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Comparative Study Of Bonded & Unbonded Post-Tensioning For Long Span Beam In Building

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Abstract- *During the past century, the use of prestressing has increased tremendously. most important techniques of prestressing is post-tensioning. In post tensioning two different method bonded and unbonded technic. Due to those technic used in tendons/strands, thus overcome the more flexible and fast construction compare to RCC. Bonded and unbonded system in stress, strength, deflection , bending moment and load balancing condition with solve by theoretical and software. System present in graphical and designing data. Both methods applying and solve base on case-study. Also find steel quantity span upto 10-40 meter use for both system, steel tendons in post-tensioning applications, is described. At results of bonded and unbonded system which is best for minimum losses and construction suitability on given by study data.*

Keywords*-Adapt-pt, Bonded rectangular beam, Unbonded rectangular beam, Post-tensioning system, tensile stresses,*

I. INTRODUCTION

Unbonded tendons typically consist of single (mono) strands or threaded bars that remain unbonded to the surrounding concrete throughout their service life - giving them freedom to move locally relative to the structural member. The strands in unbonded mono-strand systems are coated with specially formulated grease with an outer layer of seamless plastic extruded in one continuous operation to provide protection against corrosion. Depending on the application and the level of protection that is needed, the anchorages of unbonded mono-strand systems may also be encapsulated. Light and flexible, unbonded mono-strand can be easily and rapidly installed - providing an economical solution Bonded post-tensioning systems are comprised of tendons from one to multiple strands (multi strand) or bars. For bonded systems the pre-stressing steel is encased in a corrugated metal or plastic duct. After the tendon is stressed, cementitious grout is injected into the duct to bond it to the surrounding concrete. In addition, the grout creates an alkaline environment which provides corrosion protection for the pre-stressing steel.

II. ANALYSIS AND DESIGN FOR LONG SPAN BEAM

The complete analysis and design done in structural analysis tool ADAPT-PT BUILDER and also ETABS 2016 Design of Post-Tensioning and RCC Structural Systems". The results for the different long span beam are given here for different span length. Post tension beam analysis base on bonded and unbonded system. Data using analysis beam are 10m to 20m,also data give bending moment, shear force, deflection, mid top stress, mid bottom stress. All parameter give different between bonded and unbonded beam. Non pt-reinforcement are define by the graphically with long span beam. Size of beam consider 600mmx750mm,this size and must prefer for both system. Also apply dead load, self weight live load consider 5kN/m^2 ,with standard, column size 500mmx500mm. All losses are included by span. In beam up to 7 tendon use. Cable profile in maximum tensile zone. Long span beam Manually calculated help of IS-1343:1980, ACI:318 code. Analysis result give total service load (D.L+L.L+PT)and sustained load(D.L+0.3L.L+P.T) combination. In manual calculation IS-1343:1980 code refer limit state collapse design (ch.22) and ACI-318 code refer ch.18 prestressed concrete design.

III. RESULT AND DISCUSSION

The following are the results from the study. The comparison for bonded and unbonded system of post tensioning is done based on the following parameters.

- Rectangular beam with 10-20m span.
- Extra reinforcement in both system.
- Deflection, Bending Moment, Top-Bottom stress, Shear force,
- Manual calculation base on IS-1343:1980,ACI-318 code including all parameter.

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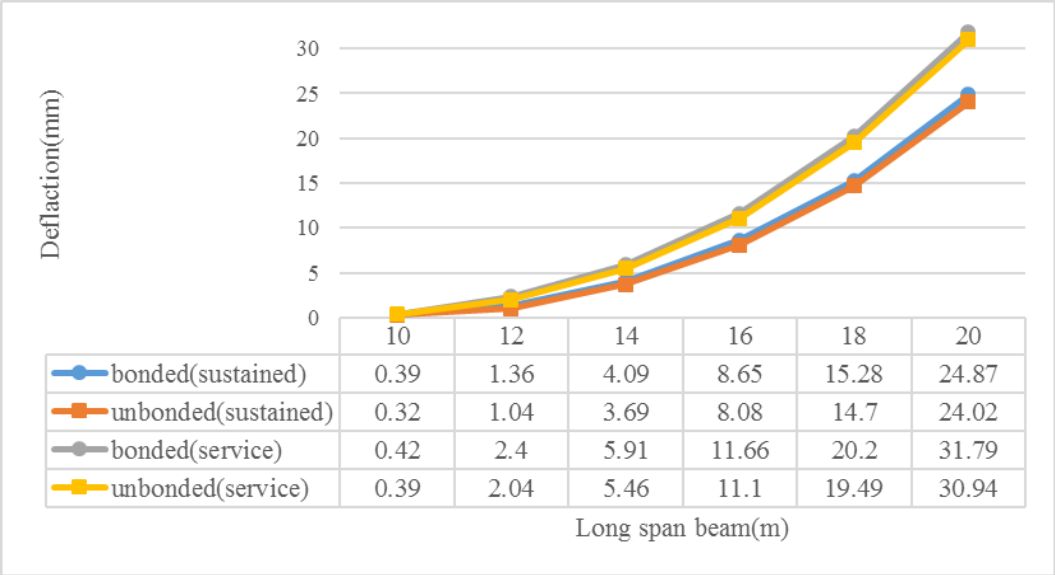

