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Comparative Study of Building Frame under DynamicLoading Including the Effects of Post-Tensioned Edge Members Analyzed using ETABS

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ABSTRACT: Today's infrastructure has resulted in the use of the discount method behind mass projects in the commercial and residential sectors. Looking at the disadvantages of the conventional manufacturing method, post-tensioning can be used to improve the disadvantages of the conventional manufacturing method. For example, the structural members are thin, lightweight & small floor-to-floor is achieved. Therefore, the weight in each design is guaranteed to be very economical and safe. The reaction spectrum analysis to Zone V is taken into consideration within this comparative analysis in order to take into account the symmetrical organisation of many floors. I.S1893-2016. The structural planning analysis tool ETABS is used to design and analyze a case study for the parameters shear forces, maximum bending, torsion, max. storey drift & displacement in x andy directions. The results of the analysis are used to check the stability of the structure after tension in the degree of resistance to seismic forces at the corners of the structure.

KEYWORDS: Post-Tensioning Tendons, Displacement, Moment, Forces.

I. INTRODUCTION

Generally, High-rise buildings must withstand the forces produced by wind & earthquakes, but their designs differ to do so. While strong winds have an impact on the exposed portion of the building, which is known as force-type leading, earthquake forces impair the structure at its foundation. A new method of conveying this difference is by means of the structure's cargo-distortion wind (perpendicular axis). provides the deviation seen because of wind and relegation whereas deviation on the(vertical axis) in the relegation type lading assessed on the structure due to earthquakes. Structure faces minimum variations in the stress field due to wind loads. The history of concrete dates back to the 1930s, when a Frenchman named Eugène Frisint discovered that placing concrete under pressure greatly increased its strength. Laying the shielded lines and pouring concrete around them, allowing them to harden, pull the lines, and lock them into place. After World War II, concrete islands came popular as sword was in short force and islands damaged and destroyed by the war had to be replaced. The design and use of this system declined until themid-1960s when it was substantially used in basements for storages, structures, and domestic bottoms. In post-tensioning, external forces are applied while the structural membrane maintains its excellent performance. Post-tensioning support is handed through tendons, beaches, or bars, anchored at specific points, generally at the ends of the structure. These tendons are penciled along the span, with precisely deposited high and low points. The ligaments respond to external stresses by delivering upward forces at depressed locations of lowering forces at high points, which serve to counteract the upward forces. the part's freight.

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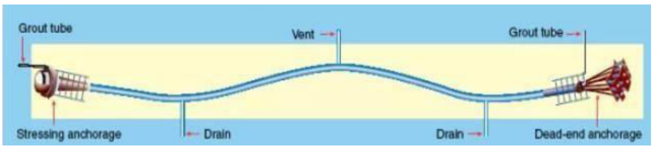

Fig 1: Post Tensioning Cables

II. LITERATURE REVIEW

Zbigniew Zee Manko and **Arkadiusz Mordak** (2016) The author's exploration paper presented the findings from an experimental study on a recently developedpre-stressedpost-tensioned road ground located over a water force factoryin Topola Village, Poland. Several distinct tests were conducted for a comprehensive evaluation of the colorful concrete rudiments and structural sweats of the ground. The expansive compass of the dynamic tests led to flexible assessments and evaluations of the ground's factors, forming the foundation for a thorough analysis which was extension good for necessary management in compliance with Poland's regulations.

K.Manju. (2014) The author conducted a thorough disquisition of inflexibility, rigidity, energy dispersion, and related factors. The end of the study was to develop guidelines for precast structures in earthquake-prone areas. The tests showed that a precast,pre-stressed concrete system was doable and demonstrated significant eventuality. **Veerat Srilaxmi, K.Manju, M.Vijaya (2018)** Prestressed concrete is an essential advancement in the field of construction, offering advanced strength and continuity. It's extensively used in structures like islands, structures, and other architectures that bear high tensile strength. The two primary styles of prestressing concrete arepre-tensioning andpost-tensioning. The literature on these two systems reveals the complications and benefits they offer in colorful structural operations.

