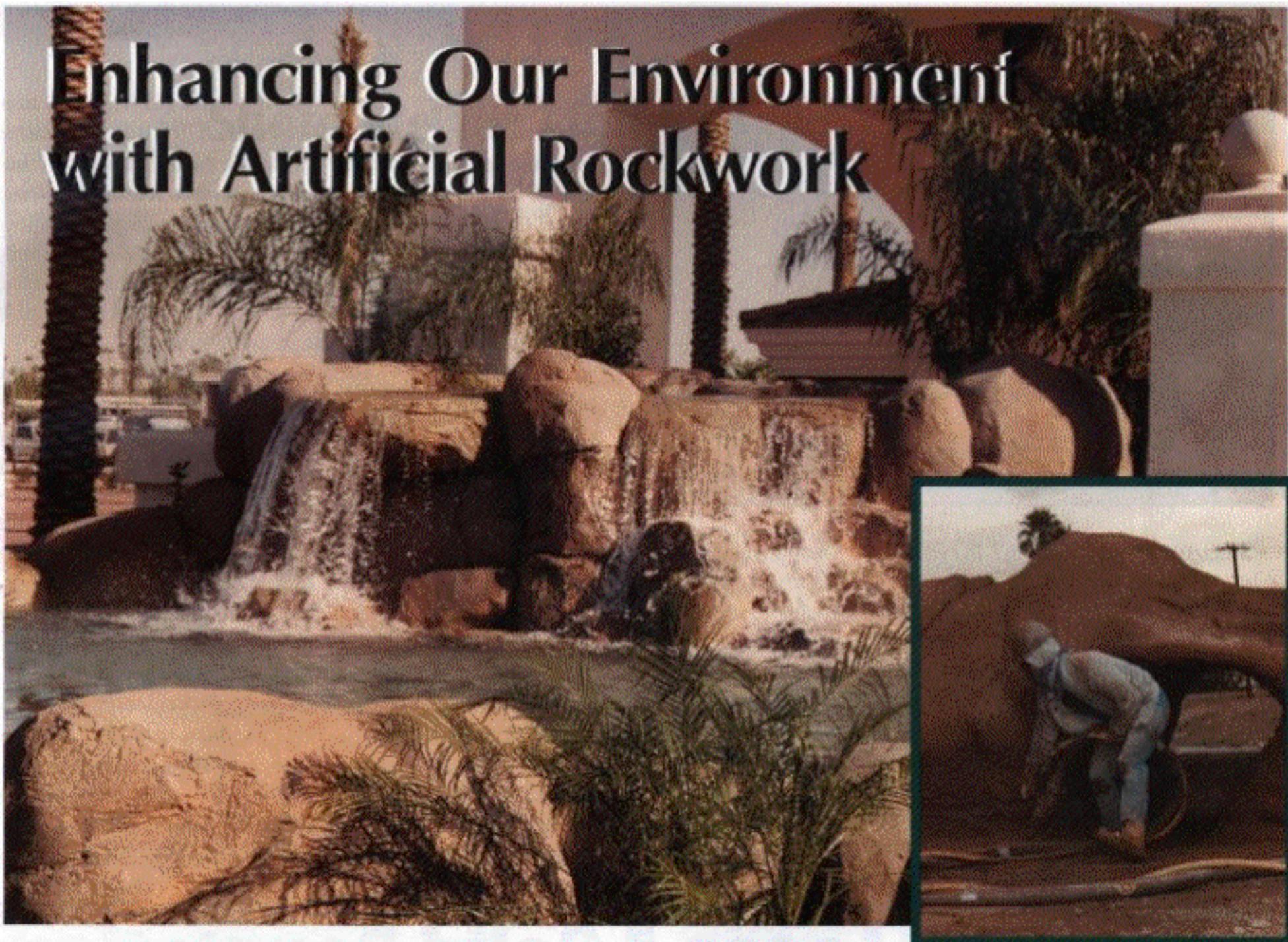


Enhancing Our Environment with Artificial Rockwork



by George Evans

In addition to the uses that typically come to mind, artificial rockwork is another avenue for the use of shotcrete that can enhance a project aesthetically, structurally, or both. The strength and durability of shotcrete have been combined with the naturally pleasing appearance of rockwork to make a visually appealing structure in a natural setting.

