
Enhancing Efficiency and Safety in Concrete Shaft Restoration: A Shotcrete Success Story

By Jacqueline Ipema

In September 2021, American Concrete Restorations Inc. was contracted to perform 60 yd³ (46 m³) of concrete repairs to an existing shaft that is used to access an underground tunnel system in a southern suburb of Chicago, IL. The job was for the Metropolitan Water Reclamation District of Greater Chicago, Thornton Construction Shaft. The dimensions of the shaft are 250 ft (76 m) deep and 30 ft (9 m) in diameter, and the only access is from the top using a crane basket. The project specifications called for the use of a polymer-modified, bagged product using the form-and-pour method to replace the old concrete.

After an initial sounding of the shaft, it was evident there would be additional material required. Upon demolition, the depths of the patches increased as well—some up to 18 in. (450 mm) deep and exposing two layers of rebar. We saw a perfect opportunity to submit shotcrete as an approved alternative to the originally designed form-and-pour method.

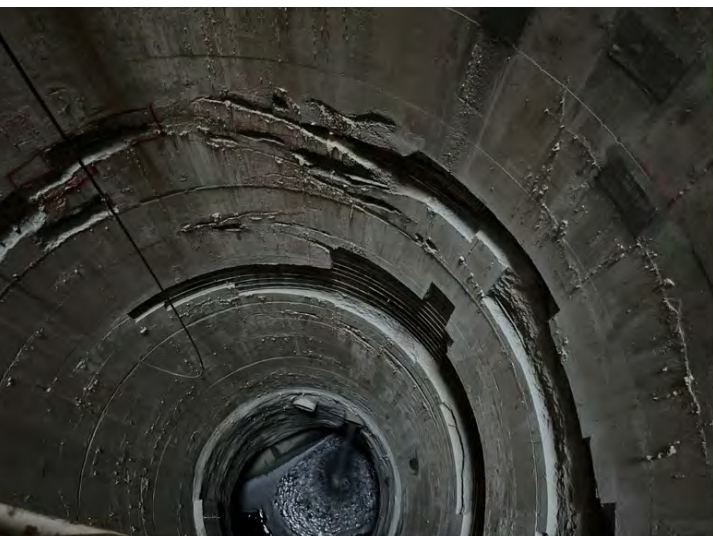


Fig. 1: Photo looking down shows several of the large repairs extending the whole circumference of the shaft.

