How Carl Akeley Saved Christmas

By Cathy Burkert

For more than 50 years, the trees along Chicago's North Michigan Avenue have been illuminated to signal the official kick-off of the holiday season and encourage everyone to join in the spirit and enjoy a host of festive experiences along Chicago's Magnificent Mile.

The centerpiece of the day-long festival is the evening parade, and the lights on Michigan Avenue are illuminated block-by-block as the procession passes. More than one million spectators line the parade route each year to see the lighted floats, marching bands, balloons, and performing artists. The 1.2 mile (1.9 km) parade route travels under millions of twinkling lights along Michigan Avenue from Oak Street to Wacker Drive.[1]

However, on October 1, 2012, just 6 weeks before the day of the festival and parade, the Chicago Department of Transportation (CDOT) wanted to begin a necessary rehabilitation of the deteriorated viaduct and retaining walls along the northbound entrance ramp to Lake Shore Drive at Michigan Avenue and Oak Street, exactly where the route of the parade begins. As explained by the city:

"This repair project is necessary due to the deteriorated condition of the concrete of the viaduct deck and retaining walls of the ramp, which has not seen any significant rehabilitation since its original construction in 1963," said CDOT Commissioner Gabe Klein. "We want to complete this repair work immediately before another winter cycle of freezing and thawing, as well as additional damage that could come from the use of road salt."

Fig. 1: Shoring towers at 8.5 ft (3 m) apart made for tight access between the exposed deteriorated concrete

During the 6-week rehabilitation project, the on-ramp will be closed to traffic until mid-November. Northbound vehicles will be rerouted along Inner Lake Shore Drive for 1 mile (1.6 km) to LaSalle Drive, where they can proceed north on Lake Shore Drive. Adjustments to traffic signals and the deployment of traffic control aides will help move vehicles along the detour route.

The $1.78 million project will include the repair of the underside and topside of the on-ramp viaduct, repairing the concrete retaining walls, and miscellaneous electrical and lighting repairs."[2]

American Concrete Restorations (ACR), a Chicago-based shotcrete contractor, was awarded the project due to its vast knowledge, experience, and reputation to perform efficiently. ACR accepted the challenge of a rigorous 4-week schedule to complete the overhead repairs. However, many more challenges were in store. The entire bottom of the deck, approximately 4000 ft^2 (372 m^2), was to be repaired; but due to the extent of deterioration, CDOT required temporary shoring be installed—spaced every 8.5 ft (3 m)—to support the loads from the traffic above. This restricted mobility for equipment and materials. The shotcrete contractor, needing access to the 15 ft (5 m) tall underside, required special equipment to gain access between the 8.5 ft (3 m) spaced shoring towers.

The shoring tower arrangement was so restricting that the turning radius of standard manlifts was too large to maneuver between the towers. ACR called five different equipment rental companies with no luck. Finally, one company was found that rented manlifts that would work, but only had two in inventory. They were delivered to the job site the next day and, with fingers crossed, successfully made the tight-radius turn and fit between the towers (Fig. 1).

Additionally, due to the congestion of shoring towers and workers from other trades, all equipment needed to be staged outside the viaduct. The shotcrete pump, compressors, and water tanks were stored at each end of the bridge and the hoses were lined along the inside of the wall. The center of the viaduct was to be left open to construction traffic, as seen in Fig. 2.

And that was only the first challenge! CDOT required the repairs be performed sequentially, so that no more than four sections of load-bearing shoring could be in place at a time. This required ACR to chip and prepare the surface and place shotcrete in four phases. Considering the short time frame to complete the project, ACR proposed moving the shoring towers when the in-place shotcrete reached 75% of its design strength to accelerate the job. In addition, ACR recommended using epoxy-set "L-shaped" dowel bars to support the reinforcing steel rather than the specified expansion anchors. ACR documented the success of the proposed changes from successful use on past projects where time was of the essence. CDOT agreed to the proposed changes. They also allowed the shotcrete to be tested for compressive strength from 72 to 96 hours after placement instead of the specified 14 days. This allowed earlier resetting of the shoring as soon as 75% of the design strength was confirmed.

ACR mobilized in mid-October and began the removal of the first segment of overhead repairs, averaging 6 in. (150 mm) in depth (Fig. 3). The repair areas needed to be cleaned and wire mesh needed to be installed prior to shotcrete placement. Special attention was given to the saw-cut edges because saw cutting leaves a polished surface that must be heavily blasted to ensure proper bonding. All existing reinforcing bars exposed by the concrete removal were coated with zinc-rich primer. The freshly sandblasted surface was prewetted to a saturated surface-dry (SSD) condition. Due to the depth of the repairs, the areas needed to be shot in two lifts and the surface of the first lift was power-washed prior to placing the second lift. The prepackaged, pre-blended Illinois Department of Transportation (IDOT)-approved shotcrete material typically reached 75% of the design strength in 3 to 4 days. Once complete, the repair areas were sounded by ACR to assure that all the shotcrete was fully bonded to the substrate. After sounding was complete, the ironworkers moved the shoring towers and ACR was able to proceed with the next section of removals, followed by the surface preparation and mesh installation.

As late fall approached Chicago, the temperature became the next challenge. Work in the cold temperatures causes equipment delays and inefficient production. Additionally, the CDOT specification for shooting shotcrete required that environmental conditions be a minimum ambient temperature of 45°F (7°C), a 50°F (10°C) material temperature, and a 40°F (4°C) substrate temperature. The experienced shotcrete contractor brought in large heaters to raise the ambient and surface temperatures. Heated water was used in the shotcrete mixture to keep it in compliance.