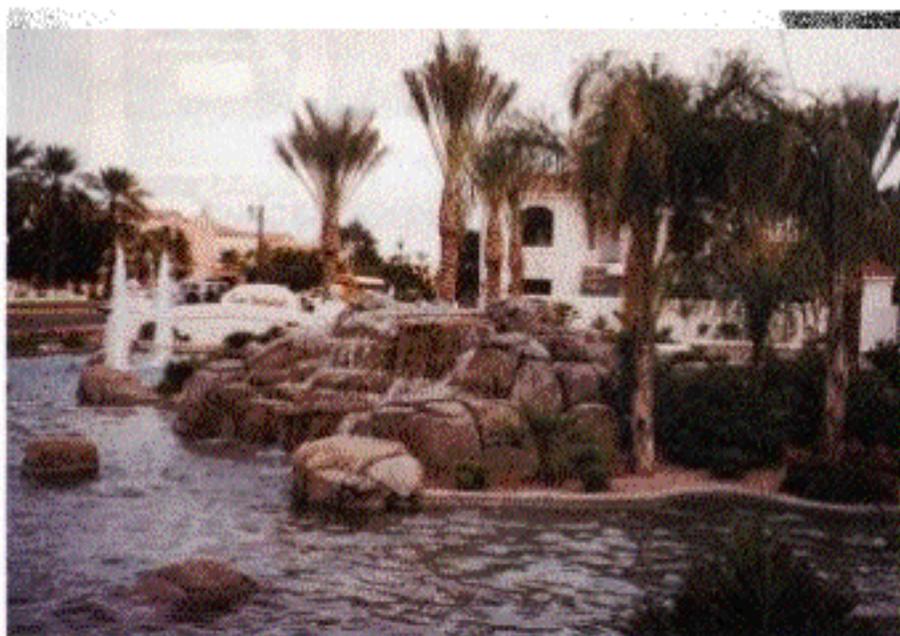
Traditionally, various sizes and styles of shotcrete swimming pools are enhanced with sculpted features. Skilled craftsmen work along with the shotcrete crew while the placement of the shell is being done.

Typically, and depending on the size of the

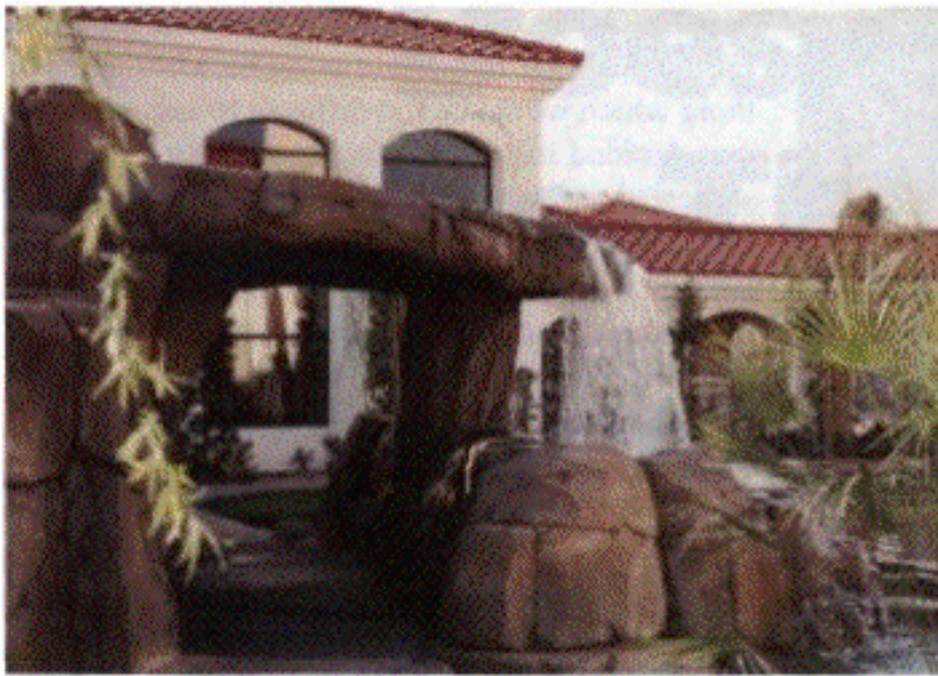
feature, a steel mat is tied into the reinforcing cage of the pool using #3 (10 mm) rebar at 6 in. (150 mm) on center. As the pool is shotcreted, a mound in the rough shape of the water feature is shot at the same time. This mound can then be shaped and sculpted by the rock crew until they have the correct shape and form. Once that is accomplished the shotcrete is slick troweled and then covered with aluminum foil. The foil has a twofold purpose - to stop the shotcrete from drying too quickly and to give the rock a texture similar to that of natural stone.

