

Concrete Repair Terminology

abrasion damage—surface deterioration caused by rubbing and friction against the surface.

abrasive—any hard, strong substance, such as rocks, sand, water, or minerals, that will cut, scour, pit, erode, or polish another substance.

abrasive blasting—a process for roughening, cleaning, or finishing a surface by propelling an abrasive medium at high velocity against it; commonly used methods include **sandblasting**, **shotblasting**, and **high-pressure water blasting**.

accelerated aging—deteriorating a material at a faster-than-normal rate by subjecting the material to specified accelerated test conditions.

accelerator—(1) a substance which, when added to a cementitious material, increases the rate of hydration of the hydraulic cement, shortens the time of setting, or increases the rate of hardening, strength development, or both; (2) any substance which increases the rate of a chemical reaction.

acceptance test—a test conducted to determine whether an individual lot of materials conforms to specifications or to determine the degree of uniformity of the material, or both.

acid etching—application of acid to clean or alter a concrete surface; typically used only when no alternative means of surface preparation can be used.

acoustic emission—sounds, both audible and subaudible, that are generated when a material undergoes irreversible changes, such as cracking in concrete; provides the basis for a nondestructive monitoring technique.

acoustic impact—a method used to detect the presence of delaminations or subsurface voids in concrete based on the sounds made by the concrete upon impact. (See also **chain drag** and **sounding**.)

acrylic resin—one of a group of thermoplastic resins formed by polymerization of the esters or amides in acrylic acid; used in concrete maintenance and repair as a surface sealer or bonding agent.

activator—a material that actuates a catalyst.

active cracks—those cracks for which the mechanism causing the cracking is still at work; any crack that is still moving.

adhesion—the bonding of two surfaces through interfacial effects such as molecular (valence) forces or interlocking action, or both.

adhesive failure—a rupture of an adhesive bond such that the separation appears to be between the adhesive and one or both of the adherends. (See also **cohesive failure**.)

adhesives—the group of materials used to cause similar or dissimilar materials to cohere.

admixture—a material other than water, aggregates, hydraulic cement, or fiber reinforcement, added to concrete, mortar, or grout, during batching or mixing to enhance plastic or hardened material properties, or both.

advancing-slope grouting—a grout injection technique that causes the leading edge of a mass of grout to move horizontally through preplaced aggregate.

age hardening—the progressive change in the chemical and physical properties of an adhesive leading to embrittlement. (see also **aging**.)

aggregate—granular materials, such as sand, gravel, and crushed stone, commonly used in concrete, mortar, or grout.

aggregate, reactive—aggregate containing substances capable of reacting with the alkalis in Portland cement; products of the reaction may cause abnormal expansion and cracking of concrete or mortar under certain service conditions.

aging—the cumulative effects of time on the properties of materials or substances.

agitation—the mixing and homogenization of slurries or finely ground powders by either mechanical means or injection of air.

agitator—a device for maintaining plasticity and preventing segregation of mixed grout, mortar, or concrete by shaking or stirring.

agitator tank—a vertical, open-top tank equipped with rotation blades used to prevent segregation of mixed grout.

air-entraining admixture—a material that creates microscopic air bubbles in concrete, mortar, or cement paste during mixing; used to increase the workability and frost resistance of the mixture.

air content—the volume of air voids in cement paste, mortar, or concrete, exclusive of pore space in aggregate particles, usually expressed as a percentage of total volume of the paste, mortar, or concrete.

air entrainment—the deliberate addition of microscopic air bubbles (generally smaller than 1 mm) to concrete or mortar during the mixing. (See also **air-entraining admixture**.)

air ring—perforated manifold in nozzle of wet-mix shotcrete equipment through which high pressure air is introduced into the material flow.

air-water jet—a high-velocity jet of air and water mixed at the nozzle, used to clean surfaces or remove deteriorated concrete; water sprayed at pressures less than 5,000 psi (35 MPa) will remove dirt and loose, friable material; water sprayed at pressures between 5,000 and 45,000 psi (35 - 300 MPa) will remove heavy encrustations of dirt and loose, friable material, including deteriorated concrete.

alignment wire—see **ground wire**.

alkali—salts of alkali metals, specifically sodium and potassium, occurring in constituents of concrete and mortar; usually expressed in chemical analyses as the oxides Na_2O and K_2O .

alkali-aggregate reaction—a chemical reaction between alkalies (sodium and potassium) from Portland cement or other sources and certain constituents of some aggregates that can cause abnormal expansion and cracking of concrete or mortar under certain service conditions.

alkali-carbonate rock reaction—the reaction between the alkalies (sodium and potassium) in Portland cement and certain carbonate rocks (particularly calcitic dolomite and dolomitic limestones) present in some aggregates.

alkali-silica reaction—the reaction between the alkalies (sodium and potassium) in portland cement and certain siliceous rocks or minerals, such as opaline chert, strained quartz, and acidic volcanic glass, present in some aggregates.

alligator cracks—surface cracking that forms a pattern similar to alligator hide.

ambient—surrounding natural conditions or environment in a given place and time.

angle of repose—the angle between the horizontal and the natural slope of loose material below which the material will not slide.

anisotropic—exhibiting different physical properties in different directions.

anode—the electrode in electrolysis at which negative ions are discharged, positive ions are formed, or other oxidizing reactions occur.

anodes, sacrificial—see **sacrificial anodes**.

anodic inhibitor—an inhibitor that reduces the corrosion rate by acting on the anodic (oxidation) reaction.

anodic protection—a technique to reduce the corrosion rate of a metal by polarizing it into its passive region where dissolution rates are low.

anodic reaction—corrosion reaction in which electrons are consumed; also referred to as oxidation.

anodic ring effect—corrosion process in which the steel reinforcement in concrete surrounding a repair area begins to corrode preferentially to reinforcement in the newly repaired area.



anticoagulant—a substance which prevents the coagulation of a colloid suspension or emulsion; also called a stabilizer and latex preservative.

antifoaming agent—an additive used to increase surface tension and reduce foaming tendencies, particularly in admixtures and materials applied by roller coating equipment.

antiwashout admixture—an admixture that increases the cohesiveness of concrete and prevents an excessive amount of fines from washing away from the aggregates when the concrete comes in contact with water.

application life—the period of time during which a material, after being mixed with a catalyst or exposed to the atmosphere, remains suitable for application.

application rate—the quantity (mass, volume, or thickness) of material applied per unit area.

aramid—a manufactured fiber in which the fiber-forming substance is a long-chain synthetic aromatic polyamide in which is at least 85 percent amide linkages are attached directly to two aromatic rings.

articulated joint—a joint with movement limited by restraint.

aspect ratio—the ratio of length to diameter of a fiber.

autogenous healing—a natural process of filling and sealing cracks in concrete or mortar when kept damp.

backer rod—a flexible, compressible rod placed in a joint to reduce the depth of sealant and improve its shape factor; it also serves to support the sealant against sagging and indentation.

backpack grouting—filling the annular space between a permanent tunnel lining and the surrounding formation with grout.

base—primary material in a multi-component system.

batch—quantity of material (concrete, mortar, grout, etc.) mixed at one time.

batch method—a quantity of grout materials are mixed or catalyzed at one time prior to injection.

batch mixer—a machine that mixes batches of concrete, mortar, or grout, in contrast to a continuous mixer.

batching—weighing or volumetrically measuring and introducing into the mixer the ingredients for a batch of either concrete or mortar.

bead—a strip of applied sealant, glazing compound, or putty.

bed joint—a horizontal mortar joint between a repair material and a substrate.

bentonite—a distinct type of fine-grained clay containing not less than 85 percent montmorillonite clay.

binders—cementing materials, either hydrated cements or products of cement or lime and reactive siliceous materials or other materials such as polymers that form the matrix of concretes, mortars, and sanded grouts.

blanket grouting—a method for reducing the permeability and strengthening the upper layers of bedrock by drilling and grouting shallow, closely spaced shallow holes according to a grid pattern.

bleaching—the fading of color toward white generally caused by exposure to chemicals or ultraviolet radiation.

bleeding—(1) the flow of mixing water within, or its emergence from newly placed concrete or mortar; (2) the absorption of oil resin or plasticizer from a compound into an adjacent porous surface; (3) the diffusion of color matter through a coating from underlying surfaces causing a color change.

blemish—a shallow defect in a hardened material that mars an otherwise smooth, uniformly colored surface. (See also **bleaching, bloom, bug holes, efflorescence, honeycomb, laitance, mottled, popout, rock pocket, and sand streak.**)

blended cement—see **cement, blended.**

blistering—(1) the irregular raising of a thin layer at the surface of placed mortar or concrete during or soon after completion of the finishing operation; (2) bulging of the finish plaster coat as it separates and draws away from the base coat; (3) the formation of air or gas pockets trapped within a thin-film coating, elastomeric membrane, or any impervious membrane.

bloom—(1) a visible exudate of efflorescence on the surface of a material; (2) a haziness which develops on coated surfaces caused by the exudation of a component of the coating system.

blow pipe—air jet used in shotcrete gunning to remove rebound other loose material from the work area.

blushing—a coating defect which manifests itself as a milky appearance which is generally caused by rapid solvent evaporation or the presence of excessive moisture during the curing process.

board butt joint—shotcrete construction joint formed by sloping gunned surface to a 1-in. (25-mm) board laid flat.

bond—adhesion and grip of a material to other surfaces against which it is placed; adherence between repairs and existing substrates.

bonded anchors—anchor systems which develop their holding capacities by the bonding of the cementitious or polymer adhesive to both the anchor and the concrete at the wall of the drilled hole.

bond breaker—a material used to prevent adhesion at a designated interface.

bond line—the interface between two surfaces bonded together with an adhesive.

bond strength—resistance to separation of a repair from the existing substrate or from reinforcing and other materials with which it is in contact.

bond strength, direct tension—see **tensile bond strength**.

bond strength, shear—see **shear-bond strength**.

bond strength, slant shear—see **slant-shear bond strength**.

bonding agent—a material applied to a suitable substrate to enhance bond between it and a succeeding layer.

boom-mounted breakers—mechanically operated equipment for removal of concrete by repeated, highenergy and low-frequency striking of the surface to spall and fracture the concrete. (See also **hand-held**

breakers, impact breakers, and scabblers.)

brittle—a tendency to crack or break when subjected to deformation; frangible.

broadcast—to toss granular material, such as sand, over a horizontal surface so that a thin, uniform layer is obtained.

broom and seed—a method for application of polymer concrete in which alternate layers of resin and aggregate are built up to form an overlay.

bruised surface—a surface layer weakened by interconnected microcracks in concrete substrates caused by use of high-impact, mechanical methods for surface preparation; fractured layer typically extends to a depth of 1/8 to 3/8 in. (3 to 10 mm) and frequently results in lower bond strengths as compared to surfaces prepared with nonimpact methods.

bubbling—a temporary or permanent film defect in which bubbles of air or solvent vapor are present in the applied film.

bug holes—small cavities in the surface of formed concrete caused by entrapment of air bubbles during placement and consolidation; usually no larger than 5/8 in. (15 mm) in diameter.

build—the wet or dry thickness of a coating or film.

build-up—placing material in layers to increase thickness.

bush-hammer—a serrated hammer with rows of pyramidal points used to roughen or dress a surface; to finish a surface with a bush-hammer.

calcium chloride—a white, deliquescent, hygroscopic compound, CaCl_2 ; can be used, in various technical grades, as a drying agent, an accelerator, a deicing chemical, a refrigerant, and to prevent dust.

carbon fiber—reinforcing fiber with light-weight, high-strength, and high-stiffness characteristics produced by oxidizing organic polymer fibers.

carbonation—the conversion of calcium ions in hardened cementitious materials to calcium carbonate by reaction with atmospheric carbon dioxide.

cast-in-place—frequently used repair technique in which mortar, concrete, or other materials are deposited in workable condition in the place where they harden and become part of the structure.

catalyst—a substance that significantly increases the rate of curing of a binder when added in a small quantity relative to the amount of primary reactants.

catalyst system—those materials that, in combination, cause chemical reactions to begin; catalyst systems normally consist of an initiator (catalyst) and an activator.

cathode—the electrode at which chemical reduction occurs.

cathodic protection—a form of corrosion protection for reinforced concrete wherein a sacrificial metal is caused to corrode in preference to the reinforcement, thereby protecting the reinforcement from corrosion.

cathodic protection, impressed current—a protection system that uses an external power supply to force a small amount of electric current through the reinforcing steel to counteract the flow of current caused by the corrosion process; a metal, such as platinum that corrodes at a very slow rate, is typically provided as an anode.

