

UMA Corrects Shotcrete Pool Settlement Issues with HDPR Injection

By Brian M. Fraley



The engineer chose UMA's High-Density Polyurethane Resin (HDPR) Injection to remediate the voiding below the shotcrete surface of a pool that was experiencing settlement issues.

UMA was contacted in January 2021 regarding a residential pool in Winston-Salem, North Carolina that was experiencing settlement issues in the shallow end. Prior to UMA's involvement, Catawba Valley Engineering & Testing (CVET) conducted soil test borings at the property to determine the in-situ soil conditions.

Drilled soil test borings, hand auger borings, and dynamic cone penetrometer (DCP) tests in the settlement area

revealed existing fill, alluvial, and residual soils. The fill and alluvial soils consisted mainly of sandy clay with very soft to stiff cohesive soil consistencies. There was also a review of aerial photos that revealed an apparent open ditch excavation for a storm drainage pipe that had been installed in February of 2005. The pipe appeared to be directly under the existing pool. All of these factors contributed to the observed settlement and distresses in the shotcrete lining.



HDPR was injected by performing a series of Deep Injections (DIs) at increments of 3 ft below the bottom of the pool to a final depth of 9 ft.

Based on the findings, CVET recommended UMA's High-Density Polyurethane Resin (HDPR) Injection to remediate the voiding below the shotcrete surface. UMA's approach was to eliminate future settlement by densifying the low consistency soils and filling the void space without lifting the pool and causing potential damage to the reinforced shotcrete structure.

UMA determined that injecting HDPR by performing Deep injections (DIs) was the best method to solve this problem. The plan was to perform a series of DIs at increments of 3 ft (0.9 m) below the bottom of the pool to a final depth of 9 ft. (2.7 m) The pool treatment area consisted of approximately 640 ft² (60 m²) with DIs placed on approximate 3 ft centers.

Extreme caution had to be exercised, because if the structure was lifted, even the slightest cracking in the shotcrete surface could cause more damage. UMA deployed laser measuring devices capable of measuring tolerances within 1/16 in. (1.6 mm). In addition to monitoring elevations, avoiding further damage, and alleviating pore pressure increases from excess water, crews had to methodically inject material by periodically "jumping" back and forth between the shallow and deep ends. This made the process slower than working in a single area because equipment had to be constantly moved and re-calibrated. Despite the additional time required, the work was done effectively and damage-free. The client's pool technician repaired the surface of the pool following UMA's injections.

Injections, like the type performed by UMA, can salvage quality work performed by pool shotcrete contractors. Having geotechnical information is a luxury that not every homeowner or shotcrete pool enthusiast can afford or even knows that they need. The damage caused at the Winston-Salem pool was due to subsurface construction of the site



The settlement was easily corrected, and voids were filled without the need to rip out and replace the valuable shotcrete.



UMA deployed laser measuring devices capable of measuring tolerances within 1/16 of an inch to ensure that no lifting or shotcrete damage occurred.



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developer and was unknown to the homeowner or pool contractor. Due to the resilient nature of reinforced shotcrete construction, the settlement was easily corrected, and voids were filled without the need to rip out and replace the structural shotcrete.

It is important to consider all factors when deciding if a rip out and replace option is even possible. Cost is the first that comes to mind. Intricate shotcrete pools require precise excavation and a qualified nozzleman to construct.

Pools constructed in an elevated water table require significant and costly dewatering to complete. These dewatering methods must be performed prior to emptying the pool for repairs because of buoyancy and a risk of the pool lifting out of the ground when emptied. With injections, technicians using waders can inject the polymer while the pool is still partially filled to counteract the buoyancy.



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506.6T-17: Visual Shotcrete Core Quality Evaluation Technote

During shotcrete construction, owners, architects, engineers, and contractors want to verify the quality of shotcrete being placed. Shotcrete cores are normally extracted from shotcrete sample panels or when needed from as-placed shotcrete for evaluation of shotcrete quality (ACI 506.4R). In addition to the routine tests such as compressive strength or other material quality tests required by project specification, visual examination of shotcrete cores by an experienced licensed design professional (LDP) is an important tool for evaluation of shotcrete quality.

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