MEMS Horizontal In-Place Inclinometer

Applications

The remote, continuous, and automatic monitoring of…

- **The stability of structures, underground openings, and foundations**
- **The stability of tank foundations and subway tunnels**
- **Ground movements and differential settlements in, around and above tunnels and underground openings**

Model 6155 MEMS Horizontal In-Place Inclinometer. Inset photo reveals installation detail with a section of the Model 6500 Inclinometer Casing removed.

Operating Principle

The Model 6155 MEMS In-Place Inclinometer consists of a string of MEMS (Micro-Electro-Mechanical Sensor) 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 vertical deflection. Each tilt sensor contains a thermistor to permit temperatures to be recorded.

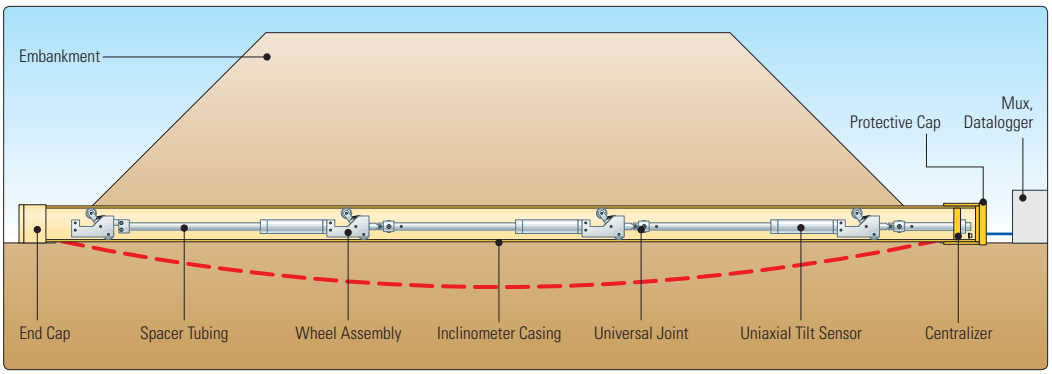
Advantages and Limitations

MEMS 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 horizontal. Their long-term stability is excellent and they are immune to shock loading.

Sensor outputs are compatible with most data acquisition systems and optional serial systems are available for multiplexed installations using a single cable.

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.

Micro-1000 Datalogger.



Typical application to monitor the settlement of an embankment.

System Components

Components of the MEMS Horizontal In-Place Inclinometer are shown above. The tilt sensors are uniaxial, with wheel assemblies and universal joints separated by spacer tubing of various lengths determined by the required interval between the tilt sensors.

The outer end of the system is terminated in a manhole, or other structure, and blind ended systems are available allowing the instruments to be "pulled" into the casing.

For more installation details ask for the Model 6155 MEMS Horizontal In-Place Inclinometer Installation Manual and the Model 6500 Inclinometer Casing Installation Manual.

Data Acquisition

Tilt sensors are read with the RB-500 Readout Box. For automatic monitoring, readout is best accomplished using the Geokon Micro-10 datalogger or any other datalogger capable of reading ±5 volt sensors (Campbell Scientific CR10X, Data Electronics Datataker 600, Geomation Model 2380, etc.).

Technical Specifications

Standard Range[1]	±15°
Resolution	±0.01 mm/m (±2 arc seconds)
Sensor Output	±3 volts @ ±10°
Supply Voltage	12 VDC
Materials	304 Stainless Steel
Electrical Cable[2]	6 conductor polyurethane jacket
Temperature Range	–20°C to +80°C
Thermistor Operating Accuracy	±0.5°C
Sensor Dimensions	187 × 32 mm dia.
Sensor Weight	0.4 kg

[1]Other ranges available on request.
[2]12 conductor for serial systems.

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The World Leader in Vibrating Wire Technology™

Geokon, Incorporated
48 Spencer Street
Lebanon, NH 03766
USA

1 • 603 • 448 • 1562
1 • 603 • 448 • 3216
geokon@geokon.com
www.geokon.com