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Influence of core wall on the geometric non-linear behavior of RC framed structure

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Abstract - *Geometric nonlinear analysis is a force follower approach is one in which when member losses stability the force follows the deformed member and creates further more instability very quickly. Second order effects introduce additional deflections, moments and forces beyond those calculated first order analysis, so it should be considered in the design. In this present paper attempt is made to carry out geometric non linearity analysis in higher story structure and also study on the influence of core walls at corners and at the center of the framed structure on the magnification of internal forces due to geometric non linearity. 40 story structures have been modeled and analyzed using ETABS software for gravity and seismic loads. Magnification of displacement and drift with and without p-delta effects is calculated and compared for all the models. It shows that P-delta effects reduces when core walls are installed at center when compare to those installed at the edges.*

Key Words: **Geometric non-linearity, P-delta effects, Core wall.**

1. INTRODUCTION

With the increase in urbanization, there is growing need to accommodate higher number of people at compact spaces. So there is need for high rise structures. With the increase in the height of the structure, the chances of them being susceptible under lateral force also increases.

A P-delta analysis is not as simple as it sounds and its effect will be very adverse if neglected. These effects will be more severe in case of soft lateral force resisting systems like moment frames as compared to stiff systems like core wall system. When a model is loaded, it deflects. The deflections in the members of model may induced secondary moments due to the facts that ends of the member may no longer be vertical in the deflected position. These secondary effects for members can be calculated through the use of P-delta analysis.

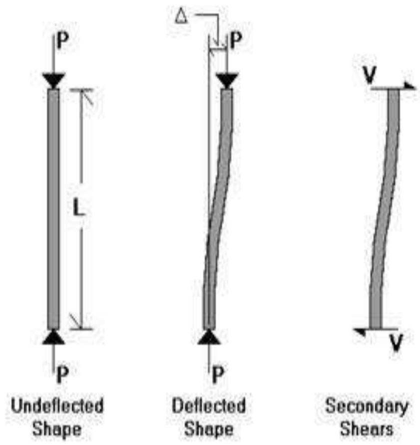

Fig -1: Representation of effects of P-Delta

2. PRESENT STUDY

To perform 1st order analysis and 2nd order Analysis on 40 story RC framed structure. To study the influence of core walls at corners and at the center of the framed structures on moments, displacement and drift magnifications from P-delta analysis

3. METHODOLOGY OF PRESENT STUDY

In this present study the linear static analysis is carried out on 3D RC framed structures using ETABS, and the geometric non-linear analysis (P-delta analysis) on 3D RC framed structures using ETABS.

3D framed structures of 40 storeys shall be considered. The columns and beam sections considered will be designed for gravity and lateral loads as per relevant Indian codes (IS456:2007, IS875:2000 and IS 1893:2016).

It is also intended to study the influence of presence of core wall on the P-delta effect. For this purpose core wall are modeled as shell element and different configurations of core walls are considered (such as core wall at center, core wall at corners).

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4. MODELING AND ANALYSIS

Table -1: Detailed structural parameters considered

Material and Geometry Data		Loading data	
Span of slab	5.5m X 5.5m	Live Load	3kN/sq.m
Typical height story	3.5m	Finishing Load	1.5kN/sq.m
No of storeys	40	Loads due to wall	14kN/m
Grade of concrete	M30	Seismic Zone	Zone 2
Grade of steel	Fe500	Soil type	Type 2 (Medium soil)
Beam size	500 X 500mm	Importance Factor	1.2
Column size	Varies	Response reduction Factor	3 (OMRF)
Slab thickness	160mm	Time period	Varies