Depending on outside temperatures and the properties of the shotcrete, the foil is left on from twenty minutes to two hours. When the time is right, the foil is pulled off to allow the feature to be hand carved. After the shotcrete has properly cured, usually up to five days, the rock crew returns to color-stain the rockwork to match the existing surroundings. This process can be varied in the sculpturing, carving, or coloring to blend in naturally with different settings of the surrounding landscape.

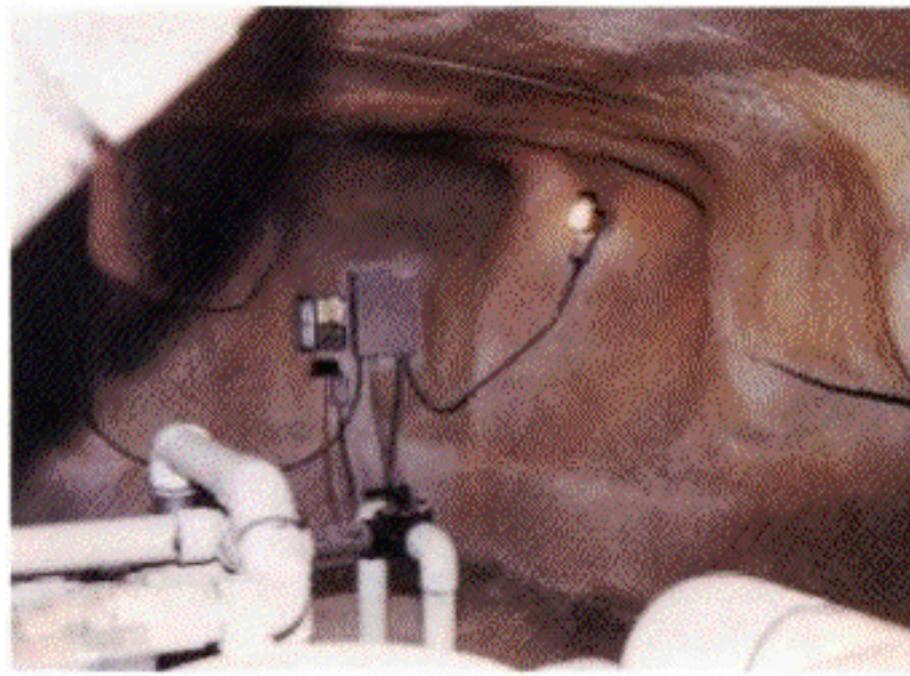
After developing different techniques on these smaller features, this process has been expanded to include larger scale projects. Because of the structural nature of shotcrete and the natural look of



