

# ICPI TECH SPEC

INTERLOCKING CONCRETE PAVEMENT INSTITUTE®

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## Glossary of Terms for Segmental Concrete Pavement

**AASHTO:** American Association of State Highway and Transportation Officials is an association that includes U.S. state and Canadian provincial highway engineers. AASHTO publishes structural design methods for pavement, material standards and test methods, as well as many other documents on roads, highways and transportation.

**Abrasion:** The mechanical wearing, grinding, scraping or rubbing away (or down) of paver surface by friction or impact, or both.

**Absorption:** Weight of water incorporated by a concrete paver unit during immersion under prescribed conditions, typically expressed as a percentage relating to the dry weight of the unit.

**Admixture:** Prepared chemicals added to the concrete during the mixing process to improve production efficiencies and/or hardened properties such as density, absorption, efflorescence control, visual appeal, durability and strength.

**Aggregate:** Sand, gravel, shell, slag, or crushed stone used in base materials, mixed with cement to make concrete, or with asphalt.

**Albedo:** The ratio of outbound reflected solar radiation from a pavement surface to inbound radiation.

**Angularity:** The sharpness of edges and corners of particles. Used to describe sand and aggregates.

**Arris:** The sharp or salient angle formed by the meeting of two surfaces.

**Aspect Ratio:** The overall length of a paver divided by its thickness. Example: A 4 in. (100 mm) wide by 8 in. (200 mm) long by 3<sup>1</sup>/<sub>8</sub> in. (80 mm) thick paver has an aspect ratio of 2.5. Compare to Plan Ratio.

**ASTM C 936:** American Society for Testing and Materials, Standard Specification for Solid Concrete Interlocking Paving Units. This product standard defines dimensions, dimensional tolerances, maximum absorption, minimum compressive strength, maximum abrasion and freeze-thaw durability through various test methods.

**Aquifer:** A porous, water-bearing geologic formation that yields water for consumption.

**Band Cutter:** A plier-like tool designed to cut metal or plastic bands around cubes and bundles of paving units without injury.

**Base or Base Course:** A material of a designed thickness placed under the surface wearing course of paving units and bedding course. It is placed over a sub-base or a subgrade to support the surface course and bedding. A base course can be compacted aggregate, cement or asphalt stabilized aggregate, asphalt or concrete.

**Base Rake:** A rake with a flat and toothed side to move and level aggregate base (similar in appearance to an asphalt lute). A base rake can be used to evenly spread joint sand on the surface of paving units for faster drying.

**Bedding Sand Degradation Tests:** Evaluation of the degree of attrition of sand. Tests are conducted with steel balls or other abrading devices agitated with a sand sample in a container. Pre- and post-testing sieve analyses are conducted to determine the increase in fines. The tests are used to evaluate the durability of bedding sand under heavy loads or channelized traffic. Tests are often called Micro-Deval tests.

**Bedding Sand or Bedding Course:** A layer of coarse, washed sand screeded smooth for bedding the pavers. The sand can be natural or manufactured (crushed from larger rocks) and should conform to the grading requirements of ASTM C 33 or CSA A23.1 with limits on the percent passing the No. 200 (0.075 mm) sieve. A screeded sand layer is 1 to 1<sup>1</sup>/<sub>2</sub> in. (25 to 40 mm) thick.

**Bentonite Clay:** Clay with a high content of the mineral montmorillonite, usually characterized by high swelling on wetting that can be used to help seal paver joints.

**Best Management Practice (BMP):** A structural device or non-structural program designed to reduce stormwater runoff and water pollution.

**Bishop's Hat:** A five-sided paver often used as an edge paver with a 45° herringbone pattern.

**Bitumen:** A class of asphalts combined with neoprene and used as an adhesive under unit paving.

**Bitumen Setting Bed:** A sand-asphalt mix used for a bedding layer typically less than 1 in. (25 mm) thick. Paving units are often adhered to the layer with a neoprene-asphalt adhesive.

**Blending Pavers:** Mixing colored concrete pavers from three or four cubes to insure an even color distribution.

**Bulge or Belly:** Convex sides of a concrete paver that are often due to excessive water in the concrete mix.

**Bundle:** Paver clusters stacked vertically, bound with plastic wrap and/or strapping, and tagged for shipment to and installation at the site. Bundles of pavers are also called cubes of pavers. Concrete paver bundles supplied without pallets are strapped together for shipment then delivered and transported around the site with clamps attached to various wheeled equipment. Bundles can also refer to a portion of paving units or band of pavers for transport around the site with wheeled equipment such as a bundle buggy.

**Bundle Buggy:** A wheeled device (with or without an engine) specifically designed to carry a band or portion of a cube of pavers around a job site.

