

SLAB SYSTEM CONCRETE REQUIREMENTS FOR EARLY AGE STRESSING

Post-tensioned concrete relies upon the transfer of the prestressing force into the surrounding concrete. This process occurs early in the life of a structure and therefore the specification of the concrete performance is critical. Of course, the attainment of good concrete compaction around all post-tensioning anchorages is vital.

Post-tensioning is usually carried out in 2 stages as noted below:

Initial stress	About 25% of the prestressing force is applied when the concrete strength reaches 7 to 9 MPa.
Final stress	100% of the prestressing force is applied when the concrete strength reaches 22 MPa for 12.7mm diameter strands and 25 MPa for 15.2mm diameter strands. (Usually between day 4 and day 7 after the concrete pour, and based on 'site cured' test cylinders).

It is therefore essential that the concrete early age strength is specified. Clause 19.6.2.8 of AS3600 Concrete Structures deals with the testing of cylinders for early age strength and states in part "the sample specimens stored and cured under conditions similar to those of the concrete in the works". Therefore 'site curing' of cylinders used for early age testing is mandatory. The test cylinders should be left on site until the morning of the test.

The early stressing of concrete relies on the compressive, bond and tensile strength of the concrete. Anecdotal evidence suggests that concrete mixes containing low levels of cement (and corresponding high levels of flyash) exhibit a lower gain of tensile strength in the first 48 hours. This can lead to bond failures of the post-tensioning 'dead' end, which are more closely related to tensile strength rather than compressive strength. It is therefore recommended that a limit on flyash be applied, or alternatively, the specification of a minimum amount of cement in the mix (notionally 320 to 330kg/m³).

Post-tensioned slabs-on-grade are common and rely upon the early application of the prestressing force. Requirements for the concrete include additional measures to limit early age shrinkage via the mix design and the use of "aliphatic alcohol" prior to the application of particular curing compounds. Refer to a PTIA member company for specific details.

The 56 day shrinkage strain of the concrete is also important. Post-tensioned concrete structures shorten axially partly due to their response to the shrinkage of concrete. It is usual to specify the maximum 56 day shrinkage strain of the concrete. This value varies across Australia due mainly to the variance in aggregates used within the concrete. The value commonly used is between 600 and 750µ. Generally concrete with a higher shrinkage strain will exhibit larger axial shortening and a greater chance of minor shrinkage cracks. For this reason, joint spacing in post-tensioned structures need careful consideration depending upon the concrete shrinkage strain.

For concrete which has been designed to be watertight it is usual to specify a 56 day shrinkage stress far lower than previously stated. A value between 500 and 550µ is recommended. Of course the attainment of waterproofing concrete is quite a complex issue and relies on a great deal more than a simple limitation on concrete shrinkage. Refer to a PTIA member for more detail.