Figure 1. Deflection in long span beam vs Different Span Length

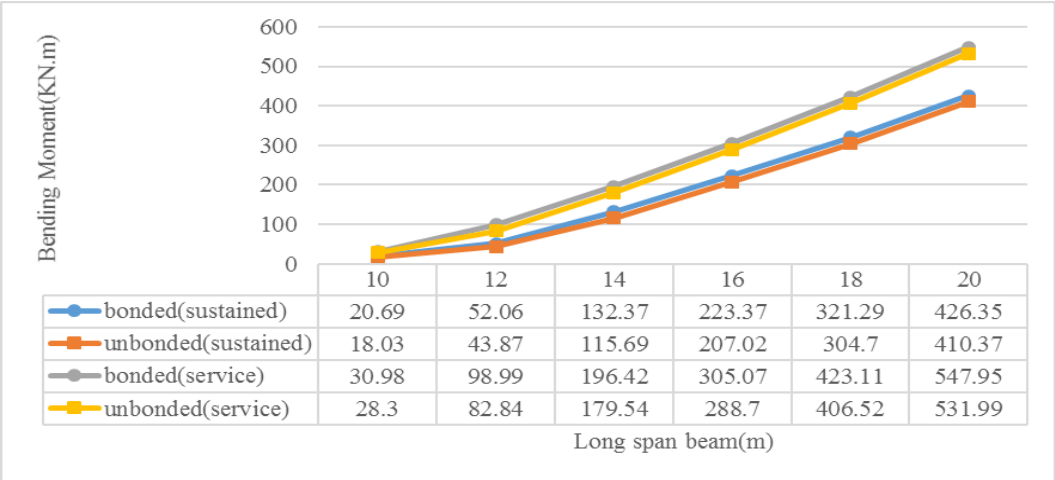

Figure 2. Bending moment in long span beam vs Different Span Length

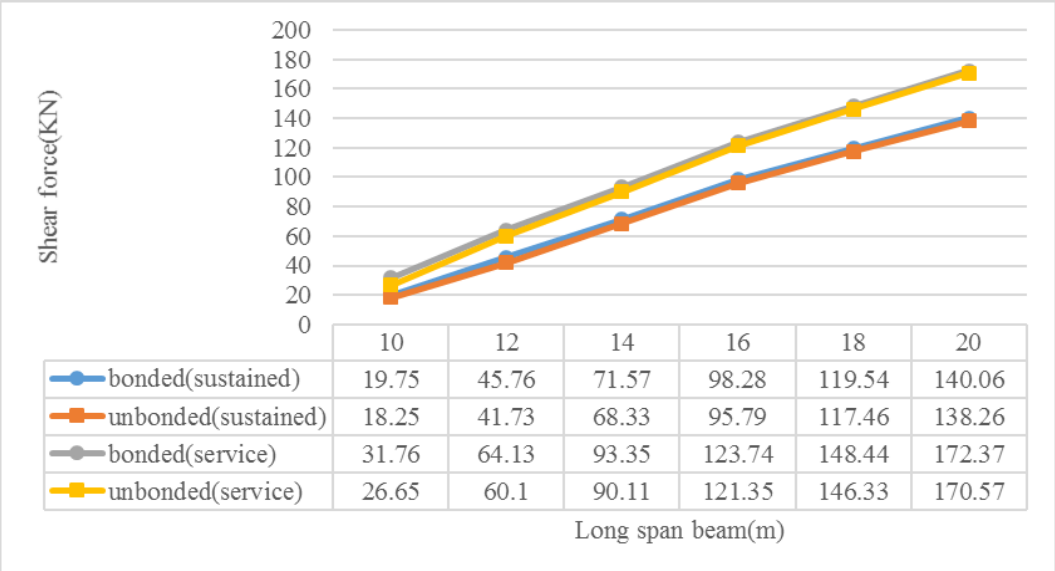

Figure 3. Shear force in long span beam vs Different Span Length

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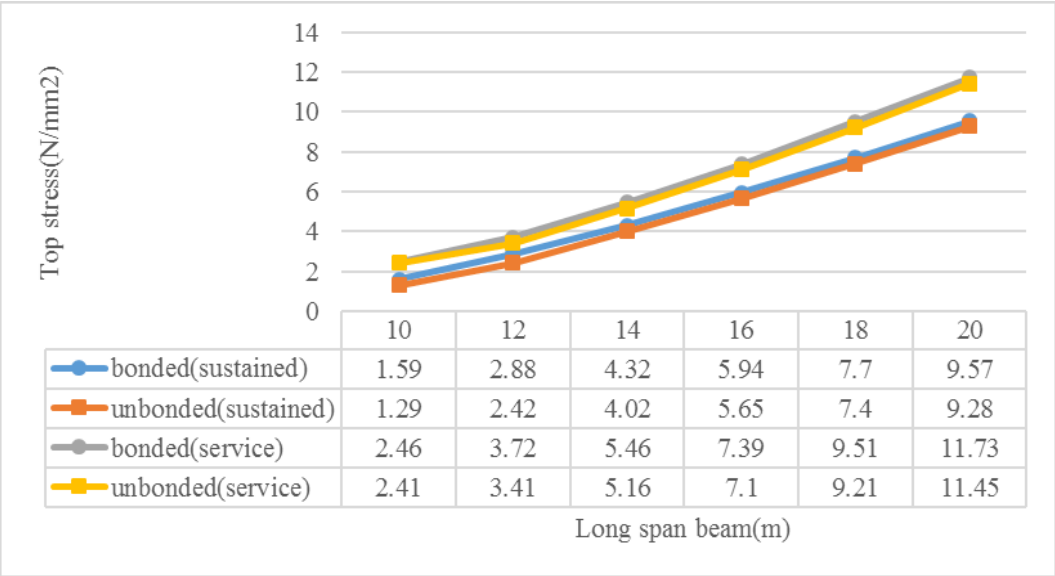

