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A REVIEW ON EFFECT OF DROP PANELS ON SEISMIC PERFORMANCE OF FLAT SLAB BUILDINGS

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ABSTRACT

Flat slab systems are widely adopted in modern construction due to their architectural flexibility, reduced floor-to-floor height, and ease of formwork. However, their seismic performance has been a major concern because of low lateral stiffness and vulnerability to punching shear failure at column–slab connections. The incorporation of drop panels is one of the effective techniques used to enhance the structural performance of flat slab buildings under seismic loading.

This review paper focuses on the influence of drop panels on the seismic behavior of flat slab structures by analyzing various parameters such as storey displacement, storey drift, base shear, stiffness, and overall stability. A comprehensive review of existing literature highlights that the presence of drop panels significantly improves load transfer mechanisms, increases punching shear resistance, and enhances lateral stiffness, thereby reducing seismic vulnerability. Comparative studies between flat slabs with and without drop panels, as well as with conventional beam–slab systems, are also discussed.

The findings indicate that flat slab buildings with drop panels exhibit better seismic performance than those without drops, though they may still be less efficient than conventional framed structures in high seismic zones. The paper concludes with recommendations for design considerations and future research directions aimed at optimizing flat slab systems for earthquake-resistant construction.

KEYWORDS: Flat slab, Drop panels, Seismic performance, Storey drift, Base shear, Punching shear, Lateral stiffness, Earthquake analysis, Structural behavior, RCC structures.

INTRODUCTION

An earthquake is a natural geophysical phenomenon caused by sudden energy release within the Earth's crust due to tectonic movements, fault ruptures, or other subsurface activities, making it highly unpredictable and potentially devastating, especially in densely populated areas; however, it is not the ground shaking alone that causes fatalities, but rather the failure of poorly designed or inadequately constructed buildings, which highlights the critical responsibility of structural engineers to incorporate seismic-resistant design principles based on past earthquake data, material behavior, soil-structure interaction, and anticipated future hazards to ensure safety and performance.[5] To evaluate how structures respond under seismic loading, several analytical techniques are available, among which Nonlinear Time History Analysis (NLTHA) is considered the most accurate because it simulates the structure's response over time using real or synthetic earthquake ground motion records, capturing material nonlinearity, dynamic effects, and inelastic behavior in detail; however, due to its complexity, high computational demand, and requirement of detailed input data, it is not always practical for all projects.[3] Therefore, for structures of lesser importance or in regions with moderate seismic risk, engineers often use Nonlinear Static Procedures (NSPs), such as pushover analysis, which apply gradually increasing lateral loads to estimate the structure's capacity and performance; while NSPs are simpler, less time-consuming, and useful for performance-based design, their results may lack precision because they approximate dynamic behavior and may not fully capture higher mode effects, load reversals, and complex interaction between structural components, leading to potential discrepancies in accurately predicting real earthquake response.[7]

Flat plate slab systems are a type of reinforced concrete floor construction in which the slab transfers loads directly to columns without the use of beams or girders, resulting in a clean, simple structural layout and economical formwork. However, this simplicity introduces a critical structural concern known as Punching Shear, where high concentrated stresses develop around the column–slab junction and may cause the column to "punch" through the slab if not properly designed. To mitigate this risk, engineers often increase slab thickness, enlarge column dimensions, or provide shear reinforcement such as shear heads—steel sections (I or channel shapes) embedded in the slab around columns to enhance shear resistance.[5,6] Despite the added cost of these strengthening measures, flat plates often remain economical overall due to reduced formwork complexity, faster construction, and lower labor requirements. These systems are most suitable for moderate spans and relatively light loads, such as in residential apartments and hotel buildings, while heavier industrial loads or longer spans may require alternative systems like beam-supported slabs. Flat plates are distinct from flat slabs in that they do not include drop panels or column capitals (flares), yet they offer flexibility in architectural layout, allowing for both regular rectangular grids and irregular column arrangements, including triangular or non-uniform spacing, making them highly adaptable to diverse design requirements.[10]

