This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D653 – 26a

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

This standard is issued under the fixed designation D653; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C143/C143M Test Method for Slump of Concrete
C150/C150M Specification for Portland Cement
C802 Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials
D558/D558M 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/ft^3 (600 kN-m/m^3))
D854 Test Methods for Specific Gravity of Soil Solids by the Water Displacement Method
D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
D1586/D1586M Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
D1883 Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
D2166/D2166M Test Method for Unconfined Compressive Strength of Cohesive Soil
D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate
D2435/D2435M 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)
D2488 Practice for Description and Identification of Soils for Engineering Purposes (Visual-Manual Procedures)
D3282 Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
D4043 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques
D4044/D4044M Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers (Withdrawn 2024)[3]
D4050 Test Method for (Field Procedure) for Withdrawal and Injection Well Testing for Determining Hydraulic Properties of Aquifer Systems
D4104/D4104M Practice for (Analytical Procedures) Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests)
D4105/D4105M Practice for (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Modified Theis Nonequilibrium Method
D4106 Practice for (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method

[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 www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

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

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D4186/D4186M 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 (Withdrawn 2025)[3]
D4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density (Withdrawn 2025)[3]
D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D4429 Test Method for CBR (California Bearing Ratio) of Soils in Place (Withdrawn 2018)[3]
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 Cohesive Soils by the Water Submersion 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/D5092M Practice for Design and Installation of Groundwater Monitoring Wells
D5269 Test Method for Determining Transmissivity of Nonleaky Confined Aquifers by the Theis Recovery Method (Withdrawn 2024)[3]
D5270/D5270M Practice for (Analytical Procedures) 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 and Data Records in Geotechnical Data
D6028/D6028M Practice for (Analytical Procedure) Determining Hydraulic Properties of a Confined Aquifer Taking into Consideration Storage of Water in Leaky Confining Beds by Modified Hantush Method
D6029/D6029M Practice for (Analytical Procedures) Determining Hydraulic Properties of a Confined Aquifer and a Leaky Confining Bed with Negligible Storage by the Hantush-Jacob Method
D6128 Test Method for Shear Testing of Bulk Solids Using the Jenike Shear Tester
D6312 Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs at Waste Disposal Facilities (Withdrawn 2026)[3]
D6429 Guide for Selecting Surface Geophysical Methods
D6910/D6910M Test Method for Marsh Funnel Viscosity of Construction Slurries
D6913/D6913M Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
D6940/D6940M Practice for Measuring Sifting Segregation Tendencies of Bulk Solids
D6941 Practice for Measuring Fluidization Segregation Tendencies of Powders
D7099 Terminology Relating to Frozen Soil and Rock
D7382 Test Methods for Determination of Maximum Dry Unit Weight of Granular Soils Using a Vibrating Hammer
D7743 Test Method for Measuring the Minimum Fluidization Velocities of Free Flowing Powders (Withdrawn 2021)[3]
D8081 Guide for Theory and Principles for Obtaining Reliable and Accurate Bulk Solids Flow Data Using a Direct Shear Cell
D8198 Specification for Hydraulically Applied 100 % Wood Fiber Mulches
D8297/D8297M Test Method for Determination of Erosion Control Products (ECP) Performance in Protecting Slopes from Sequential Rainfall-Induced Erosion Using a Tilted Bed Slope
D8298/D8298M Test Method for Determination of Erosion Control Products (ECP) Performance in Protecting Slopes from Continuous Rainfall-Induced Erosion Using a Tilted Bed Slope
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 meter[4]
M—Mass, such as kilogram, gram
T—Time, such as second, minute

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

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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.

3.8 *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*—These groupings are presented in Table 1A.

TABLE 1A Listing of Groupings*

Aquifer
Coefficients: Earth
Consolidation
D18.24
Density
Head
Measurement
Principal Plane
Specific Gravity
Stress
Unit Weight
Wave

*Groupings can be editorially added or removed by the subcommittee chair as they are changed within D653.

3.8.1.1 *Sub-Term Groupings*—These groupings are presented in Table 1B.

TABLE 1B Listing of Sub-Term Groupings*

ASTM cement types
horizon or soil horizon
moisture equivalent
plastic equilibrium
shear failure or failure by rupture
site investigation
soil structure

*Groupings can be editorially added or removed by the subcommittee chair as they are changed within D653.

3.8.2 *Listings (see Appendix X3)*—The listing of related terms is given in Table 1C. This listing may include all of the terms defined within standards under the jurisdiction of a specific technical subcommittee, such as D18.14, D18.24, D18.25, and D18.26.

