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# SEISMIC EFFECT ON POST-TENSIONED BUILDINGCOMPARE TO RC BUILDING

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**Abstract—**Generally Reinforced concrete (RCC) frame structure are made of concrete, steel and other materials while Post-Tensioned (PT) building are made of same material with including tendons, the yield strength of tendon is about four times than HYSD deformed bars so that the member section of PT member is reduce compare to normal RC members so that behavior of both the section may be different during an earthquake of the same building so it is very important to check behavior of pt building and its max. force and moment compare with RC building and also there are many advantages of PT building so that its use is so vast in residential as well as commercial and other important building.

**Keywords:**post-tension building, pre-stress building, seismic force, pt building.

## I. INTRODUCTION OF PRESTRESS

A pre-stressed concrete structure is different from a conventional reinforced concrete structure due to the application of an initial load on the structure prior to its use. the initial load or "pre-stress" is applied to enable the structure to counteract the stress arising during its service period. The pre-stressing of a structure is not only instance of pre-stressing.In pre-stressing system, Stress is given prior to the loading is such that pre-stress and upcoming loading balance each other.Pre-stressing is used from ancient time in a different ways and now a days it is used in RCC members. there are two types of pre-stressing system.1)pre-tensioning,2)post-tensioning.in pre-tensioning first cables lay as per profile and stressing it prior to pour concrete and when concrete achieves sufficient strength cable are cut so that force transfer from cable to harden concrete. In post-tensioning, first cables are lay as per design profile after that concrete is poured when concrete achieves sufficient strength cables are stressed and then lock it so that stress transfer from cables to harden concrete.

## II. LITERATURE REVIEW

There are many researchers work on post-tensioning element's behavior during an earthquake because there are many advantages of post-tensioning but it's behavior during an earthquake is unknown. An attempt has been made in paper to summarize the study carried out by various authors and evaluate the requirement of further research in the area.

**Vijaya Narayanan A.R, Rai D. C** [1] presents fragility curves are developed using experimental data available in literature for, RC slab-column connections without shear reinforcement, with shear reinforcement other than shear-studs, with shear-studs as shear reinforcement, and PT slab-column connections without shear reinforcement. Fragility curves are developed for three defined limit states, corresponding to yield, peak and post peak states. Fragility curves developed without considering the specimen-to-specimen variability results in a poor estimation of vulnerability. Effects of specimen-to-specimen variability and epistemic errors are included in the development of fragility curves. Specimen-to-specimen variability is included by incorporating the gravity shear ratio. The seismic performance of PT slab-column connection is better only marginally than that of its RC counterpart. Use of shear reinforcement significantly reduces the vulnerability of connections. The use of shear stud for shear reinforcement is observed to be more effective than stirrups.

**Minehiro Nishiyama**[2]Non-linear time-history analyses on single-degree-of-freedom systems with load-displacement relations of pre-stressed and conventional reinforced concrete are reported. The analytical results are used for investigating response characteristics of pre-stressed concrete systems and deriving substitute damping. Energy time-history of pre-stressed concrete system is compared with that of reinforced concrete. The substitute damping obtained is compared with equivalent viscous damping derived directly from load-displacement relationship of the systems. Referring to the substitute damping from the dynamic response analyses and the equivalent viscous damping from stationary load-displacement curves, equivalent damping for the capacity spectrum method is proposed.

**Virote Boonyapinyo et. all** [3]presents seismic capacity evaluation of post-tensioned concrete slab-column frame buildings designed only forgravity loads and wind load is presented. The series of nonlinear pushover analysis are carried out byusing the computer program SAP2000. An equivalent frame model with explicit transverse torsionmembers is introduced for modeling slab-column connections. The analyses are carried out by followingguidelines in ATC-40 and FEMA-273/274, where several important factors such as P-Delta effects,strength and stiffness contributions from masonry infill walls, and foundation flexibility are well takeninto account. The pushover analysis results, presented in the form of capacity curves, are compared withthe seismic demand from the expected earthquake ground motion at Bangkok site and then the seismic performance can be evaluated. The numerical examples are performed on the 9-story post-tension flatplate building in Bangkok. The results show that in general post-tensioned concrete slab-column frame buildings possess relatively low lateral stiffness, low lateral strength capacity, and poor inelastic response characteristics. The evaluation also shows that the slab-column frame combined with the shear wall system and drop panel can increase the strength and stiffness significantly.

**Blakeley R. W. G, Park R., Shepherd R.**[4] presents deals with fundamentals properties like stiffness, damping, energy absorption and ductility of the structure will affect the response so under earthquake loading structural behavior is also change due to these properties they conclude that The internal damping of pre-stressed concrete is less than RCC structure. The critical damping percentage of pre-stressed concrete is less than RCC structure Pre-stressed structure under earthquake load performs well .if pre-stressed structure fails then possibility of joint fails is maximum. So special provisions apply near joint connection then chance of failure is less.

## III. OBJECTIVE

To show the behavior of same building built with RC frame and Post-tensioning method during a lateral force and compare with each other and make conclusion from that.

