

Comparative Analysis of Conventional Slab, Flat Slab and Post-Tensioning Slab

Vishal Gupta¹ Rohit Sahu² Dr. Pankaj Singh³

¹M. Tech Scholar ²Assistance Professor ³Head of the Department

^{1,2,3}Department of Civil Engineering

^{1,2,3}RKDFIST College Bhopal, India

Abstract— In the present study main focus on economic analysis between conventional and post tensioning slab. Post tensioning method is very popular now days, because difficult method of construction. It is not use in frame structures like buildings. It is widely used in heavy structures like bridges, mat foundation etc. Application of post tension slab for industrial and office building with large span is corporately better then rain forced concrete slab. In small span post tensioning slab is not good in economical aspect but in other aria likes serviceability, durability of structure and faster construction with respect to convention slab can provoke the over look of economical expect post tensioning methods can be majorly divided into two part either bonded or unbounded tendon first method that is or bounded tendons method is achieved by grouting the duct containing steel tendon after stressing, so the bound between the prestressing steel and concrete transfer the prestressing force to the members. Unbounded tendons is achieved by transmitted the force by anchorage of prestressing steel. In this method tendon ducts are left without grouting and grouting process is only used at anchorage portion. This paper introduces economical comparison between different type of slab and different type of construction technique. The analysis and design is verified all Indian stranded codal provision in manual calculations as well as a power full computer software SAP2000.

Key words: Post Tension Slab, Bounded Tendons, Unbounded Tendons, Concrete

I. INTRODUCTION

Post-tensioning is use for different structural element by which economical as well as technical benefits achieved. Post-tensioning concrete slab is rarely used in India because of lack of skilled person and myth it is uneconomical. Post-tensioning method is widely used in concrete slab for residential and office building in Europe gulf countries and America reason. Post –tensioning slab required less cross-sectional area or thickness as compared to conventional slab and also fast construction for each and every floor with more floor to floor height and durable crack free structure in economical aspect. Overall cost of a building is majorly depending upon floor system, and post-tensioning slab is comparatively more economical as compared to conventional slab with additional advantages as follow

- 1) Post tensioning method save the material to be used in construction as this method increase the permissible limit of material of taking loads and moment in both face like compression as well as tension.
- 2) It more easy to control deflection in post tensioning method as compare to conventional slab.
- 3) Resistance against the fatigue failure is high as compare conventional slab.

- 4) It shows the similar serviceability with good crack resistive strength.
- 5) In case of slightly over load temporary cracks will disappear when load is removed.
- 6) Post tensioning process prevent closer placing of reinforcement bars in cast in situ members and make easy pouring of concrete with assurance of minimum void in presence of proper vibration.
- 7) In Post tensioning method, tendons are usually balance the dead load on the member and reinforcements are provided to balance tensile stresses induced due to only live loads on that member.

With these above advantages, post tensioning member has more often used in construction not only in larger span but reasonably some smaller span also. In this study main advantages of post tensioning slab are more economical because the use of prestressing steel of high tensioned strands. Post tensioning allow to used greater slenderness ratio as compare to conventional slab and because of this section has lesser dead load as compare to conventional slab.

II. SCOPE OF THE STUDY

With the wide range of application and advantages of post tensioning method its use is increase day by day. Post tensioning method give more economical and safe design but in shear and deflection criteria for slab more precautions should be used in construction. In is code there are two method of design of flat slab i. e. load balancing and equivalent frame method; equivalent frame method is more widely used. In load balancing method the 65% to 80% of the dead load is resist by the post tensioning tendon and rather than other load is resist by the reinforcement provided in the RCC slab. These tendons produce some upward deflection so the overall deflection can be reducing. This phenomenon can use to control the deflection in concrete. In present study, comparison between the conventional slab and post tensioning is done by using manual as well as software analysis and design. In design of both slab in economical parameter using the same loading condition and material. Design is done in parameter that is thickness of slab, area of reinforcement and ultimately economic calculation of the slab in per square meter analysis. For the post tensioning slab shear and deflection check is most important check that is very precisely carried out in design of the members.