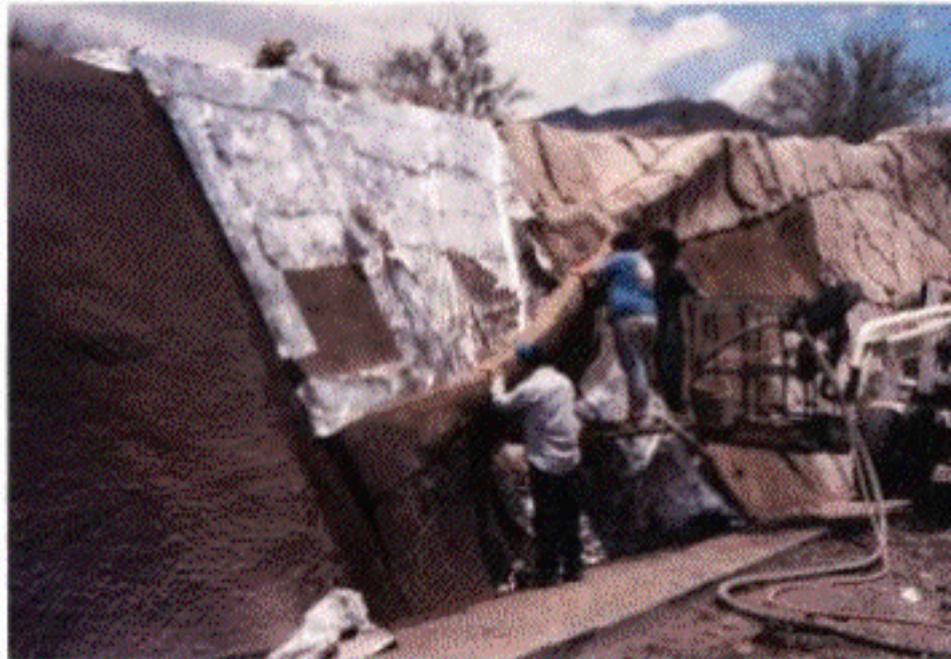
Appearance of rockwork to make a visually appealing structure in a natural setting



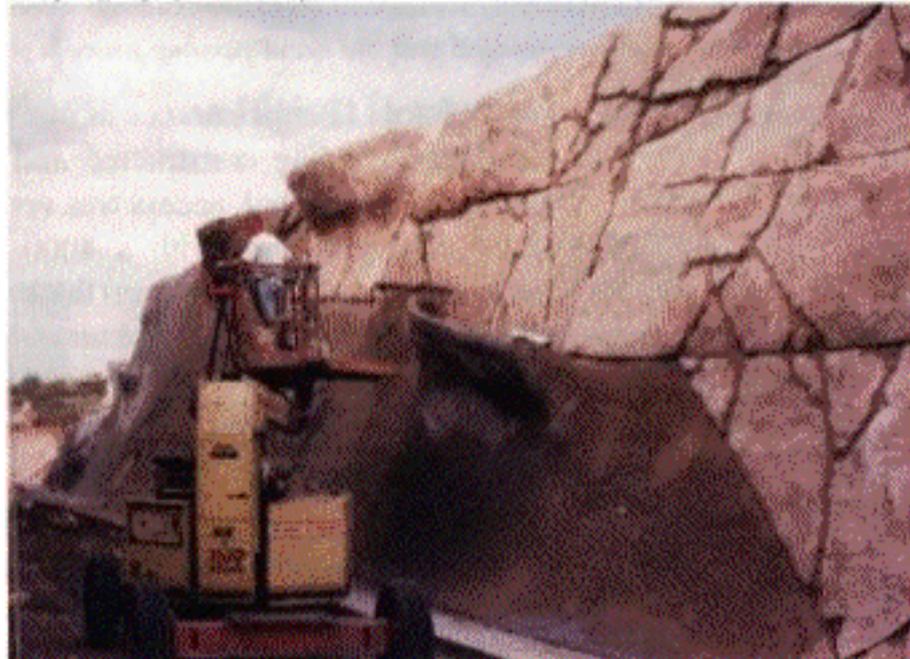
Overhangs can be constructed so that the water can flow over, but can also be walked under



A cave can be constructed within the rockwork and made hollow so that pumping equipment is protected and hidden.



