Eksplorium *p*-ISSN 0854-1418
Volume 46 No. 1, May 2025: 712–720 *e*-ISSN 2503-426X

Effect of different Location and Shear Wall Area Ratio on the Seismic Behavior of the Building. – A Review Paper

Darshika Shah[1], Dr. Abhijitsinh Parmar[2], Dr. Shital Shah[3]
1. Research Scholar, Department of Civil Engineering, Silver Oak University
2. Associate Professor & Head, Department of Civil Engineering, Silver Oak University
3. Principal, Apollo Institute of Engineering & Technology
darshikashah91@gmail.com[1], abhijitsinhparmar.cl@silveroakuni.ac.in[2], jaytushil@yahoo.co.in[3]

Article Received: 26 Feb 2025, Revised: 23 April 2025, Accepted:04 May 2025

Abstract: An earthquake is a terrible natural disaster caused by a rapid release of energy beneath the earth. Shear walls are structural components that help buildings withstand lateral loads and gravity. As a result, they can withstand the majority of the seismic forces that an earthquake produces. Shear walls have become more and more common in structures because of their advantages for structural design. Their locations, however, are significant and require careful consideration. The aim of this article is to investigate the effect of different location and varying shear wall area to floor area ratio in a reinforced concrete building. it is concluded by many papers that the structure with shear walls placed symmetrically will show better results in terms of all the seismic parameters. And shear wall area to floor area ratio depends on the type of building and location of shear wall. Though shear wall area to floor area ratio between 1 to 2% should be the subjected to analysis.

Keywords: Shear wall, Shear wall ratio, location of shear wall, response spectrum method, Etabs.

INTRODUCTION

Earthquake is a natural disaster caused by the abrupt release of energy underneath the earth, and it is observed as one of the worst natural tragedies, trembling up a portion of the earth's surface and all manmade matters, living and non-living beings that exist on it. Shaking are caused by energy discharged from exterior and internal materials on the surface, resulting in loss of life and structural damage. Earthquakes may vary with different intensities and magnitudes, and it is very essential to study the seismic behavior of RC structure for different functions in terms of responses such as base shear, displacements etc. (Akhil Ahamad and Pratap, 2021). Shear walls are structural components that help structures withstand gravity and lateral loads. Their primary objective is to add lateral rigidity to buildings. As a result, they can withstand the majority of seismic forces generated by an earthquake. Shear walls are becoming more popular in structures due to their structural design advantages. However, their positions are critical and require careful consideration. They should be situated as close to the center of mass as possible in a floor arrangement to avoid any supplementary moments that might occur otherwise. Therefore, it is important to use the adequate number of shear walls with the adequate cross-sectional area(Günel, n.d.).The aim of this article is to investigate the effect of different location and varying shear wall area to floor area ratio in a reinforced concrete building.

LITERATURE SURVEY

(Magendra et al., 2016)Shear wall systems are one of the most feasible and hence commonly used lateral load resisting mechanism employed in high rise buildings. They have great strength and plane stiffness, which allows them to withstand immense horizontal loads while sustaining gravity loads. Shear walls are increasingly required in multi-story buildings to withstand lateral stresses such as seismic and wind loads. As a result, determining the optimal position for shear walls is critical. Shear wall arrangement must be completely precise, or it will have a adverse effect. When the mass centre and hardness centre concur, the distance between the shear wall and the mass centre is also essential in determining the shear involvement of the wall. In this project, a research was conducted to discover the optimal structural design for a multi-story building by drastically altering the shear wall placements. Four potential shear wall positions for a G+10 storey structure with zero eccentricity between mass and hardness centers were investigated and constructed as a frame system using the computer application software ETABS. The framed structure is subjected to lateral and gravity loads in line with IS specifications, and the results are assessed to identify the best placement of the Shear wall. It is hence safe to conclude that among all other possibilities, CASE 4 (Building with Box-type Shear Wall at the centre of the geometry) is the ideal framing technique for high rise buildings.

(Rajiv Banerjee, J.B. Srivastava et al., 2019) Shear walls are used to create lateral stiffness in the structure, which protects it from lateral stresses. We see a significant decrease in lateral displacement and an increase in base shear upon the addition of a shear wall. The position of the shear wall within the building determines how much lateral force resistance it can withstand. A G+15-story structure is examined in this study. The structure is a T-shaped irregularity. To determine the best location for the shear wall in the structure, a comparative analysis is conducted. The overall length of the structure's shear wall is maintained constant for optimization. The entire analysis and modelling is completed by ETABS v. 2016.The comparative study is done on the basis of base shear, storey displacement & storey drift. From the comparative study, it was concluded that The location should be such that it should distribute the gravity loads and the lateral loads such that the building retains it centre of gravity in best way possible.

