

Definitions of Key Shotcrete Terminology

Shotcrete specifications—from mixture design through application—hold pool contractors responsible for shotcrete performance. Engineering plans, architectural renderings, or referenced concrete standards applied to pool construction use a variety of shotcrete terminology—both correctly and incorrectly. Understanding the meaning of the terminology is paramount to understanding the entire process as it relates to the pool construction industry. These key shotcrete terminology definitions are a starting point for any contractor building concrete swimming pools using the shotcrete process.

Shotcrete as a technology is not industry-specific. ASA and its Pool & Recreational Shotcrete Committee, however, are currently narrowing the focus on some key phrases or definitions that are used consistently in their practice area. These are steps to increase the cohesiveness and the uniformity of the shotcrete industry. Having contractors understand and use the same terminology for both the dry- and wet-mix processes immediately improves communication and understanding of all involved in the shooting applications. This understanding is the first step toward the universal acceptance of the shotcrete process by the entire pool industry.

TERMS

DEFINITIONS

Shotcrete

A concrete-placing process where concrete mixtures are conveyed through a hose and then pneumatically projected at a high velocity onto a surface to achieve high-quality, in-place compaction. It produces high-quality dense concrete with a low water-cementitious material ratio (*w/cm*), low permeability, and a high cementitious material content.

ACI

The American Concrete Institute (ACI) develops and publishes consensus documents (codes, specifications, and guides) for the shotcrete process through ACI Committee 506, Shotcreting. ACI also maintains the ACI Shotcrete Nozzleman Certification program under the guidance of ACI Committee C660.

ASA

ASA is a nonprofit organization of contractors, suppliers, manufacturers, designers, and engineers that encourages and promotes the safe and beneficial use of the shotcrete process. ASA is the primary sponsoring group for administering the ACI Shotcrete Nozzleman Certification program.

Admixture

Any material deliberately added to concrete before or during mixing, other than cementitious material, water, aggregates, and fiber reinforcement.*

Blowpipe

Air jet operated by a nozzleman's helper in shotcrete shooting to assist in keeping rebound or other loose material out of the work. Also known as an air lance.†

Brooming

A finishing procedure in which a broom is pulled across the shotcrete surface to roughen the surface.†

Cementitious paste

Mixture of cementitious material and water that is part of concrete.*

Compressive strength

Measured maximum resistance of a concrete or mortar specimen to axial compressive loading, expressed as a force per unit cross-sectional area (for example, lb/in.²).*

Concrete

A mixture of two components: aggregate and paste. The paste is made of cementitious materials and water and acts as the glue that binds the aggregates (sand and/or ground or crushed stone) into a hardened mass due to the chemical reaction of the cement and water (hydration).**

Consistency

The relative mobility or ability of freshly mixed concrete or mortar to flow.*

Cracking

It occurs when the rate of evaporation exceeds the rate of bleeding.*

Curing	Action taken to maintain moisture and temperature conditions in a freshly placed mixture to allow cementitious material hydration to occur so that the potential properties of the mixture may develop.
Cuttings	Shotcrete material that has been applied beyond the finish face and is cut off in the trimming or rodding process. [†]
Delivery equipment	Equipment that introduces and conveys shotcrete material into the delivery hose.
Delivery hose	Hose through which shotcrete materials pass on their way to the nozzle; also known as the material hose or conveying hose. [†]
Dry-mix shotcrete	Shotcrete in which most of the mixing water is added at the nozzle. [†]
Earth surface	When used as forms, must be firm, stable, and trimmed to the desired lines of the finished concrete.
Entrained air	Microscopic air bubbles intentionally incorporated in mortar or concrete during mixing, usually by use of a surface-active agent; typically between 0.0004 in. (10 μm) and 0.04 in. (1 mm) in diameter and spherical, or nearly so. [†]
Finish	The texture of a surface after consolidating and finishing operations have been performed. [‡]
Finisher	Craftsman who trims and finishes the surface of the shotcrete (also refer to Rodman). [†]
Fly ash	The finely divided pozzolanic residue resulting from the combustion of ground or powdered coal, which is transported from the firebox through the boiler by flue gases.*
Forms	A system for the in-place support of fresh shotcrete, which is rigid enough to resist the impact force of shotcrete while maintaining the intended shape and preventing excessive vibration.
Ground wire	Small-gauge, high-strength steel wire used to establish line and grade for shotcrete work; also called alignment wire, screed wire, or shooting wire. [†]
Gun	Dry-mix shotcrete delivery equipment. [†]
Gun finish	Undisturbed final layer of shotcrete as applied from a nozzle without hand finishing. Sometimes referred to as a natural finish. [†]
Gun operator	Craftsman on dry-mix shotcreting crew who operates delivery equipment. Sometimes referred to as “gunman.” [†]
Gunite	Trade name originally used for dry-mix shotcrete. [†]
Hose tender	Crew member responsible for moving and/or adjusting delivery hose to aid nozzleman; also responsible for delivery hose connections.
Hydration	The chemical reaction between hydraulic cementitious material and water.*
Impact velocity	The velocity of the material particles at impact on the receiving surface. [†] (Ideal at 350 to 400 ft/s [106 to 122 m/s].)
Mortar	A mixture of cementitious paste, fine aggregate, water, and admixtures. In fresh concrete, this is the material that occupies the spaces between the particles of coarse aggregate.*
Nozzle	Attachment at end of delivery hose where shotcrete is projected at high velocity. [†]
Nozzleman	Craftsman on a shotcrete crew who manipulates the shotcrete nozzle, controls material consistency (dry process), and controls the final placement of the material.
Overspray	Shotcrete material deposited away from intended receiving surface. [†]
Plastic shrinkage	Cracking that occurs in the surface of fresh concrete soon after it is placed and before initial set.
Pneumatic feed	Shotcrete delivery equipment in which a pressurized air stream conveys material. [†]
Positive displacement	Wet-mix shotcrete delivery equipment in which a pump or other non-pneumatic means pumps the material through the delivery hose in a solid mass. [†]