**California Bearing Ratio (CBR):** A standardized soils test defined as the ratio of: (1) the force per unit area required to penetrate a soil mass with a 3 in. sq. (19 cm sq.) circular piston (approximately 2 in. (51 mm) diameter) at the rate of 0.05 in. (1.3 mm)/min, to (2) that required for corresponding penetration of a standard material. The ratio is usually determined at 0.1in. (2.5 mm) penetration, although other penetrations are sometimes used. See ASTM D 1883.

**Cation:** A positively charged atom or group of atoms in soil particles that, through exchange with ions of metals in stormwater runoff, enable those metals to attach themselves to soil particles.

**Cement-Aggregate Ratio:** The proportional weight of cement to fine and coarse aggregate in concrete.

**Cement, Portland:** Hydraulic cement produced by pulverizing clinker consisting essentially of hydraulic calcium silicates, and usually containing one or more forms of calcium sulfate.

**Chamfer:** A 45° beveled edge around the top of a paver unit usually  $\frac{1}{16}$  to  $\frac{1}{4}$  in. (2-6 mm) wide. It allows water to drain from the surface, facilitates snow removal, helps prevent edge chipping, and delineates the paving individual units.

**Choke Course:** A layer of aggregate placed or compacted into the surface of another layer to provide stability and a smoother surface. The particle sizes of the choke course are generally smaller than those of the surface into which it is being pressed.

**Clay:** Fine-grained soil or the fine-grained portion of soil that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. The term can designate soil particles finer than 0.002 mm (0.005 mm in some cases).

**Cluster:** A group of pavers forming a single layer that is grabbed, held, and placed by a paver-laying machine typically on a sand bedding course.

**Coarse Aggregate:** Aggregate predominantly retained on the U.S. Standard No. 4 (4.75 mm) sieve; or that portion of an aggregate retained on the No. 4 (4.75 mm) sieve.

**Compaction:** The process of inducing close packing of solid particles such as soil, sand, or aggregate.

**Compressive Strength:** The measured maximum resistance of a concrete paver to loading expressed as force per unit cross-sectional area such as pounds per square inch or newtons per square millimeter (megapascals).

**Concrete Block Pavement:** A system of paving consisting of discrete, hand-sized paving units of either rectangular or dentated shapes, manufactured from concrete. Either type of shape is placed in an interlocking pattern, compacted into coarse bedding sand, the joints filled with sand and compacted again to start interlock. The paving units and bedding sand are placed over an unbound or bound aggregate layer. Also called interlocking concrete pavement.

**Concrete Grids:** Concrete units (generally small slabs) that have up to 50 percent open area. The units are generally no larger than 16 in. (400 mm) by 24 in. (600 mm). Aggregate or grass can be placed in the openings to promote infiltration of stormwater. Grids are generally used for intermittent parking, access lanes, abating runoff and/or controlling erosion. See ASTM C 1319, Standard Specification for Concrete Grid Paving Units for product standards.

**Concrete Pavers:** Concrete paving units, rectangular, square or dentated, capable of being placed with one hand into a laying pattern. The surface area is typically 100 in.<sup>2</sup> (0.065 m<sup>2</sup>) and the overall length to thickness is 4 or less. Compare to Paving Slab.

**Concrete Sand:** Washed sand used in the manufacture of ready-mix concrete which conforms to the grading requirements of ASTM C 33 or CSA A23.1. See Bedding Sand.

**Course:** A row of pavers.

**Creep:** Slow lateral movement of pavers from horizontal forces such as braking tires. The movement is usually imperceptible except to observations over a long duration.

**Crown:** The slightly convex shape of a road cross section. It is beneficial to surface drainage and interlock.

**Crushed Stone:** A product used for pavement bases made from mechanical crushing of rocks, boulders, or large cobblestones at a quarry. All faces of each aggregate have well-defined edges resulting from the crushing operation.

**Crusher Run:** The total unscreened product of a stone crusher.

**CSA-A231.2:** Canadian Standards Association product standard for Precast Concrete Pavers (interlocking units) that defines standards for dimensions, minimum compressive strength, and durability under freeze-thaw cycles with deicing salt through various test methods.

**Cube(s):** Pavers stacked at the factory, strapped or wrapped, with or without a wooden pallet, for shipping and for transfer around the site. The cube has several layers of pavers. The number of layers and pavers on a cube varies with their thickness and shape. See Bundle.

**Curve Number (CN):** A numerical representation of a given area's hydrological soil group, plant cover, impervious cover, interception, and surface storage. A curve number is used to convert rainfall depth into runoff volume.