Sopan Chinchole, Rohan Kapgate Shubham Nighot, and Sujesh D. Ghodmare (2020) provides precious perceptivity into the design and analysis ofpost-tensioned crossbeams using ETABS software. Post-tensioning offers multitudinous advantages over conventional corroborated concrete crossbeams, including material savings, reduced diversions, and bettered cargo- bearing capacity. The use of ETABS software allows for detailed modeling and analysis of the complex relations between prestressing tendons and concrete, icing a safe and effective design.

Magdalena Szreniawa and Rafal Szydlowski (2016), Concerning the Post-tensioned Transfer Beam Project and Research Beneath the five-story Warsaw Centre building, The 4th International Conference on Civil Engineering and Architecture (ACE 2016). This research by **Rafal Szydlowski and Magdalena Szreniawa (2016)** demonstrates the significant advantages of using multistory buildings with post-tensioned transfer beams, particularly in dense urban environments where architectural flexibility and efficient use of space are critical. Post-tensioning allows for longer spans, reduced beam sizes, and improved structural performance, making it an ideal solution for modern high-rise and commercial buildings. However, the successful application of post-tensioned systems requires careful design, skilled labor, and effective quality control to ensure long-term durability and safety.

C. L. Maheshkumar A Comparison of Post-tensioned, Waffle, and Flat Slabs in Response to Dynamic Forces (Resilient Infrastructure, Harper Singapore, 2022). The selection of an appropriate slab system is crucial in modern structural engineering, particularly for buildings that experience dynamic loads such as seismic forces or wind loads. Different slab systems, such as flat slabs, waffle slabs, and post-tensionedslabs, offer distinct advantages and challenges depending on the project's design requirements. **K. G. Shwetha and C. L. Maheshkumar (2022)** conducted a comparative study of these three slab systems—three types of slabs: dynamic, waffle, and flat. loading conditions, contributing valuable insights into their performance characteristics and suitability for various applications.

The study by **M. Shinde and R. Shinde (2015)** provides a comprehensive analysis of the seismic performance of soft storey buildings, demonstrating the vulnerabilities associated with these structures under dynamic loads. Using a performance-based seismic design approach, they identified the critical weaknesses of soft storey buildings, including excessive drift, concentration of seismic forces, and the potential for collapse. Their research emphasizes the need for retrofitting solutions such as shear walls, bracing systems, and column

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jacketing to improve the seismic resilience of soft storey buildings.

The research by **Pradeep Pandey and Sujal P. Jasani (2017)** provides a comprehensive analysis of post- tensioned transfer girders in high-rise buildings using FEM-based software ETABS. Their study demonstrates the significant benefits of post-tensioning in enhancing the performance of transfer girders, including improvedload-carrying capacity, reduced deflection, and increased material efficiency. ETABS software played a crucialrole in accurately modeling and analyzing the behavior of post-tensioned girders, allowing for a detailed assessment of their performance under various loading conditions.

The study conducted by **Komal Bedi and Deepak Prajapati (2019)** provides valuable insights into the application of post-tensioning for buildings in seismic Zone V, utilizing ETABS software for detailed analysis. Their findings demonstrate the significant advantages of post-tensioning in enhancing load-carrying capacity, reducing deflection, and improving seismic resilience. The research highlights the effectiveness of ETABS in modeling complex seismic interactions and optimizing post-tensioned designs to achieve superior performancein high seismic zones

Objectives:
The following are the investigation's objectives::
To determine the capacity of post-tensioning cables in a tall structure as lateral load-resisting elements.
1. To investigate how buildings respond to earthquakes utilising IS 1893:2016.
2. To analyse the stories G+9 conventional building in zone V seismic condition.
3. comparing the outcomes of the building's torsion, bending moment, shear force, and story drift.
4. To study the multi-storey buildings in ETABS in Response spectrum analysis.
5. To compare the results of models namely the Conventional model & Post tensioning model.

