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Seismic Response Control of Multi-Storey using Shear Wall - A Literature Review

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Abstract: ***Shear walls are the most important elements for a building. Especially in Albania as a seismic place, shear walls are very used due to the resistment of the forces coming from the earthquake. Different techniques utilizing either shell elements or combination of frame elements can be used. Modelling shear walls is very important issue for static and dynamic analyses of building structures. This study consist in finding the most effective way of modelling shear walls in structural analyses of building.***
Keyword: Shear Wall, Stiffness, Lateral Forces, Multi-storey building, Earthquake.

I. INTRODUCTION

Shear walls are the members used to resist the forces i.e. parallel to the plane of the wall. It is an important structural member which helps to resist lateral forces acting on the building. In other words, we can say that shear walls are vertical elements of the system for resisting horizontal forces. The shape and position of the shear walls show a major impact on the behavior of the structure. A significant stiffness is necessary to resist the wind and seismic activities acting on high rise building. Shear walls made up of reinforced cement concrete are provided in the structure because of their high strength, high ductile, and high stiffness. A large part of lateral loads is assigned to this kind of structural elements made up of reinforced cement concrete. The stairways, utility core and elevated shafts thus act as a shear wall to resist the horizontal force on high rise building. By providing a shear wall with proper design, it is very helpful and provides great protection to the high rise structure during a seismic activity of a moderate level. This helps towards non-structural damage and safety of the costly structural system. Shear wall made up of reinforced cement concrete have sufficient ductility and sufficient strength that it can avoid brittle failure during the strong earthquake lateral loads.

Shear infill in the structures named as basic infills are intended to oppose horizontal powers that are created in the plane of the divider because of wind, quake, and other sidelong powers. In arranging shear infill, one will endeavour to diminish the bowing worries because of parallel loads on segments by exchanging the horizontal burdens to shear infill of extensive firmness. The disappointment methods of the infill are commonly depicted as pursues: flexure disappointment (for the most part saw in thin shear infill), which implies that there is yielding of vertical steel pursued by steel crack, and pulverizing of cement or steel clasping. Shear disappointment (for the most part saw in squat shear infill) implies there can be inclining pressure (steel yielding and break at slanting splits) or there can be askew pulverizing (between corner to corner strain splits). Another critical method of disappointment that can be seen in short infill is sliding shear disappointment. This sort of disappointment creates after flexural yielding, i.e., if level breaks are opened by the cyclic minute. Sliding shear happens in these opened breaks and there is loss of interface shear exchange quality crosswise over even splits. For wind stacking, the overseeing plan criteria are constantly top diversion. At the point when as far as possible are fulfilled, it is just important to fulfil the quality necessities for an endorsed burden factor. On account of seismic stacking, notwithstanding fulfilling the utmost conditions of solidarity and diversion, the necessity of malleability winds up significant. The shear infill must have the capacity to scatter vitality conferred to it by seismic tremors through hysteretic conduct. It is realized that precise assessments of a minute or shear limit of infill under cyclic stacking with hub load are hard to make. Increasingly over the pivotal burden on shear divider impacts the malleability of the shear divider. Essentially shear infill are arranged by their conduct: squat and slim infill. A squat divider (low-ascent or short shear divider) is one in which avoidance and quality are constrained by shear. A thin divider (skyscraper or tall shear divider) is one in which diversion and quality are constrained by flexure. When all is said in done, the infill with a perspective proportion (tallness to width proportion) not as much as solidarity are squat shear infill, while proportions more prominent than 2 are characterized as slim infill. Infill with a medium angle proportion somewhere in the range of 1 and 2 are experiencing significant change; the disappointment is represented by both flexure and shear. Be that as it may, brought together angle proportion esteems to choose squat and slim infill are not accessible around the world. Diverse codes and norms give somewhat unique rules for characterizing squat and slim infill. Hub load on shear divider additionally manages its conduct with respect to whether the execution is squat or slim. There are various research papers distributed on the shear divider in the last 50 years with spearheading work started in the United States, New Zealand, and Japan.

