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Analysis of Post-Tensioned Flat Slabs, Conventional Slabs, and Flat Slabs using Etabs Software

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Abstract: The modern-day submit-tensioning method is especially well-known because of its practicality; so, we will design the maximum safe and economical construction using this method. Every time we are planning the application of this technique, we must include more protective measures for slabs' shear and deflection criteria. The rewards of submit stressing and especially of submit-tensioning are only to be acknowledged in any growing united state of America like our u.s.a. India. An enterprise is created to review the charge viability, durability, first-rate, maintainability of set up-Tensioned diploma piece frames as for built-up stage bite framework inside the examination. The reason for this new exam paper is improvement innovation problems in India and discovery of relevant causes, seriousness, affects to cover changes. Exploration must pave the way for improvement project strategy changes and reduce social and hierarchical adjustments in companies to boost advantage, care for warriors, and manipulate project to limit value and timetable crush. Classic slab, flat slab, and publish-tensioned flat slab comparisons are the topic of this thesis. In these studies, traditional slab, flat slab, and post-tensioned flat slab for G+10 storey structure with unique span length were compared. This slab was analyzed and designed using ETABS.
Keyword: Classic slab, flat slab, tensioned flat slab, economical construction, submit-tensioning

I. INTRODUCTION

Though it was not until much later, the basic idea to apply pre-stressing to concrete originated in the United States in the year 1886. Studies carried out by renowned French engineer Eugene Freyssinet in the 1930s were the only factor that helped this idea come to pass. Pre-strain concrete is concrete with inner compressive stresses purposefully added to balance the tensile stresses generated by outside loads to a specified level. We call this kind of concrete pre-strain concrete. An easier name for pre-compressed concrete is pre-stressed concrete. Over the past 90 years, pre-stressed concrete research has yielded technological and scientific advances. Jacksone de San Francisco patented concrete pavements and artificial stones in 1886. The concept was to introduce pre-stress by tensioning reinforced roads in sleeves. 1888 saw Dohring Germany create the slab and tiny beam. Cracks were avoided using a wire embedded tensioning mechanism within concrete. The first person to suggest the concept of applying it to offset load-induced stresses in 1896 was Austrian engineer Mandlebin. M. Koenen of Germany originally introduced the idea of losses in pre-stress concrete brought on by concrete shortening in 1907. Simultaneously, Steiner of the United States discovered the idea of shrinkage causing major losses in pre-stress concrete.

Dischinger made the first known demonstration of using unbound tendon in pre-stress conditions in 1928. Freynssinet innovated the double-acting jack for stressing high-tensile steel wires and developed vibration methods for high-strength concrete between 1928 and 1933. Both of these advances rank among the most important ones made.

Usually, pre-stress is applied to concrete members by tensioning the tendon—a process made possible using hydraulic jacks. Pre-tensioning—that is, the tensioning processes done before concrete is cast—or post-tensioning—that is, the tensioning processes carried out following concrete casting—are two ways you might do the tensioning operations. We call both of these techniques tensioning procedures. Slabs are designed using these techniques, which also help to construct cracking free tennis courts.

II. METHODOLOGY

A. Examining The Existing Body Of Literature

According to the Indian code, the ETABS software is modeling the conventional slab system in a G+10 multi-story building by supplying section property, material property, and loads.

Modeling the flat slab system in a G+10 multi-story structure using the ETABS program with section property, material property, and loads according to Indian regulations.

Modeling a G+10 multi-story building's post tensioned flat slab system using ETABS and supplying section property, material property, Indian code loads, and post tensioning data.

Analyze and design all three systems.

Compare three systems' results.

B. Modelling

The MODELLING that we are using is a G+10 storey, which means that the height of the base storey is 4 meters, the height of the topmost level is 4.6 meters, and the rest of the intermediate heights are 3.6 meters. The size of the unsymmetrical building is 32.25 meters by 19.55 meters.

C. Material property

Specific grade for R.C.C. and PTare: Concrete beam and column grade is M35. M35 is standard slab concrete. Concrete for flat slabs: M35

M35: Post-tension flat slab concrete.

The design composition of M35 follows Indian code IS 10262:2009.

