RITE GEOSYSTEMS

ENCARDIO RITE
METASENSING FOR MEGA STRUCTURES

DATA SHEET

3D IN-PLACE INCLINOMETER WITH SETTLEMENT (X-Y-Z)

MODEL EAN-61MS

INTRODUCTION

Encardio-rite model EAN-61MS in-place 3D inclinometer with settlement (IPIS) system is used wherever lateral movement along with settlement/heave is to be monitored. It is widely used in measurement of subsurface lateral movement and settlement in boreholes in applications like deep foundations, deep excavations, tunneling and dam abutments. It is also very useful in monitoring landslide areas.

EAN-61MS 3D IPIS is a versatile system that can be used in multiple sensor configurations, as per site requirement. It can be used to monitor only X-Y lateral movement (with IPI sensor), only Z movement (with settlement sensor), or a combination of IPI and settlement sensors at different levels in single borehole.

FEATURES

- Complete 3D (X-Y-Z) profile of gage well/borehole
- Versatile system that can be used in different sensor (IPIS, IPI, Settlement) configurations, as per site requirements
- Reliable, accurate and simple to read
- Probes can be removed, reconfigured and reused at different projects/boreholes
- Excellent temperature stability
- Easy connection to compact datalogger with user friendly configuration software.

OVERVIEW

The EAN-61MS 3D in-place inclinometer with settlement (IPIS) system provides significant quantitative data on magnitude of lateral movement along with settlement or heave and its variations with time. It also provides the pattern of deformation, zones of potential danger and effectiveness of construction control measures undertaken.

The real-time monitoring data with instant alerts help to provide early warning in case of failures. It also helps in observing behavior of ground movement after construction and indicates potentially dangerous conditions that may adversely affect stability of the structure.

The advanced IPIS system has a great advantage as it allows online monitoring of transverse movement as well as settlement using the same borehole. This was not possible until now using presently available instruments.

DESCRIPTION

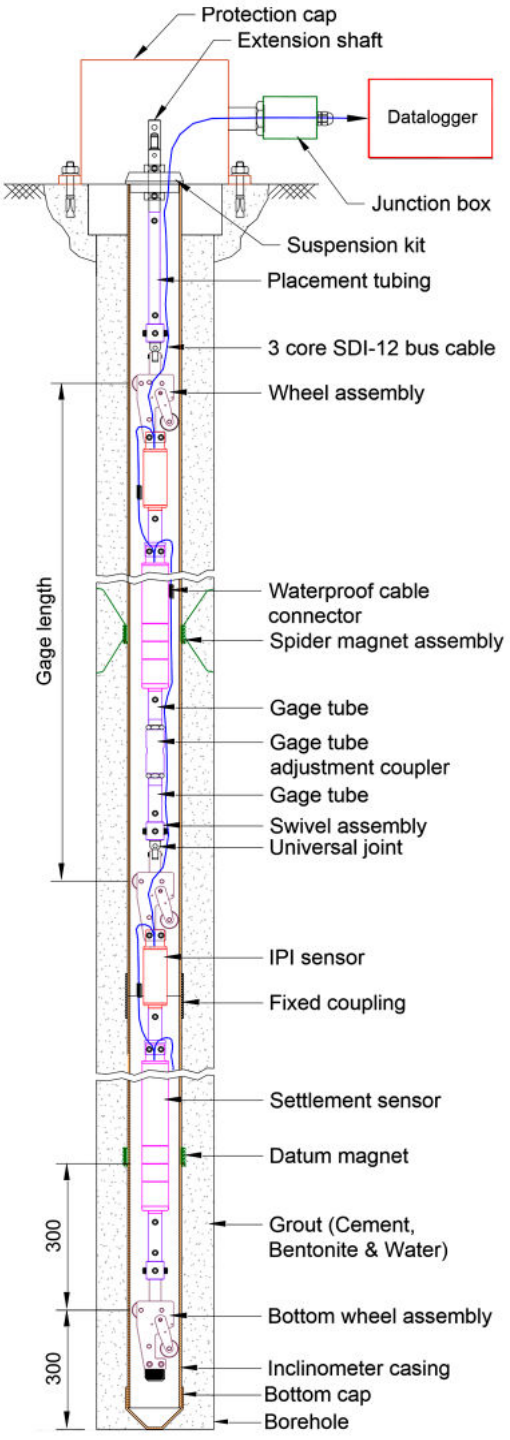
A series of ABS inclinometer access tubes, attached to each other with fixed/telescopic couplings, are installed in a borehole with special spider magnet rings (different from our regular spider magnets) at required depths.

