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Wind Analysis over Multistorey Building Having Flat Slab-Shear Wall Interaction: A Review

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Abstract**—** *In high rise multistorey building there is a big problem to resist the lateral forces which are acting over it such as wind forces so it is important to make the structure more stiff. To counteract various lateral forces on a structure in which beam is not used, it is very difficult to make it stable. Furthermore, when the flat slab used in the structure, lateral effects are very high and the result parameters are very worst. In this paper, the approaches for finding the objectives which the researchers have already defined in their research, but no one have first designed the structure manually and then analyze the worst wind effects by software approach. Equivalent frame method is selected for the further analysis and data collection for software approach.*

Keywords**— Building cases, Equivalent Frame Method, Flat slab, Shear wall, Wind load.**

I. INTRODUCTION

In present time during the construction, the researchers faces many problems related to stability of building, height of building, load bearing and also aesthetic purposes so that to fulfil these type of criteria, the flat slab is important components in the multistorey buildings in present time because it has many advantages over the R.C. framed structures. Beamless structure which is directly supported to vertical columns to transfer its load is called Flat slab. It is used for appealing point of view in the structure. The headroom in the flat slab which is more as compare to Reinforced Concrete slab which may be one way or two ways or grid slab. Flat slab are more flexible as compare to other type of slabs but weak in lateral loading such as wind load and earth quake load so that it is important to find the behaviour of flat slab in lateral loading. The flat slab is good as compared to R.C. frame buildings but in flat slab buildings has low base shear capacity and large deflection.

In architectural point of view, flat slabs are good. Flat slab permits flexibility in building construction. It takes clear space, low height, easy framework and taken less time. Therefore flat slab buildings are used now-a-days in India. Flat slabs are used now-a-days but there is no any best design procedures of flat slab. In Indian standard code of practice, there is not any provisions of irregular geometry and design of it.

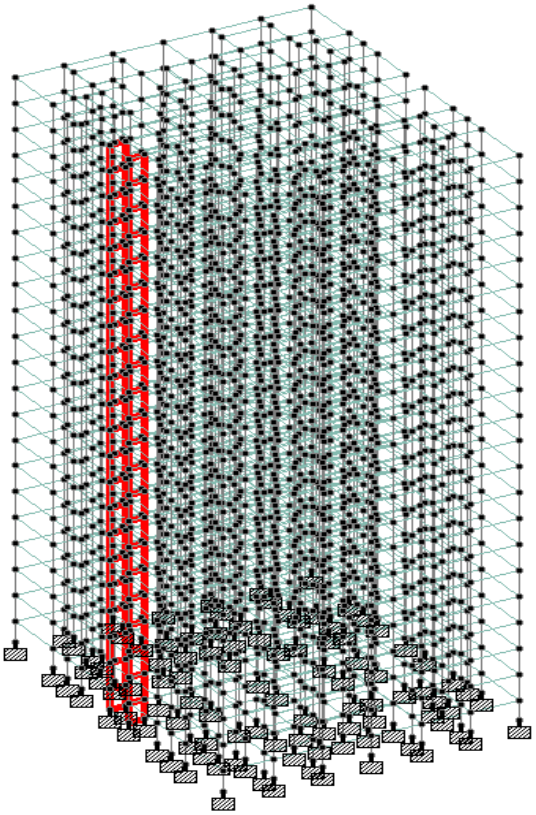

Fig. 1: Model building plan case 1 provided shear around the lift area.

Table 1: Wind forces as per IS code. (Zone wise table)

Wind Speed (m/s)	Wind type
55	Type 1
50	Type 2
47	Type 3
44	Type 4
39	Type 5
33	Type 6

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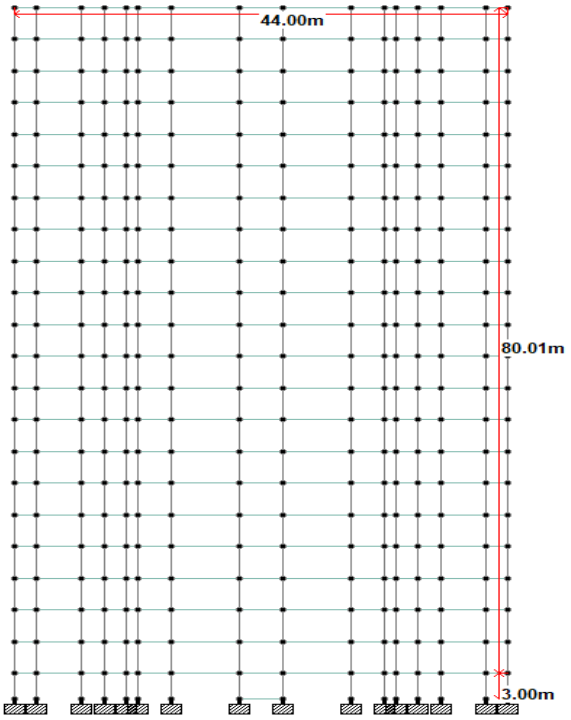

