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# Analysis of A High Rise Building Frame Considering Seismic Load Using ETABS A Review

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ABSTRACT

Buildings must be able to safely withstand any significant ground motions that could happen during construction or regular operation in order to be considered earthquake resistant. The impacts that ground motions have on structural reactions, however, are special. The timehistory analysis is the analytical method that is most accurate for structures that are subjected to severe ground vibrations. For this analysis, a stepwise solution is used to integrate the pushover analysis of a multi-degree-of-freedom system, or MDOF, in the time domain in order to depict the real reaction of a structure. Although it can be applied to all practical uses, this method takes time. The pushover analysis was developed because it was necessary to develop quicker techniques that would nevertheless provide a trustworthy structural assessment or design of structures subjected to seismic loading. The foundation of pushover analysis is the presumption that during a seismic event, structures vibrate primarily in the first mode or in the lower modes. As a result, the multi-degree-offreedom system is reduced to a single-degree-of-freedom system that has attributes that are predicted by the nonlinear static analysis of the multi-degree-of-freedom system, or SDOF system. The ESDOF system is then subjected to a response spectrum analysis with constantductility spectra, or damped spectra, or a nonlinear time history analysis. Through modal connections, the seismic demands for the MDOF system are converted from the ESDOF system's computed seismic demands.

Keywords: RCC frame, Irregular building, FEMA hinge, capacity spectrum, pushover analysis, seismic reaction.

## I. INTRODUCTION

Modern high rise building construction began to address a variety of objectives, including the need to accommodate a growing population, the high cost of land, and even to demonstrate the state of the economy in the case of corporate structures. Earlier, these structures were regular in shape, but with modern technology and materials, it is now feasible to build structures with a variety of plans, shapes, and sizes. Due to their practical and aesthetically pleasing qualities, these atypical structures are quite prevalent all over the world. Different story heights, excess mass in one or more storeys that may be caused by the presence of public meeting areas like gyms, halls, etc., abrupt changes in stiffness made in accordance with architectural considerations, and other factors can all contribute to irregularity. The majority of apartments favour soft-storey structures with sizable parking areas. Irregular buildings are those that have discontinuities in their bulk and rigidity in their layout or elevation. Performance level describes the state of the building's damage, providing information on whether it is safe for occupants to occupy it or how much repair work will be required, as well as its serviceability following an earthquake. Different design requirements are needed at various performance levels. Therefore, it is impossible for a single design parameter to achieve all performance goals. Even though these performance goals could place competing demands on stiffness and strength, one shouldn't sacrifice life safety.

## II. LITERATURE REVIEW

D J Zavala et.al (2022) author analyzed the influence of the stiffness irregularity and the p-delta effect on the structural behavior of a reinforced concrete building. The main objective was to determine the impact of the stiffness irregularity and the p-delta effect on the structural behavior in regular and irregular buildings. The linear dynamic analysis procedure was performed in order to determine the structural response in terms of drifts, shear force and moments per floor. A comparative analysis of the responses from the linear and nonlinear analysis was carried out to determine the percentage variation of the results

Thokala Brahmendra Rao et.al (2022) in the research paper, p- delta (P-Δ) effect on high- rise building was investigated for the analysis of G+29 RCC framed building and models were done by ETABS2016. Seismic and wind loads were applied to model as per IS-1893 (2002) and IS-875 (PART-III). The displacements, storey drifts, Bending Moments and Shear Forces are compared to the different models by considering with and without P-delta effect and by providing shear walls at different locations. Results stated that displacements of conventional building models (without p-delta) is less when compare to building with p- delta. The storey drifts in building models with p-delta effect are more when comparing with models analysed using equivalent static analysis method(without p-delta effect). The bending moment (BM) in shearwall 18% increases after p-delta effect. Shearwall placed at centre of frame shows more effectiveness when comparing with shear wall placed at corner and without shear wall of the structure.

Pavithra.S and Jegidha.K.J (2021) in the research paper, p-delta (P-Δ) effect on highrise building was investigated for the analysis of G+10 building and models were done by ETABS. Seismic and wind loads are applied to model and the displacements, storey drifts, Bending Moments and Shear Forces was compared for the structure by considering with and without P-delta effect and by providing shear walls at different locations. The results revealed that the seismic response becomes very sensitive to building models if P-Delta effect was considered.

Drisya S Kumar and Margaret Abraham (2019) objective of the research paper was to investigate seismic analysis of multi - story RC building with and without P Delta effects using ETABS structural analysis software. Results concluded that the P delta effect is very important in the case of high-rise building. So, designing without considering this effect will leads to the collapse of buildings in earthquake or heavy wind. Since there is a change of base shear overturning moment and story displacement with and without considering the P delta effect with a maximum of 187%. There is variation in % values for different models. If the variation is more than 10% P delta effect should be considered in analysis. P delta effect have importance in designing of high -rise building than 1st order analysis. For regular building the p delta effect will increase the displacement, shear, moment. For irregular buildings the effect may increase or decrease the displacement, shear, moment. The effect of p delta effect on irregular buildings is unpredictable.

PhaniKumar.V et.al (2019) in the research paper, p delta (P-Δ) effect on high-rise building was investigated for the analysis of G+29 RCC framed building and models were done by ETABS2016. Seismic and wind loads was applied to model as per IS1893 (2002) and IS-875 (PART-III). The displacements, storey drifts, Bending Moments and Shear Forces were compared to the different models by considering with and without P-delta effect and by providing shear walls at different locations. Results stated that storey drifts in building models with p-delta effect was more when compared with models analysed using equivalent static analysis method(without pdelta effect). Shearwall placed at centre of frame shows more effectiveness when compared with shear wall placed at corner and without shear wall of the structure. Bending moment (BM) in column at fifth floor found75% increase after the investigation of p-delta analysis. The results show the bending moment (BM) in shear wall 18% increases after p-delta effect.