cathodic protection, sacrificial—protection system that does not require an external power supply; a metal, such as zinc that is less noble or more prone to corrosion than steel, corrodes in place of the reinforcing steel thus protecting the structure.

caulk—to install or apply a sealant across or into joints, cracks, or crevices to prevent the passage of air or water.

cavitation damage—pitting of concrete caused by implosion of water vapor bubbles in fast-flowing water; bubbles form in areas of subatmospheric pressures immediately downstream from an obstruction or offset and collapse as they enter areas of higher pressure.

cement, expansive—a type of cement that produces a paste that, after setting, increases in volume to a significantly greater degree than does portland-cement paste; used in some repair materials to compensate for drying shrinkage.

cement, high-early-strength—cement that reaches a given level of strength in mortar or concrete earlier than normal cement does.

cement, portland—a hydraulic cement produced by pulverizing portland-cement clinker and usually containing calcium sulfate.

cement, regulated set—a hydraulic cement containing fluorine-substituted calcium aluminate, capable of very rapid setting.

cement, sulfate-resistant—portland cement with a low tricalcium aluminate content, which makes concrete more resistant to damage from dissolved sulfates in water or soils.

cement, white—portland cement which hydrates to a white paste, made from raw materials of low iron content.

cement paste—a mixture of cement and water.

cementation process—pressure injection of cement grout into gravel, fractured rock, etc, to solidify it. **cementitious**—having cementing properties.

chain drag—a nondestructive testing method in which the sounds from chains dragged over a concrete surface are used to detect delaminations; dull or hollow sounds indicate delaminated areas, whereas nondelaminated concrete exhibits a clear ringing sound.

chalking—the loose powder caused by decomposition of a concrete surface or degradation of a coating.

charging—placing materials into a mixer or other container for further processing.

checking—shallow, closely spaced cracks that form an irregular pattern. (See also **craze cracks** and **crazing**.)

chemical attack—material degradation as a result of the action of chemical agents such as acids, bases, salts, and moisture.

chemical bond—bond between materials that is the result of cohesion and adhesion developed by chemical reaction.

chemical compatibility—any combination of materials that results in a chemically stable repair system.

chemical grout—any grouting material characterized by being a true solution; no particles in suspension. (See also **particulate grout**.)

chemical grout system—any mixture of materials used for grouting purposes in which all elements of the system are true solutions (no particles in suspension).

chemical resistance—resistance to chemical reaction as a result of contact with or immersion in various solvents, acids, alkalies, salts, etc.

chipping—to remove all or part of a hardened concrete section with a chisel.

chisel point—point with two major planes forming a “V” and a pair of minor planes on each flank; forming a hexagonal cross section.

chloride content—total amount of chloride ion present in concrete or mortar.

chloride diffusion—the dispersal of chlorides within a concrete section.

chloride ion—anion of the commonly used deicing salts and of the accelerating admixtures calcium chloride and sodium chloride.

chloride threshold—the amount of chloride required to initiate steel corrosion in reinforced concrete under a given set of exposure conditions; commonly expressed in percent of chloride ion by mass of cement.

chlorinated rubber—resin produced by the reaction of natural rubber with chlorine gas; coatings formulated from this resin have good resistance to acids, alkalis, and chemicals generally, but not to aromatic solvents, gasoline, etc.

chopped strand—rovings fibers that are chopped into short lengths for use in mats, spray-up, or molding compounds.

circuit grouting—a grouting method by which grout is circulated through a pipe extending to the bottom of the hole and back up the hole via the annular space outside the pipe, the excess grout being diverted back over a screen to the agitator tank by means of a packing gland at the top of the hole; used where holes tend to cave and sloughing material might otherwise clog openings to be grouted.

cleanup—treatment of existing concrete substrate to remove all surface material and contamination down to a condition of cleanness corresponding to that of a freshly broken surface of concrete.

closure—achieving the desired reduction in grout take by splitting the hole spacing; if closure is being achieved, there will be a progressive decrease in grout take as primary, secondary, tertiary, and quaternary holes are grouted.

coal tar—a material produced by the destructive distillation of coal; coal tar epoxies are coatings in which the binder is a combination of coal tar and epoxy resins.

coating—liquid, with or without fillers or reinforcement, that is applied to a substrate by brushing, dipping, mopping, spraying, troweling, etc., to form a material that will bond to and preserve, protect, decorate, seal, or smooth the substrate; also used to provide a barrier to contain chemicals.

coating, high-build—see **high-build coating**.

coaxial dispenser—a two-component device that contains one dispensing cartridge within another; plungers for each cartridge are depressed simultaneously to extrude the adhesive components in the proper proportions, usually through a static mixing tube.

coefficient of permeability—the rate of discharge of water under laminar-flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions (usually 20°C).

coefficient of thermal expansion—change in linear dimension per unit length or change in volume per unit volume per degree of temperature change.

cofferdam—a temporary structure enclosing all or part on a construction area so that construction or repair can proceed in the dry.

cohesion—the state in which the constituents of a mass of material are held together by chemical and physical forces.

cohesive failure—rupture of an adhesive bond such that the separation appears to be within the adhesive.

cold joint—a unplanned joint or discontinuity resulting from a delay in placement of sufficient time to preclude a union of the material in two successive lifts.

cold-weather concreting—special concreting and construction practices used to offset the limiting effects of cold conditions.

collar—(1) jackets which surround only a portion of a column or pier; typically used to provide increased support to the structural member at the top of the column or pier. (2) the surface opening of a borehole.

colloid—a substance that is in a state of division preventing passage through a semipermeable membrane, consisting of particles ranging from 0.1 to 0.001 μm in diameter.

colloidal grout—see **grout, colloidal**.

communication—subsurface movement of grout from an injection hole to another hole or opening.

compaction grout—injection grout with less than 1 in. (25 mm) slump; normally a soil-cement with sufficient silt sizes to provide plasticity and sufficient sand sizes to develop internal friction; generally does not enter soil pores but remains in a homogenous mass that provides controlled displacement to compact loose soils or lift structures, or both.

compatibility—(1) a balance of physical, chemical, and electrochemical properties and dimensions between a repair material and the existing substrate; (2) the capacity of two or more materials to combine or remain together without undesirable aftereffects; (3) mutual tolerance.

composite—a product or system that is a combination of individual elements or materials, e.g., a typical composite repair system includes the concrete substrate, the adhesive bonding agent, and the repair material.

composite construction—a type of construction with different materials and structural elements that are sufficiently interconnected that the combined components respond to loads as a unit.

compound—a mixture of a polymer with other ingredients such as fillers, stabilizers, catalysts, processing aids, lubricants, modifiers, pigments, or curing agents.

compression seal—a seal that is attained by a compressive force on the sealing material.

compressive strength—the measured maximum resistance of a test specimen to axial compressive loading; expressed as force per unit cross-sectional area.



concrete—a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate; in portland-cement concrete, the binder is a mixture of portland cement and water.

concrete, epoxy—a mixture of epoxy resin, curing agent, fine aggregate, and coarse aggregate. (See also **epoxy mortar**, **epoxy resins**, and **concrete, polymer**).

concrete, fiber-reinforced—concrete containing dispersed, randomly oriented fibers.

concrete, fresh—unhardened concrete that can be consolidated by the intended method.

concrete, high-early-strength—concrete that contains high-early-strength cement or admixtures which allow it to reach a specified strength earlier than normal concrete would.

concrete, high-strength—concrete that has a specified compressive strength for design of 6000 psi (41 MPa) or greater.

concrete, mass—any volume of concrete with dimensions large enough to require that measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking.

concrete, plain—concrete without reinforcement.

concrete, polymer—a composite material in which the fine and coarse aggregates are bound together in a dense matrix with a polymer binder; also known as **resin concrete**.

concrete, polymer-modified—a mixture of water, hydraulic cement, aggregate, and a monomer or polymer; polymerized in place when a monomer is used.

concrete, preplaced-aggregate—concrete produced by placing coarse aggregate in a form and later injecting a portland cement-sand grout, usually with admixtures, to fill the voids.

concrete (mortar, grout), preshrunk—(1) concrete that has been mixed for a short period in a stationary mixer before being transferred to a transit mixer. (2) grout, mortar, or concrete that has been mixed 1 to 3 hr before plng in order to reduce shrinkage during hardening.

concrete, pumped—concrete which is transported through a hose or pipe by means of a pump.

concrete, reinforced—concrete containing adequate reinforcement (prestressed or not prestressed) and designed on the assumption that the two materials act together in resisting forces.

concrete, roller-compacted—concrete compacted by roller compaction; concrete that, in its unhardened state, will support a roller while being compacted.

concrete, structural—concrete used to carry structural load or to form an integral part of a structure; concrete of a quality specified for structural use.

concrete, tremie—concrete placed underwater with a tremie pipe or hose.

concrete breakers—hand-held or machine mounted equipment commonly used for removal of concrete by repeated striking of the surface to spall and fracture the concrete. (See also **boom-mounted breakers**,

hand-held breakers, **impact breakers**, and **scabblers**.)

condensed silica fume—see **silica fume**.

condition—to equalize the moisture in a material with that of a specified atmosphere.

conductive-polymer mortar—a rigid material formulated by polymerization of a select resin system and conductive petroleum coke which is capable of distributing impressed anodic current; the material is used to fill cut slots, as strips or ribbons in grid-fashion on a bridge deck or structure, or applied as a thin overlay to substructure concrete members to stop the corrosion of reinforcing steel.

conductivity, thermal—see **thermal conductivity**.

consolidation—the process whereby the volume of freshly placed mortar or concrete is reduced to the minimum practical space, usually by vibration, rodding, tamping, or some combination of these actions; to mold mortar or concrete within a form or repair cavity and around embedded items and reinforcement and eliminate voids other than entrained air. (See also **rodding** and **tamping**.)

consolidation grouting—injection of a fluid grout, usually sand, portland cement, and water, into a compressible soil mass in order to displace it and form a lenticular grout structure for support.

construction joint—interface between two successive placements; bond is typically required at such joints and reinforcement may be continuous.

contact grouting—see **backpack grouting**.

contact splice—a means of connecting reinforcing bars in which the bars are lapped and in direct contact. (See also **lap splice**.)

continuity, reinforcement—see **reinforcement continuity**.

continuous mixer—a mixer into which the ingredients of the mixture are fed without stopping, and from which the mixed product is discharged in a continuous stream.

contraction—a drawing together that reduces the volume or length of a mass or object.

control joint—formed, sawed, or tooled groove in a repair surface to create a weakened plane and regulate the location of cracking resulting from restrained contraction of the repair material.

controlled low-strength material—a self-compacted, cementitious material used primarily as a backfill in lieu of compacted fill.

conveying hose—see **delivery hose**.

coping—the top layer or a covering on a wall or pier exposed to the weather, usually sloped to carry off water.

copolymerization—see **polymerization**.

copper-copper sulfate half cell—a commonly used standard reference electrode used to measure the electrical potential between it and the reinforcing steel.

core—a cylindrical sample of hardened concrete or rock obtained by means of a core drill.

core recovery—ratio of the length of core recovered to the length of hole drilled, usually expressed as a percentage.

coring—the process of drilling and extracting cores from concrete structures or rock foundations.

corrosion—degradation of concrete or steel reinforcement caused by electrochemical or chemical attack.

corrosion inhibitor—a chemical compound which, when used as an admixture in fresh concrete or as a topical application to hardened concrete, inhibits corrosion of embedded metal.

corrosion threshold—total chloride or soluble chloride content necessary to initiate corrosion of metals embedded in concrete. Usually assumed to be 1.0 to 1.4 lb/cu yd or approximately 0.4% by wt of cement?

cover—(1) in reinforced concrete, the least distance between the surface of the reinforcement and the outer surface of the concrete. (2) in grouting, the thickness of rock and soil material overlying the stage of the hole being grouted.

coverage—the area that a specified volume of coating will cover to a specified dry thickness.

covermeter—a nondestructive testing method for locating embedded steel reinforcement, measuring depth of cover, and estimating the diameter of reinforcement by measuring the change in a low frequency alternating magnetic field applied on the surface of a member.

crack—a complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.

crack bridging—the ability of repair or protective surface treatment to remain continuous when installed on a cracked concrete surface.

crack injection—a method for sealing or repairing cracks by injecting a polymer.

crack monitor—a device that measures the movement of cracks.

cracks, active—see **active cracks**.

cracks, dormant—see **dormant cracks**.

craze cracks—fine random cracks or fissures in a surface.

