



ADVANTAGES AND BENEFITS OF UNBONDED POST-TENSIONING

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Unbonded post-tensioning is an efficient structural system that has successfully been used worldwide in construction. There are a wide range of advantages and benefits for large as well as small projects. The system's efficiency begins with the use of high-strength materials that allow for a more effective use of materials and construction techniques. The ability of unbonded tendons to resist applied loads by varying the force and location of the prestressing steel within the concrete cross section provides the designer with added flexibility. The combination of high-strength prestressing steel and concrete allows structural members to resist compressive and tensile forces created by various loads.

Unbonded post-tensioning has made it possible for owners, designers, and builders to see their projects come to life with:

- Exceptional design flexibility and aesthetically pleasing architecture.
- Superior strength, durability, and fire resistance.
- Fast and efficient construction schedules.
- Long design lives with low maintenance requirements.

The construction benefits that unbonded post-tensioning provides in structures include:

- Significant reduction of concrete and reinforcing steel quantities.
- Superior structural integrity provided by continuous framing and tendon continuity.
- Permanent compressive forces result in greater control of cracks, deflection, and camber.
- Thinner structural members allow lower structure heights, reduced foundation loads, and longer spans when compared with conventionally reinforced structures.
- Monolithic connections between slabs, beams, and columns eliminate troublesome joints between elements.
- Profiled tendons result in balanced gravity loads, significantly reducing total deflections.
- Post-tensioning reduces overall building mass, which is important in zones of high seismicity.

Unbonded post-tensioning has found widespread use and effectiveness in a variety of structure types, including:

- Slabs-on-Ground: residential slab-on-ground foundations, light industrial foundations, heavy industrial foundations, mat foundations, sport courts, and pavements.
- Buildings: office buildings, condominiums/residential buildings, hotels, mixed-use, theaters, shopping centers/malls, schools, casinos, libraries, manufacturing plants, research/academic institutions, and governmental.
- Parking Structures: commercial, airport, underground parking structures, and mixed-use.
- Storage Structures: water storage tanks (floors, walls, roof), clarifiers, digesters, and silos.
- Grandstands and Stadiums
- Staged Construction: transfer plates, transfer podiums, transfer slabs, and transfer girders.
- Tension Members: tension rings and tie-beams.

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Construction advantages of unbonded post-tensioned structures compared to steel, non-prestressed concrete, and precast construction include:

- **Faster Floor Construction Cycle:** use of standard design details for post-tensioning elements, minimum congestion of prestressed and non-prestressed reinforcement, use of high-strength concrete, and earlier stripping of formwork after tendon stressing can also significantly reduce the floor construction cycle.
- **Lower Floor Weight:** greater span-to-depth ratios are allowed for post-tensioned members as compared to non-prestressed members resulting in a lighter structure.
- **Lower Floor-to-Floor Height:** greater span-to-depth ratios are allowed for post-tensioned members as compared to non-prestressed members resulting in a reduction in floor height while maintaining required headroom.
- **Reduced Exterior Shell Costs:** by reducing the individual floor-to-floor heights the overall building height is decreased thus the costs for the exterior building treatment is reduced.
- **Larger Spans between Columns:** the reduced weight and structural integrity of a post-tensioned member allows for greater spans between support points.
- **Reduced Foundations:** the reduced weight of the post-tensioned structure allows the reduction in the size of the foundations.
- **Increase in Flexibility for Space Planning:** increasing the column spacing and the use of flat soffits allows for greater flexibility of space for tenants and mechanical and electrical services.

Unbonded post-tensioning is used in all areas of construction, such as new construction, repair, rehabilitation, and retrofit. Project applications range from Residential Slab-on-Ground to Parking Structures to High-rise Condominiums. Structural members are primarily slabs, beams, joists, and girders; however, unbonded tendons have also been used in walls and columns.

Cast-in-place, unbonded post-tensioned structures are the construction technique of choice when owners, designers, and builders look to minimize initial and life-cycle costs while maintaining structural integrity and durability.

References

1. PTI, "Post-Tensioning Manual, 6th Edition," Post-Tensioning Institute, Phoenix, AZ, 2006.
2. Franz A. Zahn and Hans R. Ganz, "VSL Report Series 4.1, Post-Tensioning in Buildings," VSL International, Berne, Switzerland, June 1992.
3. Bijan O. Aalami and Allan Bommer, "Design Fundamentals of Post-Tensioned Concrete Floors," Post-Tensioning Institute, Phoenix, AZ, April 1999.
4. Bijan O. Aalami, "Unbonded and Bonded Post-Tensioning Systems in Building Construction, *A Design and Performance Review*," Post-Tensioning Institute, Phoenix, AZ, Technical Note, Issue 5, September 1994.