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Standard Terminology Relating to Soil, Rock, and Contained Fluids[1]

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These definitions were prepared jointly by the American Society of Civil Engineers and the American Society for Testing and Materials.

INTRODUCTION

A number of the definitions include symbols and indicate the units of measurement. The symbols appear in italics immediately after the name of the term, followed by the unit in parentheses. No significance should be placed on the order in which the symbols are presented where two or more are given for an individual term. The applicable units are indicated by capital letters, as follows:

F—Force, such as pound-force, ton-force, newton
L—Length, such as inch, foot, millimeter
T—Time, such as second, minute
D—Dimensionless

Positive exponents designate multiples in the numerator. Negative exponents designate multiples in the denominator. Degrees of angle are indicated as "degrees."

Expressing the units either in SI or the inch-pound system has been purposely omitted in order to leave the choice of the system and specific unit to the engineer and the particular application, for example:

FL^{-2}—may be expressed in pounds-force per square inch, kilopascals, tons per square foot, etc.
LT^{-1}—may be expressed in feet per minute, millimeters per second, etc.

Where synonymous terms are cross-referenced, the definition is usually included with the earlier term alphabetically. Where this is not the case, the later term is the more significant.

Definitions marked with (ISRM) are included for the convenience of the user and were taken directly from the International Society for Rock Mechanics. For a list of ISRM symbols relating to soil and rock mechanics, refer to Appendix X1.

See Reference section at the end of this standard.

AASHTO compaction—see **compaction test**.

''A" Horizon—see **horizon**.

abandonment—see **decommissioning**. **D 5299**

abrasion—a rubbing and wearing away. (ISRM)

abrasion—the mechanical wearing, grinding, scraping or rubbing away (or down) of rock surfaces by friction or impact, or both.

abrasive—any rock, mineral, or other substance that, owing to its superior hardness, toughness, consistency, or other properties, is suitable for grinding, cutting, polishing, scouring, or similar use.

abrasiveness—the property of a material to remove matter when scratching and grinding another material. (ISRM)

absorbed water—water held mechanically in a soil or rock mass and having physical properties not substantially different from ordinary water at the same temperature and pressure.

absorption—the assimilation of fluids into interstices.

absorption loss—that part of transmitted energy (mechanical) lost due to dissipation or conversion into other forms (heat, etc.).

accelerator—a material that increases the rate at which chemical reactions would otherwise occur.

activator—a material that causes a catalyst to begin its function.

active earth pressure—see **earth pressure**.

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active state of plastic equilibrium—see **plastic equilibrium**.

additive—any material other than the basic components of a grout system.

adhesion—shearing resistance between soil and another material under zero externally applied pressure.

	Symbol	Unit
Unit Adhesion	c_a	FL^{-2}
Total Adhesion	C_a	F or FL^{-1}

adhesion—shearing resistance between two unlike materials under zero externally applied pressure.

admixture—a material other than water, aggregates, or cementitious material, used as a grout ingredient for cement-based grouts.

adsorbed water—water in a soil or rock mass attracted to the particle surfaces by physiochemical forces, having properties that may differ from those of pore water at the same temperature and pressure due to altered molecular arrangement; adsorbed water does not include water that is chemically combined within the clay minerals.

adsorption—the attachment of water molecules or ions to the surfaces of soil particles.

advancing slope grouting—a method of grouting by which the front of a mass of grout is caused to move horizontally by use of a suitable grout injection sequence.

aeolian deposits—wind-deposited material such as dune sands and loess deposits.

aggregate—*as a grouting material*, relatively inert granular mineral material, such as sand, gravel, slag, crushed stone, etc. "Fine aggregate" is material that will pass a No. 4 (6.4-mm) screen,

"Coarse aggregate" is material that will not pass a No. 4 (6.4-mm) screen. Aggregate is mixed with a cementing agent (such as Portland cement and water) to form a grout material.

agitator tank—a tank, usually vertical and with open top, with rotation paddles used to prevent segregation of grout after mixing.

air entry value—the applied suction at which water menisci of the porous segment of a suction sampler break down, and air enters. **D 4696**

air-space ratio, G_a **(D)**—ratio of: (*1*) volume of water that can be drained from a saturated soil or rock under the action of force of gravity, to (*2*) total volume of voids.

air-void ratio, G_v **(D)**—the ratio of: (*1*) the volume of air space, to (*2*) the total volume of voids in a soil or rock mass.

alkali aggregate reaction—a chemical reaction between Na_2O and K_2O in the cement and certain silicate minerals in the cement and certain silicate minerals in the aggregate, which causes expansion resulting in weakening and cracking of Portland cement grout. See **reactive aggregate**.

allowable bearing value (allowable soil pressure), q_a, p_a **(FL^{-2})**—the maximum pressure that can be permitted on foundation soil, giving consideration to all pertinent factors, with adequate safety against rupture of the soil mass or movement of the foundation of such magnitude that the structure is impaired.

allowable pile bearing load, Q_a, P_a **(F)**—the maximum load that can be permitted on a pile with adequate safety against movement of such magnitude that the structure is endangered.

alluvium—soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.

amplification factor—ratio of dynamic to static displacement.

amorphous peat—see **sapric peat**.

angle of external friction (angle of wall friction), δ (degrees)—angle between the abscissa and the tangent of the curve representing the relationship of shearing resistance to normal stress acting between soil and surface of another material.

angle of friction (angle of friction between solid bodies), ϕ *s* **(degrees)**—angle whose tangent is the ratio between the maximum value of shear stress that resists slippage between two solid bodies at rest with respect to each other, and the normal stress across the contact surfaces.

angle of internal friction (angle of shear resistance), ϕ (degrees)—angle between the axis of normal stress and the tangent to the Mohr envelope at a point representing a given failure-stress condition for solid material.

angle of obliquity, α, β, ϕ, Ψ (degrees)—the angle between the direction of the resultant stress or force acting on a given plane and the normal to that plane.

angle of repose, α (degrees)—angle between the horizontal and the maximum slope that a soil assumes through natural processes. For dry granular soils the effect of the height of slope is negligible; for cohesive soils the effect of height of slope is so great that the angle of repose is meaningless.

angle of shear resistance—see **angle of internal friction**.

angle of wall friction—see **angle of external friction**.

