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Standard Terminology Relating to Soil, Rock, and Contained Fluids¹

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This standard has been approved for use by agencies of the U.S. Department of Defense. These definitions were prepared jointly by the American Society of Civil Engineers and the American Society for Testing and Materials.

1. Scope*

- 1.1 These definitions apply to many terms found in the Terminology section of standards of ASTM Committee D18.
- 1.2 This terminology standard defines terms related to soil, rock, and contained fluids found in the various sections of standards under the jurisdiction of ASTM Committee D18.
- 1.3 Definitions of terms relating to frozen soils are contained in Terminology [D7099](#).

2. Referenced Documents

2.1 *ASTM Standards:*²

- [C150 Specification for Portland Cement](#)
- [C802 Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials](#)
- [D558 Test Methods for Moisture-Density \(Unit Weight\) Relations of Soil-Cement Mixtures](#)
- [D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort \(12 400 ft-lbf/ft³ \(600 kN-m/m³\)\)](#)
- [D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer](#)
- [D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort \(56,000 ft-lbf/ft³ \(2,700 kN-m/m³\)\)](#)
- [D1883 Test Method for CBR \(California Bearing Ratio\) of Laboratory-Compacted Soils](#)
- [D2435 Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading](#)
- [D2487 Practice for Classification of Soils for Engineering Purposes \(Unified Soil Classification System\)](#)
- [D4043 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques](#)
- [D4044 Test Method for \(Field Procedure\) for Instantaneous Change in Head \(Slug\) Tests for Determining Hydraulic Properties of Aquifers](#)
- [D4050 Test Method for \(Field Procedure\) for Withdrawal and Injection Well Testing for Determining Hydraulic Properties of Aquifer Systems](#)
- [D4104 Test Method \(Analytical Procedure\) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head \(Slug Tests\)](#)
- [D4105 Test Method for \(Analytical Procedure\) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Modified Theis Nonequilibrium Method](#)
- [D4106 Test Method for \(Analytical Procedure\) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method](#)
- [D4186 Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading](#)
- [D4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table](#)
- [D4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density](#)
- [D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils](#)

¹ This terminology is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.93 on Terminology for Soil, Rock and Contained Fluids.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

- [D4429 Test Method for CBR \(California Bearing Ratio\) of Soils in Place](#)
- [D4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well \(Observation Well\) \(Withdrawn 2010\)³](#)
- [D4943 Test Method for Shrinkage Factors of Soils by the Wax Method](#)
- [D5084 Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter](#)
- [D5088 Practice for Decontamination of Field Equipment Used at Waste Sites](#)
- [D5092 Practice for Design and Installation of Groundwater Monitoring Wells](#)
- [D5269 Test Method for Determining Transmissivity of Nonleaky Confined Aquifers by the Theis Recovery Method](#)
- [D5270 Test Method for Determining Transmissivity and Storage Coefficient of Bounded, Nonleaky, Confined Aquifers](#)
- [D5878 Guides for Using Rock-Mass Classification Systems for Engineering Purposes](#)
- [D6026 Practice for Using Significant Digits in Geotechnical Data](#)
- [D6028 Test Method \(Analytical Procedure\) for Determining Hydraulic Properties of a Confined Aquifer Taking into Consideration Storage of Water in Leaky Confining Beds by Modified Hantush Method](#)
- [D6029 Test Method \(Analytical Procedure\) for Determining Hydraulic Properties of a Confined Aquifer and a Leaky Confining Bed with Negligible Storage by the Hantush-Jacob Method](#)
- [D6312 Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs](#)
- [D6910/D6910M Test Method for Marsh Funnel Viscosity of Clay Construction Slurries](#)
- [D6913 Test Methods for Particle-Size Distribution \(Gradation\) of Soils Using Sieve Analysis](#)
- [D7099 Terminology Relating to Frozen Soil and Rock](#)
- [D7382 Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer](#)
- [E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)

3. Significance and Use

3.1 Definitions in this standard are to be regarded as the correct ones for terms found in other ASTM standards of Committee D18. Certain terms may be found in more than one standard issued under the jurisdiction of this committee and many of these terms have been placed in this standard.

3.2 Terms that are defined in some textbooks may differ slightly from those in this terminology standard. Definitions in this terminology standard are to be regarded as correct for ASTM usage.

3.3 See [Appendix X1](#) for References.

3.4 Definitions marked with (ISRM) are included for the convenience of the user and were taken directly from the International Society for Rock Mechanics (see [X1.3](#)).