Fig. 2: Viaduct center left open for construction traffic

In addition to the shotcrete operation, other trades were in close proximity performing their work, including but not limited to crack injection, lighting, and formed concrete repairs. Because everyone was aware of the expedited schedule, it was important that the entire construction team work together to get the project done. As the project was located in downtown Chicago, near several large hotels, there were city noise ordinances that had to be accommodated with the workday schedules. The noise restriction only allowed 12 hours of construction work per day. Along with the project time constraints and noise ordinances, the project was abandoned for a few days due to 20 ft (6 m) waves flooding the underpass from a tremendous storm on Lake Michigan, just 200 ft (60 m) away from the project. All the contractors pulled together as a team and regular communication between the trades was a key element in making this project successful.

In the four different phases of shotcrete, over 300,000 lb (136,000 kg) of material was applied. The shotcrete process, performed by the qualified shotcrete contractor, was given high praise for the completion of the project on schedule, even with

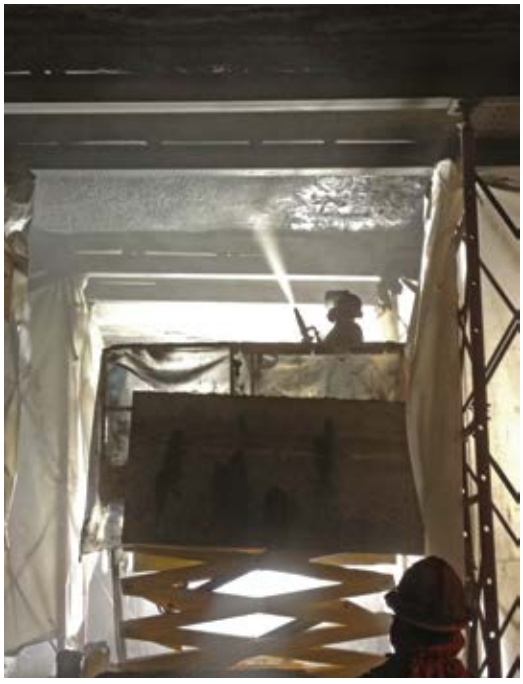

Fig. 3: Nozzleman shooting on the scissor lift between the temporary shoring

all the challenges. While ACR used American Concrete Institute (ACI) certified nozzlemen, the entire shotcrete team—including the pump tender, the finisher, and the grounds man, all of whom have many years of experience in the shotcrete operation—made the project a success. This experience and qualification of the individuals made the shotcrete process a successful and efficient team effort.

While some DOT specifications have not yet adapted to shotcrete, the CDOT's innovative specification wisely requires shotcrete for all overhead repairs. Shotcrete repairs on overhead applications are far more cost-effective and structurally efficient than formed concrete. Using shotcrete readily allows visual confirmation of the full encapsulation of the reinforcing bar and complete compaction of the shotcrete in place, whereas casting concrete into a closed, blind form often results in large voids. Workers using ready mixed concrete in a "form-and-pour" approach would have only had a little time to work with the concrete after it was transported from the concrete batch plant to the site through downtown Chicago traffic. Shotcrete also has enhanced safety benefits in the tight quarters of a project. The air and water hoses for shotcrete offer considerably less risk than raising and roughly handling lumber overhead in the large underside area of the bridge deck.

Furthermore, sustainability continues to grow as a driving force in the decision-making of owners and specifiers regarding construction materials and placement strategies. Shotcrete offers many significant sustainability advantages. Because shotcrete is simply a method of placing concrete, it offers all of the sustainability benefits of concrete as a building material in addition to a long list of advantages that are unique to the shotcrete method of placement.[3]

In conclusion, the project was successfully completed while reporting zero accidents. All construction on the project was completed while over 200,000 vehicles a day traveled on the bridge above. Carl Akeley, a taxidermist by trade, would be proud that 101 years after his patent of the "cement gun," developed in Chicago at the Field Museum of Natural History, Chicago still benefits from his innovation. The shotcrete solution resulted in a durable and cost-effective repair that will significantly extend the life of the original concrete structure. CDOT was impressed that the project stayed on schedule. All the contractors involved contributed to the success and the Festival of Lights parade went on as planned!

References

1. "Magnificent Mile Lights Festival," The Buckingham, Chicago, IL, 2012, http://thebuckinghamchicago.com/event/magnificent-mile-lights-festival. (last accessed March 20, 2013)

2. "Rehabilitation of Lake Shore Drive On-Ramp at Michigan Avenue and Oak Street to Begin October 1st," City of Chicago, Chicago, IL, 2012, http://www.cityofchicago.org/city/en/depts/cdot/provdrs/bridge/news/2012/sep/rehabilitation_oflakeshoredriveon-rampatmichiganavenueandoakstre.html. (last accessed March 20, 2013)

3. "Sustainability," American Shotcrete Association, Farmington Hills, MI, 2013, http://www.shotcrete.org/pages/why-shotcrete/sustainability.htm. (last accessed March 20, 2013)

Related Links

History of Shotcrete
en.wikipedia.org/wiki/Shotcrete#History

American Concrete Restorations
www.americanconcreterestorations.com

Cathy Burkert *received her bachelor's degree in business management and thereafter started working at American Concrete Restorations, a Chicago-based shotcrete contractor. She joined the laborers' apprenticeship program to learn the intricate details of the trade. After 2 years in the program, she began running her own shotcrete crews and shortly after earned the title of Field Office Coordinator. In March 2009, Burkert became the first female ACI Certified Nozzleman for the wet-mix, vertical, and overhead processes. She has been involved with two award-winning ASA infrastructure projects: the Abraham Lincoln Memorial Bridge in 2008 and the Dan Ryan Expressway in 2009.*