

Review Of Wind Load Effects on The Structural Behavior of Composite Shear Wall Systems in High-Rise Buildings

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Abstract—The present study investigates the influence of shear wall inclusion in reinforced concrete (RCC) and composite structural systems. In structural analysis, a shear wall behaves similarly to a vertical cantilever beam anchored at its base, significantly enhancing the lateral stiffness of the building. This increased stiffness helps control overall structural displacement, minimize storey drift, and improve the serviceability performance of the structure by reducing excessive sway and protecting non-structural components. These wind pressures generally increase with elevation due to higher wind velocities at greater heights and are evaluated using standard design provisions such as IS 875 (Part 3), which incorporate parameters related to terrain conditions, topography, and structural geometry. The review analysis focuses on key structural response parameters including storey displacement, storey drift, stiffness, lateral force, and base shear. Comparative evaluations are performed for high-rise building configurations of G+20, G+25, and G+30 storeys with varying shear wall dimensions to assess their effectiveness in enhancing lateral load resistance and overall structural performance under wind loading conditions. ETABS 22 is being utilised for the modeling and to analyze the structure.

Index Terms—Steel Plate Shear Wall, Composite Shear Wall, Storey Displacement, Storey Stiffness, Storey Drift, Wind Analysis.

I. INTRODUCTION

Shear walls are widely recognized as one of the most efficient structural elements used to resist lateral loads in high-rise buildings. A shear wall is a vertically oriented structural component, typically constructed of reinforced concrete, that behaves as a cantilever member fixed at the foundation. It resists horizontal forces primarily through a combination of shear and

flexural actions. Due to their high stiffness and significant load-carrying capacity, shear walls effectively limit lateral deflections, reduce storey drift, and enhance the overall stability of buildings subjected to wind loads. Their application is particularly advantageous in tall structures where conventional moment-resisting frame systems alone may not provide adequate resistance against wind-induced forces.

The increasing rate of urban development and population growth has led to the construction of taller and more slender building structures in contemporary urban environments. As building height and slenderness increase, the structures become more sensitive to lateral loads such as wind and seismic forces. Among these, wind loads represent a major consideration in the design of high-rise buildings due to their continuous, dynamic, and fluctuating nature. Wind-induced actions can result in excessive lateral displacement, increased inter-storey drift, and potential structural instability, which may negatively influence both the structural safety and the serviceability performance of buildings, including occupant comfort. Therefore, the integration of efficient lateral load-resisting systems has become an essential aspect in the design and analysis of modern multi-storey structures.

The primary objective of this review is to examine the wind performance of various types of composite shear wall systems used in high-rise buildings in addition to improving structural strength and stability, shear walls play an important role in ensuring serviceability by controlling excessive sway and minimizing vibrations that may affect occupant comfort. With the advancement of computational structural analysis

tools such as ETABS and other finite element-based software, engineers can accurately model and analyze the performance of shear wall systems. These tools enable detailed evaluation and optimization of structural configurations, thereby enhancing both safety and economic efficiency in high-rise building design.

Wind loads act as lateral forces on structures, producing pressure on the windward face and suction effects on the leeward and side faces of buildings. The magnitude of these pressures depends on several parameters, including wind speed, terrain conditions, building height, and structural geometry. In India, wind load calculations are carried out in accordance with the provisions of IS 875 (Part 3): 2015, which specifies basic wind speeds for different zones across the country and provides guidelines for determining design wind pressures. The geometry of the building, particularly its shape, size, and exposed surface area facing the wind direction, plays a significant role in wind load evaluation, as these factors directly influence the magnitude and distribution of wind pressure acting on the structure, with particular emphasis on the influence of wall thickness on their structural behavior.

The study focuses on evaluating the effectiveness of composite technology in enhancing structural efficiency while potentially reducing the dimensions of structural members without compromising strength, stiffness, and overall stability. The adoption of composite structural systems offers significant advantages in modern construction by optimizing material usage and improving load-resisting capacity. Such advancements are especially relevant in densely populated metropolitan regions such as Mumbai, where limited land availability necessitates the development of high-rise structures. Therefore, the implementation of efficient composite shear wall systems can contribute to more economical, space-efficient, and structurally resilient building designs under wind loading conditions.