3.5 A number of the definitions include symbols. The symbols appear in italics immediately after the name of the term.

3.5.1 No significance should be placed on the order in which the symbols are presented where two or more are given for an individual term.

3.5.2 The symbols presented are examples; therefore, other symbols are acceptable.

3.5.3 See [Appendix X2](#) for ISRM Symbols.

3.6 A number of definitions indicate the units of measurements in brackets and which follow the symbol(s) if given. The applicable units are indicated by italic capital letters, as follows:

D—Dimensionless

F—Force, such as pound-force, ton-force, newton

L—Length, such as inch, foot, millimeter, and meter⁴

M—Mass, such as kilogram, gram

T—Time, such as second, minute

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

3.6.2 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, meters per second, etc.

3.7 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ In accordance with IEEE/ASTM SI 10, the alternate spelling for meter, liter, and deka, may be metre, litre, and deca.

3.8 *Grouping of Definitions and Listing of Related Terms*—To aide users in finding terms, this terminology standard provides grouping of definitions and listing of related terms.

3.8.1 *Groupings*—Some of these groupings of definitions are *consolidation*, *density*, *density*, *head*, *measurement*, *unit weight*, and *specific gravity*.

3.8.2 *Listings* (see *Appendix X3*)—The listing of related terms might be headed by such items as *aquifer*, *aquifer*, *compaction*, *density*, *gradation*, *index*, *specific gravity*, and *unit weight*.

4. Terminology

AASHTO compaction—see *compaction test* in **compaction** (grouping).

“A” Horizon—see **horizon**.

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)

adsorbed water—*in soil and rock*, 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.

DISCUSSION—

See **adsorbed water**.

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—*in grouting*, a material that increases the rate at which chemical reactions would otherwise occur.

accuracy—see same in **measurement** (grouping).

activator—*in grouting*, a material that causes a catalyst to begin its function.

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

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

activity number, *A*—*in cohesive soils*, the ratio of (1) the plasticity index of a soil to (2) the percent by mass of particles having an equivalent diameter smaller than 2 μm. **D4318**

additive—*in grouting*, any material other than the basic components of a grout system.

adhesion—*in soils*, 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—*in soil and rock*, 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.

DISCUSSION—

See **adsorbed water**.

adsorption—*in soils*, the attachment of water molecules or ions to the surfaces of soil particles.

advancing slope grouting—*in 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 [2.75-mm][4.75-mm] screen, “Coarse aggregate” is material that will not pass a No. 4 [2.75-mm][4.75-mm] screen. Aggregate is mixed with a cementing agent (such as Portland cement and water) to form a grout material.

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

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—*in grouting*, 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.

DISCUSSION—

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.

DISCUSSION—

See **bearing capacity** (of a pile).

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, $\alpha, \beta, \phi, \Psi$ (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.

DISCUSSION—

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—*in borings*, the space between two concentric tubes or casings, or between the casing and the borehole wall.

DISCUSSION—

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. **D5092**

apparent cohesion—see **cohesion, apparent**.

aquiclude—*in groundwater*, 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—*in geohydrology/hydrogeology*, a geologic ~~formation~~, formation, group of formations, or part of a formation that is saturated and is capable of providing a significant quantity of water, groundwater. **D5092**

aquifer, confined—see **confined aquifer**.

aquifer, leaky—see **leaky aquifer**

aquifer, unconfined—see **unconfined aquifer**.

aquitard—a confining bed that retards but does not prevent the flow of water, groundwater 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, $\alpha [L^2]$ —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:

$$A_r = \left[\frac{D_e^2 - D_i^2}{D_i^2} \right] \times 100$$

where: <https://standards.iteh.ai/catalog/standards/sist/e0e18281-8c72-4bc6-a8b3-154723e63d58/astm-d653-14>

— D_e = maximum external diameter of the sampling spoon, and

— D_i = minimum internal diameter of the sampling spoon at the cutting edge.

D_e = maximum external diameter of the sampling spoon, and

D_i = minimum internal diameter of the sampling spoon at the cutting edge.