angular aggregate—aggregate, the particles of which possess well-defined edges formed at the intersection of roughly planar faces.

anisotropic mass—a mass having different properties in different directions at any given point.

anisotropy—having different properties in different directions. (ISRM)

annual space; annulus—the space between two concentric tubes or casings, or between the casing and the borehole wall. This would include the space(s) between multiple strings of tubing/casings in a borehole installed either concentrically or multi-cased adjacent to each other. **D 5092**

apparent cohesion—see **cohesion**.

aquiclude—a relatively impervious formation capable of absorbing water slowly but will not transmit it fast enough to furnish an appreciable supply for a well or spring.

aquifer—a geologic formation, group of formations, of part of a formation that is saturated and is capable of providing a significant quantity of water. **D 5092**

aquifer, confined—an aquifer bounded above and below by confining beds and in which the static head is above the top of the aquifer. **D 4050, D 4104, D 4105, D 4106, D 5269**

aquifer, unconfined—an aquifer that has a water table. **D 4043, D 4105, D 4106**

aquitard—a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed.

arching—the transfer of stress from a yielding part of a soil or rock mass to adjoining less-yielding or restrained parts of the mass.

area grouting—grouting a shallow zone in a particular area utilizing holes arranged in a pattern or grid.

DISCUSSION—This type of grouting is sometimes referred to as blanket or consolidation grouting.

area of influence of a well, α (L^2)—area surrounding a well within which the piezometric surface has been lowered when pumping has produced the maximum steady rate of flow.

area ratio of a sampling spoon, sampler, or sampling tube, A_r **(D)**—the area ratio is an indication of the volume of soil displaced by the sampling spoon (tube), calculated as follows:

$$A_r = [(D_e^2 - D_i^2/D_i^2] \times 100 \tag{1}$$

where:

D_e = maximum external diameter of the sampling spoon, and
D_i = minimum internal diameter of the sampling spoon at the cutting edge.

armor—the artificial surfacing of bed, banks, shore, or embankment to resist erosion or scour.

armor stone—(generally one ton to three tons in weight) stone resulting from blasting, cutting, or by other methods to obtain rock heavy enough to require handling two individual pieces by mechanical means.

ash content—the percentage by dry weight of material remaining after an oven dry organic soil or peat is burned by a prescribed method.

assessment monitoring—an investigative monitoring program that is initiated after the presence of a contaminant in ground water has been detected. The objective of this program is to determine the concentration of constituents that have contaminated the ground water and to quantify the rate and extent of migration of these constituents. **D 5092**

ASTM cement types—Portland cements meeting the requirements of Specifications C 150. Cement types have slightly different formulations that result in various characteristics which address different construction conditions and different physical and chemical environments. They are as follows:

Type I (Portland)—a general-purpose construction cement with no special properties. **D 5092**

Type II (Portland)—a construction cement that is moderately resistant to sulfates and generates a lower head of hydration at a slower rate than Type I **D 5092**

Type III (Portland: high early strength)—a construction cement that produces a high early strength. This cement reduces the curing time required when used in cold environments, and produces a higher head of hydration than Type I. **D 5092**

Type IV (Portland)—a construction cement that produces a low head of hydration (lower than Types I and II) and develops strength at a slower rate. **D 5092**

Type V (Portland)—a construction cement that is a high sulfate resistant formulation. Used when there is severe sulfate action from soils and ground water.

attapulgite clay—a chain-lattice clay mineral. The term also applies to a group of clay materials that are lightweight, tough, matted, and fibrous.

attenuation—reduction of amplitude with time or distance.

"B" horizon—see **horizon**.

average interstitial velocity—see **velocity, average interstitial**.

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

DISCUSSION—Same as crown grouting and backfill grouting.

back-packing—any material (usually granular) that is used to fill the empty space between the lagging and the rock surface. (ISRM)

baffle—a pier, weir, sill, fence, wall, or mound built on the bed of a stream to parry, deflect, check, or regulate the flow or to float on the surface to dampen the wave action.

bailer—a hollow tubular receptacle used to facilitate withdrawal of fluid from a well or borehole. **D 5092**

ballast—materials used to provide stability to a buoyant object (such as casing within a borehole filled with water). **D 5092**

barometric efficiency—the ratio of the change in depth to water in a well to the inverse of water-level change in barometric pressure, expressed in length of water. **D 4043**

base—*in grouting*, main component in a grout system.

base course (base)—a layer of specified or selected material of planned thickness constructed on the subgrade or subbase for the purpose of serving one or more functions such as distributing load, providing drainage, minimizing frost action, etc.

base exchange—the physicochemical process whereby one species of ions adsorbed on soil particles is replaced by another species.

batch—*in grouting*, quantity of grout mixed at one time.

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

batch mixer—*in grouting*, a machine that mixes batches of grout, in contrast to a continuous mixer.

bearing capacity—see **ultimate bearing capacity**.

bearing capacity (of a pile), Q_p, P_p **(F)**—the load per pile required to produce a condition of failure.

bedding—applies to rocks resulting from consolidation of sediments and exhibiting surfaces of separation (bedding planes) between layers of the same or different materials, that is, shale, siltstone, sandstone, limestone, etc. (ISRM)

bedding—collective term signifying the existence of layers of beds. Planes or other surfaces dividing sedimentary rocks of the same or different lithology.

bedrock—the more or less continuous body of rock which underlies the overburden soils. (ISRM)

bedrock (ledge)—rock of relatively great thickness and extent in its native location.

bench—(*1*) the unexcavated rock having a nearly horizontal surface which remains after a top heading has been excavated, or (*2*) step in a slope; formed by a horizontal surface

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and a surface inclined at a steeper angle than that of the entire slope. (ISRM)

bending—process of deformation normal to the axis of an elongated structural member when a moment is applied normal to its long axis. (ISRM)

bentonitic clay—a clay with a high content of the mineral montmorillonite, usually characterized by high swelling on wetting.

berm—a shelf that breaks the continuity of a slope.

biaxial compression—compression caused by the application of normal stresses in two perpendicular directions. (ISRM)

biaxial state of stress—state of stress in which one of the three principal stresses is zero. (ISRM)

binder (soil binder)—portion of soil passing No. 40 (425-µm) U.S. standard sieve,

binder—anything that causes cohesion in loosely assembled substances, such as clay or cement.