Literature Review

Shri. Shreehari R et al (2025) this study was presents in recent years, seismic safety has become a critical design consideration in the construction of multi-storey reinforced concrete (R.C) structures. Background: The type of slab system adopted plays a significant role in influencing the structural behavior under seismic loads, especially in terms of stiffness, mass distribution, and load transfer mechanisms. This study focuses on a detailed seismic performance analysis of three distinct slab systems—conventional slab (beam-slab system), flat slab, and grid slab (waffle slab)—commonly used in R.C framed buildings. The primary objective is to analyze how different slab configurations affect key seismic response parameters such as storey displacement, storey drift, base shear, and Time period. For this purpose, a set of building models with identical plan geometry, number of storeys, and loading conditions were developed using ETABS, a widely used structural analysis and design software. The models were designed in compliance with IS 456:2000 for structural detailing and IS 1893 (Part 1): 2016 for seismic loading. A Response Spectrum Method was adopted for seismic analysis, with the buildings assumed to be located in a high seismic Zone V, resting on medium soil conditions. Each model was carefully evaluated to understand the influence of slab type on the lateral load-resisting behavior of the structure. Results of the study reveal that: Conventional slabs, which include beams and slabs, offer higher lateral stiffness and better resistance to seismic loads. They show lower values of storey drift and displacement due to the effective beam-column frame action. Flat slabs, characterized by the absence of beams, provide architectural advantages such as flexible planning and reduced floor heights. However, they exhibit greater lateral displacement and longer natural periods, making them more flexible and less efficient in resisting seismic forces unless supplemented with lateral load-resisting elements like shear walls. Grid slabs provide high structural efficiency due to their ribbed configuration, distributing loads more evenly and increasing torsional rigidity. These systems demonstrated intermediate performance, showing better results than flat slabs but slightly less stiffness compared to conventional slabs, while being complex in construction and detailing. The analysis also highlighted that base shear is significantly influenced by the slab system, with conventional slabs attracting the highest base shear due to their higher stiffness, while flat slabs showed reduced base shear but with higher drift. In conclusion, the study provides valuable insights into the seismic performance of different slab systems. While conventional slabs are structurally more reliable under seismic loading, flat slabs require additional design measures to enhance lateral load resistance. Grid slabs, though effective, demand intricate design and are best suited for buildings requiring both structural strength and architectural flexibility. This research contributes to improved decision-making in slab system selection during the preliminary design stages of seismic-resistant R.C buildings, especially in earthquake-prone regions.

Ataur Rahman et al (2024) due to the scarcity of usable land in Bangladesh, the construction of high-rise buildings has significantly increased in recent decades. Reinforced Cement Concrete (RCC) structures are widely used for residential, educational, institutional, and commercial purposes. Since Bangladesh lies in an earthquake-prone region, seismic performance assessment is essential in structural design. This study presents a comparative seismic analysis of three slab systems: conventional RCC slab, flat slab with drop panel, and flat slab with drop panel combined with shear wall. The conventional slab system consists of beams, columns, and slabs, often resulting in increased structural depth due to beam thickness. Flat slabs with drop panels are introduced to reduce this depth, though they lack sufficient lateral stiffness. To enhance stability, shear walls are incorporated with flat slabs. The analysis is carried out considering seismic provisions of BNBC 2006 and BNBC 2020, where seismic zoning has been updated from three to four zones. Key parameters such as maximum storey displacement, storey drift, overturning moment, and storey shear are evaluated across all seismic zones. The results indicate that flat slab structures exhibit higher displacement and drift compared to conventional slabs and flat slabs with shear walls, demonstrating greater flexibility. Conventional slabs show the highest overturning moment and storey shear, while flat slabs exhibit the lowest, with flat slabs with shear walls showing intermediate behavior. The study concludes that the incorporation of shear walls significantly improves the seismic performance of flat slab systems, making them more suitable for high-rise construction in seismic regions.

