A Literature Review Study on Comparative Study on Behaviour of High Rise R.C.C Structure with Shear Wall and High Rise R.C.C. Composite Structure With consideration of Non-Linear P-Delta Analysis

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Abstract: ***The P-Delta effect are the second order effects which increase lateral displacement(The lateral displacements can be caused by wind or seismically induced inertial forces) in the high rise structure. The increase in number of storey in the structure directly proportion to the delta effect in the structure. The present work concerned with the Comparative Study On Behaviour of High Rise R.C.C Structure With Shear Wall and High Rise R.C.C. Composite Structure With consideration of Non-linear P-Delta Analysis. The present study give overview of different research works to be done in high rise structure for the P-Delta analysis.***

Keywords: High rise RC.C. Structure with shear wall, High rise R.C.C. composite structure, non-linear P-Delta analysis, Drift, Displacement, ETABS

1. Introduction

Limitation of the area for constructions work of domestic buildings and high cost of available land, the high rise structures are preferable now a days. As the increase in the height of the structure then increasing in lateral load. For the lateral load resisting structures become very important than the structures that resist the gravitational loads. In recent decades, shear walls and tube structures are the most appropriate structural forms, which have caused the height of concrete buildings to be soared. So, recent RC tall buildings would have more complicated structural behaviour than before. Therefore, studying the structural systems and associated behaviour of these types of structures would be very interesting. The lateral load resisting structure consist shear wall, composite columns, composite beams and deck slab are mostly used. Shear walls have high in-plane stiffness thus it resists the lateral loads and control the deflection more efficiently. Shear walls are flexible in the orthogonal plane and can distribute the lateral loads in their own plane by developing resistance against moment and shear. A composite high-rise building structural system with steel reinforced concrete column, steel beam and reinforced concrete core tube has been adopted in the recent construction activity. The seismic performance of such structural systems is an important aspect for the structure to maintain its seismic safety when it exposes to earthquake events. The main benefits from the use of high rise composite R.C.C. structures construction are in terms of construction time and cost.

2. High Rise Composite RCC Structure

A steel-concrete composite column is a compression member, comprising either a concrete encased hot-rolled steel section or a concrete filled tubular section of hot-rolled steel and is generally used as a load-bearing member in a composite framed structure. increased strength for a given cross sectional dimension. x increased stiffness, leading to reduced slenderness and increased buckling resistance. x good fire resistance in the case of concrete encased columns. x corrosion protection in encased columns. Significant economic advantages over either pure structural steel or reinforced concrete alternatives. x identical cross sections with different load and moment resistances can be produced by varying steel thickness, the concrete strength and reinforcement. This allows the outer dimensions of a column to be held constant over a number of floors in a building, thus simplifying the construction and architectural detailing. x erection of high rise building in an extremely efficient manner. x formwork is not required for concrete filled tubular sections.

I-beams (or I-sections), as the name states are manufactured in the shape of a capital "I". The core of the I-beam, better known as the web, will ensure that resistance against shear forces is provided. Except for the web, the I-beam also consist of flanges, taper or parallel flange, on either side of the web and at both ends. The flanges provide resistance to bending moments.

In the construction industry I-beams are used as cross sections providing strengths to girders, it also provides support to joists which in turns support ceilings and/or floors. They are also widely used in the construction industry as a support for buildings to ensure that the structure is strong enough. Even though I-beams can resist bending, it should preferably not be used in cases where torque forces are present along the axis or length of the beam as they are not torsion resistant. The best advantage of

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a webbed and flanged beam (I section) is that the material is present where it should be and in the right quantities. This makes the beam more economical and lighter and in turn again making it even more economical. A beam primarily resists bending, shear and torsion. The height of the section is a determinant of stress due to bending in the order of square of itself. The farther the flanges are from each other, the better it is. Shear is resisted by the web and you just put in enough thickness of web that the shear is taken care of.

