

Definitions of Civil Engineering Terms

(1992)

**Prepared by TALAL AHMED KAMAL
/ Engineer Specialist**

This is a non – profit handbook. It is written to support the Civil Engineer's effort to gain more knowledge of their profession.

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Arizona Department of Transportation
Contracts and Specifications

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PREFACE

AUTHOR

Talal Ahmed Kamal is Fifty-two years old, a citizen of United States of America, born in Lebanon, grew up in Kuwait and has been living in United states since 1972. Talal has a Bachelor's Degree in Civil Engineering from Cleveland State University, Ohio, United States of America.

Talal has been working for the Arizona Department of Transportation since 1988. Currently he serves as a Traffic Design Engineer. Previous Engineering assignments include Roadway Design Team Leader, Highway projects' assessment Engineer, contracts and specifications project Engineer, highways and bridges construction quality assurance Engineer, residential buildings construction Engineer and scheduling and planning Engineer for civil design phases of nuclear power plant.

Talal goal for preparing this Civil Engineering Dictionary, which contains approximately 400 definitions, briefly describing all major elements of the Civil Engineering field, is to help the young Engineers possess more knowledge and become more familiar with their field of work within a short period. The information in this book is aimed at helping the Civil Engineer to the less specialized technical readers, such as the architect, the contractor and the ordinary construction worker. The expert Civil Engineer shall possess a good knowledge of all the information written in this dictionary.

(A)

ABRASION: The process of wearing away by friction.

ABUTMENT: A concrete support wall constructed at both ends of a bridge or an arch, in order to resist the horizontal force from the bridge or the arch, support the ends of the bridge span and to prevent the bank from sliding under.

ACCELERATOR: A substance such as calcium chloride (CaCl_2), added in small quantities (max. 0.03% of the cement) to plain concrete to hasten its hardening rate, its set or both.

ACQUISITION: The process of obtaining Right-of-Way.

ACTIVE EARTH PRESSURE: The horizontal push from earth onto a wall. The active earth force from sand on to a free retaining wall is equivalent to that from a fluid of density 0.25 to 0.30 times that of the sand. The force from sand on to a fixed retaining wall is very much more.

ADDENDUM OR ADDENDA: Written instruments or documents issued prior to the execution of a contract to modify or revise the bidding documents.

ADHESION OR BOND: The sticking together of structural parts by mechanical or chemical bonding using a cement or glue.

ADMIXTURE OR ADDITIVE: A substance other than aggregate, cement or water, added in small quantities to the concrete mix to alter its properties or those of the hard concrete. The most important admixtures for concrete are accelerators, air-entraining agents, plasticizers and retarders.

AFFIDAVIT OF NON-COLLUSION: A sworn statement, by bidders for the same work, that their proposal prices were arrived at independently without consultation or a secret agreement or cooperation for a fraudulent or deceitful purpose between or among them.

AGENT: The person who legally represents the contractor and acts for him on all occasions. He is often a Civil Engineer.

AIR-ENTRAINED CONCRETE: A concrete used for constructing roads. It has about 5% air and is therefore less dense than ordinary good concrete, but it has excellent freeze-thaw resistance. The strength loss is roughly 5% for each 1% air entrained. Air entrained concrete produced by adding an admixture to concrete or cement, which drags small bubbles of air (Smaller than 1 mm in diameter) into the concrete mix. The bubbles increase the workability and allowing both sand and water contents to be reduced.

ALIGNMENT: (1) The fixing of points on the ground in the correct lines for setting out a road, railway, wall, transmission line, canal, etc. (2) A ground plan showing a route, as opposed to a profile or section, which shows levels and elevations.

APPURTENANCE: An item which belong with, or is designed to complement something else (For example, a manhole is a sewer appurtenance.)

APRON: A floor constructed along the channel bottom to prevent scour. Aprons are almost always extension of culverts.

AQUIFER: An underground source of water capable of supplying a well.

ARITHMETIC MEAN: The average value which is defined as the sum of all of the observations divided by the number of observations.

ARTESION WELL: A spring which water flows naturally out of the earth's surface due to pressure placed on the water by an impervious overburden and hydro-static head.

ARTERIAL HIGHWAY: A general term denoting a highway primarily for through traffic usually on a continuous route.

AS-BUILT DRAWINGS OR RECORD DRAWINGS: Construction drawings revised to show significant changes made during the construction process, usually based on marked-up prints, drawings and other data furnished by the contractor or the Engineer.

ASPHALTIC CONCRETE FRICTION COURSE (ACFC): A hot mixture of asphalt cement with an open-graded aggregate (20% to 25% air voids) of a maximum size of 3/8 inch used as a surface (Wearing) course.

ASPHALT RUBBER (AR): A mixture of asphalt cement and rubber used as a crack sealent, binder, or membrane.

ASPHALTIC CONCRETE (ASPHALT RUBBER): A hot mixture of asphalt cement, rubber, fine and coarse aggregate and mineral admixture mixed together and placed as an asphaltic concrete pavement surface layer. The advantages of this mix are: It stops cracks from reflecting through pavement layers, reduce the riding tires noise and is a useful way to dispose of the used rubber tires.

AUXILIARY LANE: The portion of a roadway adjoining the traveled way for truck climbing, speed change or for other purposes supplementary to through traffic movement.

(B)

BALLAST: Coarse stone or hard clinker, sand or slag carried by a moving unit to keep it held down or to keep equilibrium steady.

BANK: A mass of soil rising above a digging level.

BASE COURSE: One or more layers of specified materials of designed thickness (Usually asphaltic concrete course), placed on a subbase course or a subgrade to support a surface course.

BASEMENT MATERIAL: The material in excavation or embankment underlying the lowest layer of subbase, base, pavement, surfacing or other specified layer which is to be placed on.

BASIN: A receptacle for runoff (Storm) water.

BATTER: Inward slope from bottom to top of a wall face.

BERM: An artificial horizontal ledge in an earth bank or cutting to ensure the stability of a steep side slopes of roadbed (Shoulder). Also berms are built to hold water on land that is to be flood irrigated.

BEAM: A horizontal structural member designed to resist loads which bend it.

BEARING: (1) The supporting section of a beam length or area. (2) The compressive stress between a beam and its support (bearing pressure), particularly on foundations. (3) The horizontal angle turned between a datum direction such as true north and a given line.

BENCH MARK: A relatively fixed point whose elevation is known and used as a datum for leveling.

BENDING FORMULA : Formula for beams of any homogeneous material.

Moment (M)= Stress X Modulus of Section or (M)= Force X Arm

BERNOULLI EQUATION: Is an Energy equation for two points along the bottom of an open channel experiencing uniform flow.

$$\frac{P_1}{2g} + \frac{V_1}{2g} + Z_1 + W_{\text{pump}} = \frac{P_2}{2g} + \frac{V_2}{2g} + Z_2 + h + W_{\text{turbine}}$$

BIDDER: Any individual, firm, partnership, corporation, or combination thereof, submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

BINDER: (1) A material such as cement, tar, bitumen, gypsum plaster, lime, or similar material, when mixed with other material, it causes uniformity, consistency, solidification or cohesion. (2) The clay or silt in hoggin or the cement rock. (3) A stirrup or steel rod usually about 6 to 10 mm diameter used for holding together the main steel in a reinforced-concrete beam or column.

BITUMINOUS SEAL COAT: A thin bituminous application to a surface or wearing course to seal and waterproof small voids and to embed sand or chips to provide better traction.

