Nozzleman Techniques: Improve Accuracy and Reduce Fatigue

By Oscar Duckworth

If there is one thing all skilled nozzlemen have in common, it is that they make their job look easy. The nozzle appears weightless in their hands, but anyone who has ever held a nozzle knows better. Although strength and stamina are important, a skilled nozzleman does not rely on brute strength. Overpowering the nozzle is never a long-term strategy. Mastery of the nozzle requires knowledge of techniques that offset the weight and thrust of the nozzle. Balance, physical efficiency, and the use of shooting positions that combine mobility with precise nozzle control are traits shared by all skilled nozzlemen. Good nozzlemen are artists—their movements are deliberate and perfectly executed. Their skill and experience are obvious to anyone who sees them work. Mastery of the craft requires study, practice, and sufficient time to learn the essential techniques used by all skilled nozzlemen. Professionals from every craft must master specific movements or positions to provide optimum efficiency. Athletes continually practice movements and refine techniques to boost performance. Like athletes, skilled nozzlemen select equipment, control timing, and use specific techniques to improve their performance. All professional nozzlemen share similar shooting positions, methods, and equipment configurations to diminish the risk of injury, minimize fatigue, and maximize placement accuracy.

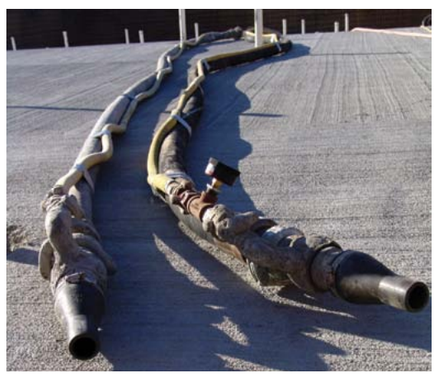


Fig. 1: Although visibly similar, nozzle end hoses may feel very different to a nozzleman. Choose an end hose that is sufficiently rigid, not "doughy"

Safety First

Professional nozzlemen are exposed to unique hazards that are specific to the craft. A placement system's weight and occasional violent thrust can create the risk of injury at any time. If scaffolding is required, it must be sufficiently wide to safely work without compromising balance. Adequate hand rails are **mandatory**. Shotcrete placement equipment can generate enormous pressure if there is a blockage within the system. A placement system rupture caused by a blockage can generate explosive force. It is essential that the nozzleman can signal to quickly stop the pump. A nozzleman should not operate equipment that cannot be immediately stopped in the event of an emergency. Wear the personal protection devices (PPDs). PPDs are there for **your** protection. Gloves, dust masks, safety glasses, ear protection, boots, and hard hats are requirements of a naturally hazardous job.

Equipment Choices Affect the Nozzleman's Body

Shotcrete placement systems must be properly sized. Placement systems and nozzles 1-1/2 and 2 in. (38 and 50 mm) in size are commonly used for most wet- and dry-mix hand nozzle applications. The placement system weight dramatically impacts the nozzleman's mobility. Professional nozzlemen carefully consider the weight of every component that must be lifted. Hoses used near the nozzle must be sufficiently rigid to resist kinking or collapsing during placement. Soft, "doughy" hoses should not be used as the nozzle end hose (Fig. 1).

Adjust the Pump or Gun to Run as Smoothly as Possible

Smooth shifts and a predictable flow of material are necessary to precisely control material placement. Slugging or bursts of air will affect a nozzleman's balance and reduce placement precision. Uneven material flow can be caused by worn wear components, poor shift calibration, or nonfunctioning augers (Fig. 2). Guns and pumps must be kept full. Allowing a pump to run low on material creates unpredictable airbursts that can unbalance any nozzleman. If material flow is irregular, the nozzleman should stop and investigate the cause before continuing.

Fig. 2: A wet-mix pump with missing auger cannot effectively fill material cylinders. Unpredictable flow and slugging will affect nozzleman placement quality

Adjust Placement Speed to Your Own Comfort Level

High flow rates generate excess thrust that must be counteracted by the nozzleman. Modern shotcrete placement equipment can convey material much faster than a nozzleman can accurately place it. The mark of a master nozzleman is not how quickly he can install material—it is the precision with which the material is placed with proper consolidation. Choose a flow rate that feels right. A nozzleman must work within a speed range such that thrust generated by excess flow does not interfere with the nozzleman's ability to accurately direct the flow.

