Designation: ~~D653 – 20~~ D653 – 20ε1

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.

ε[1] NOTE—Editorial corrections were made in October 2020.

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 Hydraulic-Cement Concrete
~~C150~~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~~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 Water Pycnometer
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

[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.

Current edition approved June 15, 2020. Published August 2020. Originally approved in 1942. Last previous edition approved in 2014 as D653–14. DOI: 10.1520/D0653-20.

[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**

~~D2435~~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 (Visual-Manual Procedures)
D4043 Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques
~~D4044~~D4044/D4044M 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~~D4104/D4104M Practice for (Analytical Procedures) Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests)
~~D4105~~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
~~D4186~~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
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
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~~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
~~D5270~~D5270/D5270M ~~Test Method for~~ 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 in Geotechnical Data
~~D6028~~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~~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
D6429 Guide for Selecting Surface Geophysical Methods
D6910/D6910M Test Method for Marsh Funnel Viscosity of Construction Slurries
~~D6913~~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
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] The last approved version of this historical standard is referenced on www.astm.org.

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

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
~~Coefficient of Earth~~
Coefficients: Earth
Consolidation
D18.24
Density
Head

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

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.~~
*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 ~~1B.~~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 1B Listing of Related Terms***~~
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.~~
*Listings of related terms can be editorially added or removed by the subcommittee chair as they are changed within D653.

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)

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

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 ~~pressure~~stress/pressure—see same in **~~earth pressure.~~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 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.

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 ~~(allowable~~ or allowable soil ~~pressure),~~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 external friction** or **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 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~~ friction,~~or~~ **angle of shear resistance,** φδ (degrees)~~—angle between the~~see same in **axis of ~~D18.24~~ D18.24 Grouping.**~~normal stress and the tangent to the Mohr envelope at a point representing a given failure-stress condition for solid material.~~

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

angle of repose, α (degrees)**—**angle between the horizontal and the maximum slope that a soil assumes through natural processes.

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

~~*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**~~**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**~~**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.

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 ~~*n*~~—*[L^2]*—~~*see*~~*in* ~~*Aquifer*~~*aquifers,* ~~Grouping.~~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**~~**D4104/D4104M**, ~~**D4105**~~**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**~~**D4104/D4104M**, ~~**D4105**~~**D4105/D4105M**, **D4106**, **D5269**

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

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

~~free-water elevation (groundwater elevation),~~ groundwater, free water, gravitational water, n—or **phreatic water—** ~~elevation(s) at which the pressure in the water is zero with respect to the atmospheric pressure.~~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),~~ 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 ~~(observation)~~ 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~~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~~D4104/D4104M, ~~D4105~~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~~D4104/D4104M, ~~D4105~~D4105/D4105M, D4106**

unconfined aquifer, *n—in geohydrology/hydrogeology*, an aquifer that has a water table. **D4043, ~~D4105~~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,~~a[L~~n—^{2}~~]~~—~~area surrounding a~~*see same in **~~well within~~ Aquifer Grouping.**~~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:
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, *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~~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~~D5092/D5092M**

SUB-TERM GROUPING

ASTM cement types—Portland cements meeting the requirements of Specifications ~~C150~~C150/C150M. 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.~~

Type I (Portland)—a general-purpose construction cement with no special properties. **D5092/D5092M**

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/D5092M**

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/D5092M**

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/D5092M**

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

"B" horizon—see **horizon**.

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

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

DISCUSSION—
Same as crown grouting and backfill grouting.

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

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

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

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

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~~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)

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, 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**~~**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**~~**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**~~**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}]—**~~the mass of a quantity of a bulk solid divided by its total volume.~~see same in **Density Grouping**.

bulk ~~*solid—density,*~~ ρt **[ML^{-3}]—***~~in characterization and handling of powders and bulk solids~~*~~, 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.~~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—*~~*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.~~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)

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

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 (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~~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~~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~~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~~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; 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~~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~~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~~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)