BLEEDING or FLUSHING: (1) Separation of clear water from the cement paste of mortar or concrete. Two types are known, the first beneficial, the second harmful to concrete strength, but they may co-exist. The first occurs during compaction, water can flow out of concrete, lie on its surface, and thus encourage good curing for the first few hours during hot weather. The second type of bleeding occurs after compaction, water segregates beside or under the steel or larger stones, weakening the bond between them and the body of the concrete. A plasticizer should enable the water to cement ratio to be lowered to reduce this type of bleeding. (2) Upward migration of bituminous material resulting in a film of asphalt on the surface.

BLEMISH: Any imperfection which mars the appearance of wood, concrete, paint or other finished surface.

BLINDING: Mat or mattress or sealing coat. A layer of lean concrete usually 2 to 4 inches thick, put down on soil such as clay to seal it and provide a clean bed for reinforcement to be laid on.

BLOTTER: Absorbant material (i.g., sand) to dry freshly wet surfaces.

BORING: A drilling into the earth to bring up samples of the soil.

BORROW: Suitable material excavated from sources outside the roadway prism (i.g., Borrow Pit), to provide fill elsewhere, primarily for embankment.

BOULDER: A rock which is too heavy to be lifted readily by hand.

BOULEVARD: A wide city street usually planted with shade-trees (Landscaped).

BRIDGE: A single or multiple span structure, including supports, erected over a depression or an obstruction such as water, a highway or railway and having a track or passageway for carrying traffic.

BRIDGE BEARING: The support at the bridge pier or abutment, which carries the weight of a bridge.

BRIDGE DECK: The load-bearing floor of a bridge, that carries and spreads the loads to the main beams.

BRIDGE LENGTH: The greater dimension of a structure measured along the center of the roadway between backs of abutment backwalls or between ends of the bridge floor.

BRIDGE ROADWAY WIDTH: The clear width of structure measured at right angles to the center of the roadway between the bottom of curbs or between the inner faces of parapet or railing.

BYPASS: Road joining two parts of an older road to avoid a town or village.

(C)

CALENDAR DAY: Any day shown on the calendar, and the 24-hour period thereof from 12:01 a.m. to midnight.

CANTILEVER: A beam which is securely supported at one end, and hangs freely at the other; an overhanging beam.

CAMBER: A slightly arched surface of a road to compensate for anticipated deflection or to allow for drainage.

CANTILEVER FOOTING: A combined footing that supports an exterior wall or exterior columns.

CAPILLARY PRESSURE OR SEEPAGE FORCE: In ground which is being drained from outside an excavation, capillary pressures help the excavated earth to stand steeply. However, if the ground is being drained from inside and not from outside the excavation, the capillary pressures will help the earth face to collapse.

CAPILLARY WATER: Water just above the water table which is drawn up out of an aquifer due to capillary action of the soil.

CARRIAGEWAY: The part of a highway which carrier vehicles.

CASSION: A cylindrical or rectangular rigged-wall for keeping water or soft ground from flowing into an excavation while digging for foundations or piles.

CAST-IN-PLACE or CAST-IN-SITU: Concrete deposited in its permanent place.

CAULKING: Using pressure gun for filling of a crack, crevice, seam or joint to make it air or water-tight.

CEMENT: A mixture of silicates and aluminates of calcium that when mixed with water it binds a stone-sand mixture into a strong concrete within a few days.

CEMENT MORTAR: Mortar usually composed of four parts sand to one of cement, with a suitable amount of water.

CENTER LINE OF HIGHWAY: A line equidistant from the edges of the median separating the main traveled ways on a divided highway, or the center line of the main traveled way on undivided highway.

CHANNEL: A natural or artificial water course.

CHAINAGE: A length (Usually 100 feet) measured by chain or steel tape.

CHANGE ORDER: A written order issued by the Engineer to the Contractor, and signed by both, which set forth any necessary or desirable changes in the contract including, but not limited to, extra work, increases or decreases in contract quantities, the basis of payment, contract time adjustments and other additions or alteration to the contract. A change order signed by the Contractor indicates his agreement therewith.

CHARACTERISTIC: A measurable property of a material, product or item of construction.

CHEVRON: V shaped strips meeting at an angle.

CHEZY-MANNING EQUATION: Used to measure water flow in open channels.

$$Q = V A = \frac{1.49}{n} (A) (rH) S =$$

CHROMATING: Priming with lead or zinc to prevent forming of rust.

CLAY: Very fine-grained soil of colloid size (Finer than 0.002 mm), consisting mainly of hydrated silicate of aluminum. It is a plastic cohesive soil which shrinks on drying, expands on wetting, and gives up water when compressed.

COARSE AGGREGATE: (1) For concrete: aggregate which retained on the No. 4 sieve (4.76 mm). (2) For bituminous material: aggregate which retained on a sieve of 3 mm square opening.

COBBLE: Rock fragments between 3 to 6 in size.

COHESION OF SOIL: The stickiness of clay or silt. It is the shear strength of clay, which generally equals about half its unconfined compressive strength.

COHESIVE SOIL: A sticky soil like clay or clayey silt.

COHESIONLESS SOIL: Sand, gravel and similar soils, also known as frictional soils since their properties are defined more by their angle of internal friction than by cohesion.

COMPACTION: Artificial increase of the dry density of a granular soil by mechanical means such as rolling the surface layers, or driving sand piles for deep compaction, vibroflotation, or impact methods. There are many methods of compaction, six main types of compacting equipment are: (1) pneumatic-tyred rollers, in which the rear wheels cover the gaps left by the front wheels, (2) tamping rollers, (3) sheepsfoot rollers, (4) vibrating rollers, (5) frog rammers (trench compactors), and (6) vibrating plates. The last two are used for confined spaces.

COMPOUND: A homogeneous substance composed of two or more elements that can be decomposed by chemical changes only.

CONCRETE: A mixture of water, sand, stone, and a binder (Usually portland cement) which hardens to a stonelike mass. There are four types of portland cement:

Type I: Normal portland cement: This is a general-purpose cement used whenever sulfate hazards are absent and when the heat of hydration will not produce objectionable rises in temperature. Typical uses are sidewalks, pavement, beams, columns and culverts.

Type II: Modified portland cement (Sulfate-resistant portland cement): This type of cement is applicable when exposure to severe sulfate concentration is expected, generally used in hot weather in the construction of large concrete structures. Its heat rate and total heat generation are lower than for normal portland cement.

Type III: High-early strength portland cement: This type develops its strength quickly. It is suitable for use when the structure must be put into early use or when long-term protection against cold temperatures is not feasible. Its shrinkage rate, however, is higher than for types I and II, and extensive cracking may result.

Type IV: Low-heat portland cement: For extensive concrete structures, such as gravity dams, low-heat cement is required to minimize the curing heat. The ultimate strength also develops more slowly than for the other types.

CONDUIT: Any open channel, pipe, etc., for flowing fluid. A pipe or tube in which smaller pipes, tubes, or electrical conductors are inserted or are to be inserted.

CONSISTENCY OF CONCRETE: Ease of flow or workability of concrete, measured by slump test or Kelly ball test.

CONSOLIDATION: The gradual, slow compression of a cohesive soil due to weight acting on it, which occurs as water, or water and air are driven out of the voids in the soil. Consolidation only occurs with clays or other soils of low permeability, it is not the same as compaction, which is a mechanical, immediate process and only occurs in soils with at least some sand.