Material data entered into ETABS to determine the concrete grade

D. Conventional Slab Detail

III. RESULTS AND DISCUSSION

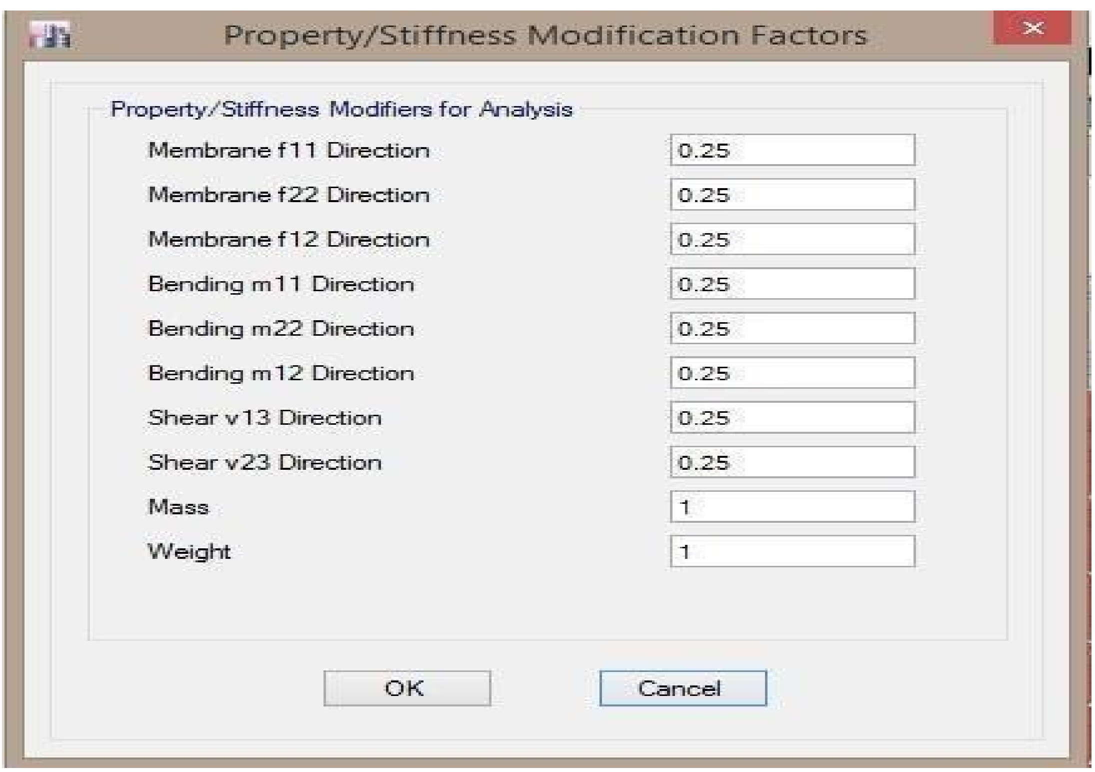

Figure 1 Stiffness of slab

Since conventional and flat slab design and analysis are hard and time-consuming, ETABS software is employed. Post-tensioned flat slabs are also ETABS-designed. To verify the variations in various structural systems, the detail of reinforcement following structural design has been eliminated and compared.

The results compare concrete values in normal, flat, and post-tensioning slabs. Multiple slab models of concrete are compared:

Table 1

COMPARISON OF CONCRETE						
ELEMENT TYPE	MATERIAL	NORMAL SLAB CONCRETE WIEGHT IN KN	PIECES	FLAT SLAB CONCRETE WEIGHT IN KN	FLAT SLAB WITH POST TENSIONING CONCRETE WEIGHT IN KN	PIECES
Column	M35	13730.9441	220	13730.9441	13730.9441	220
Beam	M35	42890.0135	517	2271.3791	2271.3791	22
Wall	M35	14599.8875	88	14599.8875	14599.8875	88
Floor	M35	64545.0171	11	81980.5992	49058.3407	11
	TOTAL :-	135765.8622		112582.8099	79660.5514	

