DEFINITION OF TERMS

Many terms in this handbook are common to drainage, highway, and other related design and construction disciplines. Most of these are defined, described or illustrated where they appear in the book. However, to aid the engineering student and to clear up unfamiliar words for the professional engineer, a number of terms are here defined even though they may be elementary. For other unfamiliar terms, many are keyed in the index of this book, particularly where the definitions already appear in the text.

Sources:

1. Brown, V. J. and Runner, D. G., "Engineering Terminology", Gillette Publishing Co., Chicago, IL, 439 pp.
2. American Society of Civil Engineers, "Nomenclature for Hydraulics, Abbreviations, Units of Measurement, Symbols and Glossary", Task Force Report, 1801 Alexander Bell Drive, Reston, VA 20191-440, 1962, 501 pp.
3. American Society for Testing and Materials, "Standard Specifications", 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA 19428-2959.
4. American Iron and Steel Institute, "Modern Sewer Design", 1101 17th Street, NW, Suite 1300, Washington, DC 20036-4700.
5. Corrugated Steel Pipe Institute, "Glossary of Drainage and Transportation Design Terminology", 652 Bishop St. N., Unit 2A, Cambridge, Ontario N3H 4V6.
6. Manufacturer's literature.

A

abrasion – Wear by hydraulic traffic.

abutment – A wall supporting the end of a bridge or span, and sustaining the pressure of the abutting earth.

aerial sewer – An unburied sewer (generally sanitary type) supported on pedestals or bents to provide a suitable grade line.

aggradation – Progressive raising of the general level of a channel bed over a period of years by an accumulation of sediment.

allowable headwater elevation – The maximum permissible elevation of the headwater at a culvert at the design discharge.

allowable headwater depth – The depth corresponding to the allowable headwater elevation, measured from the invert at the first full cross-section of the culvert.

allowable fish passage velocity – The maximum velocity fish can tolerate when passing upstream through a culvert.

anchor bolt – A foundation bolt; a drift spike, or any other device used for holding any mechanism or structure down. It may or may not be threaded.

angle – A rolled piece of steel having a cross section shaped into a right angle.

angle of repose – The angle which the sloping face of a bank of loose earth, or gravel, or other material makes with the horizontal.

anti-seep collar – see diaphragm

apron – Protective material laid on a stream bed to prevent scour at a culvert outlet, abutment, pier, toe of a slope, or similar location. (see also end section)

arch – Structural plate corrugated steel pipe formed to an arch shape and placed on a footings. The invert may be the natural stream bed or any other suitable material but is not integral with the steel arch.

armor stone – A layer of stone protecting erodible material underlying the bed of a channel.

arching – The transfer of pressure or load between the soil masses adjacent to and above the conduit which move relative to one another. Positive arching is that which results in the transfer of loads away from the conduit; negative arching produces the opposite effect.

asphalt coating – Dipping corrugated steel pipe products, in a bath of hot asphalt for protection.

B

backfill – Earth or other material used to replace material removed during construction, such as in culvert, sewer and pipeline trenches and behind bridge abutments and retaining walls. Also refers to material placed in bin-walls or between an old structure and a new lining.

backfill density – Percent compaction for pipe backfill (required or expected).

backwater – The rise of water level upstream due to an obstruction or constriction in the channel.

backwater curve – Term applied to the calculation of the piezometric line from the obstruction.

baffle – A flow interference structure usually in the form of a low weir, which is attached to a culvert invert and extends partially or entirely across the culvert width. Baffle designs are constructed to aid in fish passage through the culvert barrel, or the channel.

band coupling – A collar or coupling which fits over adjacent ends of pipe to be joined, which when drawn tight, holds the pipe together by friction or by mechanical

means. Types commonly available include: universal, corrugated. semi-corrugated, channel, flat, wing channel and internal expanding.

base (course) – A layer of specified or selected material of planned thickness, constructed on the subgrade (natural foundation) or subbase for the purpose of distributing load, providing drainage, or upon which a wearing surface or a drainage structure is placed.

batter – The slope of inclination from a vertical plane - as the face or back of a wall.

bedding – The earth or other material on which a pipe or conduit is supported.

bedding – The prepared portion of the engineering soil on which the base of the closed conduit wall is placed.

bed load – Sediment in the flow that moves by rolling, sliding, or skipping along the bed; and is essentially in contact with the stream bed.

bend section – Intersection of the fall slope and barrel slope in a slope-tapered inlet.

bent protection system – Casing of structural plate or corrugated steel pipe installed to protect pile or framed bents.

berm – The space between the toe of a slope and excavation made for intercepting ditches or borrow pits.
- An approximately horizontal space introduced in a slope.
- Often used for word "shoulder" in road work.

bevelled end – The termination of the wall of a conduit, cut at a plane inclined to the horizontal.

bevelled inlet – A large chamfer or flare on the inlet edge of a culvert to improve the inlet coefficient k_e. Usually cast-in-place.

binwall – A series of connected bins, generally filled with earth or gravel to serve as a retaining wall, abutment, pier, or as protection against explosions or gunfire (See Chapter 13).

bituminous (coating) – Of or containing bitumen; as asphalt or tar.

blue-green concept – The provision of stormwater detention ponds or lakes as an integral part of a park or greenbelt. In urban design, culvert sizing at roadways may be used to create temporary storage in the channel.

boring – An earth-drilling process used for installing conduits or pipelines.

box beam – Steel guardrail consisting of box sections cold formed from steel tubes.

box culvert – Drainage structure fabricated with deep corrugated structural plate, reinforced with circumferential ribs or corrugated plates having straight side legs bolted to corner plates, curved to a small radius and a crown of large radius plates.

buoyancy – The power of supporting a floating body, including the tendency to float an empty pipe (by exterior hydraulic pressure).

buried structure – A structure with one or more conduits, which is designed by taking account of the interaction between the conduit wall and engineered soil.

burst speed – The swimming speed a fish can maintain for only a few seconds or for short distances without gross reduction of performance.