Gandhemalle Pavan Kumar et al (2022) a flat slab is a reinforced concrete slab system in which loads are transferred directly from the slab to the supporting columns without the use of intermediate beams, resulting in a simpler structural configuration and greater architectural flexibility. In such systems, an enlarged portion of the slab around the column, known as a drop panel, is often provided to enhance shear resistance and reduce the risk of punching shear failure, which is a critical concern due to the direct load transfer mechanism. Compared to conventional beam–slab systems, flat slabs are considered more economical because they reduce formwork, reinforcement congestion, and overall construction time, while also allowing for reduced floor-to-floor height, leading to savings in materials and improved aesthetics. The present study focuses on optimizing the cross-sectional dimensions of structural elements such as slabs, columns, and drop panels to ensure that the building satisfies stability and safety requirements as specified in Indian Standards, particularly under seismic loading conditions. A G+10 (ground plus ten storeys) building model is analyzed across different seismic zones to evaluate the structural performance, including parameters such as storey displacement, drift, base shear, and overall stiffness. The analysis is carried out using CSI ETABS 2018, which enables detailed modeling and simulation of the building under earthquake forces, helping to identify the most economical yet safe structural configuration by comparing various design alternatives in terms of material usage, cost efficiency, and compliance with code provisions.

Abhishek D S et al (2021) flat slab structures are increasingly adopted in modern infrastructure because they eliminate beams and transfer loads directly from slabs to columns, making them more economical, faster to construct, and architecturally flexible compared to conventional slab systems; however, despite these advantages, their structural performance under seismic loading is a critical concern due to reduced lateral stiffness and weaker resistance to earthquake forces. In this study, a detailed comparative analysis is carried out between flat slab and conventional slab systems for multi-storey buildings of G+11 configuration, each storey having a height of 3 m, designed according to IS 456:2000, considering different plan irregularities such as rectangular, L-shaped, T-shaped, and U-shaped layouts, which significantly influence seismic behavior. The flat slab is modeled with a thickness of 200 mm while the conventional slab is taken as 150 mm thick, and the analysis is performed in seismic zone I (zone factor 0.1), representing a low seismic risk region, using ETABS based on finite element modeling. Key structural parameters such as lateral displacement, storey shear, base shear, and deflection under dead load are evaluated to understand how each slab system responds to both gravity and lateral loads; typically, flat slab buildings tend to exhibit higher lateral displacements and lower stiffness due to the absence of beams, while conventional slab systems provide better resistance to seismic forces owing to their beam-column framework, resulting in improved load distribution and reduced deflections. The study ultimately highlights the importance of considering plan configuration and seismic performance when selecting slab systems, as irregular shapes (L, T, U) can further amplify torsional effects and displacements, making flat slab structures more vulnerable unless additional measures such as shear walls, drop panels, or column capitals are incorporated to enhance stability and safety.

Suri Jain et al (2018) conducted a comprehensive analysis of three different building models using ETABS software. The study examined conventional slab systems and flat slab systems with perimeter beams in two Indian seismic zones, Zone III and Zone IV, to evaluate their structural behavior under earthquake loading. Bangladesh lies in a seismically active region and is vulnerable to frequent earthquakes; therefore, it is essential to adopt effective safety measures in structural design. Seismic forces have a significant impact on building performance, making detailed seismic analysis crucial for understanding structural response during earthquake events. Conventional reinforced cement concrete (RCC) structures generally involve greater slab thickness, resulting in increased dead load. In contrast, flat slab systems can reduce overall structural weight and seismic forces. However, flat slabs tend to exhibit higher lateral displacement and inter-storey drift, which necessitates the incorporation of shear walls to provide adequate lateral stiffness and stability. The present study aims to develop and analyze three structural models: (i) conventional RCC slab system, (ii) flat slab with drop panels, and (iii) flat slab with drop panels and shear walls. These models will be analyzed using finite element software to evaluate parameters such as maximum storey displacement, storey drift, overturning moment, and storey shear. The results will then be compared across different seismic zones to derive meaningful conclusions regarding their seismic performance.

Abhijit Salunkhe et al (2017) flat slab construction is a structural system in which the conventional beam–slab arrangement is eliminated, and loads are transferred directly from the slab to the supporting columns, sometimes with beams provided only along the perimeter to enhance overall rigidity. This system has gained widespread acceptance in modern building construction due to several advantages over conventional reinforced cement concrete

(RCC) framed structures, including reduced construction cost through simplified formwork, improved architectural aesthetics due to a flat soffit, greater flexibility in space planning, reduced storey height leading to savings in building materials, and faster construction cycles. However, despite these benefits, flat slab systems exhibit significantly lower lateral stiffness because of the absence of beams, making them more susceptible to lateral forces such as those induced by earthquakes. As a result, they tend to experience larger lateral displacements and inter-storey drifts compared to conventional framed structures, which can affect overall structural stability and performance during seismic events. Therefore, the primary objective of this study is to perform a comparative evaluation of the seismic behavior of flat slab structures and conventional RCC framed structures, focusing on key response parameters such as displacement, storey drift, and base shear. Additionally, the study investigates the impact of slab openings—introduced for functional requirements like staircases, elevators, and service ducts—on the structural performance of flat slab systems, as such discontinuities can further weaken stiffness, alter load distribution, and increase vulnerability under seismic loading conditions.