A deck slab are use in high rise building structures and bridge or road bed is the roadway, or the pedestrian walkway, surface of a bridge, slab of the buildings, and is one structural element of the superstructure of a bridge. It is not to be confused with any deck of a ship. The deck may be constructed of concrete, steel, open grating, or wood. Sometimes the deck is covered with asphalt concrete or other pavement. The concrete deck may be an integral part of the bridge structure (T-beam or double tee structure) or it may be supported with I-beams or steel girders. The benefits of composite construction include speed of construction, performance and value. Steel framing for a structure can be erected quickly and the pre-fabricated steel floor decks can be put in place immediately. When cured, the concrete provides additional stiffness to the structure.

Additionally, the concrete encasement protects the steel from buckling, corrosion and fire. Service integration within the channels on the composite decks is another advantage to composite construction. Building quality standards can be adhered to easily by the use of pre-fabricated decks. Excessive deflections can be controlled by cambering the beams or by shoring the metal decks to limit deflection when concrete is poured.

3. Literature View

In this paper the effect of lateral load on the structural system is considered for the P-Delta effect. The drift ratio is found for both, earthquake and wind loading, considering with and without P-Delta effect for different number of stories such as G+10, G+20, G+30 and G+40 stories. The load deflection curves and drift ratios have been obtained for different cases and results so obtained have been compared to identify the drift ratios for different stories of the structure. The results of the analysis show that the P-Delta effect is more in the upper stories. The Non-Linear static analysis has been carried out using ETABS 9.7 with identification of P-Delta effects in multi-storey buildings based on its behaviour[1].

In the present study seismic analysis and wind load analysis of a multi -storey RC building with and without P-Delta effects is analysed by using ETABS structural analysis software. The seismic zone factor of 0.36 is considered which falls under Zone-V. From the analysis, both the displacement and drifts with respect to earthquake loads are minimum when compared with earthquake load with P-delta effects. P-delta investigations and linear static analysis are carried out for 13 storey RC framed structure[2].

In this project an attempt is to compare seismic analysis of water tanks using elastic analysis and p-delta effect. The circular and Intz type water tank are analyzed for critical load combinations considering sever zone. The analysis is to be carried out for Axial Force, Shear force, and moment with p-delta and without p-delta conditions. In over all study of seismic analysis, critical load is found out. For three critical load combinations for different height like 16M,20M,24 various parameter are calculated. Important part of this project is to find out height wise variation in column displacement and column moment for same capacity tank at different height of staging by taking same dimensions of bracing and column and significant co-relationship between these parameters are established[3].

P-delta effect is secondary on structure. It is also known as 'Geometric nonlinearity effect'. As number of stories increases, P-delta effect becomes more important. If the change in bending moments and displacements is more than 10%, P-delta effect should be considered in design. In this study the P-delta effect on high rise building is studied. Linear static analysis(without P-delta effect) on high rise building having different number of statics is carried out. For the analysis G+14, G+19, G+24 R.C.C. framed building are modelled. Earthquake load is applied on model of structure as per IS-18939(2002) for zone 3 in E-Tab software. Load combination for analysis is set as per IS-456(2000). All analysis is carried out in software ETAB. Bending moment, Story displacement with or without P-delta effect is calculated and compared for all the models. 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[4].

For most structures, a second-order analysis, which imposes equilibrium and kinematic relationships on the deformed geometry of the structure, is required for stability design In the traditional first order analysis or linear static analysis of structures, the effects of change in the structure actions due to structure deformations are neglected. However, when a structure deforms, the applied loads may cause additional actions in the structure that are called second order or P-Delta effects. Engineers have been aware of the P-Delta for many years. However, it is only relatively recently that the computational power aided to provide analytical approximations to this effect, which has become widely available. It is an engineer's judgment as to how accurately the second order effect needs to be accounted for in determining design forces and moments. In present study Seismic analysis of a multi-storey RC building with and without P-Delta effects is analysed by using STAAD structural analysis software[5].

