Post-Tension Slab Design for Residential Sites with Highly Reactive Soils

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Intrax are actively involved in the research and development of new engineering practices and methodologies. In partnership with our clients we have begun testing new designs that provide cost effective solutions to projects on sites with highly reactive soils. One promising design that has seen wide spread adoption overseas is the post-tension slab. Intrax Executive Director Danny Borzillo, Structural Engineer Richard Hu and Graduate Engineer Joseph Cullia provide a brief overview of the technology and a discussion of its strengths and weaknesses.

Executive Summary

1. Sites with highly reactive soils can add significantly to the cost and time involved in construction

2. Post-tension slabs involve replacing the reinforcing steel mesh and bars in a conventional raft slab with steel high strength post-tensioned tendons.

3. This method introduced a higher overall stiffness to the slab, reducing the depth and width needed for stiffening ribs, as well as reducing the amount of concrete needed.

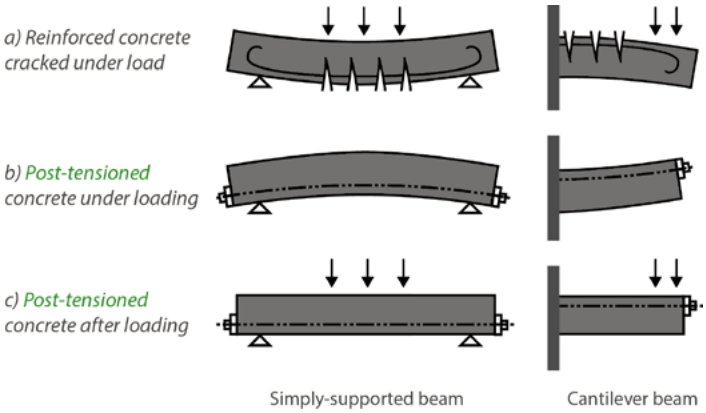
4. These designs are widely used in the United States for highly reactive sites due to quicker turnaround and cost savings resulting from reduced excavation, steel and concrete.

5. Current adoption in Australia is hindered by lack of industry knowledge, increasing risk for builders.

6. Forward thinking builders that adopt the use of post-tension slabs will be able to offer more competitive prices and time frames compared to their lagging competitors.

Post-Tension slabs have been around since the 1960's. This method of slab construction can be found in the American Post-Tensioning Institute (PTI) standard first published in 1980. A post-tensioned slab is identical to a conventional raft slab in terms of its slab footing layout. The major difference between them is the steel reinforcing mesh and bars are replaced with steel high-strength post-tensioned tendons. Steel tendons are installed as specified by the engineer with the formwork before concrete is poured around them. After the initial curing of the concrete these tendons are then stressed with a hydraulic jack. High compressive force is applied to the slab once the tendons are fully tensioned and this introduces an initial stiffness to the overall system. Due to this, the stiffening ribs usually have less depth and width, reducing the amount of concrete needed for the same soil conditions.

Post-tensioned slab on ground have been used for low rise residential housing in America for over 25 years. It is extensively used in Texas and some parts of California, which are well known areas for expansive clay soils. However it is not yet commonly used in Australia. These designs have significant posi-



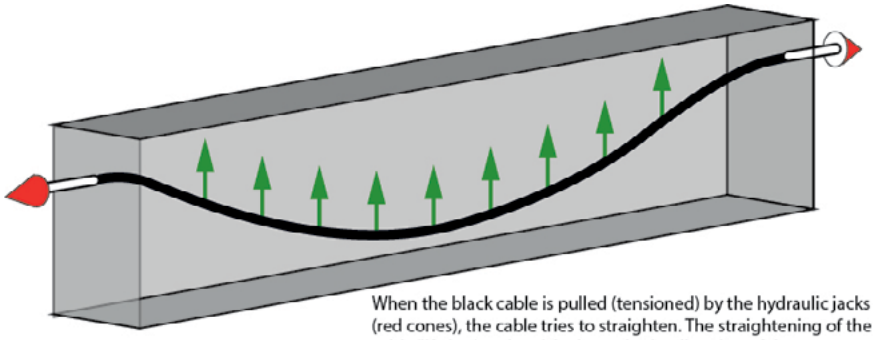
tives that explain their widespread use in America. There is less concrete and steel needed for the same structural capacity as the slab stiffness is increased, improving resistance against bending caused by soil movements. This saves money in excavation, steel and concrete use, reducing costs. Further, it reduces cracking and keeps any cracks that might form tight,

"There is less concrete and steel needed for the same structural capacity"

preventing entry of insects and reducing possible water penetration, which can damage flooring and cause mould problems and other structural complications. Greater maximum spacing of tendons compared to normal steel reinforcement results in faster installation of steel work and a more workable platform for the concreter.

However, whilst post-tension slabs have the potential to realise significant time and costs savings on the correct site, most builders and concreters in Australia at present lack the adequate knowledge, skills and experience with this type of system. This has the potential to add to construction costs due to the risk and uncertainty involved in the process during the initial learning curve. In addition, the ductility of post-tensioned slab on ground is a concern when compared to a conventional raft slab because of the introduction of a tendon. The presence of the tendon means the slab is far stiffer and does not 'bend' under duress like a conventional slab might. Whilst this means the slab is better equipped for highly reactive sites, to avoid any chance of failure, the engineer must be cautious in the design and layout of the slab. Lastly, repairs and modifications to post-tension slabs require specific scanning of the slab, experience and expertise, which may add to potential costs.

Overall, well-designed post-tensioned slabs have the potential to save costs for builders and provide a better solution to construction on highly reactive sites. However, short term adoption may be slowed by the lack of expertise in the industry. Construction workers and contractors will generally prefer to do what they know as they perceive it to be less risky. As forward thinking builders and concreters begin to invest in training and expertise in construction of post-tension slabs, costs will fall for sites, making them more competitive on highly reactive sites. If you have any questions about post-tension slabs or other designs, or would like to talk with us about partnering, please contact us at any of our offices around Australia.



When the black cable is pulled (tensioned) by the hydraulic jacks (red cones), the cable tries to straighten. The straightening of the cable 'lifts' or 'cambers' the beam in the direction of the green arrows. The lift is used to balance loads and increase beam capacity.

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