

## Correct Shotcrete Nozzling Technique

by Ray Schallom III

In recent months, a lively debate has ensued between ASA members over the proper way to handle a shotcrete hose and nozzle during shotcrete application. This article presents a case for the traditional way to hold the hose and nozzle and explains why it has been performed this way for over 95 years.

Shotcrete nozzling, when performed correctly, is a learned craft with some common sense added in. Over the years, experienced nozzle men developed a shooting style that maximizes production while minimizing body fatigue. They have learned how to work the hose instead of having the hose work them. It often appears to the inexperienced observer that shotcrete nozzling is an easy task to perform, but this is not the case. It takes a considerable amount of training and skill.

Since 1910, when the dry-mix shotcrete process was first used, nozzle men have been taught to straddle the hose and place it between their legs while keeping the hose directly behind them to act as a counter weight. They bring the hose up across their chest using either arm to snake the nozzle around with one hand. This technique allows approximately 3 ft (0.9 m) of the hose weight to be supported by the nozzle man at any given time.

Performed correctly, a nozzle man can free up one hand to help adjust the nozzle or signal the gun operator. Keeping the material hose perpendicular to the body enables the nozzle man to move from side to side with minimal effort and with the least amount of aid from a hose tender. This inherently gives the nozzle man better hose/nozzle control and stability. If the hose is held under the arm on the side of the body, the nozzle man loses that counter weight effect and begins to feel the full velocity and force of the material being shot. It also requires the nozzle man to exert more energy to move from side to side without the aid of a hose tender. Figure 1 shows a nozzle man back in 1916, demonstrating the proper way to handle the hose and nozzle.

This nozzle technique, which consists of straddling the hose and squeezing it between the legs to help support its weight and shotcrete force, has been successfully applied to the wet-mix shotcrete process as well. Figure 1 (also found in the ACI CP-60 (02) Craftsman Workbook) is used in the Nozzleman Certification Program and illustrates the correct way to hold onto the hose as well as how to properly angle the nozzle to the surface. During the ACI Nozzleman Certification Performance exam, nozzle men are graded on their nozzling technique during actual shotcrete placement, including the way in which they hold and maneuver the hose and nozzle.

Some critics will argue that placing the hose between your legs is dangerous and unsafe. Some quote sections out of the OSHA Code book about high pressure hoses. The air pressure in the hose for the dry-mix shotcrete process is no more than what is registering on the air gauge (80 to 100 psi [0.55 to 0.69 MPa]). The forces experienced by the nozzle man for the dry-mix process come from the ft<sup>3</sup>/minute of air, not the psi pressure in the hose. In the wet-mix process, we deal with working pressure from the pump. Most wet-mix hoses are rated at 800 psi (5.5 MPa) working pressure. Without attaching an air nozzle at the end of the wet-mix hose, you would only have a concrete sausage being pumped out of it and experience very little force. The air nozzle attached to the end



Fig. 1: Correct dry-shotcrete nozzling technique, 1916 (This photo is also found on the cover of Shotcrete, Winter 2003, V. 5, No. 1)

# Technical Tip

of the hose displaces the sausage to achieve the required material velocity using a minimum 185 ft<sup>3</sup>/minute air compressor and a pressure of approximately 100 psi (0.69 MPa).

The myth about the danger of placing a high pressure hose between the legs in the shotcrete process is just that—a myth. Most of the shotcrete critics who are trying to change a 95-year-old industry have had limited or no nozzleman experience. Some of these critics would rather see the nozzlemen hold the hose and nozzle to the side of their body, drape the hose over their shoulder and helper as well, or hold the hose directly over their head with arms fully extended (Fig. 2 and 3). Techniques such as these increase the risk of injury to the nozzleman or a crew member should a hose plug or line surge occur. Such techniques also increase body and arm fatigue, in addition to increasing the number of personnel needed to help hold the hose during shooting. The body stress and increased fatigue endured while nozzling this way can substantially shorten a nozzleman's career. Figures 4 to 9 also show correct nozzling techniques.

In conclusion, the aforementioned correct nozzling technique has been passed down to nozzle men for more than 95 years. The reason for using this method is simple—it is proven and it works. It

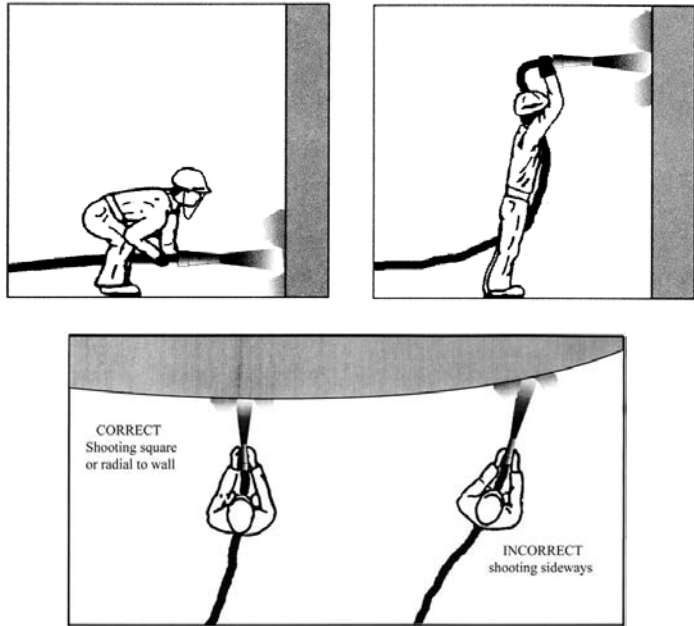


Fig. 4: Correct nozzling technique



Fig. 2: Incorrect nozzling technique



Fig. 3: Incorrect nozzling technique



Fig. 5: Acme 1.5 in. (38 mm) nozzle/Las Vegas Mega Demo 2001



Fig. 6: Acme 2 in. (50 mm) nozzle/Staten Island Terminal Tunnel (Photo courtesy of George Yogy)



*Fig. 7: Dry-mix vertical shotcrete*



*Fig. 8: Correct dry-mix nozzling placement on horizontal surface*



*Fig. 9: Correct wet-mix nozzling placement on horizontal surface*

minimizes body fatigue and gives the nozzleman more stability and control over the hose. ASA has created a high-quality shotcrete training program that includes a section on correct nozzling techniques. Most ACI certified nozzlemen listed on the website

have gone through the ASA training program. This program is a good educational tool for owners, representatives, or engineers who would like to better understand the shotcrete process from concrete mixture design to nozzling techniques.



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