Here 8x8 grid G+ 5 models is prepared for zone 3 with help of Staad- pro and same model is design using Adapt floor pro.

Another model is also prepared for 8x8 grid of the same building without earthquake.

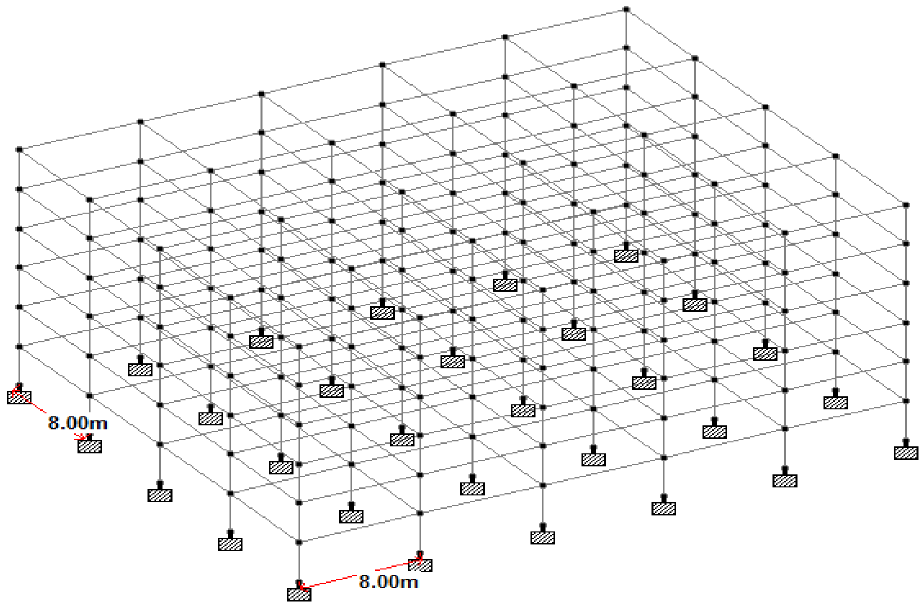


Fig: 1 8x8 grid G+5 Staad modal

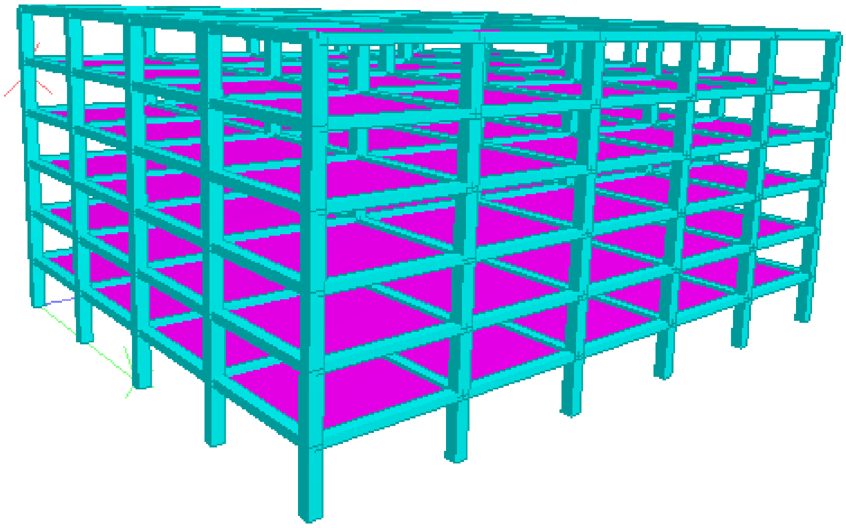

Fig.2 8x8 grid G+5 Staad modal reder view

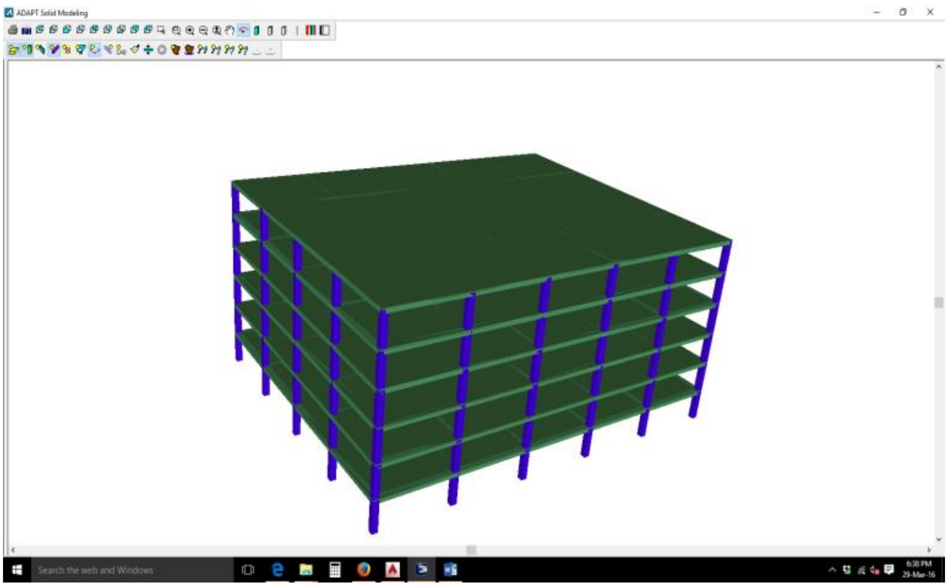

Fig 3 8x8 grid G+5 Adapt modal

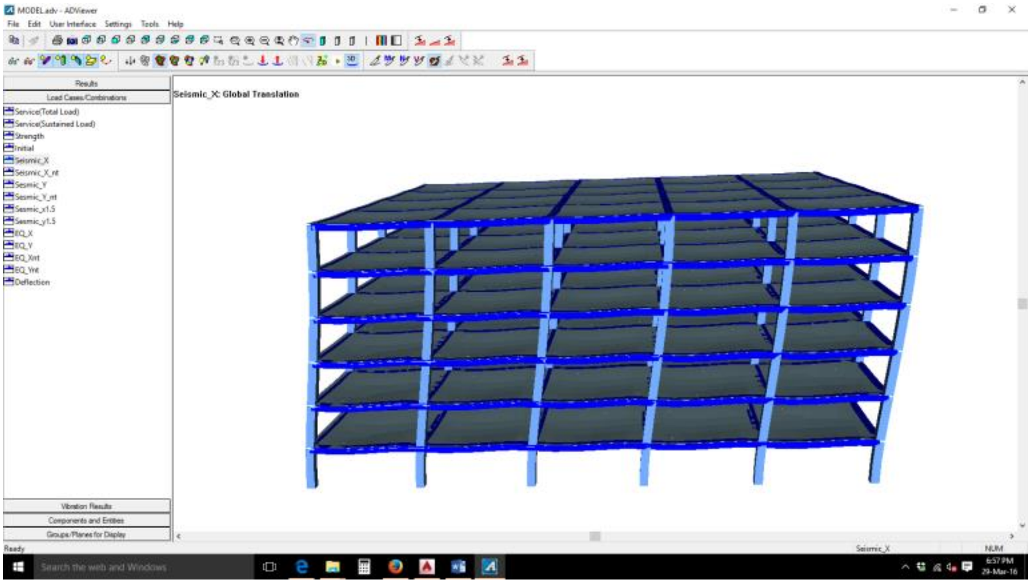


Fig 4 Lateral translation in PT modal due to lateral force

## IV. LOADS & LOAD COMBINATION

there are various loads used for preparing the modal that are self-weight, wall load , earthquake load .here following load combination used for prepare the modal according to IS:1893:2002

1. 1.5DL+1.5LL
2. 1.5DL+1.5EQX
3. 1.5DL-1.5EQZ
4. 1.2DL+1.2LL+1.2EQX
5. 1.2DL+1.2LL+1.2EQZ
6. 1.2DL+1.2LL-1.2EQX
7. 1.2DL+1.2LL-1.2EQZ
8. 0.9DL+1.5EQX
9. 0.9DL+1.5EQZ
10. 0.9DL-1.5EQX
11. 1.5DL+1.5EQZ
12. 0.9DL-1.5EQZ
13. 1.5DL-1.5EQX

**Results**

8x8 G+5 RCC and Post-tensioning modal analyzed with help of Staad-pro and Adapt floor pro respectively for zone 3 earthquake and gravity loads. The results of the models are as followings.

**Table 1 ResultComparison of 8x8 grid G+5 PT modal and RCC modal (without earthquake load)**

| Sr. no. | Description | PT modal | Section id | RCC modal | Beam no. | Remarks |
|---|---|---|---|---|---|---|