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A. Types of Shear Walls

1) RC Shear Wall: RC concrete shear walls are one of the most commonly used shear walls in residential buildings. These walls are of different size according to the height of the building, the age of the building, need and purpose of the construction. The size of RC shear wall varies from 125mm to 500mm. commonly RC shear walls are used for the elevated lift shafts. In shear wall construction, the reinforcement is provided in vertical as well as a horizontal direction. But at the end of each wall, the reinforcement bars are closed to each other or anchored, this is also called as barbells or boundary elements.

2) Plywood Shear Wall: Plywood shear walls are also called as timber shear walls. This is the traditional shear walls consist of studs and plywood sheets. In the plywood shear wall, studs are responsible for resistance against tension or compression, while the plywood sheets are responsible for the transfer of shear force.

3) Steel Shear Wall: Steel shear walls are the type of shear walls in which instead of reinforced cement concrete, steel is used. In this system, a steel plate is used as a shear wall. This acts as a plate girder. This shear wall consists of steel plate, horizontal column and boundary column. In which the boundary columns behave like a flange, steel plate behaves like a web of plate girder and horizontal beams behave like a stiffer of plate girder in the shear wall.

4) Mid-Ply Shear Wall: Mid-ply shear wall is a type of shear wall in which an extra sheet of plywood is arranged or kept at the center of a normal plywood wall. In this type of shear wall, a series of studs or pairs of studs are arranged at the center or at both sides are positioned of mid-plywood wall. Studs help to join the outer plywood sheets with mid-ply. This system eliminates the problem to occur in the normal shear wall. The mid-ply shear wall also has the more lateral load carrying capacity as compared to plywood shear wall.

5) RC Hollow Concrete Block Masonry Wall : In this type of shear wall, Hollow concrete blocks with steel reinforcement are used to form a shear wall. The steel reinforcement is used to increase the effect of hollow concrete block shear wall against the lateral loads acting on the building. In this system, the reinforcement is arranged in concrete blocks in both the direction i.e. horizontal and vertical directions. As the reinforcement placing is done, the hollow areas are filed with concrete and allowed to set for proper strength. This type of shear wall is helpful in resisting both lateral and gravity loads. This shear wall also works like a load bearing wall.

II. OBJECTIVE

A. To analyse the RC framed structure with and without using the shear wall.
B. To examine the behaviour of building for different location of the shear wall.
C. To study the parameters like bending moment, shear force and deflection of a structure.

III. REVIEW OF LITERATURE

Misam.An in his study he considers 4 frames of G+14 in which in the first model no shear wall is provided and in other 3 frames he provided the shear wall at the different location. In his study, he considers seismic zone V whose zone factor value is 0.36.he found that the stiffness decreases as we increase the no. of floors. All the models he considered are provided with shear wall except model 1. In his calculations, he found that the structure without shear wall has 70% less stiffness at first storey as compared to the stiffness at first storey of other models in which shear wall is provided. In his study, it is also found that displacement in model 3 is less to that of the other 3 models. Also, a considerable reduction in Bending Moment, Storey Drift and shear force observed in the structure in which shear wall is provided.

MD. Rokanuzzaman studied that building without the shear wall will exhibit poor performance as compare to the building provided with shear wall to resist any type of lateral load. Among the three models that he considers, Model2 (Building with a shear wall placed at the middle of 4 periphery sides) shows the minimum top displacement value as compare to Model 1 (Building without the shear wall) which shows the maximum top displacement value. The shear force at the ground level of model3 (building with a shear wall placed at 4 corners in L shape)is larger compared to model 2. Hence, it can be said that building with a shear wall placed at the middle along the 4 peripheries (Model 2) is more efficient than the shear wall in other positions.

Pavithra R By the study of Comparison of a single soft storey taken floors in the building, it is found that the earthquake response is maximum in the model with the open storey at bottom floor and minimum in the model with the soft storey at the top floor. In the same manner, he also considers 3 models (T4, T5 and T6) in which he considers the multi soft storey in a building at different locations. In these 3 models, it is found that the soft storey at ground floor and 8th floor have more earthquake response when compared to the response of the building in which soft storey is provided at 8th floor and top floor. Thus we can say that the soft storey at the top floor will absorb more energy which results in the reduction of Earthquake response of the building. According to this study, as we shift the location of the soft storey to upper floors the value of maximum lateral drift decreases. So it is beneficial to provide soft storey above the middle floor of the building to minimize the earthquake response.