crazing—the development of craze cracks; the pattern of craze cracks existing in a surface. (See also **checking** and **craze cracks**.)

creep—time-dependent deformation resulting from a sustained load.

creep, compressive—creep that occurs because of compressive load.

creep, drying—creep caused by drying.

creep, tensile—creep that occurs because of tensile load.

critical saturation—the condition reached when the degree to which freezable water fills a pore space in cement paste or aggregate affects the response to freezing; usually taken to be 91.7 percent because of the 9 percent increase in volume of water when it changes to ice.

crosshole logging—a nondestructive testing method for locating low-quality concrete with transducers positioned along the length of holes drilled into a deep foundation. (See also **ultrasonic pulse velocity**.)

cross-linking—the chemical bonding between linear polymer chains to form a three-dimensional network.

crystallization—arrangement of previously disordered material segments of repeating patterns into geometric symmetry.

cure—the process by which a compound attains its intended performance properties by means of evaporation, chemical reaction, heat, radiation, or combinations thereof.

cure time—the time interval between formation or placement of a material and the materials' reaching specified design properties; some materials require specified treatment during this interval.

curing—the maintenance of a favorable temperature and moisture environment for freshly placed repair materials during some definite period following placing, casting, or finishing so that the desired properties may develop.

curing agent—see **catalyst** and **hardener**.

curing compound—a liquid coating that can be applied on fresh cementitious materials to minimize moisture loss or reflect heat so that the properties of a material can develop in a favorable environment.

curling—the distortion of an originally essentially linear or planar member into a curved shape such as the warping of a slab due to creep or to differences in temperature or moisture content in the zones adjacent to its opposite faces. (See also **warping**.)

curtain grouting—subsurface injection of grout to create a barrier of grouted material transverse to the direction of anticipated water flow.

cutting screed—sharp-edged tool used to trim shotcrete to finished outline. (See also **rod**.)

damp—either moderate absorption or moderate covering of moisture; implies less moisture than a wet condition and slightly more moisture than a moist condition.

dampproofing—treatment of a material to retard the passage or absorption of water or water vapor either by application of a suitable coating to exposed surfaces or by use of a suitable admixture.

D-cracking—a series of cracks in concrete near and roughly parallel to joints, edges, and structural cracks.

dead load—a constant load that in structures is due to the mass of the members, the supported structure, and permanent attachments or accessories.

debond—a separation of bonded surfaces.

deflection—movement of a point on a structure or structural element, usually measured as a linear displacement transverse to a reference line or axis.

deformation—a change in shape or size.

deformation, time-dependent—deformation caused by time-dependent factors such as autogenous volume change, thermal contraction or expansion, creep, shrinkage, and swelling.

degradation—a detrimental change in the physical and/or chemical properties of a material.

delamination—a separation along a plane parallel to a surface as in the separation of a coating from a substrate or the layers of a coating from each other, or in the case of a concrete slab, a horizontal splitting, cracking, or separation of a slab in a plane roughly parallel to, and generally near, the upper surface.

delivery equipment—equipment which introduces shotcrete material into the delivery hose.

delivery hose—hose used to place shotcrete, grout, or pumped concrete or mortar; also known as a **conveying hose** or **material hose**.

deterioration—physical manifestation of failure of a material (e.g., cracking, delamination, flaking, pitting, scaling, spalling, staining) caused by service conditions or internal autogenous influences. (See also **disintegration** and **weathering**.)

dew point—the temperature of a surface at a given ambient temperature and relative humidity, at which condensation of moisture will occur.

dewatering—the removal and control of subsurface groundwater from soil or rock formations. (See also **unwatering**.)

diagonal crack—an inclined or slanted crack that is nonparallel to the transverse or longitudinal axis of a member.

diamond wire cutting—a method for removal of concrete sections with a wire that contains modules impregnated with diamonds; the wire is wrapped around the concrete mass to be cut and connected to a power pack so that it travels in a continuous loop.

differential settlement—a relative variation in rate and/or magnitude of settlement in different areas of a structure.

dimensional compatibility—a balance of dimensions, or volumetric stability, between a repair material and the existing substrate.

direct shear test—a shear test in which a material under an applied normal load is stressed to failure by moving one section of the specimen relative to the other section in direction perpendicular to the applied normal load.

discoloration—fading or other alteration of a color that changes the normal appearance.

disintegration—reduction of a mass to components, fragments, or particles. (See also **deterioration** and **weathering**.)

dispenser, coaxial—see **coaxial dispenser**.

dispersing agent—a material capable of increasing the fluidity of cement paste, mortars, or concrete by reduction of interparticle attraction.

displacement grouting—injection of grout into a formation in such a manner as to move the formation; movement may be controlled or uncontrolled. (See also **penetration grouting**.)

distortion—see **deformation**.

distress—physical manifestation of cracking and distortion in a structure as the result of stress, chemical action, or both.

dormant cracks—those cracks not currently moving or whose movement is of such magnitude that the repair will not be affected.

dowel—(1) a steel pin, commonly a plain round steel bar, which extends into adjoining portions of a concrete construction, as at a joint in a pavement slab, so as to transfer shear loads; (2) a deformed reinforcing bar intended to transmit tension, compression, or shear through a construction joint.

drain—a pipe or channel used to remove water.

drainage curtain—a row of open holes drilled parallel to and downstream from the grout curtain of a dam for the purpose of reducing uplift pressures.

drainage gallery—an opening or passageway within a concrete structure from which grout holes or drainage holes are drilled. (See also **grout gallery**.)

drilled-in port—pipe nipple for grout hose connection which is embedded in a short entry hole drilled into the concrete surface.

dry-mix shotcrete—shotcrete to which most of the mixing water is added at the nozzle. (See also **pneumatic feed**.)

dry pack—very dry portland-cement mortar or polymer-modified mortar usually compacted by ramming.

dry packing—hand placement of very dry mortar and the subsequent tamping or ramming of the mortar into a confined place.

drying shrinkage—shrinkage resulting from loss of moisture.

durability—the ability of a structure or its components to maintain serviceability in a given environment over a specified time.

durability factor—a measurement of the ability of a material to retain its properties over a period of time in which it is exposed to deleterious conditions; usually expressed as percentage of the value of a given property before exposure.

dusting—the development of a powdered material at the surface of a cementitious material.

dye tracer—an additive whose primary purpose is to change the color of grout or water.

dynamic modulus of elasticity—the modulus of elasticity computed from the size, weight, shape, and fundamental frequency of vibration of a concrete test specimen, or from pulse velocity.

efflorescence—a deposit of white salts left on a surface when a solution containing the salts leaches from concrete or masonry and then evaporates.

efflux time—time required for all grout to flow from a flow cone. (See also **flow cone**.)

elastic modulus—see **modulus of elasticity**.

elasticity—that property of a material that enables it to return to its original size and shape after deformation.

elastomer—a rubber-like material that returns rapidly to approximately its initial dimensions and shape after removal of the deforming force.

elastomeric—having the characteristics of an elastomer.

electrical resistivity—a measure of the resistance of a material to flow of electric current.

electric log—a record or log of a borehole obtained by lowering electrodes into the hole and measuring any of the various electrical properties of the materials traversed.

electrochemical chloride extraction—removal of chlorides from concrete by application of a direct current that causes chlorides to migrate to the concrete surface.

electrochemical compatibility—a balance of electrochemical properties of two materials in contact.

electrolysis—production of chemical changes by the passage of current through an electrolyte.

electrolyte—a conducting medium in which the flow of current is accompanied by movement of matter; usually an aqueous solution.

electrolytic cell—a unit apparatus in which electrochemical reactions are produced by applying electrical energy, or that supplies electrical energy as a result of chemical reactions and that includes two or more electrodes and one or more electrolytes contained in a suitable vessel.

elephant trunk—an articulated tube or chute used in concrete placement.

elongation—increase in length.

emulsion—a two-phase liquid system in which one liquid is immiscible in and uniformly dispersed throughout another liquid.

endothermic reaction—a chemical reaction in which heat is absorbed.

envelope grouting—grouting of rock surrounding a hydraulic pressure tunnel to consolidate the rock and reduce permeability of the area.

epoxy injection—a method for sealing or repairing cracks in concrete by injecting epoxy adhesives.

epoxy mortar—a mixture of epoxy resin, curing agent, and fine aggregate.

epoxy resins—a class of organic chemical bonding systems used in the preparation of special coatings for concrete, adhesives for injection of cracked concrete, or as binders in epoxy-resin mortars and concretes.

erosion—progressive disintegration of a solid by the abrasive or cavitation action of gases, fluids, or solids in motion. (See also **abrasion damage** and **cavitation damage**.)

ettringite—a mineral, high-sulfate calcium sulphoaluminate, occurring in nature or formed by sulfate attack on mortar or concrete.

ester—a class of compounds formed by the reaction of alcohols and organic acids.

evaluation—the process of determining the need for maintenance, repair, or rehabilitation of concrete and concrete structures by identifying the cause and extent of distress or deterioration. (See also **repair**, **maintenance**, and **rehabilitation**.)

evaporable water—water in set cement paste that can be removed by specified drying conditions. (See also **non-evaporable water**.)

exfoliation—disintegration by scaling or peeling off in thin flakes; corrosion along planes parallel to the surface that forces metal away from the body of the material resulting in a layered appearance.

exotherm—heat released during a chemical reaction.

exothermic reaction—a chemical reaction in which heat is evolved.

expansion—increase in either length or volume.

expansion anchors—anchor systems which develop their strength from friction against the side of the drilled hole, from keying into a localized crushed zone of the concrete resulting from the setting operation, or keying into an undercut at the bottom of the drilled hole, or from a combination of friction and keying; includes torque-controlled, deformation-controlled, and undercut anchors.

expansive cement—see **cement, expansive**.

extender—a finely divided inert mineral or coarse aggregate added to provide economical bulk in synthetic resins and adhesives or cementitious mortars.

extensibility—the maximum tensile strain that hardened cement paste, mortar, or concrete can sustain without formation of a continuous crack.

extensometer points—an arrangement of three embedded plugs or surface-mounted discs, two on one side of a crack and the third on the other, which, when used in combination with a mechanical strain gage, provides a technique for monitoring crack width.

external strengthening—the bonding or anchoring of reinforcing elements, e.g., steel plates, fiberreinforced plastics, and external posttensioning, on the exterior of structural members to increase structural capacity.

explosive blasting—a method for fracturing and removing concrete with rapidly expanding gas confined within a series of bore holes; a cost effective and expedient means for removing large quantities of concrete.

exudation—a liquid or viscous gel-like material discharged through a pore, crack, or opening in the surface of concrete.

failure—a point at which a material stops performing as it was intended to.

failure, adhesive—see **adhesive failure**.

false set—the rapid development of rigidity in a freshly mixed portland cement paste, mortar, or concrete without the evolution of much heat, which rigidity can be dispelled and plasticity regained by further mixing without addition of water.

fascia—a flat member or band at the surface of a building or the edge beam of a bridge; also exposed eave of a building.

fatigue—the weakening or failure of a material subjected to prolonged or repeated stress.

faulting—a crack or joint in a surface along which there has been relative vertical displacement of the two sides parallel to the discontinuity.

feather edge—to smoothly blend the edge of a repair or topping into the existing concrete at an acute angle.

feed wheel—material distributor or regulator in certain types of shotcrete equipment.

fiber mat—a fibrous reinforcing material composed of chopped filaments (for chopped-strand mat) or swirled filaments (for continuous-strand mat) with a binder applied to maintain form; available in blankets of various widths, weights, thicknesses, and lengths.

fiber-reinforced composite—any composite material consisting of a matrix reinforced by continuous or discontinuous fibers.

fiber-reinforced plastics (FRP)—a general term for a composite material or part that consists of a resin matrix containing reinforcing fibers such as glass or carbon having greater strength or stiffness than the resin; FRP is most often used to denote glass fiber-reinforced plastics while the term “advanced composite” usually denotes high-performance aramid or carbon fiber-reinforced plastics.

fibrous concrete—see **concrete, fiber-reinforced**.

field-cured cylinders—test cylinders that are left at the jobsite for curing as nearly as practicable in the same manner as the repair material to indicate when supporting forms may be removed, additional construction loads may be imposed, or the structure may be placed in service.

field-molded sealant—a liquid or mastic sealant that is shaped by the joint into which it is placed.

filaments—individual fibers of indefinite lengths used in tows, yarns, or roving.

filler—a general term for an inert material that occupies space and may improve physical properties or lower cost. (See also **extender**.)

film—a thin coating over the surface of a material.

finish coat—the final thin coat of shotcrete applied prior to hand finishing. (See also **flash coat**.)