CONTINUOUS BEAM: A beam extending over several spans in the same straight line.

CONTINUOUS or COMBINED FOOTING: A long footing supporting a continuous wall or two or more columns in a row.

CONTRACTOR: The person or persons, firm, partnership, corporation, or combination thereof, private or municipal, who have entered into a contract with the State (Client).

CONTRACT: The written agreement between the State (Client) and the contractor setting forth the obligation of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor, equipments and materials and the basis of payment. The contract includes the Advertisement for Bids, Proposal, Bidding Schedule, Contract Agreement and Contract Bonds, Certificate of Insurance, Standard Specifications, Supplemental Specifications, Special Provisions, Project Plans, Standard Drawings and any Supplemental Agreements that are required to complete the construction of the work in an acceptable manner within a specified period, including authorized extensions thereof, all of which constitute one instrument.

CONTRACT PAYMENT BOND: The approved form of security, executed by the Contractor and his surety or sureties, guaranteeing complete performance of the contract and all supplemental agreements pertaining thereto and the payment of all legal debts pertaining to the construction of the project.

COPING: The cap or top course of a wall.

CORROSION: Disintegration or deterioration of metal, concrete or reinforcement by electrolysis or chemical attack.

CORRUGATIONS: Regular transverse undulation or alternate ridges upon a metal pipe surface to give greater rigidity to thin plates.

COURSE: The roadway horizontal pavement layer.

CRITERIA: The Client's requirements for the design and construction of a particular type of building, or structure.

CRITICAL: (1) Of, relating to, or being a turning point or specially important juncture. (2) Relating to or being a state in which a measurement or point at which some quality, property or phenomenon suffers a definite change.

CRACKING IN CONCRETE: Cracking is always expected in reinforced concrete, since it has such a high shrinkage on hardening. Additional cracks will occur on the stretched side of a beam. Reinforcement shall be inserted sufficient in quantity and closeness to make the cracks invisible to the naked eye and very close together. Contraction and expansion joints are constructed to reduce cracking.

CRACK: An open seam not necessarily extending through the body of a material. Some types of cracks in asphaltic or portland cement concrete are:

- (1) **ALLIGATOR CRACK:** A crack caused by fatigue of the asphaltic concrete surface layer or excessive movement of the underlying layers. Typically alligator cracks form an interconnected network of irregularly shaped polygons varying in size from a few square inches to 1 square foot.
- (2) **BLOCK CRACK:** A crack caused by shrinkage of the bound surface material. Typically block cracks form an interconnected network of nearly square shapes varying in size from 1 square foot to several square feet.
- (3) **DURABILITY (D) CRACK:** A series of closely-spaced cracks adjacent and roughly parallel to concrete pavement joints. caused by the freezing and thawing of unsound aggregates that have a high moisture content.
- (4) **RANDOM CRACK:** A crack that is neither longitudinal or transverse crack and that has a little or no interconnection with other cracks. May be caused by movement, either of the pavement structure or subgrade or both.
- (5) **REFLECTIVE CRACK:** Crack in a pavement surface layer caused by the high stresses from movements of a cracked underlying layer.
- (6) **TRANSVERSE OR TEMPERATURE CRACK:** A long crack approximately perpendicular to the centerline caused by longitudinal shortening of the bound surface layer, sometimes called temperature cracks as the shortening is often caused by contraction from temperature changes. Typically transverse cracks extend across the full width of the pavement.
- (7) **CRAZE CRACK:** Numerous fine cracks which appear on the surface of concrete in a hexagonal or octagonal pattern. This type of crack is caused by improperly trowelled concrete surface.

CULVERT: A covered channel up to about 12 feet in width or a large pipe for carrying a watercourse below ground level, usually under a road or railway.

CURING: Keeping freshly poured concrete or mortar damp for specified time (Usually the first one week of its life) so that the cement is always provided with enough water to harden. This improves the final strength of concrete, particularly at the surface, and should reduce surface cracking or dusting.

(D)

DADO: Concrete barrier on the sides of bridge approach slab; the part of pedestal between cap and base.

DATUM: Any elevation taken as a reference point for leveling.

DECK: (1) A flat roof, a quay, jetty or bridge floor, generally a floor form with no roof over upon which concrete for a slab is placed. (2) Formwork for a level surfaces.

DEFORMED BAR: A reinforcing bar with ridges to increase bonding between the reinforcing bar and concrete.

DENSITY INDEX (relative density): is a measure of the tendency or ability to compact soil during loading. The density index is equal to 1 for a very dense soil; it is equal to 0 for a very loose soil.

DETOUR: A temporary route for traffic around a closed portion of a road.

DEVIATION: Difference between the value and the average of a set.

DIAPHRAGM: (1) A stiffening plate in a bridge between the main girders in a bridge or a stiffening web across a hollow building block. (2) Legamentous wall separating two cavities.

DILUTION: Reducing a concentration of soluble material by adding pure water.

DISTILLATION: Salt removal process from brackish or sea water by boiling and condensation.

DITCH: Long narrow excavation for drainage, irrigation or burying underground pipelines.

DIVIDED HIGHWAY: A highway with separated traveled ways for traffic, generally in opposite directions.

DREDGE: To dig or excavate under water.

DUCT: A protective tube or a brick or concrete trench or corridor along which pipes or cables pass through the ground.

DUCTILITY: The ability of a metal to undergo cold plastic deformation without breaking, particularly by pulling in cold drawing.

DURABILITY: The ability of materials to resist weathering action, chemical attack, abrasion or other conditions of service.

DYKE: (1) A mound of earth along a river or channel bank to retain floodwater. (2) large ditch. (3) A tabular-shaped igneous intrusion.

(E)

EASEMENT: The right to use or control the property of another for designated purposes.

ECCENTRIC LOAD: A load on a column applied at a point away from the column center and therefore putting a bending movement on the column equal in amount to the load multiplied by the arm.

EFFICIENCY: It is the power output divided by the power input.

ELASTOMER: Elastic rubber like substance, neoprene, etc.

EMBANKMENT: A ridge of earth or rock placed, shaped and compacted to carry a road, railway, canal, etc., or to contain water.

EMPIRICAL FORMULA: A formula or rule based on one or many series of observations or trials, but with no theoretical calculation.

EMULSION: A mixture with water. Asphalt emulsions are produced by adding a small amount of emulsifying soap to asphalt cement and water. When the water evaporates, the asphalt sets.

ENCROACHMENT: The use of the highway right-of-way for nonhighway structures or other purposes.

ENERGY: A capacity for doing work, expressed in work units. Energy may be inherent in the speed of a body (Kinetic energy) or in its position relative to another body (Potential energy).

ENGINEER: The State (Client) representative Engineer, acting by and under the authority of the laws of the State (Client). The Engineer is responsible for the Engineering monitoring and checking of construction work progress and conformance to the project specifications requirements.

ENGINEERING: The science through which the properties of matter and the sources of power are utilized for man's benefit.

EPOXIDE, EPOXY, ETHOXYLENE RESIN: A synthetic, usually two-part material that can set and harden under water or be used for bonding roof bolts or for repairing concrete in heavily trafficked areas, etc.

EROSION: Wearing or scouring caused by the abrasive action of moving water or wind.

ERRATIC: Values which seem to vary excessively from the average.

ERROR: A difference from an average value. An unintentional deviation from correct value.

EXPANSION OR CONTRACTION JOINT: A gap or space in the steel or the concrete to accommodate both thermal expansion and contraction.