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Rajat Bongliwar in his study, it shows that providing shear walls is beneficial in the building to avoid seismic behavior that can collapse the structure. He considers a G+8 storied building in which he found that stiffness and strength increases as we provide the RCC wall which is also called as shear wall in the building. From his study and the analytical result, it is found that base shear value is high in the building with the shear wall as compared to the building without the shear wall. Also, the lateral displacement value in the building with the shear wall is less in comparission to without a shear wall structure.

Varun Sourav He considers 6 frames one is bare frame and other 5 models are provided with the shear wall at different locations. During the consideration of a bare frame with a shear wall, the displacement of the building decreases to a large extent. He also found that model 4 in which he considers the shear wall at core gives the best result and have minimum lateral displacement as compared to other models that he considers. According to his study, 67% displacement towars the direction of X-axis and 58% towards the direction of Y-axis is reduced. And around 15% of the axial force is reduced in the column when the shear wall is provided. During the consideration of infilled frame without a shear wall, as the infill wall is considered as a structural element and compared to the bare frame structure without shear wall and the result was found that 85% reduction in displacement towards X-direction and 52% reduction in displacement towards Y-direction. During the consideration of the infill frame system with a shared wall located at the best location, the 85% of displacement in X-direction is reduced and 81% of displacement in Y-direction is reduced. Also, 27% of the axial force is reduced in the column when a shear wall is considered with the infill frame system as compared to the bare frame without a shear wall structure. According to his study, by considering the infilled frame with a shear wall the displacement is very much reduced and it is very economical in comparison to the bare frame structure. And due to less displacement, the column size can also be reduced.

Aditya Deshmukh studied he considers a symmetrical building in which he performs the analysis in a different model like Bare Frame Building, Building with Uniform-Infill in All Storey, Building with Open Ground Story, OGS with Stiffer Column (MF 2.5), OGS with Corner Shear wall, OGS with Cross Bracing, OGS with Composite Column. In which he performs the analysis of bending moment, base shear, lateral displacement, storey drift by considering the different seismic zones. By his study, he found that by providing infill in the building the stiffness increases in terms of displacement as compared to open ground storey. The ductility is also more in the structure considered with infill as compared to the open ground story. He also found that the base shear value also increases by increasing the stiffness of the building and vice-versa. The most effective design is that in which the shear wall and cross bracings were provided, this majorly helps in the reduction of stiffness and bending moment generating in the column.

Prof. Dipak Jivani in his study he considered 3 stories of G+5, G+7 and G+9 in which he performs static time period analysis and dynamic time period analysis and he also perform pushover analysis with different infill percentage.

From his study, we found that static time period analysis gives the lower result as compared to dynamic time period analysis which can be due to the sudden reduction in stiffness of the structure. Also, the maximum base shear capacity and displacement result are lower in the structure with the infill system and higher in the no infill system. He also considered infill with the different opening percentage in which he found that the stiffness gets reduce as we increase the opening in infill wall. There is more ductility in a system without infill as compared to the system with infill. This clearly shows that the presence of the infill system is better than that of no infill as it also increases the stiffness of the structure and reduces the earthquake effect on the structure.

IV. CONCLUSION

The above literature review concluded that providing shear walls in a structure at adequate locations reduces the displacement due to the earthquake and other lateral loads. Construction of shear walls reduces the damages due to the effect of lateral forces due to the earthquake and high winds acting on a high rise building. From the above study, it is clear that the Shear wall provided along the periphery is most efficient and shows the minimum deflection in comparison to the shear wall considered at other locations. The result of Storey drift of building with openings in the shear wall is greater than shear wall without openings, thus the opening provided in shear wall lowers down the efficiency of resistivity of the shear wall. And also the arrangement of shear walls have an influence on concrete consumption, material consumption and steel. Placing steel bars in the direction of applied stresses increase the seismic performance of the shear wall. This study majorly shows that internal shear walls are more effective than shear walls provided at the exterior part of the structure. Shear walls are more effective in high rise buildings than in low rise buildings and also shear wall is effective in reducing soft storey effect.

