HMEC Glossary

68-95-99.7 Rule: The values that represent what percentage of a population will fit in a normal distribution depending on the number of standard deviations from the mean. Approximately 68% of values would lie within 1 standard deviation of the mean, approximately 95% of values would lie within 2 standard deviations of the mean, and approximately 99.7% of values would lie within 3 standard deviations of the mean.

AASHTO Classification System: A soil classification system where transportation agencies relate soil classification to transportation type structures.

Absorption: In the case of electromagnetic radiation, the process of matter absorbing energy and transforming it, such as electromagnetic energy transforming into heat.

Acceptable Quality Level (AQL): The quality level (e.g., percent within limits value) at which the material is just considered acceptable.

Acceptance: The process whereby all factors used by the agency are evaluated to determine the degree of compliance with contract requirements and to determine the corresponding value for a given product.

Acceptance Plan: An agreed-upon process for evaluating the acceptability of a *lot* of material. The process should consider point of sampling, method of test, sample size, acceptance limits, risks, and operating characteristics.

Accuracy: Refers to the absence of bias in a measurement. The degree of conformity of the measurement to the true value of the quality characteristic being measured.

Additive Silo: An additional silo for storing mineral filler, fines, or special additives that are added to the aggregate blend in the drum at different locations in an asphalt plant.

Adjusted Payment: An increased or reduced payment in the contract price based on using the sample results to measure the conformity of the lot to the specification requirements.

HMEC Glossary

Admixtures: Materials in the form of powder or fluids that are added to concrete to give it certain characteristics not attainable with plain concrete mixes.

Aggregates: Materials used in construction, including sand, gravel, crushed stone, slag, or recycled concrete that serve as reinforcement to add strength to the overall composite material.

Alligator Cracking: Interconnecting or interlaced cracking due to a loading failure, subbase failure, or other causes related to the highway or roadway load.

Alternate Hypothesis: The hypothesis that sample observations are influenced by some non-random cause.

Amine Blush: Coating failure resulting from epoxy coatings being applied in cold, damp conditions and curing under those same conditions.

Anode: An electrode through which positive electric charge flows into a polarized electrical device.

Apparent Specific Gravity: The ratio of the mass of a unit volume of the impermeable portion of aggregate (does not include permeable pores) to the mass of an equal volume of gas-free distilled water at the stated temperature.

Arithmetic Mean ($\bar{X}$ or μ): A measure of the center of a set of data (i.e., the average value). For a sample set of observations, the symbol used is $\bar{X}$, which is defined as the sum of all of the observations divided by the number of observations. For a population, the symbol used is μ, which defines the true value of the center of the population.

Asphalt: A dark brown to black cementitious material in which the predominant constituents are bitumen that occur in nature or are obtained in petroleum processing.

HMEC Glossary

Asphalt Concrete (AC): A mixture of mineral aggregates, asphalt binder, and additives that is designed to meet specific engineering properties.

Asphalt Concrete Base (ACB): Asphalt concrete used as a base course.

Asphalt Concrete Pavement (ACP): A pavement structure placed above a subgrade or improved subgrade and consisting of one or more courses of asphalt concrete or a combination of asphalt concrete and stabilized or unstabilized aggregate courses.

Asphalt Concrete Surface (ACS): Asphalt concrete used as a surface course.

Asphalt Treated Permeable Base (ATPB): A permeable base containing a small percentage of asphalt cement to enhance stability.

Assignable Cause: A relatively large factor, usually due to error or process change, which contributes to variation and whose effects are of such importance that the expenditure of time and money for its identification is justified.

Attribute Data: Data that are from a counting rather than a measurement process. Examples of attribute data include screening tests, which are conducted on a go or no-go basis.

Average: See *Arithmetic Mean*.

Average Annual Daily Traffic (AADT): A measure used in transportation that calculates the total volume of traffic for a given highway or road in a year divided down by 365 days. It can determine where funding or construction is focused, or can be focused on a type of vehicle, like a truck.

Average Annual Daily Truck Traffic (AADTT): The estimate of typical truck traffic on a road segment for all days of the week over the period of a year.

HMEC Glossary

Average Range ($\bar{R}$): The sum of the individual sample ranges divided by the number of ranges.

Back calculation: A mechanistic evaluation of pavement surface deflection basins generated by various pavement deflection devices. Back calculation takes a measured surface deflection and attempts to match it (within some tolerable error) with a calculated surface deflection generated from an identical pavement structure using assumed layer stiffnesses (moduli).

Base: The layer or layers of specified or select material of designed thickness placed on a subbase or subgrade to support a surface course. The layer directly beneath the PCC slab is called the base layer.

Base Course: The layer of material in an asphalt roadway that is located directly under the surface layer, typically consisting of aggregate.