Work in Positions that Use the Body's Frame to Provide Natural Balance and Mobility

Any worker attempting to operate a nozzle for the first time will likely either hoist the placement hose and nozzle up and over his shoulder or try to hold it from the side. After a short but valiant struggle, the nozzle usually wins. Professional nozzlemen realize that these awkward positions generate poor results. A nozzle held from the side or over the shoulder limits the nozzle's range of movement and overall placement precision (Fig. 3(a) and (b)). Over the shoulder and from the side shooting positions transfer the system's full weight as an off-center load through the nozzleman's back. Pump surges then produce continuous twisting forces that must be counteracted by the nozzleman's back, hips, and upper body. Poor shooting positions affect placement quality, reduce

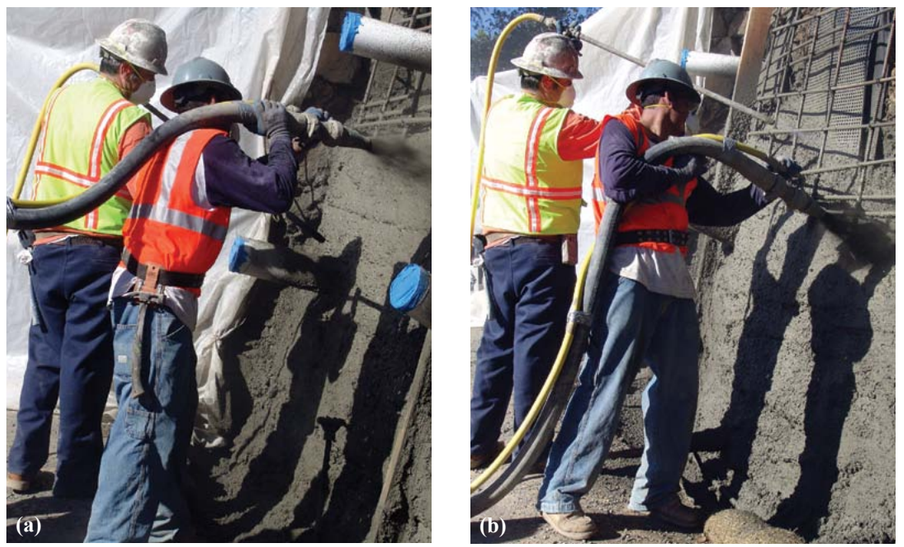
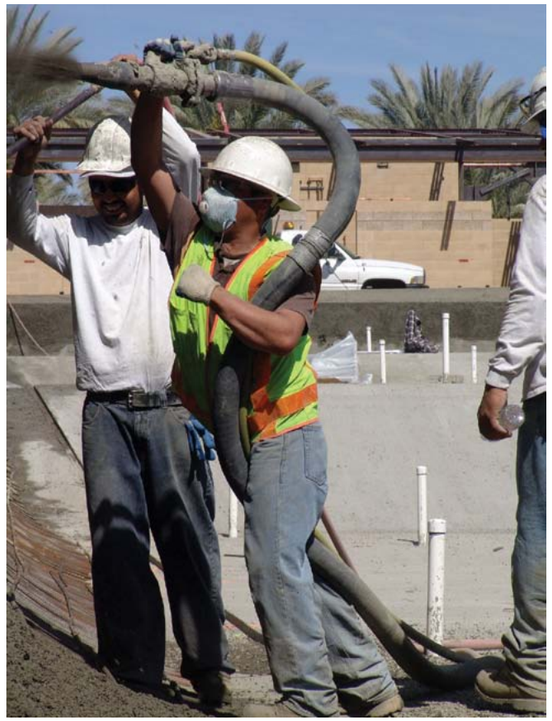


Fig. 3: Examples of awkward nozzle positions. Nozzles held (a) over the shoulder or (b) from the side reduce mobility, range of motion, and overall placement precision

Nozzleman Knowledge



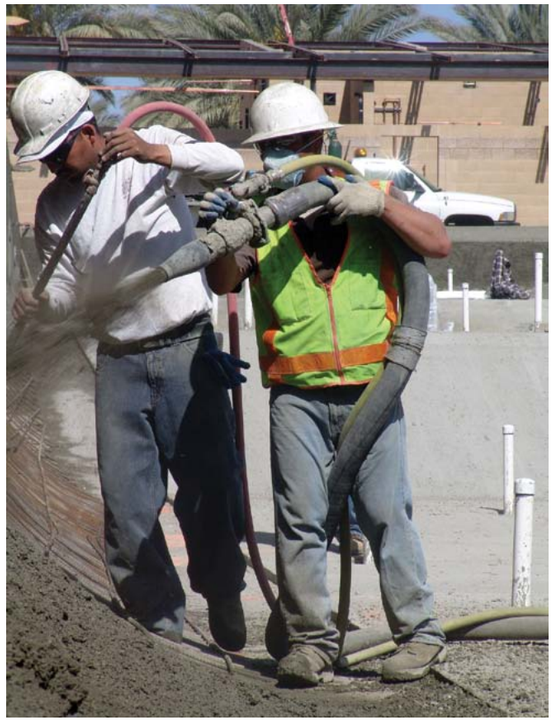


Fig. 4: Professional nozzleman demonstrates excellent shooting positions

Fig. 5: Professional nozzleman works in a relaxed, well-balanced position. Note: Hose is relatively rigid and remains firmly on the ground behind the nozzleman

