

Overhead Dry-Mix Shotcrete

by Ted W. Sofis

Preparation

In overhead shotcreting, it is important to first make sure that the reinforcing steel and/or mesh is tightly tied and anchored in place. The reinforcing steel and/or mesh needs to support a lot of weight, approximately 140 lb/ft³ (2240 kg/m³). Unlike a vertical surface where there

is a great deal of lateral support, the reinforcement provides dead weight pulling directly down. There can be no flex or sag in the reinforcement because when the material is shotcreted in place, the added weight can pull on any loosely tied reinforcement, sometimes causing it to separate from the surface causing delamination. To check your work, a good rule of thumb is to reach up with both hands when tying mesh overhead, grab onto the mesh, and pull your body up. If the mesh is fastened tightly enough to support your body weight without flexing, then it is usually safe to assume it will support the weight of the applied material. If there is any appreciable give or sagging in the mesh, then more anchors need to be installed or more ties made to existing reinforcing bars to tighten up those areas. Remember it's always easier to make sure the mesh is secure than to deal with sagging mesh during the installation or to do the work a second time.

The next consideration is the positioning of the mesh from the finished surface. The mesh should be placed at least 2 in. (50 mm) from the surface to ensure an adequate cover. Care should be taken, however, not to try to build up too much material over the mesh. Usually 2 to 4 in. (50 to 100 mm) beyond the mesh is a good guideline to stay within. When there is too much unsupported weight of wet material beyond the reinforcing, the mesh can act as a shear plane and the shotcrete can pull itself off. Anyone who has ever done overhead shooting has had to deal with this problem. It is much easier to take the extra time in proper preparation and application than to have to deal with falling material while you are shooting.

Another important issue to address when chipping out deteriorated concrete is to make sure you get at least 1 in. (25 mm) behind the existing reinforcing bars. Often when the reinforcing bars rust and develop heavy scale, they expand creating cracks and fissures in the concrete. The concrete below the reinforcing is often fairly easy to remove. It can be tempting to remove only that which comes out easily, however, it is essential to remove even sound concrete, if necessary, to get at least 1 in.



Overhead shooting on the underside of an elevated structure at the United States Steel, Clairton Works, Clairton, PA

Technical Tip

(25 mm) of clearance behind the metal reinforcing bars to ensure a good repair. In short, proper preparation for overhead shotcreting can be every bit as important as proper shotcrete placement.

Installation

Now that all the preparation has been done properly, we can look at a few guidelines to follow. First and foremost, make sure you have adequate water pressure. Often, when applying dry-mix shotcrete overhead, the distance from the nozzle tip to the shooting surface is greater due to the spacing of scaffold bucks and other factors, so it's often necessary to increase the air pressure, and it's important that there is adequate water pressure to match. Unlike vertical applications, it's not as easy as taking a step forward or a step back to optimize the shotcrete impacting velocity. The shooting angle is also extremely important; the nozzleman needs to get as close to a 90-degree angle to the shooting surface as possible. In overhead shotcrete applications, with the rebound continually raining down on the nozzleman, this can be hard to do. The better the angle you have in shooting, however, the easier it is to hang the material overhead, and the quicker you'll get the work done. With a good shooting angle, there will be substantially less rebound and the nozzleman will be less impacted by rebound.

So keep in mind that by implementing good preparation and shooting practices, you'll achieve a better result, finish sooner, and use less material, resulting in a more economical construction.



Ted W. Sofis is a principal owner, along with his brother William J. Sofis, Jr., of Sofis Company, Inc. After graduating from Muskingum College with a BA in 1975, Ted began working full time as a shotcrete nozzleman and operator in the steel industry and began managing Sofis Company in 1984. He resides in Pittsburgh, PA, and has over 30 years of experience in the shotcrete industry.

Over the years, Sofis Company has been involved in bridge, dam, and slope projects using shotcrete, as well as refractory installations in power plants and steel mills. Sofis Company is a member of the Pittsburgh Section of the American Society of Highway Engineers (ASHE) and the American Shotcrete Association (ASA).