Shotcrete Waterproofing Guideline Summary

Introduction. The use of shotcrete for constructing below-grade structural walls is becoming more common than using cast-in-place concrete in the Western United States. Shotcrete construction is typically faster and more cost-effective than a comparably sized cast-in-place concrete wall. The application of shotcrete, however, complicates the design of a functional blind-side waterproofing system. Shotcrete is typically blown through a hand-held nozzle at high operating pressure, with lower water/cement ratios than normal concrete, directly onto the waterproofing membrane.

Shotcrete Problems. The nature of shotcrete renders it likely that there will be much less uniformity of coverage across the waterproofing membrane than with cast-in-place concrete. Voids are created from unevenly mixed or placed shotcrete, as well as from “shadowing” effects behind rebar or from rebar cage vibration. Additionally, overspray can reduce the necessary structural bond that occurs between the waterproofing membrane and the shotcrete. Even if all these problems are eliminated, shotcrete is prone to crack during curing and long-term settlement, thereby creating conduits for water flow which further increase the chance for leakage. For all these reasons, CETCO believes that shotcrete walls are the most difficult form of foundation construction to make waterproof. Special design, installation, and inspection procedures are needed to address the inherent difficulties of shotcrete construction.

Guidelines for Shotcrete Projects. To address these concerns, CETCO has developed a comprehensive Shotcrete Application Manual for both Voltex DS and Ultraseal SP, the two products that CETCO would authorize for use in blind-side shotcrete construction waterproofing projects. Architects, consultants, engineers, applicators, inspectors, and contractors must follow these guidelines to help ensure that a given project will qualify for the protection under CETCO’s industry-leading Hydroshield™ warranty program.

This guide is not intended to replace the aforementioned Shotcrete Application Manual but is instead intended to highlight the most important aspects of this type of project from the varied points of view of designers, applicators, and inspectors.

Design

- Design a strip of Waterstop RX into each shotcrete lift joint, regardless of whether the lift joint is considered a cold or warm joint, or whether the wall is in hydrostatic or non-hydrostatic conditions.
Design two strips of Waterstop RX at the cold joint between the structural wall and structural slab/footing regardless of hydrostatic conditions.

Require that the shotcrete contractor utilize ACI Committee C-660-certified nozzlemen. The certification should be in writing during pre-construction submittals and should be required to be available to on-site inspectors.

Require that shotcrete walls be placed in strict accordance with ACI 506.2-95, Section 3 specifications, which include, but are not limited to, minimizing the lift height (traditionally 4 feet), limiting overspray, and preventing excessive rebound above and below the lift area.

Require the use of a project-specific shotcrete wall quality control/quality assurance plan, created by the General Contractor, shotcrete subcontractor, or Owner, that contains the basic control elements outlined in ACI 506 and best industry practices. Additional details of such a plan are included in the “Quality Assurance” section of this document.

Require that proper tieback covers are designed utilizing CETCO’s standard guidelines for complete encapsulation of any permanent tiebacks. These details would include the use of prefabricated “TB Boots” or generic galvanized steel boxes. Temporary tiebacks (those that de-tensioned and/or removed) must blocked out properly with wood boxes or cardboard forming tubes. The use of Stay-Form® is not allowed for this purpose. The final sealing of the block-outs must utilize at least one layer of Waterstop-RX, along with associated membrane patching and flashing components as necessary.

CETCO strongly recommends that the designer consider forming and casting-in-place any heavily reinforced columns and pilasters integrated within or attached to the structural wall. These areas are especially difficult to ensure uniform shotcrete coverage.

Design or require the reinforcement contractor to supply a stable rebar cage that will resist vibrational movement during application of the shotcrete.

**Installation**

Install two strips of Waterstop RX in cold joints between the structural slab or footing and the structural shotcrete wall. This material must be continuously adhered using WB Adhesive before starting the shotcrete application.
• Install one strip of Waterstop RX into each lift joint of shotcrete immediately after completion by pressing the Waterstop into the warm joint. Utilize adhesive if conditions dictate.

• Increase the standard overlap of Voltex DS membrane from 4 inches to 6 inches (Ultraseal SP overlaps is already 6 inches). Attach materials to substrate every 24 inches on center.

• In hydrostatic conditions, Volclay bentonite panels must be utilized in-lieu of Aquadrain. The panels must be placed to a minimum elevation of +5 feet above the historical high ground water table.

• In hydrostatic conditions, the Voltex/Ultras eal overlap joints must be sealed with AKWASWELL or Bentoseal and then stapled every 6 inches.

• Install temporary protective plastic or paper sheeting above the specific shotcrete lift being applied. This protective cover will provide protection from shotcrete overspray.

Quality Assurance

• CETCO recommends that the Quality Assurance procedure include a mock-up test on the waterproofing surface, with enough wall area exposed to allow the application of two lifts of shotcrete. Cores should be taken of the mock-up and analyzed to ensure that the shotcrete core grade is no greater than a quality level of “2” as demonstrated in ACI 506.2-95 Section 1.7. If the shotcrete core grade is greater than a “2,” the Quality Assurance Manager should consider requiring another mock-up until satisfactory results are achieved.

• All projects that qualify for a comprehensive CETCO “System” warranty must include a CETCO-approved third-party inspector for both the waterproofing installation and periodic inspection of the shotcrete installation, to ensure that the shotcrete is being applied to best installation practices. This includes inspecting the integrity of Waterstop RX in all concrete cold joints before shotcrete is applied.