II. CORRESPONDING LITERATURE

A. Comparative Analysis of RCC Wall and Composite Shear Wall.

QiuHong Zhao's, et al. (2004)¹ study investigates the cyclic behavior of traditional and innovative composite shear wall systems designed for seismic

resistance in high-rise buildings. The research focuses on experimental testing of two half-scale specimens consisting of a steel boundary frame, a steel plate shear wall, and a reinforced concrete (RC) wall. Cyclic static loading tests were performed to evaluate ductility, strength, and energy dissipation. Cyclic static tests were conducted on two half-scale specimens representing each system and both specimens showed highly ductile and stable inelastic behavior. The specimens were able to tolerate more than 17 cycles of inelastic shear displacements and reach maximum inter-story drift of more than 0.05. The traditional system has the RC wall in direct contact with the steel frame, while the innovative system introduces a gap between them.

Athira Haridas and S.A. Rasal, et al. (2022)² has studied the seismic behaviour of high-rise buildings using composite shear walls. The research compares different types of composite shear wall systems such as double skin composite shear walls, steel plate encased shear walls, steel plate encased walls with I-sections, and shear walls with I-sections with conventional RCC shear walls. The analysis was carried out using response spectrum analysis, and parameters such as storey displacement, storey drift, and storey stiffness were evaluated to understand the seismic performance of the structures. This reduces displacement by a maximum percentage of 20% to 25%.

Drift is reduced in the range of 20% to 30%. Stiffness is increased by 65% to 95%. Thus, providing I section at boundary element improves the overall seismic performance of the models.

Xiang Sun and Co-Authors, et al. (2023)³, studied the design method and mechanical properties of a plug-in composite shear wall used in prefabricated buildings. The research proposes a new composite shear wall system that can be prefabricated in factories and assembled on site, improving construction efficiency. The study investigates the structural behaviour of the proposed wall under cyclic loading to evaluate stiffness, bearing capacity, hysteretic behaviour, and seismic performance. In addition, parameters such as height-to-span ratio, axial compression ratio, and end column stiffness were analyzed to understand their influence on the mechanical performance of the composite shear wall.

Akansha Dwivedi and B.S Tyagi, et al. (2020)⁴ Evaluated the seismic analysis of multi-storey buildings with and without shear walls. The research focuses on evaluating the structural response of buildings subjected to earthquake forces by comparing models that include shear walls and those without them. In case of RCC framed structure the lateral displacement is very high. It is observed that in presence of shear wall the displacement at top reduces by approx 40% in case of static analysis and 47% in case of response spectrum analysis in both RCC and composite column buildings. Also, the building with composite column reduces the displacement by approx 20% as compared to RCC building. the seismic analysis of multi-storey buildings with and without shear walls. The research focuses on evaluating the structural response of buildings subjected to earthquake forces by comparing models that include shear walls and those without them. In case of RCC framed structure the lateral displacement is very high. It is observed that in presence of shear wall the displacement at top reduces by approx 40% in case of static analysis and 47% in case of response spectrum analysis in both RCC and composite column buildings. Also, the building with composite column reduces the displacement by approx 20% as compared to RCC building.

Devendra R. Hargunani and Dr S.A. Rasal, et al. (2023)⁵ have presented the behavior of concrete columns confined by fiber composites and the lateral load resistance of buildings with shear walls. It was found that fiber composites increase the strength and ductility of concrete, while shear walls effectively resist lateral forces and reduce seismic damage. The presence of shear walls at critical locations in buildings led to enhanced stiffness and reduced drift, indicating their importance in seismic design. Comparisons between different types of shear walls, including steel plate shear walls and composite shear walls, were made to understand their seismic response. Composite shear walls exhibited higher ductility and energy dissipation, making them effective for resisting seismic effects in high-rise buildings. Researchers also investigated the influence of various parameters on the behavior of shear walls, such as aspect ratio, shape, thickness, and presence of openings. The findings suggested that increasing the thickness of steel plates improved the ultimate bearing capacity, and the

presence of holes enhanced the deformation capacity. External stiffeners were found to improve the seismic behavior of shear walls, reducing buckling and improving lateral resistance.