Model EAN-61MS in-place 3D inclinometer with settlement system consists of a string of probes positioned inside the inclinometer casing in a continuous array to span the movement zone. Separate IPI and settlement sensors are coupled together to form the probe assembly. The IPI is a high accuracy biaxial MEMS sensor to monitor lateral movement (X-Y). A contactless magnetic sensor housed in a waterproof stainless steel body monitors settlement or heave (Z)

The probe measures tilt and settlement in successive segments to accurately monitor a change in the profile (X-Y-Z) of the inclinometer casing. Each probe is fitted with a pair of pivoted sprung wheels which rests inside the grooves of the inclinometer casing. The probes are connected to each other by gage tubes (with provision to adjust the length). Length of gage tubes determines the distance between each probe i.e. length of each segment over which the tilt is monitored.

APPLICATION

- To accurately measure subsurface lateral movement and settlement/heave in deep foundations, deep excavations, tunneling, dam abutments, ports, airports, bridges or landslide areas
- Construction control, stability investigation and monitoring of ground movement caused by tunnel construction, deep excavation or nearby heavy construction activity.



EAN-61MS IPIS and datalogger (with GSM/GPRS modem)

Each EAN-61MS/1 sensor has a displacement range of 100 mm. This range is marked on each sensor (two ends and the middle) for ease in positioning the settlement sensor over the ring magnets. A coarse adjustment of 25 mm/50 mm/75 mm and a fine adjustment of 50 mm (± 25 mm) is provided in the gage tube.

VERSATILE USE

Model EAN-61MS 3D IPIS system has an advantage of optimizing costs by using the three sensors (IPIS, IPI and Settlement) separately or in a single chain, depending on field requirement. This provides a cost effective solution, meeting various monitoring requirements, precisely and effectively.

- To monitor only X-Y lateral movement, IPI sensors (model EAN-52M) can be used at required depths
- To monitor subsurface lateral movement (X-Y) and settlement or heave (Z), 3D IPIS sensors (model EAN-61MS/1) can be used at required depths.
- To monitor only subsurface Z movement (settlement), settlement sensors (model EAN-61MS/1.1) can be used at desired depths
- To monitor X-Y-Z, X-Y and Z movements at different levels in single borehole, a combination of IPIS, IPI and settlement sensors can be used at respective depths.

For example, in a tunnel application, IPIS sensors can be used only to span the excavation depth (tunnel diameter). Settlement sensors can be used above and below the tunnel location in the same chain/borehole.

Similarly, to monitor ground movement during any deep excavation, IPIS sensor chain can be used to span the complete excavation depth.

MEASUREMENT

To start with, a magnetic probe is lowered down the inclinometer casing to determine the exact location of the special spider magnets mounted outside the casing. During assembly of the sensors string, the location of settlement sensors is adjusted with provided holes and threads on the gage tubes to set the string to monitor expected heave or settlement at the installation location.

Lateral movement occurring in the ground, displaces the inclinometer casing, causing a change in tilt of the IPI sensors. This results in a change in output of sensors proportional to the tilt i.e. the angle of inclination from vertical. Simultaneously, if any settlement/heave takes place, it is measured by the position change between the contactless magnetic sensors and the magnet rings fixed outside the inclinometer casing. Settlement/heave of all the sensors is thus determined with respect to a reference, which can be the top of the borewell or a datum magnet installed at the bottom fixed end.

Deformation 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 and settlement at the desired levels. By comparing these profiles, the lateral displacement (X-Y) of the borewell along with the settlement (Z) at different depths, over a period of time, may be determined.

It is advisable to determine initial Northing (X) and Easting (Y) positions of casing top (using prism target with adaptor) and elevation of the pipe top (using a settlement marker) after the casing is set, for future correlation/cross reference. It is also advised to take a set of initial readings with a manual digital inclinometer system and magnetic probe for future reference.

SYSTEM COMPONENTS

Following sub-assemblies are available in the Encardio-rite model EAN-61MS 3D in-place inclinometer system:

EAN-61MS/1	Digital 3D IPIS probe, with pair of wheels (tilt + settlement sensor).
EAN-61MS/1.1	Digital settlement probe
EAN-52M	Digital IPI probe, with pair of wheels
EAN-61MS/2	Expandable gage coupler tube; minimum 2 m gage length. 3 m to 5 m gage lengths also available.
EAN-61MS/3	Bottom wheel assembly
EAN-61MS/4	Suspension kit with protective cap
EAN-61MS/5	Placement tubing (specify length) for placing string of sensors.
EAN-61MS/6	Protective rope to prevent loss of sensor down hole
EAN-61MS/7	Suspension stainless steel wire rope for positioning single or group of sensors in specific portion of borehole
EAN-61MS/8	Spider magnet ring
EAN-61MS/9	Datum magnet ring
EAN-61MS/10	Battery pack for supply (15 V)
CS-1002	3 core SDI-12 bus cable
Casings	For casing refer to datasheet 1064 on model EAN-26M Inclinometer system.
EDS-91/2.1	Magnetic probe with cable reel assembly

Special spider magnet

Datum magnet

Gage tube with adjustment coupler

ABS casing

Magnetic probe

Datalogger

Advantage of digital probes

The digital probes have a great advantage over conventional analog probes. For a string of analog probes, routing of individual sensor cable to the top is a cumbersome, costlier affair. It increases the weight of the whole assembly. This limits the number of sensors to be used in a single borehole. Thus, where large number of sensors are required, probes with SDI-12 interface are a good choice as it enables to collect and transmit data from all the individual probes through a single bus cable..