Foil is added to stop the shotcrete from drying too quickly and to give the rock a texture similar to that of natural stone.



The rock crew returns to place the final coat of shotcrete.

artificial rock, the possibilities are almost endless. This has opened the door to projects incorporating caves, playgrounds, slides, and retaining walls, for example, in both residential and commercial work.

As these features get larger, either for custom home projects or large apartment or condo complexes, the structural aspect increasingly comes into play. Structural ledges and overhangs can be constructed so that the water can flow over, but can be walked under. A cave can be constructed within the rockwork and made hollow so that the pumping equipment is not only housed, but also protected and hidden. Prior to any shotcrete placement, the cave, taking on the basic shape of the waterfall, is constructed of #3 (10 mm) rebar at a minimum of 6 in. (150 mm) on center. Heavy metal lath is placed on the underside of the rebar so that when the shotcrete is placed it can penetrate the lath while leaving the cave hollow inside. Having the equipment inside also minimizes the noise of the pumps while the feature is in operation. A door is added to the backside to allow easy access for maintenance; this door also blends into the rockwork.

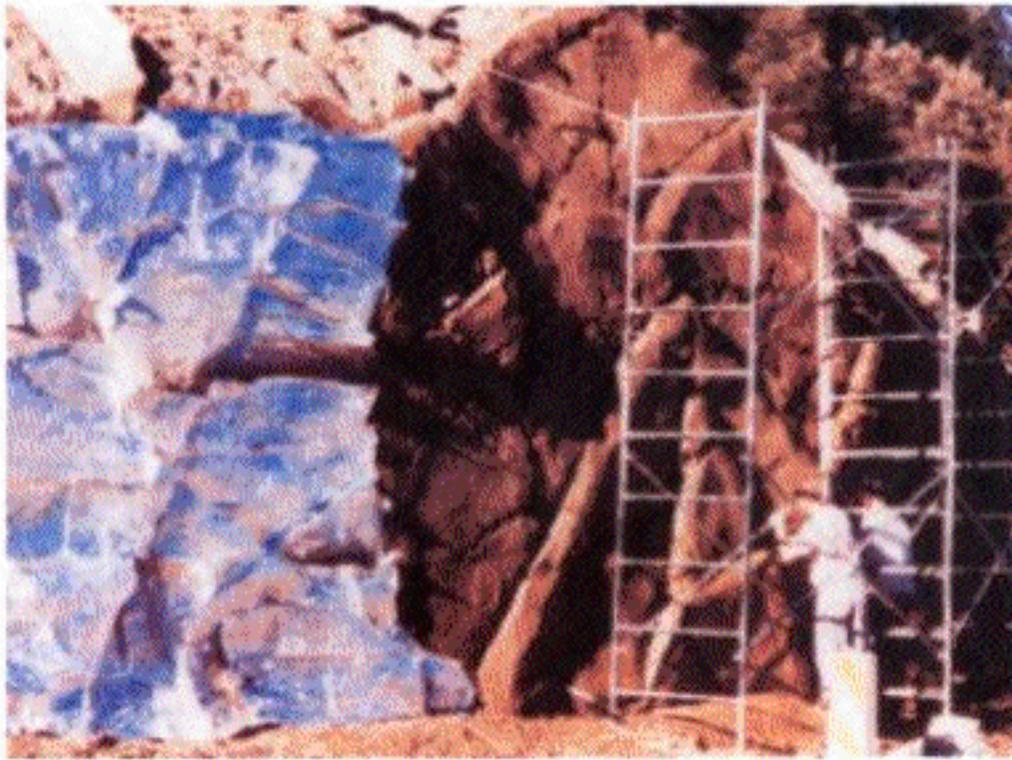
After the structural phase is complete and the curing process has finished, the rock crew returns to

place the final coat of shotcrete. This mix has a higher cement content and no coarse aggregate, allowing for a smoother but very durable material to be shaped, cut, and crafted. A base color is added in this mix at the time of placement. When this layer has cured, the crew returns to complete the feature with staining and highlighting colors, applied by a fogging and dashing method.

