advantageous concepts which can be used to strengthen or retrofit the existing structures. The lateral displacement of the building is reduced by 35 % to 45 % by the use of X type steel bracing type reduced maximum displacement.

Rohit Kumar Singh et al. (2014) **[14]** have designed and analyzed concrete diagrid building and compared it with conventional frame building. A regular five storey RCC building with plan size 15 m X 15 m located in seismic zone V is considered for analysis. The STAAD.Pro software is used for modeling and analysis of structural members. All structural members are designed as per IS 456:2000 and load combinations of seismic forces are considered as per IS 1893(Part 1): 2002. The comparison is carried out the analysis results in terms of storey drift, node to node displacement, bending moment, shear force, area of reinforcement and economical aspects. From the results and observations it has been concluded that diagrid building showed less lateral displacement, storey drift. Diagrid showed more economical in terms of steel and better resistance to lateral loads.

Sanjay Sengupta (2014) **[15]** investigated effect of different thickness and corresponding reinforcement percentages required for shear walls on multi-storey buildings for all seismic zones in India. Building models with shear walls are developed using ETABS software. The location of the shear walls are kept same and a comparative study is done for different thickness of the shear wall for different height of the building (5 storey, 10 storey and 15 storey). In each of the cases corresponding reinforcement percentages required are found out. It is observed that for a constant thickness of shear wall, reinforcement percentage increases with increase of both seismicity and number of stories. It is also observed that for all zones, the reinforcement percentage increases if the shear wall thickness increases for a certain range of thickness and then decreases for a certain range of thickness. From the results concluded that increase of shear wall thickness is not always effective for earthquake resistant design.

Ugale Ashish B. and Raut Harshalata R. (2014) **[16]** have studied effect of steel plate shear wall on behavior of Structure by designing and analyzing G+6 storey steel building frame with and without steel plate shear wall. Equivalent static analysis is carried out for steel moment resisting building frame having (G+6) storey situated in zone III. Steel plate shear wall and the building are analyzed by using software STAAD.Pro. The parameters considered for comparing the seismic performance of building such as bending moment, shear force, deflection and axial force. From the results, it is concluded that due to using of steel plate shear wall in building the value of different parameters is reduced as compared to building without steel plate shear wall and also the quantity of steel is reduced. Steel building with steel plate shear wall is economical compared to without steel plate shear wall.

G. S. Hiremath et al. (2014) **[17]** have studied effect of change in shear wall location with uniform and varying thickness in high rise building. They have prepared six models of 25 storey of building using ETABS v 9.7.1 software and performed push over analysis in the form of displacements and storey drift. The study of 25 storey building is carried out in seismic zone IV with preliminary investigation to reduce the effect of earthquake; reinforced concrete shear walls are used in the building. It is concluded from the study that providing shear walls at adequate locations substantially reduces the displacements due to earthquake. A model with shear wall at mid span having varying thickness achieves highest reduction in displacement with base shear in elastic regions.

U. L. Salve and R. S. Londhe (2014) **[18]** have studied effect of curtailed shear wall on storey drift of high rise building subjected to seismic loads. Two symmetrical structures of 15-storey and 21-storey are prepared and analyzed by using STAAD.Pro V8i software. The parameters considered for the analysis are Shear wall, No. of Storey's, No. of bays (x, z), bay width, lateral displacement, storey shear. It has been concluded that there is no significance increase in lateral displacement, axial force, bending moment, shear force, for all column groups since shear wall is decreased up to considerable floors and shear wall can be used up to 60 % of total height of the structure without reduction of lateral loads and hence reduction in concrete cost also.