C

caisson – A watertight box or cylinder used in excavating for foundations or tunnel pits - to hold out water so concreting or other construction can be carried on.

camber – An adjustment required in the longitudinal profile of the bedding to compensate for post-construction settlement.

cantilever – The part of a structure that extends beyond its support.

catch basin – A receptacle for diverting surface water to a sewer or subdrain, having at its base a sediment bowl to prevent the admission of grit and other coarse material into a sewer.

cathodic protection – Preventing corrosion of a pipeline by using special cathodes (and anodes) to circumvent corrosive damage by electric current.
- Also a function of zinc coatings on iron and steel drainage products. Galvanic action.

channel treatment – Refers to the design to improve flow, or to reduce scour and/or erosion in the channel above or below the culvert. This may include debris barriers before the inlet; paving or rip-rap to accelerate or decelerate flow velocity; training walls to direct flow; channel linings such as gabions, gobimats, special grasses, etc.; special inlet designs to improve or upgrade culvert capacity; special outlet designs for velocity scour prevention and/or energy dissipation; tailpond level control weirs for fish passage; and fish ladders above or below the culvert, or inside the culvert barrel.

chute – A steeply inclined channel for conveying water from a higher to a lower level.

closed invert culvert – A culvert having an invert which is structurally integral with the walls.

coefficient of runoff – Percentage of gross rainfall which appears as runoff. Also ratio of runoff to depth of rainfall.

cofferdam – A barrier built in the water so as to form an enclosure from which the water is pumped to permit free access to the area within.

cohesive soil – A soil that when unconfined has considerable strength when air-dried, and that has significant cohesion when submerged.

collar – An end treatment for a culvert, usually consisting of a concrete ring surrounding a cut-end treatment. The collar is usually attached to a cutoff wall.

combined sewer – A sewer that carries both storm water and sanitary or industrial wastes.

compaction – The process of soil densification, at a specified moisture content, by the application of pressure through rolling, kneading, tamping, rodding, or vibratory actions of mechanical or manual equipment.

competent velocity – The velocity of water which can just move a specified type or size of material on a streambed.

conduit – A pipe or other opening, buried or above ground, for conveying hydraulic traffic, pipelines, cables or other utilities.

conduit wall – The corrugated metal plate shell or reinforced concrete wall lining the conduit.

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

connection – An overlapped bolted joint between two structural metal plates, or a joint between two reinforced concrete elements.

conventional culvert – A closed invert culvert having no major inlet improvements such as a side-tapered or slope-tapered inlet. It may incorporate minor improvements such as, cut-end treatments, bevelled edges, wingwalls, a fall, or a prefabricated end section.

conveyor conduit – Corrugated steel structures of varying diameters used to enclose a conveyor system.

conveyor cover – Half circle steel arch sections supported on band sheets which are bolted to the conveyor frame.

conveyor tunnel – Usually a large diameter structural plate pipe installed to enclose a materials handling system. Commonly used under aggregate piles.

cooling water intake or discharge lines – A large diameter conduit carrying cooling water to a power plant and heated return water to the source. These lines are usually subaqueous requiring special underwater installation by divers.

corrugated steel pipe (CSP) – Metallic coated sheet steel formed to finished shape by the fabricator:

riveted – A corrugated steel pipe with annular corrugations, fabricated from cut-to-length corrugated steel sheet with lapped longitudinal and circumferential seams fastened with rivets.

double wall – A full circular cross-section pipe helically formed with an outer corrugated shell and integrally seam-connected with an inner liner of smooth or uncorrugated steel sheet.

helical – Corrugated steel pipe with helical corrugations, fabricated from coiled corrugated steel pipe sheet, with a continuous helical seam, either lock or welded.

spiral rib – A full circular cross-section pipe with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.

corrugated steel pipe sheet (CSP sheet)– A mill product in sheet or coil form for fabricating riveted or helical corrugated steel pipe products, metallic-coated by the continuous hot-dip process.

cost effective – Answering the purpose of providing the optimum effect at the most reasonable cost.

coupler – See band coupling.

critical density – Zone separating the levels of backfill compaction that will and will not prevent deflection failure of a pipe (between 70% and 85% standard density).

critical depth – Depth of flow at which specific energy is a minimum for a given flow. Water depth in a conduit at which certain conditions of maximum flow will occur. Other conditions are: (1) the conduit is on a critical slope with water flowing at critical velocity, (2) there is an adequate supply of water.

critical flow – A condition that exists at the critical depth, and where the sum of the velocity head and static head is a minimum. Also, that flow which has a Froude number of one.

critical migration delay period – The maximum delay fish can tolerate during the spawning migration without harmful biological consequences.

critical slope – The slope at which a maximum flow will occur at minimum velocity. The slope or grade that is exactly equal to the loss of head per foot resulting from flow at a depth that will give uniform flow at critical depth.

critical velocity – Mean velocity of flow when flow is at critical depth.

crown – The highest point on a transverse section of conduit. (Also see soffit and obvert.) Also the highest point of a roadway cross section.

culvert – A culvert is a conduit for conveying surface water through an embankment. It is a "grade separation" for water and the traffic or facility above it. The embankment may be for a highway, railway, street, industrial roadway, spoil bank, dam or levee.