EXPRESSWAY: A divided arterial highway for through traffic with full or partial control of access.

EXTRAPOLATE: To project tested values, assuming a continuity of an established pattern.

EXTRA WORK: Additional construction work for which no price or compensation is provided for in the contract and for which the Contractor is not deemed liable under any other provision of the contract, but found by the Engineer to be necessary or desirable for the satisfactory completion of the contract.

EXTRUSION: Forming rods, tubes, or sections of specified shape by pushing hot or cold metal or plastics through a shaped die to the required section.

(F)

FACTOR OF SAFETY: The stress at which failure is expected, divided by the design stress (maximum permissible stress).

FALSEWORK: Support for concrete formwork or for an arch during construction.

FATIGUE: The lowering of the breaking-load of a member by repeated reversals of stress so that the member fails at a much lower stress than it can withstand under static loading.

FAULTING: The difference in elevation of two adjacent concrete slabs at a joint, primarily caused by the traffic-induced movement of base material particles from under one joint edge to under the adjacent joint edge.

FILL: Earthwork in embankment or backfilling.

FILLET: 3 to 6 inches wide chamfer for column to add beauty and strength by avoiding sharp angles.

FILLET WELD: A weld of roughly triangular cross-section between two pieces at right angles.

FINE AGGREGATE: (1) Sand or grit for concrete which passes the No. 4 sieve (4.76 mm) and retained in the No. 200 sieve (74 micron or 0.074 mm). (2) Sand or grit for bituminous road-making which passes a sieve of 3 mm square opening.

FIXED COSTS: Any necessary labor, material and equipment costs, directly expended on the item or items under consideration which remain constant regardless of the quantity of the work done.

FLAKING: Peeling off of the coating.

FLEXIBLE PAVEMENT: An asphaltic pavement structure having sufficiently low bending resistance to maintain intimate contact with the underlying structure, yet having the required stability furnished by aggregate interlock, internal friction between particles and cohesion to support traffic.

FLEXURE: Word meaning bending.

FLUME: A wooden, steel or concrete open channel to carry or measure water flows.

FLY-ASH: The ash which goes to the chimney from pulverized coal and is caught in the flue-gas dust extractors. It is used as pozzolan or as an admixture to cement.

FORCE: That which tends to accelerate a body or change its movement (i.g., the weight of a body is a force which tends to move it downwards).

FORMATION LEVEL: The surface level or elevation of the ground surface after all digging and filling, but before concreting.

FORMWORK: The wood molds used to hold concrete during the placement and curing processes.

FOUNDATION FAILURE: Foundations of buildings can fail in one of two ways, first by differential settlement, secondly by shear failure of the soil.

FREEWAY: A divided arterial highway with full control of access.

FRICTIONAL SOIL: A clean silt, sand or gravel that is a soil whose shearing strength is mainly decided by the friction between particles. In Coulomb's equation, sand shear strength is given by the statement $S = P \tan O$, since sand has no cohesion.

FRONTAGE ROAD: A local street or road auxiliary to, and located on the side of an arterial highway for service to an abutting property and adjacent areas, and for control of access.

FROST: Weather during which dew is deposited as ice. The danger to construction caused by frost is that water expands by about 9% of its volume when it freezes. Therefore concrete or mortar which have not set and contain free water are disintegrated by it.

FUSION WELDING: The welding of metals or plastics by any method which involves melting of the edges of the parts to be joined without pressure. Usually a filler rod provides the weld metal.

(G)

GABIONS: Compartmented rectangular containers made of galvanized hexagonal steel wire mesh and filled with stone. Gabions are used to stabilize and protect embankment slopes from erosion.

GANTRY: (1) A temporary staging for carrying heavy loads, such as earth. (2) overhead structure that supports signs, usually built of square timbers or steel joists.

GEOSYNTHETICS (GEOMATRIX, GEOMEMBRANE AND GEOTEXTILE): Thin fabrics membranes and composites placed between soil layers to prevent sliding and for reinforcing or to retard the migration of clay into the pavement structure or placed between pavement layers for reinforcing or to retard crack propagation from an underlying layer to the one above it.

GIRDER: A large beam, usually of steel or concrete. Its chords are parallel or nearly so, unlike a truss.

GORE: The V (Triangular) shaped area immediately beyond the divergence of two roadways bounded by the edges of those roadways.

GRANULAR: Material that does not contain more than 35 percent of soil particles which will pass a No. 200 sieve.

GRADING: Shaping and leveling the ground surface, usually by earth-moving equipments such as graders.

GRADIENT OR GRADE: The rise or fall per unit horizontal length (Slope) of a pipe, road, railway, flume, etc. Slope also expressed as the number of degrees from the horizontal or as a percentage.

GRAVEL: Granular material retained on a No. 4 sieve (4.76 mm) which is the result of natural disintegration of rock, or untreated or only slightly washed, rounded, natural aggregate, larger than 5 mm.

GRID: Any rectangular layout of straight lines (Generally used in locating points on a plan).

GRILLAGE: A footing or part of a footing consisting of horizontally laid timbers or steel beams.

GROOVING: The process of producing grooves in a concrete pavement surface to improve frictional characteristics.

GROUNDWATER: Water contained in the soil or rocks below the water table. Water table if lowered too much, the ground may settle disastrously.

GROUNDWATER LOWERING: Lowering the level of groundwater is to ensure a dry excavation in sand or gravel or to enable the sides of the excavation to stand up. Groundwater lowering in this sense is always carried out from outside the excavation either by well-points or from filter wells.

GROUT: (1) To fill with grout. (2) Fluid or semi-fluid cement slurry or a slurry made with other materials for pouring into the joints of brickwork or masonry or for injection into the ground or prestressing ducts. Grouting of ducts improves the bond and may reduce corrosion of the tendons but it prevents their inspection and re-tensioning or renewal.

GUNITE, SHOTCRETE: A cement-sand mortar, thrown on to formwork or walls or rock by a compressed-air ejector, which forms a very dense, high-strength concrete. It is used for repairing concrete surfaces, making the circular walls of preload tanks, protecting wearing surfaces of coal bunkers; covering the walls of mine airways or water tunnels, stabilizing earth excavation slopes and so on.

GULLEY: (1) A pit in the gutter by the side of a road. It is covered with a grating. (2) A small grating and inlet to a drain to receive rainwater and wastewater from sinks, baths or basins.

(H)

HEAVE: Upward movement of soil caused by expansion or displacement resulting from phenomena such as moisture absorption, removal of overburden, driving of piles, frost action, etc.

HEDGE: A row of closely planted shrubs forming a fence.

HIGHWAY: The whole right of way or area which is reserved and secured for use in constructing the roadway and its appurtenances.

HONEYCOMBING: Local voids or roughness of the face of a concrete structure, caused by the concrete having segregated so badly that there is very little sand to fill the gaps between the stones at this point. Such concrete is weak and should be cut out in a rectangular or square shapes and rebuilt if the wall is heavily loaded.

HYDRATION: The combination of water with any substance such as lime or minerals, which is responsible for the alteration of minerals in weathering; the formation of hydrated lime; the setting of cement and so on.

HVEEM'S RESISTANCE VALUE TEST (The R-Value): The R-value is a measure of the ability of a soil to resist lateral deformation when a vertical load acts upon it. The R-value ranges from zero (the resistance of water) to 100 (the approximate resistance of steel). R-values of soil and aggregate usually range from 5 to 85.