(Akhil Ahamad and Pratap, 2021) The primary goal of structural engineers is to determine how a structure will respond to horizontal forces. High-rise buildings must have sufficient stiffness to withstand horizontal forces caused by earthquakes and winds. Shear walls are added to the interior of the planned structure in order to counteract the horizontal forces, or lateral loads created by earthquakes, and to give the building more rigidity. The purpose of this work is to use Response Spectrum Analysis to investigate the nature of the structure exposed to earthquakes and the use of shear walls at several points in a G + 20 multi-story residential building. The analysis for base shear, storey drift , torsional irregularity and maximum allowable displacement is carried out of the Multi storied building with G + 20. By using prominent FEM integrated software named Etabs 2015, the analysis and modelling for the entire structure is carried out in all the seismic zones of India indicated by IS 1893 (Part-1) 2016. In this project the dynamic analysis is carried out on type -III (i.e., soft soil) for a irregular structure in plan in all the zones as specified and it is concluded that the structure with shear walls (i.e., Case C) placed symmetrically will show better results in terms of all the seismic parameters when compared with the structures without shear wall (i.e., Case A) and with shear wall at one end (i.e., Case B).

(Reshma et al., 2021) When an earthquake causes significant damage to the earth's surface, a disaster results. An earthquake's impact is lessened by a framed structure. Shear walls are essential in these kinds of buildings because they efficiently withstand horizontal shear. The flexural components that give the structure enough stiffness to effectively withstand displacement are known as the shear wall. This paper examines the longitudinal and transverse behavior of a structure while taking into account the location of a shear wall in a different location under distinct seismic zones. ETABS design software is used to analyze the dynamic response spectrum in accordance with IS code. Base shear, time-period, drift ratio, and displacement are all examined in a 20-story RCC building. The comparative analysis at different locations of the building is carried out by considering with and without shear walls. The best feasible position of the shear wall is emphasized in our studies. From the dynamic response method of analysis, we can say that model 3(RCC building frame with shear wall at corners) is performing better in all aspects compared to other models.

(Balakrishna and Saishanker, 2022) Today's high-rise skyscrapers are slimmer and more aesthetically pleasing than earlier high-rise structures, which increases the likelihood of more sway. By creating fundamental techniques for tall buildings, the dynamic behavior of these structures will be tracked. using better material grades and more suitable construction types, like tube constructions and shear walls. The main project standard of contemporary wall building frameworks for behavior walls is the integrated structural operation of floor and roof structures with walls. The foundation, which serves as a diaphragm, receives the vertical and lateral stresses that the floor structure transfers to the walls. Similar to the lateral charge approach, shear walls withstand earthquake and wind-induced lateral stresses. Shear resistance and resistance to overturning allow these shear walls to transfer the lateral stresses to the base. A 45-story structure with a platform up to the fourth floor is the subject of the current study. If the structure is affected by a significant seismic force or any other less horizontal force, there is no sudden design change made above podium level (4th storey level); if there is, construction stiffness and torsional unpredictability will follow. In order to optimize the structure repeatedly until it is stable enough to withstand pressures, the optimization techniques employed in this project begin with the assumption that the building's shear walls are all the same size. Analyses are then conducted as a result, and the failing shear wall dimensions are extended to overcome the entire system. The Etabs Software is used to design and optimize the shear wall in this project, and the shear walls are meant to resist lateral stresses in zone III across the construction as per Indian norms. The building was successfully constructed using ETABS, and the performance of the construction was carried out using response spectrum research says that Shear wall configuration being symmetric reduces it damping effect than from an asymmetric arrangement.