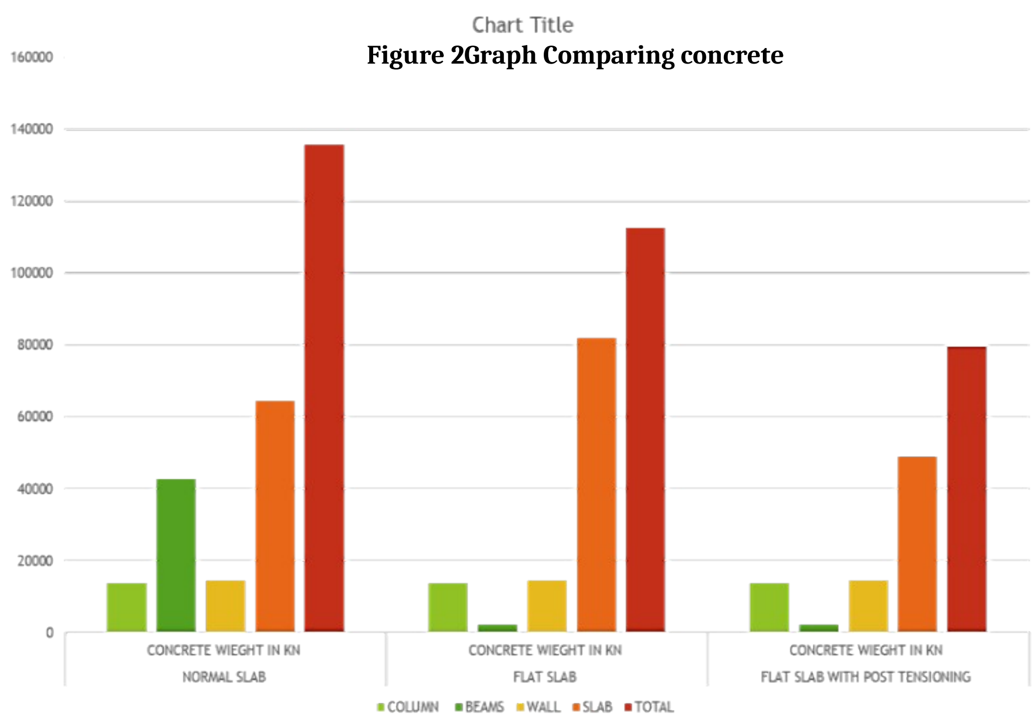

Figure 2Graph Comparing concrete

Table 2 Column Maximum Moment Comparison

Maximum moment in columns kn-m			
Base	Normal Slab	Flat Slab	Flat Slab with PT
1	140.1039	164.4755	205.061
2	479.799	304.600	198.653
3	378.6362	292.492	227.020
4	390.552	289.104	228.568
5	379.697	287.682	288.061
6	375.0168	286.981	227.512
7	370.466	286.396	226.925
8	366.655	285.681	226.185
9	366.357	284.830	224.650
10	355.673	285.225	223.212
11	403.447	288.226	229.226

Table 3Comparison of Story Drift in slabs

	Normal Slab		Flat Slab		P.T. Flat Slab	
	X Orientation(m m)	Y Orientation(mm)	X Orientation(m m)	Y Orientation(m m)	X Orientation(mm)	Y Orientation(mm)
Story11	$5x10^{-5}$	0.000387	$9.3x10^{-5}$	0.000387	0.000123	0.000364
Story10	$3.9x10^{-5}$	0.00034	$8. 4x10^{-5}$	0.00034	$8.8 x10^{-5}$	0.000261
Story9	$3.9x 10^{-5}$	0.00032	$7.7 x10^{-5}$	0.00032	$7.4 x10^{-5}$	0.000232
Story8	$3.7x 10^{-5}$	0.000306	$7.4 x10^{-5}$	0.000306	$7.2 x10^{-5}$	0.000221
Story7	$3.5 x10^{-5}$	0.000284	$6.9 x10^{-5}$	0.000284	$6.8 x10^{-5}$	0.000205
Story6	$3.2 x10^{-5}$	0.000258	$6.3 x10^{-5}$	0.000258	$6.3 x10^{-5}$	0.000185
Story5	$2.9 x10^{-5}$	0.000227	$5.6 x10^{-5}$	0.000227	$5.7 x10^{-5}$	0.00016
Story4	$2.4 x10^{-5}$	0.000189	$4.7 x10^{-5}$	0.000189	$5.3 x10^{-5}$	0.000129
Story3	$1.9 x10^{-5}$	0.000149	$3.8 x10^{-5}$	0.000149	$6.4 x10^{-5}$	0.000115
Story2	$1.5 x10^{-5}$	0.000119	$3.3 x10^{-5}$	0.000119	$7.8 x10^{-5}$	0.000117

The post tensioned flat slab has the lowest minimum moment when compared to the flat slab. The diagram illustrates the value of moment in normal slab, flat slab and post tensioned flat; the highest value of moment in flat slab is 3726.98kN-m while in post tensioned flat slab the value reduces to 3034.86kN-m.

Here in the diagram below the yellow shaded area is the positive bending moment. Furthermore, the red shaded area indicates the negative bending moment in the slab; hence, it is evident that the positive bending is displayed in the fig and implies resistance against it. While the area of steel needed in yellow is above the neutral axis, its required area for resisting the negative bending moment is in below the neutral axis.

IV. CONCLUSION & FUTURE SCOPE

A. Conclusion

We reduced steel and concrete quantities, therefore post-tensioning flat slab was cheaper than flat slab and standard slab. PT slabs use 41% and 29% less concrete than flat slabs.

It found that post-tensioning flat slabs use less steel than normal slabs. Pt slab steel reduction is 85% of standard slab.

Post-tensioned flat slab systems have much higher floor-to-floor height.

Post-tensioned flat slab construction allows for faster formwork removal if a floor takes less time to build.

Post-tensioned flat slabs are cheaper to produce since the floor construction takes less time and labor.

Flat slabs deform more than post-tensioned slabs.

As shown, post-tensioned flat slabs can be used for longer spans, thus future research can investigate slabs with varying thicknesses and column sizes.

The moment of slab in post tension is less than that of a flat slab.

B. Future Scope

All above, we can grasp post tensioning slab is much more inexpensive for longer span rather than normal slab and traditional flat slab and it is extremely useful in longer span. We can increase the span and study the slab with variable thickness and column size in future research.

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