(I)

IMPERVIOUS: Resistant to movement of water; a description of relatively waterproof soils such as clays through which water percolates at about one millionth of the speed with which it passes through gravel.

INITIAL SETTING TIME: The time required before a concrete mix can carry a small load without sinking like a mud. This is after about one hour in warm weather.

INHERENT SETTLEMENT: The sinking of a foundation due only to the loads which it puts on the soil below it and not to the loads on any nearby foundations. In city sites where the foundations are on clay, all foundations suffer both inherent and interference settlement.

INTERFERENCE SETTLEMENT: The sinking of a foundation due to loads on foundations near it and the natural extension of their settlement craters beyond their own boundaries.

INTERPOLATION: (1) Inferring the position of a point between known points on a graph by assuming that the variation between them is smooth. Usually the assumption is that the variation is linear (A straight-line variation). (2) To estimate untested values which fall between tested values.

INVERT LEVEL: The level of the lowest part of a pipe invert.

(J)

JOINT SEALANT: A material used as a filler in concrete pavement joints to prevent infiltration of water, soil and other fine particles.

JOIST: A horizontal wooden, steel or precast concrete beam directly supporting a floor.

(K)

KEYWAY: A recess or groove in one lift or placement of concrete which is filled with concrete of the next lift, giving shear strength to the joint, also called a key.

KINETIC ENERGY: The energy of a moving body due to its mass and motion.
 $K.E. = W \times V / 2 g.$

(L)

LAITANCE: A layer of weak and non-durable cement concrete caused by bleeding as a result of excessive vibration of concrete or over trowelling the mortar. It is weaker than the rest of the concrete and should be cut away and covered with a pure cement wash before laying more concrete on it.

LANDSLIP OR LANDSLIDE: A sliding down of the soil on a slope because of an increase of loading (Due to rain, new building, etc.), or a removal of support at the foot due to cutting a railway or road or canal. Clays are particularly liable to slips.

LEAN CONCRETE BASE (LCB): A mixture of aggregate, cement and water used directly under concrete pavement. The mixture has a lower modulus of rupture than the concrete pavement, and a higher compressive strength than cement treated base.

LEDGE: A horizontal projection or cut forming a shelf, cliff or rock wall.

LIME: Calcium oxide (CaO).

LIQUID LIMIT: The moisture content at the point between the liquid and the plastic states of a clay.

LIQUIDATED DAMAGES: The amount prescribed in the contract specifications, to be paid to the State (Client) or to be deducted from any payments due or to become due the Contractor, for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the contract specifications.

LLOYD DAVIES FORMULA: A method for calculating the run-off, from which the sizes of sewers are calculated (Runoff water in cubic feet = 60.5 X area drained in acres X rainfall in inches per hour X impermeability factor).

LOESS: Deposit of very porous and cavitated wind-blown silt and clay.

LONG COLUMN: A column which fails when overloaded, by buckling rather than by crushing. In reinforced-concrete work this is assumed to happen when columns which are longer than fifteen times their least dimension.

LONGITUDINAL JOINT: A joint normally placed between traffic lanes in rigid pavements to control longitudinal cracking.

LOSS OF PRESTRESS: Losses of prestressing force after transfer arise mainly through elastic shortening, shrinkage and creep of the concrete and creep of the steel.

LOT: An isolated quantity of material from a single source.

LUMINAIRE: Complete lighting device for the highway.

(M)

MARSHES: Low lying wet land; swamp.

MATERIALS: Any substance specified for use in the construction of the project and its appurtenances.

MAXIMUM DRY DENSITY: The dry density obtained by a stated amount of compaction of a soil at the optimum moisture content.

MEAN: An arithmetic mean is an average in which all signs are taken as positive. In an algebraic mean the signs of the quantities are considered and the mean may be either positive or negative.

MEDIAN: That portion of a divided highway separating the traveled ways for traffic in opposite directions including inside shoulders.

MEMBRANE: A thin film or skin, such as the skin of a soap bubble or a waterproof skin.

MILLING: (1) Removing a specified thickness of an existing pavement surface by grinding with a milling machine. (2) Removing metal shavings from a surface by pushing it on a moving table past a rotating toothed cutter.

MIST: Very thin fog.

MOISTURE CONTENT: The weight of water in a soil mass divided by the dry weight of the solids and multiplied by 100.

MOMENT CARRYING ABILITY OF REINFORCED CONCRETE BEAM (Nominal Strength, M_n):

$$M_n = A_s f_y \frac{[d - 0.59 A_s f_y]}{[f_c' b]} \quad \text{or} \quad M_n = b d^2 f_y \frac{[1 - 0.59 f_y]}{[f_c']}$$

MONOLITHIC CONSTRUCTION: Constructed as one piece.

MORTAR: A paste of cement, sand and water laid between bricks, blocks or stones.

MOVEMENT JOINTS IN CONCRETE: Movement joints may be of five types, though it is possible for one to combine the properties of one or more others. They reduce or prevent cracking or buckling caused by temperature changes, shrinkage, creep, subsidence and so on. Their location is important. Where possible, they should be placed at points where cracking (or buckling) might start. The five types of joints are: contraction, expansion, hinge or hinged joint, settlement and sliding joints.

MULCH: Mixes of wet straw and leaf peat.

MUNICIPALITY: City, town or county.

(N)

NEGATIVE MOMENT: A condition of flexure (Bending) in which top fibers of a horizontally placed member (Beam), or external fibers of a vertically placed exterior member (Column), are subjected to tensile stresses.

NEOPRENE: Synthetic rubber resistant to chemical compound, oil, light, etc.

NEUTRAL SURFACE: In a beam bent downwards, the line or surface of zero stress, below which all fibres are stressed in tension and above which they are compressed. The neutral axis passes through the center of area of the section (Centroid), if it is of homogeneous material.

(O)

OFFSET: A horizontal distance measured at right angles to a survey line to locate a point off an edge line.

OPTIMUM MOISTURE CONTENT: That moisture content of a soil at which a precise amount of compaction produces the highest dry density. It is particularly important to achieve this in soil stabilization before the road is completed. It is the percentage of moisture at which the greatest density of a particular soil can be obtained through compaction by a specified method.

OVERBURDEN: Material of inferior quality which overlies material of desired quality and which must be removed to obtain the desired material quality.

OVERLAY: One or more courses of asphaltic concrete layers placed over existing worn or cracked pavement.

(P)

PARAPET: Any protective railing, low wall or barrier at the edge of a bridge, roof, balcony or the like.

PARKWAY: An arterial highway for non-commercial traffic, with full or partial control of access, usually located within a park or a ribbon of parklike development.

PASSIVE PRESSURE: A pressure acting to counteract active pressure.

PAVEMENT: The uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with surfacing.

PAVEMENT STRUCTURE: The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the subgrade.

PEAT: Plant material partly decomposed by action of water.

PEBBLES: Smaller pieces of material (0.12 to 0.25 inch minimum size) which have broken away from a bedrock..

PEDESTAL: An upright compression member whose height does not exceed three times its average least lateral dimension.

PERFORATED: Pierced with holes.

PERMEABILITY: That property of a material which permits a liquid to flow through its pores or interstices.

pH VALUE: An index of the acidity or alkalinity of a soil in terms of logarithm of the reciprocal of hydrogen ion concentration (e.g., a pH indication of less than 7.0 is acidic, whereas a reading of more than 7.0 is alkaline).