Fig.2: Model building case front view

II. REVIEW OF LITERATURE

The four types of flat slab i.e. simple flat slab nor drop nor head, flat slab added drop, flat slab added column capital and flat slab added drop and column capital are described by them. They compare only simple flat slab, flat slab added drop and grid slab to find most economical slab among them. As per this work, the description of flat slab is economical i.e. simple flat slab or added drop with flat slab and grid slab have shown. Therefore to come up this research work it has been found that the added drop flat slab is more economical as compare to without drop and grid slab. They compare simple flat slab, flat slab added drop and grid slab on the basis of concrete used, steel and total rate of each slab component. They also found that grid slab is not economical as compared to flat slab because in grid slab concrete is more required. Therefore the result obtained is, the flat slab with drop is the most economical among them [1].

The analytic definitions of 15 storey model building with and without shear walls under seismic loading are used by them. To find the different locations of shear wall with the help of R. S. A. using software ETAB was one of their objectives. Cases of shear wall are used in building with different locations of shear wall, building without shear wall, building with L type shear wall, building with shear wall along periphery and building with non-parallel shear wall along periphery. Since the results have been observed that the building with shear wall is better due to difference in storey displacement, time period, base shear and storey drift. Shear wall along periphery is also better for the effect of seismic load and earthquake load. Base shear in X and Y directions for building with shear wall are 3.08% for former and less for latter one, without shear wall values along EQX=48.52% and EQY=53.36% are detected. So the results are the building with shear wall is better because of difference in storey displacement, time period, base shear and storey drift. Shear wall along periphery is good for the effect of wind load and earth quake load [2].

The behaviour of buildings having flat slabs added drops with shear wall and flat slab added drop without shear wall are presented by them. So for this, comparison of the actual behaviour of multistorey buildings having flat slabs added drop provided shear wall and without shear wall to check these two types of buildings under seismic forces. The zones 3rd, 4th, 5th are taken by them. To analyze this using Staad pro software, for this they take six model cases on the basis of different storey.

Table.2: Different model cases

Model case 1 (16x24) G+7 provided Shear wall at plinth
Model case 2 (16x24) G+9 provided Shear wall at plinth
Model case 3 (20x30) G+7 provided Shear wall at plinth
Model case 4 (20x30) G+9 provided Shear wall at plinth
Model case 5 (20x30) G+11 provided Shear wall at plinth and 1st floor
Model case 6 (20x30) G+13 provided Shear wall at plinth

The result is that the flat slab added drop has more drift as compare to simple flat slab so that for shorter span of flat slab building can be used as master slave and for longer span using realistic approach [3].

The expression about G+8 storey building model and the method to design the flat slab is the direct design methods are described by them. To increase the performance of seismic behavior of a building is analyzed with the help of E-Tab software. In this paper the comparison of basically two shapes of flat slab have been evaluated. They are:-

a) Rectangular Flat slab (6.8*6.4) added drop , without drop
b) Square flat slab (6.4*6.4) added drop , without drop

Manual design and software analysis results are equal for Punching shear. Base shear is greater in flat slab without drop as compared to flat slab with drop. Storey drift is nearly same in Rectangular slab as well as square slab.

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Storey displacement has observed maximum in rectangular slab and minimum in square slab [4].

Using SAP 2000 software, on the basis of seismic loading, the comparison of flat slab building and regular frame building have discovered by them. For this, they took G+ 3 model with plan area of (24*24) m^2, plinth height of 1.8m and took floor height of 3.6m. After comparing the result the regular frame building performance found to be better than flat slab. To increase the performance of flat slab building using shear wall has suggested by them [5].

The consequences after punching failure of flat slab are considered by them. The flat slab structures are fail due to punching so it would become danger for humans and other damages. So those in this work, to find the post-punching shear strength of slab-column joints with the help of an experimental and theoretical research. So after punching, the residual shear strength could be increased due to the activation of the flexural reinforcement. To enhance the punching shear strength they suggested providing bent-up bars [6].

Comparative studies of flat slab with post tensioned flat slab are publicized by them. In this paper, they take two types of flat slabs i.e. simple Flat slab and Post tensioned slab. These two types of slabs are compared with each other. For this purpose, they used code IS-1893 and considering Zone 2 and 3. There are various types of model building considered which was G+9,G+11,G+14,G+19,and G+24 storey which have different in their geometrical properties and material properties. Linear time history analysis method is used by software ETAB 2015. The results observed that the flat slab is more flexible as compared to post tensioned slab and also the post tensioned flat slab is uneconomical and the former one fails earlier to lateral loading. In post tensioned slab roof displacement is minimum as compared to R.C. Flat slab buildings having drops [7].