| 1 | Bending moment | 382.79 KN.m | 5505000 | 515.345 KN.m | 359 | Decrease |
| 2 | Shear force | 398.44 KN | 5505000 | 311.512 KN | 359 | Increase |
| 3 | Axial force | 307.912 KN | 5203010 | 37.48 KN | 399 | Increase |

Table 2 Result Comparison of 8x8 grid G+5 PT modal and RCC modal (with earthquake load)

| Sr. no. | Description | PT modal | Section id | RCC modal | Beam no. | Remarks |
|---|---|---|---|---|---|---|
| 1 | Bending moment | 403.419 KN.m | 5405010 | 619.076 KN.m | 347 | Decrease |
| 2 | Shear force | 500.337 KN | 5305010 | 373.368 KN.m | 466 | Increase |
| 3 | Axial force | 212.276 KN | 4903000 | 34.411 KN | 435 | Increase |

## V. CONCLUSIONS

- Post-tensioned modal behaves better than RCC modal either during earthquake condition or gravity condition.
- Bending moment in PT modal compare to RCC modal is about 40% So due to reduction in bending moment section size decreases thus more headway access and large span possible without intermediate beam and column.
- While considering lateral force, shear force of PT modal is increased around 30%
- Axial force in PT modal is increased compare to RCC modal because of cable stressing at beam end
- In short PT modal behaves better during an earthquake load
- Due to reducing moment the non pre-stressing steel requires less and section size also reduces so large span is possible without intermediate column or beam

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