A distinction is made between culverts and storm sewers, mostly on the basis of length and the types of inlets and outlets. Distinction is also made between culverts and bridges in that the top of a culvert does not serve as a road surface, whereas a bridge is a definite link in a roadway surface. Culverts larger than about 5 to 8 meter span are usually referred to as "soil-steel bridges", to connote the need for greater engineering involvement.

culvert uplift – The upward movement of a culvert end, resulting from hydraulic and buoyancy forces.

cut-end treatment – Refers solely to what is done to the steel inlet or outlet. May be standard pipe bevels, or pipe-arch bevels, or skew cuts. Combinations of bevels and skews are not recommended practice. (See end treatment and slope treatment.)

cutoff wall – A wall intended to prevent seepage or undermining (see diaphragm). Usually a buried vertical wall below the end of a culvert.

D

deadman – Buried anchorage for a guy, cable, etc. Commonly used in retaining walls, cutoff walls, piling and other designs.

debris – Any material including floating woody materials, and other trash, suspended and moved by a flowing stream.

degradation – The progressive general lowering of a stream channel by erosion, other than that caused by a constriction.

depression storage – The fraction of precipitation that is trapped in depressions on the surface of the ground, with the only outlet through infiltration or evaporation.

depth-of-cover – The vertical distance between the profile grade and the crown. Serves as basis for calculation of dead load on structure.

depth-of-scour – The depth of material removed from a stream bed by scour, measured below the original bed elevation.

design discharge – A quantity of flow that is expected at a certain point as a result of a design storm, or flood frequency. Usually expressed as a rate of flow in cubic feet per second, or cubic metres per second. Also the discharge which a structure is designed to accommodate without exceeding the adopted design constraints.

design frequency – The recurrence interval for hydrologic events used for design purposes. As an example, a design frequency of 50 years means a storm of a magnitude that would be expected to recur on the average of once in every 50 years.

design life – The length of time for which it is economically sound to require a structure to serve without major repairs, or replacement.

design storm – A precipitation event that, statistically, has a specified probability of occurring in any given year (expressed either in years or as a percentage). May also be a particular storm that contributes runoff for which the drainage facilities were designed to handle.

design thickness – Base metal thickness of metallic coated sheet used for design calculations.

detention storage – Temporary storage of excess runoff in surface ponds, or underground tanks, for the purpose of attenuating excess runoff.

detritus – Rock, gravel, sand, silt or other materials carried by flowing water.

diameter – Inside diameter, measured between inside crests of corrugations.

diaphragm – A metal collar at right angles to a drain pipe for the purpose of retarding seepage or the burrowing of rodents. Often specified on pipe spillways, or other drainage structures designed to operate under static head, or head ponding at the inlet.

dike – An embankment or wall constructed to prevent flooding.

discharge – The actual volume of water flowing from a drainage structure per unit of time. Usually measured in cubic feet per second or cubic metres per second.

ditch check – Barrier placed in a ditch to decrease the slope of the Bowline and thereby decrease the velocity of the water.

drainage – Interception and removal of ground water or surface water, by artificial or natural means.

drop structure – A structure in a channel or conduit which permits water to drop to a lower level.

dry well – A steel catch basin with open bottom and perforated walls, that is used to store surface runoff for infiltration, or recharge, into the ground.

E

EOS – Equivalent Opening Size, a major parameter in the selection of a filter fabric for use in filtration and separation.

effluent – Outflow or discharge from a sewer or sewage treatment equipment.

ellipsed – With reference to structural plate corrugated steel pipe, factory-formed to an elliptical shape. May be vertical or horizontal ellipse. Term "elongated" usually refers to a 5% vertical ellipse shape.

embankment (or fill) – A bank of earth, rock or other material constructed above the natural ground surface.

embedment – The depth to which a culvert invert is embedded below the natural stream bed.

end area – The area calculated on the basis of inside diameter (see diameter); or the available flow area through the conduit.

end section – Flared metal attachment on inlet and outlet of a culvert to prevent erosion of the roadbed, improve hydraulic efficiency, and improve appearance.

end treatment – The overall design of a culvert inlet and/or outlet. This may involve channel treatments, cut end treatments, slope treatments, headwalls, anchorage, etc.

energy dissipator – A structure used to dissipate the energy possessed by high-velocity flow at the outlet of a culvert.

energy grade line – A hydraulic term used to define a line representing the total amount of energy available at any point along a water course, pipe, or drainage structure. Where the water is motionless, the water surface would coincide with the energy grade line. As the flow of water is accelerated the water surface drops further away from the energy grade line. If the flow is stopped at any point the water surface returns to the energy grade line. The energy grade line is established by adding together the potential energy at the water surface elevation (referenced to a datum); and the kinetic energy (usually expressed as a velocity head), at points along the channel or conduit profile.

energy gradient – Slope of a line joining the elevations of the energy head of a stream. (See Chapt. 4, Hydraulics)

energy head – The elevation of the hydraulic gradient at any section, plus the velocity head.

engineered soil – A selected soil of known properties placed around a conduit in a prescribed manner.

entrance head – The hydraulic head required to cause flow into a conduit; it includes both entrance loss and velocity head.

entrance loss – The head lost in eddies and friction at the conduit inlet.

equalizer – A culvert placed where there is no channel but where it is desirable to have standing water at equal elevations on both sides of a fill.

equivalent diameter – The diameter of a round corrugated steel pipe from which a pipe-arch or other shape is formed.

erosion – Wear or scouring caused by hydraulic traffic or by wind.

