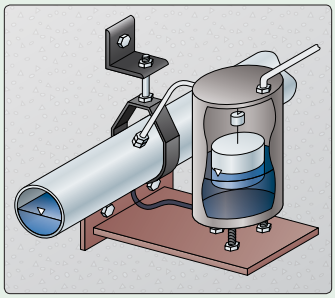
Precision Settlement Monitoring System

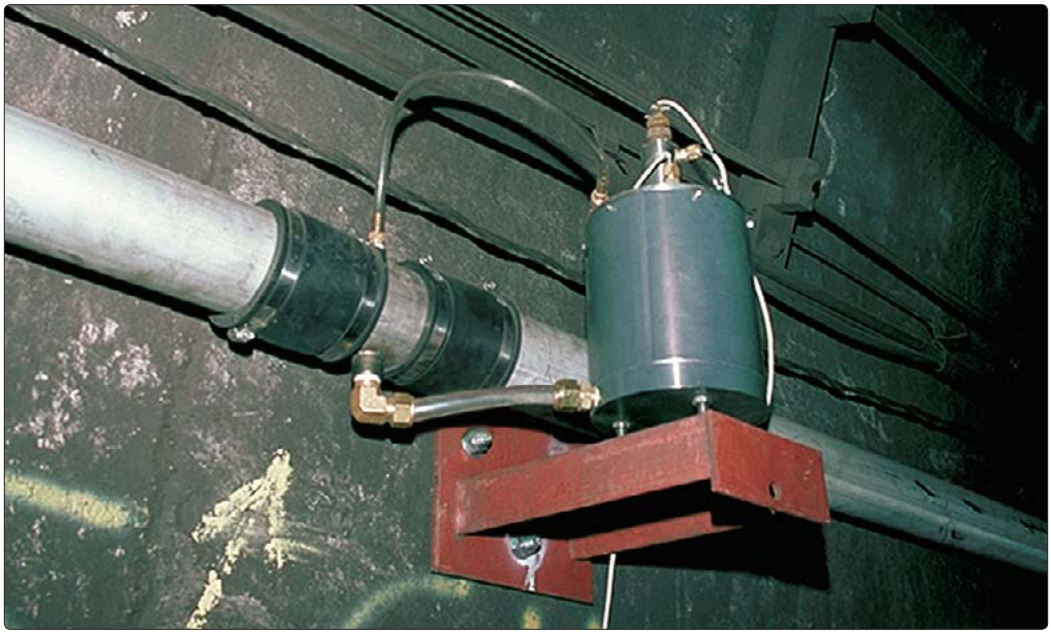
Applications

The Model 4675OC Precision Settlement Monitoring System is designed to measure differential settlement in dams, tunnels and foundations. It provides…

- **High resolution (<0.025 mm)**
- **Long term stability**
- **High accuracy**
- **Locking mechanism for easy installation and portability**



The Model 4675OC Precision Settlement Monitoring System.



The Model 4675OC Liquid Level Vessel with cantilevered mounting bracket.

Operating principle

The Model 4675OC Precision Settlement Monitoring System was designed in conjunction with Shannon & Wilson, Inc. to measure differential settlements with a very high degree of accuracy and resolution. Therefore, the system is suitable for applications of a highly critical nature where the expected settlements are small.

The system uses a 3 inch diameter horizontal open channel pipe, which is half filled with water or antifreeze solution. The pipe is fixed to the structure or tunnel under observation. Sensors are situated at intervals along this pipe, which are connected hydraulically to the water in the pipe through short lengths of tubing.

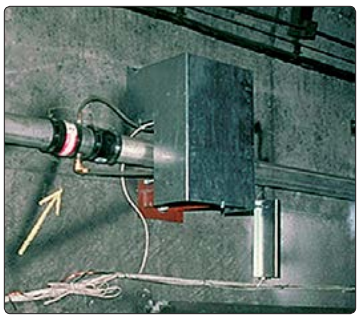
The sensor is similar to the Model 4675LV precision water level sensor but differs from it by the inclusion of a locking mechanism, which locks the suspended cylinder in place inside the sensor and permits the sensor to be moved from location to location without fear of damage. This greatly eases the task of installation.

The sensor consists of a cylindrical weight partially submerged in liquid and suspended by a vibrating wire force transducer.