Figure 4. Shear force in long span beam vs Different Span Length

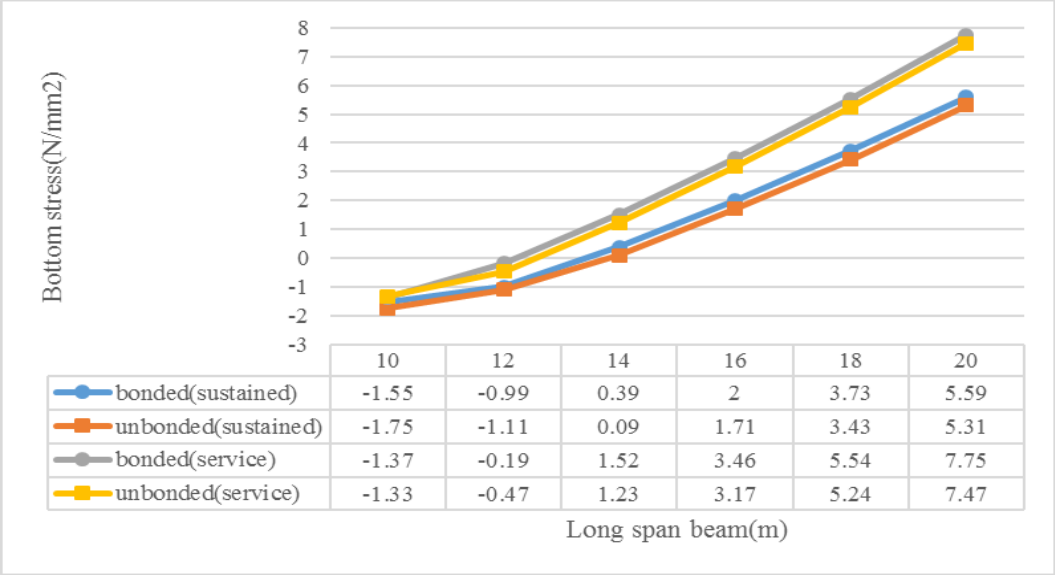

Figure 5. Bottom Stress in long span beam vs Different Span Length

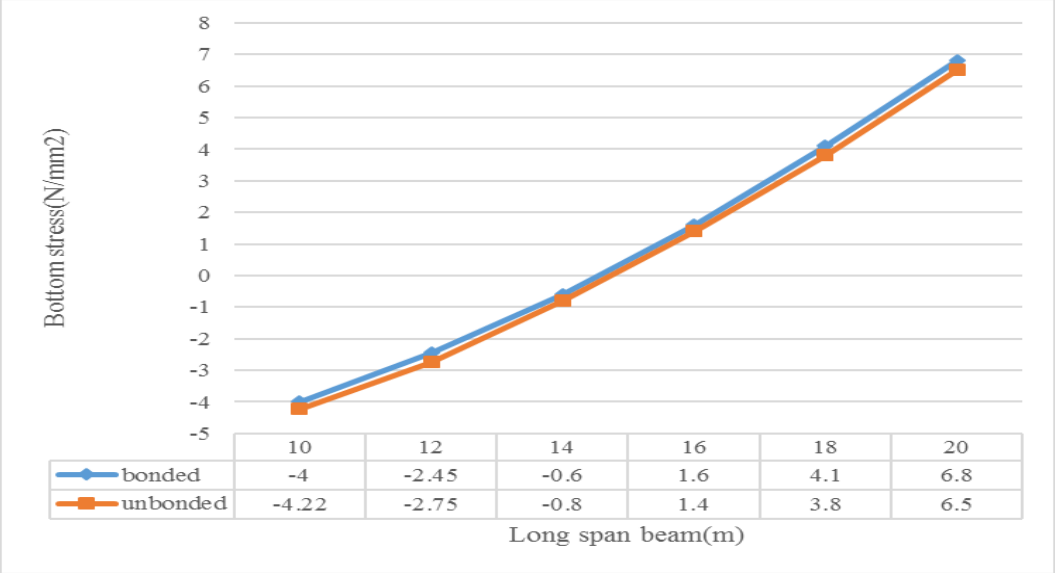