F

fabricator – A manufacturer of corrugated steel pipe or structural plate corrugated steel pipe product, or other steel construction products. Premises of a manufacturer are referred to as the fabricating plant.

face section – The upstream face of the enlarged and fully enclosed opening of an improved inlet.

fall – A steeply inclined length of channel in or immediately upstream from a culvert inlet to improve hydraulic capacity.

fan duct – Mine ventilation system in which a conduit extends from the ventilating fan to the portal of the fresh air tunnel or air shaft.

fiber-bonded protected corrugated steel pipe – A mill product in which an aramid nonwoven fabric is embedded in the zinc coating, followed by asphalt coating.

filter – Granular material placed around a subdrain pipe to facilitate drainage and at the same time strain or prevent the admission of silt or sediment.

filter cloth – See geotextiles.

fishway – A facility to permit fish to pass an obstruction with minimum stress.

flap gate – A hinged watertight flap covering the outlet of a culvert to allow outflow from the culvert but prevent backflow resulting from higher flood stages downstream.

flexibility factor (FF) – Relative elastic deflection of a conduit.

flood – A relatively high flow, in terms of either water level, or discharge.

flood plain – The relatively level land which adjoins a water course, and which is subject to periodic flooding, unless protected artificially by a dike, or similar structure.

flood routing – An analytical technique used to compute the effects of system storage (i.e. detention ponds); and system dynamics on the timing and shape of a flood wave at recessive points along a stream or channel.

flow area – See end area.

flume – An open channel or conduit of metal, concrete or wood, on a prepared grade, trestle or bridge.

ford – A shallow place where a stream may be crossed by traffic.

foundation – That portion of a structure (usually below the surface of the ground) which distributes the pressure to the soil or to artificial supports. Footing has similar meaning.

foundation drain – A perforated CSP, or a system of CSP sub-drains which collects ground water from the foundation or footings or engineered structures, for the purpose of draining unwanted waters away from such structures.

freeboard – The height from a design water level to the top of an embankment, roadway, dam or wall.

free field overburden pressure – The vertical earth pressure at a level in a semi-infinite mass, due to the load of earth and other materials above that level.

free outlet (as pertaining to critical flow) – Exists when the backwater does not diminish the discharge of a conduit.

free water – Water (in soil) free to move by gravity (in contrast to capillary or hydroscopic moisture).

frost-susceptible soil – A soil that tends to heave excessively under frost action with the consequence of a severe degradation in strength and stiffness.

G

gabion – A steel wire mesh basket filled with stones or broken concrete, and forming part of a larger unit of several such baskets, usually for channel or end treatment, for erosion or scour control, or other purposes.

gauge – Reference system for thickness of metal sheets or wire (and bearing a relation to the weight of the metal).

gaskets – A thin sheet of rubber, sheet metal, or other materiel forming a joint between two pieces of metal to prevent leakage. Gaskets for corrugated steel pipe are O-ring, sleeve, or strip type.

geotextiles – Woven or nonwoven engineering fabrics that act as separators to keep soil or fines out of a subdrainage piping system while serving as a filter to allow free flow of water.

gradation – Sieve analysis of aggregates.

grade – Profile of the center of a roadway, or the invert of a culvert or sewer. Also refers to slope, or ratio of rise or fall of the grade line to its length. (Various other meanings.)

grade separation – A corrugated steel structure, usually structural plate, installed to allow passage of a road or railroad over another road or railroad. An underpass.

gradient (slope) – The rate of rise or fall of a grade-expressed as a percentage or ratio as determined by a change in elevation to the length.

granular – Technical term generally describing the uniformity of grain size of gravel, sand or crushed stone.

groin – A jetty built at an angle to the shore line, to control the waterflow and currents, or to protect a harbor or beach.

ground water table (level) – Upper surface of the zone of saturation in permeable rock or soil. (When the upper surface is confined by impermeable rock, the water table is absent.)

grout – A fluid mixture of cement, sand, and water that can be poured or pumped easily.

guiderail – A barrier located along the edge of a roadway shoulder for the purpose of guiding errant vehicles onto the roadway.