Batch Tower: Tower containing hot bins that separate aggregates into sizes (sieves the aggregates from the dryer) and then blends or combines the aggregate sizes into the proper amounts before entering the pugmill in an asphalt plant.

Beneficial Reuse: Typically a designation granted by a governing body that the material in question has been deemed to be acceptable to use in specific applications within their jurisdiction.

Bias: An error, constant in direction, common to each of a set of values, which cannot be eliminated by any process of averaging.

Biased Sample: A sample obtained by a biased sampling process, i.e., a sampling process for which each portion of the population does not have an equal chance of being included in the sample. Non-random, or judgment sampling, may be subject to bias.

Bimodal Distribution: A set of data or a population that exhibits two modes when plotted as a frequency distribution.

HMEC Glossary

Blaine Fineness: The fineness of granular materials such as cement and pozzolans, expressed as the total surface area in square centimeters per gram, determined by the Blaine air-permeability apparatus and procedure.

Bleeding/Flushing: A result of excess asphalt binder coming to the surface due to elevated temperatures in combination with heavy truck loads.

Blistering: Coating failure that results from a coating being exposed to immersion situations.

Blocky: Cohesive soil that can be broken into smaller angular lumps that resist further breakdown.

Bottom-Up Transverse Cracking: Occurs when the truck axles are near the longitudinal edge of the slab, midway between the transverse joints, and a critical tensile-bending stress occurs at the bottom of the slab under the wheel load.

Bulk Specific Gravity: The ratio of the mass of a unit volume of aggregate (including the water permeable voids) at a stated temperature to the mass of an equal volume of gas-free distilled water at the stated temperature.

Bulk Saturated Surface Dry Specific Gravity: The ratio of the mass of a unit volume of aggregate (including the weight of water within the voids filled to the extent achieved by submerging in water for approximately 15 hours) to the mass of an equal volume of gas-free distilled water at the stated temperature.

Buyer's Risk (β): The probability of accepting unsuitable material or construction as a result of using a particular acceptance plan. It is the risk the highway agency takes of accepting material that does not comply with the specification requirements.

Caliche: Formed when minerals leach from the upper layer of the soil and accumulate in the next layer allowing natural cementing between calcium carbonate and other materials.

California Bearing Ratio (CBR): A penetration test (developed by the California Department of Transportation) for evaluation of the mechanical strength of subgrades and basecourses in pavement.

Cathode: An electrode from which a conventional current leaves a polarized electrical device.

Cement-Treated Base (CTB): A base course consisting of mineral aggregates blended in place or through a pugmill with a small percentage of Portland cement to provide cementitious properties and strengthening.

Cement-Treated Permeable Base (CTPB): An open-graded aggregate base treated with Portland cement to provide enhanced base strength and reduce erosion potential.

Center: The central value about which a set of measurements tends to cluster. It may be thought of as the single value that can be used to represent all of the values in a set of observations.

Central Limit Theorem: A theorem which states that given any population with mean, μ, and variance, σ^2, as the sample size, n, increases without limit, the distribution of sample means approaches a normal distribution with mean, μ, and variance, σ^2/n.

Central Tendency: See *Center*.

Chalking: The process of the sun's harmful ultraviolet rays breaking down the polymer matrix of a coating's resin, exposing the pigments and fillers. Rain then washes away the chalk, exposing fresh undercoats.

Chance Cause: The natural, inherent, variation that occurs in any process.

Class: A group of observations which all satisfy a given set of conditions.

Class Frequency: The number of observations falling into a particular class.

Class Interval: The difference in value between the upper and lower limits for a given class.

Class Limits: The upper and lower values that define a given class.

Class Mid-Point: The center value of a particular class.

Classification: A laboratory-based process of grouping soils with similar engineering characteristics into categories based on index test results (group name and symbol; AASHTO M 145, ASTM D2487).

Cleanliness: Amount of fines in the graded coarse aggregate.

Coarse Aggregate: Aggregate predominantly retained on the 4.75mm (#4) sieve.

Coarse Grained: Components of soil that can be distinguished visually; coarse-grained soils are those that have more than 50% retained on the #200 sieve.

Coefficient of Thermal Expansion (CTE): A measure of a material's expansion or contraction with temperature.

Coefficient of Variation: The ratio of the standard deviation and the arithmetic mean. It gives a measure of spread relative to the mean and is generally expressed as a percentage.

Cohesion: Bond between soils, especially clay.

Compressive Strength: The measured resistance of a concrete or mortar specimen to axial loading expressed as pounds per square inch (psi) of cross-sectional area; the maximum compressive stress which materials are capable of sustaining.

Consolidated Drained: A sample is consolidated, sheared in compression, and allowed to drain.