Pratham Singh and Co-Authors, et al. (2023)⁶ have done analysis and comparative study of international codes and standards for a long-wind load effects on tall buildings. The authors analyzed various design codes used around the world and compared their approaches for estimating wind loads and structural responses. Rectangle model outperforms L shape, T shape, and 4-way models in base reactions with % differences of 54%, 54%, and 46% respectively in F_z and % differences of 59%, 47%, and 48% respectively in M_x , implying it can handle higher loads and moments at the base, making it more stable. Rectangle model performs better than H and C shape models with % differences of 88% and 19% respectively at the highest story, indicating higher resistance to lateral loads and lower displacements.

Nancy Kashyap and Swati Choudary, et al. (2022)⁷ analyzes the effect of shear wall location on high-rise RCC buildings subjected to earthquake loads. Structural modelling and analysis were used to compare several configurations. The maximum time period is without the shear wall in original plan and the minimum time period is thickness of steel plate in 26mm. The time period slightly reduces when the thickness of the RCC wall and steel plate is decreased. The story drift decreases in the case of RCC shear wall and increases in the case of steel plate shear wall. The authors evaluated different positions of shear walls in multi-storey buildings to determine how structural response parameters such as displacement, drift, and base shear are affected. RC slab buildings.

Mahammadasfak Memon and Ashutosh Patel, et al. (2021)⁸ presented research on comparison of composite steel-concrete shear walls with vertical steel encased profiles. The authors performed both theoretical and experimental analyses to examine the structural response of composite shear walls under lateral loads. With different type of Indian standard section using as a boundary element in shear wall storey shear increasing hardly 6% to 8%. Increasing of Storey Shear is Depend on Type of Section Which is used in the Shear wall. In Tubular and Angle Section

Increasing of Storey Shear is 8% and 2% respectively. slab with drop, post- tensioned flat slab without drop and reinforced concrete flat slab are 15 Kg/m², 20.15 Kg/m² & 25.15 Kg/m² respectively. This increment of Storey Shear is Depend on per meter Weight and Type of Indian Standard section. The research focused on parameters such as stiffness, strength, and deformation characteristics.

Reslan N, Masri A and Machaka M, et al. (2018)⁹ have presented this paper will first highlights on the structural characteristics and behavior of the CSW as a seismic resistant system. Second, the behavior of the CSW will be investigated analytically and compared to that of the RCSW. The investigation is performed on buildings with variable heights provided with either RCSW or CSW. Three-dimensional models for the case-study buildings are prepared using ETABS. A significant reduction in the total dead load of the building due to less thickness of the steel wall compared to the RC shear wall. Consequently, the story-shear forces and base shear are reduced by 46% in the eight-story buildings, and 38% in the twenty-story buildings. The inelastic drifts in the buildings with composite shear walls are higher than those in the buildings with RC shear walls by 9% in the eight-story buildings, and 26% in the twenty-story buildings. Composite shear walls are characterized being of higher ductility than RC shear walls with higher energy of dissipation, a basic requirement for seismic design.

A. A. Kale and S. A. Rasal, et al. (2015)¹⁰ this study many investigations have been done to calculate all required wind & seismic data. Analysis of model comprises mainly linear static & dynamic analysis. Analysis of all model gives the results in the form of Story displacement, Story drift, Base shear, Overturning moments, Acceleration, Time period. According to the results obtained from 15, 30 & 45 storey square, rectangular, triangular & circular shaped building comparison has been done. It shows that wind effect is critical for 45 storey building & in other hand seismic shows critical at 15 storey & 30 storey building. Circular shape is more stable amongst the all four shapes in both seismic & wind effect. Finally conclude that wind effect is very critical than earthquake for more than 30 storeys. Structural analysis is mainly concerned with finding out the

behavior of a structure when subjected to some action. The dynamic loads include wind, waves, traffic, earthquakes, and blasts. Any structure can be subjected to dynamic loading. Structural symmetry can be a major reason for buildings poor performance under severe seismic loading, asymmetry contributes significantly to increased lateral deflections, increased member forces and ultimately the buildings collapse.

