Shotcrete and Sustainability

By Ted W. Sofis

Sustainability has become one of the big catch phrases of our evolving energy-conscious society. In a world where we are looking at greater demands on our natural resources and energy efficiency, green buildings and economy in general have become integral ingredients in construction planning. Years ago, no one would ever refer to "the carbon footprint" of anything. Time was money and we moved full speed ahead. Today there is a greater awareness of sustainability and its long-term benefits. Architects, engineers, developers, and construction planners are under ever-growing pressure to use more efficient methods in construction. In looking at our industry from this perspective, shotcrete has a lot to offer.

The sustainability of shotcrete becomes apparent when you consider the myriad of ways that the process saves us in labor, materials, material handling, and construction time. The most obvious advantage of using shotcrete is that the material is gunned or sprayed in place, so forming, in many cases, becomes unnecessary. This in itself is a big deal. It not only saves the wood used in forming but also—if you are looking at it from the big picture—saves the lumber and the labor and transportation costs involved in providing the lumber on thousands upon thousands of construction sites. That correlates to a lot of lumber that basically would have been sacrificial. In addition to the lumber materials that become unnecessary, there is a tremendous amount of labor involved in the forming operations. Time and money is expended in the building of forms, whalers, bracing, and forming support structures. This too disappears with the use of shotcrete when material can be sprayed in place without the need for building forms. Even in instances where a one-sided form must be built as a backstop to gun against, the forming structure would only require 50% of the lumber than would be necessary in a conventionally formed-and-poured concrete structure.

Overhead shotcrete repair on a bridge pier near Pittsburgh, PA, provides a cost-effective repair to existing structures that can prolong the life of the structure

Shotcrete enables us to effectively repair the undersides of elevated structures on bridges, parking decks, arches, and other overhead structures. Forming and pouring to place material overhead is terribly expensive and labor intensive. Shotcrete provides an effective, less costly alternative for the rehabilitation of elevated structures. When repairs to an existing structure can be accomplished in a fast and inexpensive manner, the structure can be preserved and its life extended, saving vast amounts of materials that would be necessary in building a new structure. Even on bridge piers, retaining walls, and other vertical surfaces, repairs can be undertaken and completed more efficiently with less labor. This makes repair and rehabilitation a more attractive option. In any argument concerning sustainability, preserving our infrastructure is of vital importance. When the life of a bridge or dam can be extended, the savings in materials, fuel, and transportation are tremendous and the resources that we preserve will be available for other uses.

Shotcrete can easily conform to irregular shapes like arches, domes, cones, and rounded piers, pools, and hillsides. It can easily be placed on surfaces and shapes that would be difficult or prohibitively expensive to form. It enables us to

stabilize slopes on hillsides and rock faces in mining and tunneling operations. In the steel and power industries, shotcrete is routinely used for refractory installations to repair ash hoppers, coal bunkers, burners, ladles, and blast furnaces. Again, in these industrial applications, cost-effective methods of repair prolong the life of the refractory linings. The use of shotcrete saves labor and energy in conveying materials into hard-to-reach areas. It would be difficult to transport material in a boiler or vessel when the only access is an 18 in. (457.2 mm) man door. Transporting repair mortar though a manhole in a storm sewer would not be cost effective without being able to run shotcrete hoses to the work areas.

In shotcrete mixtures, recycled materials can and have been used in prepackaged materials. As technology improves, I have no doubt that more and more recycled aggregates will be used in the future of shotcrete and other methods of construction. Looking for better and more efficient ways of doing things can lead to savings in energy consumption, materials, labor, and time. The use of shotcrete saves us in eliminating or reducing forming costs, transporting material, and prolonging the life of structures. It enables us to make repairs in difficult-to-reach areas and effectively places material with less time and labor.

Ted W. Sofis *and his brother, William J. Sofis Jr., are principal owners of Sofis Company, Inc. After graduating from Muskingum College, New Concord, OH, with a BA in 1975, he began working full time as a Shotcrete Nozzleman and Operator servicing the steel industry. He began managing Sofis Company, Inc., in 1984 and has over 34 years of experience in the shotcrete industry. He is an ASA-approved Shotcrete Nozzleman Educator, the Treasurer for ASA, and a member of the ASA Publications and Education Committees. Over the years, Sofis Company, Inc., has been involved in bridge, dam, and slope projects using shotcrete as well as refractory installations in power plants and steel mills. Sofis Company, Inc., is a member of the Pittsburgh Section of the American Society of Highway Engineers (ASHE) and ASA.*

In this slope stabilization in Westernport, MD, the shotcrete conforms to the irregular rock surface

Using dry-process shotcrete, the walls of the sump are easily repaired without forming. The newly placed shotcrete is cut down to grade with the edge of a trowel

Using the dry process, the nozzleman guns the lower section of the Two Lick Dam in Indiana, PA, with shotcrete. The material is efficiently placed without having to form the repair areas