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REVIEW-"SEISMIC ANALYSIS OF FLAT SLAB MULTISTORIED BUILDING WITH SHEAR WALL

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ABSTRACT:

Seismic analysis of structures is critical to ensuring their stability and safety during earthquakes. This paper reviews the current state of research on the seismic performance of flat slab multistoried buildings with shear walls. Emphasizing the combination of flat slab systems and shear walls, the review examines their behavior under seismic loads, methods of analysis, advantages, limitations, and design considerations. In present construction practice flat slab systems has become widely used in reinforced concrete buildings. In RC buildings flat slab system exhibit several advantages over conventional moment resisting frames. Flat slab system reduces floor height to meet the architectural and economical demand. However, under earthquake loading, the structural effectiveness of flat slab constructions is hindered by its alleged inferior performance. Shear walls are used to resist lateral forces parallel to the plane of the wall. Large forces are generated due to seismic action resist by high in plane stiffness and strength of shear wall. Mainly to avoid the total collapse of the buildings under seismic forces, shear wall act as a flexural member.

Keywords: Flat slab, Shear wall, Seismic loads, RC building

I. INTRODUCTION

In general practice of design and construction, the slabs are supported by beams and beams are supported by columns. This type of construction may be called as beam-slab construction. The available net ceiling height is reduced because of the beams. Therefore offices, warehouses, public halls and tall buildings are sometimes designed without beams and slabs are directly rest on columns. This type of beamless-slab construction called as flat slab, in which slab supported directly by columns without beams. For engineers, flat slabs construction give reduced floor height and for architectures, it give aesthetically and beautiful appearance.

So as to reduce the punching shear present in slabs, the column head is sometimes widened. These widened portions are known as column heads. The columns head are provided with some angle from the consideration point of architecture but for effective design, the portion of concrete at 45° on either side of vertical is considered only.

The moments in the slab are more near to supporting column. That is why the slab is often thickened closed to the columns by providing drops. Flat slab is enlarged and thickened so as to increase the perimeter of the critical section, to provide enough strength in shear and to lessen the amount of negative reinforcement in the support regions. These enlargements are known as capital of the column.

The shear wall is a structural element used to resist the earthquake forces or the forces parallel to the plane of wall. Generally, it is provided in tall buildings to avoid total collapse of the structure under seismic loads. We can control the side bending of structure, by providing shear wall. The shear wall will devour shear forces and prevents the location-position of construction from changing and consequently destruction. But one thing must be given importance that the shear wall arrangement must be supremely accurate, if not the resultant will give a negative effect instead. The shear wall comprises of braced panels (shear panels) to counter lateral load effects acting on a structure. Seismic loads and wind is amongst the most common loads that shear wall designed to carry. When shear wall is build, it is constructed in line form of heavily braced and reinforced panels. This is why they are also known as braced wall lines in some region. The wall perfectly connects two exterior walls and braces other shear walls in the structure. Bracing is achieved with heavy timbers and metal brackets or support beams that keep the wall steady and strong. The shear walls are now a vital part of mid and high rise buildings. A building to be an earthquake resistant design, these walls are positioned in the building plans which reduces lateral displacements under seismic loads. Thus shear wall frame structures are attained.

II. METHDOLOGY & MODELLING

[1] S. Bharath et.al (2021) considered three irregularities such as mass irregularity, vertical irregularity and plane irregularity. The prominence of the irregularities is analysed for G + 10 storey constructed in zone IV over medium soil. In order to confine the seismic effect the lateral load resisting elements considered in the study are shear wall and bracings. To identify the optimum location for placing of these elements are considered as corner and middle location. The analysis carried out by equivalent static method using Etabs 2016 software. Total 15 models are studied considering various parameters like lateral displacement, storey drift, storey stiffness, base shear and natural time period, and results are brought out comparing with shear wall and bracings.

[2] Prafoolla Thakre et.al (2020) Reviewed on the study is to explore the reduction in shear wall area in multistory building to reduce cost. Total 5 buildings framed in Staad Pro software abbreviated as SA, SB, SC, SD, SE supposed to be situated at Seismic Zone III. Post parametric analysis results shows that, the reduction in shear wall area should be adapted to a certain limit up to 20 % for cost cutting.

[3] Syed Shahebazullah Quadry et.al (2019) Investigated is to analyze effect of shear wall and perimeter beam for flat slab building, and also effectiveness of core shear wall. For present work five models are studied 1) conventional slab building 2) simple flat slab building considered without any drop and column head 3) flat slab with drop building is considered without column head 4) flat slab with drop with perimeter beam building 5) flat slab with perimeter beam and shear wall buildings, each of plan size 25mX25m are selected.

[4] Manish Dubey et.al (2018) Reviewed to determine the effect of shear wall configuration on seismic performance of flat slab buildings. Time history analysis has been done to flat slab buildings with various configurations with same plan. The top storey displacements have been obtained and compared to each other for all models to meet the effect of shear wall configuration on seismic performance of flat slab buildings.

[5] Sagar Jamle et.al (2017) Objective was the behavior of various frames when the structure length is greater than its width. For this, G+9, G+18, G+27 and G+36 Storeyed models, each of plan size 20X50m are selected. For stabilization of the variable parameters, shear wall are provided at different locations. To study the effect of different location of shear wall on flat slab multi-storey building, static analysis (Equivalent Static Analysis) in software Staad Pro is carried out for zone V. The seismic parametric studies comprise of lateral displacement, storey drift, drift reduction factor and contribution factor.