TABLE 1C Listing of Related Terms*

compaction
density
effective
specific gravity
unit weight

*Listings of related terms can be editorially added or removed by the subcommittee chair as they are changed within D653.

4. Terminology

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—*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**.

absolute solids specific gravity—see same in **Specific Gravity Grouping**.

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 stress/pressure—see same in **Coefficients: Earth Grouping**.

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

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the same temperature and pressure due to altered molecular ar-rangement; adsorbed water does not include water that is chemically combined within the clay minerals.

DISCUSSION—See **absorbed 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.

agency, *n*—an organization, or part of an organization, engaged in activities of technically oriented testing or inspection, or both.

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 [4.75-mm] screen, "Coarse aggregate" is material that will not pass a No. 4 [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 or allowable soil pressure, q_a, p_a [FL^{-2}]**—***in foundations*, 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*]**—***in foundations*, 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 friction or **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***,** δ (degrees)**—**see same in **D18.24 Grouping**.

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.

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 wall friction***,** φ (degrees)**—**see same in **D18.24 Grouping**.

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/D5092M**

*apparent bulk (surface dry) density***—**see same in **Density Grouping**.

*apparent bulk (surface dry) specific gravity***—**see same in **Specific Gravity Grouping**.

*apparent dry bulk specific gravity***—**see same in **Specific Gravity Grouping**.

*apparent saturated (surface dry) specific gravity***—**see same in **Specific Gravity Grouping**.

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

*apparent dry bulk density***—**see same in **Density Grouping**.

*apparent saturated (surface dry) density***—**see same in **Density Grouping**.

*saturated***—**see **percent saturation**.

AQUIFER GROUPING

aquifer, *n—in geohydrology/hydrogeology*, a geologic formation, group of formations, or part of a formation that is saturated and is capable of providing a significant quantity of groundwater. **D5092/D5092M**

aquiclude, *n—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.

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aquitard, *n—in groundwater*, a confining bed that retards but does not prevent the flow of groundwater to or from an adjacent aquifer; a leaky confining bed.

area of influence of a well, α *[L²]—in aquifers*, area surrounding a well within which the piezometric surface has been lowered when pumping has produced the maximum steady rate of flow.

confined aquifer, *n—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/D4104M, D4105/D4105M, D4106, D5269**

confining bed, *n—in geohydrology/hydrogeology*, a hydrogeologic unit of less permeable material bounding one or more aquifers. **D4043, D4050, D4104/D4104M, D4105/D4105M, D4106, D5269**

effective drainage porosity, *n*—see **effective drainage porosity**.

groundwater—see **groundwater** (in *alphabetized listing*).

groundwater, free water, gravitational water, or **phreatic water—**water that is free to move through a soil or rock mass under the influence of gravity.

groundwater barrier, *n—in aquifers*, soil, rock, or artificial material which has a relatively low permeability and which occurs below the land surface where it impedes the movement of groundwater and consequently causes a pronounced difference in the potentiometric level on opposite sides of the barrier.

groundwater basin, *n—in geohydrology/hydrogeology*, a groundwater system that has defined boundaries and may include more than one aquifer of permeable materials, which are capable of furnishing a significant water supply.

Discussion—A basin is normally considered to include the surface area and the permeable materials beneath it. The surface-water divide need not coincide with groundwater divide.

groundwater discharge, *n*—see **groundwater discharge**.

groundwater elevation or **free water elevation,** *n*—elevation(s) at which the pressure in the water is zero with respect to the atmospheric pressure.

Discussion—Also see **groundwater table**, **water table**, or **piezometric surface**.

groundwater flow, *n*—see **groundwater flow**.

groundwater recharge, *n*—see **groundwater recharge**.

groundwater table, water table, or piezometric surface, *n—in geohydrology/hydrogeology*, the surface of a groundwater body at which the water pressure equals atmospheric pressure.

Discussion—Earth material below the groundwater table is saturated with water. It is common practice to determine the water table using a monitoring or observation well or piezometer, or both.

hydrologic unit, *n—in geohydrology/hydrogeology*, geologic strata that can be distinguished on the basis of capacity to yield and transmit fluids. Aquifers and confining units are types of hydrologic units. Boundaries of a hydrologic unit may not necessarily correspond either laterally or vertically to lithostratigraphic formations. **D5092/D5092M**

leaky aquifer, *n—in aquifers*, whether artesian or unconfined, that lose or gain water through adjacent less permeable beds.