Consolidated Undrained: Shear of a sample is measured without drainage and the sample is assumed to be fully saturated.

Continuous Data: Values obtained from a measurement process for which all values, within a given range, are possible.

Continuously Reinforced Concrete Pavement (CRCP): Portland cement concrete pavement with no transverse joints and containing longitudinal steel in an amount designed to ensure shrinkage cracks are held tightly closed. Joints exist only at construction joints and on-grade structures.

Control Charts: Graphical plots of process control which detect when assignable causes are acting on a process and when a systematic variation from the expected results is occurring in a continuous production line process.

Controlled Conditions: Conditions in a process or experiment that stay the same throughout the population.

Creep: The tendency of a solid (soil, rock, etc.) to slowly move or deform under stress.

Cumulative Frequency Histogram or Polygon: A frequency histogram or polygon that is constructed by adding up the total number of occurrences of values less than or equal to a designated value.

Data: Measurements collected for a planned purpose and suitable for the inference of conclusions.

Degrees of Freedom: The number of free choices. For example, given that $X_1 + X_2 + X_3 = 10$, any two of X_1, X_2, or X_3 may be assigned at will (two free choices = two degrees of freedom), but once these two have been determined, the value of the third variable is fixed.

Delamination: A clean separation of one coating layer from another due to physical effects.

Deleterious Materials: The weight percentage of contaminants such as shale, wood, mica, and coal in the blended aggregate.

Densification: A depression that is confined to underneath each wheel that is usually related to insufficient compaction and additional densification in the asphalt layer at or near the surface. These ruts are typically shallow or relatively low.

Description: The process of estimating the relative percentage of each component of given soil.

Discrete Variable: A variable for which the possible values are observed on a discrete or integer scale.

Dispute Resolution: An agreed-upon procedure to resolve conflicts resulting from discrepancies between agency and contractor when the results have a sufficient enough magnitude to have an impact on payment.

Draindown: When asphalt binder simply drains off of the aggregate surface, potentially causing fat spots and areas of asphalt binder segregation.

Drilled Shaft Foundation: A deep foundation that consists of a drilled hole filled with reinforced concrete.

Dry Spray: Coating failure that results from spraying with a spray gun held too far away from a surface or spraying during high wind due to solvent evaporation from paint before it hits the surface.

Ductility: The ability of asphalt to stretch without breaking.

Effective Specific Gravity: The ratio of the mass in air of a unit volume of a permeable material (excluding voids permeable to asphalt) at a stated temperature to the mass in air (of equal density) of an equal volume of gas-free distilled water at a stated temperature.

Elasticity: The physical property of an asphalt binder when it bends under stress but returns to its original shape when the stress is removed.

Electrolyte: A substance that ionizes when exposed to an ionizing solvent.

Enhanced Integrated Climatic Model: A tool used to model temperature and moisture within each pavement layer and the foundation soil.

Equivalent Single Axle Load (ESAL): A numerical factor that expresses the relationship of a given axle load to another axle load in terms of the relative effects of the two loads on the serviceability of a pavement structure. Often expressed in terms of 18,000-lb. (80 kN) single axle loads.

Erosion: The weathering and transportation of soil and rock.

F-distribution: The ration of two chi-square distributions, commonly used in Analysis of Variance.

***F*-test:** A statistical test to see if two populations have equal variances by comparing the ratio of the two variances.

Fabrication: Cutting, bending, and assembling processes used in steel and metal manufacturing and construction.

Falling Weight Deflectometer (FWD): A testing device used by civil engineers to evaluate the physical properties of pavement, most notably pavement structural capacity. It is a non-destructive and non-intrusive test that drops differing amounts of weight onto a load plate positioned on a given pavement structure.

Fatigue Cracking: Cracking of the pavement surface as a result of repetitive loading; may be manifested as longitudinal or alligator cracking in the wheel paths for flexible pavement and transverse cracking (and sometimes longitudinal cracking) for jointed concrete pavement.

Fatigue Resistance: The ability of a material to withstand repeated flexing caused by repeated traffic loading.

Faulting: Elevation or depression of a PCC slab in relation to an adjoining slab, usually at transverse joints and cracks.

Fine Aggregate: Aggregate predominantly passing the 4.75mm (#4 sieve).

Fine Grained: Components of soil that cannot be distinguished visually; fine-grained soils are those in which more than 50% pass the #200 sieve.

Fines: Another term for *Fine Aggregate*.

Fisheyes: Holes or deep depressions in paint film (also called cratering).

Fissured: Breaks along definite planes of fracture with little resistance to fracturing related to soils or rock.

Flushing/Bleeding: A result of excess asphalt binder coming to the surface due to elevated temperatures in combination with heavy truck loads.