Figure 6. Bottom stress in long span beam vs Different Span Length (manual)

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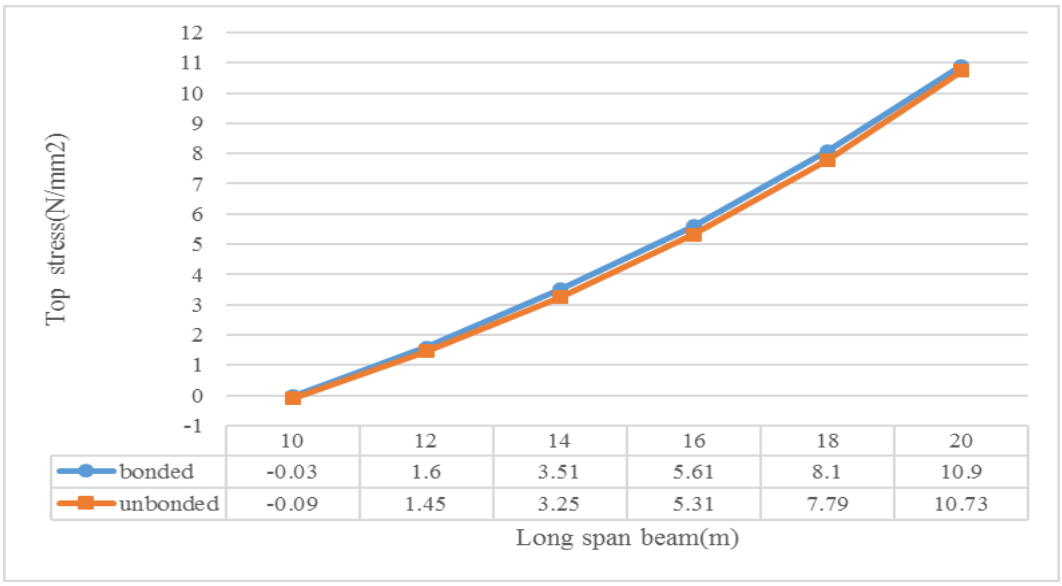

Figure 7.Top stress in long span beam vs Different Span Length(manual)