For the study of in economical aspect of design considering office slab case study for the ground floor and design this slab in all four case with beam, column drop and column head. After the design of the thickness and reinforcement in both direction as well as shear reinforcement and tendon an economical study is done that is represent in graphical from.

III. METHODOLOGY, ANALYSIS AND DESIGN

Frist of all selecting all the parameter of slab required for design, in both conventional and post tensioning. Although the main prestressing steel runs only along the length of slab, transverse steel, either prestressed or not, may be added to take care of shrinkage and to distribution any concentrated load. The design of the tranverse reinforcement in both reinforced and Prestressed structure has always been a controversial issue, although the analysis of the transvers stress produced by concentrated load has been solved both theoretically and experimentally for certain researchers. But in this study the main objective of the study is economic analysis of conventional and post tensioning slab of different types.

The design of post-tensioned slab is completed by 2 ways, load balancing technique and therefore the equivalent frame technique. The load balancing technique introduced by T. Y. Maya Lin is most suitable for the indeterminate structures instead of the determinate structures. During this technique the 60 to 80 % of loading is balanced by the tendons in order that the flexural member won't be subjected to bending stress below a given load conditions. On the opposite hand the equivalent frame technique is wide use for the planning of post-tensioned slabs. Here load leveling technique and equivalent frame technique ar mentioned within the following section.

A. Load-Balancing Technique

The idea of load leveling is introduced for prestressed concrete structures, as per T.Y lin et al [3] a third approach when the elastic stress and therefore the final strength technique of design and analysis. it's 1st applied to easy beams and cantilevers so to continuous beams and rigid frames. This load-balancing technique represents the best approach to prestressed style and analysis, its advantage over the elastic stress and supreme strength strategies isn't important for statically determinate structures. Once addressing statically indeterminate systems together with flat slabs and thin shells, load-balancing technique offers tremendous advantage each in scheming and visualizing. in line with load-balancing technique, prestressing balances a precise portion of the gravity masses in order that flexural members, like slabs, beams, and girders, won't be subjected to bending stresses below a given load condition. So a structure carrying crosswise masses is subjected solely to axial stresses.

B. Equivalent Frame technique of research

The equivalent frame technique of research is understood because the beam technique. This technique of research

utilizes the traditional elastic analysis assumption and models the block or block and columns, as a beam or as a frame, severally. This is often the foremost wide used and applied technique of research for the post-tensioned flat plates. in line with Y. H. Luo, A. Durrani et al [4] the result of vertical of lateral services and style loading on post-tensioned flat plates, warranted or unbonded, could also be analyzed as for rigid frames in accordance with the provisions of the code (IS, ACI etc.). Once the columns are comparatively slender or not stiffly connected to the block, their stiffness could also be neglected and continuous beam analysis applied. As per A.C. Scordelis, Lin, T.Y, and R Itaya et al [5] the instant iatrogenic by prestressing may additionally be determined by the same analysis of a rigid frame or continuous beam, exploitation equivalent load or load leveling idea. but it ought to be unbroken in mind that the distribution of moments owing to masses might dissent significantly from the distribution of moments owing to prestressing. Service masses manufacture terribly pronounced moments peaks at columns, whereas the instant curve made by post-tensioning contains a a lot of light undulating variation of an equivalent type because the connective tissue profile. In line with A .Pan, and J. P. Moehle [6] the results of reversed connective tissue curvature at supports ar typically neglected in applying the load leveling technique to style of flat plates since the reverse curvature has solely a minor influence on the elastic moments (in the order of five to ten percent), and doesn't have an effect on the last word moment capability. it's necessary to think about reverse connective tissue curvature wrongdoing adequately value the shear carried by the tendons within the important section.