**Deflection:** The temporary movement of a pavement structure due to traffic loads.

**Deformation:** A change in the shape of the pavement.

**Degradation Testing:** Testing of sands or aggregate to determine resistance to change in particle size or gradation under loading.

**Dense-Graded Aggregate Base:** A compacted crushed stone base whose gradation yields very small voids between the particles with no visible spaces between them. Most dense-graded bases have particles ranging in size from  $1\frac{1}{2}$  in. (38 mm) or  $\frac{3}{4}$  in. (19 mm) down to fines passing the No. 200 (0.075 mm) sieve.

**Density:** The mass per unit volume.

**Dentated Paver:** A unit that is not rectangular or square in shape.

**Detention Pond or Structure:** The temporary storage of stormwater runoff in an area with the objective of decreasing peak discharge rates and providing a settling basis for pollutants.

**Drainage Coefficient:** Factor used to modify layer coefficient of pavements. It expresses how well the pavement structure can handle the adverse effect of water infiltration. See Layer Coefficient.

**Dry Mix Joint Sand Stabilizer:** Joint sand treated with chemicals that when placed in contact with water, activates them to bind together the sand particles. This stabilizes the joint sand, reduces its permeability, sand loss and helps prevent weeds.

**Edge Paver:** A paving unit made with a straight, flush side, or cut straight for placement against an edge restraint.

**Edge Restraint:** A curb, edging, building or other stationary object that contains the sand and pavers so they do not spread and lose interlock. It can be exposed or hidden from view.

**Efflorescence:** A white deposit of calcium carbonate on concrete surfaces. It results from the reaction of calcium hydroxide with carbon dioxide from the air. The calcium hydroxide is a byproduct when cement hydrates. It is slightly soluble in water and migrates to the surface through capillary action. The calcium hydroxide remains on the surface, reacts with carbon dioxide, which forms calcium carbonate and water. This conversion, depending on weather conditions, will dissipate over time. Calcium carbonate is the most common type of efflorescence. The presence of efflorescence does not compromise the structural integrity and is not indicative of a flawed product.

**Elastic Deformation:** A reaction from applied loads where pavement returns to its original position after the load is removed. Compare to permanent deformation under Rutting.

**Elephant's Foot:** A solid extension formed as part of the bottom of the paver typically the result of a rounding at the bottom of the mold due to excessive wear. Also known as legs.

**Embodied Energy:** The energy used through the life-cycle of a pavement material or product to extract, refine, process, fabricate, transport, install, commission, utilize, maintain, remove, and ultimately recycle or dispose of pavement materials.

**Engraved Pavers:** Pavers that have been engraved with letters or images by molding during or after manufacture, shot blasting, wet cutting or that have a cast metal plate set into the surface.

**Equivalent Single Axle Loads (ESALs):** Summation of equivalent 18,000 pound-force (80 kN) single axle loads used to combine mixed traffic to a design traffic load for the design period; also expressed as Equivalent Axle Loads or EALs.

**Erosion:** The process of wearing away soil by water, wind, ice and gravity; also the detachment and movement of soil particles by the same forces.

**Exfiltration:** The downward movement of water through an open-graded, crushed stone base into the soil beneath.

**Face Mix or Hard Facing:** The application of a thin layer of fine aggregate and cement to the top surface of a concrete paver. The layer is often colored and is used to provide a more intense appearance, greater abrasion resistance, or provide a base for a textured finish.

**Failure:** The point at which a pavement does not adequately service its intended use. For flexible pavements, rut depth is often a criterion for failure.

**False Joints:** Grooves on the surface of concrete pavers that appear as full joints between pavers that contribute to the installed joint pattern. False joints can enhance the appearance of the pattern and speed installation compared to placing separate (sub) units. Sometimes called dummy grooves.

**Fines:** Silt and clay particles in a soil, generally those smaller than the No. 200 or 0.075 sieves.

**Fineness Modulus:** A factor obtained by adding the total percentages by weight of an aggregate sample retained on each of a specified series of sieves, and dividing the sum by 100; in the United States the standard sieve sizes are No. 100 (0.150 mm), No. 50 (0.300 mm), No. 30 (0.600 mm), No. 16 (1.18 mm), No. 8 (2.36 mm) and No. 4 (4.75mm), and  $3/8$  in. (9.5 mm),  $1\frac{1}{2}$  in. (37.5 mm), 3 in. (75mm), and 6 in. (150 mm).

**Finished Grade:** The final elevation of a soil, base, or pavement surface which is often indicated on construction drawings. Also Finish Elevation.

**Flash:** A thin, brittle layer of cement around the bottom edges or at the top edges of a paver composed of cement, typically due to minor leakage of liquid cement between elements of the mold assembly. Also known as Flange.