Fluvial Soils: Soils deposited by water.

Fly Ash: A silica and alumina residue from burning away the carbon in a coal-fired power plant. Fly ash particles are usually spherical with a fineness similar to that of Portland cement.

Frequency: The number of items or observations that occur within a given interval.

Frequency Histogram: A type of bar chart that displays the relative number of measurements for different classes in terms of area. The width of the bar represents the class interval, while the height represents the number of measurements in the interval.

Frequency Polygon: A broken line graph constructed by drawing line segments that join the midpoints at the top of each column or bar in the frequency histogram.

Frequency Table: A tabular presentation of statistical data, generally showing the number of classes, class limits, class midpoint, tallied frequency, relative frequency, and cumulative relative frequency.

Gaussian Distribution: See *Normal Distribution*.

Geogrid (GG): A geosynthetic formed by a regular network of tensile elements with apertures of sufficient size to interlock with surrounding fill material, used primarily as reinforcement of base and subbase layers and in stabilization of soft subgrade layers. Also used in overlays for asphalt reinforcement.

Geology: A science that studies rocks, layers of soil, etc. in order to learn about the history of the earth and its life.

Geosynthetic: A planar product manufactured from a polymeric material used with soil, rock, earth, or other geotechnical-related material as an integral part of a civil engineering project, structure, or system.

Geotextile (GT): A permeable geosynthetic made of textile materials, used as a separator between base, subbase, and subgrade layers, used as filters in drainage features, and used in stabilization of soft subgrade layers. Also used in asphalt overlays as a membrane absorption and/or waterproofing layer.

Glacial Till: Vast amounts of rock and soil that are ground up, mixed together, and deposited in a compact condition by means of glaciers.

Grand Mean (*X*): The sum of the arithmetic means of sets or groups of data divided by the total number of sets or groups.

Gravel: Coarse aggregate resulting from natural disintegration and abrasion of rock or processing of weakly bound conglomerate. In geotechnical engineering, the particles of rock that range in size from 76.2 mm (3-in. U.S. sieve) to 4.75 mm (#4 U.S. sieve). To be classified as a gravel in the Unified Classification System (UCS), at least 50% of the material must be in this range.

High-Density Polyethylene (HDPE): HDPE is produced from petroleum and molded into a variety of forms. Recycled HDPE is produced by recovering various HDPE products and reprocessing them to a resin form for use in second generation products.

High-Performance Concrete (HPC): Concrete that exceeds the typical standards established for Portland cement concrete.

Histogram: See *Frequency Histogram*.

Hot-In-Place (HIP): HIP recycling is an on-site, in-place method using heat to remove the existing surface and rehabilitates deteriorated asphalt pavements, thereby minimizing the use of new materials.

Hot Mix Asphalt (HMA): Asphalt produced by heating the asphalt binder to decrease its viscosity and drying the aggregate to remove moisture from it prior to mixing.

Hubbard-Field Stability Test: A method for determining the optimum binder content of sheet asphalt surface mixtures and sand asphalt bases.

Hydrologic Cycle: The movement of water over land and through the subsurface.

Identification: The process of determining the components of a given soil, such as gravel, sand, silt, or clay.

Igneous Rocks: Rocks formed by the solidification of molten materials, either at depth in the earth's crust (intrusive) or by extrusion at the earth's surface.

Independent Assurance (IA): Activities that are an unbiased and serve as an independent evaluation of all the sampling and testing procedures used in the quality assurance program.

Indurated: Hardened or cemented layer that will not soften when exposed to water (related to soils).

In-Situ Testing: Testing that takes place on the soil or rock while the material is still undisturbed in its original subsurface position.

Jointed Plain Concrete Pavement (JPCP): Jointed Portland cement concrete pavement containing no distributed steel to control random cracking; may or may not contain joint load transfer devices.

Jointed Reinforced Concrete Pavement (JRCP): Jointed Portland cement concrete paving containing distributed steel reinforcement to control random cracking and usually containing joint load transfer devices.

Judgment Sampling: Sampling based solely on the judgment of the sampler. The sampler decides when and where a sample should be taken.

Karst Terrain: Regions where the type of rock below the land surface can naturally be dissolved by groundwater circulating through them.

Layered: Alternating layers of varying material or color.

Lean Concrete: A variation of Portland cement concrete that uses a lower cement content, higher water/cement ratio, and generally a gap-graded aggregate resulting in substantially lower strength and durability.

Level of Significance: The probability of rejecting a null hypothesis when, in fact, it is true.

Limit State: A condition beyond which a structural component ceases to satisfy the provisions for which it was designed.

Liquefaction: The process of transforming any soil from a solid state to a liquid state, usually as a result of increased pore pressure and reduced shearing resistance.