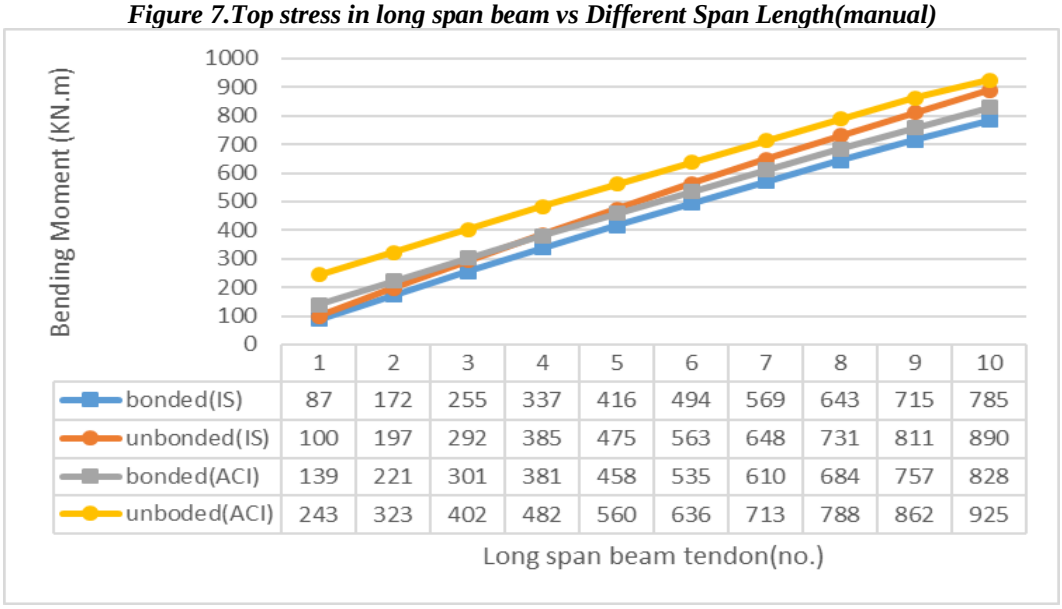

Figure 8. Bending moment rectangular vs long span beam (manual)

The following figure show the beam for both cases for providing Extra reinforcement.

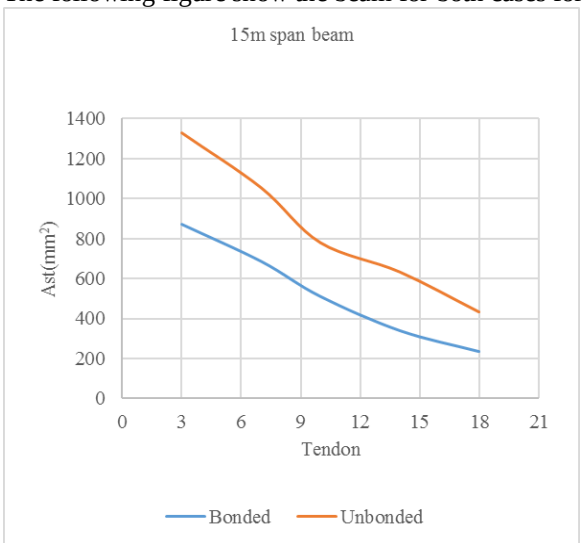

Figure 9. extra reinforcement in 15m long span beam

Figure 10. extra reinforcement in 20m long span beam

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Figure 11. Extra reinforcement in 25m long span beam