In this study the P-delta effect on high rise building is studied. Linear static analysis (without P-delta effect) and nonlinear static analysis (with P-delta effect) on high rise buildings having different number of storey is carried out. For the analysis G+19, G+24, G+29 (i.e. 20, 25, 30 storey) R.C.C. framed buildings are 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 is calculated and compared for all models[6].

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The high rise building require high frame structure stability for safety on the tall steel structures and compared with linear static analysis. In this study, a 40 storey steel frame structure with m has been modelled by using SAP2000 structural analysis software with the consideration of P-delta effect. A the same time the influence of different bracing patterns has been investigated. For the reason five type of bracing systems including X,V, single Diagonal, Inverted V, with un braced model of same configuration are modelled and analysed. The frame structure is analysed for Earthquake load[7].

In this paper, the design of a 45 storey reinforced concrete frame wall case study structure is use to highlight the significance of p-delta limit within the model response spectrum analysis procedure of the Euro code 8. It is found that the strength of the structure is dictated by the P-delta limit for seismic actions. Despite anticipated storey drifts and ductility demands being relative low. A series of non-linear time-history analysis using a suite of spectrum compatible real[8].

In this paper the effect of P-Delta on multi storey buildings is studied. The four models i.e. 5, 10, 15, and 20 storey are modelled and analyzed using ETABS v 13.1 software. The non-linear static analysis is performed to account for the P-Delta effect on the four types of building models and is compared with linear static analysis using ETABS v. 13.1. The variation in the axial forces, storey shears, displacements and bending moments with and without the consideration of P-delta effect is compared[9].

This paper is an attempt to study systematically the effects of p-delta in tall tubular buildings. In this paper 9 models are analyzed and designed to understand the effect of p-delta. The models considered are of tubular rigid frame structures of total height of 126 m consisting of 42stories each. The models are analyzed for vertical as well as lateral earthquake loads using STAAD-Pro software[10].

The present study focuses on the effectiveness of p-delta analysis in the design of tall slender reinforced concrete structures. A study on the stability of tall structures to lateral forces with and without considering p-delta effects is carried out in the present investigation. The building models with different storey heights have been analysed to investigate the maximum response in the building in terms of displacement, moment and shear forces. The analysis of multi-storeyed RC building have been done using ETABS 2015 Structural analysis software. This paper presented the variation of displacement with increasing height, slenderness; considering P-Delta analysis keeping Linear static analysis as base[11].

In modern multi-storied building construction, irregular type buildings (with irregularity in plan and elevation) are commonly increasing, mainly because of architectural aesthetics and functional requirements. Such types of construction will be highly fragile buildings in seismological sensitive areas. Inappropriate design of these irregular buildings leads to abrupt destruction of the structures; hence it requires special consideration in analysis and design. The additional action in the structure due to the structural deformation by virtue of the applied loads is termed as P-delta effect. P-Delta is a non-linear effect that occurs in every structure where elements are subject to axial load. Due to little knowledge of P-Delta and complexity of analysis, architectures and structural engineers are tempted to perform linear static analysis, which may eventually become the cause of a sudden collapse of the structure. In the case of short columns and medium rise structures, P-delta effect will be small and hence negligible. But in slender columns or high rise structures, P-delta effect becomes more significant. In the design of high rise buildings with vertical irregularity, it is very much important to examine whether the second order P-delta effects are significant[12].

Seismic analysis of a multi-storey RC building is analyzed by using STAAD structural analysis software. The building models with different storey have been analyzed to investigate the maximum response in buildings in term of displacements, storey, drifts, column moment, beam moment, column shear and beam shear[13].

Our study is based on “P-Delta” analysis which incorporates geometric nonlinearity in the analysis. The study will be performed on structural software ETABS. In this study of G + 24 story structure, is analyzed with static linear and static non-liner analysis, here Geometric non linearity is considered by accounting, p-delta effect it is 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-) shows 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[14].

