

U.S. Air Force Academy - Air Gardens

Category: 5 - Best Building Project – Specialty Contractor (\$2 - \$6 Million)

Contractor: Colorado Hardscapes

Solutions of Special Projects

When the U.S. Air Force Academy (USAFA) opened in 1954, the focal point of the Cadet Parade Ground landscape was a 600-foot grid of grass and fountains known as the Air Gardens. It originally consisted of two large fountains connected by an orderly grid of thirteen pools and eighteen bridges. Unfortunately, its interconnected pools were filtered by a single chlorine-based unit, meaning all 600,000 gallons of water had to be drained when maintenance was needed in just one. The fountain pipes were constrained by concrete basin walls when they were built and while operational, underwent many random band-aid fixes. In the early 1970s, the Academy determined they were too difficult to maintain and filled 13 of 15 pools with landscaping soil. For almost half a century, they remained poorly drained, swampy patches of grass surrounded by meaningless strips of deteriorating concrete.

Then, in 2018, Colorado Hardscapes received the honorable invitation of returning to the USAFA and restoring its Air Gardens to its former glory. Excited to take on this amazing opportunity, Colorado Hardscapes would soon discover that it came with many complexities, including, imperfectly aligned pool basins, tedious forming, and a collection of unforeseen mechanical complications. According to Aaron Wallin (Project Manager, GE Johnson), “We choose Colorado Hardscapes as the premier architectural concrete resource in Colorado. They developed beautiful solutions to a whole host of issues from cost to quality and the finished work is spectacular.”

Excellence in Execution

Colorado Hardscapes’ history at the USAFA began in 2008 when the Academy asked for a 10,000-SF mockup of the campus’ concrete plazas, including the cadet parade grounds known as The Terrazzo. After a decade of choosing Colorado Hardscapes to replace and rehabilitate their

concrete, the Academy made a smart choice when selecting someone to resurrect their abandoned Air Gardens.

Having previously done work at the USAFA, it was anticipated getting through their security would be challenging. In fact, the Academy is the most secure and logistically complex site Colorado Hardscapes has ever encountered. But access complications didn't end with the campus's security, it stretched from the work zone all the way to Castle Rock due to I-25 GAP construction.

The traditional "mix to discharge" limit for standard gray concrete is 90 minutes, meaning, any truck carrying concrete older than that from plant to pour is rejected. This posed an unavoidable challenge as guard station inspections took up to an hour in addition to the time spent in traffic. The process of pouring sub slabs to go under the bonded overlay would likely waste a large amount of product.

As a preventative measure, Colorado Hardscapes expedited access through security and established a special inspection line for concrete trucks at the entrance, avoiding wasting any concrete. On top of that, a hydration stabilizer was added to the concrete to delay the set process and extend the mix time. As a result, none of the batches were rejected.

Delays didn't cease at the gate though. Through 14-months of construction, it was required for all work to stop and equipment be turned off while the Cadets marched by, out of respect for their customs. Additionally, graduations and other public activities periodically shut down the work site for days at a time.

Furthermore, the Academy's weather usually consisted of high winds and 25-degree temperature drops from I-25 compared to the base; as if Colorado weather doesn't provide enough of a challenge. Since temperature and wind have a huge impact on the strength and consistency of concrete, the chances of the finished product being subpar were huge.

Colorado Hardscapes took preventative measures while maintaining an onsite presence through the fall and winter months by using concrete blankets, ground heaters, and snow removal to advance the process and to get a consistent concrete finish.

Beyond weather and security challenges, this was one of the most intense pre-construction efforts of Colorado Hardscapes' history. It was unknown what would be found when the 700' long, multi-basin system was unearthed. Concerns included the condition of the concrete, plaster, plumbing, and filtration and how well the site corresponded to the campus' rigid geometric order. Frankly, before excavation, even scheduling was an enigma. Production rates for the topping slab were unknown and the logistics of getting concrete onsite within batch windows were unpredictable.