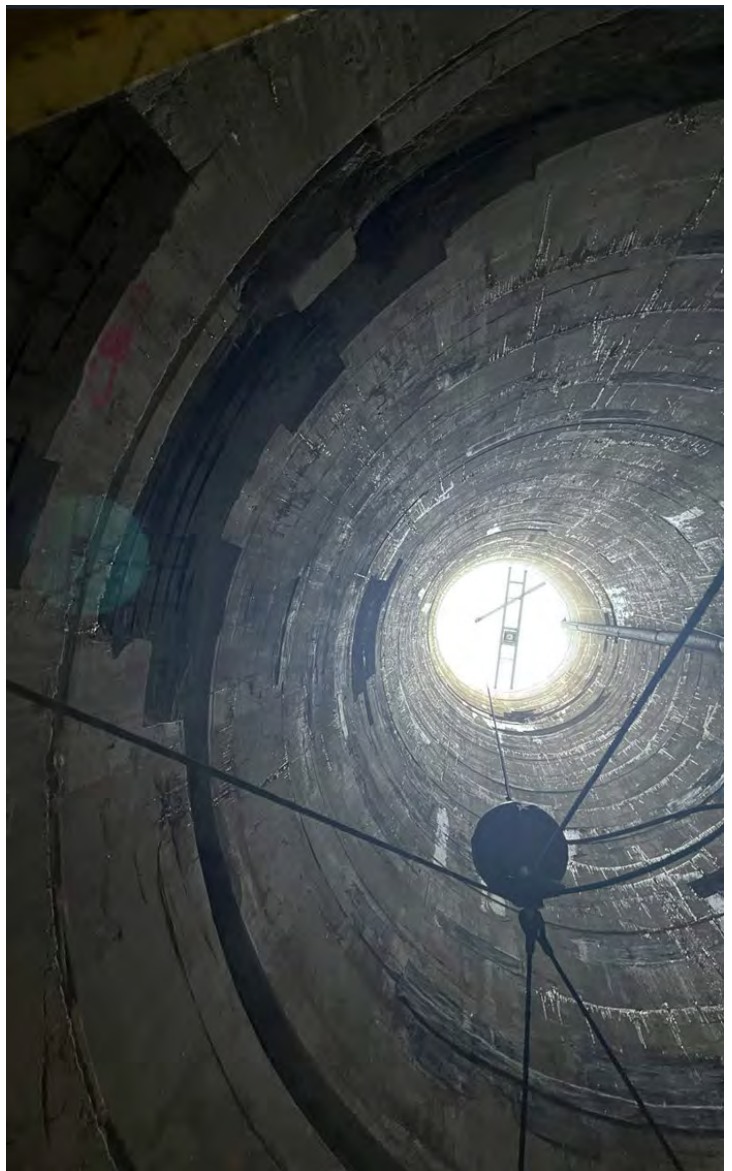


Fig. 2: Photo from the work basket showing distance to some of the further repairs.



Fig. 3: Photo showing large repair areas with complex shapes making it difficult to form.



Fig. 4: Large Repair area.



Fig. 5: Large repair that was converted from a form-and-pour to a shotcrete method repair.

We submitted a 6000 psi (41 MPa) ready-mix concrete mixture with steel fibers. After careful review, it was accepted and approved. Our request for doubling the thickness of a spray-on curing compound to enhance curing was also approved.

Using shotcrete placement, we were confident we could increase productivity. However, supply chain issues affected the availability of ready-mix shotcrete, specifically with



Fig. 6: Finished repair.



Fig. 7: Completed shaft repairs.

the specialty admixtures needed for shotcrete. Overall, using shotcrete placement increased productivity when compared to the original schedule that used form-and-pour. The biggest factor in saving time was not having to install and remove formwork. Because the shaft is circular, special curved formwork would have been required, along with additional reinforcing of the formwork to prevent blowouts from the liquid concrete pressure during casting. Additionally, using a curing compound on the shotcreted surface eliminated the time needed to remove the formwork and patch any imperfections to the formed surfaces of the repairs.

Using shotcrete's versatility and efficiency clearly demonstrated its many advantages when compared with form-and-pour. Not only was shotcrete the solution for greater productivity, it was also the solution for numerous safety concerns. All of the shotcrete work was performed from the top of the shaft, including the delivery of concrete from the ready-mix trucks. The mounted steel delivery line, air, and water hoses going down the shaft offered considerably less risk than lowering and manhandling lumber in mass quantities for formwork. Also, if a problem with concrete placement had occurred in the middle of an unreachable patch, it would have required the removal of the form to remedy the issue.

Shotcrete placement by ACI-certified nozzle men could be completed immediately after preparing the old concrete substrate with sandblast or high-pressure water blasting of the area to be patched. The shotcrete process allows immediate visual confirmation of the encapsulation of the embedded reinforcing steel as opposed to pumping concrete blindly into a form that could easily result in voids if not fully vibrated and consolidated.

Because of the inherent versatility and efficiency of shotcrete placement, we were able to place high-quality and durable concrete while improving safety measures and saving time.



Jacqueline Ipema is the President of American Concrete Restorations Inc (ACR), was established in 2003 and specializes in concrete repairs and restoration to key infrastructure and industrial projects. Jackie graduated with a bachelor's degree from Bradley University in 2010 and has had a variety of business-related jobs until starting at American Concrete in 2020. With a family history in concrete and business ownership, she has always been interested in the construction industry and is thrilled to be part of such a great community.