III. METHODOLOGY

Table 1: Geometrical properties

Design data of building	**Dimension**
Dimension of plan	30 x 18 mt
No. of bays in X direction	5 Bays
No. of bays in Y direction	4 Bays
No. of storeys	G+9 storey
Height of typical Storey	3.5 m
Height of Bottom Storey	2.0 m
Size of Columns	500 x 500
Size of Beams	350 x 300
Slab Thickness	120 mm
Concrete Grade	M 25
Steel Grade	Fe415
Wall thickness	100 mm for external wall
Post tensioning cable	600 mm diameter cable

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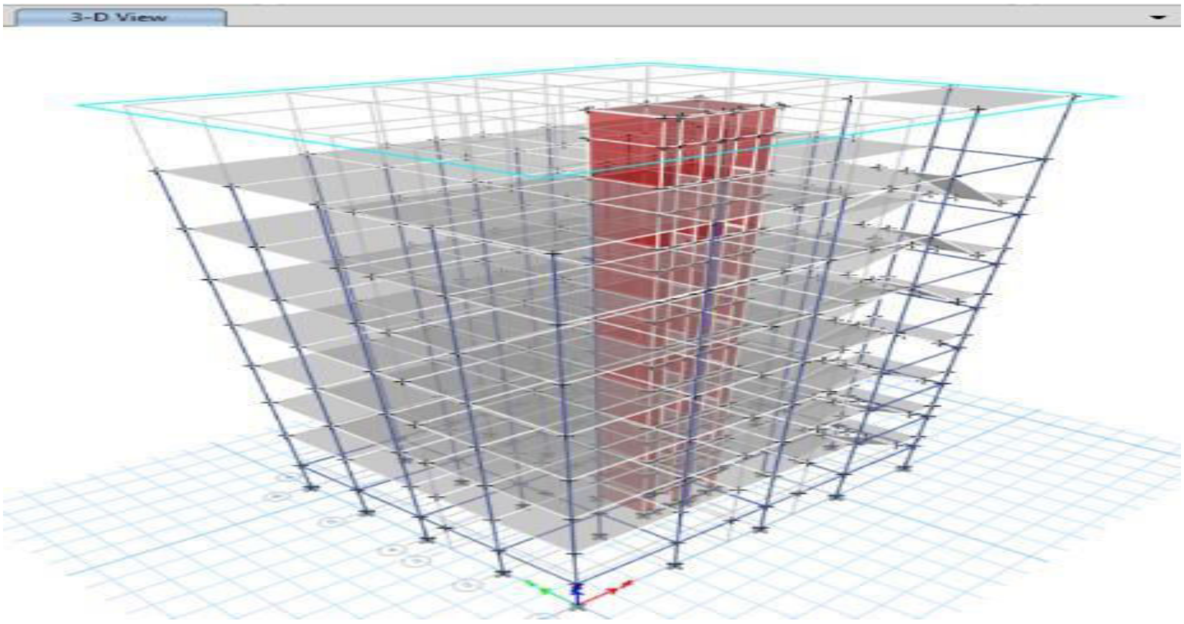

