Applicability of Bonded and Un-bonded PT System in Shear Walls of Multi-Storey Building - A Review

[1]Mohnish Lad, [2]Yati R. Tank, [3]Dr. Kamalsinh M. Padhiar
[1]Student, [2]Assistant Professor, [3]Assistant Professor
[1]Chhotubhai Gopalbhai Patel Institute of Technology,Bardoli,
[2]Chhotubhai Gopalbhai Patel Institute of Technology,Bardoli,
[3]Bhagwan Mahavir College of Engineering and Tech., Surat

Abstract - **During the past century the use of post tensioning has increased greatly. The design should not reduce or eliminate sufficient shrinkage cracking prior to use of the post-tensioning process. The structure has a lot of system joints. Cracks that didn't hold on firmly. It has several benefits over regular reinforced steel (rebar) after it has been used. It can reduce fracturing of the shrinkage, thereby allowing less joints. Cracks are fixed together closely and also permitted to weaken the slabs and other structural components. In post tensioning technique, there are two different method like bonded & un-bonded. This system is cheap compare to R.C.C. The shear wall using with PT system that provided the more strength, stability and hardening to the structural members for the lateral load like wind, seismic load. This paper attempts to review the studies related to post tensioning methods with shear wall for different location for multi-storey building, preliminary focusing on studied published within the last decade. The present study is categorized in to following parts, i.e. the papers related to (a) Related to multi-storey building with shear wall, (b) Related to pre-stress concrete structure (Bonded and un-bonded system.) and (c) Related to unit of multi-storey buildings with shear wall and pre-stress concrete structure. It has been concluded that, In each of the three groups, a substantial amount of research was carried out. The principle objective of this review is to relate the report of each of three group by way of a detailed and critical analysis.**

keywords - **Bonded System, Un-bonded System, ADAPT-PT, Prestressed concrete, Shear wall, Multi-storey Building, Post-tensioning system.**

I. INTRODUCTION

The application of compression strength to the concrete at some point after casting is the post tensioning process. The toughness of the cement refers to the fact that the steel tendons flow through the tubes cast into the concrete and the strained tendons are tightened up using hydraulic anchors.. The concrete becomes more stress able.

UNBONDED TENDONS: Single (mono) strings or threaded bars that remain unbound to the surrounding concrete for the remainder of the service life are typically un-bonded, and give them the freedom to travel locally in relation to the structural component. The strands in un-bonded mono strand systems are coated with a specially formulated grade with a seamless plastic outer layer, extruded in a single permanent operation for corrosion protection. The anchors of un-bonded mono strand systems can also be encapsulated, depending on the specification and the appropriate level of protection. In the new construction of high layers, latches, pillars, and transition girders, joists, shear walls, and pad floors, unbundled mono strand structures generally are used. The un-bonded, lightweight and durable mono beam can be mounted easily and quickly a cost-effective alternative.

BONDED TENDONS: The bonded post-tension systems consist of tendons of one to multiple strands or bars. The pre-stressing steel is embedded in a metallic or plastic canal for bonded systems. Following the stress of the tendon, cement grout is injected into the duct to connect it to the surrounding concrete. In addition, the grout creates an alkaline environment which protects the pre-stressing steel against corrosion. An advanced duct system, PT-Plus TM, encloses a corrugated and plastic connector system with the pre-tensile steel. Coupled post tension systems may range in one tendon from one beach to 55 or more bearings while local area reinforcement, bearing plates, anchor head, wedges or grout cap is included in the anchor assembly. Bonded multi-strand systems can and have been applied successfully to commercial buildings, even though they are extensively used in new building bridges and transport structures. When used in large structures such as bars and transmission girders, these multi-strand systems offer design advantages such as higher range lengths and load-carrying power.

II. REVIEW OF LITERATURE

The tensioning mechanism blends cement or other composite components with steel strings or cables of high strength, also referred to as tendons. Plan includes buildings with office and apartments, car parks, slabs, bridge, sports stadium, tanks of water, stone and soil anchors. Post-voltage plan. Some authors already discussed about the post-tensioning, Load balancing concept for the post- tensioning buildings, shear and deflection criteria for the post tensioning buildings.

- **GENRAL REVIEW**

Attila Puskas et. al. [1] analyzed structural design in ADAPT-PT Builder software The writer estimated that, a decrease in the product quantity can be 10-20 percent for a minimum length of 7 m and a minimum lived load of 3 kN / m2. This saving is directly affecting on the distribution bar & shape of structure. Min Sook Kim et. al. [2] presented an increased mechanical efficiency joint

for the precast section and concluded the load resistance capacity of shear key & post tension applied SGSP joint was around 86.4% of monolithic girder. P. Kalpana et. al. (2016)[8] analyze study for the structural shear wall with different height for many models & Zone 3 and 5 that take load combination take as pr IS:1893(PART-1)-2002 and concluded that that the displacement less in building with shear wall compare to without shear wall building and the node displacement are more for zone 5 compare zone 3. Thapa Axay et. al. (2017)[11] compared the dynamic response of frame structure with & without shear wall and make different model like G+5, G+10, G+15 with the different height with & without shear wall in STAAD Pro and analysis by static method & response spectrum method at last gave result The bar frame & shear wall frame displacement would be increase with the increase height. In displacement big variation in G+5 floor was comparatively less than that of G+15 floor.

