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Analysis of a Prestressed RCC Building Frame Considering Dynamic Loading

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ABSTRACT

In this quick paced and aggressive world, building part is at the pinnacle of the development of any nation. Elevated structures are respected by each individual. Generally the development of a structure is finished by RCC yet in present world, development of tall structures ought to be finished by Post-Tensioning to oppose horizontal powers and improving structure quality. In RCC, the financial consumption is high in business and institutional structures due to progressively material required in development and thus, Post Tensioned structure ends up being increasingly monetary and strong. Post-Tensioned structure spares amount of steel and concrete when contrasted with RCC and builds clear range in rooms. Through this examination, the accentuation is to plan a post-tensioned structure utilizing ETABS. ETABS represent Extended Three-Dimensional Analysis of a structure frameworks. The fundamental motivation behind this product is to plan multistoried structure in a methodical procedure which will be as per Indian Standard plan codes.

In this relative examination we have consider an unsymmetrical arrangement of G+9 floors considering Wind load according to I.S. 1983-I:2016 and Black cotton soil. In this investigation near examination is finished with exposed edge building structure considering same stacking information to decide most extreme story relocation, pivotal powers, shear powers, greatest twisting, story float, solidness, toppling minute, dislodging in x and z course and cost investigation according to S.O.R.

Keywords: Etabs, High rise building, analysis, post tensioning, cost analysis, S.O.R, SAFE, Drift.

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I. INTRODUCTION

Dynamic activities are caused on structures by both breeze and seismic tremors. Be that as it may, plan for wind powers and for seismic tremor impacts are unmistakably extraordinary. The natural rationality of auxiliary plan utilizes drive as the premise, which is steady in wind structure, wherein the structure is exposed to a weight on its uncovered surface zone; this is constrain type stacking. In any case, in tremor plan, the structure is exposed to arbitrary movement of the ground at its base, which incites dormancy powers in the structure that thusly cause focuses on; this is removal type stacking. Another method for communicating this distinction is through the heap twisting bend of the structure – the interest on the structure is drive (i.e., vertical hub) in power type stacking forced by wind weight, and relocation (i.e., flat hub) in uprooting type stacking forced by seismic tremor shaking. Wind constrain on the structure has a non-zero mean segment superposed with a generally little swaying part. In this manner, under wind powers, the structure may encounter little vacillations in the pressure field, yet inversion of stresses happens just when the heading of wind switches, which happens just over a huge span of time. Then again, the movement of the ground amid the tremor is cyclic about the unbiased position of the structure. In this manner, the worries in the structure because of seismic activities experience many complete inversions and that too over the little length of quake.

The essential explanations behind the reinforcing of solid structures are regularly to increment existing components' ability to convey new loads or to determine a current inadequacy. A few fortifying systems, for example, area development, remotely fortified fiber strengthened polymer (FRP) support, supplemental steel components, and post-tensioning can be utilized to build the heap conveying limit and improve workableness of existing structures. In any case, there are numerous specialized elements that ought to be viewed as while choosing a fortifying framework. Notwithstanding specialized concerns, for example, workableness, quality, toughness, appearance, and fire rating, one ought to consider non-specialized factors, for example, constructability, feel and cost.

In this near examination we have consider an unsymmetrical arrangement of G+9 floors thinking about Seismic zones V and delicate sort soil according to I.S. 1893 section 1 2016. for breaking down and displaying reason ETABS 17 writing computer programs is used and think about is done on the reason of most extreme story uprooting, pivotal powers, shear powers, greatest twisting, story float, firmness, upsetting minute, removal in x and z course and cost investigation according to S.O.R. (C.P.W.D.)

Need of Study:

As because of uncommon addition in populace in our nation, need of tall structures are quickly developing around all the metro urban communities and towns, in this way to settle such intense expanded populace tall structures are expanding. We realize that tall structures are especially influenced by parallel powers which can cause there disappointment and death toll. To forestall such tremors Here in this examination work our principle thought process is to express a benchmark for the future work utilizing post tensioning individuals in India according to 1893:2016 codal arrangement for development of tall structures even in extreme zone regions.

Objectives:

The objectives of the study are as follows:

a) Determination of the effect of External Post Tensioning members on a High rise building
b) Evaluation of cost effectiveness and variation in cost as per S.O.R.
c) Seismic strengthening of the building due to post tensioning members at exterior region.
d) Utilization of Advance analysis tool ETABS'17 for post tensioning method.

To prepare a reference study for implementation of post tensioning members in Indian region as per seismic code 1893-part-1:2016.

II. LITERATURE SURVEY

K Bednarz (2018) Analyzed the method for correct construction of large span, slim post-tensioned concrete slabs is conditioned by an appropriate cross-section selection. It is generally accepted that the thinnest slab can be constructed using the full cross-section as the largest compression stress storage. However, completely different cross-sections may help to overcome large spans. The paper presents the results of the computational analysis of several types of cross-sections (full, with internal relieving inserts and ribbed) in the application to a post-tensioned slab with a span of 15.0m. Based on the results presented, appropriate conclusions were drawn.