Discussion—See aquitard and aquiclude in this grouping.

perched groundwater, *n*—see **perched groundwater**.

perched groundwater, *n*—see **perched water table**.

specific storage, *n—in aquifers*, the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head. **D4043, D4050, D4104/D4104M, D4105/D4105M, D5269**

transmissivity, *n—in aquifers*, the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit width of the aquifer.

Discussion—It is equal to an integration of the hydraulic conductivities across the saturated part of the aquifer perpendicular to the flow paths. **D4043, D4050, D4104/D4104M, D4105/D4105M, D4106**

unconfined aquifer, *n—in geohydrology/hydrogeology*, an aquifer that has a water table. **D4043, D4105/D4105M, D4106**

End of Grouping

aquitard, *n*—see same in **Aquifer Grouping**.

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, *n*—see same in **Aquifer Grouping**.

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:

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.

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articulating concrete block (ACB) revetment 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.

artifactual 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/D5092M

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/D5092M

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

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 or borehole—*in wells*, a hollow tubular receptacle used to facilitate withdrawal of fluid from a well or borehole. D5092/D5092M

ballast—*in drilling*, materials used to provide stability to a buoyant object (such as casing within a borehole filled with water). D5092/D5092M

barometric efficiency—*in wells*, the ratio of the change in depth of 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**.

bed—see **specimen**.

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 same in **Measurement Grouping**.

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

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

bin—see same in **D18.24 Grouping**.

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—*in tunneling*, 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/D5092M**

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)

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, 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/D5092M**

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/D5092M**

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/D5092M**

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 **[ML^{-3}]**—see same in **Density Grouping**.

bulk density, ρt **[ML^{-3}]**—see same in **Density Grouping**.

bulk solid—see same in **D18.24 Grouping**.

bulk unit weight—see same in **Unit Weight Grouping**.

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—see same in **D18.24 Grouping**.

buoyant density—see same in **Density Grouping**.

buoyant unit weight or 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)

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, to (*2*) the stress required to penetrate a standard material (crushed aggregate) using standard equipment and procedures prescribed by Test Method D1883 or D4429.

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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 same in **Head Grouping**.

capillary migration—see **capillary action**.

capillary rise or **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/D5092M**

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/D5092M**

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/D5092M**

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 or sloughing—*in drilling*, the inflow of unconsolidated material into a borehole which occurs when the borehole walls lose their cohesive strength. **D5092/D5092M**

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 or **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/C150M. 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/D5092M**

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/D5092M**

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

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the pump, hose and swivel, drill pipe, annular space in the hole and returning to the mud pit. D5092/D5092M

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, *n*—minerals consisting of colloidal particles exhibiting plasticity when moist.

DISCUSSION—For additional information, refer to Practice D2487 or Practice D3282 for classification purposes and Practice D2488 for identification of soils containing these minerals.

clay-sized, *adj—in gradation of soil, not relating to classification*, consisting of soil particles equal to or finer than 2 µm.

DISCUSSION—Fine-grained soil consists of silt-sized particles, clay-sized particles, or any combination of both. Some classification systems use different starting points to describe fine-grained soils.

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.

coarse-grained, *adj—in gradation of soil, not relating to classification*, consisting of particles that are either gravel-sized, or sand-sized, or any combination of such particles. See **sand-sized** and **gravel-sized**.

DISCUSSION—The size ranges for gravel and sand depend upon the soil classification system being used. Refer to D18 Standards D2487 (Unified Soil Classification System) and D3282 (Highway Construction).

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 **Coefficients: Earth Grouping**.

coefficient of compressibility or *coefficient of compression*—see same in **Consolidation Grouping**.

coefficient of consolidation—see same in **Consolidation Grouping**.

coefficient of friction or **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_s.

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

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

coefficient of earth stress/pressure at rest—see same in **Coefficients: Earth Grouping**.

coefficient of internal friction, f, µ [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 **Coefficients: Earth Grouping**.

coefficient of permeability or **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).

DISCUSSION—The present protocol for this term is hydraulic conductivity, see **hydraulic conductivity**. Also, "coefficient" is rarely used.

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

coefficient of subgrade reaction or **modulus of subgrade reaction,** k, k_s [FL^{-3}]—the slope of a plot of: (*1*) the normal stress applied to the surface of a mass of soil, versus (*2*) the corresponding displacement of that surface in the direction of the applied stress.

DISCUSSION—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.

