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A Review Paper on Analysis and Design Optimization of Shear-Wall in Case of High-Rise Building using ETABS

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Abstract – Shear walls are commonly utilized in excessive earthquake-susceptible areas, as they're enormously green in taking the loads, and in excessive-upward thrust homes in which large column length isn't always viable and cargo is more. Steel-concrete composite, steel, and R.C.C. options are taken into consideration for comparative study. An equal static approach of evaluation is used. For modeling of composite, steel, and R.C.C. structures, the ETABS software program is used and the outcomes are compared. The evaluation is the method of figuring out the conduct of the shape below distinct load combinations. Design is the system, which calls for the correct specification of the shape. Using software program evaluation and layout system is done easily. If there's any unexpected shift, it'll bring about constructing stiffness/ torsional instability if the shape is struck with the aid of using a robust seismic fore or with the aid of using a few different much less horizontal forces. The optimization method is used and in this, it is first taken into consideration that the dimensions of the shear wall are identical withinside the construction after which the evaluation is executed, and because of that, the failed shear wall dimensions are modified to conquer the whole shape, thereby optimizing for no. of instances till the whole structure is strong to withstand the force. There are a few structural parameters that have an effect on the overall performance of the structure as storey drift, base shear, and storey displacement which affected the demeanor of the structure towards the wind and seismic loads. From the outcomes of shear force, Bending Moment, story shear, story displacement, story drift, and amount of concrete and steel the optimized shear wall may be decided.

***Key Words*: Shear wall, ETABS, Earthquake loads, Load combination, Base shear**

1. INTRODUCTION

In structural engineering, a shear wall is a vertical detail of a machine this is designed to withstand in-plane lateral forces, commonly wind and seismic loads. In many jurisdictions, the International Building Code and International Residential Code govern the design of shear partitions. A shear wall resists masses parallel to the plane of the wall. Collectors additionally referred to as drag members, transfer the diaphragm shear to shear partitions and different vertical factors of the seismic force-resisting system. Shear partitions are commonly light-framed or braced timber partitions with shear panels, reinforced concrete walls, reinforced masonry partitions, or steel plates. A shear wall is stiffer in its predominant axis than it's far withinside the different axis. It is taken into consideration a number one shape that offers highly stiff resistance to vertical and horizontal forces performing in its plane. Under this mixed loading condition, a shear wall develops compatible axial, shear, torsional, and flexural strains, ensuing in complex inner strain distribution. In this way, masses are transferred vertically to the building's foundation. Therefore, there are 4 vital failure mechanisms; as proven in Figure 1. The elements figuring out the failure mechanism encompass geometry, loading, material properties, restraint, and construction.

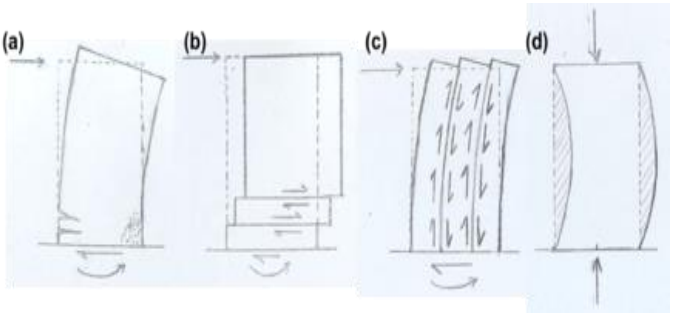

Fig -1: Failure mechanisms of shear walls. (a) flexural failure, (b) horizontal shear, (c) vertical shear, (d) buckling.

Recently, shear wall structural system is one of the best options for Tall Concrete-steel buildings because of its better structural and economic efficiency in terms of steel tonnage compared to other structural systems.

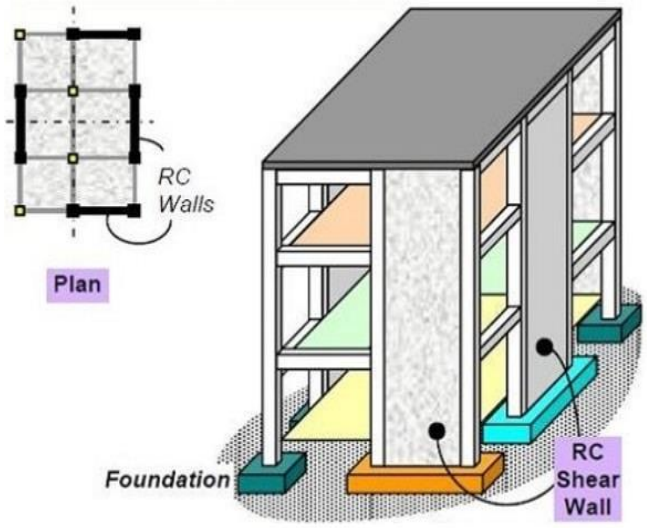

Fig -2: Shear wall system

1.1 OBJECTIVE

- To create the model of shear wall structure in ETABS.
- To analyse shear wall system for 2 different variations pertaining to thickness of shear wall and material of shear wall.
- To study on the variations in the structural response due to the earthquake motions.
- To determine best configuration of shear wall for seismic zone which results into optimal solution.