[6] Athira M.V. et.al (2017) Reviewed study of 14 storey building in zone IV is considered, and is analysed with flat slab by changing various shapes of shear wall to determine different parameters like storey shear, storey displacement, storey drift and time period. Analysis is done using ETABS V.16.Software.

[7] Anuj Bansal, et.al (2016) Objective was compare the behavior of multi-storey buildings having flat slab with that of having grid slab and to study the effect of base shear, storey drift a maximum displacement on it under seismic forces. For this purpose three cases of multi-storey buildings are considered witarea 20 m x 20 m having 4 storey, 8 storey and 12 storey with 3.6 m storey height considered. All the three cases are considered having flat slab and grid slab, and also analyzed by using software SAP2000.

[8] Durgesh Neve, et.al (2016) study of G+8 storey hospital building in Zone III is presented with some investigation which is analyzed by replacing complete columns by shear walls for determining parameters like storey drift, storey shear and displacement and is done by using Etabs software. Due to high seismic zone the column sizes of structure increases which decreases carpet area and also the aesthetic look from inside. Shear Walls are specially designed structural walls included in the buildings to resist horizontal forces that are induced in the plane of the wall due to wind, earthquake and other forces.

[9] Dhanaji R. Chavan, et.al (2016) study on flat slab is most widely used systems in reinforced concrete construction. Flat-slab building structures possesses major advantages over traditional slab-beam-column structures taking a advantages of reduced floor height, shorter construction time, architectural –functional and economical aspects. But in flat slab building columns are directly provides supports to slab with eliminating beams so there is requirement of provision of shear walls to increase the stiffness of building against lateral forces. Shear wall system are one of the most commonly used lateral load resisting in high rise building. Shear wall has high in plane stiffness and strength.

[10] Maikesh Chouhan et.al (2016) investigation in this project contains a brief description of building with shear wall and without shear wall thoroughly discussed structural analysis of a building to explain the application of shear wall. The design analysis of the multi storied building in our project is done through Staad Pro, most popular structural engineering software. It is featured with some ultimate power tool, analysis and design facilities which make it more users friendly.

[11] Manu K V1 et.al (2015) Investigation on the behavior of multi storey buildings having conventional RC frame building, flat slabs and to study the effect of height of the building on the performance of these types of buildings under seismic forces. Present study covers information on the parameters storey drift, lateral displacement, seismic base shear, natural time period.

[12] Salman I Khan et.al (2015) review of comparative study of multistoried RCC building with grid slab and flat slab for their seismic performance. They concluded that the seismic behavior of structures with gird slab and flat slab are comparable but the differences exist. High rise structures with flat slab has less base shear and they are weaker than grid slab system. In case of flat slab structure, additional moments were developed as storey drift was more. Therefore, columns of such structure are designed by considering these additional moments due to drift.

[13] Sumit Pawah et.al (2014). investigation also told us about seismic behavior of heavy slab without end restrained. For stabilization of variable parameter shear wall are provided at corner from bottom to top for calculation. Results is comprises of study of 36 models, for each plan size, 18 models are analyzed for varying seismic zone. For these case studies we were created models for two way slabs with shear wall and flat slab with shear wall, for each plan size of 16X24 m and 15X25 m, analyzed with Staad Pro. 2006 for seismic zones III, IV and V with varying height 21m, 27 m , 33 m and 39 m.

[14] Kalyanshetti M.G, et.al (2013) Reviewed on multi-storey reinforced concrete framed buildings of different heights with shear wall at five alternate locations in the building incorporating the effect of soil flexibility is considered to investigate the effectiveness of shear walls to control SSI. The study reveals that, shear walls play important role to control SSI effect and very effective when placed centrally, near to centroid of building in resisting seismic load.

[15] Rajib Kumar Biswas, et.al (2013) Study on, a 15 storied flat plate garments building have been modeled using software package "Staad Pro" for earthquake zone II in Bangladesh .This model is considered in most vulnerable situation where we took wind speed as 260 kmph and Earthquake load has been taken as per Bangladesh National Building Code(BNBC).

[16] Umesh N. Karadi et.al (2013) reviewed of 25 storey building in the zone V was presented with some investigation that was analyzed by changing locations of shear wall for finding parameters like storey shear, storey drift and displacement. The analysis had been executed by using software ETAB. 3D building model were created for both linear static and dynamic method of analysis and influence of the concrete core wall provided at centre of building.

III. CONCLUSION

- The combination of flat slab systems with shear walls offers a viable solution for multistoried buildings in seismic regions, balancing architectural flexibility with structural safety. Ongoing research and advancements in seismic analysis methods will continue to improve the understanding and performance of these systems, contributing to safer and more resilient structures.
- From the previous study it is concluded that buildings with shear walls are preferred because of notable difference in lateral displacement and storey drift.
- From the previous study it is concluded that the maximum lateral displacement is found for flat slab building without shear wall and minimum for flat slab building with shear wall. Lateral displacement is maximum at top storey and minimum at bottom storey for all type of building. Thus the lateral displacement increases drastically with the storey level.
- From the previous study it is concluded that there are no remarkable changes in the drift values with the change in position of shear walls and with the change in thickness of shear walls with height. However at the level where shear walls are curtailed, a sudden change is observed, still the effect is negligible.

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