- **RELATED TO PRE-STRESS CONCRETE STRUCTURE (BONDED AND UN-BONDED SYSTEM).**

Dobaria Nishant et. al. (2017)[6] carried out two different method like bonded & unbonded post-tensioning system for long span T-beam. In this paper author used rectangular T-beam 10m to 20m span & given extra reinforcement for both systems. This is a main parameter of this paper. Author found stress, strength deflection, B.M & load balancing condition by using structural analysis tool E-tabs& ADAPT PT builder software base & also find this problem as a theoretical based form IS:1343-1980 & ACI code. At last it has been resulted that the two system compared that 5 to 20 % reduction in depth of un-bonded beam & initial losses in un-bonded beam. Costs of labour are more and for bonded beam the volume of steel is less and for un-bonded beam, vice versa. For casting the un-bonded beam, the time needed is reduced. Tables reveal that for manually built T-beams the bending moment value is higher, according to ACI, as opposed to IS 1343-1980. The deflection of the unbundled beam is decreased by 2-5-fold relative to bonded beam.

Shanmathi Sridhar et. al. (2019)[10] investigated the four single-point monotonous rectangular PT beams with 2-point loading state. Shridhar Shanmathi et, al. worked on load, Deflation behavior, stress - strain behavior and also work on pattern of crack used RAPT Software base and testing on hydraulic machine of 1000 kN Capacity with Simply Supported condition. In this is observation Author observe High PT force with Prestressed concrete Beam take maximum Load to compare other Beam like two points loading & single point loading system.

Padhiar Kamal et. al.(2010)[7] studied had considered for the current study as flat plate and flat slab with drop panel on the two different floor post-tensioning system. Author changing the concrete grade from M35 to M50 with changing concrete grade, the punching shear ratio, the mid span factor and also finding out the quality after tension. The author also found the flat plate with a maximum length of 8 m and a flat plate with a maximum length of the drop panel 13 m. Padhiar Kamal et. al. The aim was to reduce the quantity of non-pt steel to 5-10 percent by rising the concrete scale.

- **RELATED TO PRE-STRESS CONCRETE STRUCTURE (BONDED AND UN-BONDED SYSTEM).**

Mohammed Kohail et. al. (2018) [5] studied Full scale actions DSIM shear wall below cyclical in the application of victimization mounting & performance Post stress instead of grout and ring. The developer created nine masonry shear walls, including three completely different type of masonry blocks, such as regular, azar and spar lock. The samples were subsequently tested for loss under reserved lateral cyclic fill. Writer found deformity reaction mode, failure mode, ductility, wall stiffness etc. authors found. Eventually, it was shown the identical behavior of the azar and the conventional masonry in each process, such as strengthening and the atomic number of 78 samples. The absolutely grouted atomic number 78 DSIM azar walls gave constant most drift displacement of malleability and lateral load capability compare to traditional reinforcement absolutely grouted wall, it had been additionally mentioned that the rise the atomic number 78 stress level improved the lateral load capability & effective stiffness.

T. Nagae et. al. [12] 2D & 3D test results similar. The author has been informated by means of an e-defense shaking facility of a simulation test for a full-scale four-storey building and a prestressed concrete building. Two P-T framework in one direction and two unbonded P-T precast walls in another were composed by the earthquake force resistive system of the test building. The researcher then pointed out that several earthquake soil motions ranging from serviceability to near-collapse was created. The sample weighed 5592 kN in total Rising floor weighted 996 kN to the ceiling, the third floor 813 kN, the second floor 806 kN, and the third floor 804 kN. T. Nagae et. al. concluded that the main parameter like vibration period, stiffness, maximum base shear, maximum drift point, hysteresis shape is adequate simulated using the analysis this model also while further improvement many be desirable. These model approach capable of generating to use the details of unbonded P-T & precast structural wall system

- **RELATED TO MULTI-STOREY BUILDING WITH SHEAR WALL**

Deshpande Medini et. al. **[3]** provided shear wall at various location in building frame by changing percentage length of shear wall & also changing number of storey. Author put shear wall equally in x & y direction. Also placed x or y direction individually. Author worked on parametric study like roof displacement, storey drift & time period. After this study, the result concluded that the provision shear wall in one direction has resisted more lateral force in that direction but the weakness is observed in other direction. So, the shear wall is recommended in both direction for the safety & stability.

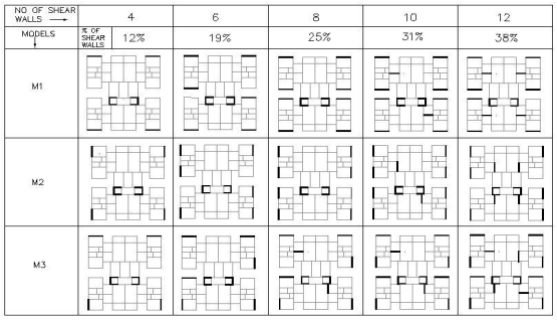

Fig. 1. Models with different number and location of shear walls

III. CONCLUDING REMARK

After the detailed review of categorized papers, following remarks can be concluded,

- High PT force with Prestressed concrete slab takes maximum load as compared to other slab systems i.e. two points loading (TPL) system & single point loading (SPL) system.
- In post tensioning system, if the building span is more than 7m, material saving of 10% to 20% can be achieved and this savings are directly affecting on the distribution bar & shape of structure.
- Un-bonded beam is good for 5 to 20 m as compared Bonded beam.
- The intense bending power and tendon pressure is strong precision below 5% and bound tendons are displaced.
- The bar frame model gave higher displacement compare to shear wall frame model and the lateral stiffness is increase in shear wall frame as compared to bar frame model for zone V.
- There is increment noted in bar frame & shear wall frame displacement with the increase in height.
- The displacement is less in building with shear wall as compare to without shear wall building and the node displacement are more for zone V compare to zone III.
- In PT system, as the PT stress level increases, the lateral load capacity & effective stiffness is observed to be improved.

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