B. Wind Analysis of RCC Wall And Composite Shear wall.

Maza Mohmad Sahil S, Nirmal S. Mehta and Kamlesh Damdoo, et al. (2021)¹¹ analyzed and designed the wind have very large scale of Horizontal movement of free air. In the air there is a continuously transport of wind from low to high layers in order to make the earth's radiation without balance. The wind code criteria for defined of dynamic analyses for earthquake loads are diverse from wind loads. In the design of high-rise buildings both wind loads and earthquake loads need to be considered. Also analyzed for wind load case at different terrain category are studied. It is analyzed different types of story heights with gust factor method of wind load. It is study of G+15, G+25 and G+35 multistorey building. As the height of the structure increases, deflection on top storey also increases. It is maximum at top Story and goes on lower and becomes zero at the base of the structure for with Gust factor for square and rectangle plan. The Displacement and story drift of terrain category-1 is more as compared to terrain category 2,3 &4 for both square and rectangular plan.

Kale Shivani Rajendra and Dr. Y. M. Ghugal, et al. (2023)¹² have presented the wind-induced response of a tall building depends on a variety of factors. These include the building's geometrical and dynamical characteristics as well as the approach flow's turbulence characteristics. There are a few analytical methods available for calculating the wind-induced response of tall buildings in both along and across wind directions. Aerodynamic forces, such as the drag force and lift force, act on structures under the influence of wind flow. There is a drag force acting parallel to the mean wind and a lift force acting perpendicular to that force. As a result, serviceability requires a precise measurement of building motion. Both the national building code and other Indian standard codes fall short in addressing the various

problems associated with towering buildings. BIS just published the Code IS 16700: 2017 “Criteria for Structural Safety of Tall Concrete Buildings”. This Work deals with the detailed wind analysis of 180m tall building as per IS 16700: 2017. The variation of wind force on a structure must be known for the preliminary design, which includes the proportioning of the structure.

Ashitha V Kalam and Reshma C, et al. (2019)¹³ presents vulnerability assessment study of tube in tube structures against heavy wind loads using dynamic wind analysis, when it is assembled as bundled tube structures. For the calculation of wind load and response the Gust factor method is used. Bundled tube structural system is one of the most efficient structural systems against heavy lateral load. From the above results it is clear that bundled tube in tube structures response against heavy lateral loads of entire building. From the study it can be concluded that by providing shear core at the central portion of each tube in bundled tubular structure can improve the efficiency of the structure. Thus, it will act like bundled tube in tube structure. The portion of inner tubular core can be used for super elevators or double ducker elevators which is essential for super tall buildings. For super-tall buildings, connecting the inner tube with exterior mega columns opens up the facade system for flexible aesthetic and architectural articulation thereby overcoming a principal drawback of closed-form tubular system.

Wei Wanga, Yan Wanga and Zheng Lu et al. (2017)¹⁴ have presented two specimens for experimental setup were of different width and same thickness and same height. From the results it was observed that hysteresis curve of the specimens was plump. The shear span ratio had impact over the peak load. Energy absorption was more for shear wall with wide span. It was concluded that overall seismic performance was satisfactory in terms of energy dissipation, deformation and ductility.

The seismic behavior of steel plate reinforced concrete composite shear wall is systematically investigated. A total of 16 SPRW specimens and 3 traditional RC walls with various parameters are designed, the corresponding low cyclic tests are implemented to study the seismic performance, including failure phenomena, failure mechanism, load carrying

capacity, ductility and energy dissipation characteristics, etc.

K. Sai Lakshmi and P. Prabha A et al. (2015)¹⁵ analyzed composite panel made of cold formed steel sheeting as skin and lightweight foam concrete as infill material has been developed and tested under monotonic in-plane shear load. This research provided information on the strength, stiffness, load-deformation response, interaction between profiled steel sheets and concrete, and also the possible failure modes, based on the experimental investigations. The number of steel-concrete intermediate fasteners along the height and width of the specimens provided sufficient steel-concrete composite action which prevented early elastic buckling of the profiled steel sheets and initiated failure due to steel yielding. The ductile behaviour is observed after post-peak with controlled lateral deformations of the panels due to steel sheets interconnected with studs. The composite shear wall IJERTV4IS030397 exhibited higher shear resistance in static loading.