finishing—leveling, smoothing, consolidating, and otherwise treating the surface of a repair material to produce the desired appearance.

fissure—a narrow opening, crack, or separation on a concrete surface.

flash coat—a thin coat of shotcrete applied from a distance greater than normal for use as a final coat or for finishing.

flash point—the lowest temperature of a liquid at which sufficient vapor is provided to form an ignitable mixture when combined with air.

flexural strength—the property of a solid that indicates its ability to resist failure in bending. (See also **modulus of rupture**.)

fouling—marine growth such as barnacles adhering to a substrate.

form and pump—repair method for vertical and overhead repairs in which a formed cavity is filled with mortar or concrete under pump pressure.

flow—a measure of the consistency of freshly mixed concrete, mortar, or cement paste in terms of the increase in diameter of a molded, truncated cone specimen after that has been jiggled a specified number of times.

flow line—a defect induced by discontinuous flow velocities and lack of proper consolidation during placement of concrete by pumping.

fluidifier—an admixture employed in grout to decrease the flow factor without changing water content. (See also **water reducer**.)



fly ash—the finely divided residue resulting from the combustion of pulverized coal in electric power generating plants.

fly ash, Class C—ash normally produced by burning sub-bituminous coal or lignite; usually has significant cementitious properties in addition to pozzolanic properties, particularly those ashes with CaO contents of 15 to 30 percent.

fly ash, Class F—ash usually produced by burning anthrte or bituminous coal; ashes generally have CaO contents less than 10 percent and are rarely cementitious when mixed with water alone.

fog curing—application of atomized fresh water to cementitious repair materials.

form—a temporary structure or mold for the support of a repair while it is curing and gaining sufficient strength to be self-supporting.

form lining—materials used to line the interior face of formwork in order to impart a smooth or patterned finish to the repair surface, to absorb moisture from the repair material, or to apply a set-retarding chemical to the formed surface.

form scabbing—inadvertent removal of the surface of a repair material because it had adhered to the form.

fracture—a crack or break, as of concrete, or a rock mass; the configuration of a broken surface; also the action of cracking or breaking. (See also **crack**.)

friction—force that resists the relative motion of two surfaces in contact.

full-depth repair—removal and replacement of damaged or deteriorated concrete that constitutes the full depth of a member or element.

fungicide—a substance poisonous to fungi used to retard or kill mold and mildew growth.

furan resin—a thermosetting catalyzed condensation reaction product from furfuryl alcohol, furfural or combination thereof.

fuzzy—a hairy appearance caused by protruding broken fibers or filaments.

gage length—the original length of that portion of a specimen or structure over which a deformation measurement is made.

galvanic corrosion—accelerated corrosion of a metal because of an electrical contact with a more noble metal or nonmetallic conductor in a corrosive electrolyte.

gel—(1) matter in a colloidal state that does not dissolve, but remains suspended in a solvent from which it fails to precipitate without the intervention of heat or of an electrolyte. (2) the condition where a liquid grout begins to exhibit measurable shear strength.

gel time—the time interval between mixing the constituents of a liquid material and the formation of a gel.

geomembrane—a flexible, watertight polymeric membrane with a thickness of one-half to a fewmillimeters; a wide range of polymers, including plastics, elastomers and blends of polymers are used to manufacture geomembranes.

geonet—a geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids and gases.

glass fibers—reinforcing fiber made by drawing molten glass through bushings; the predominant reinforcement for polymer matrix composites, known for its good strength, process ability, and low cost.

glass-fiber reinforced cement—a composition material consisting essentially of a matrix of hydraulic cement paste or mortar reinforced with glass fibers; typically precast into units less than 1-in. (25-mm) thick.

glass-transition temperature—the midpoint of the temperature range over which an amorphous material (such as glass or a high polymer) changes from (or to) a brittle, vitreous state to (or from) a plastic state.

go-devil—a ball of rolled-up burlap or a specially fabricated device placed in a tremie pipe immediately prior to introduction of the concrete to keep the concrete from mixing with water in the pipe as the concrete flows to the bottom of the pipe.

gravity feed—the movement of materials from one container to another container or location by force of gravity.

gravity grouting—grouting by using only the height of the fluid column to provide pressure.

gravity soak—method for repair of cracks in horizontal concrete sections by topical application of a low viscosity resin.

grinding—the removal of thin coatings, mineral deposits, or slight protrusions on a concrete surface with rotating abrasive stones or discs under pressure at right angles to the surface.

grit blasting—abrasive blasting with small irregular pieces of steel or malleable cast iron.

groove joint—a joint created by forming a groove in the surface of a repair to control random cracking.

grooving—a process in which narrow parallel channels are cut into the surface of a material to improve

drainage and skid resistance of surfaces subjected to traffic.

ground penetrating radar—see **short-pulse radar**.

ground wire—small-gage high-strength steel wire used to establish line and grade as in shotcrete work; also called **alignment wire** and **screed wire**.

grout—a mixture of cementitious material and water, with or without aggregate, proportioned to produce a pourable consistency without segregation of the constituents; also a mixture of other composition but of similar consistency.

groutability—the ability of a formation to accept grout.

grout cap—a cap that is formed by placing concrete along the top of a grout curtain; often used in weak foundation rock to secure grout nipples, control leakage, and form an impermeable barrier at the top of a grout curtain.

grout, colloidal—grout in which a substantial proportion of the solid particles have the size range of a colloid.

grouting—the process of injecting or placing grout.

grout gallery—an opening within a dam used for grouting or drainage operations.

grout header—a pipe assembly attached to a ground hole, and to which lines for injecting grout are attached; sometimes called a grout manifold.

grout mixture—the proportions or amounts of the various materials used in the grout, expressed by weight or by volume.

grout nipple—a short length of pipe installed at the collar of the grout hole to facilitate drilling grout injection.

grout slope—the natural slope of fluid grout injected into preplaced-aggregate concrete.

grout system—combination of materials used in a specified grout mixture.

grout take—the measured quantity of grout injected into a unit volume of formation, or a unit length of grout hole.

guideline—a written statement of policy or procedure.

gun—delivery equipment that pneumatically places shotcrete and freshly mixed concrete.

gun casting—a procedure in which concrete or mortar is placed with a special velocity-reducing casting head and standard shotcrete delivery equipment.

gun finish—undisturbed final layer of shotcrete as applied from nozzle, without hand finishing.

Gunite—a proprietary term for shotcrete.

gunman—workman on shotcreting crew who operates delivery equipment.

gunning—pneumatically projecting shotcrete onto surface to be gunned.

gunned pattern—(1) conical outline of material discharge stream in shotcrete operation; (2) the sequence of gunning operations to insure complete filling of the space, total encasement of reinforcing bars, easy removal of rebound, and thickness of shotcrete layers.

hairline cracks—cracks in an exposed concrete surface that are barely visible because of their extremely narrow widths.

halo effect—see **anodic ring effect**.

half-cell potential—a nondestructive testing method for identifying regions in a reinforced concrete structure where there is a high probability that corrosion is occurring at the time of test by measuring the potential difference (voltage) between the steel reinforcement and a standard reference electrode; a copper-copper sulfate half cell is commonly used on bridge decks.

Hamm tip—flared shotcrete nozzle having a larger diameter at midpoint than at either inlet or outlet; also designated premixing tip.

hand-held breakers—equipment commonly used for removal of concrete by repeated, low-energy and high-frequency striking of the surface to spall and fracture the concrete. (See also **boom-mounted**

breakers, impact breakers, and scabblers.)

hardener—in a two-component adhesive or coating, the chemical component that causes the resin component to cure.

hardness—the resistance of a material to deformation, particularly permanent deformation, indentation, or scratching.

heat-deflection temperature—the temperature at which a plastic material has an arbitrary deflection when subjected to an arbitrary load and test condition; this is an indication of the glass-transition temperature.

heat of hydration—heat evolved during the setting and hardening of portland cement.

heat of solution—heat emitted or absorbed by a substance being dissolved in a solvent.

high-build coating—protective surface treatment with a dry thickness greater than 10 mils (0.25 mm) and less than 30 mils (0.75 mm) applied to the surface of concrete.

high-molecular weight methacrylate—a low-viscosity substituted methacrylate monomer that is characterized by low volatility.

high-pressure water blasting—a process for cleaning, or roughening with a stream of water under high pressure that contains an abrasive such as sand, aluminum oxide, or garnet.

high-pressure water jets—water jets with a force capable of selectively cutting through deteriorated concrete; widely used as a surface preparation method in concrete repair.

high-range water reducer—a water-reducing admixture capable of producing large water reduction or great flowability without causing undue set retardation or entrainment of air in mortar or concrete.

holiday—a discontinuity in a coating material that exposes the substrate.

hollow-core bit—carbide-tipped drills with internal ports for water flushing or vacuum extraction of cuttings during drilling; used in drilling deep injection ports to minimize plugging of internal cracks intersected by drill hole.

homogenous material—a material that exhibits essentially the same physical properties throughout the material.

honeycomb—voids in concrete created when the mortar does not fill all the spaces among coarse aggregate particles.

humidity, relative—see **relative humidity**.

hybrid composite—a composite made with two or more types of reinforcing fibers.

hydration—combining water with another substance to create a compound; in concrete, the chemical reaction between hydraulic cement and water.



hydraulic splitting—a method for removal of concrete by means of hydraulic forces that split concrete into smaller masses.

hydro nozzle—a special prewetting and mixing nozzle consisting of a short length of delivery hose inserted between the nozzle body and nozzle tip.

hydrodemolition—a method for removal of concrete by means of water under high pressure directed against a surface; provides a sound concrete substrate and cleans steel reinforcement for reuse.

hydrogen embrittlement—cracking or loss of ductility caused by hydrogen in a metal.

hydrophilic—material which exhibits a strong affinity for water; wettable.

hydrophobic—material which does not exhibit affinity for water; tends to repel water.

hydrostatic head—the fluid pressure of a liquid produced by the height of that liquid above a given point.

hygrometer—an instrument used to measure humidity.

hygroscopic—material that readily absorbs and retains moisture from the air.

impact—instantaneous contact of a moving body with another body, either moving or at rest.

impact breakers—equipment for removal of concrete by repeated striking of the surface to spall and fracture the concrete; may produce microcracking in the concrete substrate. (See also **hand-held breakers**, **boom-mounted breakers**, and **scabblers**.)

impact echo—a nondestructive testing method, based on stress wave propagation, that uses impact to generate a low frequency wave; the presence and position of a reflector, such as a crack, delamination, or void, are indicated by the echo amplitude and time.

impact resistance—resistance to fracture under the sudden application of an external force.

impending slough—a consistency of a shotcrete mixture containing the maximum amount of water such that the product will not flow or sag after placement.

impregnation—a process in which the void structure of a hardened material is filled by saturation with a liquid.

impulse radar—a nondestructive testing procedure that uses low-power impulse radar elements and advanced signal processing techniques to detect and image the internal structure of reinforced concrete.

incompatible—a condition in which two or more materials are unable to combine or remain together without undesirable aftereffects.

incrustation—a crust or coating, generally hard, formed on the surface of hardened concrete.

induction time—the time between mixing of two-component materials and the time they can be used.

inert—devoid of active properties; incapable of or resisting combination.

infrared thermography—a nondestructive testing method for locating delaminations in pavements and bridge decks and detecting moist insulation in buildings; the presence of flaws within concrete affects the heat conduction properties of the concrete and the presence of defects is indicated by differences in surface temperatures when the test object is exposed to correct ambient conditions.

infiltration—the uncontrolled ingress of air or liquid through cracks and pores in concrete.

inhibitor—a substance that slows chemical reaction.

initiator—a substance capable of causing a chemical reaction (such as polymerization or curing) to start.

injection grouting—a method for sealing or repairing cracks in concrete and filling voids within a concrete structure or foundation.

injection port—entry point where grout is introduced into cracks and voids.

inspection, visual—see **visual inspection**.



interface—the common boundary surface between two materials, e.g., an existing concrete substrate and a bonded repair material.

intumescent coating—a fire retardant coating which, when heated, produces nonflammable gases that convert the coating to a foam, thereby insulating the substrate.

isotropic material—a material that exhibits the same properties in all directions.

jacket—an integral covering which is applied over an existing structural element, e.g. a concrete pile, whose primary function is to strengthen or provide environmental protection, or both.

jackhammer—hand-held mechanical breaker for removal of concrete.