bit—any device that may be attached to or is an integral part of a drill string and is used as a cutting tool to bore into or penetrate rock or other materials.

blaine fineness—the fineness of powdered materials, such as cement and pozzolans, expressed as surface area usually in square centimetres per gram.

blanket grouting—a method in which relatively closely spaced shallow holes are drilled and grouted on a grid pattern over an area, for the purpose of making the upper portions of the bedrock stronger and less pervious.

blastibility—index value of the resistance of a rock formation to blasting. (ISRM)

blasting cap (detonator, initiator)—a small tube containing a flashing mixture for firing explosives. (ISRM)

bleeding—*in grouting*, the autogeneous flow of mixing water within, or its emergence from, newly placed grout caused by the settlement of the solid materials within the mass.

bleeding rate—*in grouting*, the rate at which water is released from grout by bleeding.

blocking—wood blocks placed between the excavated surface of a tunnel or shaft and the main bracing system. (ISRM)

blow-in—the inflow of ground water and unconsolidated material into a borehole or casing caused by differential hydraulic heads; that is, caused by the presence of a greater hydraulic head outside of a borehole/casing than inside. **D 5092**

blowout—a sudden or violent uncontrolled escape of fluids or gas, or both, from a borehole. **D 5299**

body force—a force such as gravity whose effect is distributed throughout a material body by direct action on each elementary part of the body independent of the others. (ISRM)

bog—a peat covered area with a high water table and a surface dominated by a carpet of mosses, chiefly sphagnum. It is generally nutrient poor and acidic. It may be treed or treeless.

bond strength—*in grouting*, resistance to separation of set grout from other materials with which it is in contact; a collective expression for all forces such as adhesion, friction, and longitudinal shear.

borehole—a hole of circular cross-section made in soil or rock.

DISCUSSION—normally, a borehole is advanced using an auger, a drill, or casing with or without drilling fluid. **D 4750**

borehole log—the record of geologic units penetrated, drilling progress, depth, water level, sample recovery, volumes and types of materials used, and other significant facts regarding the drilling of an exploratory borehole or well. **D 5092**

borehole television log—a borehole or well video record produced by lowering a television camera into the borehole or well. This record is useful in visually observing downhole conditions such as collapsed casing or a blocked screen.

bottom charge—concentrated explosive charge at the bottom of a blast hole. (ISRM)

boulder clay—a geological term used to designate glacial drift that has not been subjected to the sorting action of water and therefore contains particles from boulders to clay sizes.

boulders—a rock fragment, usually rounded by weathering or abrasion, with an average dimension of 12 in. (305 mm) or more.

breakwater stone—(generally three tons to twenty tons in weight) stone resulting from blasting, cutting, or other means to obtain rock heavy enough to require handling individual pieces by mechanical means.

bridge—an obstruction within the annulus which may prevent circulation or proper emplacement of annular materials. **D 5092**

bubbling pressure—the applied air pressure at which water menisci of the porous segment of a suction sampler break down, and air exists. **D 4696**

buckling—a bulge, bend, bow, kink, or wavy condition produced in sheets, plates, columns, or beams by compressive stresses.

bulb of pressure—see **pressure bulb**.

bulk density, ρ —the mass of a quantity of a bulk solid divided by its total volume.

bulk solid —an assembly of solid particles handled in sufficient quantities that its characteristics can be described by the properties of the mass of particles rather than the characteristics of each individual particle. May also be referred to as granular material, particulate solid or powder. Examples are sugar, flour, ore, and coal.

bulkhead—a steep or vertical structure supporting natural or artificial embankment.

bulking—the increase in volume of a material due to manipulation. Rock bulks upon being excavated; damp sand bulks if loosely deposited, as by dumping, because the apparent cohesion prevents movement of the soil particles to form a reduced volume.

bunker — synonym for **bin**, but sometimes understood as being a bin without any or only a samll vertical part at the top of the hopper.

buoyant unit weight (*submerged unit weight*)—see **unit weight**.

burden—*in an explosive blasting*, the distance between the charge and the free face of the material to be blasted.

burden—distance between charge and free surface in direction of throw. (ISRM)

''C" Horizon—see **horizon**.

California bearing ratio, *CBR* **(D)**—the ratio of: (*1*) the force per unit area required to penetrate a soil mass with a 3-in.^{2}(19-cm)^2 circular piston (approximately 2-in. (51-mm) diameter) at the rate of 0.05 in. (1.3 mm)/min, to (*2*) that required for corresponding penetration of a standard material. The ratio is usually determined at 0.1-in. (2.5-mm) penetration, although other penetrations are sometimes used. Original California procedures required determination of the ratio at 0.1-in. intervals to 0.5 in. (12.7 mm). Corps of Engineers' procedures require determination of the ratio at 0.1 in. and 0.2 in. (5.1 mm). Where the ratio at 0.2 in. is consistently higher than at 0.1 in., the ratio at 0.2 in. is used.

caliper log—a geophysical borehole log that shows to scale the variations with depth in the mean diameter of a cased or uncased borehole. **D 5299**

camouflet—the underground cavity created by a fully contained explosive. (ISRM)

capillary action (capillarity)—the rise or movement of water in the interstices of a soil or rock due to capillary forces.

*capillary flow***—**see **capillary action**.

capillary fringe—the basal region of the vadose zone comprising sediments that are saturated, or nearly saturated, near the water table, gradually decreasing in water content with increasing elevation above the water table. **D 5314**

capillary fringe zone—the zone above the free water elevation in which water is held by capillary action.

capillary head, *h* **(L)**—the potential, expressed in head of water, that causes the water to flow by capillary action.

*capillary migration***—**see **capillary action**.

capillary rise (height of capillary rise), h_c **(L)**—the height above a free water elevation to which water will rise by capillary action.

capillary water—water subject to the influence of capillary action.

cascading water—perched ground water that enters a well casing via cracks or uncovered perforations, trickling, or pouring down the inside of the casing. **D 5696, D 4700**

casing—pipe, finished in sections with either threaded connections or bevelled edges to be field welded which is installed temporarily or permanently to counteract caving, to advance the borehole, or to isolate the zone being monitored, or combination thereof. **D 5092**

casing, protective—a section of larger diameter pipe that is emplaced over the upper end of a smaller diameter monitoring well riser or casing to provide structural protection to the well and restrict unauthorized access into the well. **D 5092**

casing, surface—pipe used to stabilize a borehole near the surface during the drilling of a borehole that may be left in place or removed once drilling is completed. **D 5092**

catalyst—a material that causes chemical reactions to begin.