In addition to water features, artificial rockwork can be utilized as a decorative retaining wall. In two particular instances, this technique provided the only practical way these projects could have been done.

The first is an apartment complex built into an existing mountainside. In order to maximize the use of the land, the face of the mountain was excavated so that all buildings could be built deep into the property. After the mountainside was excavated and the site leveled, the back of the complex had a sheer earth wall approximately 40 feet (12 m) high and almost 1200 feet (365 m) long. To protect the slope, and to enhance the visual appearance of the property, it was decided to place a textured shotcrete retaining wall against it.

Using #4 (13 mm) rebar at 12 in. (300 mm) on center, a rebar curtain was built against the exposed face. With



Aluminum foil was applied and the hand carving process proceeded

only a 7 foot (2 m) clearance at one point between the building being constructed and the retaining wall being shotcreted, access was very limited. The entire wall was shot with a 4000 psi (28 MPa) shotcrete mix at 8 in. (200 mm) thick. After the wall had been stabilized by the structural shotcrete, it was faced with 2 to 4 in. (50-100 mm) of the mix utilizing a higher cement content and no coarse aggregate. Aluminum foil was then applied and the hand carving process proceeded.

Another example of this process, which also saved time and money, resulted from a landslide which caused damage on a narrow and winding state highway leading to the top of Mt. Graham outside of Safford, Arizona. To hold back the mountainside from further slides, the US Forest Service and the Arizona DOT decided to construct a concrete retaining wall. Their intent was to come up with a design to make the wall look natural. First, conventional forming methods were considered. This was structurally sound, but did not conform to the curve of the road or the existing landscape of the terrain. Because of the slope of the hill, it could not be exca-

vated back any further to allow room for the forms. Further, using forms would mean backfilling, something which would be too difficult to accomplish. It was decided instead to place a structural, sculpted shotcrete wall directly against the mountainside.

After the slide area was cleared away and shaped, the face was shotcreted 1-2 inches (25-50 mm) thick—just enough to stabilize the area so that the dirt would not give way while a steel curtain was constructed against the face. This was done by using #6 (19 mm) rebar at 6 in. (150 mm) on center in two layers. For additional stability, 80 ft. (24 m) anchor bolts were drilled into the mountainside, to which the rebar curtain was attached. A 12 in. (300 mm) wall was then shotcreted over this frame with some shaping. To blend into the natural terrain, the wall was enhanced by a second coat of shotcrete which, as in the previous project, was sculpted and carved, then later colored.