Sajad Ahmad Bhat et.al (2019) in the research paper, seismic performances of reinforced-concrete buildings was evaluated by nonlinear static analysis (pushover analysis) and nonlinear time history analysis considering 20-story reinforced concrete building in ZONE V. The global and local responses obtained from the pushover analysis were compared with those obtained from the nonlinear dynamic analysis of MDOF system.

Parsa Heydarpour et.al (2018) Columns with low and medium axial load which were redesigned using both Paulay and MacRae method for compensating for P-Delta effects showed promising results in terms that nonlinear time-history analysis on redesigned columns with inclusion of P-Delta effects achieved damage ductility very close to target damage ductility. For single column bents supported on fixed foundation Caltrans recommends design target ductility of four which is used in this research. Obtained results for columns with high axial load ratio and high column aspect ratio showed that the redesigned columns collapsed under nonlinear time-history analysis. For columns with high axial load ratio and high column aspect ratio, which suffer the most from P-Delta effects it is suggested to perform time-history analysis with multiple earthquake records to study the instability effects of P-Delta effects instead of using static nonlinear analysis which is unable to fully capture the dynamic nature of P-Delta effects under dynamic loading. The stability problem under seismic loading is dynamic by nature, and using static procedures such as pushover analysis especially for cases with high P-Delta effects is discouraged.

T. Nagarjuna and R. B. N. Santhosh (2018) in the research paper, the plan with dimensions 15 x 40m was considered and varied the stories of the building 15, 20 and 25 was modeled and earthquake load is applied on model of structure as per IS18939(2002) for zone III. Then by trial and error method suitable cross-section are provided for unsafe building to bring within acceptable limit by increasing stiffness of a building. Bending moment and story displacement with P-Delta effect was considered and compared for all the models.

Nikunj Mangukiya et.al (2016) in the research paper, G + 24 story structure, was analyzed with static linear and static non-liner analysis, here Geometric non linearity is considered by accounting, p-delta effect it was shown from displacement comparison that there is about 12% to 20% variation in the result. Similarly, the bending moment for the load combination (EQ Y-) showed 5% to 20% variation, value of modal period, in the different mode shapes are also variable. It is advisable to account such effect in tall structures.

Pushparaj J. Dhawale and G. N. Narule (2016) author analyzed the P-delta effect on high rise buildings. Linear static analysis (without P-delta effect) and nonlinear static analysis (with P-delta effect) on high rise buildings having different number of storey was carried out. For the analysis G+19, G+24, G+29 (i.e. 20, 25, 30 storey) R.C.C. framed buildings was modelled. Earthquake load is applied on model of structure as per IS-1893(2002) for zone III in SAP2000-12 software. Load combinations for analysis are set as per IS-456(2000). All analysis is carried out in software SAP 2000-12. Bending moment, story displacement with and without P-delta effect was calculated and compared for all models. Results stated that it was essential to consider the P-delta effect for 25 storey building. So buildings having height more than or equal to 75m, should be designed considering P-delta effect. Up to 25 storey building, it is not necessary to consider P-delta effect in design and first order analysis is sufficient for design.

Prashant Dhadve et.al (2015) in the research paper, P-delta effect on high rise building was investigated and Linear static analysis (without P-delta effect) on high rise building having different number of stories was carried out. For the analysis G+14, G+19, G+24, (i.e 15, 20, and 25storey) R.C.C. framed building was modeled. Earthquake load was applied on model of structure as per IS18939 (2002) for zone III in E-Tab software. Load combination for analysis is set as per IS-456 (2000). All analysis was carried out in software ETAB. Bending moment, story displacement with and without p-delta effect was calculated and compared for all the models.

## III. REFERENCES


[1]. Pushparaj J. Dhawale and G. N. Narule, [Analysis of P-Delta Effect on High Rise Buildings], International Journal of Engineering Research and General Science Volume 4, Issue 4, July-August, 2016 ISSN 2091-2730.

[2]. PhaniKumar.V, M.Deepthi, Saikiran K and R.B.N. Santhosh, [Behavior of PDelta Effect in High- Rise Buildings With and Without Shear Wall], International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878 (Online), Volume-8 Issue-2, July 2019.

[3]. Drisya S Kumar and Margaret Abraham, [Analysis of High Rise Building for P-Delta Effect using ETABS], International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 12, 2019 (Special Issue).

[4]. Dharanedharan K S and Sivakumar C G, [Significance Of P-Delta Effects In High Rise RC Structure In Various Seismic Zones], International Journal of Aquatic Science ISSN: 2008-8019 Vol 12, Issue 02, 2021.

[5]. T. Nagarjuna and R. B. N. Santhosh, [An Evaluation of P-Delta Effect in HighRise Building], International Journal of Science and Research (IJSR), Volume 7 Issue 6, June 2018.

[6]. Parsa Heydarpour, Pedro F. Silva and Rigoberto Burgueño, [An Investigation on the Pushover Analysis Based Methods for Compensating the P-Delta Effects], International Journal of

Structural and Civil Engineering Research Vol. 7, No. 1, February 2018.

[7]. Thokala Brahmendra Rao, Dr M Janardhan and M.Venkata Narasaiah, [Study of P-Delta Effect in High- Rise Buildings with and without Shear Wall], INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, September 2022| IJIRT | Volume 9 Issue 4 | ISSN: 2349

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