Review Paper: Analysis of Flat Slab Shear Wall Interaction For Multistoried Building Under Seismic Loading

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Abstract- *The aim of the present study is to compare the behavior of multi-storey building having flat slab with or without shear walls and to analyze the effect of building height on the performance under earthquake forces. Also effect of with or without shear wall for flat slab building on seismic behavior with varying thickness and varying position of shear wall are studied. In this work, the effects of varying seismic zones on these buildings are also carried out.*

For that, G+9 and G+19 Storey models, each of plan size 20X20m are selected. For stabilization of the variable parameters, shear wall are provided at corners, center and along the periphery. To study the effect of varying thickness and 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 IV and V. The seismic parametric studies comprise of lateral displacement, storey drift, drift reduction factor and contribution factor.

Keywords- Lateral displacement, Storey drift, Drift reduction factor, Contribution factor. Flat Slab, Shear Wall

I. INTRODUCTION

One of the major problems in the modern construction world is the problem of vacant land. This scarcity in urban areas has led to the vertical construction growth of low-rise, medium-rise, tall buildings and even sky-scraper (over 50 meters tall). These buildings generally used Framed Structures subjected to the vertical as well as lateral loads. In these structures, the lateral loads from strong winds and earthquakes are the main concerns to keep in mind while designing rather than the vertical loads caused by the structure itself. These both factors may be inversely proportional to each other as the building which is designed for sustaining vertical loads may not have the capacity to sustain or resist the above mentioned lateral loads. The lateral loads are the foremost ones as they are in contrast against one another as the vertical loads are supposed to increase linearly with height; on the other hand lateral loads are fairly variable and increase rapidly with height. When lateral loads of a uniform wind or an earthquake load arrives the overturning moment at base of the structure is humongous and varies proportionally to square of the building height. This causes the building to act as cantilever as these lateral loads are notably higher in the topmost storey rather than the bottom storey. These lateral forces from the sideways tend to sway the frame. The seismic prone areas where the chances of earthquakes are comparatively higher the buildings collapsed which have not been designed in concern to these seismic loads. All these above mentioned reactions make it very important to study the causes and effects of lateral loads.

1.1 Flat Slab:

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.

1.2 Shear Wall:

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. LITERATURE REVIEW

DurgeshNeve, et.al (2016) In this project, 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

Salman I Khan et.al (2015)presents the 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.

Manu K V1 et.a] (2015) Recently, Flat slab buildings are commonly used for the construction because use of flat slab building provides many advantages over conventional RC Frame building in terms of economical, use of space, easier formwork, architectural flexibility and importantly shorter construction time. The structural efficiency of the Flat slab construction is most difficult by its poor performance under earthquake loading. It is necessary to analyse seismic behaviour of buildings for various heights to see what are the changes are going to occur for the conventional RC frame building, flat slab building with and without drops

SumitPawahet.al (2014)this 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**.**

Umesh N. Karadi et.al (2013) In this, study 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.

Prof K S Sable, et.al (2012) focusedon **t**all commercial buildings which are mainlya response to demand by business actions to be as close to each other, and to city centre as possible, thus putting severe pressure on available land space. Structures with a great degree of indeterminacy are greater to one with less indeterminacy, because of more members are monolithically connected to one another and if yielding take place in whichever one of them, subsequently a redistribution of forces takes place. So it is essential to analyze seismic behavior of building for different altitudes to see what changes are going to happen if the height of traditional building and flat slab building changes.

N.F. El-Leithyet.al (2011) investigates the most common structural systems which are used for RC tall buildings under the action of wind and gravity loads. These systems include “Rigid Frame”, “Wall Frame Interaction”, “Shear wall/Central Core”, “Tube in Tube” and “Outrigger”. The fundamental modeling technique and postulations are made by “ETABS” Program in 3D modeling

III. CONCLUSION

The various research and studies shows the different merits of flat slabs& shear walls .In some cases flat slabs are lacking due to its less stiffness and shear strength where as the conventional slabs steps ahead due to its less flexibility. The additional structure like shear wall, bracings and retrofiitings helps in reducing the story drift, base shear, lateral displacement to some extent. Likewise the components of flat slabs like drop panel and column heads also plays a vital role in minimizing the seismic risk to great extent. The construction of flat slab in high seismic zones is to be analysed carefully by checking the different seismic parameters like natural time period, story displacement, axial forces etc and location of shear wall is to be placed at the side center of the building to minimizethe risk of damage occurred by earthquake and wind forces in the future.

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