V. B. Dawari, et al. (2021)¹⁶ took the composite shear wall with encased steel profiles for the study were RCC with I-sections and hollow box steel sections at different locations is selected. Also, author compared composite shear wall with RCC shear wall. Design details of composite shear wall is done using EURO codes. Ductility of the specimens are analysed using ductility coefficient which is the ratio between horizontal displacement and lateral displacement at yield. From the research it is observed increase in ductility and margin of safety against collapse. This system exhibits higher stiffness and less probability toward damage for midrise building. The response of coupled shear wall is explained I terms of degree of coupling (DC). The depth of coupling beam is slightly greater than RCC shear wall. Composite shear wall showed improvement in terms of stiffness and displacement. the composite steel-concrete shear walls can be recommended to improve the lateral stiffness of the building located in severe earthquake zone. The seismic performance of mid-rise buildings with reinforced concrete shear wall and composite shear wall panels has been compared.

G. Sijwal and K. Phuvoravan et al. (2022)¹⁷ have investigated new type of innovative composite shear

wall, concrete-filled cold-formed steel shear wall (CFCSW) is proposed, composed of cold-formed channel sections arc-welded together by 20 mm length of welds and filled with concrete. The main study of CFCSW focuses on the overall behavior, ultimate load capacity, stiffness and ductility. Three specimens of CFCSW with an aspect ratio of 1.0 are tested under lateral monotonic load. Three-dimensional finite element models are developed and benchmarked with the experimental results. The validated models are used to carry out parametric studies to determine the influence of the parameters on the performance of the CFCSW. The parameters are the height, steel plate thickness, weld spacing and concrete thickness of the CFCSW. The experimental and finite element modeling results indicate that increasing the weld spacing from 105 mm to 211 mm improves the stiffness, ductility and load carrying capacity, and similarly, providing holes inside the wall increases the stiffness, ductility and peak strength of the CFCSW. The ultimate capacity of the CFCSW is the most influenced by changing the height of the wall and least influenced by varying the concrete thickness of the wall.

S. Bahadır Yüksel and Alptuğ Ünal et al. (2015)¹⁸ This study was performed in order to investigate the seismic behaviors of CSW having L section folded plate as longitudinal reinforcement in boundary regions. For this purpose, the CSW with 1/3 geometricscale having L section folded plate as longitudinal reinforcement in boundary regions were tested under earthquakesimulated reversible repeatable lateral loads and the results obtained were evaluated. The cracks and damages occurred in test specimen presented that the test specimen indicated bending behavior. As it can be observed from hysteresis and envelope curves of test specimen, horizontal load bearing capacity of CSW reached a maximum when relative floor shift was about 1.5%. When relative floor shift rate was about 3%, the experiment was terminated. After CSW reached its maximum lateral load, a sudden decrease did not occur in load and it was observed that it displayed a more ductile behavior than reinforced shear walls. This indicates the positive effect of Lshape folded plate structural steel materials on shear wall behavior. When rigidity graphs are considered, it was observed that the value of rigidity decreased with the formation of

damages and cracks although rigidity was approximately constant until the formation of first crack in test specimen. When the rate of relative floor shift is about 3%, rigidity curves became parallel to horizontal axis. This means that the test specimen lost its horizontal stability at the end of the experiment. Energy consumption increased in test specimen with the progress of the experiment. The cracks formed in test specimen served the energy consumption to increase.

Sanjivan Mahadik, Pravin Gunawareand S.R. Bhagat et al. (2020)¹⁹ examined the behaviour steel fibre reinforced concrete shear wall (SFRC)under later loading. Authors used ETABS software to model concrete shear wall with and without opening and steel fibre reinforced concrete shear wall with same specification as the selected conventional model. From the analytical study it is found out that there is an increase in load carrying capacity considering strength criteria by 2.45% for SFRC shear wall and 1.8% increase for SFRC shear wall with opening. Load carrying capacity of shear wall decreased by 56.6% due to the presence of 16% central opening. Considering stiffness criteria, the load carrying capacity of SFRC shear wall increase by 10% and 9.4% increase for SFRC shear wall with opening.