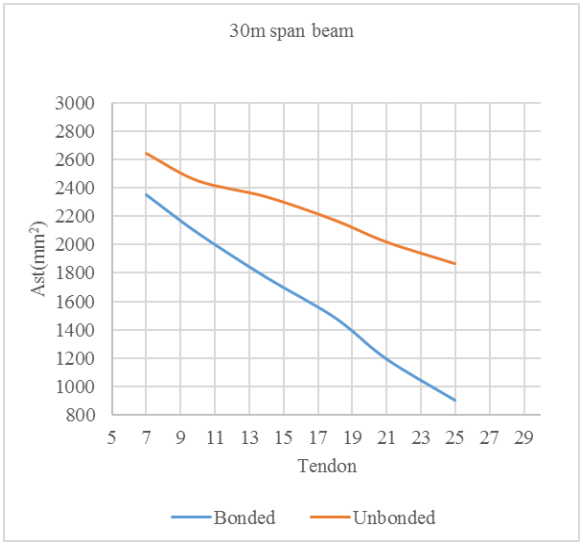

Figure 12. Extra reinforcement in 30m long span beam

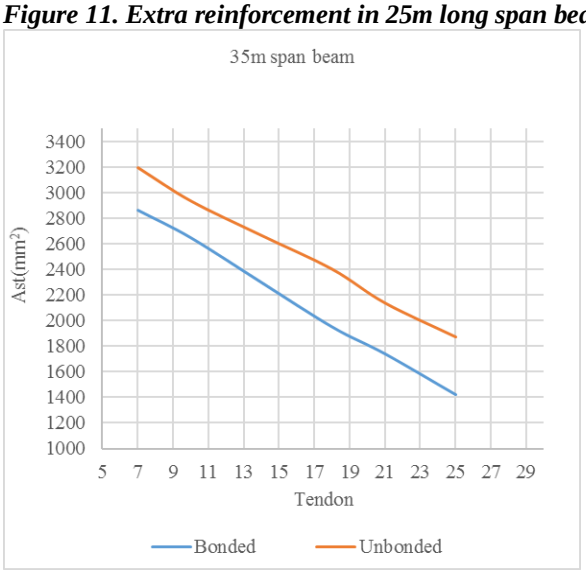

Figure 13. Extra reinforcement in 35m long span beam

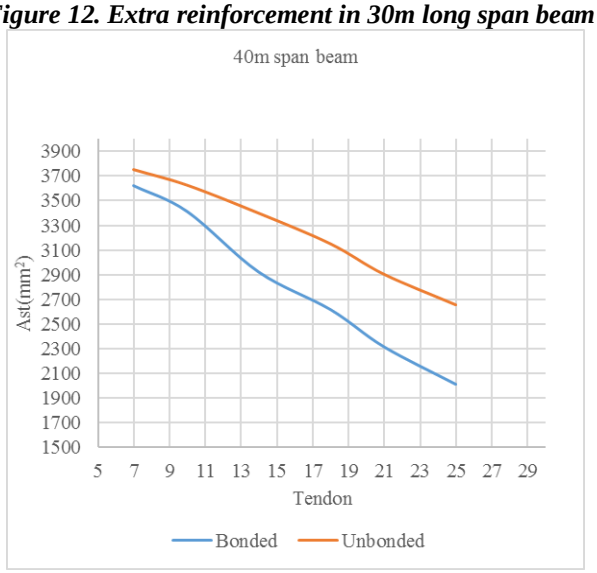

Figure 14. Extra reinforcement in 40m long span beam

Case study of Abrama school hall, surat

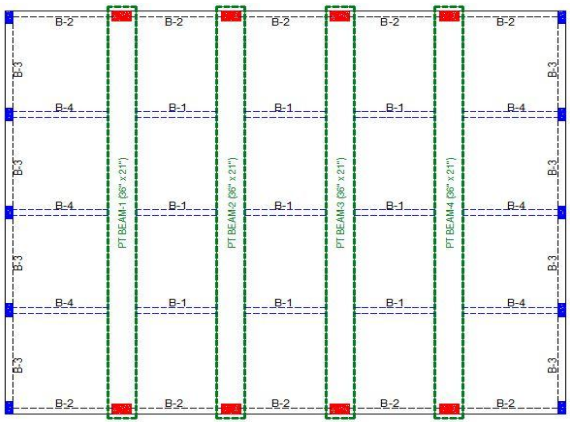

Figure 15. Plan of abrama school hall ,Surat

Above figure shows the plan of the cross Abrama school hall situated at Surat. This is a hall having ground plus two storey building. Building was designed in the post-tensioned long span beam concrete with the 15m length of beam and beam size 900 mm x 525 mm consider. The existing structure has been analyzed based on the post-tensioning system results obtained in the case parametric study of post-tensioned long beam. For the present hall the design had considered same section of beam while for the present study the slab thickness is 6 inches. Beam length in the existing hall is 15m.

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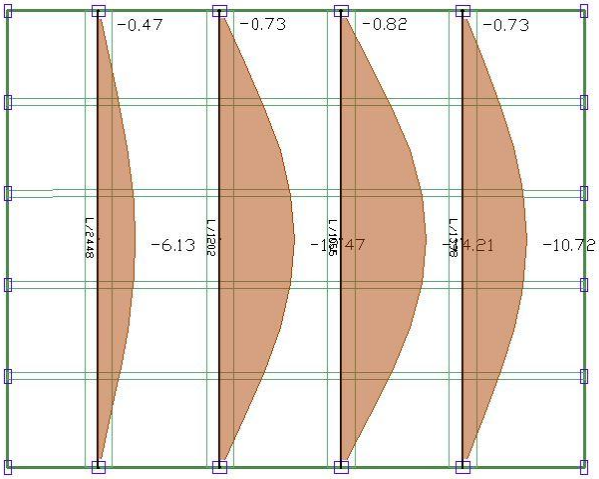