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

armor stone—*in erosion control*, (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.

articulating concrete block (ACB) revetment system, system, n —*in erosion control*, a matrix of interconnected concrete block units for erosion protection that are typically connected by geometric interlock, cables, ropes, geotextile, geogrids or combination thereof, and typically including a geotextile underlayment.

artificial turbidity—*in monitoring wells*, particulate matter that is not naturally mobile in the groundwater system and that is produced in some way by the groundwater sampling process. May consist of particles introduced to the subsurface during drilling or well construction, sheared from the target monitoring zone during pumping or bailing the well, or produced by exposure of groundwater to atmospheric conditions. **D5092**

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—*in groundwater*, an investigative monitoring program that is initiated after the presence of a contaminant in groundwater has been detected. The objective of this program is to determine the concentration of constituents that have contaminated the groundwater and to quantify the rate and extent of migration of these constituents. **D5092**

assessment monitoring program, *n*—*in geoenvironmental programs.* groundwater monitoring that is intended to determine the nature and extent of a potential site impact following a verified statistically significant exceedance of the detection monitoring program. **D6312**

ASTM cement types—Portland cements meeting the requirements of Specifications **C150**. 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:

DISCUSSION—

See **cement, API**.

Type I (Portland)—a general-purpose construction cement with no special properties. **D5092**

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 **D5092**

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. **D5092**

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. **D5092**

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

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.

Atterberg Limits—*in cohesive soils,* Originally, six “limits of consistency” of fine-grained soils were defined by Albert Atterberg: the upper limit of viscous flow, the liquid limit, the sticky limit, the cohesion limit, the plastic limit, and the shrinkage limit. In current engineering usage, the term usually refers only to the liquid limit, plastic limit, and in some references, the shrinkage limit. **D4318**

“*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.

<https://standards.iteh.ai/catalog/standards/sist/e0e18281-8c72-4bc6-a8b3-154723e63d58/astm-d653-14>
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—*in wells,* a hollow tubular receptacle used to facilitate withdrawal of fluid from a well or borehole. **D5092**

ballast—*in drilling,* materials used to provide stability to a buoyant object (such as casing within a borehole filled with water). **D5092**

barometric efficiency—*in hydraulic properties,* 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. **D4043**

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.

DISCUSSION—

See **allowable pile bearing load**.

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 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.

bias—see **measurement** (grouping)

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- μ m] 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-grouting*, $\bar{}$ 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—*in tunneling-tunneling*, $\bar{}$ wood blocks placed between the excavated surface of a tunnel or shaft and the main bracing system. (ISRM)

blow-in—*in drilling*, the inflow of groundwater 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. **D5092**

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—*in drilling*, a hole of circular cross-section made in soil or rock.

DISCUSSION—

normally; **Normally**, a borehole is advanced using an auger, a drill, or casing with or without drilling fluid.

D4750

borehole—an open or uncased subsurface hole, generally circular in plan view, created by drilling.

D5092

borehole log—*in drilling*, 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.

D5092

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

bridge—*in drilling*, an obstruction within the annulus which may prevent circulation or proper emplacement of annular materials.

D5092

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 **small** vertical part at the top of the hopper.

buoyant unit weight (submerged unit weight)—see **same in unit weight** (grouping).

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]—*in pavement design*, the ratio in percent and at a standard penetration of either 0.1 or 0.2 in. (2.54 or 5.08 mm) of: (1) the force per unit area (stress) required to penetrate a soil mass with a 3-in. mass, ²[19-cm²] 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 stress required to penetrate a standard material (crushed aggregate) using standard equipment and procedures prescribed by Test Method **D1883** ratio **D4429** at 0.2 in. is consistently higher than at 0.1 in., the ratio at 0.2 in. is used.

DISCUSSION—

Refer to Test Method **D1883** or **D4429** for further information on the standard equipment and procedures, and values of the “standard material.”

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

capillary head—see **capillary heads** same in **head** (grouping).

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.

casing—*in drilling*, 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. **D5092**

casing, protective—*in drilling*, 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. **D5092**

casing, surface—*in drilling*, 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. **D5092**

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_n —*in soils*, is a pH dependent measure of the negative electrical charge present on the surfaces of soil minerals, particularly clay minerals, and on soil organic materials, especially humic compounds, capable of dynamically adsorbing positively charged ions (cations) and polar compounds.