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coefficient of viscosity or **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 or *modulus of volume change*—see same in **Consolidation Grouping**.

COEFFICIENTS: EARTH GROUPING

coefficient of earth stress/pressure, K [D], *n—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_0 [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.

End of 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, $s = c + p \tan \varphi$ or $\tau = c' + \sigma' \tan \phi'$. 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.

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/D558M (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/D6913M**

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**.

compression index—see same in **Consolidation Grouping**.

compression wave or irrotational wave—see same in **Wave Grouping**.

compressive strength or **unconfined/uniaxial compressive strength,** p_c, q_u, [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**

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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/D5092M**

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—see same in **Aquifer Grouping**.

confining bed—see same in **Aquifer Grouping**.

confining unit—*in hydrogeology*, a body of relatively low hydraulic conductivity formation material stratigraphically adjacent to one or more aquifers.

DISCUSSION—Synonymous with or may include formations that are considered to be "aquiclude," "aquitard," and "aquifuge." **D5092/D5092M**

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 **liquidity index**.

consistency terms, *adj*—as used in describing cohesive soils and based on undrained compressive strength are:

very soft	<0.25 tsf or <25 kPa
soft	≥0.25 to <0.5 tsf or ≥25 to <50 kPa
medium	≥0.5 to <1.0 tsf or ≥50 to <100 kPa
stiff	≥1.0 to <2.0 tsf or ≥100 to <200 kPa
very stiff	≥2.0 to <4.0 tsf or ≥200 to <400 kPa
hard	≥4.0 tsf or ≥400 kPa

DISCUSSION—Two brief examples are: medium lean clay (CL) and very stiff fat clay (CH). Some references also base consistency on the standard penetration test results (D1586/D1586M) or hand penetration (D2488, Table 5). However, these approaches lack quantification and are therefore not presented. Parenthetically, the source for these undrained compressive strength values can be found in NAVFAC, Soil Mechanics, Design Manual 7.01, and Table 4 (search the Internet using "NAVFAC DM7.01"). Furthermore, these strength values were based on unconfined compression testing (D2166/D2166M).

consolidated-drained test or **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.

consolidation—see same in **D18.24 Grouping**.

consolidated-undrained test or **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.

DISCUSSION—This definition incorrectly identifies the test type and the usage of a direct shear test. It is an R-Test in accordance with the USACE and present technology prohibits performing an undrained direct shear test.

CONSOLIDATION GROUPING

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

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

initial consolidation or **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, or 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, or 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 or 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.

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coefficient of volume compressibility or 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 $a_v/(1 + e)$.

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* or *percent consolidation* in this 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, or 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 or **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:

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

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 or 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.

End of Grouping

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 same in **Consolidation Grouping**.

consolidation-time curve—see same in **Consolidation Grouping**.

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—*in soil, rock and groundwater*, an undesirable substance not normally present or an unusually high concentration of a naturally occurring substance in water or soil. **D5088**

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—*in decontamination*, water used for equipment washing and rinsing having a known chemistry. **D5088**

control well—*in aquifer testing*, well by which the aquifer is stressed, for example, by pumping, injection, or change of head. **D4043, D4044/D4044M, D4104/D4104M, D4105/D4105M, D5269**

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)

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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 or **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—see same in **Density Grouping**.

critical frequency—see same in **Wave Grouping**.

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, e_c [*D*]**,** *n—in soil*, the void ratio above which the soil will exhibit contractive behavior at high shear strain and below which it will exhibit dilative behavior at high strain. See *critical density* under **Density Grouping**.

DISCUSSION—The critical density or critical void ratio (the two definitions are alternate and equivalent measures of soil packing) is an aspect of soil behavior that has now been known since the 1930s. The critical density/void ratio of a given material varies with effective confining stress and is affected by other factors. Some of those factors being the fabric of the material, stress history, type of loading, and duration of loading. "High strain" is associated with strain at and after peak strength conditions. The critical density/void ratio arises in the context of both liquefaction of cohesionless soil and in the fundamental modeling of soil constitutive behavior (including sands, silts, and clays). For the particular case of saturated soil subjected to undrained deformation, contractive behavior will cause a strength reduction because of the build up of excess pore water pressure during shear. In very loose soil, this pore pressure increase will often be so large as to cause brittle strength reduction with shear strain (liquefaction). For dense soil, dilative behavior will produce a strength gain whether drained (as an increase in the soils friction angle) or undrained (as an increase in shear strength). For constitutive modeling, the variation of critical void ratio with mean effective stress is often referred to as a critical state locus (CSL) and in this form appears widely in modern models of soil behavior (including the Modified Cam Clay model found in most commercial finite element programs as the default "advanced" soil model).