jaw crusher—boom-mounted mechanical crusher for removal of concrete from decks, walls, columns, and other concrete members where the shearing plane depth is 6 ft (1.8 m) or less; pulverizing jaw attachment can debond concrete from steel reinforcement for recycling purposes. (See also **mechanical shearing**.)

joint—a physical separation in concrete, including cracks if intentionally made to occur at specified locations.

joint filler—compressible material used to fill a joint to prevent the infiltration of debris and to provide support for sealants.

joint sealant—compressible material used to prevent water and debris from entering joints.

joint spall—a fragment detached from a concrete mass adjacent to a joint.

jumbo—a specially built mobile carrier used to provide a work platform for tunneling operations, such as installing rock bolts and grouting.

kerf—a saw cut in a concrete surface for embedment of the perimeter of a membrane or other thin surface treatment.

keyway—a recess or groove in a concrete substrate which is filled with repair material to provide increased shear strength along the interface.

laitance—a thin layer of weak and nondurable material containing cement and fines, brought to the top of overwet concrete and other cementitious repair materials by bleeding water or improper finishing.

laminates—to bond layers of a material.

lance—equipment for shooting refractory shotcrete material into areas that have a high temperature; typically, a length of metal pipe with an extended nozzle with various configurations.

latex—a stable emulsion of natural or synthetic rubber in water.

latex-modified concrete—see **concrete, polymer-modified**.

leakage—the quantity of material that accidentally enters or escapes through an opening such as a hole or crack.

length change—increase or decrease in length. (See also **volume change** and **deformation**.)

lift—individual layer of repair material where several layers or courses are required to achieve the total depth of a repair.

lifting—softening and raising or wrinkling of a pervious coat by the application of an additional coat; often caused by coatings containing strong solvents.

linear polarization—a nondestructive testing method to determine the instantaneous corrosion rate of the concrete reinforcement located below the test point by measuring the current required to change by a fixed amount the potential difference between the reinforcement and a standard reference electrode.

lining—any protective material applied to the interior surface of a conduit, pipe, or tunnel to provide watertightness, erosion resistance, chemical resistance, or reduced friction.

liquid-volume measurement—measurement of grout on the basis of the total volume of solid and liquid constituents.

live load—a moving load on a structure.

load cell—device for measuring the magnitude of an applied load.

longitudinal crack—crack that generally parallels the length of a member.

lot—a definite quantity of a product or material accumulated under conditions that are considered uniform for sampling purposes.

lubricity—in grouting, the physico-chemical characteristic of a grout material flow through a soil or rock that is the inverse of the inherent friction of that material to the soil or rock; comparable to “wetness.”

macrocell corrosion—process whereby one layer of metallic reinforcement corrodes preferentially to another layer. (See also **microcell corrosion**.)

magnesium phosphate cement—a rapid-setting cement that can be used at low temperatures.

maintenance—taking periodic actions that will delay damage or deterioration or both. (See also **preservation and protection**.)

manifold—see **grout header**.

map cracking—generally orthogonal cracks that extend below the surface of a hardened material; caused by a restrained decrease in volume of the material near the surface, such as drying shrinkage of cementitious materials, the restraint being provided by the material at greater depths where minimal shrinkage occurs or by a previously existing substrate. (See also **checking**, **crazing**, and **pattern cracks**.)

mastic—a thick adhesive material used to hold waterproofing membranes in place or as a sealant.

mat—a fibrous reinforcing material composed of chopped filaments (for chopped-strand mats) or swirled filaments (for continuous-strand mats) with a binder applied to maintain form; available in blankets of various widths, weights, thicknesses, and lengths.

match—to provide, by selection, formulation, adjustment, or other means, a surface repair that is indistinguishable from or within specified tolerances of the surrounding area.

material hose—see **delivery hose**.

matrix—(1) in the case of mortar, the cement paste in which the fine aggregate particles are embedded; in the case of concrete, the mortar in which coarse aggregate particles are embedded; (2) in the case of fiber-reinforced composites, the material in which the fiber reinforcements are embedded.

mechanical anchors—see **expansion anchors**.

mechanical bond—in general concrete construction, the physical interlock between cement paste and aggregate, or between concrete and reinforcement (specifically, the sliding resistance of an embedded bar and not the adhesive resistance).

mechanical properties—those properties of a material that are associated with elastic and inelastic reaction when force is applied, or which involve the relationship between stress and strain.

mechanical shearing—a method for removal of concrete and steel with hydraulically powered jaws; especially applicable for demolition work. (See also **jaw crusher**.)

membrane—protective surface treatment with a thickness greater than 30 mils (0.75 mm) and less than 250 mils (6 mm) applied to the surface of concrete.

membrane, liquid—a liquid material applied to a surface to form a continuous waterproof film after it cures.

membrane, sheet—any functionally continuous flexible structure of felt, fabric, or mat, or combinations thereof, and plying cement.

membrane curing—a process that involves either liquid sealing compound or nonliquid protective coating, both of which function as films to restrict evaporation of mixing water from cementitious repair materials.

metering pump—a device incorporating one or more pumps for pressurizing and delivering fluids such as grout; for multi-component materials, the flow rates of the pumps are synchronized to dispense the components at the desired ratio.

methacrylate—one of a group of resins formed by polymerizing the esters or amides of acrylic acids.

methyl methacrylate—a colorless, volatile liquid derived from acetone cyanohydrin, methanol, and dilute sulfuric acid.

microcell corrosion—localized corrosion in which anodic and cathodic reaction sites are in close proximity to one another. (See also **macrocell corrosion**.)

microcrack—a crack too small to be seen with the unaided eye.

microsilica—see **silica fume**.

mil—one thousandth of an inch, 0.001 in. (0.0254 mm); typically used as the unit of measurement for thickness of thin coatings.

mildew—a superficial growth produced by fungi in the presence of moisture that causes surface discoloration and decomposition.

milling—method commonly used for removal of a specified depth of concrete from large areas of horizontal or vertical surfaces. (See also **scarifier**.)

mineral filler—a finely divided mineral product at least 65 percent of which passes the U. S. Standard 75- μm (No. 200) sieve.

minimum-film-forming temperature—the lowest temperature at which latex will coalesce to form a continuous film.

mist—a process in which a very fine spray of water is applied to, (a) a fresh concrete surface to minimize the potential for plastic shrinkage cracking, or (b) a hardened concrete surface for moist curing.

mix—to combine or blend two or more materials into a single mixture; a compound of two or more materials.

mixer—a machine used for blending the constituents of concrete, grout, mortar, cement paste, or other mixture.

mixing speed—rotation rate of a mixer drum or of the paddles in an open-top, pan, or trough mixer, when mixing a batch.

mixing time—the time from completion of mixer charging until the beginning of discharge.

mixture—the assembled and blended ingredients of cementitious repair materials or the proportions for their assembly.

modulus of elasticity—the ratio of normal stress to corresponding strain for tensile or compressive stress below the proportional limit of the material; also referred to as **elastic modulus** or **Young's modulus**.

modulus of rupture—a measure of the ultimate load-carrying capacity of a beam tested in flexure. (See also **flexural strength**.)

moisture content—the ratio, expressed as a percentage, of the mass of absorbed or adsorbed water in a given material to the total mass.

moisture movement—the movement of moisture through a porous medium. (See also **shrinkage** and **swelling**.)

monolithic repair—a repair system wherein the individual components react together as a uniform, continuous mass.

monomer—an organic liquid, of relatively low molecular weight, that creates a solid polymer by reacting with itself or other compounds of low molecular weight or both.

mortar—a mixture of cement paste and fine aggregate.

mortar, polymer—a composite material of fine aggregates bound together by an organic polymer.

mottled—adjacent spots of different tones and colors in a coating film that create a blotchy effect.

mudcracking—a coating defect characterized by a broken network of cracks in the surface film.

mudjacking—see **slabjacking**.

neat cement grout—a mixture of hydraulic cement and water.

neat cement paste—a mixture of hydraulic cement and water.

necking—the change in cross-sectional area of a material as it elongates.

needle scaling—a surface preparation method in which the surface is impacted with the pointed tips of a bundle of steel rods contained by a steel tube and pulsed by compressed air.

negative side waterproofing—applying waterproofing to the side of a structural element opposite the one subjected to hydrostatic pressure.

neoprene—an elastomer, polychloroprene, formed by adding hydrogen chloride to monovinylacetylene.

nondestructive testing—examination of materials and structures in ways that do not impair future usefulness and serviceability in order to detect, locate, and measure discontinuities, defects, and other imperfections to assess integrity, properties, and uniformity, and to measure geometrical characteristics.

non-evaporable water—the water that is chemically combined during cement hydration; not removable by specified drying. (See also **evaporable water**.)

nozzle—an open-ended metal or rubber tip attached to the discharge end of a shotcrete nozzle body.

nozzle body—a device at the end of a shotcrete delivery hose that contains a regulating valve and a manifold for adding water or air to the shotcrete mixture.

nozzle liner—a rubber lining placed inside the nozzle tip to provide abrasion protection.

nozzleman—the operator who manipulates the nozzle and controls placement of the shotcrete; in the case of dry-mix shotcrete, the operator also controls the water content of the shotcrete.

nozzle velocity—the rate at which shotcrete is ejected from the nozzle.

opacity—the ability of a surface-applied coating to obliterate or hide the color of the surface to which it is applied.

open-circuit grouting—a grouting system with no provision for recirculation of grout to the pump.

orange peel—the dimpled appearance of a dried surface-applied coating that resembles the peel of an orange.

osmosis—the diffusion of a solvent or of a dilute liquid through a skin (permeable in only one direction) into the more concentrated solution.

outgassing—the upward and outward emission of air or moisture vapor from concrete or mortar.

overbreak—the quantity of material that is excavated or breaks out beyond the perimeter of a specific removal area.

overlay—a bonded or unbonded layer of material placed on a concrete surface to either restore or improve the function of the previous surface.

overspray—(1) in protective coatings, any material not deposited within the surface area specified for coating. (2) in shotcreting, material deposited away from the intended receiving surface.

oxidize—to unite with oxygen; cause the oxidation of; rust.

pachometer—nondestructive testing device commonly used to detect and locate embedded reinforcing steel; the device emits an electromagnetic field and detects disturbances in the field caused by embedded metals.

packer—an expandable device inserted into a hole to be grouted that prevents the grout from flowing back around the injection pipe.

paddle mixer—a mixer consisting essentially of a trough within which mixing paddles revolve about the horizontal axis, or a pan within which mixing blades revolve about the vertical axis.

pargeting—to cover with plaster.

partial-depth repair—removal and replacement of damaged or deteriorated near-surface concrete that constitutes only a portion of the depth of a member or element.

particle size—the controlling lineal dimension of individual particles.

particulate grout—any grouting material characterized by undissolved (insoluble) particles in the mix. (See also **chemical grout**.)

pass—one movement over an area; a layer of material placed in one movement over an area.

passivation—the process in metal corrosion by which metals become passive. (See also **passive**.)

passive—the state of a metal surface characterized by low corrosion rates in a potential region that is strongly oxidizing for the metal.

pattern cracks—see **craze cracks, map cracking**.

pea gravel—screened gravel, most of the particles of which pass a 9.5-mm ($\frac{3}{8}$ in.) sieve and are retained on a 4.75-mm (No. 4) sieve.

peeling—a process in which thin flakes of mortar are broken away from a concrete surface, such as by deterioration or by adherence of surface mortar to forms as forms are removed.

penetrability—a grout property descriptive of its ability to fill a porous mass; primarily a function of lubricity and viscosity.

penetration grouting—filling joints or fractures in rock or pore spaces in soil with a grout without disturbing the formation; this grouting method does not modify the solid formation structure. (See also **displacement grouting**.)

penetration probe—a device for obtaining a measure of the resistance of concrete to penetration; customarily determined by the distance that a steel pin is driven into the concrete from a special gun by a precisely measured explosive charge.

penetrating sealer—material that has the ability to penetrate and seal the surface to which it is applied. (See also **sealing compound**.)

percussion drilling—a drilling process in which a hole is advanced by using a series of impacts to the drill steel and attached bit; the bit is normally rotated during drilling. (See also **rotary drilling**.)

perimeter grouting—injection of grout, usually at relatively low pressure, around the periphery of an area which is subsequently to be grouted at greater pressure; intended to confine subsequent grout injection within the perimeter.

perm—the mass rate of water vapor flow through one square foot of a material or construction of one grain per hour induced by a vapor pressure gradient between two surfaces of one inch of mercury or in units that equal that flow rate.

permanent set—inelastic elongation or shortening.