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

cation—an ion that moves, or would move toward a cathode; thus nearly always synonymous with positive ion.

*cation exchange***—**see **base exchange**.

cation exchange capacity (CEC)—the total capacity of a porous system to absorb cations from a solution. **D 4696**

caving; sloughing—the inflow of unconsolidated material into a borehole which occurs when the borehole walls lose their cohesive strength. **D 5092**

cavity—a natural underground opening that may be small or large.

cavity—underground opening created by a fully contained explosive. (ISRM)

cement, API, Class A—a cement intended for use from the surface to a depth of 6000 ft (1828 m). This cement is similar to ASTM Type I cement. **D 5299**

cement, API, Class B—a cement intended for use from the surface to a depth of 6000 ft (1828 m) when conditions require moderate- to high-sulfate resistance. This cement is similar to ASTM Type II cement. **D 529**

cement, API, Class C—this cement is intended for use from the surface to a depth of 6000 ft (1828 m) when conditions require high early strength. This cement is similar to ASTM Type III cement. Also available as a high sulfate resistant type. **D 5299**

cement, API, Class G—this cement is intended for use from the surface to a depth of 8000 ft (2438 m). It can be used with accelerators or retarders to cover a wide range of well depths and temperatures. No additions other than calcium sulfate or water, or both, can be intergound or blended with the clinker during manufacture of the cement. Also available as several sulfate-resistant types. **D 5299**

cement, API, Class H—this cement is intended for use from the surface to a depth of 8000 ft (2438 m). It can be used with accelerators or retarders to cover a wide range of well depths and temperatures. No additions other than calcium sulfate or water, or both, can be interground or blended with the clinker during manufacture of the cement. Also available as a sulfate-resistant type. **D 5299**

cement, API, Class J—this cement is intended for use from depths of 12 000 to 16 000 ft (3658 to 4877 m) under conditions of extremely high temperatures and pressures. It can be used with accelerators and retarders to cover a range of well depths and temperatures. No additions of retarders other than calcium sulfate, or water, or both, can be interground or blended with the clinker during manufacture of the cement. **D 5299**

cement bond (sonic) log—a borehole geophysical log that can be used to determine the effectiveness of a cement seal of the annular space of a well. **D 5299**

cement factor—quantity of cement contained in a unit volume of concrete or grout, expressed as weight, or volume (specify which).

cement grout—a grout in which the primary cementing agent is Portland cement.

cement; Portland cement—commonly known as Portland cement. A mixture that consists of a calcareous argillaceous, or other silica-, alumina,- and iron-oxide bearing materials that is manufactured and formulated to produce various types which are defined in Specification C 150. Portland cement is also considered a hydraulic cement because it must be mixed with water to form a cement-water paste that has the ability to harden and develop strength even if cured under water (see **ASTM cement types**). **D 5092**

cementitious factor—quantity of cement and other cementitious materials contained in a unit volume of concrete or grout, expressed as weight or volume (specify which).

centralizer—a device that assists in the centering of a casing or riser within a borehole or another casing. **D 5092**

*centrifuge moisture equivalent***—**see **moisture equivalent**.

chamber—a large room excavated underground, for example, for a powerhouse, pump station, or for storage. (ISRM)

chamber blasting (coyotehole blasting)—a method of quarry blasting in which large explosive charges are confined in small tunnel chambers inside the quarry face. (ISRM)

channeling—the process of forming a vertical cavity resulting from a faulty cement job in the annular space. **D 5299**

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).

chip—crushed angular rock fragment of a size smaller than a few centimetres. (ISRM)

chisel—the steel cutting tool used in percussion drilling. (ISRM)

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. Then the excess grout is diverted back over a screen to the agitator tank by means of a packing gland at the top of the hole. The method is used where holes tend to cave and sloughing material might otherwise clog openings to be grouted.

circulation—applies to the fluid rotary drilling method; drilling fluid movement from the mud pit, through the pump, hose and swivel, drill pipe, annular space in the hole and returning to the mud pit. **D 5092**

ciromg accelerator—a material added to cement to decrease the time for curing. Examples are sodium chloride, calcium sulfate (gypsum), and aluminum powder. **D 5299**

clay (clay soil)—fine-grained soil or the fine-grained portion of soil that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. The term has been used to designate the percentage finer than 0.002 mm (0.005 mm in some cases), but it is strongly recommended that this usage be discontinued, since there is ample evidence from an engineering standpoint that the properties described in the above definition are many times more important.

clay size—that portion of the soil finer than 0.002 mm (0.005 mm in some cases) (see also **clay**).

*clay soil***—**see **clay**.

cleavage—*in crystallography*, the splitting, or tendency to split, along planes determined by the crystal structure. *In petrology*, a tendency to cleave or split along definite, parallel, closely spaced planes. It is a secondary structure, commonly confined to bedded rocks.

cleavage—the tendency to cleave or split along definite parallel planes, which may be highly inclined to the bedding. It is a secondary structure and is ordinarily accompanied by at least some recrystallization of the rock. (ISRM)

cleavage planes—the parallel surfaces along which a rock or mineral cleaves or separates; the planes of least cohesion, usually parallel to a certain face of the mineral or crystal.

cleft water—water that exists in or circulates along the geological discontinuities in a rock mass.

closure—the opening is reduced in dimension to the extent that it cannot be used for its intended purpose. (ISRM)

closure—*in grouting*, closure refers to 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 quanternary holes are grouted.

cobble (cobblestone)—a rock fragment, usually rounded or semirounded, with an average dimension between 3 and 12 in. (75 and 305 mm).

*coefficient of absolute viscosity***—**see **coefficient of viscosity**.