DISCUSSION—

The units for CEC are typically in milliequivalents per 100 grams of oven-dry soil (meq/100 g). The SI units for CEC are centimoles of charge per kilogram of oven-dry soil (cmol_c/kg). See **exchange capacity**.

caving; sloughing—*in drilling*, the inflow of unconsolidated material into a borehole which occurs when the borehole walls lose their cohesive strength. **D5092**

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

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

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 **C150**. 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**). **D5092**

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—*in drilling*, a device that assists in the centering of a casing or riser within a borehole or another casing. **D5092**

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)

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—*in drilling*, 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. **D5092**

classification, n—*in soil or rock*, a systematic arrangement or division of materials, products, systems, or services into groups based on similar characteristics such as origin, composition, properties, or use (*Regulations Governing ASTM Technical Committees*). **D5878**

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) **D53-14**

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 quaternary 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 stress (pressure)—see same in **coefficient of earth stress or pressure** (grouping).

coefficient of compressibility (coefficient of compression)—see ~~coefficient of compressibility (coefficient of compression)~~ same in **consolidation** (grouping).

coefficient of consolidation—see ~~coefficient of consolidation~~ same in **consolidation** (grouping).

coefficient of earth stress or pressure (grouping) (grouping), $K_{[D]}$ —*in soils*, the ratio of: (1) the horizontal effective principal stress to (2) the vertical effective principal stress under drained conditions.

DISCUSSION—

The application of these coefficients is limited to situations in which there is no shear stress on the horizontal or vertical planes. Pressure is typically associated with fluids which cannot support static shear stresses, while stress is associated with materials that can support static shear stresses. Therefore, when referring to soil and rock one should not use pressure but stress. However, by tradition the geotechnical profession has used pressure, such as in “earth pressure.”

coefficient of active earth stress (pressure), $K_{A [D]}$ —the lower limiting value of this ratio under drained conditions.

DISCUSSION—

This is applicable where the soil has yielded sufficiently to develop a lower limiting value of the effective minor principal stress (horizontal stress).
coefficient of earth stress (pressure) at rest, $K_{o_}[D]$ —this ratio under drained conditions in one-dimensional conditions.
coefficient of passive earth stress (pressure), $K_{p_}[D]$ —the upper limiting value of this ratio under drained conditions.

DISCUSSION—

This is applicable where the soil has yielded sufficiently by horizontal compression to develop an upper limiting value of the major principal stress (horizontal stress) under drained conditions.

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 ϕ .

coefficient of friction, f —a constant proportionality factor relating normal stress and the corresponding critical shear stress at which sliding starts between two surfaces:

$$f = \frac{\tau}{\sigma}. \text{ (ISRM)}$$

coefficient of internal friction, $f, \mu [D]$ —the tangent of the angle of internal friction (angle of shear resistance) (see **internal friction**).

coefficient of passive earth stress (pressure)—see same in **coefficient of earth stress or pressure** (grouping).

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**.

coefficient of subgrade reaction (modulus of subgrade reaction), $k, k_s [FL^{-3}]$ —ratio the slope of a plot of: (1) load per unit area of horizontal the normal stress applied to the surface of a mass of soil, to versus (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: the corresponding displacement of that surface in the direction of the applied stress.

DISCUSSION—

ASTM D653-14

<https://standards.iteh.ai/catalog/standards/sist/e0e18281-8c72-4bc6-a8b3-154723e63d58/astm-d653-14>

The soil's surface may be inclined to the extent that it is still practical to apply a normal stress and measure displacements. The slope of the plot of normal stress versus displacement is typically determined by a linear regression analysis of the data points before the soil starts to yield; and, in some cases be indeterminate because the soil's characteristics are very nonlinear (rounded plot). The coefficient of subgrade reaction will vary depending on the size of the loaded area and the soil characteristics within the depth of influence of the applied stress.

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), $\eta [FTL^{-2}]$ —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)—see same in **consolidation** (grouping).

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, $s = c + p \tan \phi$ or $\tau = \acute{c} + \acute{\sigma}' \tan \acute{\phi}'$. See **intrinsic shear strength**.

cohesion, apparent—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.

combined Shewhart (CUSUM) control chart, *n*—*in groundwater data analysis*, a statistical method for intra-well comparisons that is sensitive to both immediate and gradual releases. **D6312**

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 or Proctor curve, *n*—*in soils*, the curve showing the relationship between the dry density or dry unit weight and the molding water content of a soil using a standard test method. See **compaction test**.

compaction test, *n*—*in soils*, the determination of the dry density or dry unit weight versus molding water content relationship using a standard test method in fine grained or coarse grained soils; or the direct determination of the maximum dry density or maximum dry unit weight using a standard test method in coarse grained soils.