(Kaushik and Dasgupta, 2022)Structural walls are the predominant form for lateral load resistance under earthquakes for construction of reinforced concrete buildings over four stories.(Kaushik and Dasgupta, 2022) Current Indian seismic code for design of frame shear wall buildings (FSWB) does not clearly consider the forces transferred from the floor slabs to the shear wall for seismic design. A nonlinear static analyses is carried out using ABAQUS program to assess stress concentration at the wall-slab junction region of the building and to observe the extent of possible damages in wall, slab and their junction region,. Further, to stimulate the observed behavior of the walls in the multi-storeyed buildings and the behavior is compared with the isolated cantilever shear wall , a wall-slab sub-assemblage is also analysed. The primary goals of the study are to examine how the shear wall and floor slab junction region behaves and to create a straightforward yet effective analytical model for analyzing such a junction. Between two consecutive floors, it has been found that the presence of floor slabs at varying levels along the height of the slender shear wall tends to divide the wall into squat wall panels. Nonlinearity in concrete begins at substantially lower drift levels for all models under study. Additionally, for lower or comparable drift levels, the vertical reinforcement in the wall exhibits yielding. Therefore, taking into account the realistic behavior, the current codal prescription for RC wall constructions needs to be re-examined.

(Shukla and .K, 2022) In the design of high-rise structures, lateral loads like wind and seismic loads are crucial. Therefore, one of the main concerns for structural engineers is to ensure that high-rise buildings have sufficient lateral rigidity against such loads. One of the vertical components utilized in constructions to meet lateral stiffness requirements is a shear wall. This study is to determine the reaction of high-rise buildings with shear walls subjected to lateral stresses because its placement and arrangement should be appropriate to successfully resist lateral loads. The current work used finite element-based ETABS software to analyze seismic and wind loads in a variety of high-rise rectangular building models, both with and without shear walls. Wind loads have been computed using IS Code 875 (Part-3): 2015, and seismic loads have been computed using the corresponding static approach provided in IS Code 1893 (Part-1): 2016. According to the Indian Standard Code, the results of storey displacements and storey drifts have been retrieved while taking into account four load combinations. Shear walls positioned in the center, forming a core, have been shown to successfully withstand lateral stresses. Such a skyscraper's top story displacement is roughly 2.5 times smaller than that of a building without a shear wall. Shear walls located at corners are the least effective.

(.K and Shukla, 2023) If positioned and placed properly, a shear wall is one of the vertical components that fulfills the aforementioned role by offering sufficient lateral rigidity. Therefore, the study's goal is to ascertain how different high-rise structures with diverse shear wall configurations react to seismic loads. ETABS software, which is based on finite elements, has been used to create nine G+30-story models. The distribution of shear walls in each model ensures that the length of the walls in each building's floor plan is the same, therefore the arrangement and placement of the walls alone affect the outcomes.

The response spectrum approach, which adhered with Indian codal regulations, was used to apply seismic loads. The outcomes of story shear, storey displacements, and storey drifts were taken out. The most successful shear walls are those that are positioned in the middle of the structure in the shape of a core. In comparison to the model without shear walls, it displays a top-story displacement decrement that is 1.8 times larger.

The building with an irregular arrangement of shear walls at the corner is the least effective in resisting earthquakes.

(Redwan-Ul-Islam et al., 2023) One of the main design factors to prevent structural collapse in reinforced concrete buildings is the generation of lateral stresses, both seismic and wind. One efficient method of offering resistance against such lateral loads is through shear walls. By providing core and corner shear walls, the current work examines the drift and defection management of RC symmetrical buildings. Based on the aspect ratio and the suggested width to length ratio (B/L ratio), different restriction requirements were established in Bangladesh's four seismic zones (Zone 1 to Zone 4). Three different width to length ratios—1, 0.7, and 0.4—were examined for each zone with and without a shear wall, as well as with both core and corner shear walls, using Equivalent Static Analysis in ETABS V.2016. The findings show that corner shear walls are more effective at withstanding lateral loads, drift, and deflection than core walls. A descending failure pattern was observed from lower to higher seismic zones for the corresponding breadth to length ratios (B/L).

(Somwanshi et al., 2023) The placements of shear walls for seismic resistance in multi-story buildings are thoroughly examined in this study. The Response Spectrum Analysis method is used in the STAAD PRO. V8i program to perform the seismic analysis. In accordance with IS 1893:2002, a G+10 multi-story building located in Seismic Zone V was constructed using three distinct models that included shear walls at different points. Important characteristics including axial force, bending moment, torsion, and lateral displacement are used to assess how well these models function. This study gives engineers and researchers important information for maximizing the seismic performance of multi-story buildings by combining the results of the examined studies and analyzing various shear wall positions.