H

haunch – In a metal-soil structure, the portion of the conduit wall between the spring line and the top of the bedding or footing; or
- in a metal-box structure, the curved portion of the conduit wall between the sidewall and top, sometimes referred to as the shoulder;
- in a concrete box section, the stiffness corner portions.

head (static) – The height of water above any plane or point of reference. (The energy possessed by each unit of weight of a liquid, expressed as the vertical height through which a unit of weight would have to fall to release the average energy possessed.) See Chapt. 4, Hydraulics.

headwall – A wall (of any material) at the end of a culvert or drain to serve one or more of the following purposes: to protect fill from scour or undermining, increase hydraulic efficiency, divert direction of flow, and/or serve as a retaining wall. Usually a separate vertical cutoff wall at the inlet, or outlet. May be square end, or wing wall, or cribwall design of varying heights; and in a steel, concrete, or masonry. Usually constructed or installed before or during backfill. A partial headwall is less than the full rise of the culvert. (See also end treatment, slope treatment, cutoff wall, cut-end treatment and improved inlet.)

headwater elevation – The water level upstream from a structure .

heat manifold – A corrugated steel pipe installed in an aggregate pile to allow passage of heat to help obtain satisfactory working and setting properties in concrete.

height of cover (HC) – Distance from crown of a culvert or conduit to bottom of flexible pavement or top of rigid pavement for highways and bottom of tie for railways.

high profile arch – A corrugated steel structure with a relatively high rise in relation to span.

hook bolt – A bolt having one end in the form of a hook.

horizontal ellipse – A long span corrugated steel structure with the major diameter horizontal.

hydraulic gradient – A line which represents the relative force available due to the potential energy available. This is a combination of energy due to the height of the water and internal pressure. In an open channel, the line corresponds to the water surface. In a closed conduit, if several openings are placed along the top of the pipe and open end tubes inserted, a line connecting the water levels in the tubes represents the hydraulic grade line.

hydraulic jump – Transition of flow from the rapid to the tranquil state. A varied flow phenomenon that produces a rise in elevation of backwater flow surface. A sudden transition from supercritical flow to subcritical flow, conserving momentum and dissipating energy.

hydraulic radius – The cross-sectional area of a stream of water divided by the length of that part of its periphery in contact with its containing conduit; the ratio of area to wetted perimeter.

hydraulics – That branch of science or engineering which treats the mechanical properties of water or other fluid motion.

hydrogen ion (pH) – Refers to acidity or alkalinity of water or soil. An ion is a charged atom or group of atoms in solution or in a gas. Solutions contain equivalent numbers of positive and negative ions.

hydrograph – A graph of runoff rate, inflow rate, or discharge rate, versus time.

hyteograph – A graph showing average rainfall, rainfall intensities, or rainfall volume over specified areas, with respect to time.

I

ice jam – The choking of a stream channel by the piling up of drift ice at an obstruction or water course constriction.

icing – The gradual accumulation of ice in a channel or culvert, resulting from freezing of ground water seepage over a period of weeks or months.

impervious – Impenetrable. Completely resisting entrance of liquids.

improved inlet – A culvert inlet incorporating geometry refinements, other than those used in conventional culvert practice, for the purpose of improving the culvert capacity. (See headwall.)

infiltration – The passage of water into the soil. The term is also used to refer to groundwater entering a sewer system through joints, manholes, etc. infiltration is not usually desirable in sanitary sewer systems, but may be desirable in urban storm drain systems to control ground water table, and protect roadway pavements.

inflow – The water discharged into a sewer system from all possible sources, but not infiltration.

inlet control – A hydraulic term which indicates that the capacity of the conduit is governed by the quantity of water which the inlet will accept, due to its size and geometry, and the nature and depth of the head pond. Flow control at a culvert in which the capacity is governed by the inlet characteristics and headwater depth only.

inlet time – The time required for runoff to flow from the most remote point of a drainage area to a point where it enters the sewer.

interaction (soil-steel) – The division of load carrying between pipe and backfill and the relationship of one to the other.

intercepting drain – A ditch or trench filled with a pervious filter material around a subdrainage pipe.

invert – The lowest point of the conduit at a transverse section.
- The bottom segment of the conduit wall.

invert paving – The bottom portion of a pipe conduit that is paved with a material to improve flow, erosion and corrosion characteristics. Asphalt is commonly used for CSP products, and wire mesh and concrete for larger structural plate structures.

inverted pear – A long span structure in which the rise is the major dimension.

J

jacking (for conduits) – A method of providing an opening for drainage or other purposes underground, by cutting an opening ahead of the pipe and forcing the pipe into the opening by means of horizontal jacks.

L

lateral – A conduit diverting water from a main conduit, for delivery to distributaries; a secondary ditch.

lift – One layer of soil placed in the backfilling process.

liner plate – Formed steel unit used to line or reinforce a tunnel or other opening .

lock seam – Helical seam in a pipe, formed by overlapping or folding the adjacent edges.

longitudinal direction – The direction of the conduit axis which is parallel to the locus of the crown.

low profile arch – A long span structure in which the span is the major dimension.

M

major system – The route followed by storm runoff when the minor system is either inoperative or inadequate. It generally consists of roads, swales, and major drainage channels. The major system is generally designed to provide 25 to 100 yr. protection against surface flooding.

manhole – Opening from street surface to provide entry for inspection and cleaning of sewer lines.

Manning's Formula – An equation for the value of coefficient C in the Chezy Formula, the factors of which are the hydraulic radius and a coefficient of roughness.

mean velocity – Average velocity within a stream or conduit cross section.

median – The portion of a divided highway separating roadways.

median barrier – A double-faced guiderail in the median or island dividing two adjacent roadways.

metallic coating – A zinc or aluminum coating applied to corrugated steel pipe for corrosion protection.

minimum depth of cover – The minimum allowable depth of cover as specified in the various clauses as they relate to the different types of buried structures.

minor system – The traditional storm runoff design of storm sewers, street gutters, roof leader connections, foundation drains, etc.-designed to convey runoff from frequent, less intense storms, to eliminate or minimize inconvenience in the area to be developed. (See major system.)

miter cut – An angle in the barrel. A wedge section is cut from the barrel, and the barrel welded to provide a change in alignment. Permits pipe curvature, or changes in grade and/or alignment.

mitered end – A culvert end the face of which conforms roughly with the face of the embankment slope. (See also the preferred term "bevelled end".)

modified Proctor density – The maximum dry density of a soil determined in accordance with ASTM Standard D1557.

modulus of soil stiffness – The ratio of the radial contact pressure to the radial strain in the soil, having values specified in Table 6.6.