Porosity	The ratio of the volume of voids in a material to the total volume of the material.
Permeability	The rate of flow of water through a cross-sectional area of a porous medium under a given hydraulic gradient and temperature condition.
Pozzolan	A siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.*
Predampening	In the dry-mix process, adding water to the aggregate before mixing to bring its moisture content to a specified amount, usually 3 to 6%.†
Pump	Wet-mix delivery equipment.†
Pump operator	Craftsman on wet-mix shotcreting crew who operates the shotcrete pump.†
Rebound	Shotcrete material that bounces away from the surface against which the shotcrete is being projected.† Rebound has inadequate cementitious content as compared to the original shotcrete.
Rod	Sharp-edged cutting screed used to trim shotcrete to forms or ground wires.†
Rodman	Craftsman on the shotcrete crew who uses a rod or other tools to trim and finish the shotcrete.†
Rolling	The result of applying shotcrete at angles less than 90 degrees to the receiving surface, resulting in an uneven, wavy, textured surface at the outer edge of the spray pattern.†
Saturated surface-dry	(SSD) The moisture condition of the substrate so that it does not absorb water from the placed shotcrete.
Sand pocket	A zone in the shotcrete containing fine aggregate with little to no cement† (sand lens).
Shadow	The area behind an obstacle that is not adequately impacted and compacted by the shotcrete stream. In hardened shotcrete, shadow refers to any porous area behind an obstacle, such as reinforcement.†
Sloughing	Subsidence or sliding of shotcrete, generally due to excessive water in the mixture, also called sagging.†
Slump	A measure of the consistency of fresh concrete equal to the subsidence of a molded specimen immediately after removal of the slump cone.*
Substrate	Any material surface onto which shotcrete is applied.
Waterproof	Completely impervious to water in either liquid or vapor state. (Because nothing can be completely “impervious” to water under infinite pressure over infinite time, this term should not be used.‡)
Watertight	Impermeable to water except when under hydrostatic pressure sufficient to produce structural failure.
w/cm	The ratio of the total amount of water (including water in high-range water-reducing admixtures [HRWRA]) to the amount of cementitious material (portland cement, fly ash, silica fume, slag, or other supplemental cementitious materials) in a concrete mixture, stated on the basis of weight or mass; frequently abbreviated w/cm.*
Wet-mix shotcrete	Shotcrete where the concrete, including water, is completely mixed prior to introduction into the delivery hose; compressed air is introduced to the material flow at the nozzle.

References

*ACI Certification Craftsman Workbook (CP-60 09), American Concrete Institute, Farmington Hills, MI, 2009.

†ACI Committee 506, “Guide to Shotcrete (ACI 506R-05),” American Concrete Institute, Farmington Hills, MI, 2005, 40 pp.

‡“ACI Terminology,” American Concrete Institute, Farmington Hills, MI, 2010, http://www.concrete.org/Technical/CCT/ACI_Concrete_Terminology.pdf. (last accessed May 23, 2012)