DATA DIGGER EQUIPMENT

DATA SHEET

WIRE IN-PLACE INCLINOMETER

INTRODUCTION

Data Digger Equipment model DDE- 501WIPI is the most advanced wireless in-place inclinometer (IPI) system, designed to measure lateral movement of earthworks or structures. This is used in critical applications where real time monitoring and early warning is required in order to protect life and valuable assets. The wireless IPI system basically consists of an array of inclination sensors with SDI-12 digital interface, placed inside inclinometer gage well, connected to a wireless mesh network with Node and Gateway, to enable real-time monitoring. Its data logging and real-time monitoring feature helps to provide early warning in case of failures. The innovative wireless mesh network used in the system, has an advantage of reliable data transfer over long distances, without any delay.

FEATURES

- Provides reliable and high resolution readings with long term stability
- Rugged and robust construction
- Excellent temperature stability
- Innovative wireless mesh-based data collection protocol that provides seamless connectivity in large sites
- Easy to install and monitor hard to access sites and tunnels remotely

APPLICATION

- To accurately measure lateral movement of structures and embankment fills and landslide areas above dams, highways, earthworks, etc.
- To monitor deformation of embankments, retaining walls etc.
- Construction control, stability investigation and monitoring of ground movement caused by tunnel construction or any such excavation

Overview

A wireless in-place inclinometer is a modern geotechnical instrument used to monitor ground displacement and structural movement without the need for physical wiring. It consists of an inclinometer probe and a wireless data transmission system, which allows real-time monitoring of horizontal and vertical shifts in soil or structures. The system is installed in a borehole or casing, and the probe detects changes in the ground's angle or position. Data is transmitted wirelessly to a central monitoring system, enabling remote access for analysis. This technology reduces installation costs and maintenance needs. It is commonly used in landslide monitoring, embankment stability, and tunnel construction.

Description

A series of inclinometer access tubes, attached to each other, are installed in a borehole or embedded in earth/rock fill or concrete structure during construction or fixed to the vertical face of a completed structure.
In-place inclinometer system, consisting of a string of inclination sensors with MEMS tilts sensors and SDI-12 digital interface, is positioned inside the inclinometer casing to span the movement zone. Each in-place inclination sensor is fitted with a pair of pivoted sprung wheels. The extension rod lengths, connecting the sensors, can be varied to suit individual gage length requirements. The sensors can also be concentrated in areas where movement is expected. A suspension stainless steel wire rope is available to position a single or group of sensors where profile of entire borehole is not of interest but only a specific portion needs monitoring. A single 3 conductor bus cable is threaded in a daisy chain fashion connecting each sensor to its next immediate neighbor and finally to the top of the borehole and directly to the wireless communication network through a Node. The design allows each sensor to move independently to each other without influence from the sensors above or below. This provides a profile of displacement over the complete length of the installation.

Operations:

When ground movement occurs, it displaces the inclinometer access tubing, causing change in the tilt of the in-place inclinometer sensors. This results in change in output of the sensors, proportional to the tilt i.e. the angle of inclination from the vertical. The tilt reading applies over the gage length of the sensor (gage length is distance between wheels). This tilt reading can be converted to lateral deviation - “L sin θ” where L is gage length and θ is angle of tilt from vertical.
Displacement i.e. the lateral movement of casing can be calculated by subtracting initial deviation from current deviation. Provided that one end of the access tubing is known to be fixed, it is possible to obtain a complete profile of the access tubing by summing readings of successive sensors. By comparing these profiles, the horizontal displacement of the gage well at different depths over a period of time may be determined.

Wireless Mesh Network

The IPI sensor array is interfaced with the long range, low power wireless mesh network through a Node that allows sensors to send recorded data to the Gateway with over 99% reliability. The Gateway then uploads all the collected sensor data to the central/cloud server. The innovative wireless mesh-based data collection network provides seamless connectivity in large sites and tunnels. The system is low-power and consists of long range wireless radios that provide a range of up to 5 km in each hop of the mesh network. Cloud-hosted data management and configuration software can be used to manage the network. The configuration can be done with an easy to use smartphone application that comes free with the system. The application provides step-by-step instructions. It even displays whether the radio signals or the battery strength is good enough. The database management system allows analysis and visualization of the sensor data collected from project site/installation locations. The data is accessible 24 x 7 to all the related

authorities. The system can generate automatic reports and provide automated alerts over SMS for any reading crossing the pre-defined alert levels. In case a number of sensor arrays/Nodes are used at site, our innovative mesh network ensures that data from all the sensor arrays/Nodes are transferred to Gateway and hence cloud server without any delay. The beauty of mesh network is that even if a Node cannot reach the Gateway directly, it can still send its data to the Gateway via other Nodes in the network. The mesh network allows all Nodes to talk to each other, thus allowing them to relay other Node data to the Gateway. The system automatically mitigates well-known wireless problems like signal blockages and interference, allowing the tilt meters to reliably send their data to the gateway every time. Every single radio transmission in the system is secured using AES-128 encryption to maximize security of the sensor data gathered by the system.

TECHINCAL SPECIFICATIONS:

WIRELESS IN-PLACE INCLINOMETER	
SENSOR	
Sensor	Uni-Axial or Bixial MEMS Sensor
Measuring Range	±15°
Accuracy	± 0.1% F.S
Temperature Range	-20°C to 80°C
RADIO FREQUENCY	
Transmission Distance	Up To 5Km (Line of Sight) Up To 2Km (cities, urban) Sub 2.4Ghz Band Compiles with unlicensed ISM band
Transmission Distance	625 bps – 2.5kbps variable bitrate
Data Security	AES128 Encrypted end to end
NODE	
Power Supply	3.6V 19Ah “D-Cell”, easily replaceable on site
Battery	Lithium Thionyl Chloride(Li-SOC12)
Battery Back up	180 Days
GATEWAY	
Power Supply	220V A.C / Solar Power Charger
Battery	12V D.C
Connectivity	In Built 3G/4G Modem
Data Retrieval	USB Drive in Excel Format, Cloud Server with secure Used ID & Password