**Flexible Pavement:** A pavement structure which maintains intimate contact with and distributes loads to the subgrade. The base course materials rely on aggregate interlock, particle friction, and cohesion for stability.

**Flexural Strength:** A property of a paver or slab that indicates its ability to resist failure in bending.

**Flowable Fill:** A low-strength concrete mix used to fill utility trenches and other excavated pavement openings; also known as unshrinkable fill or controlled low strength material (CLSM). See ASTM D 6103, D 6023, D 6024 and D 4832.

**Freeze-Thaw Durability Testing:** Tests in which pavers are exposed to cycles of freeze and thaw, partially or totally immersed in water, and with or without salt water.

**Frost Action:** Freezing and thawing of moisture in pavement materials and the resultant effects on them.

**Frost Heave:** The raising of a pavement surface due to the accumulation and expansion of ice in the underlying soil or rock.

**Geogrids:** Geogrids are two dimensional or three dimensional. The two dimensional type are flat and have small, "TV screen" shaped openings. The material is generally placed between the soil and the base to reduce rutting. Three dimensional geogrids are 4 to 8 in. (100 to 200 mm) high and provide stability under loads for cohesionless soils.

**Geotextiles:** Woven or non-woven fabrics made from plastic fibers used for separation, reinforcement, or drainage between pavement layers.

**Gradation:** Soil, sand or aggregate base distributed by mass in specified particle-size ranges. Gradation is typically expressed in percent of mass of sample passing a range of sieve sizes. See ASTM C 136.

**Grade:** (noun) The slope of finished surface of an excavated area, base, or pavement usually expressed in percent; (verb) to finish the surface of same by hand or with mechanized equipment.

**Gravel:** Rounded or semi-rounded particles of rock that will pass a 3 in. (75 mm) and be retained on a No. 4 (4.75 mm) U.S. standard sieve which naturally occurs in streambeds or riverbanks that have been smoothed by the action of water. A type of soil as defined by the Unified Soil Classification System having particle sizes ranging from the No. 4 (4.75 mm) sieve size and larger.

**Half Stone:** A half of a paver.

**Hard Edges:** A field of pavers that is restrained against a visible edge restraint or curb, thus visually reinforcing the edge of pavement.

**Herringbone Pattern:** A pattern where joints are no longer than the length of  $1\frac{1}{2}$  pavers. Herringbone patterns can be  $45^\circ$  or  $90^\circ$  depending on the orientation of the joints with respect to the direction of the traffic.

**Hotspot:** A land use that generates highly contaminated runoff with concentrations higher than those typical to stormwater.

**Human Scale:** Using paver sizes, patterns, colors and textures next to large buildings or open areas with the intent of reducing the user perception of being overwhelmed by the large scale of these spaces.

**Hydrological Soil Group:** The soils classification system developed by the U.S. Soil Conservation Service, now the Natural Resources Conservation Service that categorizes soils into four groups, A through D, based on runoff potential. A soils have high permeability and low runoff whereas D soils have low permeability and high runoff.

**Impervious Cover:** Surfaces that do not allow rainfall to infiltrate into the soil such as pavements, roofs, sidewalks, driveways, etc.

**Infiltration Rate:** The rate at which water moves through a soil tested in the field. Measured in inches per hour or meters per second. See ASTM D 3385 and 5093 and compare to Permeability.

**Interlock:** Frictional forces between paving units that prevent them from rotating, or moving horizontally or vertically in relation to each other; also defined as the inability of a concrete paver to move independently of its neighbors. The friction forces enable load transfer among the paving units. The three kinds of load transfer are vertical interlock, horizontal interlock and rotational interlock. Vertical interlock is achieved by shear transfer of loads to surrounding units through sand in the joints. Horizontal interlock is primarily achieved through the use of laying patterns that disperse forces from braking and accelerating vehicles. The most effective laying patterns for maintaining horizontal interlock are herringbone patterns. Rotational interlock is maintained by the pavers being of sufficient thickness, placed closely together, and being restrained by a stationary edge such as a curb.

**Interlocking Concrete Pavement:** A system of paving consisting of discrete, hand-sized paving units with either rectangular or dentated shapes manufactured from concrete. Either type of shape is placed in an interlocking pattern, compacted into coarse bedding sand, the joints filled with sand and compacted again to start interlock. The paving units and bedding sand are placed over an unbound or bound aggregate layer. Also called concrete block pavement.

**Joint:** The space between concrete paving units typically filled with sand.

**Joint Filling Sand:** Sand used to fill spaces between concrete pavers.

**Joint Sand Gap:** The vertical distance between the bottom of the chamfer on a paver and the top of the sand in the joint.

