

Comparative Analysis of a Building Frame Under Dynamic Loading Considering Post Tensioning Members at the edges using STaad.pro

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ABSTRACT

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The modern era construction has led to the use of post-tensioning method in every projects whether commercial or residential sectors. Looking over the flaws of the conventional method of construction, post-tensioning being an upgrade can overcome the deficiencies of the conventional method of construction, for example, more slender structural members, lighter in weight and smaller floor-to-floor heights. Post-tensioning assures every plan to quite economical and safe. The experimental results on the seismic behaviour of post-tensioned high rise G+20 structure with the bonded system is compared. A Symmetrical arrangement of (G+20) floors is been considered in this comparative analysis considering Pushover Analysis for Zone V according to I.S. 1893 section 1 2016. The analytical tool Stadd.Pro structural programming is been used for the designing and analysis of the case study on the parameters namely maximum storey displacement, axial forces, shear forces, maximum bending, storey drift, displacement in x and z direction and Quantity examination and costing.

The Analysis results demonstrated the stability of the Post-tensioned Structure as far as resisting against seismic forces against the corners of the structure. Regarding cost, we have observed that the Post Tensioning structure edge was discovered 30% not exactly uncovered casing structure.

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I. INTRODUCTION

Generally a High rise structure have to resist forces created because of wind and earthquakes, but the designing of the structure varies for resisting both the loads. Earthquake forces hampers the structure at the base level whereas, nifty wind breezes affects the

exposed area of the structure, which is termed as force-type loading. An additional process for communicating this distinction is through the load-deformation curve of the structure – (vertical axis) provides the deflection seen because of wind and displacement whereas deflection on the (horizontal axis) in the displacement type loading imposed on the structure due to earthquakes. Structure faces minimal fluctuations in the stress field under wind loadings

but situations worsen up in case of reversal of stresses with the change in direction of wind when such occur for a long time span. On the flip side, the locomotion of the ground in case of an earthquake is usually intermittent at the equitable site of the structure, but with seismic forces even for a short duration, they affect the structure harshly.

Post-tensioning is the acquaintance of outside forces with the structural membrane utilizing high-quality links, strands or bars. The PT support is associated with the current part at anchor points, normally situated at the close of the part, and profiled along with the range at deliberately found high and depressed spots. Whenever the external forces occur, the ligaments will deliver upward forces (at depressed spots) or descending forces (at high focuses) to backpedal the load on the part.

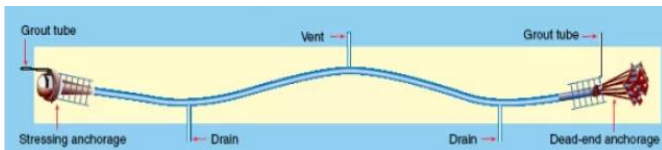


Fig 1 : Post Tensioning Cables

II. LITERATURE REVIEW

Arkadiusz Mordak and Zbigniew Zee Manko (2016) the authors' examination paper introduced the outcomes acquired from the trial research led on another development pre-focused on post-tensioned street extension situated over a water supply plant under unique field load test in Topola Village in Poland. A few unique tests were directed for the far-reaching assessment of the different solid components endeavours of the structure of the extension.

The wide scope of the dynamic test led prompted flexible endeavours and assessment of the components of the scaffold through the complete investigation offered to ascend to the premise on

which the extension qualified for essential administration according to the Poland measures.

D.Y. Wang et. al. (2014) the author completed a definite investigation as versatility, malleability, vitality scattering and so forth with the target behind the test was to create rules for precast structure in locales of a tremor zone.

The outcomes introduced that even though the vitality dispersed was low the malleability of PCB example was superior to MCB example, the leftover disfigurement of PCB example was pretty much nothing, the harm level of PCB examples was light than MCB example. In PCB examples there was just a fundamental break among shaft and segment and there were little shear splits in the bar. This implied on the parts of decreasing shear splits the PT ligament was more viable than level fortifications in the pillar.

The tests demonstrated that a precast pre-stressed solid framework was achievable and exhibited impressive guarantee.

Objectives:

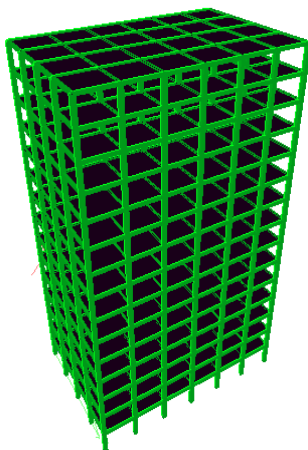
The destinations of the investigation are as per the following:

- To decide the capacity of post-tensioning cables in a tall structure as a parallel load opposing individuals.
- Estimation and costing of material according to S.O.R.
- Dynamic investigation of the tall structure considering P-delta examination.
- Utilization of Advance diagnostic application Staad.Pro for P-delta examination of horizontal load opposing structure.
- To set up a reference study for the usage of post-tensioning members in the Indian district according to seismic code 1893-section 1:2016.