PIER: A wide column or a wall of masonry, plain or reinforced concrete for carrying heavy loads, such as a support for a bridge.

PIER CAP: The top part of a bridge pier which uniformly distribute the concentrated loads from the bridge over the pier .

PIER SHAFT: The part of a pier structure which is supported by the pier foundation.

PILE: A long slender timber, concrete, or steel structural element, driven, jettied, or otherwise embedded on end in the ground for the purpose of supporting a load or compacting the soil.

PIT: Any borrow pit, mine, quarry or surface excavation to obtain sand, clay, gravel, etc.

PLANS: The official project plans and Standard Plans, profiles, typical cross sections, cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of the work to be performed. All such documents are to be considered as a part of the plans, whether or not reproduced in the special provisions.

PLASTICITY: The property of a soil which allows it to be deformed beyond the point of elastic recovery without cracking or appreciable volume change.

PLASTICITY INDEX (PI): Numerical difference between the liquid limit and the plastic limit. This is an indication of the clay content on a soil or aggregate.

PLASTICIZER OR WATER REDUCER: An admixture in mortar or concrete which can increase the workability of a mix so much, that the water content can be low and the mortar or concrete strength can thus be increased.

PLASTIC LIMIT: The water content at the lower limit of the plastic state of a clay. It is the minimum water content at which a soil can be rolled into a thread of 1/8 inch diameter without crumbling.

PLAT: A small plot of land.

PORTLAND CEMENT: A product obtained by pulverizing clinker consisting mainly of hydraulic calcium silicates. Many different cements now use portland cements or at least contain some, the varieties include: Ordinary, Rapid-hardening, Ultra-high-early-strength, Portland blast-furnace, Sulphate-resisting and Water-repellent cements, apart from Colored cements.

POST-TENSIONING: A method of prestressing concrete in which the cables are pulled or the concrete is jacked up after it has been placed. This method is usual for bridges and heavy structures which are placed in place.

POTABLE WATER: Drinking water.

POTENTIAL ENERGY: Energy due to position such as the elevation head of water or the elastic energy of a spring or structure caused by its deformation.

PRECISION: Of a measurement, the fineness with which it has been read, therefore, precision is different from accuracy.

PRECAST CONCRETE: Concrete beams, columns, lintels, piles, manholes, and parts of walls and floors which are cast and partly matured on the site or in a factory before being placed in their final position in a structure. Where many of the same unit are required, precasting may be more economical than casting in place, may give a better surface finish, reduce shrinkage of the concrete on the site and make stronger concrete.

PRESSURE: A force acting on a unit area.

PRESTRESSING: A process of preparing concrete slabs and beams for extra strength by placing the mix over tightly-drawn special steel wire rope or rods which are later released to provide strong dense concrete. prestressing accomplished by applying forces to a structure to deform it in such a way that it will withstand its working loads more effectively or with less total deflection. When concrete beams are prestressed they deflect upwards slightly by an amount about equal to their total downward deflection under design load. Downward deflection is thus less than half that of a reinforced-concrete beam of the same shape. The struts or braces to deep excavations in bad ground are prestressed to prevent settlement of the surface and damage to neighboring structures.

PRESTRESSED CONCRETE: Concrete in which cracking and tensile forces are eliminated or greatly reduced by compressing it by stretched cables, wires or bars within it. Two main methods for prestressing are : post-tensioning and pre-tensioning. Prestressed concrete is economical for spans which are large or where the beam depth must be reduced to a minimum.

PRIME COAT: The initial application of a low viscosity bituminous material to an absorbent surface, preparatory to any subsequent treatment, for the purpose of hardening or toughening the surface and promoting adhesion between it and the superimposed constructed layer.

PROFILE GRADE: The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

PROFILOGRAPH: An instrument for measuring smoothness of a surface (as of metal casting, or a highway or road) by amplification of the minute variations from the plane or arc of smoothness.

PROJECT: The specific section of the highway together with all construction to be performed thereon under the contract.

PROPOSAL: The offer of a bidder, on the prescribed forms, to perform the work and to furnish the labor, equipments and materials at the prices quoted.

(Q)

QUARRY: An open pit from which building stone, sand, gravel, mineral, or fill, can be obtained.

(R)

RAMP: (1) A steeply sloping road or floor. (2) A connecting roadway between two intersecting highways at a highway separation (3) A short length of drain laid much more steeply than the usual gradient.

RANDOM SAMPLE: A sample selected without bias so that each part has an equal chance of inclusion.

RANKINE THEORY: For dry, cohesionless backfill soil behind retaining walls, the Rankine theory is used to find the vertical and the horizontal (lateral) pressure at any depth, H . The horizontal pressure depends on the coefficient of earth pressure at rest, k_0 , which varies from 0.4 to 0.5 for untamped sand.

RAPID-HARDENING or HIGH-EARLY-STRENGTH CEMENT: A portland cement which hardens more quickly than ordinary Portland cement and is more costly because it is more finely ground.

RAVELLING OR FRETTING: Progressive disintegration of a pavement surface through the loss (Breaking away) of aggregate particles from a road surface.

RAVINE: Deep, narrow cliff or gorge in the earth surface.

RECYCLING (PAVEMENT): The re-use of existing pavement materials in a new pavement structure.

REHABILITATION: The improvement of an existing roadway surface by improving the existing surface or by removing (milling) a specified thickness of the existing pavement and placement of additional pavement layers.

RELEASE AGENT OR PARTING AGENT OR PARTING COMPOUND: A general term that includes any greases, mould oils or sealants, laid over forms or form linings either to ensure a good finish to the concrete, to prevent concrete bonding to forms or to improve the durability of the form or for both.

REINFORCED CONCRETE: Concrete containing more than 0.6% by volume of reinforcement consisting of steel rods or mesh. The steel takes all the tensile stresses (theoretically). In good design the reinforcement is sufficiently distributed so that the cracks are not conspicuous.

RESISTIVITY: A measure of a substance's resistance to the flow of electricity through it, expressed in ohm-centimeters. Used on soils to determine coating requirements for new pipe and used to determine the extent of corrosion of existing metal pipes.

RETARDER OR RETARDER OF SET: An admixture which slows up the setting rate of concrete.

RIGID PAVEMENT: A pavement having sufficiently high bending resistance to distribute loads over a comparatively large area (Portland Cement Concrete Pavement).

RIGHT-OF-WAY: A general term denoting land, property of interest therein, usually in a strip, acquired for or devoted to transportation purposes.

RIDGE: A long narrow elevation of land.

RIGIDITY: Resistance to twisting or shearing.

RIPRAP: Rock used for the protection of embankments, cut slopes, etc., against agents of erosion, primarily water.

ROADBED: The roadbed is that area between the intersection of the upper surface of the roadway and the side slopes or curb lines. The roadbed rises in elevation as each increment or layer of subbase, base, surfacing or pavement is placed. Where the medians are so wide as to include areas of undisturbed land, a divided highway is considered as including two separate roadbeds.

ROADSIDE: A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

ROADWAY: That portion of the highway included between the outside lines of sidewalks, or curbs, slopes, ditches, channels, waterways and including all the appertaining structures and other features necessary to proper drainage and protection.

RUMBLE STRIP, SERRATED STRIP OR JIGGLE BAR: A slightly raised or lowered strip of asphalt, plastic, etc., across the highway traffic lane or along the shoulder lane. Rumble strips are placed together at a spacing (usually one foot) to warn the driver, through an audible warning of the approaching hazard.