Rahul singh et. al. (2018) studied that In this fast-paced and competitive world, building sector is at the apex of the growth of any country. High-rise buildings are admired by every human being. Traditionally the construction of a building is done by RCC but in present world, construction of high rise buildings is done by Post-Tensioning. In RCC, the economic expenditure is very high in commercial and institutional buildings because of more material required in construction and hence, Post Tensioned building proves to be more economic and durable. Post-Tensioned building saves quantity of steel and concrete as compared to RCC and increases clear span in rooms. Through this paper, the emphasis is to design a posttensioned building using ETABS and SAFE. ETABS stand for Extended Three-Dimensional Analysis of a building systems. The main purpose of this software is to design multistoried building in a systematic process which will be in accordance with Indian Standard design codes.

Abbas abdul majeed allawi et. al. (2018) studied The structural behavior of Segmental Precast Post-tensioned Reinforced Concrete (SPPRC) beams largely depends on the behavior of the joints that connect between the segments. In this research, series of static tests were carried out to investigate the behavior of full-scale SPPRC beams with different types of epoxy-glued joint configurations; multi-key joint, single key, and plain key joint. The reference specimen was monolithically casted beam and the other specimens were segmental beams with five segments for each one. The general theme from the experimental results reflects an approximate similarity in the behavior of the four beams with slight differences. Due to the high tensile strength of the used epoxy in comparison to concrete, cracks at joints occurred in the concrete cover which was attached to the epoxy mortar.

Table 1 : Geometrical data

Design data of building	Dimension
Plan dimension	12 x 15 m
No. of bay in X direction	3 Bay
No. of bay in Y direction	3 Bay
No. of storey	G+9
Typical storey height	3.0 m
Bottom storey height	2.5 m
Column size	450 x 450
Beam size	450x 300
Thickness of slab	150 mm
Grade of concrete	M-25
Grade of steel	Fe-415
Wall thickness	230 mm for external wall
Post tensioning wire	230 mm diameter cable

III. METHODS AND MATERIAL

Step-1 Modelling of building frames
Step-2 Assigning section properties and material
Step-3 Assigning supports
Step-4 Assigning Post Tensioning Hinge
Step-5 Application of Load
Step-6 Selection of parameters of seismic Definition of various soil conditions
Step-7 Application of response Spectrum
Step-8 Formation of load combination (8 load combination)
Step-9 Design of RCC structure

IV. RESULTS AND DISCUSSION

Max. Bending Moment:

Table 2 : Bending moment

Storey	Max. Bending moment kN-m	
	Bare Frame	Post-tensioning frame
9th	144.8	69.18
8th	129.67	62.79
7th	114.54	56.4
6th	99.41	50.01
5th	84.28	43.62
4th	69.15	37.23
3rd	54.02	30.84
2nd	38.89	24.45
1st	23.76	18.06
0	0	0

Shear Force:

Table 3 : Shear Force

Storey	Max. Shear Force kN	
	Bare Frame	Post-tensioning frame
9th	254.05	197.93
8th	228.55	177.62
7th	203.05	157.31
6th	177.55	137
5th	152.05	116.69
4th	126.55	96.38
3rd	101.05	76.07
2nd	75.55	55.76
1st	50.05	35.45
0	0	0

Axial Force:

Table 4 : Axial Force

Storey	Max. Axial force kN	
	Bare Frame	Post-tensioning frame
9th	54.334	39.04
8th	53.21	37.87
7th	52.086	36.7
6th	50.962	35.53
5th	49.838	34.36
4th	48.714	33.19
3rd	47.59	32.02
2nd	46.466	30.85
1st	45.342	29.68
0	0	0

Displacement:

Table 5 : Storey Displacement

Storey	Max. Displacement in mm	
	Bare Frame	Post-tensioning frame
9th	17.402	8.5501254
8th	15.227	7.4813932
7th	13.052	6.412661
6th	10.877	5.3439288
5th	8.702	4.2751966
4th	6.527	3.2064644
3rd	4.352	2.1377322
2nd	2.177	1.069
1st	0.002	0.0002678
0	0	0

Drift:

Table 6 : Storey Drift

Storey	Max. Storey Drift in mm	
	Bare Frame	Post-tensioning frame
9th	23.928	11.7564559
8th	20.6655	10.1533576
7th	17.403	8.5502593
6th	14.1405	6.947161
5th	10.878	5.3440627
4th	7.6155	3.7409644
3rd	4.353	2.1378661
2nd	1.0905	0.5347678
1st	0.001	0.0001339
0	0	0

V. CONCLUSION

The Study presents results of implement post-tensioning method in the building. High-rise structure is modelled and analyzed in this study using ETABS software. Presented project is a first venture of this type in project. Results of measurements of deflection during construction of the building indicate Stability of the structure due to post tensioning members which shows deviations from predicted values.

In this study following results are observed as follows:

- Bending moment in each storey decreased due to introduction of post-tensioning members, this results in economical sections. In this study it is observed that 47.7% decrement in moment is resulted in Post tensioning frame comparing to bare frame.
- Storey shear is decreasing causing minimize risk of unbalanced forces in post tensioning structure. It is observed in above chapter that unbalanced force are observed 13.87% less in post tensioning building frame comparing to bare frame.
- Lateral force resistivity results in less deflection and stability of a structure to resist lateral forces thus assigned wind pressure can be resist easily. Displacement in post tensioning member is resist by 50.09% which make the structure more stable and lateral load resistable.
- Axial force in Post tensioning building frame is observed minimum compared to Bare frame. It is observed in above chapter that distributing forces in vertical members are 28.20% less in post tensioning member frame in comparison.
- Storey Drift is the relative displacement of two adjoining stories, In the chapter above it is observed that post tensioning member results in 49% reduction in relative displacement compared to bare frame structure.

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