Lithification: Sediment compaction under pressure.

Load Equivalency Factors (LEFs): Damage per pass to pavement by the axle in question relative to the damage per pass of a standard 18,000-lb. axle load.

Load Transfer Efficiency (LTE): The ratio of deflection of the unloaded side to the loaded side of the joint multiplied by 100. When crack LTE is reduced, the potential for punchouts to develop increases greatly.

Loess: A wind-blown silt that is lightly cemented.

Longitudinal Cracking: A form of fatigue or wheel load-related cracking that occurs within the wheel path and is defined as cracks predominantly parallel to the pavement centerline.

Lot: An isolated quantity of material from a single source. A measured amount of construction assumed to be produced by the same process.

Lower Class Limit: Value that determines the lower limit for a particular class when constructing a frequency table, frequency histogram, or frequency polygon.

Lower Control Limit (LCL): A process control criterion associated with the control chart technique. It is the limiting value above which the contractor or producer must hold his/her process if it is to remain in control.

Lower Specification Limit (LSL): The minimum limiting value used for determining acceptable material within the specification requirements.

Mean: See *Arithmetic Mean*.

Mechanically Stabilized Earth (MSE) Wall: A soil-retaining system, employing either strip or grid-type, metallic, or polymeric tensile reinforcements in the soil mass, and a facing element that is either vertical or nearly vertical. In this system, the soil mass is engaged by the strips to become a gravity type retaining wall.

Mechanistic-Empirical: A design philosophy or approach wherein classical mechanics of solids is used in conjunction with empirically derived relationships to accomplish the design objectives.

Mechanistic-Empirical Pavement Design Guide (MEPDG): A design approach based on mechanistic-empirical principles. The functions of the MEPDG are as a pavement design tool (trial-and-error process) and a pavement analysis tool (distress predictions).

Median: For a set of numbers, the median is the value for which half of the numbers are larger and half are smaller.

Metallizing: An industrial coating process that consists of a heat source (flame or other) and a coating material in a powder or wire form (usually zinc or a zinc-aluminum alloy) that is literally melted into tiny droplets and sprayed onto surfaces at high velocity. The resultant coating acts as a barrier and sacrificial coating that lasts up to and exceeds 30 years.

Metamorphic Rocks: Rocks that have altered physically or chemically by the application of intense heat and/or pressure at some time in their geologic history.

Military Standards: A handbook of tables based on the concepts of lot-by-lot sampling inspection by either attributes or variables. These standards, often referred to as Mil Standards, are published by the Federal Government.

Mode: The value of a variable that is possessed by the greatest number of the members of the population.

Modified Unified Description: A procedure that involves visually and manually examining soil samples with respect to texture, plasticity, and color and developing a "word picture" of a sample for entering on a subsurface exploration log or other appropriate data sheet. The description system is intended to provide the best word description of the sample to those involved in the planning, design, construction, and maintenance processes.

Modulus of Elasticity: A measure of material stiffness, which is also a ratio of an applied stress to measured strain.

Mohr-Coulomb Diagram: Used to determine the cohesion and friction angle for tested soil.

Mud Cracking: A pattern of overly thick coatings that irregularly crack when solvents evaporate.

Multimodal Data: Data, which when plotted as a frequency distribution, exhibit more than one mode.

National Environment Policy Act (NEPA): NEPA is a law that requires Federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of proposed actions and reasonable alternatives to those actions.

Natural Aggregate: Aggregate composed of rock fragments including sand, gravel, and crushed stone.

Natural Pozzolans: Solid particles formed when molten silica, alumina, and other impurities below the earth's crust are ejected in a volcanic eruption. Quick cooling in the atmosphere produces glassy rather than crystalline particles.

Negative Skewness: A frequency distribution that has the side to the left of the central maximum value longer than the side to the right.

Normal Distribution: A curve having a bell shape that is determined by values of μ and σ, and is often used to describe the distribution of individual measurements (such as construction materials properties).

Normalizing: A heat treatment where the plate is reheated, held at temperature, and allowed to slow cool.

Null Hypothesis: What is assumed true in an experiment before the experiment is carried out.

Open-Graded Aggregate Base (OGAB): A crushed mineral aggregate base having a particle size distribution such that when compacted, the interstices will provide enhanced drainage properties.

Operating Characteristic (OC) Curves: A graphical presentation of a sampling plan that shows the relationship between the quality of a lot (population) and the probability of its acceptance, or—where price adjustments are used—its expected payment.

Outlier: An extreme individual measurement or extreme sample mean.

Paired *t*-test: A statistical test that compares values from different populations by using pairs that include a value from each population.

Paleosol: An ancient topsoil that formed during the interglacial period that is often very thick and highly impermeable.