DISCUSSION—

Some of the D18 test methods are **D558** (standard effort compaction for soil-cement), **D698** (standard effort compaction), **D1557** (modified effort compaction), **D4253** (vibrating table), and **D7382** (vibrating hammer). The test method designation needs to be identified, such as “compaction test by **D698**” or “compaction test using **D698**.” The usage of moisture-density test or Proctor test has been eliminated because test methods **D4253** and **D7382** are also considered compaction tests.

composite sieving, *v*—*in sieving*, the process of separating a large specimen on a designated separating sieve to obtain coarser and finer particle-size portions. The coarser portion is sieved using the coarser sieve set. The finer portion is subsampled to obtain a subspecimen of manageable size (mass) and this subspecimen is sieved using the finer sieve set. The results of both sieve sets (coarser and finer) are combined mathematically to determine the gradation of the large specimen. **D6913**

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

compression curve—see *stress-void ratio curve* in **consolidation** (grouping)..(grouping).

compression index—see same in **consolidation** (grouping).

compression wave (irrotational)—(irrotational wave), *P-wave* [LT^{-1}]—wave in which element of medium changes volume without rotation.

compressive strength (unconfined or uniaxial compressive strength), p_c , q_w [FL^{-2}]—the load per unit area at which an unconfined cylindrical specimen of soil or rock will fail in a simple compression test.

DISCUSSION—

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—*in geohydrology/hydrogeology*, a simplified representation of the hydrogeologic setting and the response of the flow system to stress. **D4043**

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. **D5092**

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

confined aquifer—*in geohydrology/hydrogeology*, an aquifer bounded above and below by confining beds and in which the static head is above the top of the aquifer. **D4050, D4104, D4105, D4106, D5269**

confining bed—*in geohydrology/hydrogeology*, a hydrogeologic unit of less permeable material bounding one or more aquifers. **D4043, D4050, D4104, D4105, D4106, D5269**

confining unit—*in geohydrology/hydrogeology*, 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. **D5092**

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. **D4318**

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 (grouping)—the gradual reduction in volume of a soil mass resulting from an increase in compressive stress.

DISCUSSION—

The first three definitions presented define the basic components of consolidation; while, remaining definitions define various terms associated with the consolidation process.

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.

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.

$$c_v = \frac{k(1+e)}{\alpha_v \gamma_w}$$

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:

$$c = \frac{k}{\alpha_v \gamma_w} (1+e)$$

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 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 $\alpha_v/(1 + e)$.

compression index, C_c [D]—the slope of the linear portion of the stress-void ratio curve on a semi-log plot.

consolidation ratio, $U_z [D]$ —the ratio of: (1) the amount of primary consolidation at a given distance (location) from a drainage surface and at a given time, to (2) the total amount of primary consolidation obtainable at that point under a given stress increment. See *degree of consolidation* under **consolidation** (grouping).

DISCUSSION—

This definition applies to any given point within the layer of soil being evaluated, while degree of consolidation applies to the entire layer soil.

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) (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.

degree of consolidation (percent consolidation), $U [D]$ —the ratio, expressed as a percentage, of: (1) the amount of primary consolidation at a given time, to (2) the total amount of primary consolidation obtainable under a given stress increment within a soil mass/layer. See *consolidation ratio* under **consolidation** (grouping).

DISCUSSION—

This definition applies to the entire layer of soil being evaluated, while consolidation ratio applies to any given point within the entire layer.

preconsolidation stress—see **preconsolidation stress**.

overconsolidation ratio—see **overconsolidation ratio**.

time factor, $T_v, T [D]$ —dimensionless factor, utilized in the theory of consolidation, containing the physical constants of a soil stratum influencing its time-rate of consolidation, expressed as follows:

$$T = \frac{k(1+e)t}{a_v \gamma_w H^2} = \frac{c_v t}{H^2}$$

where:

k = coefficient of permeability [LT^{-1}],

e = void ratio (dimensionless),

t = elapsed time that the stratum has been consolidated [T],

a_v = coefficient of compressibility [L^2F^{-1}],

γ_w = unit weight of water [FL^{-3}],

H = thickness of stratum drained on one side only. If stratum is drained on both sides, its thickness equals $2H [L]$, and

c_v = coefficient of consolidation [L^2T^{-1}].

stress-void ratio curve (compression curve)—a curve representing the relationship between effective stress and void ratio of a soil as obtained from a consolidation test. The curve has a characteristic shape when plotted on semilog paper with stress on the log scale. The various parts of the curve and extensions to the parts of the curve and extensions to the parts have been designated as recompression, compression, virgin compression, expansion, rebound, and other descriptive names by various authorities.

DISCUSSION—

It is common practice to replace void ratio with axial strain in percent.

consolidation grouting—*in 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 test—see **consolidation** (grouping).

constant-head boundary—*in geohydrology/hydrogeology*, 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. **D5270**

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.