Raman Kumar et al.(2014) **[19]** investigate the seismic behavior of the buildings with shear wall at different locations and compared the results in terms of storey drift, average displacement and member forces induced in the various members of the buildings. The analysis of the building has been carried out by seismic coefficient method approach using STAAD pro 2005. Two reinforced concrete framed regular buildings with different locations of shear walls situated in seismic zone V have been analyzed in this study. Ten storey and fifteen storey buildings were taken with four different locations of shear-walls i.e. at central frame, external frame, internal frame, and combined external and internal frames. It has been conclude from the results that the storey drift increases with increase in number of storey. Storey drift decreased with the provision of shear walls. The average displacement increases with the increase in number of storey. The provision of shear wall results in reduction of average displacements. Minimum average displacement is observed when shear walls are placed at internal frames. Axial force (Fx) increases with the increase in number of stories.

Nishith B. Panchal et al. (2014) **[20]** have performed comparative analysis and design of 20 storey simple frame building and diagrid structural system of building to study the strategies to reduce the lateral forces on high rise building. A regular plan of 18m x18m size is considered and ETABS 9.7.4 software is used for modeling and analysis of structures. Compared the analysis of results in terms of top storey displacement, storey drift, steel and concrete consumption. It has been concluded that the displacement, storey drift, storey shear very much less in diagrid structures as compared to the simple frame building and diagrid structures provides more economy in terms of consumption of steel, concrete.

Nitin Chodhary et al. (2014) **[21]** have performed pushover analysis of two R.C. framed buildings with shear wall; in which plan of one building was taken symmetrical and it consist of 2 bay of 5m in x direction & 2 bay of 4m in y direction and second building having L shaped unsymmetrical plan. The shear wall was provided for studying their resisting lateral forces. In this paper highlight the effect of shear wall on R.C frame building when shear wall providing along the longer and shorter side of the building. The base shear and displacement will decreases of building. The comparative study has been done for base shear, story drift, spectral acceleration, spectral displacement, story displacement. It has been concluded that provision of shear wall results in a huge decrease in base shear and roof displacement both symmetrical and unsymmetrical building. In the unsymmetrical building shear wall must be provided on smaller side of building.

Giovanni Maria Montuori et al. (2014) **[22]** have studied geometrical patterns of diagrid in systematic and comprehensive way. Diagrid structures characterized by regular patterns are comparing to alternative geometrical configuration. It was obtained by changing the angle of diagonals (variable-angle, VA) as well as by changing the number of diagonal (variable-density, VD) along the building height. Eight different diagrid patterns (3 models for Regular patterns with 60, 70, 80 degrees angle, 3 models for variable angle pattern and 2 models for variable density pattern) are generated and designed for a 90-story model building. The resulting diagrid structures are assessed under gravity and wind loads and various performance parameters are evaluated on the basis of the analyses results. The diagrid patterns generated for the building model are analyzed using FEM numerical models, by means of SAP2000 computer code. The comparison in terms of structural weights and performances finally allows for discussing efficiency potentials of the different patterns.

Sepideh Korsavi1 et al. (2014) **[23]** studied the evolutionary process of diagrid structure towards architectural, structural and sustainability concepts: reviewing case studies. It has been concluded that according to the prevailing properties of these structures, they have made significant advances in terms of height, angle, modules, forms and materials although they are a recent trend. According to the explanations and analysis presented in each part, these advances mainly correspond to structural concepts (resistance against seismic or wind forces), architectural concepts (aesthetics, flexibility, penetration of daylight, creation of free, twisted and complex forms) and sustainability concepts (lightness, economic considerations). The diamond-shaped modules in these structures are similar but their applications vary in different projects according to structural, architectural and sustainability concepts.

Rajesh Jayarambhai Prajapati et al. (2013) **[24]** have studied effect of different positions shear wall on deflection in high rise building. The 4 models 30 storey buildings have developed using ETABS V9.5 software. They have introduced shear walls at different location on plan of building like side centre shear wall, corner shear wall, shear wall at near to centre of building plan. The effect of shear wall on deflection is studied in A1, B1, C1& D1 models of 30 storied building. Seismic zone III is considered for analysis. They have also discussed importance of the lateral stiffness of a building on its wind and seismic design. It has been concluded from discussion and study that there was marginal reduction in deflection, by introducing side centre shear wall, shear wall at centre but the deflection is reduced drastically by introducing shear wall at corner along both directions. Width of building was too small compare to length of building in plan in present work therefore wind case was governing case in their building.

