

Architectural Shotcrete for Residential and Commercial Development

by Howard L. Robbins



Apartment complex, Tucson, Arizona



Residential water feature, Phoenix, Arizona

Architectural shotcrete can be used to enhance the environment of almost any type of project, from backyard pool areas and dramatic rock and water entry features to world-class theme parks like Disneyland and Universal Studios. The versatility, strength, and durability of shotcrete can be combined with the natural appearance of rockwork to make a visually pleasing structure in a natural setting.

The use of shotcrete to create natural looking rockwork originated more than three decades ago. One of the earliest uses was in the creation of artificial boulders for use in museum exhibits in the Southwest. This type of work then evolved into the creation of rock and water features for residential swimming pools to enhance the surrounding hardscape with natural looking, sculpted rock features.

In residential applications, skilled craftsmen work alongside the shotcrete crew while the pool shell is constructed. Depending on the size of the feature, a steel mat is tied into the reinforcing cage of the pool using No. 3 reinforcing bar at 6 in. (15 cm) on center. As the pool is shotcreted, a mound in the rough shape of the feature to be constructed is shot simultaneously. This mound can then be shaped and sculpted by the rock crew until the desired shape and form is achieved. Once that is accomplished, the shotcrete is slick-toweled and then covered with the necessary material used to give the shotcrete a texture similar to natural stone.

Because of the structural characteristics of shotcrete and the natural look of sculpted rock, the project possibilities are endless. This has opened the door to projects incorporating caves, playgrounds, slides, and retaining walls in both residential and commercial settings. As these features become larger and more complex, the structural aspect becomes more significant. Structural ledges and overhangs can be constructed so that water flows over, but can be walked under. Caves can be constructed within the rockwork so that pumping equipment can be housed, protected, and hidden. This type of feature can be constructed by using No. 3 reinforcing bar at 6 in. (15 cm) on center. A heavy metal lath is placed on the underside of the

reinforcing bar, so that when the shotcrete is placed, it can penetrate the lath while leaving the cave hollow inside. A door is then added to the back of the structure for equipment maintenance access. The door is also blended into the rockwork.

Various types of materials such as aluminum foil and rubber texture pads are used to give the shotcrete its rock texture. Depending on the ambient temperature and the properties of the shotcrete, the material used to give the shotcrete its texture is left on for between 30 min and 2 h. When the material is removed, the shotcrete is then hand-carved. After proper curing time, up to 5 days, the rock crew returns to place the final coat of shotcrete. This mixture has higher cement content, but no coarse aggregate, allowing for a smoother but extremely durable material to be shaped, carved, and crafted. A color base is then added to this mixture at the time of placement. When this layer has cured, the crew returns again to complete the feature with staining and highlighting colors that are applied by a fogging and dashing method.

In addition to water features, sculpted rockwork can be used to create decorative retaining walls. Two recent projects our company constructed highlight the versatility and aesthetics of this type of wall.

An apartment complex in Tucson, Arizona, was built into the face of an existing mountainside. To maximize the usable land on the site, the face of the mountain was excavated so that all of the buildings could be constructed deep into the property. After excavation was completed and the site leveled, the back of the complex was left with a sheer earth wall approximately 40 ft (12 m) high and almost 1200 ft (366 m) in length. To protect the slope and enhance the visual appearance of the property, the developer hired Commercial Shotcrete, Inc., to construct a textured shotcrete retaining wall.

Using No. 4 reinforcing bar at 12 in. (30 cm) on center, a reinforcing bar curtain was built against the exposed face. With only a 7 ft (2.1 m) clearance at one point between the building under construction and the retaining wall being shotcreted, access was very limited. The entire wall was shot with 4000 psi (27.6 MPa) structural shotcrete at a thickness of 8 in. (200 mm). After the wall had been stabilized by the structural shotcrete, it was then faced with 4 in. (100 mm) of the final mixture using the higher cement content and no coarse aggregate. The hand carving and coloring process were then completed.

Another example of this process, which also saved a considerable amount of time and money, resulted from a landslide that caused damage to a narrow and winding state highway leading to the top of Mt. Graham near Safford, Arizona. To hold back the mountainside from future slides, the



Harkins Theater, Prescott Valley, Arizona



Mt. Graham near Safford, Arizona

U.S. Forest Service and the Arizona Department of Transportation decided to construct a concrete retaining wall. Their intent was to come up with a design to make the wall look natural. At first, conventional forming and pouring methods were considered. This was structurally sound but did not conform to the curve of the existing road or the surrounding terrain. Because of the slope of the hill, it could not be excavated back any further to provide room for the forms. Furthermore, using forms would require backfilling, something that would be extremely difficult to accomplish. It was then decided instead to place a structural, sculpted shotcrete wall directly against the mountainside.

After the slide area was cleared and shaped, the face was shotcreted 1-2 in. (25 to 50 mm) thick, just enough to stabilize the area so that dirt would not give way while a steel curtain was constructed against the face. This was done by using No. 6 reinforcing bar at 6 in. (150 mm) on center in two layers. For additional stability, 80 ft-long (24 m) anchor bolts were drilled into the mountainside to which the reinforcing bar curtain was then attached. A 12 in.-thick (300 mm) wall was then shotcreted over this frame with some shaping. To blend into the natural terrain, the wall was enhanced with a second coat of shotcrete which was then carved and colored.

A key element to any successful project is a skilled and well-trained crew. It takes years of field experience to be able to create sculpted shotcrete rock features that blend seamlessly with the surrounding environment. As demonstrated on these projects, the flexibility of shotcrete provides the means to blend in with the existing environment by creating natural-appearing sculpted rockwork. Because of the benefits inherent in the use of shotcrete, construction can be completed faster and in a more cost-effective manner than with conventional cast-in-place concrete methods. Additionally, virtually any concrete design concept that can be devised can be executed in shotcrete.



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Inc., builds arch culverts, structural walls, sculpted architectural shotcrete features, canal and lake linings, and soil stabilization projects. Robbins has more than 18 years of experience in sales, marketing, construction management, and project management of commercial concrete and shotcrete projects in the Midwest and southwestern United States. He can be reached at 602-290-0362 or via e-mail at hlobbins@earthlink.net.