Figure 2(a). Conventional structure

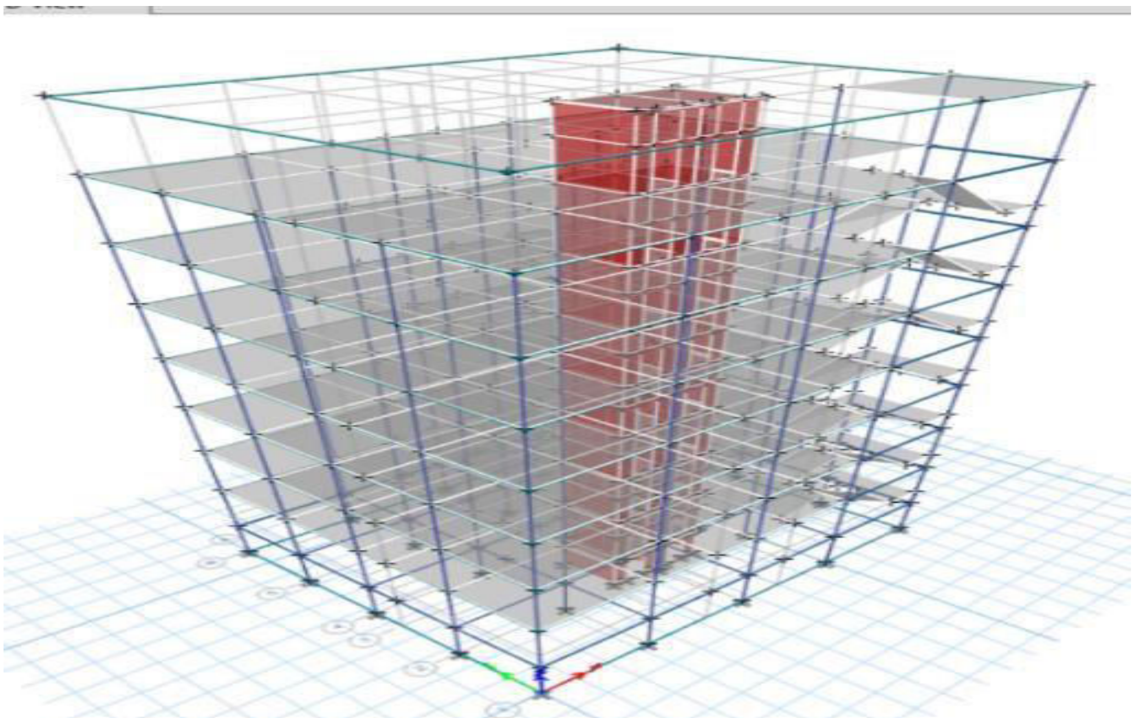

Figure 2(b). Post tensioning StructureThe backing ways are considered for this research

1: choose geometrical data based on site conditions.2: Determine sectional data and cable diameter.
3: Allocate saddling conditions following by IS.
4: Implement P-delta analysis for dynamic motion.
5: Analyze the structure, accounting for periodic motions.6: Contrast the outcomes.

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IV. RESULT ANALYSIS

Bending Moments:

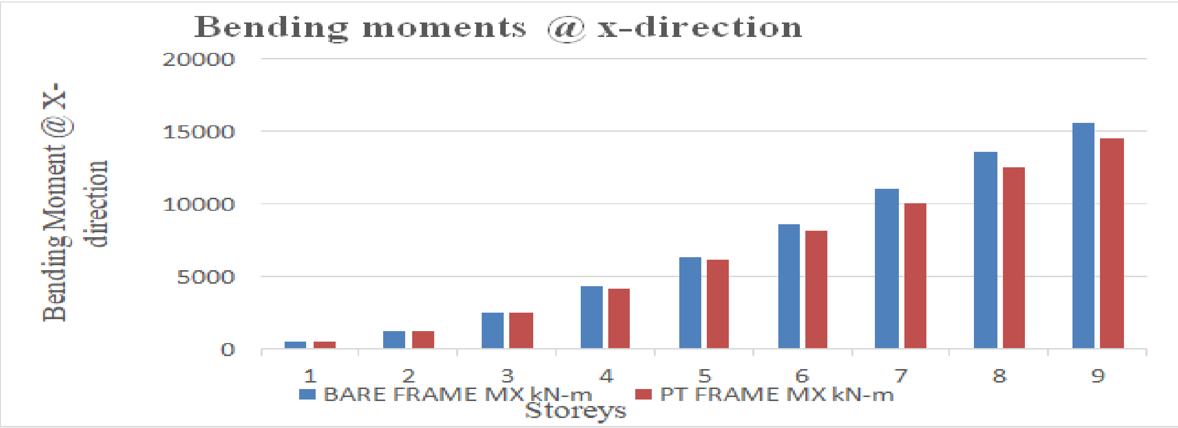

Fig 3: Bending moment @x-direction

The fig.2 shows that bending moment is lesser than we compared with post tensioning frame and conventional frame at X-direction in seismic zone V due to bending moment is not much governing in both frames.