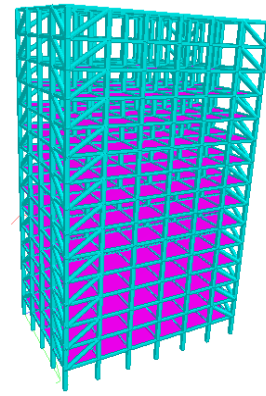
III. Methodology

Table 1 : Geometrical properties

| Design data of building | Dimension |
|---------------------------|--------------------------|
| Plan dimension | 30 x 20 m |
| No. of bay in X direction | 6 Bay |
| No. of bay in Y direction | 4 Bay |
| No. of storey | Ground + 20 storey |
| Typical storey height | 3.5 m |
| Bottom storey height | 2.0 m |
| Column size | 500 x 500 |
| Beam size | 350 x 300 |
| Thickness of slab | 125 mm |
| Grade of concrete | M-25 |
| Grade of steel | Fe-415 |
| Wall thickness | 100 mm for external wall |
| Post tensioning wire | 600 mm diameter cable |



a. Conventional structure



b. Post tensioning structure

Fig 1: Cases considered

Following steps are considered for study are as follows:
 Step-1: To select geometrical data as per site.
 Step-2: To Sectional data and cable diameter.
 Step-3: Assign loading condition as per Indian Standards.
 Step-4: To assign P-delta functioning for dynamic motion.
 Step-5: To analyze the structure considering periodic motions.
 Step-6: Compare results.

IV. Result Analysis

Bending moment

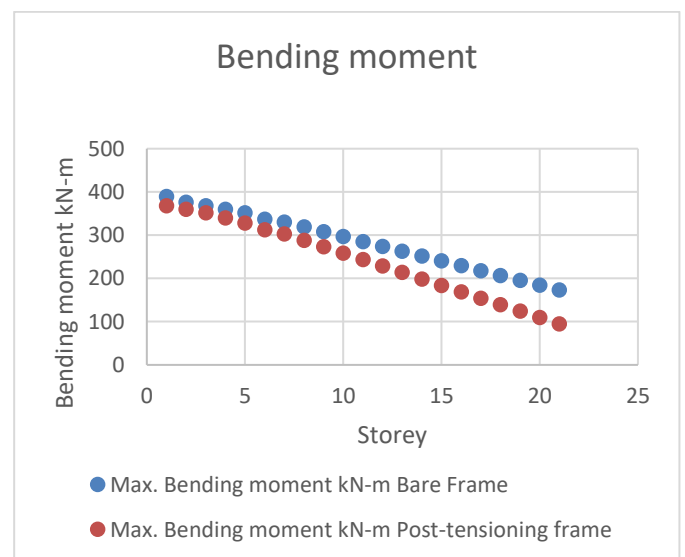


Fig 2: Bending moment

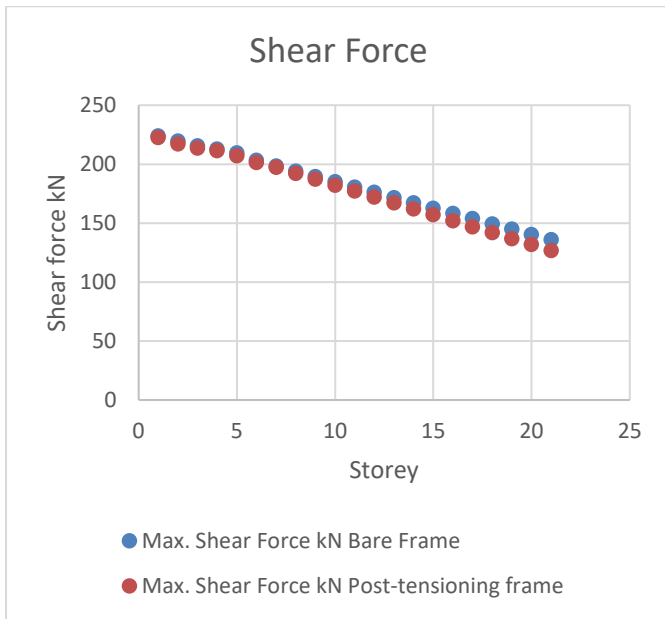


Fig 3 : Shear force

Storey Displacement :

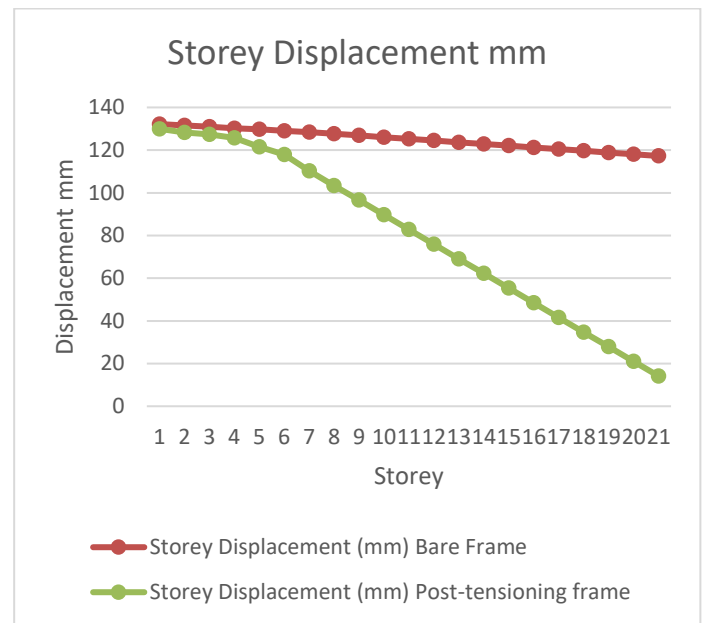


Fig 5 : Storey displacement

Axial force:

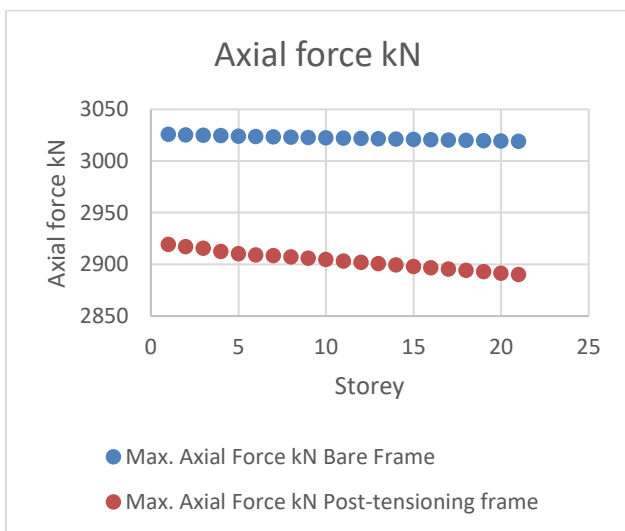


Fig 4 : Axial force

Design data:

Beam design:

Table 2: Beam design

| Beam No. 1 Design Result | | | | |
|----------------------------------|---------|-------------|--------------|-------------|
| M25 | | Fe 415 main | | Fe 415 Sec |
| Length | 4000 mm | Size | 450 x 300 mm | Cover 25 mm |
| Summary of Reinforcement (sq. m) | | | | |

| | | | | |
|-------------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Section | 0 | 1000 | 25000 | 4000 |
| Top. Reinf. | 289.76 | 1007.55 | 1140.58 | 277.65 |
| Bottom Reinf. | 13.31 | 277.73 | 277.73 | 13.87 |
| Summary of Provided Reinforcement (sq. m) | | | | |
| Top. Reinf. | T4 @ 25 | T3 @ 25 | T3 @ 25 | T4 @ 25 |
| Bottom Reinf. | T3 @ 16 | T4 @ 16 | T4 @ 16 | T3 @ 16 |
| Shear | 2 Legged @ 8mm Dia. @ 150 mm c/c | 2 Legged @ 8mm Dia. @ 150 mm c/c | 2 Legged @ 8mm Dia. @ 150 mm c/c | 2 Legged @ 8mm Dia. @ 150 mm c/c |

Column design:**Table 3:** Beam design

| Column Design Results | | | | |
|------------------------------------------------------------|---------|-------------|----------------------------------------------|-------------|
| M25 | | Fe 415 main | | Fe 415 Sec |
| Length | 3200 mm | Size | 450 x 450 mm | Cover 40 mm |
| Req. Steel Area: | | | 23030.87 sq. mm. | |
| Req. Concrete Area: | | | 616969.54 sq. mm. | |
| Main reinforcement: | | | Provide T10 @ 25 mm, (3.68%) | |
| Distribution (Tie) Reinforcement: | | | Provide 8mm dia. Rectangular ties@ 300mm c/c | |
| Section Capacity based on reinforcement provided (KNS-MTR) | | | | |
| Load: | Puz: | 15497.87 | Muz: | 673.78 |

Cost Estimation:**Table 4 :** Column design

| S.No. | Type of frame | Qty. of concrete | Qty. of reinforcement Kg | Concrete rate/cu.m | Reinforcement rate/kg | Cost of concrete | Cost of reinforcement |
|-------|-----------------|------------------|--------------------------|--------------------|-----------------------|------------------|-----------------------|
| 1 | Post tensioning | 1700.45 | 2806.5 | 3500 | 74 | 59,51,575 | 207681 |
| 2 | Bare Frame | 1830.44 | 2965.45 | 3500 | 74 | 64,06,540 | 219443.3 |

V. CONCLUSION

The examination has demonstrated that Post-tensioning structure outline with general structure outline, a tall structure G+20 is readied considering Seismic investigation according to IS 1893:I:2002 utilizing propelled investigation apparatus Staad.Pro. We have seen that as far as force, minute and relocation, Post-tensioning part building casing was discovered progressively steady, resistible against seismic force against the uncovered edge. Regarding cost, we have watched the Post Tensioning structure edge was discovered 30% not exactly uncovered casing structure.

VI. REFERENCES

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