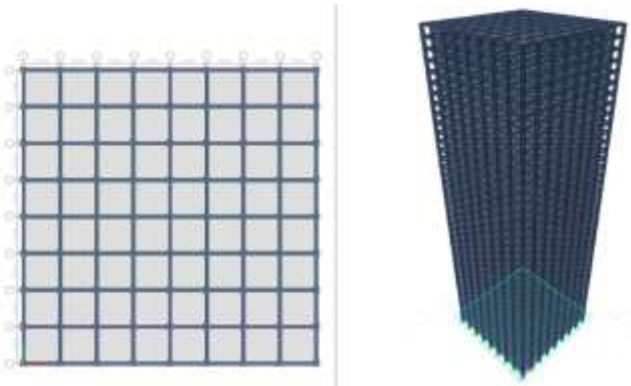

Fig -2: 40 Story structure without core wal

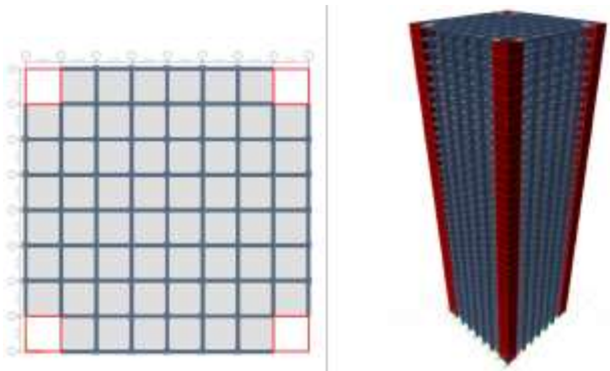

Fig -3: 40 Story structure with core wall at edges

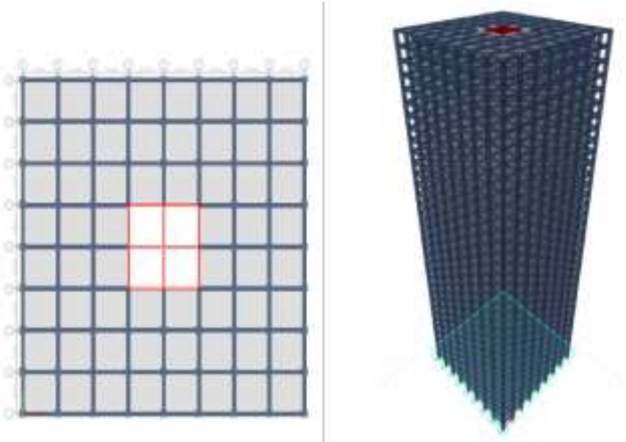

Fig -4: 40 Story structure with core wall at center

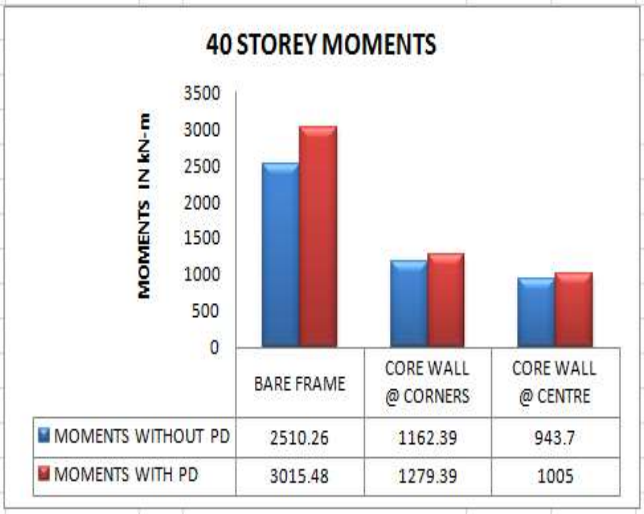

Chart -1: Plot of story moments for 40-storey structure with & without core wall

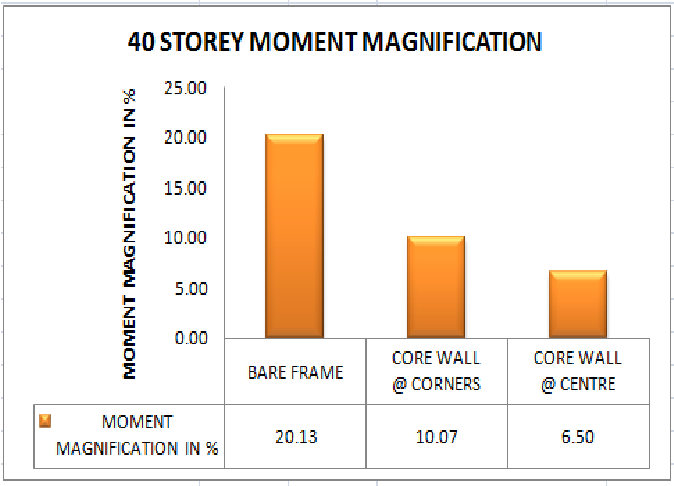

Chart -2: Plot of story moment magnification for 40-storey structure with & without core wall

