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REVIEW PAPER ON SEISMIC RESPONSE OF FLAT SLAB & CONVENTIONAL SLAB WITH DIFFERENT LATERAL LOAD RESISTING SYSTEMS

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Abstract – *Looking at the Modern trend of Construction, Flat slab are widely. Flat-slab is mostly used because it reduces the overall weight of building, increases the speed of construction & it is cost effective. Flat Slab system has many advantages over Conventional slab system, but when flat slab dealing with lateral load, it will be less potentially strong to resist lateral loads as compared to conventional slab. This Present study represent the literature review of different authors on effect of perimeter beam, shear wall & bracing system on flat slab structure under seismic loading. This paper provides study of various parameter such as lateral displacement, storey drift, Storey shear, time period & base shear.*

Key Words: **Flat Slab System, Conventional Slab system, Shear wall, Bracing, Bracing, Lateral displacement, Storey Drift, Storey Shear, Time period.**

1.INTRODUCTION

Reinforced concrete (RC) flat slabs supported on columns offers several advantages for office, residential and industrial building construction, such as large open spaces and short construction times. Due to less lateral stiffness of the structure, vertical spines (shear wall and/or core walls), bracing etc different types of lateral load resisting system are added in Seismic prone areas to carry lateral or horizontal loads generated during earthquakes. Although the slab-column system is not part of the lateral force resisting system of the structure, each slab column connection seismically induced lateral displacement of the building while maintaining its capacity to transfer vertical loads from the slab to columns. Otherwise, brittle punching shear failure of the slab occurs and the deformation capacity of the connection determines the deformation capacity of the entire building.

1.1 Flat Slab

In common practice of design and construction is the slabs supported by the beams and beams supported by the columns. This type of construction is called beam-slab construction in which due to the beam depth, the available net clear ceiling height reduces. Mostly beams are avoided in warehouses, offices and public halls, slabs are directly supported by columns. This type of design & construction is aesthetically better. These slabs which don't have beams & are directly supported by columns are called Flat slabs.

To overcome the negative bending moments near the column of flat slab column capital and drop panels are used to support. This type of system has been adopted in many buildings which are constructed recently because of the advantage of reduced floor heights, cost effective and aesthetically better.

1.2 Conventional Slab

Floor slab supported on beams or walls are called as conventional slab. In this type, slab thickness is less for supporting this slab, depth of beam will be large & loads are transferred by the slab to beams then to columns or shear walls.

A conventional slab is supported by beams on two parallel or opposite side & bending in the direction perpendicular to supports are called as one way slab. Slabs supported on four sides carrying loads and bending in two perpendicular directions such slabs are known as two-way slab.

1.3 Lateral load Resisting system (LLRS)

The design of reinforced concrete (RC) multi-storeyed structure for seismic cases, determination of lateral load-resisting system is an important matter. The choosing of lateral load resisting system for special building is clearly a design decision of fundamental importance, yet there is no system that is best for all buildings. Some of the factors to be consider while selecting a seismic force resisting system include architectural, construction cost, performance, design budget & non-structural coordination. Configuration of the lateral load resisting system within the building should satisfy the following condition of good design, concerning such problems torsion, structural irregularities, redundancy & the combination of systems. The most regularly used structural system are as follows moment resisting frames, shear wall system, braced system, tube in tube systems with interior columns & bundled tubes.

2. LITERATURE REVIEW

To study the seismic performance of RC Flat slab with and without lateral load resisting system on various seismic intensity, for that technical paper of various journals from India and abroad are reviewed. In order to design an earthquake resistant structure an engineer must have good knowledge about seismic parameters which influence the behavior of structure. Many researchers have worked and contribute their efforts for the comparative study of RC Flat Slab & Conventional Slab. The paper published by these researchers gives more information about the comparison of RC Flat slab and Conventional slab and also some papers are there for various types of seismic analysis and which analysis is better and which will provide an economic structure. In this chapter, a summary of the papers found in literature, about comparative study of RC Flat slab and Conventional slab with and without LLRS of multistoried building is presented.

Mohana H.S & Kavan M.R [2015] reviewed on comparative study of flat slab and conventional slab structure using ETABS for different earthquake zones of India. They presented dissertation work on G+5 commercial multistoried building having flat slab and conventional slab has been analyzed for the parameters like base shear, storey drift, axial force, and displacement. The behavior and performance of flat slab & conventional slab structures in all seismic zones of India has been studied. In the present work the storey shear of flat slab was more than conventional slab structure, the axial forces on flats lab building were nearly more than conventional building. This present study getting the reasonable information & result about the suitability of flat slab for all seismic zones of India without compromising the performance over the conventional slab structures.

P. Srinivasulu & A.Dattatreya Kumar [2015] studied the performance of flat slab in 4 different cases as I) flat slab system building without drop, II) flat slab system with drop panel, III). flat slab system with shear wall, IV) flat slab system structure with column drops and shear wall both, with the use of response spectrum method, by using ETABS software. The performance of the above structure studied in terms of lateral displacements, base shear & frequency. This paper also looks into on which type of combination turn out to be less punching shear at slab column joint.

Nitesh M.Patel et al. [2015] reviewed paper on flat slab with shear wall at different locations. In this paper work was made in the interest of studying various research works involved in enhancement of flat slab, shear wall and flat slab with shear wall and their behavior towards lateral loads. They concluded that building with shear wall was preferred because of considerable difference in storey displacement, base reaction, and storey drift and structures with shear wall along periphery were acceptable for the lateral load due to the effect of wind load and earthquake load on the performance of building.

