Evaluation and Repair Strategies for Post-Tensioned Slabs

By David Rodler

The evaluation of a post-tensioned slab suffering corrosion-related concrete deterioration presents several difficulties for the restoration consultant or contractor. The first question the owner wants answered is “How much is this going to cost?” The answer to this question, unfortunately, can never be known with much certainty until the project has been completed. The final cost will be affected significantly by the methodology used during the repair to uncover corrosion-related problems with the post-tensioned cables, and the judgment used in deciding whether the level of corrosion observed on a cable or anchor warrants replacement. There are, however, choices for the owner to make during the initial evaluation that can have an effect on the accuracy of the estimate. The level of exploratory demolition and testing prior to preparation of the repair estimate will affect the accuracy of the estimate, and the owner should be informed of the different methods available. The following is a summary of the tools available for the initial evaluation of the post-tensioned slab and a review of the different approaches that may be taken during the repair with regard to repair or replacement of post-tensioned cables.

Initial Evaluation

The first step in the evaluation of a post-tensioned slab should be to determine the post-tensioned hardware used. A paper-wrapped monostrand or button-head system has far less corrosion protection than an extruded sheathing system. A cigarette-wrapped system is more likely to suffer water penetration into the sheathing than an extruded system. Plastic sheathings will tend to collect water at low points in the cable profile, causing corrosion at the low points, and paper-wrapped systems will be more likely to have corrosion at the top of the slab. Knowledge of the post-tensioned hardware and details of hardware at construction joints will help in the investigative stage to focus on the potential problem areas within the slab.

Next, a complete sounding of the slab with a chain drag and mason’s hammer is needed. Delaminated areas should be located and quantified on a plan view drawing of the slab, and visible post-tensioned cables that are broken should also be noted on the plan. At this point in the investigation, there is a working knowledge of the post-tensioned hardware and the extent and location of corrosion related concrete delaminations. Broken post-tensioned cables, which are visible, have been located and quantified. The number of broken or corroded post-tensioned cables, which were not visible on the surface of the slab, is still unknown.

The options available to determine the extent of corrosion or failure of post-tensioned cables within the slab include:
- Exploratory demolition;
- X-rays;
- Lift-off stress tests at anchors;
- Ferroscan tests; and
- Load testing.

The extent to which any of the above methods is used should be discussed with the owner. It may not be practical to test a significant portion of the cables due to cost or access limitations. Exploratory demolition in delaminated areas of the slab may, however, be revealing even on a limited basis. Figure 1 shows an exploratory demolition area that uncovered several broken and severely corroded cables in an area with only one visible broken cable prior to the demolition. A previous repair can also be seen in Figure 1. Previous repairs should be suspect if no documentation is available, as broken cables may have been abandoned within the repairs.

Figure 2 shows a construction joint soffit in a slab reinforced with paper-wrapped button-head post-tensioned wires. It is clear from the photograph that water penetration through the construction joint has caused significant corrosion to the anchorage hardware and cables. Construction joints are a good place to perform exploratory demolition for the purpose of estimating the extent of cable repairs that will be needed.

The degree of certainty with which the estimate of post-tension cable repair costs is given andage of the recommended contingency for the project should be tied to the level of testing.
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