RUN-OFF: The amount of water from rain, snow, etc., which flows from a catchment area past a given point over a certain period. It is the rainfall less infiltration and evaporation. It can be increased by springs of groundwater or reduced by loss to the ground.

RUSTICATION: Having the surface rough or irregular, or the joints deeply sunk or chamfered.

RUTTING: Formation of longitudinal depressions by the displacement of soils or surfaces under traffic.

(S)

SAGGING MOMENT: A bending moment which causes a beam to sink in the middle. Usually described as a positive moment.

SAND: Granular material passing through a #4 sieve (4.76 mm), but predominantly retained above the No. #200 sieve (74 micron).

SAND EQUIVALENT: A measure of the amount of clay contamination in fine aggregate.

SATURATED SURFACE DRY (SSD): A condition of an aggregate which holds as much water as it can without having any free surface water between the aggregate particles.

SCALING: A delamination of a thin portion of the top of portland. cement concrete.

SCARIFIER, RIPPER OR ROOTER: An implement which may be self-propelled or towed behind a tractor, with downward projecting tines for breaking a road surface for approximately two feet deep or less.

SCOUR OR EROSION: Removal of the sea bed or of a river bed or banks by erosive action of waves or flowing water.

SCREED, SCREED BOARD, SCREED RAIL OR TAMPER: (1) A wood or metal templet with which a concrete surface is finished. Screeds are set to the correct level for the slab surface. The screed rail may be cambered but is usually straight. (2) A layer of mortar 2 to 7 cm thick, laid to finish a floor surface or as a bed for floor tiles.

SEALANT OR SEALING COMPOUND: (1) A fluid of plastic consistency laid over a joint surface or the outside of a joint filler to exclude water. Hot bitumen, rubber strip, plastic strip, hessian caulking, synthetic resins and building mastics are used as sealant. (2) A durable coating of plastics such as epoxy resin or polyurethane, painted on the face of form lining or timber formwork to enable it to be reused many times. (3) Liquid-membrane curing compound. A coating for roads (e.g., bituminous emulsion) over a damp, recently cast concrete surface, which prevents loss of water, and thus ensures proper curing of the concrete. (4) A treatment for a set concrete floor which strengthens the concrete surface or binds the aggregate, ensuring that it does not dust. Sodium silicate solution has been successfully used for many years.

SEDIMENT: Any material, mineral or organic matter deposited by water, air, etc., often called silt.

SEPTIC-TANK: Underground sewage collecting tank.

SETTLEMENT OR SUBSIDENCE: Downward movement of a structure such as a railway bridge, dam, or building, due to compression or downward movement of soil below it. It need not be harmful unless different parts settle by different amounts.

SHEAR: (1) The strain upon, or the failure of a structural member at a point where the lines of force and resistance are perpendicular to the member. (2) The load acting across a beam near its support. For a uniformly distributed load or for any other symmetrical load, the maximum shear is equal to half the total load on a simply supported beam, or to the total load on a cantilever beam. Maximum shear occurs at both ends of a simply supported beam (the acting moment equal to zero near the support's ends).

SHEATHING: A sheet metal covering over underwater timber to protect it against marine borers; sheeting.

SHEET PILES: Closely set piles of timber, reinforced or prestressed concrete, or steel driven vertically into the ground to keep earth or water out of an excavation.

SHORT COLUMN: A column which is so short that if overloaded it will fail not by crippling but by crushing.

SHOULDERS: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

SHOVING: Displacement of flexible pavement caused by high shear stresses or because of deficient pavement material.

SHRINKAGE: The shrinkage of concrete during hardening can amount to 0.0004 of its length at one year or half this value at two months. Cement mortar shrinks by a similar amount.

SHUTTERING: That part of formwork which either is in contact with the concrete or has the form lining attached to it.

SIDEWALK: That portion of the roadway primarily constructed for the use of pedestrians.

SILT: Granular material passing the No. 200 sieve (74 micron), finer than sand but coarser than clay, such particles in the range from 2 to 50 micron. It feels gritty between the fingers but the grains are difficult to see. It can be distinguished from clay by the shaking test or by rolling it into a thread. A thread of silt crumbles on drying, a clay thread does not. Rock flour and loess are materials of silt size.

SLAB: A flat, usually horizontal cast concrete member of uniform thickness which extends over three or more supports in a given direction.

SLAG: The waste glass-like product from a metallurgical furnace, which flows off above the metal.

SLAG CEMENTS: Cements made by grinding blast-furnace slag and mixing it with lime or portland cement or dehydrated gypsum. Slag is also used in making expanding cement and supersulphated cement.

SLIP-FORM: A narrow section of formwork in slab or wall shuttering that can easily be pulled or raised as concrete in place, and is designed to be removed first, thus making it easy to remove the remaining larger panels. It may also be called a wrecking piece or wrecking strip.

SLUMP: The decrease in height of wet concrete when a supporting mold is removed. It is a measure of consistency of freshly mixed concrete.

SLURRY: A thin, watery mixture of neat cement or cement and sand.

SOIL: Soil is gravels, sands, silts, clays, peats and all other loose materials including topsoil, down to bedrock.

SOLDIER PILE: An upright pile used to hold lagging.

SOUNDNESS: Resistance to both physical and chemical deterioration.

SPALLING: Peeling away of a surface, particularly of portland cement concrete.

SPAN: The distance between the supports of a bridge, truss, arch, girder, floor, beam, etc.

SPILLWAY OR WASTEWAY: An overflow channel.

SPREAD FOOTING: A footing used to support a single column. This is also known as an individual column footing and isolated footing.

SPECIFICATIONS: Written or printed description of construction work to be done forming part of the contract, describing qualities of material and mode of construction, and giving dimensions and other information not shown in drawings. It includes bidding procedures, legal requirements, insurance requirements, material and workmanship requirements, inspection and testing procedures, and procedures for measurement and payment of the work, also the specifications establish obligations of the contracting parties with respect to the State (Client) and his Engineer, it is the obligation to clearly define what is required; to establish a plan for its enforcement to the extent required during the period of execution; and to indicate how the work will be measured and paid for. With respect to the Contractor, it is the obligation of complying with the Contract requirements during the construction period. The Specifications includes Standard Specifications and Special Provisions.

SPECIAL PROVISIONS: Approved supplementary provisions, additions, revisions or deletions to the standard specifications which may cover conditions peculiar to an individual project.

SOIL STABILIZATION: Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness and resistance to weathering or displacement. Common methods are mixing the soil with cement or waste oil or imported soil, also compaction or merely covering with a primer.

STANDARD SPECIFICATIONS: The current edition of the State's Standard Specifications for State Road and Bridge Construction.

STANDARD DEVIATIONS: A measure of variability that can be calculated from the differences between individual measurements in a group and their average.

STEADY FLOW: Flow which does not vary with time.

STRAND: A number of steel wires grouped together by twisting.

STREET: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

STRESS-ABSORBING MEMBRANE INTERLAYER (SAMI): A low-stiffness mixture of asphalt cement, rubber and mineral aggregate placed between layers of pavement to retard the transfer of stresses between the layers.

STRUCTURES: Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, headwalls, buildings, sewers, service pipes, underdrains, foundation drains and other structural features.

STRIPPING: (1) Loss of binder (Bituminous film) from aggregate particles or from a road surface, due to presence of water. (2) Removing formwork. (3) Clearing a site of turf, brush-wood, topsoil, or the first layer of soil.