2. Literature Review

D. R. Panchal and P. M. Marathe [1] stated the structural general overall performance of shear partitions in high-rise buildings. They furnished the traits of the shear partitions, focusing interest on the structural conduct underneath gravity and lateral load and reviewing strength-primarily based totally and stiffness-primarily based totally layout criteria. After their research and assessment work, they finish an outline of the structural conduct of shear wall structures in high-rise buildings has been furnished. They have concluded that steel is a better possibility than R.C.C. but the composite is satisfactory amongst all 3 alternatives. As the sizes of the steel contributors from the steel choice to the composite choice reduce approximately 25 % in fundamental beams and approximately 60 % in secondary beams. Shear forces withinside the secondary beams prolonged from to a mean of 83.3% in steel form and reduced with the aid of using average10 % in the composite form in comparison to R.C.C. framed form on the same time as in essential beams shear forces are prolonged with the useful resource of the use of not unusual place 131% in steel form and reduced with the useful resource of the use of not unusual place 100 % in the composite form in comparison to R.C.C. framed

	R.C.C	STEEL	COMPOSITE
Max Story Displacements in mm for EQ X	X direction : 0.0431	X direction : 0.172	X direction : 0.161
	Y direction: 0.00	Y direction: 0.00	Y direction: 0.00
Max Story Displacements in mm for EQ Y	X direction : 0.00	X direction : 0.00	X direction : 0.00
	Y direction : 0.0429	Y direction : 0.176	Y direction : 0.161

Fig -3: Result Comparison

	Concrete in Cub. mt.	Reinforcement in Ton	Structural steel in Ton
R.C.C.	10174	1600	-
Steel	3200	200	3400
Composite	3600	250	3000

Fig -4: Result Comparison

L.Rahul, M.Akbar, M.Sriraman [2] mentioned the layout optimization of the shear partitions through the usage of the E-tabs software program. Three one-of-a-kind instances of shear wall thickness for a 15-storey residential tower had been analyzed and designed as an area body gadget through pc software program subjected to lateral and gravity loading according to IS code.

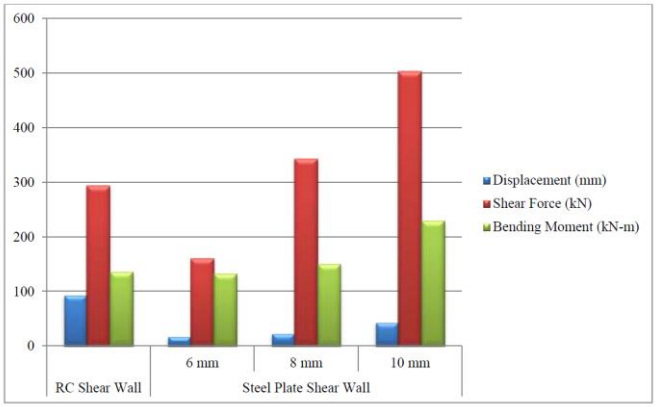

Fig -5: Comparison of results of R.C.C and steel

After their studies and evaluation work, they finish that steel plate shear partitions have a huge impact on the behavior of frames under earthquake excitation. In general, steel plate boom stiffness of the structure. In the case of without steel plate shear wall, deflection could be very huge & with steel plate shear wall, deflection could be very less.

Sayed Mahmoud and Alaa Salmana [3] mentioned the seismic reaction of RC shear wall buildings of 5--, 6--, 7--, 8--, 9--, and 10 story designed as conventional and ductile and positioned withinside the slight seismic area in Saudi Arabia according to the seismic provisions of the American code ASCE 7 16. Dynamic evaluation is carried out by the usage of the ETABS and the layout spectra of the chosen area. The seismic responses of some of the layout versions are evaluated in phrases of story displacements, drift, shear, and moments of each conventional and ductile constructing model as overall performance measures and offered comparatively. Cost estimation of ductile and traditional partitions is evaluated in comparison to every difference in phrases of a load of reinforcement bars. In addition, because of the complexity of the layout and setup of ductile shear partitions, sensitivity evaluation is carried out as well. It is found that the traditional layout significantly will increase brought of seismic responses in addition to the value in comparison to the ductile ones. And observe the conduct of high-upward thrust homes systems with the shear wall for distinctive parameters which include storey displacement, storey drift, base shear.