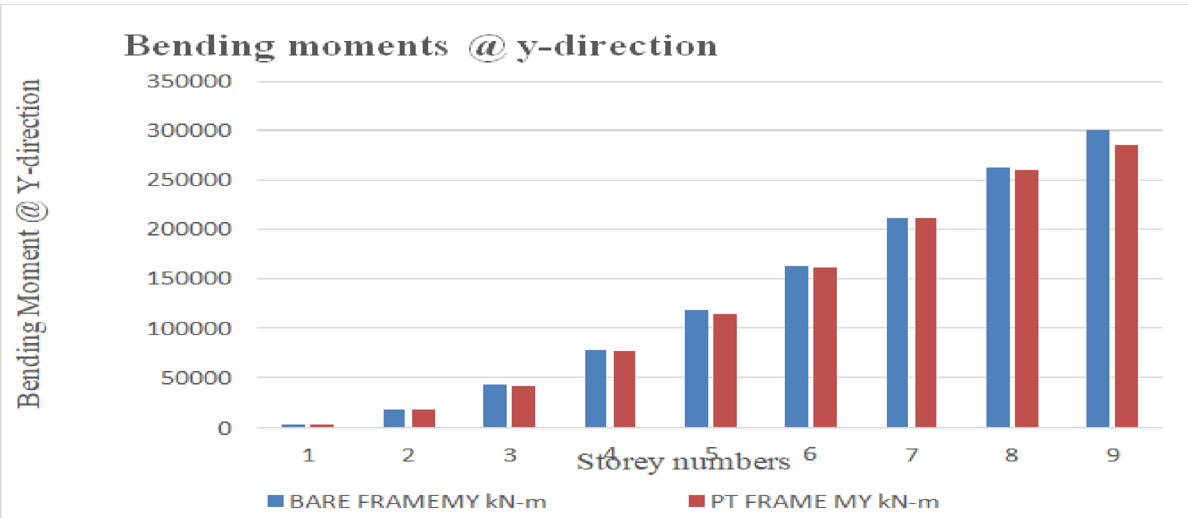

Fig 4: Bending moment @y-direction

The fig.3 shows that bending moment is lesser than we compared with post tensioning frame and conventional frame at Y-direction direction in seismic zone V due to bending moment is not much governing in both frames.

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Shear Forces:

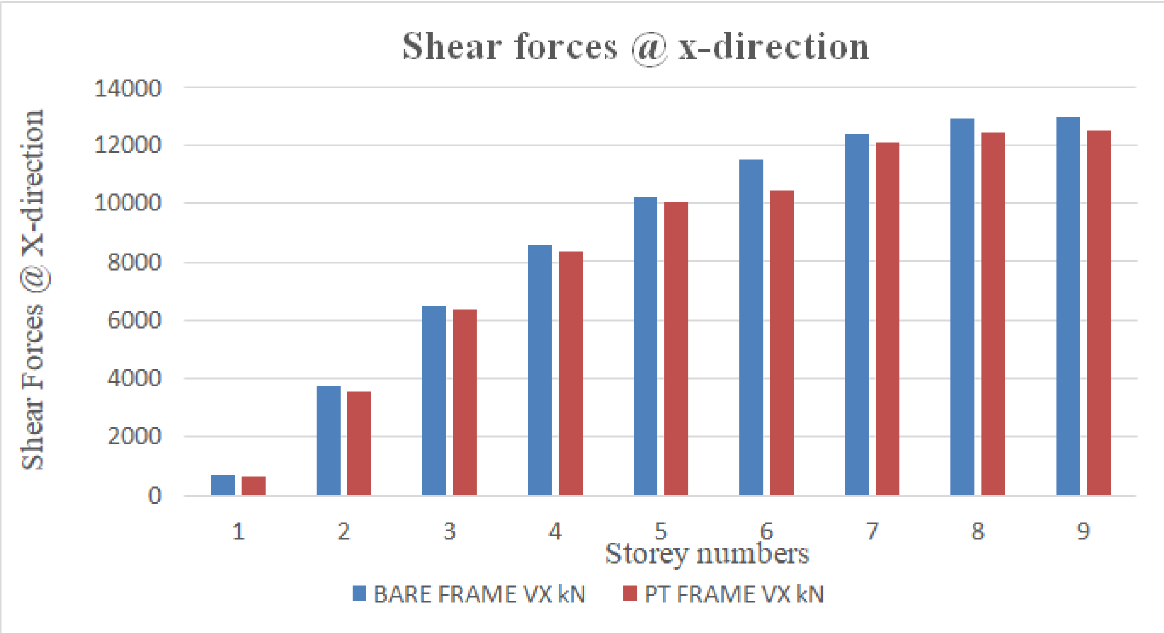

Fig 5 : Shear force @x-direction

The fig.4 shows that shear force is lesser than we compared with post tensioning frame and conventional frameat X-direction in seismic zone V condition due to shear force is not much governing in both frames.

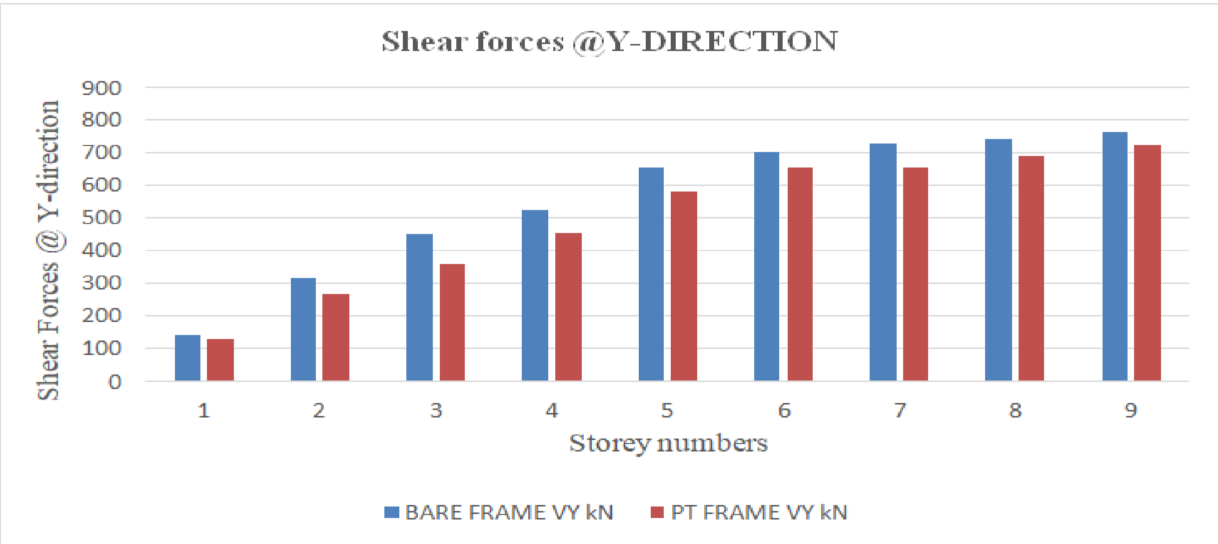

Fig 6: Shear force @y-direction

The fig.5 shows that shear force is lesser than we compared with post tensioning frame and conventional frameat X-direction in seismic zone V condition due to shear force is not much governing in both frames.