*coefficient of active earth pressure***—**see **coefficient of earth pressure**.

coefficient of compressibility (coefficient of compression), α_v **(L^2F^{-1})**—the secant slope, for a given pressure increment, of the pressure-void ratio curve. Where a stress-strain curve is used, the slope of this curve is equal to $\alpha_v/(1 + e)$.

coefficient of consolidation, c_v **(L^2T^{-1})**—a coefficient utilized in the theory of consolidation, containing the physical constants of a soil affecting its rate of volume change.

$$c_v = k\,(1 + e)/\alpha_v\gamma_w \qquad (2)$$

where:

k = coefficient of permeability, LT^{-1},
e = void ratio, D,
α_v = coefficient of compressibility, L^2F^{-1}, and
γ_w = unit weight of water, FL^{-3}.

DISCUSSION—In the literature published prior to 1935, the coefficient of consolidation, usually designated *c*, was defined by the equation:

$$c = k/\alpha_v\gamma_w\,(1 + e) \qquad (3)$$

This original definition of the coefficient of consolidation may be found in some more recent papers and care should be taken to avoid confusion.

coefficient of earth pressure, K **(D)**—the principal stress ratio at a point in a soil mass.

coefficient of earth pressure, active, K_A (D)—the minimum ratio of : (*1*) the minor principal stress, to (*2*) the major principal stress. This is applicable where the soil has yielded sufficiently to develop a lower limiting value of the minor principal stress.

coefficient of earth pressure, at rest, K_O (D)—the ratio of: (*1*) the minor principal stress, to (*2*) the major principal stress. This is applicable where the soil mass is in its natural state without having been permitted to yield or without having been compressed.

coefficient of earth pressure, passive, K_P (D)—the maximum ratio of: (*1*) the major principal stress, to (*2*) the minor principal stress. This is applicable where the soil has been compressed sufficiently to develop an upper limiting value of the major principal stress.

coefficient of friction (coefficient of friction between solid bodies), f **(D)**—the ratio between the maximum value of shear stress that resists slippage between two solid bodies with respect to each other, and the normal stress across the contact surfaces. The tangent of the angle of friction is ϕs.

coefficient of friction, f—a constant proportionality factor, μ, relating normal stress and the corresponding critical shear stress at which sliding starts between two surfaces: $T = \mu\sigma$. (ISRM)

coefficient of internal friction, μ (D)—the tangent of the angle of internal friction (angle of shear resistance) (see **internal friction**).

coefficient of permeability (permeability), k **(LT^{-1})**—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 shear resistance—see **coefficient of internal friction,** μ (D).

coefficient of subgrade reaction (modulus of subgrade reaction), k, k_s **(FL^{-3})**—ratio of: (*1*) load per unit area of horizontal surface of a mass of soil, to (*2*) corresponding settlement of the surface. It is determined as the slope of the secant, drawn between the point corresponding to zero settlement and the point of 0.05-in. (1.3-mm) settlement, of a load-settlement curve obtained from a plate load test on a soil using a 30-in. (762-mm) or greater diameter loading plate. It is used in the design of concrete pavements by the Westergaard method.

coefficient of transmissibility—the rate of flow of water in gallons per day through a vertical strip of the aquifer 1 ft (0.3 m) wide, under a unit hydraulic gradient.

coefficient of uniformity, C_u **(D)**—the ratio D_{60}/D_{10}, where D_{60} is the particle diameter corresponding to 60 % finer on the cumulative particle-size distribution curve, and D_{10} is the particle diameter corresponding to 10 % finer on the cumulative particle-size distribution curve.

coefficient of viscosity (coefficient of absolute viscosity), η (FTL^{-2})—the shearing force per unit area required to maintain a unit difference in velocity between two parallel layers of a fluid a unit distance apart.

coefficient of volume compressibility (modulus of volume change), m_v **(L^2F^{-1})**—the compression of a soil layer per unit of original thickness due to a given unit increase in pressure. It is numerically equal to the coefficient of compressibility divided by one plus the original void ratio, or $a_v/(1 + e)$.

cohesion—shear resistance at zero normal stress (an equivalent term in rock mechanics is intrinsic shear strength). (ISRM)

cohesion, c **(FL^{-2})**—the portion of the shear strength of a soil indicated by the term c, in Coulomb's equation, $s = c + p \tan \phi$. See **intrinsic shear strength**.

apparent cohesion—cohesion in granular soils due to capillary forces.

cohesionless soil—a soil that when unconfined has little or no strength when air-dried and that has little or no cohesion when submerged.

cohesive soil—a soil that when unconfined has considerable strength when air-dried and that has significant cohesion when submerged.

collar—*in grouting*, the surface opening of a borehole.

colloidal grout—*in grouting*, a grout in which the dispersed solid particles remain in suspension (colloids).

colloidal mixer—*in grouting*, a mixer designed to produce colloidal grout.

colloidal particles—particles that are so small that the surface activity has an appreciable influence on the properties of the aggregate.

communication—*in grouting*, subsurface movement of grout from an injection hole to another hole or opening.

compaction—the densification of a soil by means of mechanical manipulation.

compaction curve (Proctor curve) (moisture-density curve)—the curve showing the relationship between the dry unit weight (density) and the water content of a soil for a given compactive effort.

compaction test (moisture-density test)—a laboratory compacting procedure whereby a soil at a known water content is placed in a specified manner into a mold of given dimensions, subjected to a compactive effort of controlled magnitude, and the resulting unit weight determined. The procedure is repeated for various water contents sufficient to establish a relation between water content and unit weight.

compressibility—property of a soil or rock pertaining to its susceptibility to decrease in volume when subjected to load.

compression curve—see **pressure-void ratio curve**.

compression index, C_c **(D)**—the slope of the linear portion of the pressure-void ratio curve on a semi-log plot.

compression wave (irrotational)—wave in which element of medium changes volume without rotation.

compressive strength (unconfined or uniaxial compressive strength), p_c, q_u, C_o **(FL^{-2})**—the load per unit area at which an unconfined cylindrical specimen of soil or rock will fail in a simple compression test. Commonly the failure load is the maximum that the specimen can withstand in the test.

compressive stress—normal stress tending to shorten the body in the direction in which it acts. (ISRM)

concentration factor, n **(D)**—a parameter used in modifying the Boussinesq equations to describe various distributions of vertical stress.

conceptual model—a simplified representation of the hydrogeologic setting and the response of the flow system to stress. **D 4043**

conductance (specific)—a measure of the ability of the water to conduct an electric current at 77°F (25°C). It is related to the total concentration of ionizable solids in the water. It is inversely proportional to electrical resistance. **D 5092**

cone of impression, n—a rise of the potentiometric surface in the approximate shape of a cone that develops around an injection well.