N

nestable pipe – Half round corrugated steel pipe segments joined by interlocking notches or mating flanges. Primarily used for encasing existing utility or other lines.

nominal thickness – The order thickness for the steel sheet or plate.

normal design flood – The design flood used for the hydraulic design of structures, in the absence of imposed criteria, such as the regulatory flood.

normal water level – The average summer water level. The free surface associated with flow in natural streams.

O

obvert – The highest point of the conduit at a transverse section, or the top segment of the metal conduit wall.

open channel – A drainage course which has no restrictive top. It is open to the atmosphere and may or may not permit surface flow to pass over its edge and into another channel in an unrestricted manner. In many cases where dikes or berms are constructed to increase channel capacity, entrance of surface waters is necessarily controlled.

outfall (outlet) – In hydraulics, the discharge end of drains and sewers.

outlet control – Flow control at a culvert in which the capacity is governed principally by the barrel roughness, length and slope, and in some cases by the tailwater.

overfill – The soil placed above and beyond the required structural backfill.

P

parapet – The wall on top of an abutment extending from the bridge seat to the underside of the bridge floor and designed to hold the backfill.

paved invert – A smooth asphalt pavement that completely fills the corrugations of the lower segment of a pipe; intended to provide resistance to erosion, and to improve flow.

pear – See inverted pear.

perforated pipe – A corrugated steel pipe product with perforations completely through the pipe walls.

fully perforated – A pipe with perforations around the periphery, usually for recharge to ground of storm water or for ventilation of agricultural produce.

invert-perforated – A pipe with perforations in the lower segment, usually for subdrainage.

performance curve – A plot of discharge versus headwater elevation or depth at a culvert.

periphery – Circumference or perimeter of a circle, ellipse, pipe-arch, or other closed curvilinear figure.

permeability – A property of soils which permits free passage of any fluid. Permeability depends on grain size, void ratio, shape and arrangement of pores. Often referred to as penetrability.

pervious – Applied to material through which water passes relatively freely, such as sands and gravels.

pile – A member driven or jetted into the ground and deriving its support from bearing on the underlying strata and/or by the friction of the ground on its surface. (See also sheeting.)

pipe – A culvert having a non-rectangular cross-section, often assumed to be circular unless specified otherwise.

pipe-arch – A conduit consisting of an arched upper and side portions, which is structurally continuous with an invert whose radius of curvature is greater than that of the other portions.

piping – Subsurface erosion caused by the movement or percolation of water through fill, or natural ground.
plate – A flat-rolled steel product. See structural plate.

polymeric coating – A plastic coating, bonded to one or both sides of the CSP sheet, prior to fabricating into pipe.

ponding – The use of water to hasten the settlement of an embankment. It requires the judgment of a soils engineer. In hydraulics, ponding refers to water backed up in a channel or ditch as the result of a culvert of inadequate capacity or design to permit the water to flow unrestricted.

precipitation – Process by which water in liquid or solid state (rain, sleet, snow) is discharged out of the atmosphere upon a land or water surface.

profile grade – The top of the finished granular base of the centre-line of the highway or railway.

projecting end – A culvert end which protects from the face of the embankment.

protective coating – A coating applied to the pipe in addition to the standard zinc protection, such as asphalt, polymeric, and aramid fibers.

R

rational method – An empirical approach to estimate storm runoff, by use of the formula Q = CIA, where C is a coefficient describing the runoff potential of a drainage area. I is the rainfall intensity during the core time of concentration and A is the drainage area.

re-entrant arch – An arch with haunches or spring lines lying above the footings.

reformed end – Annular corrugations rolled onto the ends of helically corrugated steel pipe.

regulatory flood – A flood designated for a specific site by a regulatory jurisdiction. or agency, generally for flood plain management purposes.

relief flow – A portion of a major flood which bypasses the main structure at a stream crossing, by flowing over the roadway, or through a relief bridge or culvert.

retaining wall – A wall for sustaining the pressure of earth or filling deposited behind it.

return period – The average period in years between occurrences of a discharge equalling or exceeding a given value.

revetment – A wall or a facing of wood, willow mattresses, steel units, stone, or concrete placed on stream banks to prevent erosion.