Rathod Chiranjeevi et al (2016) this study focuses on evaluating the seismic performance of regular reinforced concrete (R.C.) buildings with flat slabs (with drops) and conventional slab systems using pushover analysis as per ATC-40 guidelines. Pushover analysis, a nonlinear static method, is employed to assess structural behavior beyond the elastic limit by developing capacity curves that relate base shear and displacement under lateral loads. In this work, six building models—comprising six, eight, and ten storey configurations of both conventional R.C. frame structures and flat slab systems—are analyzed using ETABS software for seismic Zone III conditions. The comparison highlights that flat slab structures offer advantages such as architectural flexibility, efficient space utilization, simpler formwork, and faster construction. However, seismic behavior varies with height, making it essential to assess performance parameters like time period, base shear, displacement, and storey drift. The results indicate that flat slab buildings exhibit significantly higher base shear than conventional structures, with increases of 67%, 59%, and 49% for six, eight, and ten storeys respectively, while showing lower displacement values by 64%, 56%, and 41% for the same heights. These findings suggest that although flat slab systems perform better in terms of reduced displacement, their higher base shear demands and changing seismic response with height require careful design considerations and additional measures to enhance their performance in earthquake-prone regions.

Archana Shaga et al (2016) the study focuses on evaluating the seismic performance of reinforced cement concrete (RCC) flat slab structures in comparison with conventional beam–slab systems for a six-story building located in seismic Zone II, using the guidelines of IS 1893 (Part 1). Since earthquakes primarily induce lateral forces, key response parameters such as story displacement, story shear, and overturning moment are critical in assessing structural safety, as excessive values of these can lead to severe damage or even collapse. To investigate this, a detailed three-dimensional model of both structural systems is developed and analyzed using ETABS 2015, which enables accurate simulation of structural behavior under seismic loading. Two analysis approaches are adopted: the Linear Static Method (equivalent static analysis), which simplifies earthquake forces into static lateral loads, and the Response Spectrum Method, which provides a more realistic representation by considering the dynamic characteristics of the structure such as natural frequency and mode shapes. Through these analyses, forces, lateral displacements, story shears, and overturning moments at each level are computed and compared for both systems. The results indicate that flat slab structures exhibit comparatively better performance under seismic loading conditions, primarily due to their reduced mass, uniform load distribution, and absence of deep beams, which leads to lower seismic forces and more favorable displacement behavior. Additionally, the simpler geometry and increased flexibility of flat slabs contribute to improved energy dissipation and reduced stress concentration. Therefore, despite concerns like punching shear, flat slab systems, when properly designed, can be more efficient and effective than conventional slab systems in resisting earthquake-induced forces, making them a viable structural option in low to moderate seismic zones.

Bhavesh Rajesh Sahni et al (2016) high-rise structures have become an essential aspect of modern urban development due to the increasing demand for space in metropolitan and rapidly developing cities. This growing trend has driven significant advancements in the field of civil and structural engineering. In the present scenario, there is a strong need for rapid construction without compromising quality. Flat slab systems offer several advantages over conventional slab systems, including reduced floor-to-floor height, improved architectural flexibility, and faster construction. However, as per IS 1893:2016, the use of flat slab systems is restricted in higher seismic zones due to their relatively low lateral stiffness and vulnerability to earthquake forces. In this study, a comparative analysis is carried out considering key structural parameters such as deflection, storey drift, overturning moment, and base reactions. Three structural models are analyzed: (i) conventional slab system, (ii) pure flat slab system, and (iii) flat slab system with shear walls. Since flat slab structures are more susceptible to lateral loads, especially in high seismic zones, the primary objective of this study is to evaluate whether the inclusion of shear walls can enhance their seismic performance to a level comparable with conventional slab systems. The analysis is performed using ETABS software, and the results are compared across different seismic zones.