**Joint Sand Stabilizer:** Liquid penetrating or dry mix applied or materials that provide early stabilization of joint sand, reduces its permeability, sand loss and helps prevent weeds. See Dry Mix Joint Sand Stabilizer and Liquid Penetrating Joint Sand Stabilizer.

**Joint Sand:** Sand swept into the openings between the pavers.

**Joint or Joint Spacing:** The distance between the sides of the pavers not including the spacers that is typically filled with joint sand.

**Karst Geology:** Regions of the earth underlain by carbonate rock typically with sinkholes and/or limestone caverns.

**K-pattern:** A paving pattern with one square unit surrounded by rectangular units. Sometimes called an I-pattern.

**Layer Coefficient:** From the AASHTO pavement design procedure; a dimensionless number that expresses the material strength per inch (25 mm) of thickness of a pavement layer (surface, base, or sub-base). Example: The layer coefficient of 3 1/8 in. (80 mm) thick pavers and 1 in. (25 mm) bedding sand is 0.44 per in. (25 mm), therefore, the Structural Number (SN) =  $4 \frac{1}{8} \times 0.44 = 1.82$ .

**Layer or Cluster:** A group of pavers manufactured in a laying pattern, generally placed by mechanical equipment.

**Laying Face:** The exposed, vertical face of a row of pavers on bedding sand; the working edge of the pavement where the laying of pavers occurs.

**Laying Pattern:** The sequence of placing pavers where the installed units create a repetitive geometry. Laying patterns may be selected for their visual or structural benefits.

**Lean Concrete:** Concrete of low-cement content used as a structural base material or as flowable fill in utility trenches.

**Life-cycle Cost Analysis:** A method of calculating all costs anticipated over the life of the pavement including construction costs. Discounted cash-flow methods are generally used, typically with calculation of present worth and annualized cost. Factors that influence the results include the initial costs, assumptions about maintenance and periodic rehabilitation, pavement user and delay costs, salvage value, inflation, discount rate, and the analysis period. A sensitivity analysis is often performed to determine which variables have the most influence on costs.

**Lift:** A layer of spread or compacted soil fill or aggregate. The rated compacted soil depth achieved by compaction equipment.

**Lippage:** The difference in vertical distance between the surface of one paving unit and an adjacent unit. An excessive amount of lippage is sometimes called fish scale.

**Liquid Penetrating Joint Sand Stabilizer:** Polymer liquid spread over the surface of pavers and allowed to penetrate the joint sand. After curing, the material stabilizes the joint sand, reduces its permeability, sand loss and helps prevent weeds.

**Macro Texture:** The deviations of a pavement surface from a true planar surface with dimensions generally 0.5 mm or greater or those that no longer affect tire-pavement interaction.

**Markers:** The use of concrete pavers with different colors, textures or shapes to mark underground utilities, traffic direction, parking stalls, lanes, pedestrian/vehicular areas, etc.

**Mechanical Installation:** The use of machines to lift and place layers of pavers on screeded sand in their final laying pattern. It is used to increase the rate of paving.

**Mechanistic Design:** Elastic analysis of structural response of applied loads through modeling of stresses and strains in a pavement structure.

**Micro Texture:** The deviations of a pavement surface from a true planar surface with dimensions generally less than 0.5 mm.

**Modified Proctor Test:** A variation of the Standard Proctor Test used in compaction testing which measures the density-moisture relationship under a higher compaction effort. See ASTM D 1557.

**Modulus of Elasticity or Elastic Modulus:** The ratio of stress to strain for a material under given loading conditions.

**Moisture Content:** The percentage by weight of water contained in the pore space of soil, sand or base, with respect to the weight of the solid material.

**Mortar:** A mixture of cement paste and fine aggregate (sand).

**Mortar Sand:** Sand used in mortar that typically conforms to ASTM C 144 or CSA A179.

**Mosaics:** Pavers used as pictorial maps, murals, or geometric patterns as a landmark, to emphasize an area, or suggest movement.

**Multi-Colored Paver (Color Blend):** A paver with two or more colors. The appearance is usually variegated.

**Multi-layer Machine:** A machine that manufactures concrete paving units one layer at a time and places each layer consisting of a number of units on top of each other to form a cube that is allowed to cure prior to packaging for delivery to the site.

**National Pollutant Discharge Elimination System (NPDES):** A broad regulatory program that seeks to control water pollution by regulating point (sewage discharge) and non-point (runoff discharge) into streams, lakes and bays of the United States. The federal program is implemented at the state and local level via water pollution control plans and a permit system for sewage discharge, as well as runoff from construction sites, urban areas and farmland.