In our IPIS system, only a single 3 conductor bus cable needs to be threaded in a daisy chain fashion connecting each probe to its next immediate neighbor and finally to the top of the borehole and directly to the datalogger (without any multiplexer).

DATALOGGER

ESDL-30 datalogger is designed to automatically collect data from digital sensors. It is of compact durable construction, suitable for unattended application to provide accurate and reliable data.

The datalogger can be programmed to take measurements from once every 5 seconds to once every 168 hours in linear mode. The number of measurements taken per day should however be kept to a minimum as higher frequency of measurement drains the battery at a faster rate.

The measured data is stored, together with the current date, time and battery voltage, as a data record in the internal non-volatile memory (2 million data points) of the datalogger.

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The datalogger features wide operating temperature range, low power consumption and compatibility with many telecommunication options.

DATA RETRIEVAL AND TRANSMISSION

Telemetry through GSM/ GPRS modem

In a location covered by any GSM/GPRS service provider, the data from the ESDL-30 datalogger can be transmitted remotely to a PC at a central location. The user needs to arrange a data SIM card for each datalogger.

Data retrieval using laptop

Logged data from ESDL-30 datalogger can be directly downloaded in field to a laptop/PC. Data can be transferred to central PC/server through Internet/pen drive.

REAL-TIME WEB-BASED DATA MANAGEMENT SYSTEM

Drishti, our cloud-hosted data management software, is available to process and manage the data collected at project site for further analysis and evaluation. The real time data is accessible to all stakeholders 24X7, with instant alarms on critical events. Early warnings help in taking timely corrective action to prevent damage and minimize delays and operational costs.

Drishti is a powerful tool that gives the user complete control of their project data. It offers an interactive user interface, taking care of all database interactions automatically.

Real time display, graphs & reports can be viewed using popular web browsers like Microsoft Internet Explorer, Google Chrome or Mozilla Firefox amongst others. It allows multiple authorized users at different locations to view any data or report from the same project site simultaneously. Data can be accessed from any type of device, like a desktop, laptop, tablet or smart phone that supports a standard web browser.

Encardio-rite cloud service is available on a rental model. User has to pay a small set-up fee for first time use and then a monthly rental for accessing the data over the cloud as long as required.

ORDERING INFORMATION

Following information will be required to place an order

- Application area, borehole depths
- Number of IPIS and IPI required per borehole
- Gage length, placement tubing length
- In case only settlement is required in a particular section of the borehole, please provide drawing.
- Data transmission option required

SPECIFICATION

EAN-61MS/1 3D probe (tilt + settlement)	
Probe	Biaxial MEMS sensor (monitors X-Y); Contactless magnetic sensor (monitors Z)
Measuring range	± 15° (X-Y), 100 mm (Z)
Accuracy[1]	± 0.1% fs
Temperature range	-20°C to 80°C
Output	SDI-12 digital (serial) output
Speed	Speed: 1200 bits/sec
[1] *As tested under lab conditions*	
EDS-91/2.1 magnetic probe with cable reel assembly	
Length 'L' (m)	30, 50, 100, 150, 200, 300 (Metric) with resolution 1 mm
Length 'L' (ft)	50, 100, 150, 300, 500 (Imperial) with resolution 0.01 in
ESDL-30 Datalogger	
No. of channels	3
No. of sensors per channel	61
Memory capacity	Flash Memory (64-Mbit); 2 Million data points
Data output format	CSV text file. Can be easily imported in many third party applications like Microsoft® Excel
Communication port	RS-232 (Standard) 115 kbps
Temp. measurement range	-20 to +70°C with 0.1°C resolution
Operating temperature range	-30 to 70°C
Humidity	100 %
Power supply	2 x D size 3.6 V/19 Ah Lithium cells, or 2 x D size 1.5 V Alkaline high power cells, or 12 V SMF battery chargeable from AC mains or solar panel
Housing	Corrosion resistant weather proof enclosure
Antenna (in telemetry option)	Built-in or separately mounted antenna
Dimensions L x W x H	220 x 140 x 90 mm

*All specifications are subject to change without prior notice

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