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## GLOSSARY

**2-D Tomographic Inversion.** Tomographic reconstruction using two dimensional matrix inversion. Each test panel is inverted independently. Therefore, if four tubes are present in a drilled shaft, 6 independent 2-D inversion is performed (4 perimeter plus 2 diagonal).

**3-D Display.** 2-D or 3-D tomographic inversion results displayed in side-by-side cross-sectional view, or plan view, or by a contoured velocity covering the shaft volume inside the rebar cage.

**3-D Tomographic Inversion.** Tomographic reconstruction using three dimensional matrix inversion. Data from all test panels are inverted simultaneously (and only once).

**Accuracy.** Refers to closeness of a measurement to the true value.

**Amplitude.** The maximum departure of a wave from the average value.

**Anomaly.** Refers herein to deviation from uniformity in a concrete structure. No determination is yet made regarding its exact size; just identification has been made. An independent verification (using another logging method) is needed to determine if it does not correspond to a false positive.

**Artifacts.** Artifacts are erroneous values produced by the tomographic matrix inversion due to inadequate scanning of the test volume, inaccuracies in travel time picking, and inversion process that is non-linear and non-unique. These artifacts mostly occur near the image boundaries.

**Attenuation, attenuate.** A reduction in energy or amplitude caused by the physical characteristics of a transmitting system.

**Bulk density.** Bulk density is the mass of material per unit volume; in logging, it is the density, in grams per cubic centimeter, of the rock with pore volume filled with fluid.

**Bulk modulus.** A modulus of elasticity, relating change in volume to the hydrostatic state of stress. It is the reciprocal of compressibility.

**Calibration.** Determination of the log values that correspond to environmental units, such as porosity or bulk density; calibration usually is carried out in pits or by comparison with laboratory analyses of core.

**Coherence.** A measure of the similarity of two oscillating functions.

**Compressional wave.** Compressional (or compression) acoustic waves (P) are propagated in the same direction as particle displacement; they are faster than shear waves.

**Compton scattering.** The inelastic scattering of gamma photons by orbital electrons; Compton

scattering is related to electron density and is a significant process in gamma-gamma (density) logging.

**Crosshole.** In this report, refers to concrete logging carried out between access tubes (see also tomography).

**Crosshole Sonic Logging (CSL)** – A crosshole method used for integrity testing of concrete whereby source and receiver probes in opposite access tubes are pulled simultaneously as to maintain near horizontal ray paths between them (See zero-offset logging).

**CSLT.** Please see offset tomography.

**Curie.** The quantity of any radionuclide that produces  $3.70 \times 10^{10}$  disintegrations per second.

**Cut-off Velocity.** An important velocity value that separates sound concrete velocity distribution from anomalous concrete velocity distribution. The cut-off velocity is used for velocity contouring in volumetric imaging of defects.

**Defect.** Refers herein to a velocity anomaly in a concrete structure with a velocity lower than a (statistically determined and significant) cut-off velocity. Whether this defect is structurally significant, depends on location, size, and design factors to be determined by the engineer (integrity testing).

**Density log.** Also called gamma-gamma density log (GDL); gamma photons from a radioactive source in the sonde are backscattered to a detector; the backscattering is related to the bulk density of the material (concrete) around the sonde.

**Depth of investigation.** See volume of investigation, also called radius of investigation.

**Detector.** Can be any kind of a sensor used to detect a form of energy, but usually refers to nuclear detectors, such as scintillation crystals.

**Dispersion.** A property of seismic surface waves in which their velocity (as well as their penetration into the subsurface) is dependent on their frequency.

**Dual Testing.** Field testing that incorporates both CSL (Sonic) and GDL (Density) logging for assessing the integrity of drilled shaft foundations.

**Elastic moduli (elastic constants).** Elastic moduli specify the stress- strain properties of isotropic materials in which stress is proportional to strain. They include bulk and shear moduli.

**Epithermal neutron.** A neutron source emits fast neutrons that are slowed by moderation to an energy level just above thermal equilibrium, where they are available for capture; most modern neutron probes measure epithermal neutrons, because they are less affected by chemical composition than thermal neutrons.