confining bed—a hydrogeologic unit of less permeable material bounding one or more aquifers. **D 4043, D 4050, D 4104, D 4105, D 4106, D 5269**

confining unit—a term that is synonymous with "aquiclude," "aquitard," and "aquifuge": defined as a body of relatively low permeable material stratigraphically adjacent to one or more aquifers. **D 5092**

conjugate joints (faults)—two sets of joints (faults) that formed under the same stress conditions (usually shear pairs). (ISRM)

connate water, *n*—water entrapped in the voids of a sedimentary or extrusive igneous rock at the time of its deposition or emplacement.

consistency—the relative ease with which a soil can be deformed.

consistency—*in grouting*, the relative mobility or ability of freshly mixed mortar or grout to flow; the usual measurements are slump for stiff mixtures and flow for more fluid grouts.

consistency index—see **relative consistency**.

consolidated-drained test (slow test)—a soil test in which essentially complete consolidation under the confining pressure is followed by additional axial (or shearing) stress applied in such a manner that even a fully saturated soil of low permeability can adapt itself completely (fully consolidate) to the changes in stress due to the additional axial (or shearing) stress.

consolidated-undrained test (consolidated quick test)—a soil test in which essentially complete consolidation under the vertical load (in a direct shear test) or under the confining pressure (in a triaxial test) is followed by a shear at constant water content.

consolidation—the gradual reduction in volume of a soil mass resulting from an increase in compressive stress

initial consolidation (initial compression)—a comparatively sudden reduction in volume of a soil mass under an applied load due principally to expulsion and compression of gas in the soil voids preceding primary consolidation.

primary consolidation (primary compression) (primary time effect)—the reduction in volume of a soil mass caused by the application of a sustained load to the mass and due principally to a squeezing out of water from the void spaces of the mass and accompanied by a transfer of the load from the soil water to the soil solids.

secondary consolidation (secondary compression) (secondary time effect)—the reduction in volume of a soil mass caused by the application of a sustained load to the mass and due principally to the adjustment of the internal structure of the soil mass after most of the load has been transferred from the soil water to the soil solids.

consolidation curve—see **consolidation time curve.**

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

DISCUSSION—In rock, grouting is performed for the purpose of strengthening the rock mass by filling open fractures and thus eliminating a source of settlement.

consolidation ratio, U_s **(D)**—the ratio of: (*1*) the amount of consolidation at a given distance from a drainage surface and at a given time, to (*2*) the total amount of consolidation obtainable at that point under a given stress increment.

consolidation test—a test in which the specimen is laterally confined in a ring and is compressed between porous plates.

consolidation-time curve (time curve) (consolidation curve) (theoretical time curve)—a curve that shows the relation between: (*1*) the degree of consolidation, and (*2*) the elapsed time after the application of a given increment of load.

constant-head boundary—the conceptual representation of a natural feature such as a lake or river that effectively fully penetrates the aquifer and prevents water-level change in the aquifer at that location. **D 5270**

constitutive equation—force deformation function for a particular material. (ISRM)

contact grouting—see **backpack grouting**.

contact pressure, *p* **(FL^{-2})**—the unit of pressure that acts at the surface of contact between a structure and the underlying soil or rock mass.

contaminant—an undesirable substance not normally present in water or soil. **D 5092**

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—linear strain associated with a decrease in length. (ISRM)

control rinse water—water used for equipment washing and rinsing having a known chemistry. **D 5088**

control well—well by which the aquifer is stressed, for example, by pumping, injection, or change of head. **D 4043, D 4044, D 4104, D 4105, D 5269**

controlled blasting—includes all forms of blasting designed to preserve the integrity of the remaining rocks, that is, smooth blasting or pre-splitting. (ISRM)

controlled-strain test—a test in which the load is so applied that a controlled rate of strain results.

controlled-stress test—a test in which the stress to which a specimen is subjected is applied at a controlled rate.

convergence—generally refers to a shortening of the distance between the floor and roof of an opening, for example, in the bedded sedimentary rocks of the coal measures where the roof sags and the floor heaves. Can also apply to the convergence of the walls toward each other. (ISRM)

core—a cylindrical sample of hardened grout, concrete, rock, or grouted deposits, usually obtained by means of a core drill.

core drilling; diamond drilling—a rotary drilling technique, using diamonds in the cutting bit, that cuts out cylindrical rock samples. (ISRM)

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

cover—the perpendicular distance from any point in the roof of an underground opening to the ground surface. (ISRM)

cover—*in grouting*, the thickness of rock and soil material overlying the stage of the hole being grouted.

crack—a small fracture, that is, small with respect to the scale of the feature in which it occurs. (ISRM)

crater—excavation (generally of conical shape) generated by an explosive charge. (ISRM)

creep—slow movement of rock debris or soil usually imperceptible except to observations of long duration. Time-dependent strain or deformation, for example, continuing strain with sustained stress.

critical circle (critical surface)—the sliding surface assumed in a theoretical analysis of a soil mass for which the factor of safety is a minimum.

critical damping—the minimum viscous damping that will allow a displaced system to return to its initial position without oscillation.

critical density—the unit weight of a saturated granular material below which it will lose strength and above which it will gain strength when subjected to rapid deformation. The critical density of a given material is dependent on many factors.

critical frequency, f_c—frequency at which maximum or minimum amplitudes of excited waves occur.

critical height, H_c **(L)**—the maximum height at which a vertical or sloped bank of soil or rock will stand unsupported under a given set of conditions.

critical hydraulic gradient—see **hydraulic gradient**.

critical slope—the maximum angle with the horizontal at which a sloped bank of soil or rock of given height will stand unsupported.

critical surface—see **critical circle**.

critical void ratio—see **void ratio**.

crown—also roof or back, that is, the highest point of the cross section. *In tunnel linings*, the term is used to designate either the arched roof above spring lines or all of the lining except the floor or invert. (ISRM)

cryology—the study of the properties of snow, ice, and frozen ground.

cure—*in grouting*, the change in properties of a grout with time.

cure time—*in grouting*, the interval between combining all grout ingredients or the formation of a gel and substantial development of its potential properties.