SUBBASE COURSE: One or more layers of specified or selected materials, of designed thickness, placed on the subgrade to support a base course.

SUBCONTRACTOR: An individual, partnership, firm, corporation or any acceptable combination thereof, or joint venture, to which the contractor sublets a part of the contract.

SUBGRADE: The roadbed materials beneath the pavement structure. The top prepared surface of the subgrade is called finished subgrade elevation.

SUBSTRUCTURE: All that part of the bridge below the bridge seats, tops of piers, haunches of rigid frames or below the spring lines of arches. Backwalls and parapets of abutments and wing walls of bridges shall be considered as parts of the substructure.

SUBSOIL: (1) The weather soil directly below the topsoil. (2) The ground below formation level also called the subgrade or foundations.

SULPHATE-BEARING SOILS: If ground water contains more than 0.1% of SO₃ or if a clay contains more than 0.5% of SO₃, high-alumina cement should be used for all concrete in the ground. Portland pozzolana cement may sometimes give enough protection at lower cost. No precautions needed with foundation concrete in water containing less than 0.02% of SO₃ or clay which contains less than 0.1% of SO₃.

SUMP: A pit in which water or sewage collects before being baled or pumped out.

SUPERELEVATION: Exaggerated tilt of roadway on a curve to counteract centrifugal force on vehicles.

SUPERSTRUCTURE: All that part of a structure above and including the bearing of simple and continuous spans, skewbacks of arches and top of footings of rigid frames, excluding backwalls, wingwalls, and wing protection rails.

SURETY: The corporate body bound with the contractor for the full and complete performance of the contract and for payment of all debts pertaining to the work.

SURCHARGE: A surface loading in addition to the soil load behind a retaining wall.

SURFACE RECYCLING: Recycling an existing pavement surface by heating, scarifying (Milling), remixing, rejuvenating with an emulsified recycling agent, placing and compacting.

SURFACE WATER: Water carried by an aggregate in addition to that held by absorption within the aggregate particles themselves. It is water in addition to saturated surface density water.

SURFACING: The uppermost layer of material placed on the traveled way, or shoulders. This term is used interchangeably with pavement.

SURFACE COURSE: One or more layers of specified materials designed to accommodate the traffic load; the top layer of which resists skidding, traffic abrasion and the disintegrating effect of climate. The top layer is sometime called a "wearing course".

SWELLING PRESSURE: The pressure exerted by a contained clay when it absorbs water. It can amount to considerably more than the pressure of the overlying soil.

(T)

TACK COAT: A thin coat of bitumen, road tar or emulsion laid on a road to improve the adhesion of a course above it.

TANDEM ROLLER: A road roller having rolls (drums) of about the same diameter behind each other on the same track.

TACK WELD: A temporary half-inch thick weld that holds steel parts together during fabrication.

TEMPERATURE STEEL: Reinforcement which is inserted in a slab or other concrete member to prevent cracks due to shrinkage or temperature stresses from becoming too large. It generally amounts to a minimum of about 0.1% of the cross-section in any direction. The requirement for a slab, which is two-dimensional, being therefore about 0.2% altogether.

TEMPERATURE STRESS: A stress due to temperature rise or drop. If the expansion due to temperature rise or the contraction due to temperature drop is restrained, the member concerned is stressed in compression during rising temperature or tension during falling temperature.

TENDON: A prestressing bar, cable, rope, strand or wire.

TERZAGHI-MEYERHOFF EQUATION: This equation is used to find the gross (ultimate) bearing capacity or gross pressure for a soil:

THRUST: A horizontal force, particularly the horizontal force exerted by retained earth.

TOPSOIL: The topmost layer of the soil which by its humus content supports vegetation. It is usually the top one foot of the soil.

TOLERANCE: Acceptable variation from a standard size.

TOUGHNESS: The resistance of a material to repeated bending and twisting.

TORQUE, TORSION OR TWIST: The twisting effect of a force on a shaft applied tangentially, like the twist on a haulage drum which winds rope on to its circumference.

TRAFFIC LANE: That portion of a traveled way for the movement of a single line of vehicles.

TRAVEL LANE: When used to distinguish between passing lane and travel lane, the travel lane is the right lane of a two lane roadway with both lanes going in the same direction. Usually both the passing lane and the travel lane are considered travel lanes with the passing lane considered to be the right travel lane.

TRAVELED WAY: The portion of the roadway for the movement of vehicles exclusive of shoulders and auxiliary lanes.

TRUSS: A frame, of steel, but also sometimes of timber, concrete, or light alloy, to carry a roof or bridge, built up wholly from members in tension and compression. It is generally a perfect frame or nearly so, and may be pin jointed.

TURFING: The covering of an earth surface with growing grass cut from another site. It can also be revetment to slopes which are usually covered by water, made by laying turves on the slope according to a technique like sliced blockwork.

(U)

UNIFORM FLOW: Flow which has a constant depth, volume and shape along its course.

UPLIFT: (1) An upward force on earth due to water leaking into a dam or from any point where water is under high pressure. (2) Lifting of a structure caused by: frost heave, or on the windward side by wind force, or in a dry climate by swelling soil.

(V)

VARRIED FLOW: Flow that had a changing depth along the water course. The variation is with respect to location, not time.

VIBRATED CONCRETE: Concrete consolidated by vibration from an internal or external vibrator. It requires very much less water for effective placing than does concrete compacted by punning, therefore it is much stronger. The formwork, however, must also be stronger when the concrete is to be vibrated. Concrete in hollow-tile floors is not vibrated.

VIBRATOR: A tool which vibrates at a speed from 3,000 to 10,000 rpm and is inserted into wet concrete or applied to the formwork to compact the concrete. Concrete vibrators are of six types:

A) For precast work:

- (1) Platform vibrators, small vibrators carried by one or two men moving up and down a pile or lamp post.
- (2) Table vibrators, which may vibrate vertically for heavy work or with rotary movement for light pieces.

B) For concrete cast in place:

- (3) Internal vibrators are the best known type.
- (4) External vibrators are used more in the factory than on the site because of the extra strength required for the formwork. External vibrators are also used for road slabs.
- (5) A hand screed 12 feet long requires one vibrator, for greater lengths two vibrators are fixed on the screed.

C) For very large capacities:

- (6) Concrete-vibrating machines are used.

Vibrators are also used for the compaction of loose soils.

(W)

WARPING: Deviation of pavement surface from original profile caused by temperature and moisture differentials.

WATER FOR DOMESTIC USE: Potable water used by the public (Home-use).

WORK: The product of a force and the distance through which it moves. It is to be distinguished from energy and from power which is a rate of doing work. Energy can, however, be expressed in the same units as work, and often is.

WORK ON ENGINEERING CONTRACTS: Work here shall mean the furnishing of all labor, materials, equipment and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all the duties and the obligations imposed by the contract.

WEEPHOLE: A hole to allow water to escape from behind a retaining wall and thus to reduce the pressure behind it.

WORKABILITY: The ease with which a concrete can be mixed, placed and finished. Wet concretes are workable but weak. Workability can be measured by the slump test, the compacting factor test, and by the V.-B. Consistometer test.

(X)

XYLEM: The botanical name for wood.

(Y)

YIELD OR BUCKLE: The permanent deformation which a metal piece undergo when it is stressed beyond its elastic limit.

(Z)

ZONING: Restrictions as to size or character of buildings permitted within specific areas, as established by urban authorities.