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.

cumulative material retained or **cumulative retained material or cumulative mass retained,** *n—in sieving*, the mass of material retained on an individual sieve plus the masses of material retained on all the coarser sieves in a given stack/set of sieves. **D6913/D6913M**

cumulative percent retained, *n—in sieving*, the ratio of cumulative material retained on a given sieve to the mass of the specimen, expressed in percent. **D6913/D6913M**

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.

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)

D18.24 GROUPING

DISCUSSION—This grouping applies to standards under the jurisdiction of Subcommittee D18.24 on Characterization and Handling of Powders and Bulk Solids. Bulk solids in this case are not directly related to soil and rock, except for such bulk solids as coal and ore. In the definitions presented, the generic delimiting phrase related to this subcommittee is omitted; however, the standard from which it was copied is identified.

angle of internal friction, φ_I [degrees]**—**the angle between the tangent to the yield locus and the abscissa. **D6128**

angle of wall friction , φ' [degrees]**—**the arctan of the ratio of the wall shear stress to the wall normal stress. **D6128**

bin—a container or vessel for holding a bulk solid, frequently consisting of a vertical cylinder with a converging hopper. Sometimes referred to as silo, bunker, or elevator. **D6128**

bulk density, ρ **[ML^{-3}]—**the mass of a quantity of a bulk solid divided by its total volume. **D6128**

bulk solid—an assembly of solid particles handled in sufficient quantities that its characteristics can be described by the

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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. D6128

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. D6128

complete fluidization velocity, U_{cf}, *n*—the superficial gas velocity at which all particles in the bed are fully suspended by the gas. D7743

consolidation—the process of increasing the strength of a bulk solid. D6128

effective angle of friction, δ [degrees]**—**the inclination of the effective yield locus (EYL) as defined by Jenike. D6128

effective yield locus (EYL)—straight line passing through the origin of the σ, τ-plane and tangential to the steady state Mohr circle, corresponding to steady state flow conditions of a bulk solid of given bulk density. D6128

elevator—synonym for **bin**, commonly used in the grain industry. D6128

failure—*in a bulk solid*, plastic deformation of an overconsolidated bulk solid subject to shear, causing dilation and a decrease in strength. D6128

flow, steady state or steady state flow—continuous plastic deformation of a bulk solid at critical state. D6128

flow function, *FF***—**the plot of unconfined yield strength versus major consolidation stress for one specified bulk solid. D6128

fluidization, *n*—the state in which a powder exhibits fluid-like properties. D6941

fluidization segregation, *n*—a mechanism that causes vertical segregation, that is, horizontal layering of fine and coarse particles, as resulting from fluidization of the bulk solid. D6941

fluidized bed, *n*—a bed of particulate matter fully suspended by a gas or liquid (liquid suspensions are not covered in this method). D7743

funnel flow pattern, *n—in storing, handling and processing bulk solids using industrial equipment*, a flow sequence in a bin or hopper characterized by having some particles moving while other particles are stagnant during discharge. D6940/D6940M

granular material—synonym for **bulk solid**. D6128

hopper—the converging portion of a bin. D6128

major consolidation stress, σ_1**—**the major principal stress given by the Mohr stress circle of steady state flow. This Mohr stress circle is tangential to the effective yield locus. D6128

mass flow pattern, *n—in storing, handling and processing bulk solids using industrial equipment*, a flow sequence in a bin or hopper characterized by having all particles moving when discharge occurs. D6940/D6940M

minimum bubbling velocity, U_{mb}, *n*—the superficial gas velocity at which gas bubbles are first observed in a bed of powder. D7743

minimum fluidization velocity, U_{mf}**—**the superficial gas velocity at which the bed is initially suspended by the fluid (or liquid). D7743

Mohr stress circle—the graphical representation of a state of stress in coordinates of normal and shear stress, that is, in the σ, τ-plane. D6128

normal stress, σ**—**the stress acting normally to the considered plane. D6128

particulate solid—synonym for **bulk solid**. D6128

powder—synonym for **bulk solid**, particularly when the particles of the bulk solid are fine. D6128

segregation, *n*—a process through which blended or uniform powders or bulk solids become non-uniform, with regions of varying composition, for example, particle size. D6941

silo—synonym for **bin**. D6128

shear stress, τ**—**a stress acting parallel to the surface of the plane being considered. D6128

shear test—an experiment to determine the flow properties of a bulk solid by applying different states of stress and strain to it. D6128

shear tester—an apparatus for performing shear tests. D6128

sifting segregation, *n—in storing, handling and processing bulk solids using industrial equipment*, a mechanism in which finer particles preferentially percolate into a zone within the bulk solid. D6940/D6940M