Reynolds' Number – A nondimensional coefficient used as a measure of the dynamic scale of a flow.

ring compression – The principal stress in a confined thin circular ring subjected to external pressure.

riprap – Rough stone of various sizes placed compactly or irregularly to prevent scour by water or debris.

rise – The maximum vertical clearance inside a conduit at a given transverse section, usually the centerline.

roadway (highway) – That portion of the highway including the shoulders, for vehicular use. A divided highway has two or more roadways. (railway) – That part of the right of way prepared to receive the track. (During construction the roadway is often referred to as the "grade.")

rodent gate – An appurtenance at the outlet end of a sub-drain or other drainage pipe that swings outwards to permit flow and detritus to pass, yet prevents the passage into the drainage network of rodents or other animals, whose nesting could block, and render inoperative, the drain system.

roof leader – A drain or pipe that conducts storm water from the roof of a structure downward and into a sewer for removal from the property, or onto or into the ground for seepage disposal.

roughness coefficient (n) – A factor in the Kutter, Manning, and other flow formulas representing the effect of channel (or conduit) roughness upon energy losses in the flowing water.

round pipe – A circular or elliptical pipe with its major diameter not exceeding 1.10 times the minor diameter.

runoff – That part of precipitation carried off from the area upon which it falls. Also the rate of surface discharge of the above. That part of precipitation reaching a stream, drain or sewer. Ratio of runoff to precipitation is a "coefficient" expressed decimally.

S

scour – The local lowering of a stream bed by the erosive action of flowing water.

general scour – is that which occurs in a waterway opening as a result of obstruction of the flow.

local scour – is that which occurs at a pier or abutment as a result of local obstruction to the flow.

natural scour – is the scour of a stream bed resulting from natural phenomena, such as channel meandering.

seam – A joint between two structural steel plates formed by overlapping and bolting them together. Also the joint or lap of riveted CSP. Also the joint or weld for continuous helical-weld CSP. (See also lock seam.)

sediment – Soils or other materials transported by wind or water as a result of erosion.

seepage – Water escaping through or emerging from the ground along some rather extensive line or surface, as contrasted with a spring, the water of which emerges from a single spot.

service tunnel – A conduit connecting two buildings to provide more direct access for employees, products, materials, or utility lines.

shaft – A pit or well sunk from the ground surface into a tunnel for the purpose of furnishing ventilation or access to the tunnel.

sheathing – A wall of metal plates or wood planking constructed to maintain trench wall stability.

sheeting – A wall of metal plates or wood planking to keep out water, or soft or runny materials.

shoulder – The portion of the conduit between the crown and the spring line.

shoulder – The portion of the conduit wall between the crown and the spring line.

side tapered inlet – An "improved" inlet having an enlarged face area with the transition to the culvert barrel accomplished by tapering the sidewalls. Both the barrel and the enclosed inlet structure are on the same grade. Usually cast-in-place.

side wall – The vertical or nearly vertical portion of the conduit wall in a box culvert structure.

sill – A low wall placed transversely in a culvert or channel level with or slightly above the invert. Often used downstream of the culvert to maintain tailpond level.

sheet flow – Water flowing across a wide, flat paved area such as a highway or parking lot; may result from rainfall or melting ice or snow.

siphon (inverted) – A conduit or culvert with a U or V shaped grade line to permit it to pass under an intersecting roadway, stream or other obstruction .

skew (skew angle) – The acute angle formed by the intersection of the line normal to the centerline of the road improvement with the centerline of a culvert or other structure.

skew number – The angle between the highway centerline and the culvert centerline measured clockwise, and specified in increments of 5 degrees.

slide – Movement of a part of the earth under force of gravity.

slope-tapered inlet – A cast-in-place side-tapered inlet, incorporating a fall within the enclosed inlet structure.

slope treatment – Describes what is done to protect the embankment slope from

scour or erosion. May be vegetation (i.e. Bermuda grass); grouted masonry or rip-rap; a "donut" type concrete collar with entrance flare to improve the inlet coefficient, usually from the headwall up over the crown (and usually on bevel ends, with embedded hook-bolts in the casting); plus others. Always placed or constructed after backfill.

slotted steel pipe – Corrugated steel pipe with reinforced longitudinal slots at the crown. Used for interception of sheet flow. The system provides an inlet, runoff pipe and grate in a single unit. Pipe can be perforated for use as an underdrain.

smooth-lined asphalt – A smooth asphalt interior lining that completely fills the corrugations in an asphalt coated corrugated steel pipe. (See also spun lining.)

snap-through instability – A buckling mode whereby a section of the structure reverses the initial curvature.

soffit – The bottom of the top of a pipe. In a sewer pipe, the uppermost point on the inside of the structure. The crown is the uppermost point on the outside of the pipe wall.

soil liquefaction – Loss of strength of a soil resulting from the combined effects of vibrations and hydraulic forces, thereby causing the material to flow.

soil-steel structure – A bridge, comprised of structural steel plates and engineered soil, designed and constructed to induce a beneficial interaction of the two materials.

span – Horizontal distance between supports, or maximum inside distance between the sidewalls.

spelter – Zinc or galvanized coating on steel products.

spillway – A low-level passage serving a dam or reservoir through which surplus water may be discharged; usually an open ditch around the end of a dam, or a gateway or a pipe in a dam.