(Burak and Comlekoglu, 2013) The impact of the ratio of shear wall area to floor area on the seismic behavior of midrise RC buildings is assessed analytically. This is accomplished by creating 24 models of midrise buildings with five and eight stories with shear wall ratios varying from 0.51 to 2.17% in both directions. Nonlinear time history analysis are then performed to investigate how these building models behave under seismic loading. The base shear responses and roof and interstory drifts are the primary factors taken into account in this study that have an impact on the buildings' overall seismic performance. According to the analytical results, midrise structures should be designed with a shear wall ratio of at least 1.0% in order to control drift. In addition, when the shear wall ratio increases beyond 1.5%, it is observed that the improvement of the seismic performance is not as significant.

(Yurdakul et al., 2014) In order to identify the essential shear wall ratio, this study examined the impact of shear wall ratio on the seismic performance of structures with insufficient seismic resistance. Two distinct structures that suffered significant damage or collapsed after the Kocaeli Earthquake in Turkey on August 17, 1999, were chosen. Information regarding the material characteristics utilized in structures is lacking, despite the availability of plan views, member dimensions, section dimensions, and reinforcement data. Nevertheless, concrete's compressive strength and reinforcing bar's yield strength might be calculated to be 10 MPa and 220 MPa, respectively, taking into account Turkish building stocks. Next, SAP2000 was used to create building models with shear wall ratios of 2, 1.5, 1, and 0.5 percent as well as models of pre-existing plans. Nonlinear response history assessments of the models were then carried out. Düzce station, which had the highest peak ground acceleration during the Kocaeli earthquake, was chosen for the intense ground motion. Different shear wall ratios were used to vary the roof displacement and interstory drift ratios, and the outcomes were compared. The seismic behavior of the structure during the 1999 Kocaeli Earthquake supported the analysis results of two separate buildings, which showed that the building without shear walls performed worse under the chosen severe ground motion. But, when the structural wall ratio increases, seismic performance of the buildings improves considerably.

(Kumar and Kumar, 2018) The use of shear walls for earthquake-resistant design is encouraged by experimental and analytical studies on seismic design approaches in order to reduce loss during earthquakes. By taking into account models with varying shear wall ratios in both directions, the current study assesses the impact of the shear wall area to floor area ratio on the seismic behavior of reinforced concrete structures. Through nonlinear time history analysis, the structures are analyzed by altering the thickness of the shear wall under the Kocaeli earthquake. According to the results, structures with a 9.60% shear wall ratio have fewer storey displacements and drifts than those with a 0.00% and 4.80% shear wall ratio. Raising the shear wall to floor area ratio to 14.40% reduces drifts and displacements. Beyond this ratio, the addition of shear wall in the structure has shown only a slight effect on seismic performance of structure.

(Mehta, 2018) In regions with strong seismic activity, reinforced concrete (RC) wall-frame buildings are often advised for urban construction. One of the most popular lateral-load-resisting solutions for tall buildings is the presence of shear wall systems. Numerous books are available for the design and analysis of shear walls. However, there is no discussion in any literature regarding the impact of shear wall to floor area ratios in multi-story buildings. Shear wall ratios are one of the key factors affecting how wall-frame buildings behave seismically. As a result, it's critical to assess how well buildings with varying shear wall ratios can withstand seismic force demands. At best 14.40% shear wall to floor area ratio should be provided to control the translations. The base shear percentage carried by shear walls increases as shear wall to floor area ratio increase, but this trend reduces for shear wall ratios greater than 14.40%.

(Ejaz Ahmad Bhat and AL-FALAH UNIVERSITY, 2020) The impact of the Shear Wall Area to level Area Ratio (SWA/FA) on the seismic behavior of multi-story reinforced concrete structures with a soft storey at the ground level is assessed analytically. Nine building models with five, nine, and twelve floors and different SWA/FA in both directions are created for this purpose. Next, using the structural analysis program Etabs, Response Spectrum Analysis and Linear Static Analysis are performed to look at how these building models behave under seismic loads. Both Response Spectrum Analysis and Linear Static are performed in accordance with IS 1893:2002, the seismic code. According to the Response Spectrum's Storey Displacement example, displacement decreases by 1.2% (X) to 0.7% (Y) when shear wall area to floor area ratios increase. It is observed that from Response spectrum that the storey drift decreases with increase in SWA/FA %.