Salman I Khan et al (2015) this paper reviews earlier studies on the seismic performance of tall buildings incorporating different reinforced concrete slab systems, with particular emphasis on flat slab and grid slab systems, which are widely preferred in modern high-rise construction due to their structural and architectural advantages. A flat slab system is characterized by the direct transfer of loads from the slab to the columns without the use of beams, resulting in a simplified formwork, reduced construction time, and decreased floor-to-floor height, which enhances architectural flexibility and allows for more usable space. However, the absence of beams significantly reduces lateral stiffness, making flat slab structures more vulnerable to shear failure and punching shear around columns during seismic events. On the other hand, the grid slab system, composed of intersecting beams arranged at regular intervals in perpendicular directions and cast monolithically with the slab, provides higher rigidity and better load distribution, improving resistance to lateral forces such as earthquakes. Although buildings with grid slab or conventional slab systems tend to have greater overall height due to beam depth and may restrict architectural flexibility, they exhibit superior seismic performance, particularly in terms of shear strength and stiffness. Therefore, while both systems are effective and widely used, flat slab buildings are generally more economical and architecturally efficient but less resistant to seismic forces, whereas grid slab systems offer enhanced structural robustness and safety under earthquake loading at the cost of increased structural depth and reduced functional adaptability.

M Vinod Kumar Reddy et al (2014) in India, most high-rise buildings are designed as reinforced concrete moment-resisting frames with brick masonry infill walls, which are traditionally treated as non-structural elements; consequently, designers often assume that the entire lateral load from earthquakes is resisted solely by the bare frame. However, this assumption overlooks the actual behavior of infill walls, which, despite being relatively brittle compared to reinforced concrete, significantly influence seismic performance. During an earthquake, masonry infill can crack or fail, but when properly integrated into the structural system—through modeling approaches such as equivalent diagonal struts, shear walls, or bracing—it contributes to increased lateral stiffness, enhanced load-carrying capacity, and improved energy dissipation. This results in reduced lateral displacements, smaller story drifts, and lower bending moments in beams and columns, thereby decreasing the likelihood of structural collapse. Ignoring infill effects, as is often done in design codes that base seismic forces on the natural period of the bare frame alone, can lead to inaccurate estimation of base shear and unsafe designs, since frame members may experience unexpected shear and axial forces. The present study addresses this gap by performing a comparative seismic analysis of three structural systems—conventional slab, flat slab with drop panels, and flat slab without drop panels—both with and without masonry infill walls using ETABS software, evaluating key parameters such as fundamental natural period, design base shear, lateral displacement, and story drift to better understand how infill walls alter the dynamic response and overall seismic behavior of different building configurations.

METHODOLOGY

The methodology for a review on the effect of drop panels on the seismic performance of flat slab buildings begins with a comprehensive literature survey of published research papers, design codes (such as IS 456:2000 and IS 1893:2016), and previous analytical and experimental studies focusing on flat slab systems with and without drop panels; based on this, representative building models reinforced concrete structures) are selected and modeled using structural analysis software like ETABS or SAP2000, considering identical plan configurations, material properties, loading conditions, and boundary conditions to ensure a fair comparison, where two primary cases are analyzed—flat slab without drop panels and flat slab with drop panels of varying thickness and size; the seismic analysis is then carried out using linear static (equivalent static method) and dynamic methods such as response spectrum analysis as per codal provisions, while key parameters including storey displacement, storey drift, base shear, natural time period, and stiffness are evaluated and compared for both models; additionally, punching shear capacity at column–slab connections is assessed to understand the structural safety enhancement due to drop panels; results obtained from the analysis are systematically compared through graphs and tables to identify trends and performance improvements, followed by a critical discussion linking analytical findings with insights from the reviewed literature, ultimately leading to conclusions on how drop panels influence seismic behavior in terms of stiffness, ductility, and overall structural stability.