curing retarder—a material added to cement to increase the time for curing. Sodium chloride in high concentrations is an example. **D 5299**

curtain grouting—injection of grout into a sub-surface formation in such a way as to create a barrier of grouted material transverse to the direction of the anticipated water flow.

cuttings—small-sized rock fragments produced by a rock drill. (ISRM)

d-10—the diameter of a soil particle (preferably in millimetres) at which 10 % by weight (dry) of the particles of a particular sample are finer. Synonymous with the effective size or effective grain size. **D 5092**

d-60—the diameter of a soil particle (preferably in millimetres) at which 60 % by weight (dry) of the particles of a particular sample are finer. **D 5092**

damping—reduction in the amplitude of vibration of a body or system due to dissipation of energy internally or by radiation. (ISRM)

damping ratio—for a system with viscous damping, the ratio of actual damping coefficient to the critical damping coefficient.

decay time—the interval of time required for a pulse to decay from its maximum value to some specified fraction of that value. (ISRM)

decommissioning (closure)—the engineered closure of a well, borehole, or other subsurface monitoring device sealed with plugging materials. Decommissioning also includes the planning and documenting of all associated activities. A synonym is abandonment. **D 5299**

decomposition—for peats and organic soils, see **humification**.

decontamination—the process of removing undesirable physical or chemical constituents, or both, from equipment to reduce the potential for cross-contamination. **D 5299**

The process of removing or reducing to a known level undesirable physical or chemical constituents, or both, from a sampling apparatus to maximize the representativeness of physical or chemical analysis proposed for a given sample. **D 5088**

decoupling—the ratio of the radius of the blasthole to the radius of the charge. In general, a reducing of the strain wave amplitude by increasing the spacing between charge and blasthole wall. (ISRM)

deflocculating agent (deflocculant) (dispersing agent)—an agent that prevents fine soil particles in suspension from coalescing to form flocs.

deformability—*in grouting*, a measure of the elasticity of the grout to distort in the interstitial spaces as the sediments move.

deformation—change in shape or size.

deformation—a change in the shape or size of a solid body. (ISRM)

deformation resolution (deformation sensitivity), R_d **(L)**—ratio of the smallest subdivision of the indicating scale of a deformation-measuring device to the sensitivity of the device.

degradable, *adj—in erosion control*,decomposes under biological, chemical processes, or ultraviolet stresses associated with typical application environments.

degree-days—the difference between the average temperature each day and 32°F (0°C). In common usage degree-days are positive for daily average temperatures above 32°F and negative for those below 32°F (see **freezing index**).

degree of consolidation (percent consolidation), U **(D)**—the ratio, expressed as a percentage, of: (*1*) the amount of consolidation at a given time within a soil mass, to (*2*) the total amount of consolidation obtainable under a given stress condition.

degrees-of-freedom—the minimum number of independent coordinates required in a mechanical system to define completely the positions of all parts of the system at any instant of time. In general, it is equal to the number of independent displacements that are possible.

degree of saturation—see **percent saturation**.

degree of saturation—the extent or degree to which the voids in rock contain fluid (water, gas, or oil). Usually expressed in percent related to total void or pore space. (ISRM)

degree of sensitivity (*sensitivity ratio*)—see **remolding index**.

delay—time interval (fraction of a second) between detonation of explosive charges. (ISRM)

density—the mass per unit, ρ (ML^{-3}) kg/m^3.

density of dry soil or rock, ρ_d (ML^{-3}) kg/m^3—the mass of solid particles per the total volume of soil or rock.

density of saturated soil or rock, ρ_{sat} (ML^{-3}) kg/m^3—the total mass per total volume of completely saturated soil or rock.

density of soil or rock (bulk density), ρ (ML^{-3}) kg/m^3—the total mass (solids plus water) per total volume.

density of solid particles, ρ_s(ML^{-3}) kg/m^3—the mass per volume of solid particles.

density of submerged soil or rock, ρ_{sub} (ML^{-3}) kg/m^3—the difference between the density of saturated soil or rock, and the density of water.

density of water, ρ_w(ML^{-3}) kg/m^3—the mass per volume of water.

depth of flow *in hydraulics***,** *n*—the distance from the channel thalweg to the water surface, measure normal to the direction of flow, for a given dishcharge.

design discharge *in erosion control***,** *n*—the volumetric quantity of water flow within a channel which is typically used in determining required channel dimensions and suitable lining materials for ensuring adequate channel capacity and stability.

Discussion—The discharge associated with a specified frequency of recurrence, for example, an n-year flood. The n-year flood event has a probability of 1/n being equaled or exceeded in any given year.

detection monitoring—a program of monitoring for the express purpose of determining whether or not there has been a contaminant release to ground water. **D 5092**

detonation—an extremely rapid and violent chemical reaction causing the production of a large volume of gas. (ISRM)

deviator stress, Δ, σ (FL^{-2})—the difference between the major and minor principal stresses in a triaxial test.

deviator of stress (strain)—the stress (strain) tensor obtained by subtracting the mean of the normal stress (strain) components of a stress (strain) tensor from each normal stress (strain) component. (ISRM)

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differential settlement—settlement that varies in rate or amount, or both, from place to place across a structure.

dilatancy—property of volume increase under loading. (ISRM)

dilatancy—the expansion of cohesionless soils when subject to shearing deformation.

direct shear test—a shear test in which soil or rock under an applied normal load is stressed to failure by moving one section of the sample or sample container (shear box) relative to the other section.

discharge velocity, *v*, *q* **(LT^{-1})**—rate of discharge of water through a porous medium per unit of total area perpendicular to the direction of flow.

discontinuity surface—any surface across which some property of a rock mass is discontinuous. This includes fracture surfaces, weakness planes, and bedding planes, but the term should not be restricted only to mechanical continuity. (ISRM)

dispersing agent—*in grouting*, an addition or admixture that promotes dispersion of particulate grout ingredients by reduction of interparticle attraction.

dispersing agent—see **deflocculating agent**.

dispersion—the phenomenon of varying speed of transmission of waves, depending on their frequency. (ISRM)

displacement—a change in position of a material point. (ISRM)

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

distortion—a change in shape of a solid body. (ISRM)

divergence loss—that part of transmitted energy lost due to spreading of wave rays in accordance with the geometry of the system.

double amplitude—total or peak to peak excursion.

drag bit—a noncoring or full-hole boring bit, which scrapes its way through relatively soft strata. (ISRM)

drain—a means for intercepting, conveying, and removing water.