Ms. Khan Shaima Khan Iftekhar Khan, Mr. Aakash Suthar et al. (2023)²⁰ designed 36 models are prepared the interaction between tall buildings and wind on flat and sloping ground, specifically focusing on the northern part of India with high wind flow. Reinforced concrete structures of different heights (G+5, G+10, and G+15) are analysed on both flat terrain and slopes (0°,10°,20°, and 30°) for various wind zones. Wind load analyses using the e-tabs software are performed in this paper there are 3 types of models has been done for the different zones.

The story displacement, story drift, mode period has been also checked and result is satisfactory. Results from software and manual calculations are compared, and design considerations are based on maximum obtained values. In Zone 3 and Zone 4, mode period increases with the number of stories and slope. This is because a taller building has more mass, which will tend to dampen the swaying motion. However, in Zone 5, mode period decreases with the number of stories. This is because the higher wind speeds in Zone 5

require a shorter mode period to prevent the building from oscillating too much.

Anjana R K Unnithan et al. (2017)²¹ studied for steel plate shear wall (SPSW) in G+ 9 storey building in seismic zone III. The model selected is with Shear wall located at core and centrally at the four sides. Response spectrum analysis with ETABS is used for the study. Displacement, storey drift, storey shear, overturning moment is analyzed for 8,16,24,32,40,48,56,64,72,80 mm thick steel plate shear wall. From the results obtained its understood that displacement decreases with increase in thickness. Minimum displacement is for 80 mm thick SPSW. Storey overturning moment decrease with increase in thickness. Storey drift varies differently with thickness. The models are analysed by Response Spectrum analysis as per IS 1893:2002. All structural members are designed as per IS 800:2007 considering all load combinations.

III. CONCLUSION

This study evaluates the structural response of high-rise buildings by examining key parameters such as storey displacement, storey drift, storey stiffness, lateral force, and base shear. A comparative analysis was conducted for building configurations of G+20, G+25, and G+30 storeys with varying shear wall dimensions to determine their effectiveness in improving lateral load resistance and overall structural performance under wind loading conditions. The modelling and analysis of the structures were carried out using ETABS 22, enabling a systematic assessment of the influence of shear wall dimensions on the stability and behaviour of high-rise buildings. The reviewed studies also indicate that the study emphasizes the significance of considering parameters such as shear wall thickness, shape, and the presence of openings during the design stage. The results indicate that selecting optimal combinations of these parameters can greatly enhance the lateral load resistance and deformation capacity of shear walls, thereby improving the overall structural performance of the building.

Based on wind analysis studies for high-rise buildings, composite walls specifically steel-concrete composite shear walls offer superior performance compared to conventional reinforced concrete (RC) systems. They

effectively combine the high compressive strength of concrete with the tensile strength and ductility of structural steel, leading to reduced wind-induced lateral displacements, lower storey drifts, and better occupant comfort.

In conclusion, the findings from these studies enhance the understanding of the behaviour of composite walls and shear walls. The insights obtained from the research can assist engineers and architects in designing more efficient and resilient high-rise buildings. This contributes to improving the overall safety, stability, and performance of structures, particularly in regions prone to seismic activity.

