Static Pore Water Pressure – SW (XS)

The Static Pore Water Pressure Gauge (SW) is a pore-water, pressure-sensing device consisting of a pressure-sensitive stainless steel diaphragm with a vibrating wire element attached. As pressure changes, the diaphragm deflects and there is a change in tension in the vibrating-wire element.

A thermistor ("XS" sensor) is part of the SW sensor. The thermistor is used to provide temperature correction to the vibrating-wire output.

There are two coils adjacent to the vibrating wire element. A pulse of varying frequency is applied to the coils causing the wire to vibrate at its resonant frequency. When excitation ends the wire continues to vibrate and an AC signal is induced in the coils and read by the data logger.

Figure 1: Geokon Static Peizometer

Function:

This instrument measures changes in pore-water pressure in base and sub-base materials

Manufacturer / Model:

Geokon Inc. / 4500 SL Vibrating Wire Piezometer

Data Type:

SW data are calculated pore-water pressure in kilo-Pascal or PSI (depending on data collection program). The calculation of pressure is a two-step process. The basic units from Vibrating-Wire Pressure Cells are "Digits." Digits are calculated as follows:

$$\text{Digits} = [1/\text{Period (seconds)}]^2 \times 10^{-3} \text{ or Digits} = \text{Hz}^2/1000.$$

Pressure is calculated by subtracting an initial reading from a current reading, in Digits, and multiplying the remainder by a calibration factor. The equation is as follows:

$$P = (R_1 - R_0) \times G,$$

Where P is pressure in kPa, R_1 is the current reading, R_0 is the initial reading, and G is the calibration factor in kPa/Digit. Geokon provides a calibration report for all pressure transducers.

Temperature is also calculated from the following equation:

$T = \{[1/(A+B(LnR)+C(LnR)^3] - 273.2\}$ where T is temperature in degrees Celsius, LnR is the natural log of thermistor resistance, $A=1.4051 \times 10^{-3}$, $B=2.369 \times 10^{-4}$, and $C=1.019 \times 10^{-7}$. The coefficients are calculated over the -50 to +150° C span.

History:

The Geokon Vibrating Wire Piezometer (SW) has been used at MnROAD since 1993 at multiple test locations and environments. Original installations were at various depths in base and sub-base materials and also in monitoring wells. Most of the original sensors are no longer in service.

Locations:

In 1993, the vibrating wire piezometers were installed in Cells 6, 7, 12, 15, 18, 22, 23 on the Interstate 94 Mainline and in Cells 26, 27, 32, 33, and 39 on the Low Volume Road. All SW sensors were retired in 2007.

Data Availability:

The original SW (1993-2007) data were collected with Optim, Megadacs data recorders. Thermistor data from these sensors were not used for temperature corrections as thermocouple data were available for the calculation. Pressure data are available in the MNR.SW_VALUES. Frequency data are not available for these early installations. Temperature output may be found in the MNR.XS_VALUES table. Some frequency data are available for the Cell 12 sensors in the MNR.FS_VALUES table.