Parameter: A constant or coefficient that describes some characteristic of a population.

Percent Within Limits (PWL): The estimated percentage of a lot of material that is within the specification limits.

Permeability: The quality or state of allowing a substance to pass through itself.

Permeable Bases: Base used to drain water that infiltrates into the pavement from rainfall, snow melt, and other surface/near-surface sources.

Pervious Concrete: A type of concrete with very high porosity that is commonly used to reduce runoff and acts as a temporary storage for precipitation, allowing for groundwater recharge.

Piezometer: A device used to measure the static liquid pressure of groundwater.

Pile Foundation: Deep foundation that consists of a group of piles driven into the ground with the pile tops encased in a concrete pile cap.

Pinpoint Rusting: Rusting in small spots or a "pinpoint" pattern that results from applying too little primer to profiled steel or excessive depth of profile.

Pitch: Black or dark-brown solid cementitious materials that gradually liquefy when heated and which are obtained as residue in the partial evaporation or fractional distillation of tar.

Plastic: A plyometric material that can be made to flow under stress.

Plasticity: The tendency of a material to permanently deform under different stresses.

Pooled Variance: The method for estimating the variance of many different populations with different means. The variance of each populations is assumed to be the same.

Population: Any set of individuals (or measurements) having some common observable characteristic. The set may be finite or infinite. In many cases a population will be finite but so large that it must be treated as though it were infinite.

Portland Cement Concrete (PCC): A broad term used to describe a variety of materials using Portland cement as the primary binder and each suited to a specific type of application; PCC is comprised of four primary components: Portland cement, aggregates, water, and admixtures. The proportion and properties of each of these constituents determines the strength characteristics, workability, durability, and all other physical properties of the PCC.

Positive Skewness: A frequency distribution that has the side to the right of the central maximum value longer than the side to the left.

Post-Consumer Recycled Materials: Material that has completed its life as a consumer item and would otherwise have been disposed as a waste product.

Post-Industrial Recycled Materials: Materials generated during the manufacturing process that may consist of scrap, trimmings, or other byproducts that are not needed for the final product.

Pozzolans: Siliceous or siliceous/aluminous materials that have little or no cementing value by themselves. Pozzolans will react with lime and water at ordinary temperatures to form a cementitious product similar to that produced by the hydration of Portland cement.

Precision: Refers to the variability of a method of measurement when used to make repeated measurements under carefully controlled conditions.

Probability: The relative frequency of occurrence of various events over the long run.

Psychrometer: A device set up with a dry and moist thermometer that can help calculate relative humidity by comparing the given temperature with that of the temperature given after the moist thermometer loses heat to evaporation.

Pugmill: The batch plant where the proper amount of asphalt is added to a specific batch or weight of aggregate and mixes the asphalt, aggregate blend, and any additive used in the asphalt mix. It is located at the bottom of the batch tower.

Punchouts: A broken area of a CRCP bounded by closely spaced cracks usually spaced less than 1 meter.

Quality Assurance (QA): The planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service.

Quality Control (QC): The system used by a contractor to monitor, assess, and adjust their production or placement processes to ensure that the final product will meet the specified level of quality.

Quality Control Plan: The sum of total activities performed by the seller (producer, manufacturer, and/or contractor) to make sure that a product meets contract specification requirements.

Quality Management: An umbrella term that relates to all aspects of producing and accepting a quality product. Quality management includes topics as diverse as specification development and implementation, quality control, product acceptance, training, communications, and laboratory and technician certification.

Random Sampling: A sampling procedure whereby any individual measurement in the population is as likely as any other to be included.

Raveling: The dislodging of aggregates from pavement, usually starting with small aggregates and then moving to larger aggregates due to processes including ground vibrations, excess pore pressure, or freeze-thaw cycles.

Reclaimed Asphalt Pavement (RAP): Granular material resulting from the removal and processing of existing asphalt pavements. When properly crushed and screened, RAP consists of high-quality, well-graded aggregates coated by asphalt cement and is typically used for a variety of purposes ranging from base and subbase materials to incorporation in new AC mixes.

Recycle: A process to change waste materials into new products.

Recycled Aggregate: Aggregate produced from the crushing and screening of broken or fragmented concrete, asphaltic pavements, or other previously cemented mixtures, usually including much of the cementing medium reclaimed in the process.

Recycled Concrete Aggregate: Granular material manufactured by removing, crushing, and processing hydraulic-cement concrete (typically PCC). This material may be used for a variety of purposes including pavement support layers, course aggregate for PCC, and others.

Reliability: The probability that a given pavement design will last for the anticipated performance period.

Reproducibility: The range within which repeated measurements are made by the same operator on the same apparatus. Essentially, the precision of a test.