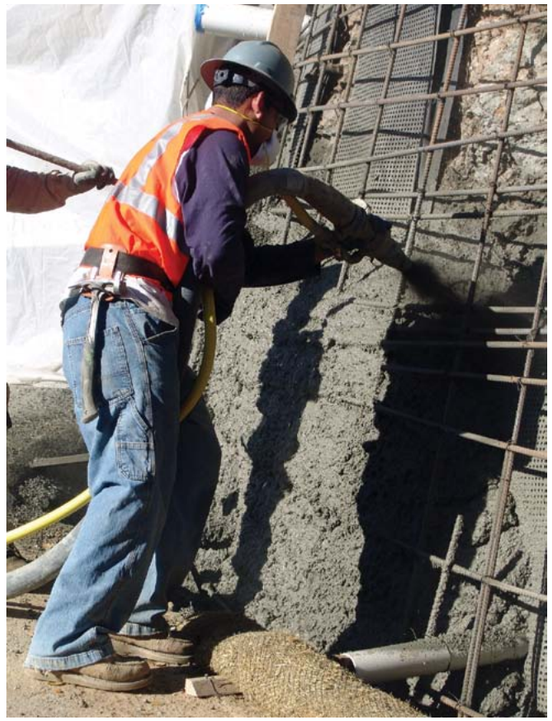
mobility, create unnecessary fatigue, and may cause back injuries.

To hold the nozzle professionally, face the work squarely with your chest, head, and shoulders facing the work. Place one foot well ahead of the other to counteract nozzle thrust. Route the placement hose directly behind you and up, between your legs, centered within your frame (Fig. 4). This position optimizes natural balance and provides the nozzleman with the maximum range of motion. Use your feet, legs, and arms—not your back—to manipulate the nozzle position.

Minimize Fatigue—Force the Hose to Hold Itself Up (So You Don't Have To)

Study the photograph in Fig. 5. The hose is placed on the ground and arced upward by the nozzleman's legs. The nozzle end hose **must** be sufficiently rigid to continue its upward arc. The nozzleman's right hand holds the hose against his body and maintains hose curvature. The nozzleman's left hand appears to hold the entire

Nozzleman Knowledge



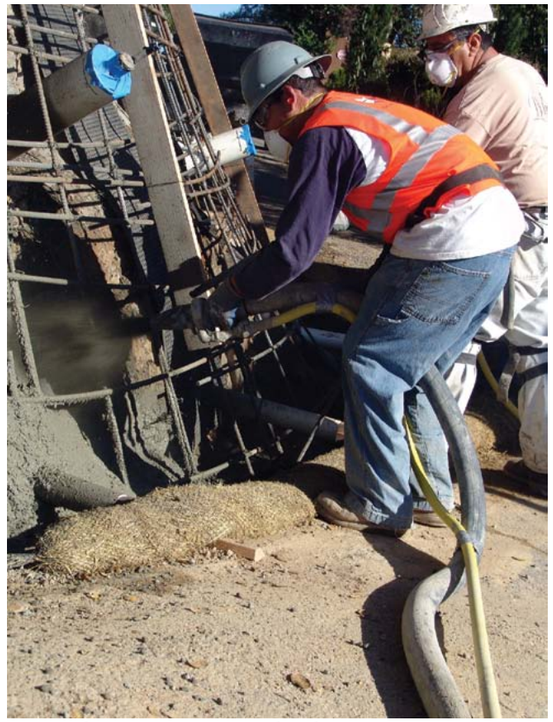


Fig. 6: Expert nozzleman maintains optimum nozzle position at various heights

hose up, but is actually pulling downward to both bend the hose and counteract nozzle thrust. This position effectively transfers much of the placement system's weight and thrust to the ground rather than through the nozzleman's body, considerably minimizing required effort. This posture is the foundation of all effective shooting positions.

Figure 6 demonstrates variations of excellent nozzleman posture. These positions combine maximum range of motion and precise nozzle control while greatly reducing fatigue.

Effective shooting positions are used by all professional nozzlemen to improve placement accuracy and offset the weight and thrust of a nozzle. It is the precision with which the material is applied—not the effort required—that defines a professional nozzleman.

Checklist

- Posture, movement, and mobility strongly affect overall placement precision.
- Study shooting positions used by experienced nozzlemen. Practice techniques that provide excellent mobility and range of movement.
- An effective shooting technique is reliant on effective placement equipment. Use properly sized, well-maintained equipment to generate a smooth, predictable nozzle stream.
- Select a flow rate that feels right. The ideal flow rate balances maximum placement precision with minimum fatigue.
- Shoot like a professional—diminish fatigue by using shooting positions that offset the weight and thrust of the nozzle.

*ACI Certified Nozzleman **Oscar Duckworth** is an ASA and ACI member with over 15,000 hours of nozzle time. He has worked as a nozzleman on over 2000 projects. Duckworth is currently an ACI Examiner for the wet- and dry-mix process. He continues to work as a shotcrete consultant and a certified nozzleman.*