permeability—the property of porous material that permits a fluid (or gas) to pass through it; in construction, commonly refers to water vapor permeability of a sheet material or assembly and is defined as water vapor permeance per unit thickness. (See also **water vapor transmission, perm,** and **permeance**.)

permeability to water, coefficient of—the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions, usually 20 C.

permeance (water vapor)—the ratio of the rate of water vapor transmission through a material or assembly between its two parallel surfaces to the vapor pressure differential between the surfaces.

permeation grouting—filling joints or fractures in rock or pore spaces in soil with a grout, without disturbing the formation.

petrographic examination—methods of examining nonmetallic matter under suitable microscopes to determine structural relationships and to identify the phases or minerals present; with opaque materials, the color, hardness, reflectivity, shape, and etching behavior in polished sections serve as means of identification.

pH—a measure of the dity or alkalinity of a solution, with neutrality represented by a value of 7, with increasing acidity represented by increasingly smaller values and with increasing alkalinity represented by increasingly larger values.

pigment—an insoluble fine powder mixed with water, oil, or other base that creates color.

pinhole—a coating defect characterized by minute holes through a coating that exposes the underlying substrate.

pitting—development of relatively small surface cavities, such as popouts in concrete or corrosion of steel.

plng—the deposition, distribution, and consolidation of a freshly mixed concrete repair material in the place where it is to harden.

plane of weakness—the plane along which a composite repair system tends to fracture.

plastic shrinkage—shrinkage that occurs prior to setting of a cementitious repair material.

plastic shrinkage cracks—cracking that occurs in the surface of a fresh cementitious repair material soon after it is placed and while it is still plastic.

plasticizer—(1) a material that increases the plasticity of a fresh cementitious repair material. (2) a substance added to an adhesive to increase softness, flexibility, and extensibility. (3) a substance added to polymer or copolymer to reduce its minimum film forming temperature or its glass transition temperature.

pneumatic feed—equipment that uses compressed air to deliver shotcrete.

pneumatically applied mortar—see **shotcrete**.

polishing—(1) abrasion of wearing course aggregates caused by traffic loads and the environment. (2) the use of abrasives to smooth a surface.

polyester—one of a group of resins, mainly produced by reaction of dibasic acids with dihydroxy alcohols; commonly dissolved in a vinyl group monomer such as styrene; used as binders for resin mortars and concretes, fiber laminates (mainly glass), adhesives, and the like. (See also **concrete, polymer**.)

polyethylene—a thermoplastic high-molecular-weight organic compound used in formulating protective coatings or, in sheet form, as a protective cover for concrete repairs during the curing period.

polymer—the product of polymerization; more commonly a rubber or resin consisting of large molecules formed by polymerization.

polymer-modified concrete—see **concrete, polymer-modified**.

polymer concrete—see **concrete, polymer**.

polymer mortar—see **mortar, polymer**.

polymer mortar, conductive—see **conductive-polymer mortar**.

polymerization—a chemical reaction in which monomers are linked together to form polymers.

polyolefin fiber—a manufactured fiber in which the fiber-forming substance is any long-chain synthetic polymer composed of at least 85 percent by weight of ethylene, propylene, or other olefin units, except amorphous (noncrystalline) polyolefins.

polypropylene—highly chemically inert, long-chain synthetic polymer; fibrillated and monofilament fibers for concrete reinforcement.

polysulfide—synthetic polymers obtained by the reaction of sodium polysulfide with organic dichlorides.

polyurethane—reaction product of an isocyanate with any of a wide variety of other components containing an active hydrogen group; used to formulate tough, abrasion-resistant coatings.

polyvinyl acetate—colorless, permanently thermoplastic resin; usually supplied as an emulsion or water-dispersible powder characterized by flexibility, stability towards light, transparency to ultraviolet rays, high dielectric strength, toughness, and hardness.

popout—the breaking away of small portions of a concrete surface due to localized internal pressure which leaves a shallow, typically conical, depression; small popouts leave holes up to 10 mm in diameter, medium popouts leave holes 10 to 50 mm in diameter, large popouts leave holes greater than 50 mm in diameter.

pore—a discontinuity, essentially circular in cross section, in a coating extending through to the underlying coating or the basis material.

porosity—the ratio the volume of all voids in a material to the volume of the whole.

port—see **injection port**.

port adapter—device used to connect an injection hose to a crack or void; may be attached to the concrete surface along a crack or inserted in holes drilled into the concrete.

portland cement—see **cement, portland**.

positive displacement—equipment that uses a piston or auger to push a solid mass of wet-mix shotcrete through the delivery hose.

positive side waterproofing—applying waterproofing material to the side of a structural element subjected to hydrostatic pressure.

potable water—water that is safe for drinking.

pot life—time interval after mixing, during which a liquid material can be applied without difficulty.

powder lance—equipment for cutting concrete with intense heat generated by the reaction between oxygen and powdered metals.

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.

practical coverage—the spreading rate of a coating calculated at the recommended dry film thickness and assuming 15 percent material loss.

preconditioning—any preliminary exposure of a material to the influence of specified atmospheric conditions for the purpose of favorably approaching equilibrium with a prescribed atmosphere.

predampening—adding water to aggregate that will be used in dry-mix shotcrete to bring the moisture content of the aggregate to a specified amount, usually 3 to 6 percent.

prepackaged—dry ingredients of grout, mortar, and concrete mixtures in packages, requiring only the addition of water to produce grout, mortar, or concrete.

prepacked concrete—see **concrete, preplaced-aggregate**.

preplaced-aggregate concrete—see **concrete, preplaced-aggregate** and **concrete, colloidal**.

preservation—the process of maintaining a structure in its present condition and arresting further deterioration. (See also **maintenance** and **protection**).

presplitting—a procedure in which hydraulic splitters, water pressure pulses, or expansive chemicals are used in bore holes drilled at points along a predetermined line to induce a crack plane for the removal of concrete.

prewetting—adding a portion of the mixing water to dry-mix shotcrete materials in the delivery hose at some distance from the nozzle.

primer—the first coat of a material applied following surface preparation; serves to improve the bond of subsequent coats and may have corrosion inhibitive properties for use on metals.

production lot—that part of one manufacturer's production made from the same nominal raw material under essentially the same conditions and designed to meet the same specifications.

profile—the topographic contour of the exposed surface of a material or substrate.

profilometer—equipment used to measure profile of traveled surface roughness.

promoter—substance that activates catalysts and promotes polymerization.

proportioning—selection of proportions of ingredients to make the most economical use of available materials to produce cementitious repair materials with the required properties. (See also **mixture**.)

proprietary—made and marketed by one having the exclusive right to manufacture and distribute.

protection—the process of maintaining a concrete structure in its present or restored condition by minimizing the potential for deterioration or damage in the future. (See also **maintenance** and **preservation**.)

pullout test—a test that measures the force required to extract an embedded insert from a concrete mass; the measured ultimate pullout load is used to estimate the in-place compressive strength of the concrete.

pulse-echo method—a nondestructive testing method based on stress wave propagation; the presence and position of a reflector, such as a crack or void, are indicated by the echo amplitude and time.

pulse velocity—the velocity at which compressional or other waves are propagated through a medium.

pultrusion—a manufacturing process for resin-impregnated reinforcements such as rods, tubes, sheets, and shapes of uniform cross section, in which the reinforcement, after being wet-out by the resin application system, is drawn through a die to form the desired cross section; the reverse of the extrusion manufacturing process.

pumpability—a measure of the properties of a particular grout mix to be pumped as controlled by the equipment being used, the formation being injected, and the engineering objective limitations.

pumped concrete—see **concrete, pumped**.

pumping test—a field procedure used to determine in situ permeability or the ability of a formation to accept grout.

quality assurance—steps taken by or for the owner to assure the quality of the work.

quality control—steps taken by the contractor to control quality of the work.

Rradar—a nondestructive testing method for locating metal embedments, voids beneath pavements, or determining thickness of members; interface between materials with different dielectric properties results in reflection of a portion of incident electromagnetic pulse.

radiography—a nondestructive testing method for locating reinforcing and prestressing steel, conduits, pipes, voids, and honeycomb; the intensity of high-energy electromagnetic radiation which passes through a member is recorded on photographic film.

ramming—using a heavy blunt tool to tamp concrete. (See also **dry pack**, and **tamping**.)

rapid chloride test—a method for on-site determinations of d-soluble and water-soluble chloride ion contents of concrete powder samples with proprietary chloride extraction liquids and calibrated instrument probes.

rapid-setting cement—see **cement, rapid setting**.

reactant—a material that reacts chemically with the base component of a grout system.

reactive aggregate—see **aggregate, reactive**.

rebound—aggregate and cement, or wet shotcrete, that bounces away from the surface against which shotcrete is being projected.

rebound hammer—a nondestructive testing apparatus that provides a rapid indication of the near-surface mechanical properties of hardened cementitious materials based on the distance of rebound of a springdriven plunger.

reflection cracking—the occurrence of cracks in overlays and toppings that coincide with the location of previously existing cracks in the substrate.

refusal—when the rate of grout take is low, or zero, at a given pressure.

rehabilitation—the process of repairing or modifying a structure to a desired useful condition. (See also **repair**, and **restoration**.)

reinforcement—(1) bars, wires, strands, fibers, or other slender members which are embedded in concrete primarily to improve tensile strength; (2) fibers and fillers that improve the physical strength of coating systems.

reinforcement continuity—a condition in reinforced concrete in which the reinforcing steel is sufficiently interconnected to provide a path for electrical current.

relative humidity—the ratio of the quantity of water vapor in the air to the maximum amount the air would hold at the same temperature, expressed as a percentage.

release agent—material used to prevent bonding of concrete to a surface. (See also **bond breaker**.)

render—to apply a coat of mortar by a trowel or float.

repair—to replace or correct deteriorated, damaged, or faulty materials, components, or elements of a structure. (See also **rehabilitation**, and **restoration**.)

repair systems—the materials and techniques used for repair.

resin—a natural or synthetic, solid or semisolid, organic material of indefinite and often high molecular weight having a tendency to flow under stress; usually has a softening or melting range, and usually fractures conchoidally.

resin concrete—see **concrete, polymer**.

restoration—the process of re-establishing the materials, form, and appearance of a structure to those of a particular era of the structure. (See also **rehabilitation**, and **repair**.)

restraint—internal or external restriction of free movement of fresh or hardened concrete, mortar, or grout.

retarder—an admixture that delays the setting of cement paste, and hence of mixtures such as grout, mortar, or concrete containing cement.

retempering—addition of water and remixing of concrete or mortar that has lost enough workability to become unplaceable or unusable. (See also **tempering**.)

rheology—the flow characteristics of a material, including viscosity.

rock pocket—a porous, mortar-deficient portion of hardened concrete consisting primarily of coarse aggregate and open voids; caused by leakage of mortar from the form, separation (segregation) during placement, or insufficient consolidation. (See also **honeycomb**.)

rod—sharp-edged cutting screed used to trim shotcrete to forms or ground wires. (See also **screed**.)

rodding—consolidating concrete with a tamping rod. (See also **rod**, and **tamping**.)

roller-compacted concrete—see **concrete, roller-compacted**.

roller compaction—use of a vibratory, or other type roller, to compact concrete.

rolling—an uneven, wavy, textured surface at the outer edge of a spray pattern resulting from the application of shotcrete at angles less than 90 deg to the receiving surface.

rotary drilling—a process for drilling a hole with a rotating drill bit under constant pressure. (See also **percussion drilling**.)

rout—to deepen and widen a crack to prepare it for patching or sealing.

roving—a collection of bundles of continuous glass fiber filaments, either as untwisted strands or as twisted yarns.

runs—sagging and curtaining of a coating usually caused by improper mixing or poor application techniques.

rust—a corrosion product consisting primarily of hydrated iron oxide.

rustication—a strip of wood or other material attached to a form surface to produce a groove in the repair.

rutting—the formation of depressions in a concrete surface caused by the excessive loading and abrasive wearing action of traffic.

sacrificial anodes—chemically active metals such as zinc, aluminum, and magnesium which, when electrically connected to the reinforcing bar, will provide the energy needed to cathodically protect the reinforcing bar; sacrificial anodes deteriorate in service at a rate proportional to the energy needed to protect the reinforcing bar plus whatever may deteriorate by local-action corrosion.

sagging—nonuniform downward flow of a material that occurs between the time of application and setting. (See also **sloughing**).

sample—a portion of material taken from a larger quantity of material which serves to provide information that can be used as a basis for action on the larger quantity.

sandblasting—a method of cutting or abrading a surface with a stream of sand ejected from a nozzle at high speed by compressed air. (See also **abrasive blasting**.)

sand pocket—a zone in concrete, mortar, or shotcrete containing fine aggregate with little or no cement.

sand streak—a streak of exposed fine aggregate in the surface formed concrete, caused by bleeding.

sanded grout—a grout mixture that contains fine aggregates.

saponification—alkaline hydrolysis of esters to produce the component soaps and alcohols.

saturated surface-dry—condition of an aggregate particle or other porous solid when the permeable voids are filled with water and no water is on the exposed surfaces.

saturation, critical—see **critical saturation**.

saw cut—a cut in hardened concrete made by abrasive blades, discs, or diamond wires.

scabblor—equipment for removal of concrete and coatings by chipping with piston-driven cutting heads placed at a right angle to the surface.

scaling—local flaking or peeling away of the near-surface portion of hardened concrete or mortar. (See also **peeling, and spalling**.) Note: **light scaling** of concrete does not expose coarse aggregate; **medium**

scaling involves loss of surface mortar to 5 to 10 mm in depth and exposure of coarse aggregate;

severe scaling involves loss of surface mortar to 5 to 10 mm in depth with some loss of mortar surrounding aggregate particles 10 to 20 mm in depth; **very severe scaling** involves loss of coarse aggregate particles as well as mortar generally to a depth greater than 20 mm.

scarifier—milling equipment for removal of concrete or brittle coatings by fracturing and pulverizing with rotary impact cutters held at a right angle to the surface.

scarification—the process of scratching, cutting, or chipping a substrate to clean and texture the surface.

