POST-TENSIONED COLUMN UNDER MOMENT CRITICAL CONDITION

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Abstract:.Pre-stressedconcrete structure is different from a conventional reinforced concrete structure due to the application of an initial load on the structure prior to its use. Generally pre-stressing is done where heavy tension in member. This paper deals with pre-stressing to compression member. Presently, in PCI building code requirement for reinforce concrete nor ACI code they have not included criteria for design of pre-stressed concrete column.This paper attempts to summarize theknowledge and approach to the design of pre-stressedconcrete columns. And to find out whether the pre-stressing is better option than conventional method or not.

I*ndexterms:* Compression member, prestressing. Moment critical condition.

I. INTRODUCTION

Pre-stressing is not beneficial for members under axial compression. Compression members like column, piles, are subjected to bending moment and axial forces due to handling. Generally post tensioning is done where member with heavy tension.(beam and slab bottom). For tensioning, the pre-stressing strands are anchored at one end, it will impart compressive force to the concrete to neutralize that tension. Thus avoids cracking. So in some members, like masts, the sections are subjected to compression and bending. Even in axially loaded columns, the external loads are rarely concentric. So result is concrete section is subjected to tension at the maximum distance from the line of action of the longitudinal load. Thus developed cracking can be prevented by pre-stress in the columns. pre-stressing element is in direct contact with concrete all along its length, there will be no "column action" in the member due to pre-stress. When the slenderness ratio exceeds the limit for short column, the compression member will buckle and fail due to instability before reaching the limit state of material failure. Due to posttensioning along the column, a heavy compressive force was introduced in the column, apart from external compressive dead and live loads. Posttensioning is done where there is a heavy lateral moment acting on it. Also posttensioning is done when concrete strength is lowest or vertical force on column is lowest

II. MATERIALS

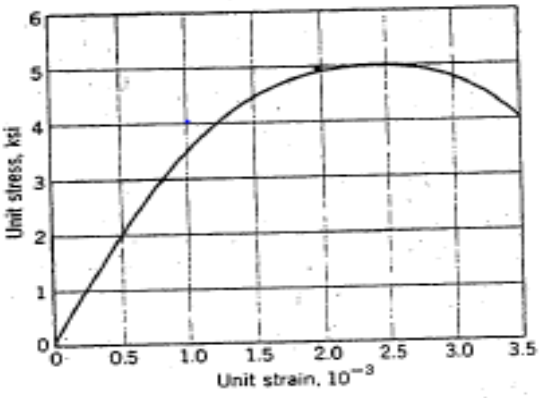
A. Concrete

Stronger concrete is usually required for pre-stressing than for normal reinforced work. Concrete of high compressive strength offers high resistance in tension and shear. 4000 to 5000-psi (28 to 34 N/mm2) strength will generally workout to be the most economic mix for pre-stressed concrete. The cost of 6000-psi (41 N/mm2) concrete averages about 15% higher than normal concrete, while it has 100% higher strength. In India the cost of 41 N/mm2. Concrete averages about 9% higher than normal concrete. [3]

Stress- strain curve for 5000-psi (34 N/mm2) concrete:

In pre-stressed concrete, it is important to know the strains and stresses produced.

It is necessary to estimate the loss of pre-stress in steel and to provide for other effects of concrete shortening.



Typical stress-strain curve for 5000 psi (34 N/mm²) concrete.

Figure1: Stress-train Curve

Steel with high-tensile strength is universal material for producing pre-stress.

The most common method for increasing tensile strength of steel for pre-stressing is by cold-drawing.[3]

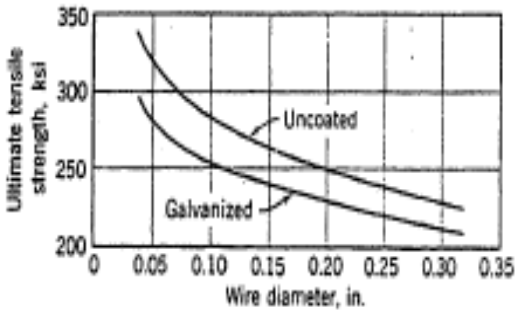


Figure2: variation of wire strength with diameter

There are three forms of steel for pre-stressing. Wires, strands, bars .Tensile strength of wires is given below.[5]

Nominal Diameter	*Tensile Strength, Min*
mm	N/mm²
2·50	2 010
3·00	1 865
4·00	1 715
5·00	1 570
7 00	1 470
8·00	1 375

