



HYDRODEMOLITION FOR CONCRETE REMOVAL IN UNBONDED POST-TENSIONED SYSTEMS— TechNote

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Question

Should hydrodemolition be used to remove concrete in structural elements with unbonded post-tensioned systems?

Answer

Hydrodemolition is not recommended for concrete removal in post-tensioned concrete elements because the high-pressure water jet may inadvertently damage critical components such as the unbonded anchorages and the protective sheathing of unbonded post-tensioned tendons, thereby compromising the structural safety, durability, and/or maintainability of the system. Concrete removal using lightweight handheld concrete breakers (chipping hammers) and needle scalers remain the most viable option in this situation.

Discussion

Hydrodemolition, also referred to as high-pressure water jetting, is an effective method for selective concrete removal on horizontal, vertical, and overhead surfaces. This technique uses a high-pressure water jet (15,000 to 45,000 psi [100 to 310 MPa]) to remove both deteriorated and sound concrete. The water jet breaks down the cementitious matrix and abrades the exposed cement and aggregate particles without damaging the coarse aggregate and steel (for example, mild reinforcement and wire strand reinforcement) embedment ([ICRI 310.3R](#)).

Unlike mechanical impact methods, hydrodemolition does not cause microcracking or bruising of the concrete substrate ([ACI 546R](#)). Furthermore, after hydrodemolition, the final substrate surface is rough and irregular, with partially exposed aggregate and amplitudes exceeding 1/4 in. (6 mm). Combination of high-surface-profile roughness and absence of bruising favors maximum bond strength between the substrate and repair concrete ([Bissonnette et al. 2006](#)).

Although hydrodemolition will not physically damage the steel tendon components, the technique is not suitable for concrete removal if there is a possibility of the high-pressure water being applied near post-tensioned tendons, anchorages, or both. Reasons why hydrodemolition is not considered to be a viable technique include the following:

(a) Hydrodemolition can accidentally undercut the stressed post-tensioned anchorages (that is, remove concrete around the anchorages) and cause explosive blowout of the tendon. Therefore, the technique creates potentially dangerous conditions that can lead to safety hazards during execution.

(b) If the post-tensioned tendon is exposed during hydrodemolition, water can penetrate the tendon sheathing and cause corrosion of the strands ([ACI RAP Bulletin 14](#)). The water jet will likely damage or even remove the protective sheathing on the tendons, whether it be composed of paper, plastic, tubing, or extruded plastic. If sheathing damage is left uncorrected, the resulting direct path for ingress of water and other deleterious materials to the prestressing strand may give rise to further damage.

(c) The high-pressure water jet can potentially force slurry into the existing sheathing where it hardens, obstructing the insertion of a new strand into the sheathing in the event of a replacement. The presence of such debris within the sheathing builds up ahead of the advancing strand and may cause the sheathing to rip and “ball up” in front of the leading edge of the strand. The use of hydrodemolition may thus preclude future replacement of deteriorated or damaged post-tensioned strands—an operation that is commonly performed in concrete repair projects—and compromise the corrosion protection over the prestressing steel ([ACI 423.4R](#)).

To avoid the aforementioned problems and minimize the risk of damaging tendons, PTI Committee DC-80 ([PTI DC80.3-12/ICRI 320.6-2012](#)) suggests the following measures for concrete removal around unbonded PT systems:

- (a) Use of lightweight pneumatic or electric impact breakers (example: maximum 15 lb [7 kg], as shown in Fig. 1 and 2, and
- (b) Use of auto-shutoff devices that interrupt power to an electric hammer when contacting grounded metal.



Fig. 1—Ongoing concrete removal operation in a post-tensioned slab using a lightweight electric impact breaker (photo courtesy of Wiss, Janney, Elstner Associates, Inc.).

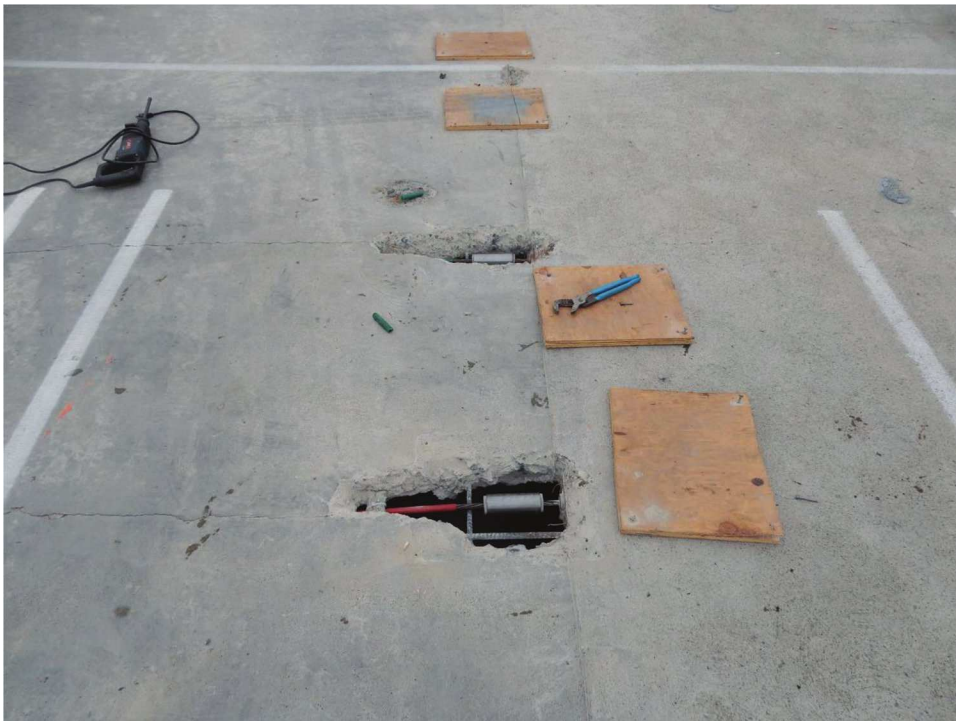


Fig. 2—Completed concrete removal operation in a post-tensioned slab using a lightweight electric impact breaker (photo courtesy of Wiss, Janney, Elstner Associates, Inc.).

As already stated, contrary to hydrodemolition, mechanical impact methods typically induce bruising (microcracking) in the concrete substrate (ACI 364.7T). Nevertheless, the extent of bruising can be limited by selecting lightweight breakers (chipping hammers) and needle scalers, such that the risks for altering the overall durability and safety of repaired unbonded post-tensioned elements are significantly less than those associated with the use of hydrodemolition. If the repair design relies on the bond between the concrete repair and the substrate, abrasive blasting should be used as a final preparation step to remove fractured particles or loosen particles.