REFERENCES

- [1] QiuHong Zhao, "Cyclic behavior of traditional and innovative composite shear walls," in *Proc. 13th World Conf. Earthquake Engineering*, Vancouver, Canada, 2004.
- [2] A. Haridas and S. A. Rasal, "Seismic behaviour of high-rise building with composite shear wall," *Int. J. Innovative Res. Technol. (IJIRT)*, vol. 8, no. 11, 2022, ISSN: 2349-6002.
- [3] X. Sun, P. Liu, Z. Jiang, Y. Yang, Z. Wang, and Z. Mu, "Analysis of design method and mechanical properties of plug-in composite shear wall," *Metals*, vol. 13, p. 177, 2023, doi: 10.3390/met13010177.
- [4] A. Dwivedi and B. S. Tyagi, "Seismic analysis of building with and without shear wall for building with RCC and composite column," *Int. J. Eng. Res. Technol. (IJERT)*, vol. 9, no. 6, Jun. 2020, ISSN: 2278-0181.
- [5] D. R. Hargunani and S. A. Rasal, "Advances in composite walling and shear wall design for seismic resilience in high-rise buildings: A comprehensive review," *J. Emerging Technol. Innovative Res. (JETIR)*, vol. 10, no. 7, Jul. 2023, ISSN: 2349-5162.
- [6] P. Singh et al., "Comparative study of wind analysis on structural shape with & without shear walls," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 10, no. 3, 2023, ISSN: 2395-0072.
- [7] N. Kashyap and S. Choudary, "Comparative study of different shear wall on irregular structure," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 9, no. 6, 2022, ISSN: 2395-0056.

- [8] M. Memon and A. Patel, "Comparative study on the effect of composite shear wall on the performance of RC buildings," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 7, no. 4, 2021, ISSN: 2395-00072.
- [9] N. Reslan, A. Masri, and M. Machaka, "Composite shear walls: An efficient seismic resistant system for multi-story buildings," *J. Steel Struct. Constr.*, vol. 4, p. 140, 2018, doi: 10.4172/2472-0437.1000140.
- [10] A. A. Kale and S. A. Rasal, "Seismic & wind analysis of multistory building: A review," *Int. J. Sci. Res. (IJSR)*, 2015, ISSN: 2319-7064.
- [11] M. M. S. Sahil, N. S. Mehta, and K. Damdoo, "Wind analysis on high rise building," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 8, no. 7, 2021, ISSN: 2395-00072.
- [12] S. R. Kale and Y. M. Ghugal, "Dynamic wind analysis of high-rise building," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 10, no. 7, 2023, ISSN: 2395-00072.
- [13] A. V. Kalam and R. C, "Dynamic wind analysis of RC bundled tube in tube structure using ETABS," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 6, no. 5, 2019, ISSN: 2395-00072.
- [14] W. Wang, Y. Wang, and Z. Lu, "Experimental study on seismic behavior of steel plate reinforced concrete composite shear wall," Research Institute of Structural Engineering and Disaster Reduction, Tongji University, Shanghai, China, 2017.
- [15] K. Sai Lakshmi and P. Prabha A, "Inplane shear behaviour of steel-foam concrete composite wall panels," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 4, no. 3, 2015, ISSN: 2278-0181.
- [16] V. B. Dawari, "Seismic performance of multi-storey building with reinforced concrete and composite shear wall systems," *Int. J. Adv. Res. Eng. Technol. (IJARET)*, vol. 12, no. 3, pp. 242–251, Mar. 2021, Art. ID: IJARET_12_03_024.
- [17] G. Sijwal and K. Phuvoravan, "Lateral load carrying capacity of concrete-filled cold-formed steel shear wall," *IJE Trans. A: Basics*, vol. 35, no. 1, Jan. 2022.
- [18] S. B. Yüksel and A. Ünal, "Experimental behavior of composite shear walls having L shape steel sections in boundary regions," *Int. J. Civil Environ. Eng.*, World Academy of Science, Engineering and Technology, vol. 9, no. 6, 2015.
- [19] S. Mahadik, P. Gunaware, and S. R. Bhagat, "Use of composite materials in RC shear wall," *Int. J. Recent Technol. Eng. (IJRTE)*, vol. 8, no. 5, Jan. 2020, ISSN: 2277-3878.
- [20] S. K. K. I. Khan and A. Suthar, "Analysis of wind load effects on R.C structure resting on flat and sloping ground by using E-tabs," *Int. Res. J. Eng. Technol. (IRJET)*, vol. 10, no. 6, 2023, ISSN: 2395-0056.
- [21] A. R. K. Unnithan, "Design and analysis of high-rise building with steel plate shear wall," *Int. J. Civil Eng. Technol. (IJCIET)*, vol. 8, no. 4, pp. 1012–1025, Apr. 2017, Art. ID: IJCIET_08_04_115.