Residual Soil: Soil that develops from the surface of bedrock through weathering and chemical actions.

Resource Conservation and Recovery Act (RCRA): RCRA is a law designed to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that waste is managed in an environmentally sound manner.

Reuse: The process of using a material again after it has been used and no longer needed for its original use.

Rheology: The science of flow and deformation of matter; describes the interrelation between force, deformation, and time.

Roadbed: The graded portion of a highway between top and side slopes, prepared as a foundation for the pavement structure and shoulder.

Rock Cycle: The formation, weathering, sedimentation, and reformation of rock.

Rock Mass Rating (RMR): A geomechanical classification system for rocks that assigns a value between 0 and 100 for overall rock quality based on six parameters.

Rock Quality Designation (RQD): A parameter that measures the degree of jointing or fracture used to help measure the overall quality of rocks used in construction. The RQD is determined by summing up the lengths of all the pieces of core that are at least 4 in. long. That sum is divided by the length of the core run (typically 60 in.) to get the RQD as a percentage.

Rust Undercutting: When corrosion has undercut the coating system and caused the coating to be compromised to the substrate, leading to corrosion.

Rutting: A surface depression in the wheel path resulting from plastic or permanent deformation in each pavement layer.

Sagging: Excessive flow of paint applied to vertical surfaces.

Sample: A small part of a lot (or population) that is taken to make inferences about the entire lot. A sample can be made up of one or more increments, or test portions.

Sampling Plan: See *Acceptance Plan*.

Saprolite: A soft, decomposed, and porous weathered rock (often rich in clay), formed by the in-place chemical weathering of igneous, metamorphic, or sedimentary rocks.

Scour (Bridges): Removal of soil and rock from around abutments or piers, especially by flowing water.

Sedimentary Rocks: Rocks formed by compaction and cementation of sedimentary soils.

Seller's Risk (α): The probability of having acceptable material or construction rejected as a result of using a particular acceptance plan. It is the risk taken by the contractor or producer of having acceptable material rejected.

Separation: The removal of the oily constituents, resins, or asphaltenes from asphalt caused by selective absorption of some porous aggregates.

Shear Susceptibility: The rate of change of viscosity with the rate of shear.

Shoving: A longitudinal displacement in a localized area of the pavement surface.

Sieve: A device used to separate materials from one another, often solids from liquids or particles of different sizes.

Skewness: A condition where the tail of a frequency distribution to one side of the central maximum value is longer than that on the other side (distribution that is not symmetric).

Slag: A glass-like byproduct left over after a desired metal has been separated from its raw ore.

Slickensided: Fracture planes appear polished or glossy, sometimes striated; used in soil descriptions.

Soil Mechanics: The body of knowledge developed by analyzing soil behavior on a theoretically sound basis.

Soundness: An aggregate's resistance to disintegration by weathering and, in particular, freeze-thaw cycles.

Specifications: A statement containing a description of requirements or enumeration of particulars, such as terms of a contract or details required of materials and/or construction.

Specific Gravity: The ratio of the mass of a unit volume of a material to the mass of the same volume of water at a stated temperature.

Specification Limits: Limits established, preferably by statistical analysis, for determining acceptable construction material within the specification requirements.

Spread Footing: Shallow foundation consisting of a reinforced concrete pad that transfers the structural load to the soil or rock through bearing.

Standard Deviation (σ or *s*): A term used in statistics to indicate the spread of a set of data or a population. It is the square root of the average difference between the individual measurements and their mean. The symbol, σ, is used to represent the standard deviation of a population, while the term, *s,* is used for the standard deviation of a sample. The equations for standard deviation are given below:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n}} \qquad s = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}}$$

Standard Normal Distribution: A normal distribution with a mean of 0 and a standard deviation of 1. Measured values of a normal distribution are usually transformed to the Z-statistic (i.e., the standard normal form where Z is the number of standard deviations a particular value is above or below the mean) to facilitate computing areas under the normal distribution curve.

Statistic: An expression or numerical value that describes some characteristic of the distribution of measurements of a sample.

Statistics: The science that deals with the treatment and analysis of numerical data. Also, a collection of numerical data.

Steel: Alloy of iron, carbon, and other alloy elements that help improve the overall properties, such as strength and hardness.

Strain: The amount of deformation applied or observed in a specimen or material.

Stratified Sampling: Selecting each of two or more parts independently from a corresponding part. Stratified sampling is inherent in any acceptance sampling based on lots.

Structure: Depositional or physical features found in soils.

Structural Number: Represents the overall structural requirement needed to sustain the design's traffic loadings. It is an abstract number that expresses the structural strength of a pavement required for given combinations of soil support (MR), total traffic expressed in ESALs, terminal serviceability, and environment.