IV. RESULT AND DISCUSSION

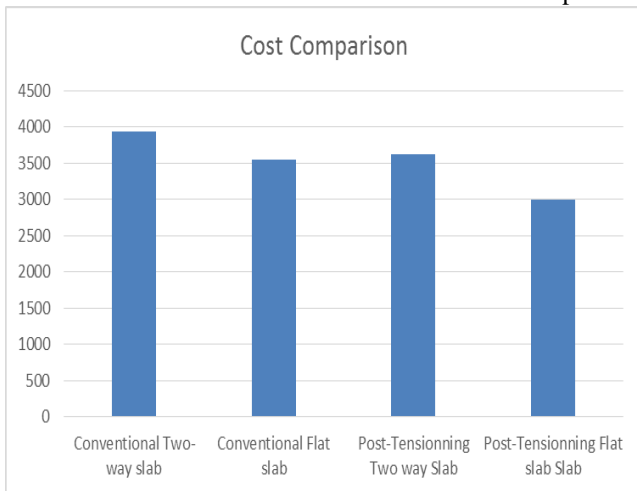
As mentioned in the objective of the study, comparison between the conventional and the post tensioning slab in the same loading and material property condition have been analysed with a powerful tool of the structural design SAP2000. The results obtained from the analysis are represented as above with manual calculations and tabular form of the sap results. In which its seen that the major parameter of design is same in sap2000 and manual calculation, therefore area of the reinforcement required is also same.

Main object of the study is economical aspect with good architectural view as no deviation of rooms with beams and because of the less thickness more floor to floor height achieve. Following table on basis of results quantity and rate as per the market condition.

Cost Evaluation of Slab							
S No.	Type of slab	Total Volume of concrete	Reinforcement Weight	Prestress steel	Rate of M30 concrete	Reinforcement rate	Per meter cost with post tensioning process
1	Conventional Two-way slab	0.210	53.492	----	6000.000	50.000	3935
2	Conventional Flat slab	0.200	46.984	----	6000.000	50.000	3549

3	Post-Tensioning Two way Slab	0.157	20.873	32.760	6000.000	50.000	3626
4	Post-Tensioning Flat slab	0.120	5.403	40.200	6000.000	50.000	3000

Table 1: Comparison of rates for all type of slab



[4] Kamal Padhiar COMPARATIVE PARAMETRIC STUDY FOR POST-TENSION FLAT SLAB AND FLAT SLAB WITH DROP SYSTEM

[5] Jayesh Jayantilal Patel Nirajkumar Dubey Comparison of Analysis Methods of Flat Slab

V. CONCLUSIONS

Based on the results derived from the analysis conducted in the study following major conclusions can be derived:

- 1) As per the economical aspect among conventional and post tensioning floor system the post-tensioned flat slab is the most economical. And the Conventional two-way slab with reinforced concrete beam is most uneconomical span.
- 2) Comparison between the both conventional slab i.e. conventional two-way slab and conventional flat slab, thickness is same but some where the reinforcement in flat slab is more than the conventional two slab but in the same time reinforcement and concrete in supporting beam is saved. So it is clearly shows that flat slab is more economical as compare to two-way slab.
- 3) From each post-tensioned slab in building frame system the post-tensioned flat slab is economical than the post-tensioned slab because of providing additional supporting concrete beams at all around.
- 4) Quantity of reinforcement in case of flat slab either it is conventional or post tensioning is greater than two-way slab because beam itself take a greater part of load and transfer to the support.
- 5) As the above mention in tabular form, quantity of concrete required in case of post-tensioned slab supported on beam is more than post tensioning flat slab.
- 6) There is another comparison on the basis of the height of floor to floor. In case of post tensioning flat slab floor to floor height is 2.88 m and post tensioning two-way slab is 2.4 m.

REFERENCES

- [1] Amr A. Abdelrahman Applications of sustainable post-tensioned concrete slabs
- [2] Kenneth B. Bondy Two-Way Post -Tensioned Slabs with Bonded Tendons
- [3] Shriraj S. Malvade A Review on Seismic Assessment of Post-Tensioned Flat Slab