A REVIEW PAPER ON APPROPRIATE LOCATION OF SHEAR IN BUILDING TO REDUCE REINFORCEMENT CONSUMTION BY STAAD.PRO V8i

[1]Madan Singh, [2] Rajiv Banerjee, [3]Dr. Syed Aqeel Ahmad, [4]Anwar Ahmad
[1]Student of M.Tech (Structural Engineering), [2]Associate Professor, [3]Professor, [4]Associate Professor, [5]Assosiate Professor
Department of Civil Engineering
Integral University, Lucknow, Uttar Pradesh-India

Abstract:
Shear wall system is one of the most efficient lateral load resisting systems. Shear wall provides high strength and stiffness, which resists large lateral loads along with gravity loads, it makes structure more efficient in seismic performance. The behaviour of shear wall is like vertical cantilever in the form of separate planar wall and as non-planar connected walls around elevators and stairs. Shear wall also gives additional strength and stiffness when used in interior of building. where external wall are not able to provide required strength and stiffness to the building. For serving actual purpose of shear wall in building it is essential to know about ideal location of shear wall in building. The goal of present study is to determine appropriate location of shear wall and their effect on seismic performance of building and comparative study of analyzing methods is also has been done. In this work a high rise building with different location of shear wall with different shapes has been analyzed. Four models were created with shear wall at different location. All four models were modelled on STAAD.PRO V8i. Linear static analysis was performed for all models. For response spectrum analysis, response spectra of IS 1893:2002 was selected and the response spectrum analysis was performed. For time history analysis a reference earthquake data of EL CENTRO earthquake was selected, this reference data was made compatible with IS 1893: 2002 and time history analysis was performed. Results obtained from all the three analysis of each models. Data obtained by STAAD.PRO V8i was used to interpretate the results and a comparison were made for all the Four analysis.

Index Terms: **Shear Wall, RCC column, RCC beam, RCC Slab, STAAD.Pro V8i Software.**

I. INTRODUCTION

Background High rise buildings became the symbol of urbanization. The trend of construction of high rise Building is increasing rapidly. The reasons which are responsible for this trend are scarcity of Land, increasing population. High cost of land in urban areas. So we realize now today and in future land is composed of tall buildings more than trees. As we know our world is affected by natural disasters like earthquakes due to seismic activities inside earth. Earthquake is one of the nature's greatest hazards to properties and human lives. It poses a unique engineering design problem. An intense earthquake constitutes severe loading to which most civil engineering structures may possibly be subjected. The number of earthquakes reported worldwide, are usually followed by enormous death and injury. Not only life but also economy that are threatened from this disaster. The approach of engineering design is to design the structures in such a way that it can survive under the most severe earthquakes, during their service lives to minimize the loss of life and the possibility of damage. Such disasters affect tall building most, this compel structural engineers to design buildings which should have sufficient resistant to lateral load.

Buildings are designed primarily to serve the needs of an intended occupancy. One of the dominant design requirements is therefore the provision of an appropriate internal layout of buildings. Once the functional layout is established, one must develop a structural system that will satisfy the established design criteria as efficiently and economically as possible, while fitting into the architectural layout. The vital structural criteria are an adequate reserve of strength against failure, adequate lateral stiffness and an efficient performance during the service life of the buildings.

An introduction of shear wall represents a structurally efficient solution to stiffen a building structural system because the main function of a shear wall is to increase the rigidity for lateral load resistance. In modern tall buildings, shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the effect of wind and earthquakes

Buildings with shear wall and moment frames are best suited for the lateral load resistant; such systems are called dual systems. The dual system with moment frame to resist lateral load in longitudinal direction and shear wall contribute to the resistance of overturning moments, story shear forces and story torsion in lateral direction. The term "shear wall" is rather misleading as such a wall behave like flexural members. They are usually used in tall buildings and have been found to be of immense use to avoid total collapse of buildings under seismic forces. It is always advisable to incorporate them in buildings built in region likely to experienced earthquake of large intensity or high winds. The design of these shear wall for wind are design as simple concrete walls. The design of these walls for seismic forces requires special considerations as they should be safe under repeated loads. Shear walls may become imperative from the point of view of economy and control of lateral deflection. Parameters like story torsion, base shear, story shear forces, overturning moments depends upon its geometric configuration, orientation & location within the building Therefore, the arrangement of shear wall in the building with dual structural system is essential in order to have building with good resistance of lateral loads.