Wenyuan Zhanga,b, Ke Wanga,b,, Yong Chenc, Yukun Dinga,b, [4] mentioned a brand new sort of composite shear wall, composed of twin steel plates, vertical stiffening steel plates to attach the twin plates, and urban infilled withinside the vertical channels fashioned via way of means of those steel plates. Fifteen specimens had been examined under horizontal cyclic loads, together with a consistent vertical axial force, to analyze their seismic behavior. Specimen failure specifically blanketed 3 modes: excessive neighborhood buckling on the corners of the flange plates and boundary channels, harm of the concrete happening withinside the center and backside of the shear wall, and neighborhood buckling waves originating on the center of the specimen. All the specimens exhibited an amazing deformation capacity: the final glide ratios of the specimens reached a mean price of 4.55%, and the ductility has a mean price of 4.0. The take a look at effects indicated that the thickness of the shear wall and the variety of channels withinside the shear wall have a giant impact on the ductility of the specimens. However, converting the variety of channels withinside the partitions have a negligible impact on the shear electricity of the wall. Formulas to are expecting the most shear electricity and preliminary stiffness of the shear wall are proposed, and its miles established that they could offer a great prediction for maximum specimens, with an error inside 10%. In this paper, a composite shear wall with stiffener steel plates and infilled concrete (CWSC) turned into proposed. Fifteen specimens had been examined under horizontal cyclic loading to assess their hysteresis.

Vineeth Vijayan, M Helen Santhi and Romy Mohan [5] mentioned In this paper specific varieties of shear partitions, namely, concrete shear wall, silica fume concrete shear wall, steel plate shear wall, and steel silica fume concrete composite shear wall are taken into consideration for carrying wall in 22 and fifty-two storeyed high-rise buildings. The seismic overall performance of those homes has been analyzed using the reaction spectrum technique with the aid of using ETABS. The elements along with storey displacement, storey drift, and storey shear are studied and observed that there's a great reduction while as compared to the traditional shear wall. Providing steel-silica fume concrete composite shear wall rather than regular RCC shear wall, in aesthetic tall buildings, the construction will become greater seismic-resistant because it gives appealing structural properties in regions. The benefits furnished to the structure because of the availability of the composite shear partitions are.

1. A great reduction withinside the storey drift of the cultured tall building because of the composite shear wall as compared to the regular RCC shear wall. The storey drift is likewise decreased while the number of storeys extended in constructing with the composite shear wall.
2. While evaluating with the regular shear wall it is obvious that a composite shear wall can lessen the seismic impact to a bigger quantity due to the fact almost 60% reduction in displacement takes place by presenting a composite shear wall.
3. The look at exhibits that the composite shear wall has the main function withinside the reduction of storey shear.

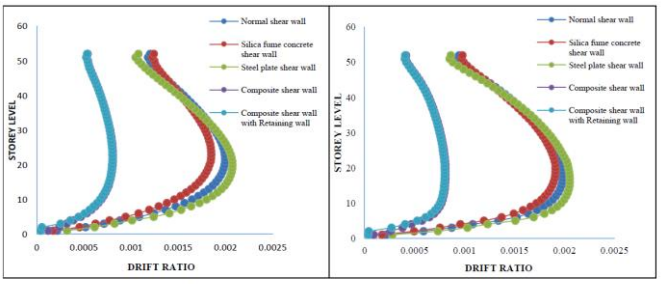

Fig -6: Story drift of G+51 building

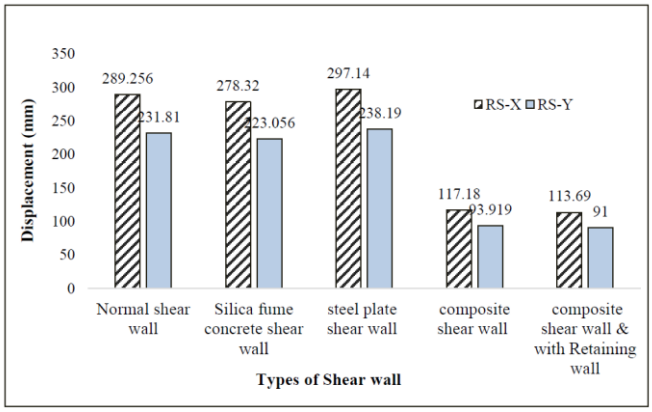

Fig -6: Max. Story displacement of G+51 building

3. CONCLUSION

From the above research paper, it is concluded that steel plate shear wall performs better compared to normal

shear wall system (i.e., R.C.C.) in terms of storey displacement. In the case of high-rise buildings, a composite shear wall is the best alternative compared to R.C.C. in terms of storey displacement and cost of construction.

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