In this paper the interaction of asymmetry of building on the P-Delta effects in elastic and inelastic ranges of behaviour is evaluated. Contributions of lateral load resisting system, number of stories, degree of asymmetry, and sensitivity to ground motion characteristics are assessed. Four buildings with 7, 14, 20 and 30 story are designed based on typical design procedures, and then their elastic and inelastic static and dynamic behaviour, with and without considering P-Delta effects, are investigated. Each building is considered for 0%, 10%, 20% and 30% eccentricity levels[15].

4. Conclusion

The study was carried out with and without P-Delta effects on the high rise and low rise structures. Study on various parameters time-history analysis, lateral displacement story drift etc. As number of storey increases P-delta effect becomes more important. Generally, P-delta effects are negligible up to 10 storey buildings where only gravity loads are governing load combinations. But having significant effects in high-rise structure. Cross section of the member increase stiffness of the structure increase. P-Delta effect is negligible up to 7 storey building. The analysis carried by using computer programs like STAAD PRO, ETABS and SAP2000 structural analysis software's.

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References

[1] Vijayalakshmi R,*"Effects Of P-Delta On High Rise Buildings Located In Seismic Zones"*, International Research Journal of Engineering and Technology (IRJET),Volume: 04 Issue: 08 | Aug -2017
[2] Rajath R T,*"P-Delta Analysis Of Multi-Storey RC Building"*, International Journal of Research in Engineering and Technology*(IRJET)*,Volume: 05 Issue: 12 | Dec-2016
[3] Kriti V.Thakare,*"Comparative Study of Elastic Analysis and P-delta Effect in Elevated Water Tank for seismic Loads"*, International Journal of Engineering Research and Applications(IJERA),(IC-QUEST-11TH April 2015)
[4] Prashant Dhadve, *"Assessment of P-Delta Effect on High Rise Buildings "*, International Journal on Recent and Innovation Trends in Computing and Communication(IJRITCC),May 2015
[5] Rupali Bondre,*"Analysis Of Structures With Respect To Linear Static Analysis Using P-Delta Effect"*, International Journal of Advance Research and Innovation Ideas in Education(IJARIIE),Vol-2 Issue-4 2016
[6] Pushparaj,J.Dhawale,*"Analysis Of P-Delta Effect On High Rise Buildings"*, International Journal of Engineering Research and General Science Volume 4, Issue 4, July-August, 2016
[7] Neeraj Kulkarni**,***"Study of P-Delta Effect on Tall steel structure"*, International Journal of Allied Practices, Research and Review(IJAPRR),2015
[8] T.J.Sullivan,*"P-Delta Effects On Tall RC Frame-Wall Buildings"*, The 14 th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China
[9] ManikRao1,*"Effect Of P-Delta In Seismic Analysis Of Multi-storey Buildings"*, International Journal of Research in Engineering and Technology(IJRET),Volume: 05 Issue: 11 | Nov-2016
[10] T.Avinash,*"Investigation Of The Effects Of P-Delta On Tubular Tall Buildings"*, International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 2, February 2017
[11] Saranya S. Pillai,*"Effectiveness of P-Delta Analysis in the Design of Tall Slender RC Structures"*, International Journal of Science and Research (IJSR),Volume 5 Issue 6, June 2016
[12] Lakshmi Subash,*" Influence Of P-Delta Effect On Reinforced Concrete Buildings With Vertical Irregularity-A Review"*, International Research Journal of Engineering and Technology (IRJET),Volume:04 Issue: 02 Feb-2017
[13] P.V.Dhanshetti,*"Effect of P-Delta Action on Multi-storey Buildings"*, International Journal of Research in Engineering and Technology(IJERT),Vol.4 Issue 01,January-2015
[14] Nikunj Mangukiya, Arpit Ravani, Yash Miyani,*" Study of "P-Delta" Analysis for R.C. Structure"*, GRD Journals | Global Research and Development Journal for Engineering | Recent Advances in Civil Engineering for Global Sustainability | March 2016
[15] A.S. MOGHADAM,*"Interaction Of Torsion and P-Delta Effects In Tall Buildings"*, 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004 Paper No. 799

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