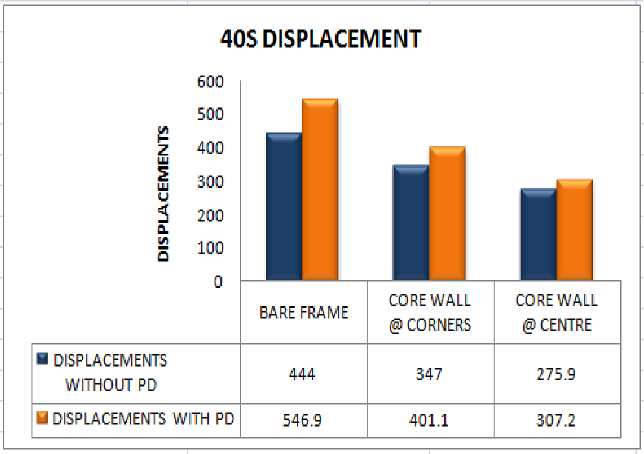

Chart -3: Plot of displacements for 40-storey structure with & without core wall

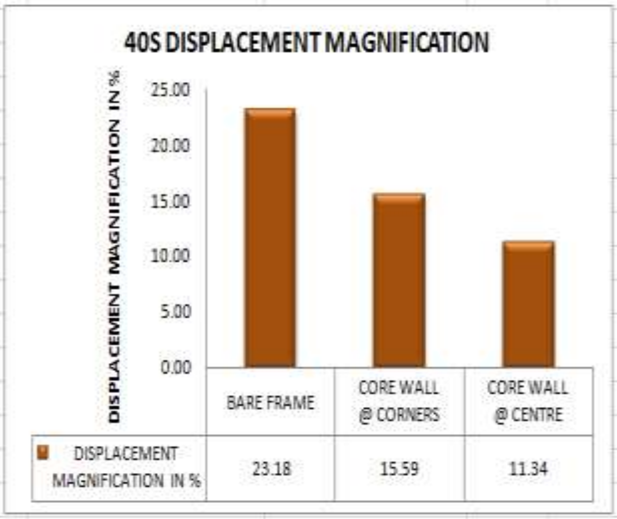

Chart -4: Plot of displacement magnification for 40-storey structure with & without core wall