**Nuclear Density Testing:** The use of a nuclear density gauge to accurately and quickly assess the density and moisture content of soils and dense-graded aggregate in the field. The machine uses a probe inserted into the soil or base that emits very low intensity radiation. See ASTM D 2922.

**Observation Well:** A perforated pipe inserted vertically into an open-graded base to monitor infiltrate rate of water into the underlying soil.

**One/One Hundred Year Storm:** A rainfall event that occurs at least once a year and has a 100% chance of occurring within a given year/an event that occurs once in 100 years or has a 1% chance of occurring within a given year.

**Open-graded Aggregate Base:** A compacted crushed stone (granular) base whose gradation has relatively large spaces between the particles. It can be used as a drainage course in base design, or as a reservoir medium for storing stormwater in permeable pavements.

**Optimum Moisture Content:** The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.

**Organic Impurities:** Peat, roots, topsoil or decomposing materials in soil, sand or aggregate.

**Organic Soil:** Spongy, compressible soils usually consisting of peat humus or vegetative matter that have undesirable construction characteristics.

**Outlet:** The point at which water is discharged from an open-graded base through pipes into a storm sewer or watercourse.

**Pavement Performance:** The trend of service ability under repetitive loads.

**Pavement Rehabilitation:** Work undertaken to extend the service life of an existing pavement. This includes placement of additional surfacing material and/or other work necessary to return an existing roadway to a condition of structural or functional adequacy. This could include the complete removal and replacement of the pavement structure.

**Pavement Structure:** A combination of subbase, base course, and surface course placed on a subgrade to support traffic loads and distribute it to the roadbed.

**Paver Extractor:** A tool used to grab a paver and remove it from the laying pattern.

**Paving Slab (or Flag):** A paving unit with a surface area over 100 in.<sup>2</sup> (0.065 m<sup>2</sup>) and with maximum length and width dimensions of 48 in. by 48 in. (1.2 m x 1.2 m). Its overall length to thickness ratio is greater than 4. Paving slabs do not rely on interlock as the principal means of load distribution.

**Paver Splitter:** A hand operated machine, sometimes hydraulically assisted, for cutting concrete pavers; also called a guillotine splitter.

**Peak Discharge Rate:** The maximum instantaneous flow from a detention or retention pond, open-graded base, pavement surface, storm sewer, stream or river; usually related to a specific storm event.

**Performance:** The total number of vehicle or ESAL applications withstood by a pavement before it reaches failure, rehabilitation, or a lower level of serviceability.

**Performance Period:** The period of time that an initially constructed or rehabilitated pavement structure will last (perform) before reaching its terminal serviceability. This is also referred to as the design period or life, expressed in years. Twenty years is normally used in North America.

**Permeability:** Measured in the laboratory, the rate of water movement through a soil column under saturated conditions, usually expressed as  $k$  in calculations per specific ASTM or AASHTO tests, and typically expressed in inches per hour or meters per second. See ASTM D 2434. Compare to Infiltration.

**Permeable Interlocking Concrete Pavement:** Concrete pavers with wide joints (10 mm to 30 mm) or a pattern that creates openings in which rainfall and runoff can infiltrate. The openings are typically filled with aggregate and occasionally with topsoil and grass. The pavers are typically placed on an open-graded aggregate base which filters, stores, infiltrates, and/or drains runoff.

**Pervious or Permeable Surfaces/Cover:** Surfaces that allow the infiltration of rainfall such as vegetated areas.

**Plan Ratio:** The overall length of a paver divided by its width. Compare to Aspect Ratio.

**Plastic Limit:** (1) The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil. (2) Water content at which a soil will just begin to crumble when rolled into a thread approximately  $1/8$  in. (3.2 mm) in diameter.

**Plate Compactor:** Also known as a plate vibrator, which is used to compact pavers into bedding sand in order to promote interlock among the individual units.

**Poisson's Ratio:** The ratio of transverse (lateral) strain to the corresponding axial (longitudinal) strain resulting from uniformly distributed axial stress below the proportional limit of the material; the value will average about 0.2 for concrete.

**Porosity:** The volume of voids in an open-graded base divided by the total volume of the base.

**Pozzolanic Materials:** Fly ash, pozzolan, silica fume, or blast furnace slag used as substitutes for cement. They are generally used in the concrete mix to increase density and durability of concrete pavers.

**Prepared Roadbed:** In-place roadbed soils compacted or stabilized according to provisions of applicable specifications.

**Present Serviceability Index (PSI):** A rating, usually between 0 (completely non-functional) and 5 (new/perfect) that generalizes several measurements of the condition of pavement. It is a convenient method of rating the overall condition and usefulness of a pavement over time and is from AASHTO pavement design methods.