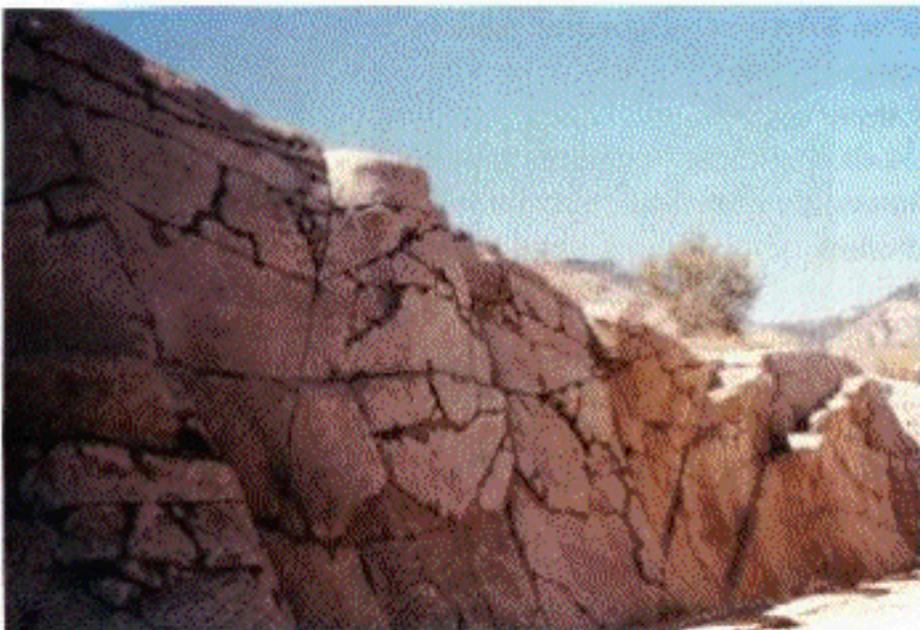
As demonstrated on these projects, the flexibility of shotcrete provides the means to blend with existing conditions by creating artificial rockwork. Because of the total control with each phase, no project is too large or too small. Beauty enhancement, cost effectiveness, speeding up a schedule, and structural concerns are all addressed by using this method. ■



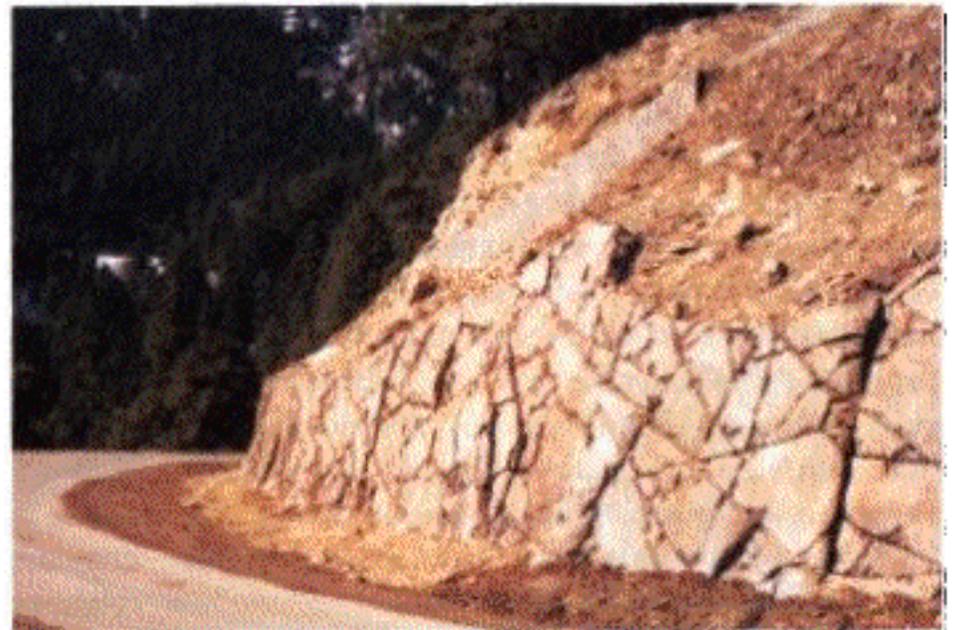
George Evans

George Evans is currently General Manager of "Creations Imitations," a division of Fisher Shotcrete, Inc. of Phoenix, AZ. He has been in the air-placed concrete business since 1975, when he started as a gunite "rebound man" and continued within the industry honing his finishing and nozzling skills. By

1988 he started to develop his technique in hand-carved artificial rockwork, and he continues to work personally on each project along with his staff, each of whom he has individually trained. His work has not only been done in the private sector, but also with various federal, state, and municipal agencies.



Artificial rock walls look natural



Narrow and winding state highway leading to the top of Mt. Graham outside of Safford, Arizona