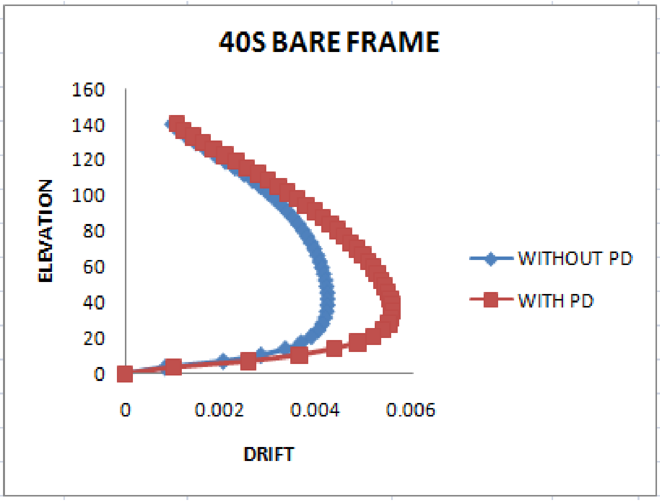

Chart -5: Plot of story drift for 40-storey bare frame structure

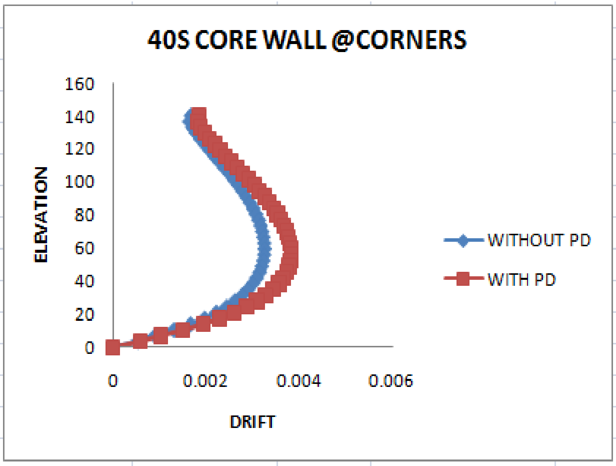

Chart -6: Plot of story drift for 40-storey structure with core wall @ corners

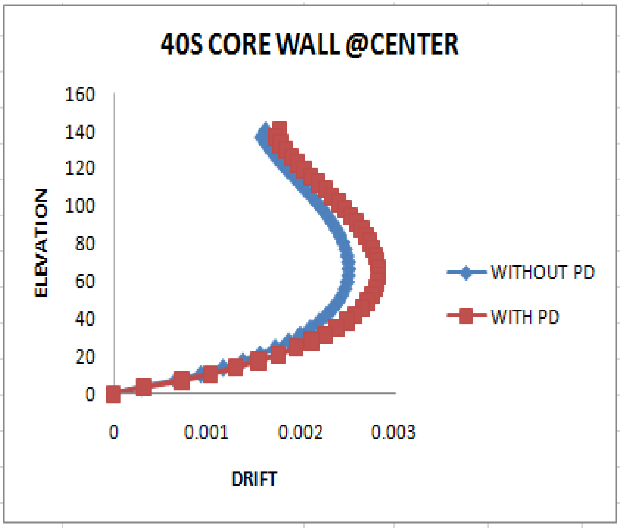

Chart -7: Plot of story drift for 40-storey structure with core wall @ center

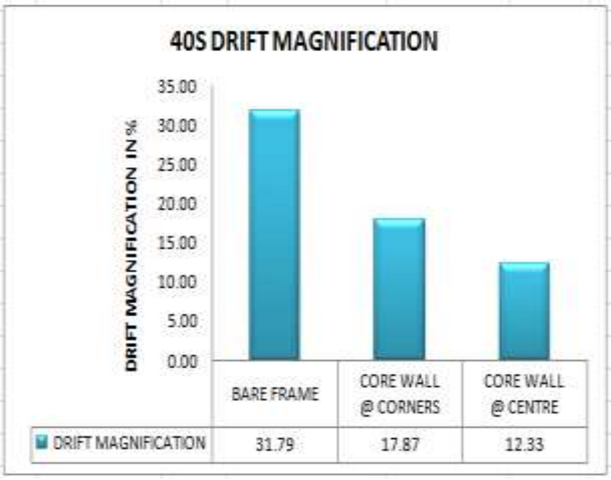

Chart -8: Plot of drift magnification for 40-storey structure with & without core wall

5. CONCLUSIONS

Following inferences can be drawn from the comparison of moment magnifications and displacements for bare frame, core wall at edges and core wall at center of the framed structure.

- The magnifications of moments due to the effects of P-delta becomes extremely significant as the height of the structure increases.
- The influence of core wall in the analysis significantly reduces the moment magnification due to p-delta effects.
- P-delta effects reduces when the core wall are installed at the center when compared to those installed at the edges.
- Comparison of moment magnification shows that consideration of core wall results in significant reduction in moments when p-delta forces are considered in the analysis and the effect is more pronounced in high rise buildings.

Comparison of maximum displacements and drift magnifications shows that consideration of core wall results in significant reduction in lateral displacements and drift when p-delta forces are considered in the analysis and the effect is more pronounced in high rise buildings.

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