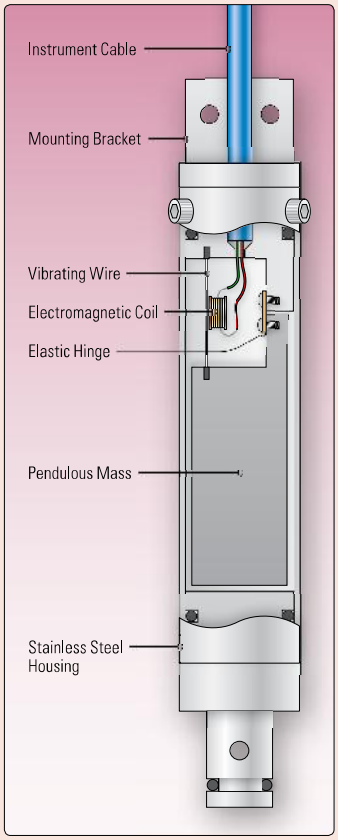
Vibrating Wire In-Place Inclinometer

Applications

The remote, continuous, and automatic monitoring of…

- **The stability of natural slopes, landslides and embankments**
- **The stability of slurry walls, sheet piling and tie-back walls around excavations**
- **Lateral ground movements and differential settlements in, around and above tunnels and underground openings**



Vibrating wire tilt sensor construction.

Model 6300 VW In-Place Inclinometer. Inset photo reveals installation detail with section of Model 6500 Inclinometer Casing removed.

Operating Principle

The Model 6300 Vibrating Wire In-Place Inclinometer consists of a string of Vibrating Wire tilt sensors mounted on lengths of stainless steel tubing which are linked together by universal joints. A spring-loaded wheel assembly designed to engage the grooves of conventional inclinometer casing is located at each joint. The string of sensors is installed inside the casing with all the sensor cables passing to the surface where they are connected to Terminal Boxes or Dataloggers.

Movements of the ground deflect the casing causing one or more of the inclinometer segments (length L) to undergo changes of inclination ($\Delta\theta$). Summation of all these tilts in the form Σ L sinθ, are plotted to give profiles of lateral deflection. Each tilt sensor contains a thermistor to permit temperatures to be recorded.

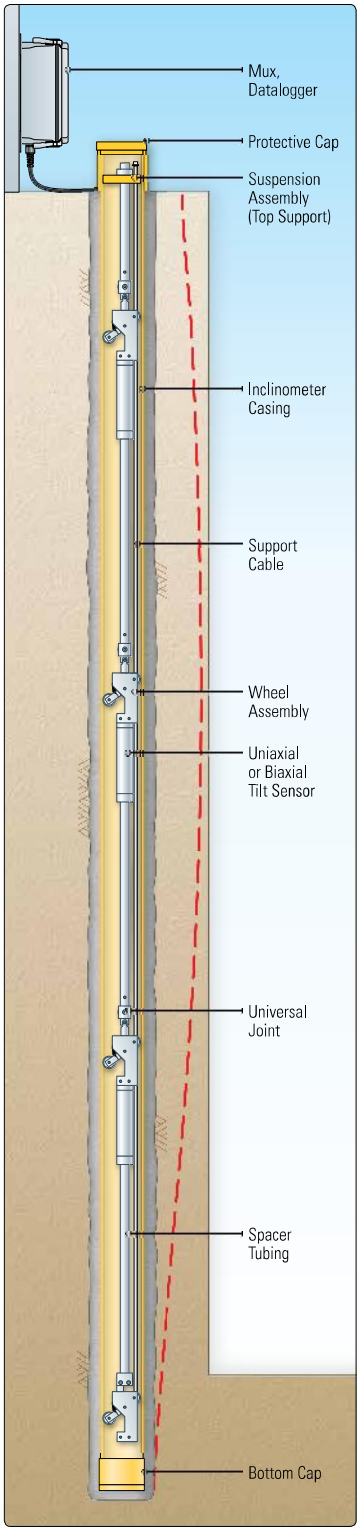
Advantages and Limitations

Vibrating Wire tilt sensors have many advantages. They have a wide range combined with high sensitivity, which makes them ideally suited for use in installations which deviate excessively from the vertical. Their long-term stability is excellent and their temperature dependence is close to zero.

The sensor output is in the form of a varying frequency which can be transmitted over very long cables without loss of accuracy. The simplicity of the design also makes this sensor less susceptible to lightning damage than most others.

Limitations include cost which, even though comparable to or less than other systems, may limit the number of sensors in any one installation. Because of this, the deflection profile obtained may not be as detailed as profiles obtained with conventional inclinometer probes. Costs can be controlled by limiting the tilt sensor placement only to those zones where the largest deflections are anticipated.

The Model 6300 incorporates novel shock absorbers for protection during transportation and installation, but some care in handling is still required.



● *Typical application to monitor the stability of a foundation wall.*

System Components

Components of the Vibrating Wire In-Place Inclinometer are shown at left. The tilt sensors may be either uniaxial or biaxial, with wheel assemblies and universal joints separated by spacer tubing of various lengths determined by the required interval between the tilt sensors.

The upper end of the system is suspended from a top support and the lower end requires a special bottom wheel assembly to which a support cable is attached.

For more installation details ask for the Model 6300 In-Place Inclinometer Installation Manual and the Model 6500 Inclinometer Casing Installation Manual.

Data Acquisition

Tilt sensors are read using a Model GK-404 or GK-405 Readout. For automatic monitoring, readout is best accomplished using the Micro-1000 datalogger or any other datalogger capable of reading vibrating wire sensors (Campbell Scientific CR1000, Data Electronics Datataker 600, Geomation Model 2380, etc.). Other dataloggers can be accommodated using the ***GEOKON®*** Single Coil Autoresonant Adapter (SCA).

Technical Specifications

Standard Range[1]	±10°
Resolution[2]	±0.05 mm/m (±10 arc seconds)
Sensor Accuracy[3]	±0.1% F.S.
Operating Frequency Range	1200-3500 Hz
Plucking Coil Resistance	180 Ω
Materials	Stainless Steel
Electrical Cable	4 conductor Polyurethane jacket, 4.7 mm diameter
Thermal Zero Drift	±0.01% F.S./°C (±4 arc seconds/°C)
Temperature Range[1]	–20°C to +80°C
Thermistor Operating Accuracy	±0.5°C
Waterproof	tested to 3 MPa
Sensor Dimensions (L × Ø)	187 × 32 mm
Sensor Weight	0.9 kg

[1]Other ranges available on request.
[2]Established under laboratory conditions.
[3]Depends on readout equipment.

● *Micro-1000 Datalogger.*

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