CONCLUSION

The overall review indicates that the inclusion of drop panels significantly enhances the seismic performance of flat slab buildings by improving their stiffness, strength, and resistance to punching shear around column–slab connections, which are typically the most critical zones under earthquake loading. Drop panels increase the effective depth of the slab near columns, thereby reducing stress concentration and delaying the onset of cracking and failure, which results in better load distribution and improved structural integrity during seismic events. Compared to flat slabs without drops, structures with drop panels exhibit reduced lateral displacement, lower storey drift, and improved energy dissipation capacity, making them more stable and reliable in moderate to high seismic zones. Additionally, drop panels contribute to increased rigidity without substantially compromising the architectural advantages of flat slabs, such as reduced storey height and construction simplicity. However, despite these benefits, flat slab systems with drop panels may still exhibit lower lateral stiffness compared to conventional beam–column systems, necessitating the use of supplementary lateral load-resisting elements like shear walls or bracings in high seismic regions. Overall, the incorporation of drop panels is an effective and economical approach to enhancing the seismic resilience of flat slab structures, provided that proper design considerations and code provisions are carefully followed.

REFERENCES

1. Shri. Shreehari R. Gudi, Prof. Sameer Chitnis "Performance Study On Seismic Analysis Of Conventional Slab, Flat Slab And Grid Slab System For R.C Framed Structures In Etabs" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 22, Issue 4 Ser. II (July - August 2025), PP 29-42 www.iosrjournals.org.
2. Ataur Rahman1, Mahmud Hasan2, Sheikh Ashikur Rahman3, Fatema Tuz Zahura "Comparison of Seismic Performance of Buildings with Conventional Slab and Flat Slab in Different Zones of Bangladesh" International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com IJFMR240424550 Volume 6, Issue 4, July-August 2024.
3. Gandhemalle Pavan Kumar1*, Shrihari Saduwale2, K. Roja "Comparison of Flat Slabs with and without Drop in Different Seismic Zones Using ETABS" International Journal of Research in Engineering, Science and Management Volume 5, Issue 8, August 2022 https://www.ijresm.com | ISSN (Online): 2581-5792.

4. Abhishek D S1, Dr Kiran T "Seismic Behaviour of Conventional Slab, Flat Slab with and Without Drop Panel for Different Building Patterns" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072.
5. Suri, R. S. & Jain, A. K. (2018), A Comparative Study of Flat Slab with Perimeter Beams and Conventional Slab Structures under Seismic Conditions, American Journal of Engineering Research.
6. Abhijit Salunkhe1, S.B.Mohite "A Comparative Study of Seismic Behavior of Flat Slab Structure and Conventional Framed Structure" DEC 2017 | IRE Journals | Volume 1 Issue 6 | ISSN: 2456-8880.
7. Rathod Chiranjeevi, Sabbineni Ramyakala, Mandala Venugopal, Nandanar Anusha "Seismic Performance of Flat Slab with Drop and Conventional Structure" IJERTV5IS100240 Vol. 5 Issue 10, October-2016 (This work is licensed under a Creative Commons Attribution 4.0 International License.) International Journal of Engineering Research & Technology (IJERT) Published by http://www.ijert.org ISSN: 2278-0181 Vol. 5 Issue 10, October-2016.
8. Archana Shaga1, Satyanarayana Polisetty "seismic performance of flat slab with drop and conventional slab structure" International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137 Volume – 01, Issue – 09, December – 2016, PP – 79-94.
9. Bhavesh Rajesh Sahni, Dr. Prashant D. Hiwase, Prasad P.Dahale "SEISMIC BEHAVIOUR OF FLAT SLAB BUILDING WITH SHEAR WALL ACCORDING TO I.S.1893 2016" International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 5, May 2018, pp. 955–963, Article ID: IJCIET_09_05_105 Available online at http://iaeme.com/Home/issue/IJCIET?Volume=9&Issue=5 ISSN Print: 0976-6308 and ISSN Online: 0976-6316.
10. Salman I Khan1 and Ashok R Mundhada "comparative study of seismic performance of multistoried rcc buildings with flat slab and grid slab: a review" ISSN 2319 – 6009 www.ijscer.com Vol. 4, No. 1, February 2015 © 2015 IJSCER. All Rights Reserved.
11. M Vinod Kumar Reddy, Dr. Vaishali G Ghorpade "Comparitive Study of Seismic Analysis Between Conventional and Flat Slab with Drop and without Drop Framed Structures with Different Masonary Infills" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 3 Issue 10, October- 2014.