As the water level inside the sensor rises or falls, the buoyancy force changes the apparent weight of the cylinder and alters the tension and the resonant frequency of the vibrating wire. This frequency is measured by either a portable readout (Model GK-404 or GK-405) or more usually by a datalogger (Model Micro-1000). It can be equated to settlement through the calibration algorithm provided.

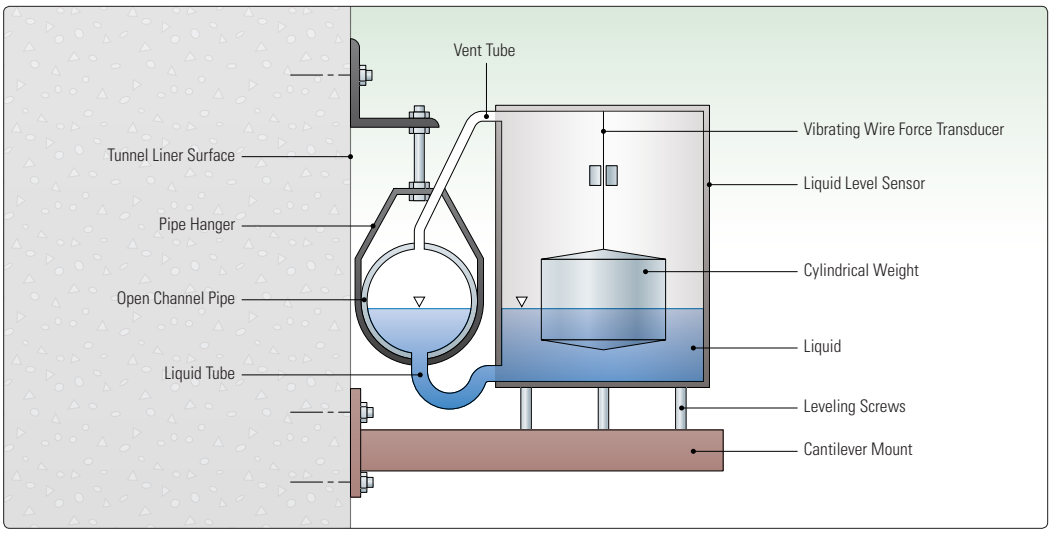
The range and resolution of the sensor is determined by the diameter of the cylindrical weight. For example, a range of 75 mm with a resolution of 0.025 mm can be achieved. Various ranges are available on request.

The use of the open channel pipe avoids any complications arising from air bubbles that might form in a pipe completely filled with water. A vent tube connects the air spaces in the upper part of the sensor and the 3" pipe and prevents any build up of back pressure inside the sensor. It is normal to have one end of the 3" pipe located on solid ground with a sensor at this location to serve as a benchmark.



Model 4675OC shown with protective cover.

Model 4675OC "through-pipe" version.



Model 4675OC schematic.

Advantages and Limitations

The advantage of the system lies in its ability to carry a stable datum over long distances as achieved by the water level in the half-filled pipe. Each sensor measures the settlement by direct reference to this datum level and not by reference to a neighboring sensor as is the case where chains of tilt measuring sensors are used. Thus the accuracy of each measurement is not diminished by the accumulation of errors in a series of dependent measurements.

Further accuracy can be obtained by using a 4675OC sensor with the cylindrical weight completely submerged in the liquid as a means of measuring any change of liquid density that might occur due to changing temperature or chemical composition. Liquid density sensors can be connected at intervals to the open channel pipe, in the same manner as the active sensors, but at a slightly lower elevation so as to just submerge the hanging weight. The density of the liquid can be measured in this way to an accuracy of ±0.5%.

As with all vibrating wire systems, the output signal is a frequency and is not affected by long cables. Also, since the sensor is a force transducer, it is immune to zero drift and temperature effects.

Technical Specifications

Standard Range[1]	75 mm
Resolution	0.025 mm
Accuracy[2]	±0.1% F.S.
Linearity	±0.5% F.S.
Stability	±0.05% F.S. per year
Repeatability	±0.2% F.S.
Temperature Range[3]	–20 °C to +80 °C

[1]Other ranges and resolutions are available.
[2]Accuracy established under laboratory conditions. Accuracy can be achieved using polynomial calibration constants.
[3]Below 0 °C an antifreeze solution is required.

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GEOKON
48 Spencer Street
Lebanon, NH 03766 • USA

www.geokon.com
e: info@geokon.com
p: +1·603·448·1562

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