The presentations of enhancement of punching shear strength of flat slabs using shear-bond reinforcement are shown by them. The main problem of flat slab is the punching failure which is known as sudden brittle failure, so that there are many ways to reduce the punching shear failure as increasing slab thickness, also increasing column thickness was found out. Since these provisions are not seems to be better for architectural purposes. So that the work suggests providing shear reinforcement and to find which shear reinforcement is reducing maximum punching failure. The results found that, without shear reinforcement, in concrete slab, there was a sudden failure in brittle manner. To increase the punching shear capacity of the slab, shear bands are provided. It is provided over the critical punching shear zone. Shear bands with vertical legs are easier in detailing placement and fail in more ductile mode. So using shear band parallel to the potential shear crack is less useful. Orthogonal distribution shear bands are slightly enhancement in failure load capacity ranges is 6% has found better. The arrangement of shear bands around the column circumference provides enhancement [8].

Flexibility in building construction permitted in flat slab is defined by them. But flat slab is weak against earthquake loading. The main purpose of this paper is to find the load carrying capacity of different proportioning of flat slab which resist the punching shear failure. The different flat slabs are the simple flat slab neither of drop, head, flat slab added drop, flat slab added column capital and flat slab added drop and column capital.

The seismic analysis of multi storey building with flat slab resting on plain and sloping ground are defined by them. In this work, the associations between plain and sloping ground against seismic loading and its effect have suggested. With the help of analysis it has been known that the construction of building is more danger in sloping ground as compare to plain ground. 3D analytical model of 10 storied building has considered by them. In plan which includes 4 bays in y-direction and 6 bays in x-direction was analyzed with the help of Response Spectrum Analysis using software ETAB. The result found with the help of dynamic linear analysis and it includes the effect of base shear, displacement, storey drift, time period, frequency and force. Hence the result observed that the performance of the building on sloping ground is more danger as compared to plain ground [9].

The investigation is based on storey displacement, frequency base shear, storey level, accelerations and punching shear failure. In above four cases we found out which type of combinations generate less punching shear at slab column joint. The structure is analyzed with the help of ETAB software [10].

The information about major issue associated with flat slab and different method for analysis of flat slab used to confirm the behaviour of flat slab. This paper gives the guidelines for designing the flat slab. Flat slab is only design for gravity loading (according to IS-code 456-2000).They define the three methodology to analyze the flat slab.

a) Direct design method- Used for gravity load (regular shapes)
b) Equivalent frame method- Used for gravity load (regular shapes)
c) Finite Element method (also known as descretisation method) - Used for gravity load (irregular shapes).

In this work they stretches the information about the data related to flat slab and different method for analysis of

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flat slab to support the behaviour of flat slab with including all information related to flat slab [11].

The Flat slab construction in India is designed by two methods which is conventional RCC and post tensioning and their relation between them have been described. Many advantages of Post tensioned flat slab over R.C.C. slab such as minimum reinforcement is provided, crack free load at full service load, smaller deflection etc., but in practical in post tensioned member the thickness is not reduce and also the cost is high. Because Post tensioned flat slab cost is very high so that conventional R.C.C. flat slab are constructed in India but it has some deficiencies so that to minimize it which is used Indian codes in combination with other code ACI, BS, EURO [12].

III. CASES TO BE SOLVED

To design the components of the flat slab multistorey building, after the literature survey, to make the building more economical, the different parameters should be checked as per the selection of different model cases-

Model case M1 = Simple Flat slab model building with shear wall around the lift area.

Model case M2 = Simple Flat slab model building with shear wall around the lift area and around the major stress plate parts.

Model case M3 = Flat slab added drop model building with shear wall around the lift area.

Model case M4 = Flat slab added drop model building with shear wall around the lift area and around the major stress plate parts.

IV. CONCLUSIONS AND OUTLINE OF THE PROPOSED WORK

After studying various research papers having different themes and reviewing the papers related to flat slab that it is designed for multistorey buildings for eliminating the projection of beams, providing the shear wall to offer the stiffness to the building. So in this work, to propose the technical work for worst wind effects, the flat slab shear wall interaction under wind loading has been detected with the help of various papers reviewed and the conclusive results are written below:

1. There are two methods for finding out the design of flat slab manually.
2. The panels are selected and divided as per different loading conditions.
3. The analysis can be done on simple flat slab, flat slab with added drop to it.
4. Worst wind condition should be defined as per wind zone selection or by city as per Indian Standards.
5. The study should conduct by both manual approaches as well as by software approach.
6. A model plan should be defined first and then various models have taken for analysis.
7. The main aim of this study is to design the simple flat slab and added drop flat slab with equivalent frame method and analyze the model building plan to resist the wind load with providing shear walls and find the most economical model plan among the all cases.

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