Maulik G. Kakadiya, Hitesh K. Dhamaliya [2016] performed research on comparison of rcc and post tensioned flat slab with or without drop, different panel sizes was analyzed and designed, based on results it was concluded that upto spans 6-7 meter not much significant economy was achieved but above 7-meter span post-tensioned flat slab with drop panel leave conventional flat slab far below in economy.

Vinod Goud et al. [2016] had done the analysis and design of flat slab with and without shear wall of multi-storied building frames. In this type of rcc structure i.e., flat slab, shear wall, columns are modelled for different heights and check the post-analysis result for the different combinations of static loading with different thicknesses of shear wall & also for varying height of multistoried building. The main objective was to study behavior & effect of shear wall – flat slab interaction and to study the performance against lateral& gravity forces acting. The analysis was carried with the help of STAAD Pro2007 software, for getting the result in terms of storey drift, storey displacement & plate stresses.

Abhinav.V, Reddy S.S, Naidu V.M & Mohan S.M [2016] analyzed and studied the G+11multistorey RCC building stiffened with shear wall using Staad Pro software. The main objective is to find the optimum location of shear wall. They concluded that shear wall along periphery of the structure is much more effective in seismic cases as compared to other location.

Karthik Prashar & Jagdeep Singh Gahir [2018] studied with help of literature review papers on the seismic behavior of RC frame structure with different types of bracing system. After studying all the literature review, they conclude that steel bracing system is an efficient effective lateral load resisting system. Out of various arrangement of bracing X bracing system are more effective in increasing lateral load capacity of structure. Bracing system reduces the shear force and bending moment of the column.

Shahid Ul Islam & Shakeel A. Waseem [2020] analyzed the behavior of different types of RCC- bracing system in High (G+10) and also the comparative study of performance of RCC diagonal, chevron and cross- Bracing system in high rise commercial structure under seismic loading in addition to gravity loads was performed. The RCC X- bracing give the better results in higher stiffness and stability over other types of bracing.

Varun N & Bhavani Shankar [2021] analyzed the multistoried building with flat slab along with shear wall & core shear wall. This study is made to determine the behavior of flat slab building with shear wall and core shear wall. For this study total six model of G+9 storey has been considered in seismic zone-II and pushover analysis has been was performed with the help of SAP2000 software. From this analysis it is concluded that base shear is maximum in core shear wall model, displacement is minimum in core shear wall model when compared to shear wall model & bare frame model. Time period for bare framed building is more compared to shear wall and core shear wall.

Arbaz Ali khan & Vaijanath Halhalli [2021] analyze and design the rcc flat slab structure with drop and shear wall under earthquake loading using etabs software. The objective

of this study is to investigate the behavior of the flat slab structure under lateral loads. G+14 storied building has been selected with four different model such as 1) Flat slab without drop 2) flat slab with drop 3) flat slab with shear wall 4) flat slab with drop & shear wall. Equivalent static method and response spectrum method is used for the structure. After studying all the model post-analysis result, they concluded that lateral displacement & storey drift of flat slab without drop & shear wall is maximum. Result obtained from response spectrum analysis is less as compared to equivalent static method.

Ms Naik Ashwini Shankarrao & Dr. P.B. Ullagaddi [2021] studied the comparative assessment of flat slab with shear wall and bracing system for different building heights. For this project work 12 models of (G+8), (G+10) & (G+12) stories with shear wall and bracing system were used. From the assessment it was found that flat slab with shear wall is the best choice as compared to bracing system. Displaced & drift values of flat slab with shear wall is less as compared to bracing system. Storey stiffness and storey shear of flat slab with shear wall was better than flat slab with bracing system.

Shailendra singh & Dr. Niraj Soni [2021] had done the comparative analysis of different lateral load resisting system in flat slab multistorey building. In this study they consider lateral load resisting such as outrigger braced system diagrid system & shear wall system. For this study, the conventional structural model having the central core of reinforced concrete and the model with outrigger at top, top & 0.75H, top & 0.5H and top where H is the height of the building are modeled for the G +20 storey building height. The main objective of the study is to determine the optimum location of the outrigger bracing system for high rise building. The result obtained from the post analysis that the top displacement and drift is minimum at the optimum location of the outrigger bracing system for high rise building is at top & mid height of the building. The outrigger system is stiffer than the conventional, diagrid and shear wall system.

3. CONCLUSIONS

From the above studies carried out by researcher, following are the conclusion or summary of the literature review.

1) Spans 6-7 meter not much significant economy was achieved but above 7-meter span post-tensioned flat slab with drop panel leave conventional flat slab far below in economy.
2) Steel bracing system is an efficient effective lateral load resisting system. Steel bracing can also be used to retrofit the existing structure for maintaining stability.
3) From the various arrangements of bracing, the performance of the cross bracing or X- bracing are more effective in increasing lateral load capacity of structure.
4) On comparison of different parameters like lateral displacement, storey drift and base shear, Flat plate system with shear wall is at higher preference and better performance against lateral load when compared to bracing & bare frame.
5) Shear wall location at building core has good response compared to other location of shear wall.
6) Base shear is inversely proportional to the storey displacement, model with least storey displacement has the maximum base shear.
7) Flat slab building shows large storey displacement and storey drift values when compared to conventional slab building.
8) Flat Slab building or Conventional slab building with shear wall at peripherical corner is suitable as compared to peripherical center for the effect of wind load and earthquake load.
9) Result obtained from response spectrum analysis is less as compared to equivalent static method.
10) After reviewing all the parameter conventional slab building has superior performance in case earthquake as compared to flat slab building. Flat slab building with shear wall is the best to safeguard against lateral loads.
11) The introduction of outrigger bracing system reduces the displacement more when compared to diagrid system and conventional slab model.
12) The optimum location of outrigger is found to be at top and 0.5 time the height of the entire building. Significant reduction in displacement and drift is seen in providing outriggers at this location.

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