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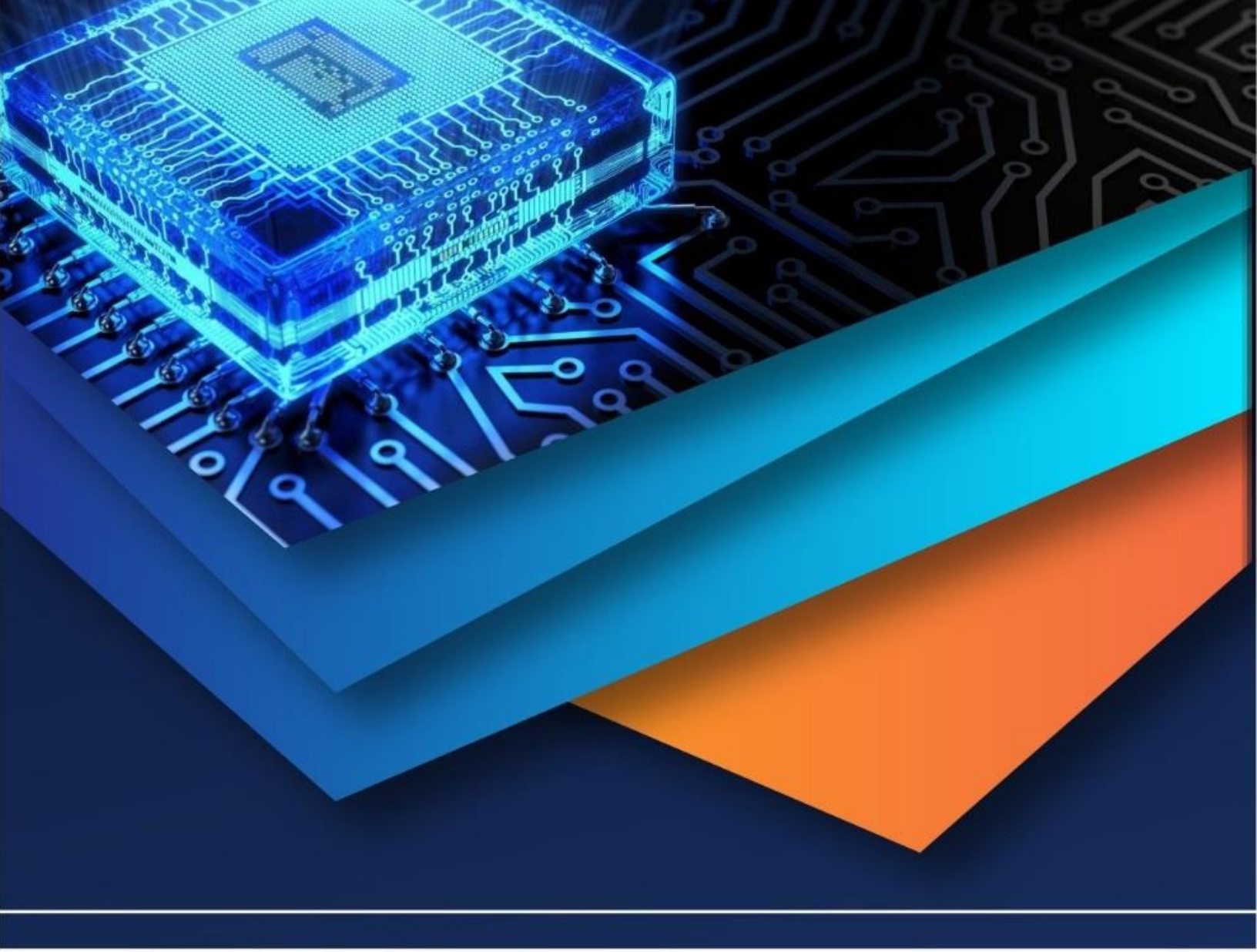
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