II. LITERATURE REVIEW

- ***Gangisetty Sri Harsha, Dr. H Sundarsana Rao analysed(2014):*** a 19 storey residential building is with and without shear walls for wind and earthquake loads. Shear walls were taken at lift and stair corners of the buildings as L shaped, optimization techniques were used to solve structural engineering problems. For this system of wall and core they were checked for displacement, internal stresses and intensities when subjected to various loadings. It was concluded that bending movements of column in both the directions were reduced at each floor lend by using shear walls for a building. Lateral forces were increased in the direction in each shear walls were constructed at each floor level by using shear walls for a building. Tensional movements were reduced by using shear walls for a building.

- ***G.S. Hiremath, Md. Saddam Husain (2014):***. Carried out a study and observed that optimum location of shear wall having uniform thickness throughout the building and to study the performance of the building with shear wall having varying thickness at certain levels of building for different locations. It is concluded that the displacement is of interest with regard to structural stability, strength and human comfort. Displacement is lowest in bottom stories, very high at upper stories.
- ***Jong Soo Kim, Kyoung-ah Lee, Dwang Hwan Kim (2004):***.The structural system of the apartment building is shear wall system. Offset out trigger walls are placed in pit space under the top floor to supplement the lack of lateral stiffness, to analyses the dynamic characteristics and estimate the diaphragm effect of the transferred structure, the accurate FEM analysis was performed the temperature analysis of basement floor was performed using FEM model. It is concluded core for lateral loads resists lateral loads by box behavior. The transfer columns of tower are designed to the system without the soft and weak storeys. In the large area of parking, delay joint are installed around tower to reduce stress of shear wall by drying shrinkage of concrete.
- ***Lakshmi K.O, Prof. Jayashree Ramanujana, Mrs. Bindu Sunil, Dr. Laju Kottallil(Dec 2014):*** This study aims at comparing various parameters such as story drift, story shear deflection, reinforced requirements in columns of a building under lateral loads based on strategic positioning of shear walls. Base on linear and non linear analysis procedure adopted, push over analysis is used to evaluate the expected performance of the structure by estimating its strength and deformation.It is concluded that in the medium high rise buildings (>10storeys) provision of shear walls is formed to be effective in enhancing the overall seismic capacity characteristics of the structure. The reinforcement requirement in column s affected by the location and orientation of adjacent shear walls and columns.

- ***Mir M. Ali and Paul J. Armstrong (2008):***.This paper examines the critical design factors and strategies that warrant consideration to accomplish sustainable or high performance tall buildings applying innovative technologies because the design of tall buildings warrants a multi disciplinary approach and requires the integration of architectural component structures and communication system. It is concluded that since tall building consume massive energy, designers of the next generation tall building will incrementally aim for zero energy design.
- ***M.R. Suresh, Ananth Shayana Yadav(2015):***. In this paper the main aim is to find the effective, efficient and optimum location of shear wall in high rise irregular R.C. building. Optimum location of shear wall has been investigated with the help of three different models (+20) storeys R.C. buildings in zone 2 and zone5 is considered. It is concluded that the plan without shear wall gives more displacement and more drift compare to plan with shear wall along four edge providing shear wall along four edge is formed to beoptimum position of shear wall.
- ***Rupali Kavilkar and Shweta Patil (2014)***: The case study analysis puts forth that high rise residential structures are not popular due to users perception that they are expansive and associated fear of safety during fire. The study includes that fly

ash is available abundantly but not used to full extent in the construction industry. The study of fly ash as a material reveals. It can be more economical to fly ash in high rise structure and minimizing the potential damage due to high temperature.