Chandurkar & Pajgade (2013) **[25]** have performed seismic analysis of RCC building with and without shear wall and determined the solution for shear wall location in multi-storey building. 10 storey building with 3 m storey height is considered for analysis. Effectiveness of shear wall has been studied with the help of four different models. ETAB Nonlinear v 9.5.0 software is used for making different models. Model one is bare frame structural system and other three models are dual type structural system. An earthquake load is applied to a building of ten stories located in zone II, zone III, zone IV and zone V. Parameters like Lateral displacement, story drift and total cost required for ground floor are calculated in both the cases replacing column with shear wall. It has been concluded that by providing shear a wall at an adequate location reduces displacements due to earthquake.

Khushbu D. Jani et al. (2012) **[26]** have performed analysis and design of 36 storey diagrid steel building. A regular floor plan of 36 m × 36 m size is considered. ETABS software is used for modeling and analysis of structure. All structural members are designed using IS 800:2007 considering all load combinations. Load distribution in diagrid system is also studied for 36 storey building. Also, the analysis and design results of 50, 60, 70 and 80 storey diagrid structures are presented. From the study it is concluded that most of the lateral load is resisted by diagrid columns on the periphery, while gravity load is resisted by both the internal columns and peripheral diagonal columns. So, internal columns need to be designed for vertical load only. Due to increase in lever arm of peripheral diagonal columns, diagrid structural system is more effective in lateral load resistance. Lateral and gravity load are resisted by axial force in diagonal members on periphery of structure, which make system more effective. Diagrid structural system provides more flexibility in planning interior space and facade of the building.

Jani et al. (2013) **[27]** further studied optimum angle for diagonal column on periphery is derived based on stiffness approach. Similarly, analysis and design of 50, 60, 70 and 80 storey diagrid structures is carried out considering optimum angle of diagrid columns. Comparison of analysis results in terms of time period, top storey displacement and inter-storey drift is presented. Concluded the optimal angle of 40, 50, 60, 70 and 80 storey diagrid structure ranges between 65 degrees to 75 degrees and the optimal value of 'S' (ratio of the displacement at the top of the structure due to bending and the displacement due to shear) for 40, 50, 60, 70 and 80 storey is 2, 2, 3, 4 and 5 respectively. From the results, it can be seen that, bending mode is governing compared to the shear mode as building become taller. Stiffness based approach can be used for preliminary design of diagonal of diagrid structures.

Ehsan Salimi Firoozabad et al. (2012) **[28]** have studied effect of shear wall location on seismic performance of building. Time history analysis has been done to buildings with different number of stories and various configurations with same plan. The top story displacements have been obtained and compared to each other for all models to meet the effect of shear wall configuration on seismic performance of buildings. The analysis and design of models have been studied based on IS codes, and SAP 2000 software have been used for this purpose. It has been concluded that different positions of shear wall can reduce the top storey drift at least twice, which means the drift of building is reduced 100 percent from highest value to lowest one.

Anshuman S. et al. (2011) **[29]** have determined solution of shear wall location in multi-storey building based on its both elastic and elastoplastic behaviors'. An earthquake load is calculated and applied to a building of fifteen stories located in zone IV. Elastic and elastoplastic analyses were performed using both STAAD Pro 2004 and SAP V 10.0.5 (2000) software packages. Shear forces, bending moment and story drift were computed in both the cases and location of shear wall was established based upon the above computations. It has been observed that the in inelastic analysis performance point was small and within the elastic limit. Thus result obtained using elastic analyses are adequate. Hence, concluded that shear wall can be provided in 6th and 7th frames or 1st and 12th frames in the shorter direction.