Figure 16. Deflection in bonded beam

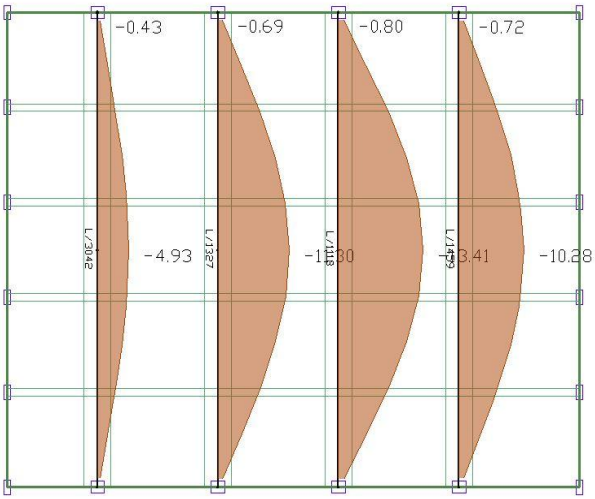

Figure 17. Deflection in unbonded beam

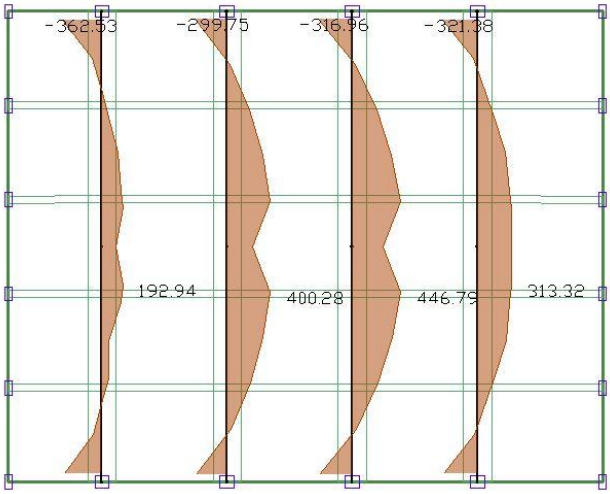

Figure 18. Bending Moment in bonded beam

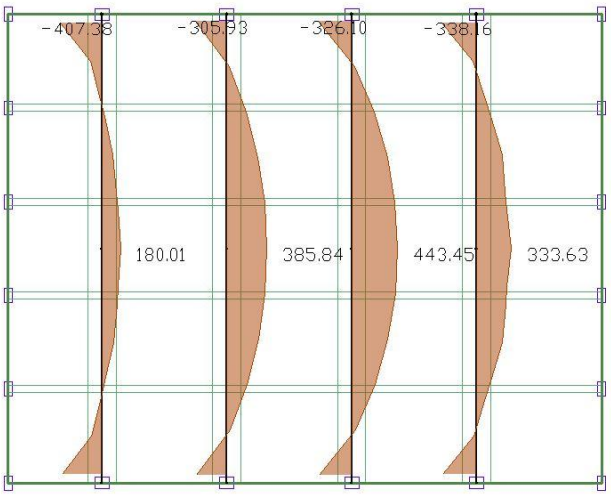

Figure 19. Bending Moment Deflection in unbonded beam

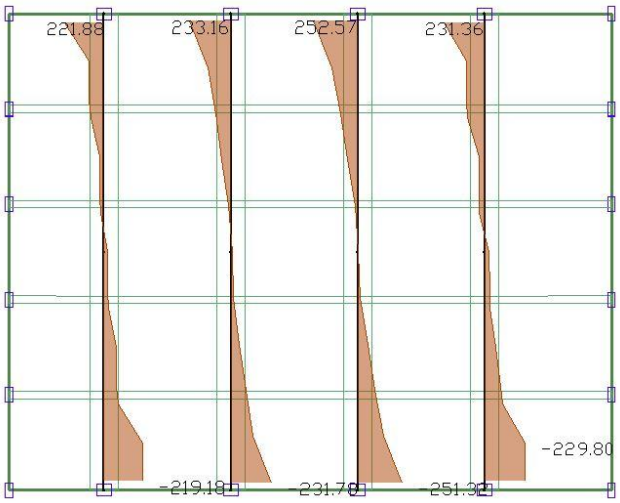

Figure 20.Shear force Moment in bonded beam

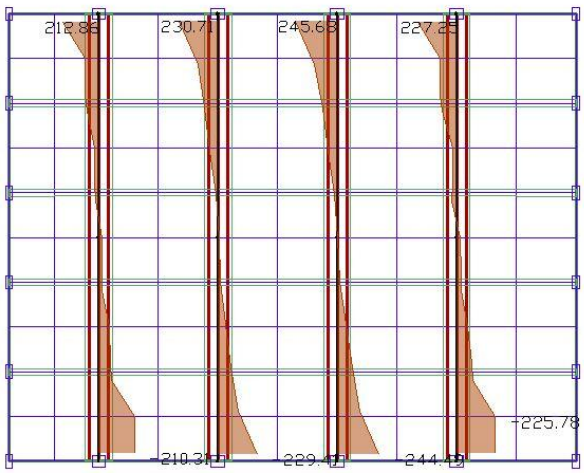

Figure 21. Shear force Deflection in unbonded beam

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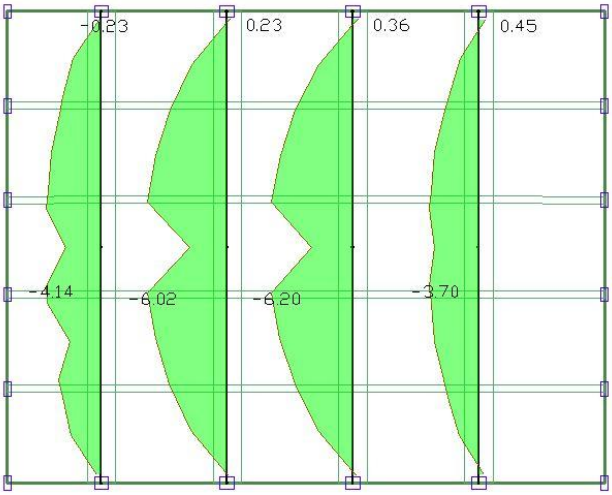