**Pre-treatment:** BMPs that provide storage and filtering of pollutants before they enter another BMP for additional filtering, settling, and/or processing of stormwater pollutants.

**Proctor Compaction Test:** A test which measures the relationship of soil density with respect to soil moisture content under a standard compaction effort. This test identifies the maximum density obtainable at optimum moisture content. See ASTM D 698.

**Progressive Stiffening:** The tendency of pavements to stiffen over time. Interlocking concrete pavement stiffens as it receives increasing traffic loads thereby offering increased structural contribution structure; also referred to as "lock-up."

**Pumping:** The ejection of saturated bedding and joint sand, through joints or cracks or along edges of pavers when a load is applied.

**Reflecting:** Using pavers to mirror geometric patterns, shapes, colors or textures in the surrounding site.

**Retention Pond:** A body of water that collects runoff and stays full permanently. Runoff flowing into the body of water that exceeds its storage capacity is released into a storm sewer or watercourse.

**Running Bond Course:** A paver course or two where lengths abut against the edge restraint. Also known as a "sailor course."

**Running or Stretcher Bond:** A laying pattern with continuous joint lines in one direction and four pavers are staggered from one row to the next.

**Rutting:** Permanent deformation from repetitive traffic loading that exceeds the ability of the pavement structure to maintain its original profile.

**Sand:** Granular material passing the  $3/8$  in. (5 mm) and retained on the No. 200 (0.075 mm) sieve, made from the natural erosion of rocks, and consisting of subangular or rounded particles. Sands made by crushing of coarse aggregates are called manufactured sands.

**Sand Spreaders:** Broomed attachments to motorized equipment used to efficiently spread joint sand across the surface of segmental concrete pavements.

**Screed Board or Strike Board:** A rigid, straight piece of wood or metal used to level bedding sand to proper grade by pulling across guides or rails set on the base course or edge restraints.

**Screed Guides or Bars:** Grade strips such as pipe that will guide the screed in producing the desired elevation of the bedding sand.

**Screenings:** A residual product not suitable for bedding sand. It is a by-product from the crushing of rock, boulders, cobble, gravel, blast-furnace slag or concrete. Most of the aggregate passes the No. 4 (4.75 mm) sieve; typically limestone or granite.

**Sealer:** A material usually applied as a liquid that is used to water-proof, enhance color, and in some cases reduce abrasion of interlocking concrete pavements.

**Sediment:** Soils transported and deposited by water, wind, ice or gravity.

**Segmental Pavement:** A pavement whose surface consists of discrete units typically made of concrete, clay, or stone.

**Shrinkage:** The reduction in volume in soil when moisture content is reduced.

**Silt:** Soil finer than 0.02 mm and coarser than 0.002 mm (0.5 mm and 0.005 mm in some cases).

**Single-layer Machine:** A machine that manufactures concrete paving units one layer at a time and places each layer consisting of a number of units on individual boards or pallets to cure prior to packaging into cubes for delivery to the site.

**Skid Resistance:** A measure of the frictional characteristics of a surface with respect to tires.

**Slip Resistance:** Resistance against pedestrian slipping; defined as the ratio of a minimum tangential force necessary to initiate sliding of a pedestrian's shoe or related device over a surface. Non-mobility impaired persons require minimum coefficient of friction values ranging from 0.2-0.3. Wheelchair users require friction values ranging from 0.5-0.7. Crutch users and those with artificial limbs require values from 0.7 to 1.0. Clean concrete pavers generally have values exceeding 0.7.

**Slump:** A measure of consistency and water content of freshly mixed concrete. Slump is the subsidence measured from a specimen immediately after removal of a cone shaped mold. See ASTM C 143. Unlike ready-mixed concrete, pavers are zero slump concrete because of low water content. They are not tested for slump.

**Soft Edges:** A field of pavers with no visible edge restraint that meets grass or other vegetation, thus giving a soft appearance to the edge.

**Soil Separation Fabric:** A layer of fabric typically placed between the subgrade and the base to reduce rutting, also called a geotextile.

**Soil Stabilization:** Chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties. Lime, fly ash or cement are typical chemical stabilization materials. Geotextiles and geogrids are typical mechanical materials for soil stabilization.

**Soldier Course:** A paver course where widths abut against the edge restraint.

**Solid Color Paver:** A paver with one color created by adding iron oxide, metal oxide, or other mixed metal oxide pigment to the concrete mix.