The decided first step was to reconfigure from a single filtration system to 15 individually filtrated pools. The entire mechanical system was redesigned, and existing vaults were repurposed to create a filtered water storage system. Original cast-iron piping and drains were abandoned and only the fountain shells were salvageable. Colorado Hardscapes plugged openings and calculated system flow rates to right-size pipes and pumps. Later, extra steps were taken to add vent lines at the coping level to eliminate noticeable gurgling noises.

Through the entire process, collaboration with the Academy and GE Johnson was incredible. Both welcomed Colorado Hardscapes' leadership and expertise on products, processes, and performance.

Construction Innovations

From past experience on projects that required white cement, Colorado Hardscapes knew installing a full-depth white concrete mix would be expensive and risky for this project. Instead, Colorado Hardscapes developed a new mix for the Air Gardens. This bonded, white cementitious topping, applied a beautiful, exposed aggregate surface to the sub-slab as a half-inch overlay. Now, the overlay could be mixed onsite with no risk of losing product to security delays. Wisconsin sand, Texas aggregate, Utah glass, and special pigments were blended to develop a beautiful surface for the rejuvenated system. The combination of pool rehabilitations and bonded topping slab results in a much higher PSI than the original concrete and updated construction practices promise a long, low-maintenance lifespan going forward. Even better, the new concrete mix considered budget concerns as stated by Vince Renaud, (Project Manager, Air Force Academy Foundation), "As originally designed the price tag was simply too much. Colorado Hardscapes presented VE solutions including the innovative topping system that allowed us to

bring this magical experience back to life. We're impressed with the craftsmanship. This will be here for many future classes."

These product innovations led to application innovations including a system to efficiently apply the topping slab across the configuration of pools and walkways. Combining a tow-behind mortar mixer and a fork-lift attachment, Colorado Hardscapes created a tool that mixes the product away from the work and is easily boomed over the slab to pour from directly above.

The topping also had to be applied on 6,500 linear feet of faced edge ranging from 6" to 18" tall alongside every pool, adjoining bridge, and sunken landscape area. Facing these slow-setting surfaces required developing new techniques of both edge forming and topping placement.

Replacing the Air Garden's walkways and bridges, as well as the coping around every pool, necessitated very intense technical forming. Basins are adjoined by pedestrian bridges of up to 25 feet in length, each of which required structurally stabilized concrete and elevated formwork.

Because of the era's construction materials and technologies, the original Air Gardens had a layout with a few misaligned pools. Applying 75 years' worth of expertise, Colorado Hardscapes realigned the intersecting interfaces returning the Air Gardens' design to its original intent.

Environmental / Safety

Trapped gas remaining in the plumbing created hazardous conditions for crew members. Overcoming this challenge included safely removing chlorine-laced gases by cycling water through the chlorinator while of course wearing a respirator. Additionally, this project had Colorado Hardscapes working through COVID, the winter months, and routinely around large, earth-moving equipment.

Colorado Hardscapes held daily employee-led stretch and bends at start-of-the-day safety meetings and conducted a sitewide safety meeting every Monday. Through the entire process, OSHA-trained Foremen oversaw a 30-man crew to execute a safe, multi-trade scope with no lost time incurred on this project with about 24,900 total man-hours.

Contribution to Community

In May, Colorado Hardscapes opened one finished pool basin, to allow seniors completing their final exams to plunge into it- a tradition kept since 1954. “As a graduate, the campus is near and dear to my heart. The Air Gardens was intended to be a meaningful part of every cadet’s experience and thanks to this wonderful restoration, once again it will be.” Disclosed Vince Renaud (Project Manager, Air Force Academy Foundation).

Funded by donations from the USAFA classes of 72, 75, and 76, the Air Gardens’ return to glory is an essential step in realizing the grand vision of the campus as originally intended. Modern materials, methodologies, and technologies were matched by craftsmanship in pouring and finishing to reinvigorate this elaborate water feature as a vital touchstone of cadet life. After improving the structural integrity, realigning the layout, and reducing required maintenance, the Air Gardens has returned to the warm welcome place it was always meant to be.