- ***Siavash Khajehpour (2011):*** The research study presents a computer based computational method for optimal cost revenue conceptual design of high-rise office buildings. The major contribution of this study is the development of a practical automatic design toll for the optimal conceptual design of high rise buildings subject to given client requirements and governing design regulations. Specifically, the computer-based tools have the capacity to account for architectural, structure, mechanical and electrical system. The computer-based procedure has the additional capability to account for life cycle costing and predicts the potential for difference conceptual design scenarios to become profitable over time, which is of particular interest to building owners.
- ***Suchita Tuppad, R.J. Fernandez (2015)***: proposed to present a procedure and application of software for optimum positioning of reinforced concrete walls called shear walls in a multi storey structure subjected to seismic behavior using generative algorithm. It is concluded that the best location of shear in multi storey building obtained from the application of genetic algorithm near the core of the building. It is concluded that, Optimization using gentic algorithm is a best procedure for determining the best solution among several locations.
- ***Sunil Kumar kalyani, Prof. Vishwanath, B. Patil (july2015)***: performed an investigation into study the behavior of the columns at ground level of multi storied buildings with soft ground floor as a satellite bus stops and floating columns in the upper stories subjected to Earthquake loading. In this study building is modeled with different shapes of shear wall with top and bottom soft storey. It is concluded that bare frame model yields higher drift values as compared to others. There is considerable reduction in drift for models with shear wall Building with top soft storey does not showed any effect in drift when subjected to seismic loading.
- ***Dario Trabucco et.al.(2016)*****:** analyzed all life phases of a tall building structural system; the extraction and production of its material, transportation of the site, construction operation, final demolition of the building and the end of life of the material. Gautam Mandal and Sudhir K. Jain(2008) carried out finite element analysis on single way with different storied in filled frames to examine. He effected the central openings of different size on the initial lateral stiffness of in filled frames. It is concluded that the effect of opening in the initial lateral stiffness in in filled frames should be neglected if the area of opening is less than 5% of the area of the infill panel. If the area of opening exceeds 40% of the area of the infill panel, frame is to be analyzed as a bare frame. Giulia Millana et.al.(2014), studied the sustainability aspects of a complex structure system and following inferences could be drawn The use of steel, intrinsically sustainable material especially for high rise building.

- ***Salenikovich and Dolan :***tested walls by various aspect ratios and overturning restraints with both statically and cyclically. Walls ductility and wall stiffness were same as result of two protocols. Capacity and corresponding displacement were 13% and greater than 30% respectively were found for walls tested monotonically and having aspect ratios less than or equal to 2:1.

- ***Zhiyuan sun, Jiliang Liu and Mingjin Chu :*** conducted cyclic loading test on a new type of adaptive slit shear wall which is introduced to improve the seismic performance of conventional shear wall structures. When compared to conventional shear walls the new wall is high ductile and failure process is progressive and is divided into two stages i.e., whole wall stage and the slit wall stage. It was found that ductile failure can be achieved and brittle shear failure can be avoided in adaptive slit shear walls with multiple seismic fortifications.

- ***Natalino Gattesco et al :*** carried experimental study to compare with code provisions on timber shear walls with particle boards and also one opening for windows. Experimental results shown that very little differences in terms of shear capacity, ductility and dissipative capacity between perforated and solid walls with equal dimensions. And a significant increase of shear capacity observed in double number nailed panels.
- ***Guendel el al*** : conducted experimental and numerical investigations on steel shear walls for seismic retrofitting tests conducted on a pure reinforced concrete (RC) frame as reference to steel shear walls with aspect ratio $\mu = 3.5$ and 5.5 with welded shear panels, shear panels made of DX56D and DX51D with excellent ductility ($\mu = 8$) SSW'S with welded shear panels and $\mu = 3.5$ and 5.5 had failure mode which separated the shear panel from the boundary elements. SSW’s with shear panels fixed with powder actuated fasteners also provide high stiffness and high strength and with limited deformation capacity due to early failure of the connection, if ordinary steel grades are used. Shear panels made with DX56D fixed by

powder actuated fasteners gave improved ductility (μ=8). Strong plastifications were occurred in the shear panel before the connection fails. The advantages observed with SSW's connection to RC frame have several advantages.

(i) Reduction of vertical reaction forces in foundations.

(ii) Additional shear forces in the RC beam are prevented and only axial forces are introduced in RC beam and RC columns with.