Unless otherwise specified, the proof stress of the wire shall be not less than 85 percent of the minimum specified tensile strength.[5]

Elongation of steel wire after fracture is given as:

Nominal Diameter	*Elongation, Percent*
mm	*Min*
2·50	2·5
3·00	2·5
4·00	3·0
5·00	4·0
7·00	4·0
8·00	4·0

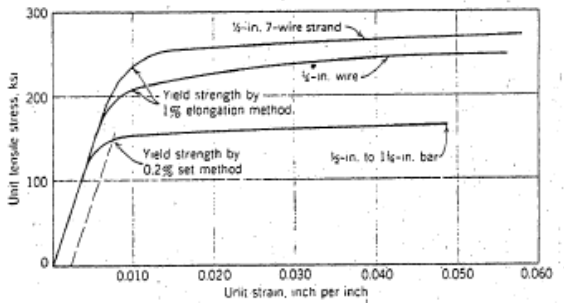


Figure3: Typical stress-strain curve for pre-stressing steel.

III. COLUMN ACTION DUE TO PRE-STRESS

A pre-stressed-concrete compression member is one that carries externalcompressive load. A pre-stressed member is not under column action due to its own pre-stress, but it is subject to column action under an external compressive load.

Consider a column PT column design having some pre-stressing force and moment, and for that section, loading and moment design the RC section and compare the reinforcement.

Comparison of reinforced column design and pre-stressed column design of given data:

Pud =1200 kN

M1= 40kN m and M2 = 100kN m

Ht of column 4m

Calculated column size given data is 230mm x 300 mm. Area of steel required by conventional method = 3588 mm2

In other hand, if we use pre-stressing method to this compression member then there is only 4 numbers of 12.7 mm dia strands required =506.7 mm2 .

Thus column post-tensioning is better option in some cases.

IV. STEEL COLUMN DESIGN

Consider a two columns having height 15m and 6m from top respectively. Canopy is on top of column.6m column is replaced by PT and steel column. So total steel section is designed in ETABS.

Critical combination of wind load and seismic load is applied on steel column by IS 800.

For terrain category 4, class A, considering general industrial building, design wind pressure is calculated which is 781.05 N/m2. From that design moment is calculated.

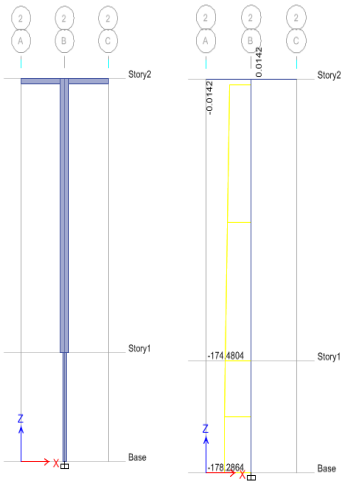


Figure3: Column model on ETABS 15

From software we got the vertical load on 6m height steel column is 174.48 KN and also sections. This column is analyzed. Sections are ISHB 600-2 and ISHB 300-2 for columns. And for flange ISLB 275.

RC column is designed by conventional method for above dimensions. And formation of PM interaction curve is done[5] Required steel for this column section is 12000 mm2.

pre-stressed column design

pre-stressed column is considered as a cantilever beam and can be designed for bending. from that we can calculate number of cables, for axial load provide steel bars.

Number of cables required = 5 nos

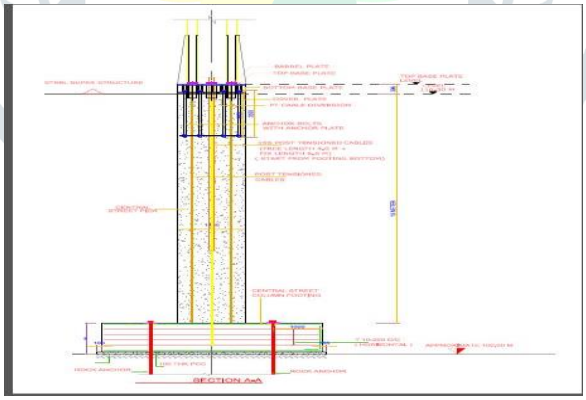


Figure3: Auto Cad model for pre-stressed column

VI CONCLUSION

For moment critical condition section required for Rccolumn much greater than PT column. Steel required for RC column column is very high than PT column.

So that PT column can be used for moment critical column.

VII REFERENCES

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