Comparative Analysis of A Building Frame Under Dynamic Loading Considering Post Tensioning Members At The Edges Using Staad.Pro

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Abstract- *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.

Keywords- Structural Analysis, post tensioning cables, displacement, moment, forces, cost, stability.

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.

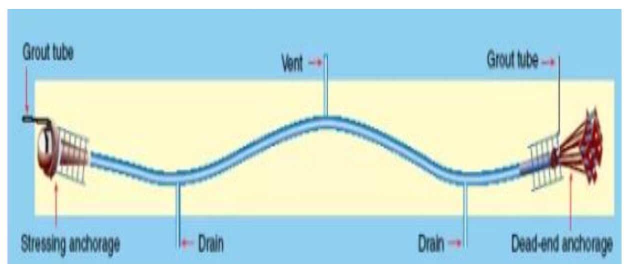


Fig 1: Post tensioning cables

II. LITERATURE REVIEW

ArkadiuszMordak 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.

III. OBJECTIVES

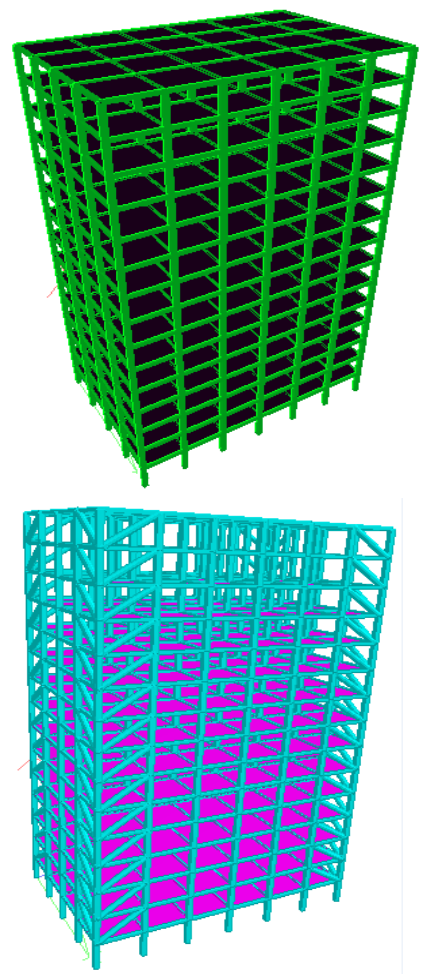
The destinations of the investigation are as per the following:

- 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.

IV. 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.

V. RESULT ANALYSIS

Bending moment:

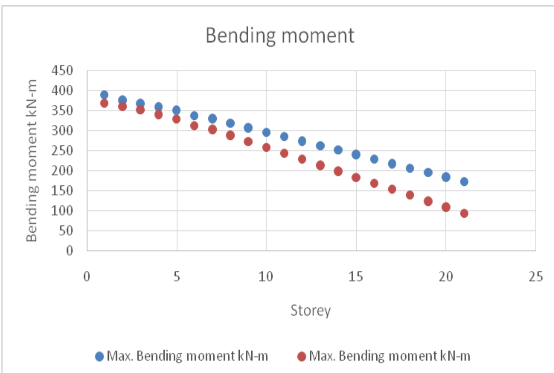


Fig 3: Bending moment

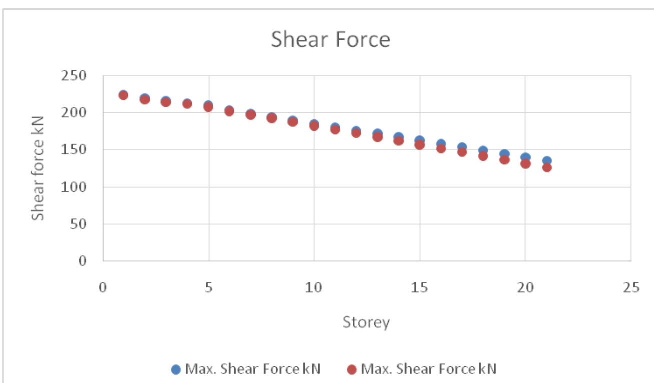


Fig 4: Shear force

Axial force:

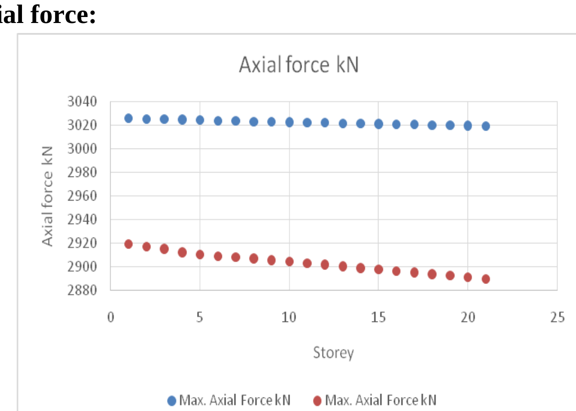


Fig 5: Axial force

Storey displacement:

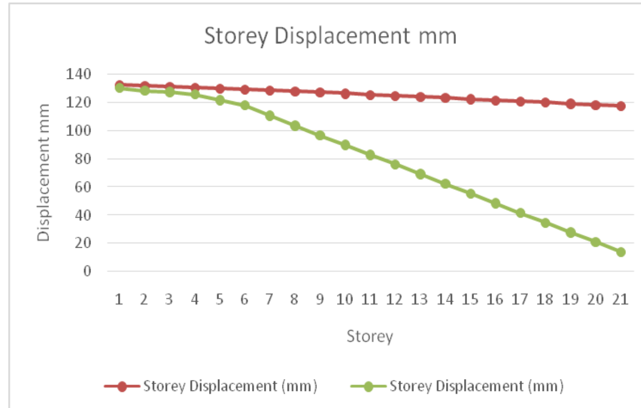


Fig 6: Storey displacement

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

VI. CONCLUSION

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

REFERENCES

[1] ArkadiuszMordak and `Zbigniew Zee Manko(2016) Effectiveness of Post-tensioned prestressed concrete road bridge realization in the light of research under dynamic loading,9th International conference, Bridge in Danube Baisn2016, BDB 2016.

[2] D.Y. Wang, Z.B. Li, W.M. Yan, E.W. Guo, L.Y. Shi(2014), SEISMIC PERFORMANCE OF PRECAST PRESTRESSED BEAM-COLUMN CONCRETE CONNECTIONS, Journal of Beijing University of Technology, 32:10, 895-900. (In Chinese)

[3] VeeratSrilaxmi , K.Manju , M.Vijaya (2018)A CASE STUDY ON PRE-TENSIONING & POST TENSIONING SYSTEMS OF A PRESTRESSED CONCRETE,[Srilaxmi et. al., Vol.5 (Iss.2): February, 2018

[4] Rahul Choat and Dr.Om Prakash (2017), APPLICATION OF POST-TENSIONING IN MULTI-STOREY BUILDINGS, Choat* et al., 6(3): March, 2017, ISSN: 2277-9655

[5] RafalSzydlowski and Magdalena Szreniawa(2016), About the Project and Study of Post-tensioned Transfer Beams Under the Five-storey Building in the Centre of Warsaw, 4th Annual International Conference on Architecture and Civil Engineering (ACE 2016).

[6] Boskey Vishal Bahoria and Dhananjay K. Parbat (2013) Analysis and Design of RCC and Post-tensioned Flat Slabs Considering Seismic Effect, IACSIT International Journal of Engineering and Technology, Vol. 5, No. 1, February 2013

[7] Maulik G. Kakadiya, Hitesh K. Dhamaliya et.at(2016)A Research on Comparison of R.C.C and Post Tensioned Flat Slab with or Without Drop Using Software, 2016 IJSRSET | Volume 2 | Issue 2 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099

[8] Sujal P Jasani and Pradeep Pandey(2017)ANALYSIS OF POST TENSIONED TRANSFER GIRDER IN G+11 STORY BUILDING USING FEM BASED SOFTWARE ETABS, IJAERD , Volume 4, Issue 4, April -2017