Schmidt hammer—see **rebound hammer**.

scour—erosion of a concrete surface, exposing the aggregate.

screed—(1) to strike off concrete lying above the desired plane or shape. (2) a tool for striking off the concrete surface, sometimes referred to as a **strikeoff**.

screed wire—see **ground wire**.

screeding—the operation of forming a surface by the use of screed guides and a strikeoff. (See also **strikeoff**.)

seal—a barrier against the passage of liquids, solids, or gases.

sealant—a material that has adhesive and cohesive properties to form a seal.

sealing compound—a liquid that is applied as a coating to the surface of hardened concrete to minimize ingress of liquid or gaseous media during service exposure.



seepage—the infiltration or percolation of water through a material to or from the surface.

segregation—the differential concentration of the components of mixed concrete, aggregate, or the like, resulting in nonuniform proportions in the mass. (See also **bleeding** and **separation**.)

self-leveling—the process whereby a material exhibits flow sufficient to seek gravitational leveling.

series grouting—similar to stage grouting, except each successively deeper zone is grouted by means of a newly drilled hole, eliminating the need for washing grout out before drilling the hole deeper.

service life—an estimate of the remaining useful life of a structure based on the current rate of deterioration or distress, assuming continued exposure to given service conditions without repairs.

set—the condition reached by a cement paste, mortar, or concrete when it has lost plasticity to an arbitrary degree, usually measured in terms of resistance to penetration or deformation.

settlement—(1) downward movement of a structure, part of a structure, or underpinning. (2) sinking of solid particles in grout, mortar, or fresh concrete, after placement and before initial set.

settlement shrinkage—a reduction in volume of concrete prior to the final set of cementitious mixtures, caused by settling of the solids. (See also **shrinkage, plastic**, and **volume change, autogenous**.)

shear—an internal force tangential to the plane on which it acts.

shear-bond strength—a measure of the ability of a repair to resist shear stresses along the interface between the repair material and the concrete substrate.

shear stress—the stress component acting tangentially to a plane.

sheath—an enclosure in which post-tensioning tendons are encased to prevent bonding during concrete placement. (See also **duct**.)

shelf life—the length of time packaged materials can be stored under specified conditions and still remain usable.

shooting—placing of shotcrete. (See also **gunning**.)

short-pulse radar—a technique for nondestructive detection of delaminations and other types of defects within a concrete mass.

shotblasting—surface preparation method in which steel shot is centrifugally propelled at high velocity onto a surface; the process is confined in an enclosed blast chamber which recovers and separates dust and reusable shot.

shotcrete—mortar or concrete pneumatically projected at high velocity onto a surface; also known as **air-blown mortar, pneumatically applied mortar or concrete**, and **sprayed concrete**. (See also **drymix shotcrete, pneumatic feed, positive displacement** and **wet-mix shotcrete**.)

shotcrete, dry-mix—see **dry-mix shotcrete**.

shotcrete, wet-mix—see **wet-mix shotcrete**.

shrinkage—a decrease in one or more dimensions of an object or material. (See also **contraction, volume change**.)

shrinkage, carbonation—shrinkage caused by carbonation.

shrinkage, drying—see **drying shrinkage**.

shrinkage, plastic—see **plastic shrinkage**.

shrinkage-compensating—a characteristic of grout, mortar, or concrete made using an expansive cement in which volume increases after setting, if properly elastically restrained, induces compressive stresses which are intended to approximately offset the tendency of drying shrinkage to induce tensile stresses. (See also **cement, expansive**.)

shrinkage crack—a crack caused by restrained shrinkage.

shrinkage cracking—cracking that occurs in a repair when the restrained contraction induced by moisture loss or carbonation exceeds the tensile strain capacity of the material.

shrinkage-reducing admixture—chemical admixture that reduces drying shrinkage by reducing capillary tension of pore water.

silane—a low-molecular-weight compound of silicon and hydrogen, solutions of which are used as penetrating sealers for concrete surfaces.

silica fume—very fine noncrystalline silica produced in electric arc furnaces as a byproduct of the production of elemental silicon or alloys containing silicon; also known as **condensed silica fume** and **microsilica**.

silicone—water-repellent resin that may be used in coatings and caulking compounds and as admixtures for concrete.

siloxane—a silicon and oxygen-based compound, also containing carbon and hydrogen, used as a penetrating sealer for concrete surfaces.

skinning—the formation of a solid membrane on the top of a liquid, caused by partial curing or drying of a coating during storage.

slabjacking—the process of either raising concrete slabs or filling voids under them, or both, by pressure injecting cementitious or noncementitious materials under the slabs.

slant-shear bond strength—adhesive bond strength measured by applying a compressive force to a cylinder or prism that is comprised of two segments joined along a surface diagonal to the direction of the compressive force.

sloughing—subsidence of shotcrete, or other repair materials placed vertically or overhead, also called **sagging**.

slugging—pulsating and intermittent flow of shotcrete material due to improper use of delivery equipment and materials.

slurry—a mixture of water and any finely divided insoluble material, such as portland cement, slag, or clay in suspension.

slush grouting—application of cement slurry to surface rock as a means of filling cracks and surface irregularities or to prevent slaking; also applied to riprap to form grouted riprap.

sodium chloride—common salt.

soffit—the underside of an element or structure, such as a beam, staircase, arch, or cornice.

solids content—the percentage by weight of the nonvolatile matter in an adhesive.

soluble chloride—the fraction of the total chloride-ion content within hardened concrete that is available to act as an electrolyte in the electrochemical process of reinforcing steel corrosion.

solution cavern—holes left in rock masses when moving water carries away soluble materials.

solvent—a liquid capable of dissolving another material.

solvent entrapment—the encapsulation of solvent within a cured coating because of improper drying conditions; results in a discontinuous coating system.

sonic echo—a nondestructive testing method for determining the length of deep foundations or the location of cracks or constrictions; a hammer is used to impact the surface and a receiver monitors reflected stress wave.

sounding—a technique to evaluate the condition of hardened concrete by striking the surface with a hammer; sound concrete will exhibit a clear ringing sound, whereas dull or hollow sounds indicate delaminated areas. (See also **chain drag**.)

sounding well—a vertical pipe, with closely spaced openings, positioned in a mass of coarse aggregate for grout injection of preplaced aggregate concrete, a float on a measured line indicates the grout level.

spall—a fragment, usually in the shape of a flake, detached from a larger mass by a blow, by the action of weather, by pressure, or by expansion within the larger mass; a small spall involves a roughly circular depression not greater than 120 mm in depth and 150 mm in any dimension; a large spall, may be roughly circular or oval or in some cases elongated, is more than 20 mm in depth and 150 mm in greatest dimension.

spalling—the development of spalls.

specific gravity—the ratio of the mass of a volume of a material at a stated temperature to the mass of the same volume of distilled water at a stated temperature.

spectral analysis of surface waves (SASW)—a nondestructive test method for determining the stiffness profile of a pavement system or the depth of deteriorated concrete; impact is used to generate a surface wave and two receivers monitor the surface motion.

splitting tensile strength—tensile strength of concrete determined by a diametrical compression test.

sprayed concrete—see **shotcrete**.

spray-up application—technique in which continuous-strand roving is fed into a chopper gun, which chops the roving into predetermined lengths and simultaneously sprays the chopped fibers and a cementing matrix onto a surface.

stage grouting—sequential grouting of a hole in separate steps or stages in lieu of grouting the entire length at once; holes may be grouted in ascending stages by using packers or in descending stages downward from the collar of the hole.

stain—discoloration caused by a penetrating substance.

stalactite—a downward-pointing deposit formed as an accretion of mineral matter produced by evaporation of dripping water from the surface of rock or of concrete, commonly shaped like an icicle.

stalagmite—an upward-pointing deposit formed as an accretion of mineral matter produced by evaporation of dripping water from the surface of rock or of concrete, commonly conical in shape.

standard—(1) a physical reference used as a basis for comparison or calibration; (2) a concept that has been established by authority, custom, or agreement to serve as a model or rule in the measurement of quality or the establishment of a practice or procedure.

stitch drilling—procedure for removal of concrete with overlapping bore holes along the perimeter of the section to be cut out.

stitching—a method for repair of cracks that involves drilling holes on both sides of the crack and grouting in stitching dogs (U-shaped metal units with short legs) that span the crack; may be used when tensile strength must be reestablished across major cracks.

straightedge—a straight wooden or metal strip used to level a concrete surface to proper grade or verify the planeness of a finished grade. (See also **rod**, **screed**, and **strikeoff**.)

strain—the change in length per unit of length, in a linear dimension of a body.

stratification—a layered structure in concrete resulting from placement of successive batches that differ in appearance.

strengthening—the process of restoring the capacity of weakened components or elements to their original design capacity or of increasing the strength of components or elements of a concrete structure. See also **external strengthening**.)

stress—intensity of internal force (i.e., force per unit area) exerted by either of two adjacent parts of a body on the other across an imagined plane of separation.

stress corrosion—the process in which the damage caused by stress and corrosion acting together is significantly greater than that produced when they act individually.

stress-corrosion cracking—a cracking process that requires the simultaneous action of a corrodent and sustained tensile stress.

stress relaxation—the time-dependent decrease in stress in a material held at constant strain. (See also **creep**.)

strikeoff—to remove repair material in excess of that which is required to fill the repair cavity evenly or bring the surface to grade; performed with a straightedge piece of wood or metal by means of a forward sawing movement or by a power operated tool appropriate for this purpose; also the name applied to the tool. (See also **screed** and **screeding**.)

structural adhesive—a bonding agent used for transferring required loads between adjacent structural elements.

structural sealant—a sealant capable of transferring required loads between adjacent structural elements.

styrene butadiene—a synthetic resin which is a copolymer of styrene and butadiene; available as a latex emulsion and in a form which can be dissolved in aromatic solvents to form alkali-resistant coatings.

substrate—the layer immediately under a layer of different material to which it is typically bonded; an existing concrete surface that receives an overlay, partial-depth repair, protective coating, or some other maintenance or repair procedure.

sulfate attack—deterioration of concrete or mortar caused when the cement-paste matrix reacts chemically or physically with sulfates in soil or ground water.

superplasticizer—see **admixture, water-reducing (high range)**.

supplemental reinforcement—additional reinforcement installed in a repair section when the original reinforcement was inadequate, the reinforcement has lost cross section, or the existing member is to be strengthened.

surface hardeners—metallic particles or hard mineral aggregate usually passing No. 16 sieve size, mixed with cement; generally applied by sprinkling on the surface of plastic concrete, or other repair material, and repeated troweling to produce a dense layer.

surface impregnants—low viscosity, surface penetrating liquids which impart a degree of water repellency to the surface.

surface preparation—the process whereby a method or combination of methods is used to remove deteriorated or contaminated concrete and roughen and clean a substrate to enhance bond of a repair material or protective coating.

surface repair—repair of a concrete surface, e.g., application of an overlay, or repair of near-surface concrete that constitutes only a small portion of the depth of a member or element. (See also **partialdepth repair**.)

surface retarder—a retarder applied to the contact surface of a form or to the surface of newly placed concrete, to delay setting of the cement, to facilitate construction joint cleanup, or to facilitate production of exposed-aggregate finish.