(Tunç and Al-Ageedi, 2020) To find the ideal ratio of shear wall area to floor area in a reinforced concrete building, a structural study was performed on 40 building models with different building heights and wall dimensions. Buildings with 20, 30, and 40 stories were chosen for this purpose in order to examine how different building heights affect their structural behaviors. Consequently, no wall and walls with 0.5%, 1%, 1.5%, and 2.0% area ratios applied in combined x and y directions were included in building models. Using the pressures produced in accordance with the 2016 American Building Code (ASCE 7-16) and the 2018 Turkish

Earthquake Code (TEC 18), each of these models was put through a response spectrum analysis. The findings showed that for the 20 and 30 storey buildings, the optimal shear wall area to floor area ratios were 1.5% and 2.0%.. However, the need for the wall area of the 40-storey building was slightly more than 2.0%. However, as the wall layout was revised for the building with the 2.0% wall area ratio, the requirement for the wall area was nearly met indicating that the 2.0% wall area ratio could also be recommended for the 40-storey building.

(Alam et al., 2024) Shear walls lessen the chance of structural damage since they are considerably less prone to waver in the direction of their orientation. The study explains the investigation of the impact of different floor area ratios on shear walls in an irregularly shaped building. Torsion development in a structure with an irregular layout is the main cause for concern. This essay discusses the causes, effects, and potential remedies of the floor area (F/A) ratio of the shear wall in an irregularly shaped building. The study focuses on a 15-story U-shaped building in Seismic Zone III with medium soil conditions. It has a 5% damping value. Modelling and analysis will be done using CSI ETABS version 19.In conclusion, the study highlights the importance it is for structural engineers and architects to choose shear wall percentages that are adequate for the structures they are designing. It would appear that a shear wall ratio of 1.8% offers the best possible compromise between the structural efficiency and performance of the building.

(Khelaifia et al., 2024) The ideal location and shear wall–floor area ratio in building design are highlighted in this study. An eight-story structure in a high seismic zone was the subject of non-linear calculations that looked at various shear wall placement and floor area ratio scenarios. The performance-based seismic design (PBSD) approach is used in the study to target acceptance criteria including damage levels and the interstory drift ratio. The results show that during the design phase, concentrating shear walls in the center of the structure performs better than peripheral dispersion. Inter-story drift dependability is increased by using shear walls that fully infill the frame and create compound geometries (such as a box, U, and L). On the other hand, short beams deteriorate and lose stiffness when there are no complete shear walls inside the frame. Achieving the desired performance level is made possible by increasing the shear wall–floor area ratio in structure design, which improves structural stiffness and reliability with regard to inter-story drift. According to the study, in order to satisfy the validation requirements for interstory drift and structural damage, a shear wall ratio of 1.0% is required. Since the structural components function close to the elastic range, exceeding this percentage leads to high performance levels and is not cost-effective.

CONCLUSION

All the literature survey for the location and optimum shear wall area to floor area ratio concluded that the building with shear walls placed symmetrically will show improved results in terms of all the seismic parameters when likened with the building without shear wall.

The position should be such that the building maintains its center of gravity as best it can by distributing the lateral and gravity loads. Shear walls positioned in the center, forming a core, have been shown to successfully withstand lateral stresses.

Additionally, it is determined that when the shear wall ratio rises, the buildings' seismic performance significantly improves. The Response spectrum shows that when the SWA/FA percentage rises, storey drift falls.

According to the analytical findings, midrise buildings should have a shear wall ratio of at least 1.0%. The most effective shear wall area to floor area ratio among 1% to 2% varies depending upon height of the building and plan dimension and location of the shear wall.

REFERENCES

[1] C.V.R.Murthy, Rupen Goswami, A.R. Vijaynarayanan, Vipul V. Mehta, Some Concepts in Earthquake Behaviour of Buildings, Gujarat State Disaster management Authority.

[2] ETABS reference guide by CADD CENTRE.

[3] IS 456: 2000 -Code of practice for plain and reinforced concrete

[4] IS 1893: 2016 - Criteria for Earthquake Resistant Design of Structures

[5] IS 875: 1987 - CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES, part 1-2.

[6] Akhil Ahamad, S., Pratap, K.V., 2021. Dynamic analysis of G + 20 multi storied building by using shear walls in various locations for different seismic zones by using Etabs. Materials Today: Proceedings 43, 1043–1048. https://doi.org/10.1016/j.matpr.2020.08.014

[7] Alam, T., Banerjee, R., Mahadeven, V., Gupta, N., Parashar, A.K., 2024. Assessment of shear wall quantity on seismic performance of high-rise building. Asian J Civ Eng 25, 3815–3822. https://doi.org/10.1007/s42107-024-01013-z

[8] Balakrishna, C., Saishanker, S.N., 2022. Shear wall analysis and optimised design for high rise buildings using ETABS. ijhs 11018–11028. https://doi.org/10.53730/ijhs.v6nS2.7956