Young-Ju Kim et al. (2011) **[30]** have performed experimental investigation of the cyclic behavior of nodes in diagrid structures under lateral loads, such as wind load or seismic load and to suggest the details and welding methods of nodes for application to an actual building based on test results. The diagrid nodes that are designed to be installed in the Lotte Super Tower located in Seoul, South Korea. Two types of specimens were developed and tested cyclically. The PA type utilized an open-section layout for the node, whereas the PB type utilized a box-section layout for the node. Concluded PB type specimens developed the superior structural performance in terms of initial stiffness, strength, ductility, and energy absorption capacity over the PA type specimens under cyclic loading.

Young-Ju Kim et al. (2010) **[31]** have studied the experimentally cyclic behavior of diagrid nodes with *h*-section braces. A new type of diagrid structural system node was proposed and tested cyclically for lateral loads such as earthquake and the wind. The cyclic load to the measure structural performance of the proposed diagrid node of a diagrid structural system under the influence of wind and seismic load. The cyclic performance for diagrid nodes is discussed with an emphasis on the hysteresis characteristics, welding methods, and failure modes concluded the PP welding method is recommended for the remaining welds, such as a web-to flange. The plastic hinge mechanism of the node formed at the end of the side stiffener, away from the node core that incorporated a rigid box section. Focusing on the load-transfer mechanism, for the upper and lower side stiffener welds, the FP welding method is also recommended. An overlapped length that is at least beyond the standard length _L_ is recommended for adequate safety.

J. Kim et al. (2010) **[32]** have investigated the seismic performance of evaluation of diagrid system buildings. The 36 storey diagrid structures with various slopes of external braces were designed and their seismic responses evaluated using nonlinear static and dynamic analyses. It has been concluded from the analysis results that the diagrid structures showed higher over strength with smaller ductility compared with tubular structures. It was also observed that as the slope of braces increased the shear lag effect increased and lateral strength decreased. Both the strength and ductility of diagrid structures increased significantly when the diagonal members were replaced by buckling-restrained braces.

Jason Krolicki et al. (2010) **[33]** have studied Dubai Towers, Dubai – Engineering the World's Tallest Sculpture. How the geometry of each tower was subtly reshaped to balance the tower and reduce the internal shear is discussed in this paper. It also discussed that the improvements made to the structural system and the simplifications created for constructability.

O. Esmaili et al. (2008) **[34]** has studied Structural aspects of RC shear wall system in a 56-Story RC tall building. The building is located in the high seismic zone. In this Tower, shear wall system with irregular openings are utilized under both lateral and gravity loads and may result some especial issues in the behavior of structural elements such as shear walls, coupling beams and etc. Seismic evaluation of the tower performed by a lot of non-linear analyses to verify its behavior with the most prevalent retrofitting guidelines like FEMA 356. Some especial aspects of the tower and the assessment of its seismic load bearing system with considering some important factors are discussed. Finally after a general study of ductility levels in shear walls; concluded the optimality and conceptuality of the tower design. Finally, having some technical information about the structural behavior of the case would be very fascinating and useful for designers.

3. Conclusion

This paper reports on research development on seismic behavior of structure by using shear wall or diagrid. Some researchers have concluded that the shear wall, diagrid and hexagrid system do not interfere in the vertical load resisting system for RC structure but they affects the lateral load resisting system of the same due to its stiffness and mass. The storey shear is linearly varying to each other but the steel bracing frame system gives the good results than shear wall system. It is observed that the deflection at the different level in multi-storey building with shear wall is comparatively lesser as compare to RC building without shear wall.

Some authors have concluded that by providing shear wall to the high rise building, seismic behavior will be affected to greater extend and also the stiffness and strength of building will be increased. It is also observed that due to diagonal columns in periphery of the structure the diagrid structure is more effective in lateral load resisting system.

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