surface sealers—(1) in epoxy injection, the material placed over cracks to contain the liquid adhesive during the injection process before the adhesive gels. (2) protective surface treatments 10 mils (0.25 mm) or less in thickness which are generally applied with brush, roller, squeegee, or spray.

surface tension—a measure of surface energy created by the predisposition of molecular forces at the surface of a liquid to confine the volume of the liquid to a minimum area.

surface texture—degree of roughness or irregularity of the exposed surfaces.

surface vibrator—a vibrator applied to the surface of freshly placed repair materials to consolidate the mass; four principal types exist: vibrating screeds, pan vibrators, plate or grid vibratory tampers, and vibratory roller screeds.

suspension—a relatively coarse, noncolloidal dispersion of solid particles in a liquid.

swelling—increase in either length or volume. (See also **contraction**; **expansion**; **volume change**; and **volume change, autogenous**.)

syneresis—the exudation of small amounts of liquid from a gel accompanied by contraction of the gel.

synthetic fibers—polymeric fibers, such as polypropylene, polyolefin, nylon, polyethylene, polyester, and acrylic, that can be used in fiber-reinforced cementitious materials and protective coating systems.

tacky—the sticky condition of an adhesive prior to hardening.

tamper—(1) an implement used to consolidate concrete or mortar in molds, forms, or repair cavities. (2) a hand-operated device for consolidating floor topping or other unformed repair materials by impact from the dropped device in preparation for strikeoff and finishing; contact surface often consists of a screen or a grid of bars to force coarse aggregates below the surface to prevent interference with finishing. (See also **jitterbug**.)

tamping—the operation of consolidating freshly placed concrete or other repair materials by repeated

blows or penetrations with a tamper. (See also **consolidation** and **rodding**.)

temperature cracking—cracking which occurs when strains, induced by restrained contraction because

of decreases in temperature, exceed the tensile strain capacity of a material.

temperature rise—the increase of temperature caused by either absorption of heat or internal generation of heat, e.g., hydration of cement in concrete.

tempering—the addition of water and mixing of concrete or mortar as necessary to bring the mixture initially to the desired consistency. (See also **retempering**.)

tendon—a steel element such as wire, cable, bar, rod, or strand, or a bundle of such elements, typically used in tension to impart compressive stress to concrete and as external strengthening to increase structural capacity.

tensile bond strength—the unit stress, applied in direct tension, required to separate a hardened repair material from other materials with which it is in contact with failure occurring in or near the bonded interface.

tensile strength—maximum unit stress that a material is capable of resisting under axial tensile loading; based on the cross-sectional area of the specimen before loading.

tensile stress—see **stress**.

test—a chemical or physical evaluation of a material, structural element, or structure by experiment, observation, or inspection.

thermal conductivity—the property (of a homogeneous body) measured by the ratio of the steady-state heat flux (time-rate of heat flow per unit area) to the temperature.

thermal contraction—contraction caused by decrease in temperature.

thermal cutting—procedure for removal of concrete with thermal or powder lances that employ intense heat generated by the reaction between oxygen and powdered metals to melt a slot into concrete.

thermal expansion—expansion caused by increase in temperature.

thermal shock—the subjection of a material or body to a rapid change in temperature which may be expected to have a potentially deleterious effect.

thermal lance—equipment for cutting concrete with intense heat generated by the reaction between oxygen and powdered metals.

thermocouple—two conductors of different metals joined together at both ends, producing a loop in which an electric current will flow when there is a difference in temperature between the two junctions.

thermography, infrared—see **infrared thermography**.

thermoplastic—a material that can be repeatedly softened by heating and hardened by cooling.

thermosetting—capable of assuming a rigid, fixed shape when cured by heat or other means.

thixotropy—the property of a material that enables it to acquire a lower viscosity when mechanically agitated and rapidly stiffen upon subsequent rest; a material having this property is termed thixotropic and can be placed vertically or horizontally without sagging during the curing process.

time-dependent deformation—see **deformation, time-dependent**.

tongue and groove—a joint in which a protruding rib on the edge of one side fits into a groove in the edge of the other side. (See also **keyway**.)

tolerance—the permissible deviation from a specified dimension, quantity, location or alignment.

tooling—the act of compacting and contouring a material in a joint.

topping—a layer of concrete, mortar, or other material placed to form a floor or surface on a concrete base.

toughness—the capacity of material to absorb energy.

toxic—poisonous.

transverse crack—crack generally perpendicular to the length of a member.

tremie—a pipe or tube through which concrete is deposited under water.

tremie concrete—see **concrete, tremie**.

tremie seal—the depth to which the discharge end of the tremie pipe is kept embedded in the fresh concrete that is being placed; a layer of tremie concrete placed in a cofferdam for the purpose of preventing the intrusion of water when the cofferdam is dewatered.

trowel—a flat, broad-bladed steel hand tool used in the final stages of finishing operations to impart a relatively smooth surface to concrete and other repair materials.

trowel finish—the smooth or textured finished of an unformed surface obtained by troweling.

troweling—smoothing and compacting the unformed surface of materials by strokes of a trowel; method for application of mortars and grouts in shallow or limited areas of repair where reinforcing steel is not exposed.

true solution—one in which the components are 100 percent dissolved in the base solvent.

tube a manchette—a grout pipe perforated with rings of small holes at intervals of about 12 in. (305 mm). Each ring of perforations is enclosed by a rubber sleeve that fits tightly around the pipe to act as a one-way valve when used with an inner pipe containing two packer elements that isolate a stage for injection of grout.

ultrasonic echo—a nondestructive testing method for locating delaminations and voids in relatively thin elements with a transducer that emits a short pulse of ultrasonic waves which is reflected by the opposite side of an element or internal defect and recorded by an adjacent receiver.

ultrasonic pulse velocity—a nondestructive testing method for assessing the relative condition of hardened concrete by measuring the travel time of a pulse of ultrasonic waves through a section with a known path length.

unwatering—the interception, removal, or control of ponded or flowing surface water within structures or excavations. (See also **dewatering**.)

uplift—vertical displacement of a structure or formation because of grout injection.

urea—white crystals or powder, soluble in water and used as a deicer.

urea resin—a synthetic resin made from urea and an aldehyde.

urethane—a class of resins obtained by the reaction of diisocyanates with organic compounds containing two or more active hydrogen atoms to form polymers having free isocyanate groups. Under the influence of heat or catalysts, the latter react with each other, with water, glycols, diamines, etc., to form a thermosetting material.

vacuum blasting—a closed-loop abrasive blasting process whereby blasting material and associated debris are contained with a vacuum.

vacuum concrete—see **concrete, vacuum**.

vacuum impregnation—a repair process in which a vacuum applied to a concrete section causes polymers such as epoxy to impregnate the concrete surface or fill cracks and voids within the section.

vapor barrier—a moisture impervious layer which retards transmission of water vapor into a material or structure.

vehicle—the liquid portion of coating in which pigment is dispersed; composed of binder and thinner.

vent—a hole or small-diameter pipe that permits the escape of air and water during material placement; also used to monitor the flow of grout.

vibration—consolidation of freshly-mixed materials following placement by mechanical devices oscillating at moderately high frequency.

vibrator—an oscillating machine used to agitate freshly-mixed materials such as concrete or mortar to produce a uniform material without gross voids, and to produce intimate contact with the substrate, boundary of repair cavity, form surfaces, and embedded materials.

vinyl ester resin—a thermosetting material produced by a reaction between epoxy resin and methacrylic, or other polymerizable unsaturated d, that is then diluted with a reactive monomer, usually styrene.

viscometer—instrument used for measuring viscosity of slurries, mortars, or concretes.

viscosity—the property of a material that resists change in the shape or arrangement of its elements during flow, and the measure thereof.

visual inspection—an evaluation procedure in which a qualified investigator observes, classifies, and documents deterioration or distress on exposed concrete surfaces; typically, one of the first steps in evaluation of a concrete structure.

void—cavity enclosed within an otherwise solid mass; may be intentionally or unintentionally formed and may be filled with air, water, or other gaseous or liquid material.

void ratio—the ratio of the volume of void space to the volume of solids.

volatile content—the percentage of materials which evaporate from a coating.

volatile organic compounds (VOC)—a measure of the total amount of organic compounds evaporating from a coating film, excluding water.

volume change—an increase or decrease in volume of a material. (See also **deformation and deformation, time-dependent**.)

volume change, autogenous—change in volume produced by continued hydration of cement, exclusive of effects of applied load and change in either thermal condition or moisture content.

warping—a deviation of a surface from its original shape, usually caused by either temperature or moisture differentials, or both, within the material. (See also **curling**.)

washout—erosion of the surface layers of a freshly-mixed material by the flow of water over its surface, e.g., the washout of cement from concrete or mortar.

water absorption—the amount of water a material absorbs under specified test conditions.

water-activated grout—a class of injection grouts that react with water to form polyurethane polymers.

water beading—surface property that causes the formation of discrete water droplets on a surface.

water blast—water discharged through a nozzle at high velocity; used to cut or abrade a concrete surface.



water-cement ratio—the ratio of the amount of water, exclusive only of that absorbed by the aggregates, to the amount of cement in a concrete, mortar, grout, or cement paste mixture; preferably stated as a decimal by mass and abbreviated *w/c*.

water-cementitious material ratio—the ratio of the amount of water, exclusive only of that absorbed by the aggregate, to the amount of cementitious material in a concrete or mortar mixture.

waterproof—impervious to water in either liquid or vapor state. (Since nothing can be completely “impervious” to water under infinite pressure over infinite time, this term should not be used.)

water-reducer—an admixture that allows for a decrease in the amount of water used in freshly mixed mortar or concrete without a decrease in slump or that will increase slump if water content is unchanged.

water ring—a device in the nozzle body of dry-mix shotcrete equipment through which water is added to the materials.

waterstop—a thin sheet of metal, rubber, plastic, or other material installed across a joint to impede seepage.

watertight—impermeable to water except when under hydrostatic pressure sufficient to produce structural discontinuity by rupture.

water vapor permeability—the time rate of water vapor transmission through unit area of flat material of unit thickness induced by vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

water vapor permance—the time rate of water vapor transmission through unit area of flat material or construction induced by vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

water vapor transmission—the rate of water vapor flow through a unit area of a material, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface. (See also **permeability**, **permance**, and **perm.**)

water vapor transmission rate—the steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface.

wearing course—an abrasion-resistant surface treatment applied to concrete pavement or concrete slabs.

weathering—degradation in color, texture, strength, chemical composition or other properties of a material caused by exposure to the weather.

wet blasting—a process for cleaning or finishing a surface by directing a water-based abrasive slurry at high velocity against the surface.

wet-mix shotcrete—shotcrete in which all components are mixed before the material is pumped into the delivery hose; an accelerator, if used, may be added at the nozzle.

wettest stable consistency—the condition of maximum water content at which cement grout and mortar will adhere to a vertical surface without sloughing.

wetting agent—a substance used to reduce the surface tension of liquids so that solid surfaces can be wetted and liquids can penetrate the capillaries.

Windsor probe—a device developed to estimate the quality and compressive strength of insitu concrete by measuring the depth of penetration of probes driven into the concrete surface by means of a powderactuated driver.

workability—that property of freshly-mixed materials which determines the ease and homogeneity with which it can be mixed, placed, consolidated, and finished.



working life—the period of time during which an adhesive, after mixing with catalyst, solvent, or other compounding ingredients, remains sufficiently workable to permit application and spreading.

X-ray diffraction—the diffraction of X-rays by substances having a regular arrangement of atoms; a phenomenon used to identify substances having such a structure.

X-ray fluorescence—characteristic secondary radiation emitted by an element as a result of excitation by X-rays, used to yield chemical analysis of a sample.

X-ray radiograph—an X-ray film, plate, or paper that is placed at the image plane and is used for recording an X-ray image of the object being examined.

yellowing—discoloration of white or clear coatings caused by aging.

yield—the volume of a freshly mixed material produced from a known quantity of ingredients; the total weight of ingredients divided by the unit weight of the freshly mixed material.

yield point—that point on the stress-strain curve when stress ceases to be linearly proportional to strain.

Young's modulus—see **modulus of elasticity**.

Zahn cup—an apparatus for the measurement of liquid or slurry viscosity expressed as the number of seconds required for the liquid or slurry to drain from the cup through a hole of definite diameter.

zinc-rich primer—a primer that contains a high enough concentration of zinc dust to make it electrically conductive when it dries so that it provides cathodic protection for ferrous materials.