A Review Paper on Dynamic Analysis of Prestressed Post-Tension Multistorey Structure in Severe Seismic Zone

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***Abstract* - Vibration of the building's structural element is difficult to well understand by many structural engineers.Dynamic behavior is a momentous design consideration for the slender, two-way floor and particularly for post-tensioned concrete building. The post-tension system plays a role to overcome architectural limit of regular RC buildings particularly in the realization of long span with shallower depth than other structural system. Slabs and beams prestressed by tendons are successfully used worldwide for several decades. During that time, many recommendations dealing with the forming of geometry and prestressing, dimensioning and erection technology were issued. Post-tension system is mainly differentiated as bonded post-tension system and unbonded post-tension system. However, the design procedure for post-tension structural element is quite difficult as well as long count. Hand calculation is mainly based on engineering judgement, which is sometime not useful for large-scale structure. Along with this, as we know that Frequency of earthquake occurrence has expanded causing extreme harm to human life and property. Consequently need of exact seismic examination of post-tension structure.**

***keywords* - Post-Tensioning, Load Balancing, Dynamic Analysis, Multistorey Structure, Bonded System**

I. INTRODUCTION

The development of prestressed concrete can be studied in the perspective of traditional building materials. In the ancient period, stones and bricks were extensively used. These materials are strong in compression, but weak in tension. For tension, bamboos and coir ropes were used in bridges. Subsequently iron and steel bars were used to resist tension. These members tend to buckle under compression. Wood and structural steel members were effective in both tension and compression.

In reinforced concrete, concrete and steel are combined such that concrete resists compression and steel resists tension. This is a **passive** combination of the two materials. In prestressed concrete high strength concrete and high strength steel are combined such that the full section is effective in resisting tension and compression. This is an active combination of the two materials.

- **Type of pre-stressing**

Pre-tensioning & Post-tensioning

In pre-tensioning, the tendons are tensioned before the concrete is placed. The tendons are temporarily anchored to abutments or stressing beds. Then the concrete member is cast between and over the wires. After the concrete has attained the required strength, the wires are cut from the bulkhead and pre-stress is transferred to the concrete member.

In post-tensioning, the concrete member is cast with ducts for the wires. After concrete has attained sufficient strength, wires are threaded into the ducts, tensioned from both or one end by means of jacks and at the precise level of pre-stress, the wires are anchored by means of wedges to the anchorage plates at the ends. IS: 1343 gives the criteria for post tensioning but the design steps is still vague.

Bonded & Un-bonded tendon

In post-tensioned members, the wires are either left free to slide in the ducts or the duct is filled with grout. In the former, the tendon is un-bonded and in the latter, it is bonded.

- **Stages of loading**

Initial stage

The member is under pre-stress but is not subjected to any superimposed external loads. Further subdivision of this stage is possible.

1. before pre-stressing: Concrete is weak in carrying loads. Yielding of supports must be prevented.
2. during pre-stress:

- Steel: This stage is critical for the strength of tendons. Often the maximum stress to which the wires will be subjected throughout their life may occur at this stage.

- Concrete: As concrete has not aged at this stage, crushing of concrete at anchorages is possible, if its quality is inferior or the concrete is honeycombed. Order of pre-stressing is important to avoid overstress in the concrete.

3. at transfer of pre-stress: For pre-tensioned members, where transfer is within a short period, and for post-tensioned members where transfer may be gradual, there are no external loads on the member except its own weight.
4. De-shuttering: The removal of formwork must be done after due consideration.Thus the initial pre-stress with little loss imposes a serious condition in the concrete and often controls the design of the member.

Final stage

This is the stage when actual working loads come on the structure. The designer must consider various combinations of live loads on different parts of the structure with lateral loads such as wind and earthquake forces and strain loads produced by settlement of supports and temperature. The major loads in this stage are:

1. Sustained load: It is often desirable to limit the deflection under sustained loads sue to its own weight and dead loads.
2. Working load: The member must be designed for the working load. Check for excessive stress and deflection must be made. However, this design may not guarantee sufficient strength to carry overloads.
3. Cracking load: Cracking in a pre-stress member signifies a sudden change in bond and shearing stresses. This stage is also important
4. Ultimate load: This strength denotes the maximum load the member can carry before collapse.

II. REVIEW OF LITERATURE

Rafal Szydlowski, Barbara Labuzek [9] presents representative projects of realized and future designs of long span prestressed slabs. They have monitored Artistic and Cultural Centre in Kozienice and Busko-Zdrój Cultural Centre building's Post-tension slab during their construction period. It has been proven, with regard to two-year monitoring behaviour of slabs constructed in Kozienice, that design of elements exceeding values recommended by dated guidelines, of span lengths and span to depth ratios is feasible. The conclusions that have been made, will allow for the construction of longer span and slenderer slabs than it was in the past. It can be noted that the research of possibility to use lightweight aggregate concrete in construction of long-span post-tensioned slabs has begun in Cracow University of Technology. It is commonly known that it is difficult to provide the desired concrete modulus of elasticity with this type of aggregate. On the other hand, preliminary computational analysis carried out by the authors indicate that important decrease of slab self-weight can lead to reduction of amount of prestressing or deflection in comparison with dense concrete of similar strength.