Sauter mean particle size, *n*—the diameter of a sphere that has the same volume to surface area ratio as the particles being measured. D7743

superficial gas velocity, *n*—the calculated gas velocity if no particles were present, that is, the gas volumetric flow rate divided by the cross-sectional area with respect to the bed diameter. D7743

time angle of internal friction, φ_i**—**inclination of the time yield locus of the tangency point with the Mohr stress circle passing through the origin. D6128

time yield locus—the yield locus of a bulk solid which has remained at rest under a given normal stress for a certain time. D6128

unconfined yield strength, f_c**—**the major principal stress of the Mohr stress circle being tangential to the yield locus with the minor principal stress being zero. A synonym for **compressive strength**. D6128

uniform bulk solid bed or **bulk solid bed,** *n*—a specimen in a direct shear cell that has a consistent bulk density throughout the bed. D6831

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wall normal stress, σ_w—the normal stress present at a confining wall. **D6128**

wall shear stress, τ_w—the shear stress present at a confining wall. **D6128**

wall yield locus—a plot of the wall shear stress versus wall normal stress. The angle of wall friction is obtained from the wall yield locus as the arctan of the ratio of the wall shear stress to wall normal stress. **D6128**

yield locus—plot of shear stress versus normal stress at failure. The yield locus (YL) is sometimes called the instantaneous yield locus to differentiate it from the time yield locus. **D6128**

End of Grouping

d-10 or D_{10}—*in soils*, see *effective diameter* or *effective size*.

d-60 or D_{60}—*in soils*, see *effective diameter* or *effective size*.

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.

*data point or recorded value—*see *observation* or *observed value (data point or recorded value)* in **measurement** (grouping).

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

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

decontamination—*in apparatus*, 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 analyses proposed for a given sample. **D5088**

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 or **deflocculant** or **dispersing agent—***in hydrometer testing*, 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)

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 or *percent consolidation—*see same in **Consolidation Grouping**.

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—*see **sensitivity** in **Measurement Grouping**.

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

DENSITY GROUPING

See **Unit Weight Grouping** and **Specific Gravity Grouping**.

Discussion—In soil and rock the term density requires the inclusion of an adjective to define its specific application, such as dry, bulk, submerged, and maximum. The adjectives “dry,” “total,” “wet,” “moist,” etc. do not modify the noun density, but the state of the soil or rock, or both, along with its voids. However; in some professions, such as Soil Science and Geology, the usage of the adjective "bulk" pertains to the volume of the soil/rock instead of its state. Acceptable SI units are kg/m^3, g/cm^3 or Mg/m^3. Acceptable inch-pound units are $slugs/ft^3$ or lbm/ft^3 (only use lbm if force units are not included in that standard). See 3.5.2 for usage of symbols in definitions.

Density is a key element in the phase relations, phase relationships, or mass-volume relationships of soil/rock. If dissolved solids, such as salt, are present in the pore fluid, then modifications to these relationships are required.

In all density definitions, mass is determined in air without any corrections for buoyancy in air and the unit total volume applies to the unit volume including both solids and voids. The density of water is a function of temperature; therefore, reference temperature should be given, such as water density [20°C]. However, this reference temperature is typically omitted and assumed to be 20°C.

For definitions involving rock and aggregates, it is common practice, especially in the concrete industry, to include the terms absolute and apparent. In this case, absolute refers to mass-volume relations without any voids (solids volume) while apparent refers to the mass-volume relations with voids (unit total volume). Surface dry means all water on the rock’s surface is removed, usually by light blotting. In definitions containing “surface dry,” the omission of “surface dry” is typical when using that term; such as, apparent bulk (surface dry) density becomes apparent bulk density. For highly porous rock, specialized surface dry techniques might be required to model specific applications. The saturation of rock or aggregate is typically accomplished by submerging in water with or with out a vacuum for a prescribed period of time.

It is acceptable practice to change the density adjective to a noun, such as dry density to density of dry soil or rock, apparent saturated density to apparent density of saturated rock or aggregate, or solids density to density of soil solids or particles.

Note 1—The most general density terms are presented first, such as

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