- ***Arturo E Schultz et al :*** conducted experiments on precast shear walls, to develop a calibrated experiments and accurate behaviour of models and design rules of precast shear walls. Application of cyclic lateral load test was conducted of twelve 2/3 scale specimens. Vertical joint connection used are notched shear plate, slotted flexure plate, inclined flat bar, pinned tension strut, brass friction device, U-shaped flexure plate. Unlike the five connections U shaped flexure plate performance, it was not possible to proportion the U-shaped plate to resist the shear forces. Panels made with notched shear plate and slotted flexure plate, assemblage acted as a monolithic unit and found with large initial elastic stiffness.

- ***P.P.Chandurkar et al*** :present a paper in determining the shear wall location of four different types of models varying with earthquake load with zones II, III, IV, V as per IS : 1893 2002 and calculated lateral displacement, story drift and total cost required for ground floor are calculated by replacing column with shear wall.

- ***Venkata sal ram kumar.N et al:*** analyzed the reinforced concrete shear walls in multi-storey buildings with effect of Lateral loads under flat terrain with varying seismic zones as per IS: 1893: 2002 and wind loads as per IS: 875: 1987 (Part: 3). In all the considered G + 2, G + 4, G+ 6, building frames, the base moment varied in power equation pattern and for base shear the graphs varied linearly. With increase in base area the stability of building increased and Minimum thickness to prevent buckling &shear wall also decreased as the stability increased.

- ***Venkata Sai Ram Kumar N et al:*** analyzed behaviour of reinforced concrete shear4 walls by considering increase of height of buildings from ground level to G+7 of height of each floor as 3.5m. The analysis involved in developing of capacity curves which relates wind drift, shear wall length, wind drift, wind shear, -wind moment, seismic drift, seismic shear, seismic moment, base moment and base shear with increase in height the base shear of medium and soft soils have no change and varied linearly, but for rocky soils there is a slight decrease in base shear after 20mts of building, height.

- ***Ugale Ashish B. and Raut Harshalata R.:*** consider a building frame with (G+6) storey situated in seismic zone III as per Indian code 1893:2002, steel plate shear wall behaviour was analyzed using STAAD PRO software, with shear wall and without shear wall also. Found steel plate shear wall enhances the stiffness of the structure. Compared without SPSW building, building with SPSW has very less deflection, bending moment, shear force, deflection and also quantity of steel is also reduced. SPSW occupies less space compared to RC shear wall which have economical and architectural aspect.

- ***M. D. Kevadkar and P. B. Kodag:*** have done lateral load analysis of R.C.C. Building (G+12) by considering 3 models. Out of this 1st model is without bracing and shear wall, 2nd model with different shear wall system and 3rd 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.

- ***O.Esmaili et al:*** study on structural RC shear wall system in a 56-Story RCC tall building. In this tower shear wall system with irregular openings are utilized under both lateral and gravity loads.

- ***S.V.Venkatesh, H.Sharada Bai*** : conducted linear static analysis with considering internal and external shear wall performance on a 10 storey framed structure for investigation of maximum joint displacement, support reaction, column forces and beam forces and found that performance of square shear walls gave better results than rectangular column of different orientations under lateral loads. Thickness of shear forces does not have much effect on decreasing of shear stresses and performance of interior shear walls are good when compared to external shear walls. External shear walls are treated as alternative to internal shear walls in retrofitting techniques.

- ***Manoj S.Medhekar and Sudhir K.Jain***: explain that the shear walls offer an economic means to provide lateral load resistance in multi-storey buildings. Their seismic behaviour, modes of failure and the factors influencing their structural strength of rectangular shear wall sections with uniformly distributed their vertical reinforcement.

III. CONCLUSION

This review paper provides information on various factors that help in understanding of factors affecting design, and analysis in the present study; G+10 building has been designed with seismic loading by using equivalent static method. The building is modelled as 3D space frame by STAAD pro software. The dead load, live load, wind loads are calculated by using IS 875(Part 1Part 2 Part 3): 1987 and seismic load as per the IS 1893:2002. Four models are taken into consideration as building frame without shear wall, building frame with side shear wall, building frame with corner shear wall, building frame with shear wall at core.

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