**Spacer Bars, Spacers or Nibs:** Small protrusions on each side of the paver (typically 1.5 to 2 mm) that maintain a minimum space so sand can fill into the joints. Spacer bars help prevent edge chipping and spalling. Some spacer bars stop short of the top surface, and are known as “blind spacers.” They cannot be seen once the pavers have been installed.

**Spall:** A fragment, usually in the shape of a flake, detached from the edge or surface of a paver by a blow or sudden force, the action of weather, or pressure from adjacent pavers.

**Stabilized Base:** An aggregate base with cement, asphalt or other material added to increase its structural capacity. The soil subgrade can be stabilized with cement, lime, fly ash or other materials.

**Stack Bond:** A laying pattern in which the joints in both directions are continuous.

**Standing Screed:** Aluminum screed with handles allowing one person to pull it across bedding sand while standing (compared to kneeling while screeding).

**Storm Water Pollution Prevention Plans (SWPPP):** A principal requirement of stormwater permits issued under NPDES that identifies all potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges from the construction site. A SWPPP also describes practices to be used to reduce pollutants in storm water discharges from the construction site and assures compliance with the terms and conditions of the construction permit. SWPPP requirements vary from state to state. (from Construction Industry Compliance Assistance Center)

**Strain:** The change in length per unit of length in a given direction.

**Stress:** The force per unit area.

**Structural Number (SN):** The basis of the flexible pavement design method developed by the AASHTO. It is a dimensionless number

expressing the relative strength of a pavement structure. The SN is calculated from an analysis of traffic, roadbed soil conditions, and environment. The SN equals the sum of layer coefficients, with each coefficient quantifying the material strength and thickness of each pavement layer.

**Sub-base:** The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course. Aggregate sub-bases are typically made of stone pieces larger than that in bases.

**Subgrade:** The soil upon which the pavement structure and shoulders are constructed.

**Sustainable Development:** Development (including pavement) that meets the needs of the present without compromising the ability of future generations to meet their own needs.

**Tactile Pavers:** A paver detectable by sight impaired persons due to change in color or texture from surrounding surfaces. Changes in texture are achieved with detectable warnings.

**Tensile Strength:** Maximum unit stress which a paver is capable of resisting under axial tensile loading, based on the cross-sectional area of the specimen before loading.

**Textured or Architectural Finish:** Paver surfaces altered by the manufacturing mold or mechanical means, such as shot blasting, bush hammering, tumbling, grinding, polishing, flame treating, or washing. The purpose of such treatments is often to simulate the appearance of stone.

**Time of Concentration:** The time required for water to follow from the most remote point of a watershed or catchment to an outlet.

**Topsoil:** Surface soil, usually containing organic matter.

**Urban Heat Island:** An urban area that, due to denuded landscape, impermeable surfaces, surfaces with low albedo, massive buildings, heat-generating cars and machines, and pollutants, is measurably hotter than surrounding rural areas.

**Void Ratio:** The volume of voids around the aggregate in an open-graded base divided by the volume of solids.

**Water-Cement Ratio:** The weight of water divided by the weight of cement in a concrete mixture. Concrete pavers typically have a water-cement ratio of 0.27 to 0.33, lower than ordinary concrete, which contributes to strength and durability.

**Wearing course:** Pavement surfacing consisting of segmental concrete pavements and joint sand on a sand bedding layer.

**Wearing surface:** The top surface that contacts traffic.

**Weave or Parquet:** A laying pattern where two or more pavers are placed side-by-side. Adjacent pavers are placed side-by-side, but turned 90° and alternated 90° throughout the pattern.

**Zoning:** Using different paver colors, textures, shapes, laying patterns, and surface elevations to delineate pedestrian and vehicular areas or districts.

## References

- Aggregate Producers Association of Ontario, *Construction Aggregate Consumers' Guide*, Downsview, Ontario, 1990.
- American Association of State Highway and Transportation Officials, *Guide for the Design of Pavement Structures*, 1993, Washington, D.C.
- ASTM International, *Annual Book of ASTM Standards*, Vols. 4.02, 4.03, 4.05, 4.08, 4.12, 2000, Conshohocken, Pennsylvania.
- Canadian Standards Association, “Precast Concrete Pavers,” CSA-A231.2-95, Rexdale, Ontario, 1995.

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Interlocking Concrete Pavement Institute  
13921 Park Center Road, Suite 270  
Herndon, VA 20171  
Tel: (703) 657-6900  
Fax: (703) 657-6901

**Canada:**  
P.O. Box 41545  
230 Sandalwood Parkway  
Brampton, ON L6Z 4R1



E-mail: [ICPI@icpi.org](mailto:ICPI@icpi.org)  
Web site: [www.icpi.org](http://www.icpi.org)

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