Subbase: The main load-bearing layer of pavement, directly under the base course; the layer or layers of specified or selected materials of designed thickness placed on a subgrade to support a base course. Note that the layer directly below the PCC slab is now called a base layer, not a subbase layer.

Subgrade: The top surface of a roadbed upon which the pavement structure and shoulders are constructed.

Sublots: Equal divisions or portions of a lot.

Surface Course: One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer of flexible pavements is sometimes called the "wearing" course.

Symmetry: Correspondence in size and shape of parts about a given axis. For example, the bell-shaped curve of a truly normal distribution is said to be symmetrical about the mean (center) value.

Systematic Error: Errors arising from causes that act consistently under given circumstances, such as a rule calibrated at one temperature and used and read at another.

Systematic Sampling: Selection of successive observations at uniform intervals in a sequence of times, areas, lengths, etc.

***t*-test:** A statistical hypothesis test used to determine if two sets of data are significantly different from one another given a normal distribution.

Tar: Brown or black bituminous material, liquid or semi-liquid in consistency, in which the predominate constituents are bitumen obtained as condensates in the destructive distillation of coal, petroleum, oil-shale, wood, or other organic materials, and which yields substantial quantities of pitch when distilled.

Tectonic Cycle: The processes of altering the Earth's crust (producing mountains, ocean basins, and continents).

Tensile Strength: The maximum stress that a material can withstand while being stretched or pulled before failing or breaking.

Top-Down Transverse Cracking: A fatigue damage at the top of a slab that eventually results in a transverse or diagonal crack that is initiated on the surface of the pavement. Occurs when repeated loading by heavy trucks with certain axle spacing is applied on pavement.

Transverse Cracking: A non-wheel load-related cracking that is predominantly perpendicular to the pavement centerline and caused by low temperatures or thermal cycling.

Unconsolidated Undrained: A sample is compressed at a constant rate and not allowed to drain.

Unified Soil Classification System (USCS): Groups soils with similar engineering properties into categories based on grain size, gradation, and plasticity.

Unimodal Data: Data which, when plotted as a frequency distribution, exhibit only one mode or maximum.

Upper Class Limit: Value that determines the upper limit for a particular class when constructing a frequency table, frequency histogram, or frequency polygon.

Upper Control Limit (UCL): A process control criterion associated with the control chart technique. It is the limiting value below which the contractor or producer must hold his process if it is to remain in control.

Upper Specification Limit (USL): The maximum limiting value used for determining acceptable material within the specification requirements.

Validation: The mathematical comparison of two independently obtained sets of data (i.e. agency acceptance data versus contractor data) to determine whether it can be assumed they came from the same population.

Variable: A measurement that can have a series of different values.

Variable Sampling: Sampling in which the characteristic of interest is measured rather than the type of qualitative classification used in attribute sampling.

Variance (σ^2): A statistical measure of spread or dispersion. It is the square of the standard deviation, or, more correctly, the standard deviation is the square root of the variance.

Variation: Differences in measured values of a characteristic within a stable pattern due to chance, or outside the normal pattern due to assignable cause.

Varved: Annual sedimentary layers deposited in still water.

Verification: The process of determining the accuracy of test results by examining the data or providing evidence, or both.

Viscoelasticity: The property of materials that exhibit both viscous and elastic characteristics when undergoing deformation.

Voids in Mineral Aggregate (VMA): The inter-granular void space between the aggregate particles of a compacted paving mixture that includes the air voids and effective asphalt content.

Voids in Total Mix (VTM): The total volume of the small pockets of air between the coated aggregate particles throughout a compacted asphalt concrete paving mixture and is expressed as a percent of the bulk volume of the compacted paving mixture.

Volatile Organic Content (VOC): Any volatile compound of carbon, excluding methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbonates, and exempt compounds.

Volatilization: The evaporation of the lighter constituents from an asphalt binder.

Warm Mix Asphalt (WMA): The generic term for a variety of technologies that allow producers of HMA pavement material to lower temperatures at which the material is mixed and placed on the road. It is a proven technology that can reduce paving costs, extend the paving season, improve asphalt compaction, allow asphalt mix to be hauled longer distances, and improve working conditions by reducing exposure to fuel emissions, fumes, and odors.

Waste Material: Material that is no longer useful for its original intent, or is a byproduct of another process.

Weathering: The breakdown of soil, rocks, and minerals by geologic processes.

Wrought Iron: Iron alloy with a very low amount of carbon.

Z-statistic: Z = X minus μ (mu) divided by σ (sigma).

Zero-Stress Temperature: Temperature (after placement and during curing) at which the concrete layer exhibits zero thermal stress (at temperatures less than this, concrete exhibits tensile stress).