Colin G. Bailey, Ehab Ell body [3] shows the behaviour of the bonded post-tensioned concrete floor plates exposed to fire and present nonlinear finite element model, based on the results of eight bonded post-tensioned concrete slab fire tests. The study has shown that the failure mode of the floor under fire conditions is predominately due to tensile splitting along the tendons in both directions that extended to the top surface while the failure mode at ambient temperature was punching shear. The failure of the floor under fire conditions occurred for the standard fire curve, but did not occur for the defined natural fires.

Bijan[1] (1998) offers an illustrative and consistent overview of the principles and the associated corollaries of load balancing. Terminology is clarified and procedures for treating more complex and general geometries are given. The application of load balancing to both the serviceability and strength aspects of prestressed members is covered and several numerical examples are presented. He introduced equations for primary moment, secondary moments and sectional strength. Paper include numerical example on change in thickness of slab in different span and non-prismatic slab. The load-balancing method may be applied to limit state conditions. It yields the known result of zero secondary actions.

Kang, Deuck[6] studied flexural behaviour model for continuous UPT(Unbonded Post-tension) members, which is a nonlinear analysis model that reflects the moment redistribution. The accuracy of the proposed analysis model was also verified by comparing to the test results of continuous UPT members that included over-reinforced members, internally and externally post-tensioned members, and the members with diverse tendon profiles and various sectional shapes. study proposed an equation for predicting the ultimate strength of the UPT members that considers key variables, such as the distribution of bending moment along the member and the steel reinforcement ratio, by revising the existing approaches to the flexural strength of UPT members. The effect of the loading types on the flexural behaviour of continuous UPT members was reflected by using the curvature distribution in the maximum moment region and the area of bending moment diagram, which were considered relatively simple and rational, based on the analysis.

Magdy T. EI-Sheikh, Richard Sause, Stephen Pessiki, Le-Wu Lu[8] have done their research work on Seismic Behavior and Design of Unbonded Post-Tensioned Precast Concrete Frames. The behavior of two six-story unbonded post-tensioned frames is studied using nonlinear pushover static analyses and time-history dynamic analyses. Two analytical models are developed for the analyses; the fiber model and the spring model. The results show that the behavior of unbonded post-tensioned precast frames, in particular, the strength, ductility and self-centering capability is more than adequate for severe earthquake loading.

Kwnag, Jungwoo, Younghye and Dohun[7] took one of the famous tall structure of Korea in which post tensioning has been done. They took five tall structures analyses and carried out stress check and deflection check. Focus of the paper was on long-term deflection.

III. CONCLUSION

The conclusions that have been made, will allow for the construction of longer span and slenderer slabs than it was in the past for severe seismic zone. Design of elements exceeding values recommended by dated guidelines, of span lengths and span to depth ratios is feasible. Temperature plays significant role to fail the structure. Load balancing is shown to be a simple and general method that can be applied to structures with complex geometries and loading for the post-tensioned structure.

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REFERENCES

[1] **Bijan O. Aalami**, "Load Balancing: A Comprehensive Solution to Posttensioning", ACI Structural journal.
[2] Building code requirements for structural concrete (ACI 318-11)
[3] **Colin G. Bailey, Ehab Ell body**, "Whole-Building Behaviour of Bonded Post-Tensioned Concrete Floor Plates Exposed to Fire," Engineering Structures 31 (2009) 1800_1810
[4] IS 1343: 2012 "Prestressed concrete – code of practice"
[5] **Jetann, Thambiratnam, David P., Kajewski, Stephen L., Farr Andrew**, "Dynamic Behaviour of Flat Post-Tension Floor Plates",The Thirteenth International Congress of Sound and Vibration
[6] **Kang Su Kim, Deuck Hang Lee**, "Nonlinear Analysis Method For Continuous Post-Tensioned Concrete Members With Unbonded Tendons", Elsevier engineering structures 40(2012).
[7] **Kwnag Ryang Chung, Jungwoo Park, Younghye Kim, Dohun Kim**, "Application Of Post-Tension Technology On Tall Buildings" , International journal of high-rise building, volume 6, number 3
[8] **Magdy T. EI-Sheikh, Richard Sause, Stephen Pessiki, Le-Wu Lu**, "Seismic Behavior and Design of Unbonded Post-Tensioned Precast Concrete Frames", PCI journal
[9] **Rafal Szydlowski, Barbara Labuzek**, "Post-Tensioned Concrete Long-Span Slabs in Projects of Modern Building Construction", Materials Science and Engineering