- An outlet pipe, flume, or channel serving to discharge water from a ditch, ditch check, gutter or embankment protector.

spread footing – A footing which transfers load directly to the underlying foundation material. Used in structural plate arches and box culverts.

spring line – The line of the outermost points of the sides of the conduit.

spun lining – An asphalt lining in a pipe, made smooth or uniform by spinning the pipe around its axis.

stable stream grade – The slope of a natural channel at which neither aggradation nor degradation occurs.

standard Proctor density – The maximum dry density of a soil determined in accordance with ASTM Standard D698.

steady flow – A flow in which the volume passing a given point per unit of time remains constant.

stiffener – A structural member, connected to the conduit wall to improve its strength and stiffness.

storage basin – Space for detention or retention of storm runoff water for controlled release during or following design storm. Storage may be upstream, downstream, offstream, onstream and/or underground.

storage bin – Built from heavy, curved corrugated steel plates. Used on construction sites and plant storage sides for coal, sand, gravel and other materials.

storm sewer – A sewer that carries only storm water, or clear water runoff.

stormwater management – A master plan, or systems approach to the planning of facilities, programs, and management organizations for comprehensive control and use of stormwater within a defined geographical area.

stream check – A barrier placed in a stream to decrease the slope of the Bowline and thereby the velocity of the water. It is provided with a throat or spillway for dropping the water to a lower level.

stream enclosure – A pipe or other conduit for carrying a stream underground paralleling a roadway or dividing otherwise useful land into smaller parts.

structural backfill – The engineered soil placed around the conduit in a controlled manner.

structural plate corrugated steel pipe – Hot-rolled sheets or plate, corrugated, custom hot-dipped galvanized, curved to radius, assembled, and bolted together to form pipes, pipe-arches, and other shapes.

subcritical flow – Flow at velocities less than critical, or with a Froude number less than one. In this state, the role played by gravity forces is more pronounced. so the flow has a low velocity, and is often described as steady, tranquil, or streaming.

sub drain – A previous backfilled trench containing a pipe with perforations or open joints for the purpose of intercepting ground water or seepage .

subdrainage – The control of groundwater. Subdrainage helps maintain stable subgrades and structure foundations, eliminates wet cuts and prevents frost heave.
subgrade – The surface of a portion of the roadbed on which paving, or railroad track ballast, or other structure is placed.

supercritical flow – Flow with a Froude number greater than one. In this state, the inertia forces become dominant, so the flow has a high velocity, and is usually described as rapid or shooting.

surcharge – The flow condition occurring in closed conduits when the hydraulic grade line is above the crown of the sewer.

T

tailwater – The water just downstream from a structure.

tailwater depth – The depth of water immediately downstream from a culvert, measured from the invert of the culvert outlet.

threading – The process of installing a slightly smaller pipe or arch within failing drainage structure.

throat section – The intersection of cast-in-place sidewall tapers and culvert barrel in a side-or slopetapered "improved" inlet.

thrust – The circumferential compressive force in the conduit wall, per unit length of the wall.

time of concentration – The time required for storm runoff to flow from the most remote point, of a drainage area to the point under consideration. It is usually associated with design storm.

toe drain – A subdrain installed near the downstream toe of a dam or levee to intercept seepage.

transverse section – A section in the vertical plane normal to the longitudinal direction.

trash rack – A pervious barrier constructed to catch debris, and prevent blockage of the inlet of a drainage conduit.

trunk (trunk line) – In a roadway or urban drainage system, the main conduit for transporting the storm waters. This main line is generally quite deep in the ground so that laterals coming from fairly long distances can drain by gravity into the trunk line.

tunnel lining – Added inner surface of a tunnel; can be concrete, brick, or steel. A bolted metal shell serving either as a permanent inner surface for a tunnel or as a form by which a concrete wall coating is built.

U

underdrain – See subdrain.

undermining – A process of scour by hydraulic action that progressively removes earth support from an engineered structure. Undermining is commonly found at the outlet of a culvert or sewer.

underpass – An opening under a roadway to allow pedestrians, livestock, or other traffic to pass in safety. Also an opening under a railroad or other roadway through which a street, highway, or railroad passes.

uniform flow – Flow in which the velocities are the same in both magnitude and direction from point to point along the stream or conduit, all stream lines being parallel.

unsteady flow – A flow in which the velocity changes with respect to both space and time.

utilidor – Utility corridor. See utility conduits.

utility conduits – Conduit installed for the protection of water, steam and gas lines, sewers, or power cables passing underneath a building, roadway, or other obstacle.

V

value analysis – Objective analysis of the features and benefits of corrugated steel pipe in relation to a specified alternate.

velocity head (symbol H_V) – For water moving at a given velocity, the equivalent head through which it would have to fall by gravity to acquire the same velocity.

vertically ellipsed pipe – An elliptical conduit with major diameter vertical and not less than 1.10 times the minor diameter.

ventilation ducts – A conduit installed to provide various degrees of ventilation to protect against health hazards arising from non-toxic gasses, heat, dust, or moisture.

void forms – A corrugated steel tube installed in the concrete deck of a bridge to reduce the amount of concrete used and the overall weight of the deck.

W

wale – Guide or brace of steel or timber, used in trenches and other construction.

washout – The failure of a culvert bridge, embankment or other structure resulting from the action of flowing water.

water course – A natural or artificial channel in which a flow of water occurs, either continuously or intermittently. Natural water courses may be either on the surface, or underground.

water table – The upper limit of the coating applied to the surfaces of portion of ground wholly saturated with water.

watershed – Region or area contributing to the supply of a stream or lake; drainage area, drainage basin, catchment area.

weir crest – The point of intersection of the upstream channel slope and the fall slope.

wetted perimeter – The length of the wetted contact between the water prism and the containing conduit, (measured along a place at right angles to the conduit).

Z

zero runoff increase – A concept in which the peak rate of storm runoff from a new urban development is limited to that which occurred prior to development.

zinc coating – A galvanic, barrier coating applied to the surfaces of steel sheet, plate, or other components.