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Max.storey drift:

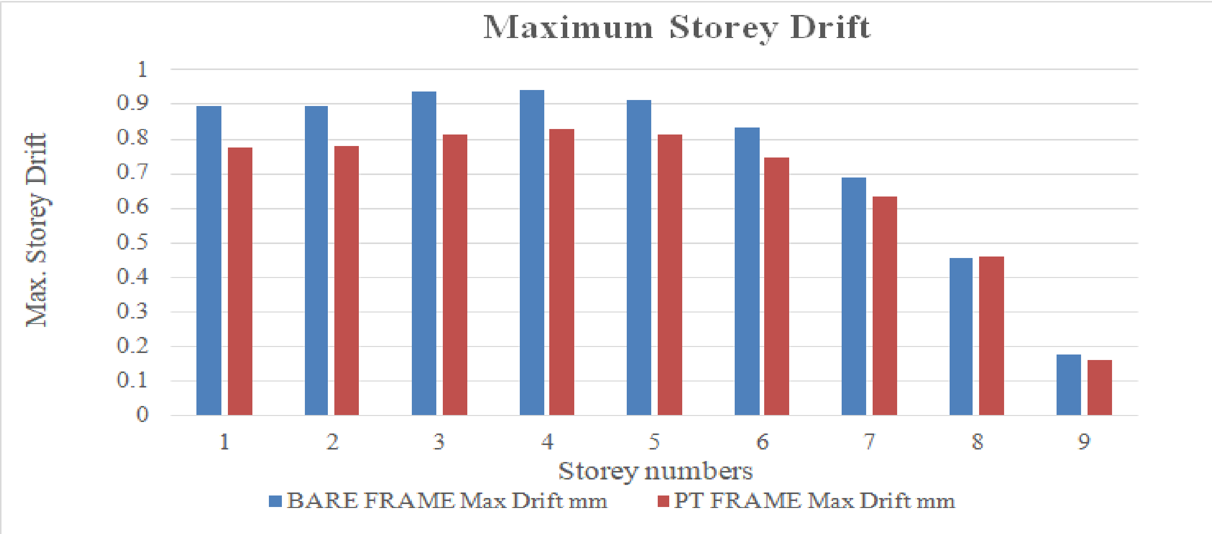

Fig 7 : Max. storey Drift

The fig.6 shows that Max. Storey drift is lesser than we compared with post tensioning frame andconventional frame direction in seismic zone V due to is not much governing in both frames.

Storey Torsion :