Figure 22. Top Stress Moment in bonded beam

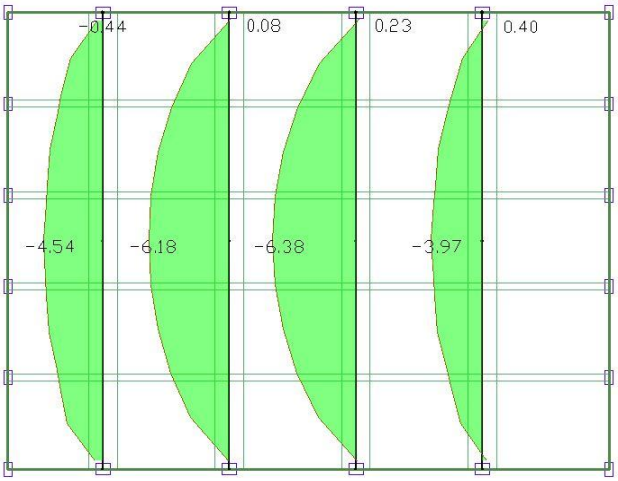

Figure 23. Top Stress Deflection in unbonded beam

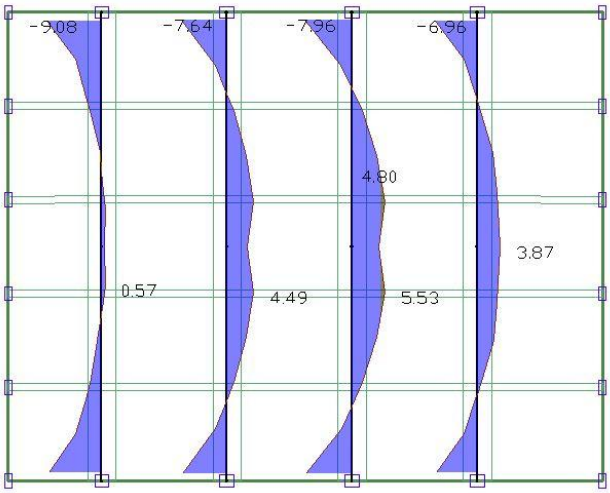

Figure 24. Bottom Stress Moment in bonded beam

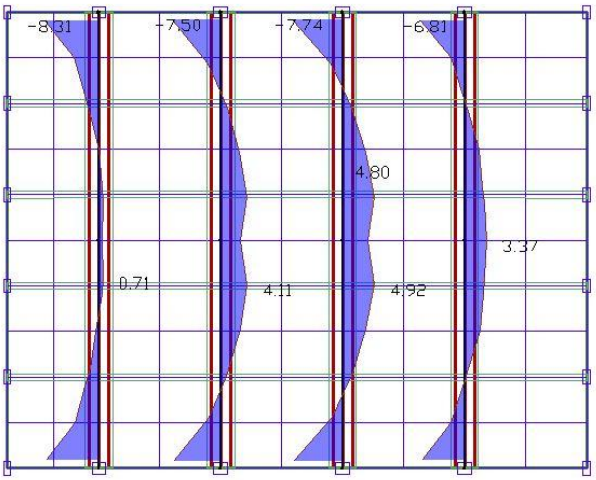

Figure 25. Botoom Stress Deflection in unbonded beam

IV. CONCLUSION

In the present study an attempt was made to compare the different post tensioned systems with different span. The following conclusion has been derived based on comparative study done for the two methods of post tensioning different type of geometries having different span length.

1. Bonded and Unbonded stressed and easily available from ACI code comparison with IS code. ACI code gives provision for design of two system bonded and unbonded system.

- There is 2 to 10% reduction in deflection of unbonded beam in comparison with bonded beam.
- There is 0.5 to 2% reduction in Shear of unbonded beam in comparison with bonded beam.
- There is 1 to 5% reduction in top stress of unbonded beam in comparison with bonded beam.
- There is 2 to 5% reduction in bottom stress of unbonded beam in comparison with bonded beam.
- There is 1 to 3% reduction in bending moment of unbonded beam in comparison with bonded beam. But upto 20m long span beam bending moment good result in bonded beam.

2. From comparison of bonded and unbonded beam it is observed that 5 to 20% reduction in depth of unbonded beam.
3. For 5 to 20m span unbonded beam is better and for over 20m span bonded beam shows good results.
4. From the table it is observed that bending moment value is greater for manually designed rectangular and tee beam as per ACI 318 in comparison with IS code.
5. On case study In bonded beam some extra length provided for anchoring system. But in unbonded beam anchoring provided on transverse direction beam.
6. It is also observed that initial losses in unbonded beam. But long term loss in bonded beam.

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