**Gamma-Gamma Density Logging (GDL or GGL).** Gamma rays from a weak Cesium-137 source are measured at one or several detectors after they migrate through concrete in, and adjacent to, the access tube. Log response primarily results from the electron density of the surrounding medium, which is proportional to the mass per unit volume.

**Gamma ray.** A photon that has neither mass nor electrical charge that is emitted by the nucleus of an atom; measured in gamma logging and output from a source used in gamma-gamma logging.

**Hydration.** Hydration is the chemical reaction between cement and water or mineral admixtures and water. When concrete hydrates it dissipates heat; this is called the heat of hydration.

**Isotropic.** Having a physical property, which does not vary with direction.

**The Maturity Method.** This method assumes that concrete derives strength from the hydration of cement, the hydration of cement produces heat, and if one can measure the amount of heat generated that the strength of the concrete can be estimated.

**Median Velocity.** The median velocity value of an individual (one dimensional) log. It is considered to be a better representative of background shaft velocity than mean (average) velocity because it is less affected by the low velocity anomalies that may be present.

**Modeling.** Computer simulation of data using a presumed model which can then be compared to observations. Agreement between observation from modeling and field conditions does not prove the model represents actual situation due to lack of uniqueness in the geophysical problems.

**Neutron Moisture logging (NML).** Neutrons from an isotopic source are measured at one or several detectors after they migrate through concrete in, and adjacent to, the access tube. Log response primarily results from hydrogen content as it can be related to moisture content.

**Noise.** Any unwanted signal; a disturbance that is not part of signal from a specified source.

**Nondestructive Testing (NDT).** Condition evaluation of a civil structure for integrity assessment or unknown geometry.

**Non-unique.** In geophysical interpretation and mathematical modeling, a problem for which two or more subsurface models satisfy the data equally well.

**Nuclear log.** Well logs using nuclear reactions either measuring response to radiation from sources in the probe or measuring natural radioactivity present in the rocks.

**Offset.** Vertical separation between the source and receiver probes in a Crosshole sonic measurement.

**Offset Log.** Continuous crosshole sonic log measurement performed with the source or the receiver offset in depth (by some nonzero angle).

**Offset Tomography.** A scanning method whereby data is collected by running a zero-offset CSL log in combination with several positive offset (receiver is shallower) and negative offset (source is shallower) logs. See CSLT.

**Permeability.** Permeability is the property of allowing passage of fluid or gases.

**Probe.** Also called sonde or tool; downhole well-logging instrument package.

**Processing.** Geophysically, to change data so as to emphasize certain aspects or correct for known influences, thereby facilitating interpretation.

**Radius of Investigation.** See depth of investigation.

**Receiver.** The part of an acquisition system that senses the information signal.

**Resolution.** Refers to the smallest unit of measurement that can be distinguished using a particular instrument or method; based on the ability to separate two measurements which are very close together.

**RMS.** The root mean square. The square root of the average of the squares of the differences between a series of measurements and their mean value; the standard deviation.

**Roughness Model.** In a roughness model, the roughness values are calculated by computing changes in velocity from its six neighboring points (or spatial derivative) and it represents the curvature (or roughness) of the velocity field. It identifies regions where a large change in velocity values has taken place.

**Standard CSL.** Data obtained using (standard practice) CSL method (see also CSL and zero-offset log).

**Static Shift.** Constant time shift corrections applied to individual offset CSL logs.

**Temperature log.** A log of the temperature of the fluids in the borehole; a differential temperature log records the rate of change in temperature with depth and is sensitive to very small changes.

**Thermal Conductivity.** The thermal conductivity is the quantity of heat transmitted within a material if a certain temperature gradient exists.

**Thermal neutron.** A neutron that is in equilibrium with the surrounding medium such that it will not change energy (average 0.025 eV) until it is captured.

**Tomography.** A method for determining the distribution of physical properties within the earth by inverting the results of a large number of measurements made in three dimensions (e.g. seismic, radar, resistivity, EM) between different source and receiver locations.

**Transducer.** Any device that converts an input signal to an output signal of a different form; it can be a transmitter or receiver in a logging probe.

**Velocity Equalization.** A process performed prior to tomography that equalizes all offset CSL logs to the same median velocity by applying constant static shift to individual logs.

**Zero-Offset Log.** Crosshole sonic measurement done with no separation between the source and receiver probe (in near horizontal plane). See CSL