[9] Burak, B., Comlekoglu, H.G., 2013. Effect of Shear Wall Area to Floor Area Ratio on the Seismic Behavior of Reinforced Concrete Buildings. J. Struct. Eng. 139, 1928–1937. https://doi.org/10.1061/(ASCE)ST.1943-541X.0000785

[10] Ejaz Ahmad Bhat, AL-FALAH UNIVERSITY, 2020. Effect of Shear Wall Area on Seismic Behaviour of Multistoried Building with Soft Storey At Ground Floor. IJERT V9, IJERTV9IS070017. https://doi.org/10.17577/IJERTV9IS070017

[11] Günel, A.O., n.d. OF MIDDLE EAST TECHNICAL UNIVERSITY.

[12] .K, N., Shukla, K., 2023. Dynamic Response of High-Rise Buildings with Shear walls due to Seismic forces. https://doi.org/10.21203/rs.3.rs-2815496/v1

[13] Kaushik, S., Dasgupta, K., 2022. Analytical Study on Seismic Behavior of Rectangular Shear Wall Connected to Floor Slabs. ASPS Conf. Proc. 1, 591–597. https://doi.org/10.38208/acp.v1.553

[14] Khelaifia, A., Chebili, R., Zine, A., 2024. Impact of the position and quantity of shear walls in buildings on the seismic performance. Asian J Civ Eng 25, 953–964. https://doi.org/10.1007/s42107-023-00824-w

[15] Kumar, Y.R., Kumar, P.B., 2018. EFFECT OF SHEAR WALL AREA TO FLOOR AREA RATIO ON SEISMIC PERFORMANCE OF R.C. STRUCTURES.

[16] Magendra, T., Titiksh, A., Qureshi, A.A., Scholar, P., 2016. Optimum Positioning of Shear Walls in Multistorey-Buildings 3.

[17] Mehta, G., 2018. ANALYTICAL STUDY OF BEHAVIOUR OF R.C.C BUILDING WITH VARYING RATIO OF SHEAR WALL AREA TO FLOOR AREA 5.

[18] Rajiv Banerjee, J.B. Srivastava, Banerjee*, R., Srivastava, Dr.J.B., Professor in Institute of Engineering and Technology, Lucknow, India., 2019. Determination of Optimum Position of Shear Wall in an Irregular Building for Zone III & IV. IJITEE 9, 174–183. https://doi.org/10.35940/ijitee.A3970.119119

[19] Redwan-Ul-Islam, Fariha, Z., Bashar Bhuiyan, M.A., Islam, R., 2023. Analysis of RC buildings under seismic zones in Bangladesh concerning shear wall, aspect ratio and breadth to length ratio. J. Phys.: Conf. Ser. 2521, 012005. https://doi.org/10.1088/1742-6596/2521/1/012005

[20] Reshma, T.V., Sankalpasri, S.S., Tanu, H.M., Nirmala, M.V., 2021. Multistorey Building Analysis and Its Behavior because of Shear Wall Location Underneath completely different Seismal Zones. IOP Conf. Ser.: Earth Environ. Sci. 822, 012044. https://doi.org/10.1088/1755-1315/822/1/012044

[21] Shukla, K., .K, N., 2022. Effective Location of Shear Walls in High-Rise RCC Buildings Subjected to Lateral Loads. https://doi.org/10.21203/rs.3.rs-2008981/v1

[22] Somwanshi, D.K., Siddharth, D., Sharma, S., 2023. Analysis of Multi-Storey Building based on Different Shear Wall Locations.

[23] Tunç, G., Al-Ageedi, M., 2020. A PARAMETRIC STUDY OF THE OPTIMUM SHEAR WALL AREA FOR MID-TO HIGH-RISE RC BUILDINGS. Konya Journal of Engineering Sciences 8, 601–617. https://doi.org/10.36306/konjes.666748

[24] Yurdakul, Ö., Avşar, Ö., Tunaboyu, O., 2014. EFFECTS OF SHEAR WALL RATIO ON THE SEISMIC BEHAVIOUR OF BUILDINGS HAVING INADEQUATE SEISMIC RESISTANCE. https://doi.org/10.4231/D3F76676C

[25] Gunel, A., 2013, Influence of the Shear Wall Area to Floor Area Ratio on the Seismic Performance of Existing Reinforced Concrete Buildings, Master's Thesis in Civil Engineering, Middle East Technical University, Ankara.