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

Discussion—Depth is ordinarily approximately one-third to one-half that of the grout curtain.

drainage gallery—*in grouting*, an opening or passageway from which grout holes or drainage curtain holes, or both, are drilled. See also **grout gallery**.

drawdown (L)—vertical distance the free water elevation is lowered or the pressure head is reduced due to the removal of free water. **D 653**

drill—a machine or piece of equipment designed to penetrate earth or rock formations, or both.

drill cuttings—fragments or particles of soil or rock, with or without free water, created by the drilling process.

drilling fluid—a fluid (liquid or gas) that may be used in drilling operations in remove cuttings from the borehole, to clean and cool the drill bit, and to maintain the integrity of the borehole during drilling. **D 5092**

drillability—index value of the resistance of a rock to drilling. (ISRM)

drill carriage; jumbo—a movable platform, stage, or frame that incorporates several rock drills and usually travels on the tunnel track; used for heavy drilling work in large tunnels. (ISRM)

drilling pattern—the number, position, depth, and angle of the blastholes forming the complete round in the face of a tunnel or sinking pit. (ISRM)

drill mud—*in grouting*, a dense fluid or slurry used in rotary drilling; to prevent caving of the bore hole walls, as a circulation medium to carry cuttings away from the bit and out of the hole, and to seal fractures or permeable formations, or both, preventing loss of circulation fluid.

Discussion—The most common drill mud is a water-bentonite mixture, however, many other materials may be added or substituted to increase density or decrease viscosity.

dry pack—a cement-sand mix with minimal water content used to fill small openings or repair imperfections in concrete.

dry unit weight **(***dry density***)—**see **unit weight**.

ductility—condition in which material can sustain permanent deformation without losing its ability to resist load. (ISRM)

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

earth—see **soil**.

earth material—soil, bedrock, or fill. **D 4750**

earth pressure—the pressure or force exerted by soil on any boundary.

	Symbol	Unit
Pressure	p	FL^{-2}
Force	P	F or FL^{-1}

active earth pressure, P_A, p_A—the minimum value of earth pressure. This condition exists when a soil mass is permitted to yield sufficiently to cause its internal shearing resistance along a potential failure surface to be completely mobilized.

earth pressure at rest, P_o, p_o—the value of the earth pressure when the soil mass is in its natural state without having been permitted to yield or without having been compressed.

passive earth pressure, P_p, p_p—the maximum value of earth pressure. This condition exists when a soil mass is compressed sufficiently to cause its internal shearing resistance along a potential failure surface to be completely mobilized.

effect diameter (effective size), D_{10}, D_e (L)—particle diameter corresponding to 10 % finer on the grain-size curve.

effective drainage porosity—see **effective porosity**.

effective force, $\bar{F}$ (F)—the force transmitted through a soil or rock mass by intergranular pressures.

effective porosity (effective drainage porosity), n_e (D)—the ratio of: (*1*) the volume of the voids of a soil or rock mass that can be drained by gravity, to (*2*) the total volume of the mass.

effective pressure—see **stress**.

effective size—see **effective diameter**.

effective stress—see **stress**.

effective unit weight—see **unit weight**.

efflux time—time required for all grout to flow from a flow cone.

elasticity—property of material that returns to its original form or condition after the applied force is removed. (ISRM)

elastic limit—point on stress strain curve at which transition from elastic to inelastic behavior takes place. (ISRM)

elastic state of equilibrium—state of stress within a soil mass when the internal resistance of the mass is not fully mobilized.

elastic strain energy—potential energy stored in a strained solid and equal to the work done in deforming the solid from its unstrained state less any energy dissipated by inelastic deformation. (ISRM)

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 rock formations or materials traversed.

electrokinetics—involves the application of an electric field to soil for the purpose of dewatering materials of very low permeability to enhance stability. The electric field produces negative pore pressures near a grout pipe that facilitates grout injection.

elevator—synonym for **bin**, commonly used in the grain industry.

emplacement—the establishment of contaminant residence in the vadose zone in a particular phase. **D 5314**

emulsifier—a substance that modifies the surface tension of colloidal droplets, keeping them from coalescing, and keeping them suspended.

emulsion—a system containing dispersed colloidal droplets.

endothermic—pertaining to a reaction that occurs with the adsorption of heat.

envelope grouting—grouting of rock surrounding a hydraulic pressure tunnel for purpose of consolidation, and primarily, reduction of permeability.

epoxy—a multicomponent resin grout that usually provides very high, tensile, compressive, and bond strengths.

equipotential line—a line connecting points of equal hydraulic head. A set of such lines provides a contour map of a potentiometric surface. **D 5270**

equivalent diameter (equivalent size), *D* (L)—the diameter of a hypothetical sphere composed of material having the same specific gravity as that of the actual soil particle and of such size that it will settle in a given liquid at the same terminal velocity as the actual soil particle.

equivalent fluid—a hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.

excess hydrostatic pressure—see **hydrostatic pressure**.

exchange capacity—the capacity to exchange ions as measured by the quantity of exchangeable ions in a soil or rock.

excitation (stimulus)—an external force (or other input) applied to a system that causes the system to respond in some way.

exothermic—pertaining to a reaction that occurs with the evolution of heat.

expansive cement—a cement that tends to increase in volume after it is mixed with water.

extender—an additive whose primary purpose is to increase total grout volume.

extension—linear strain associated with an increase in length. (ISRM)

external force—a force that acts across external surface elements of a material body. (ISRM)

extrados—the exterior curved surface of an arch, as opposed to intrados, which is the interior curved surface of an arch. (ISRM)

fabric—*for rock or soil*, the spatial configuration of all textural and structural features as manifested by every recognizable material unit from crystal lattices to large scale features requiring field studies.

fabric—the orientation in space of the elements composing the rock substance. (ISRM)

face (heading)—the advanced end of a tunnel, drift, or excavation at which work is progressing. (ISRM)

facing—the outer layer of revetment.

failure (in rocks)—exceeding the maximum strength of the rock or exceeding the stress or strain requirement of a specific design. (ISRM)