

ICRI Committee Addresses Post-Tensioning Issues

By Kelly M. Page

Repairs of post-tensioned concrete structures are fairly common, but can bring a higher level of complexity to a repair project. Because this is an important subject matter for the industry, ICRI's Repair Materials and Methods Committee has had a subcommittee working on documents dealing with post-tensioning for several years now. ICRI members Scott Greenhaus, Dick Bonin, and Michael Tabassi are co-chairs of this subcommittee.

The subcommittee's first work product was introduced in the fall of 2002, titled "Guide for the Evaluation of Post-Tensioned Concrete Structures." The guideline is intended to provide an introduction to the procedures, tests, equipment, and processes used to evaluate post-tensioned concrete structures. It includes a review of the history of the structural system, and describes evaluation procedures, field and laboratory investigation techniques, engineering analysis, a summary of investigative results, and report development (see sidebar for full Table of Contents).


Once this evaluation document was published, the committee got back to work on their next effort, a document dealing with the actual repairs. The document, "Guide for the Repair of Unbonded

Post-Tensioned Concrete Structures," is now in the final phases of review, and should be published within the next 6 to 12 months.

This new guideline will provide an introduction to the repair of unbonded post-tensioned structures. It reviews the typical unbonded post-tensioning systems, repair design considerations and specifications, contracting methods, repair procedures and techniques, safety issues, durability, and maintenance considerations of post-tensioned repair projects.


Both guidelines are intended to help familiarize owners, design professionals, contractors, suppliers, and other interested parties with the procedures, equipment, risks, and other aspects of post-tensioned repair projects.

As ICRI and the concrete repair industry looks to the future, we will seek repair methods and procedures that enhance the quality of the repair, are less labor intensive, and improve the work environment. Our committees are constantly working on projects and documents that reflect these commitments. They are open to all—why not attend a meeting at the ICRI 2005 Fall Convention in New Orleans so you can start giving your input to these important concrete repair industry projects.



TECHNICAL GUIDELINES

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Guide for the Evaluation of Unbonded Post-Tensioned Concrete Structures

The use of a variety of the investigative tools described in the following section can provide additional information on the condition of the elements of a structure. It should be noted that the nondestructive test methods do not provide absolute data relative to the existing condition of the post-tensioning tendons in a structure. The limitations of these methods should be recognized when planning an instrument-testing program. Refer to ACI 228.1R and ACI 228.2R for in-place test methods for estimating concrete strength and evaluating concrete structures.

- 1. Acoustic testing/Hammer sounding**
The chain-drag and hammer-sounding techniques are economical and relatively accurate methods of determining the general locations and extent of concrete delamination. The methods rely on the different sounds generated by sound versus damaged concrete. The techniques involve striking the concrete with a hammer or dragging a chain across the concrete surface.
- 2. Impact-echo (IE)**
- 3. Impulse response**
Impulse response is a stress-wave method for the evaluation of structures, using a greater force input at a lower frequency than impact-echo. Tests on site are performed with a portable, computer-operated field unit. Impulse response can be used to detect delamination caused by steel reinforcement corrosion, delamination, poor concrete consolidation, and honeycombing in concrete structures. The method is particularly suited to identification of anomalies or defects in large concrete volumes such as parking garage and bridge decks, fluid-retaining structures, bridge arches, and piers (Figure 16).
- 4. Covermeter**
A covermeter, or pachometer, can be used to locate and determine the concrete cover over mild reinforcing and prestressing steel. It may be necessary to carefully drill or excavate the concrete over a number of locations to calibrate the covermeter with actual concrete cover thickness. A covermeter can be used to check the cover along the tendon profile, but the accuracy of the concrete cover reading may decrease with increasing cover thickness and proximity of the tendon to mild reinforcing steel.
- 5. Ground-penetrating radar (Impulse radar)**
Ground-penetrating radar (GPR) can be used to locate tendons and reinforcing bars in slabs, joists, and beams (Figure 17). The electromagnetic pulse

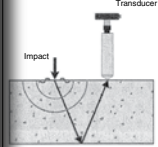


Figure 16. Impulse response

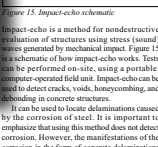


Figure 17. Ground-penetrating radar

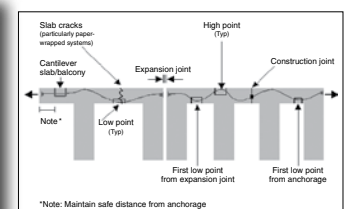


Figure 20. Recommended inspection pocket locations

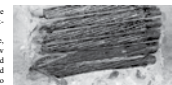


Figure 21. Inspection pocket with tendon protruding using absence of corrosion damage

most vulnerable to moisture, chlorides, surface spalling, and exposure to sawcutting and jack-hammering performed during surface repairs. Low points of a tendon profile are vulnerable, as moisture in the sheath can collect at the low point and may eventually lead to corrosion and failure. In addition, the tendon may be damaged at low points by unsuspecting workers who may install fasteners to anchor mechanical or electrical systems to a member soffit. High-point/low-point tendon observations are executed by locating the tendons to be inspected. The general location of inspection pockets is shown in Figure 20. Excavate high points (generally over supports) and low points (generally near centers of spans). Remove the sheathing and observe the condition of grout, prestressing steel, sheathing, and presence of moisture. Exercise care to avoid tendon damage during excavation. The investigation process should be adequately documented for future reference and reporting. The process of excavating high-point/low-point inspection pockets include the following steps:

1. Determine likely location of strands by covermeter, ground-penetrating radar, or visual evidence of tendon supports.
2. Carefully excavate concrete until all tendons in the group are exposed. Excavation should be minimized to maintain structural integrity. For example, damage or breakage can occur to the prestressing steel, and their capacity can be reduced by performing extensive excavation in the vicinity of a column. Location and size of excavation openings should be approved by a qualified structural engineer.
3. Using a sharp knife, carefully cut the sheath.
4. Inspect the condition of the prestressing steel and note the condition of the grout. Look for signs of moisture.
5. Wipe the grout off the strand and inspect for corrosion or pitting; and
6. The inspection pocket may be patched or temporarily covered to provide future inspection access. Cut sheathing must be repaired and grout must be replaced. Care should be taken to properly protect the strand against moisture intrusion during and after the inspection.

B. Anchor inspection
Extreme care should be taken when excavating inspection pockets in post-tensioned anchorages

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