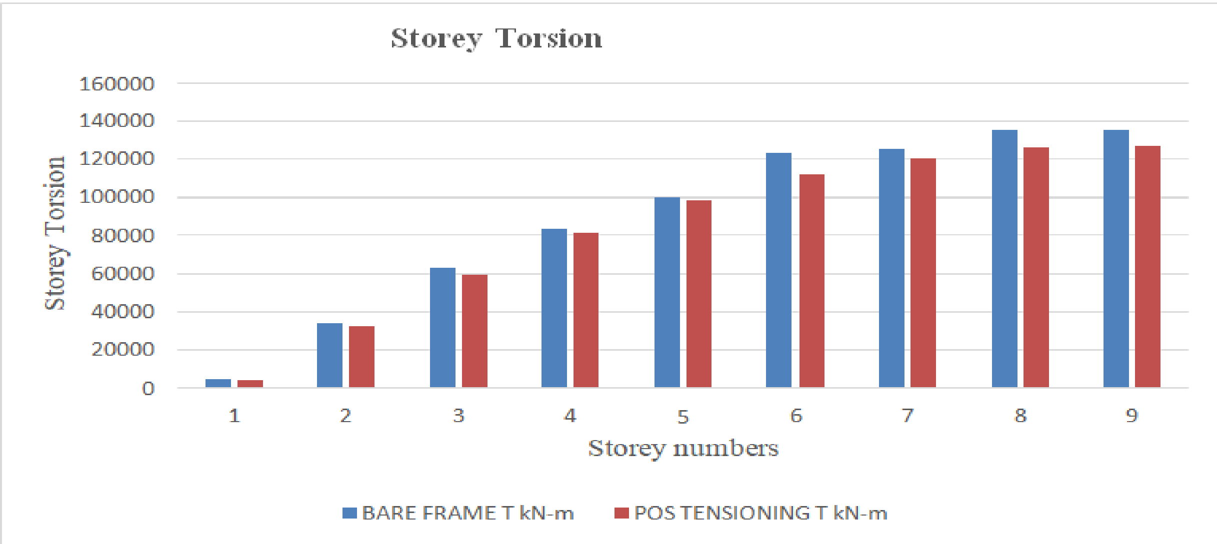

Fig 8 : Storey Torsion

The fig.7 shows that storey torsion force is lesser than we compared with post-tensioning frame andconventional frame direction in seismic zone V due to storey torsion is not much governing in both frames.

Displacement @ X-direction:

Fig 9: Displacement in X-direction

The fig.8 shows that Displacement is lesser than we compared with post tensioning frame and conventional frame at X-direction direction in seismic zone V due to bending moment is not much governing in both frames.

Displacement @ Y-direction:

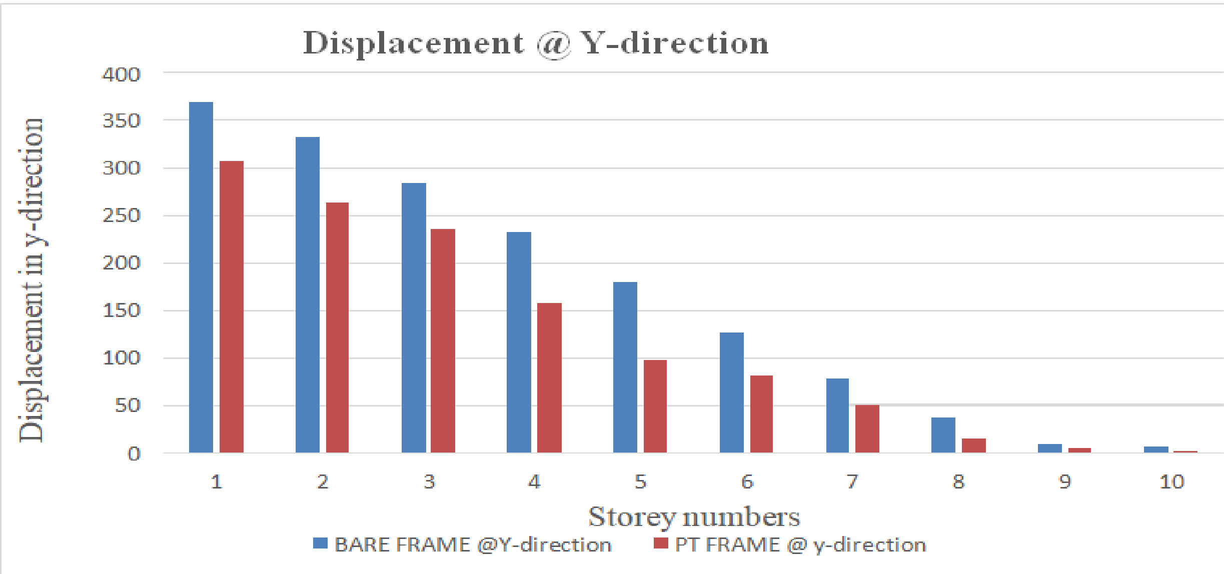

Fig 10: Displacement in Y-direction

The fig.9 shows that Displacement is lesser than we compared with post tensioning frame and conventional frame at X-direction direction in seismic zone V due to bending moment is not much governing in both frames.

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V. CONCLUSION

1. Shear force is lesser in post-tensioning frame compared to conventional frame in both directions in seismiczone V.
2. Bending moment is lesser in post-tensioning frame compared to conventional frame in both directions inseismic zone V.
3. Storey Torsion is lesser in post-tensioning frame compared to conventional frame in seismic zone V.
4. Storey max. drift is lesser in post-tensioning frame compared to conventional frame in seismic zone V.
5. Displacement is lesser in post-tensioning frame compared to conventional frame in both directions inseismic zone V.

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