

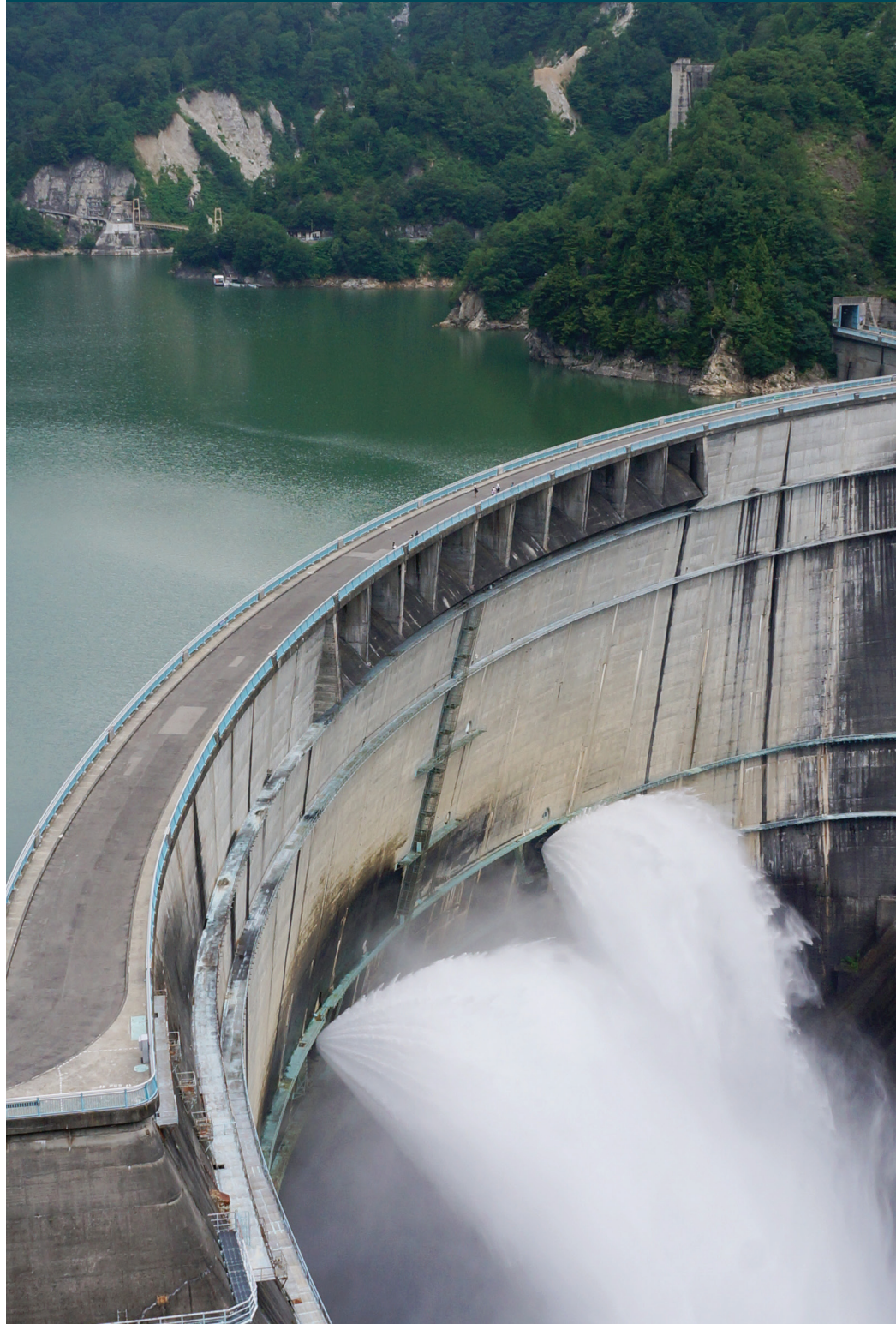


Monitor
with
Confidence

Monitoring Instrumentation for Dams, Hydropower, Irrigation and Energy Projects

Concrete Dams | Concrete Face Rockfill Dams | Earthfill Dams | Pipelines

We make monitoring instruments. You make sound decisions.





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History

Since 1977, RST's geotechnical monitoring instruments have been integral components for major dams, mines, tunnels, pipelines, and structures around the world that require monitoring, measuring and data collection.

As a world leader in the design, manufacturing and sale of innovative geotechnical, environmental and structural monitoring instruments, our customers rely on our **reliability & accuracy** to:

- + *Improve Decision Making*
- + *Manage Risks*
- + *Improve Safety*
- + *Optimize Design*
- + *Increase Productivity*
- + *Reduce Costs*

Experience

With years of geotechnical instrumentation experience, RST is capable of providing custom engineered solutions to site-specific problems. When requested, in-depth technical support is provided and all related staff members are always available to work with clients until a solution is found to meet the project requirements.

Quality



The RST Instruments management system is certified to ISO 9001:2015. It is based on evidence of corporate commitment to quality in management responsibility, design control, inspection & testing, internal quality audit procedures, training & servicing.

Products

More than half of all instruments manufactured at RST Instruments are specifically engineered to meet site-specific requirements and are designed in conjunction with client input.

RST also specializes in custom, complex data acquisition systems and holds a number of patents such as "Snap-Seal" ABS inclinometer casing and the Digital MEMS Inclinometer System. Satisfied engineers worldwide have installed RST's casing and used the Digital MEMS Inclinometer System for accurate slope stability monitoring.

Technologies



"Turn-key" data logger systems offering real-time data logging & analysis of vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR and other sensor types. Ideal for remote data logging of dams, tunnels, bridges, mines, and natural slopes.



Fully automated wireless data collection using "DT Series" Data Loggers at the sensor level, deployed in a star topology from an active RSTAR Hub with flexDAQ data logger or THREAD Gateway. Users can access collected data remotely, either on-site or off-site.



A semi-automated wireless data collection system that is an on-site wireless connection to "DT Series" Data Loggers for quick data collection. Ideal for hard to access areas where the data logger is within line of sight.



A series of rugged data loggers that provide reliable, unattended monitoring of various sensor types: Vibrating Wire, MEMS, 4-20mA Transmitters & Thermistors, Potentiometers and Load Cells. DT Series Data Loggers can be used to collect data wirelessly or as non-wireless stand-alone data loggers.



DT-BUS instruments use a series of digitally bussed sensors, all addressable, along one cable. It simplifies installation and minimizes costs by eliminating the need of a separate cable for each sensor and also reduces the amount of cable to be managed during installation.



A precision line of tilt and inclination monitoring instruments using digital MEMS (Micro-Electro-Mechanical Systems) sensors.



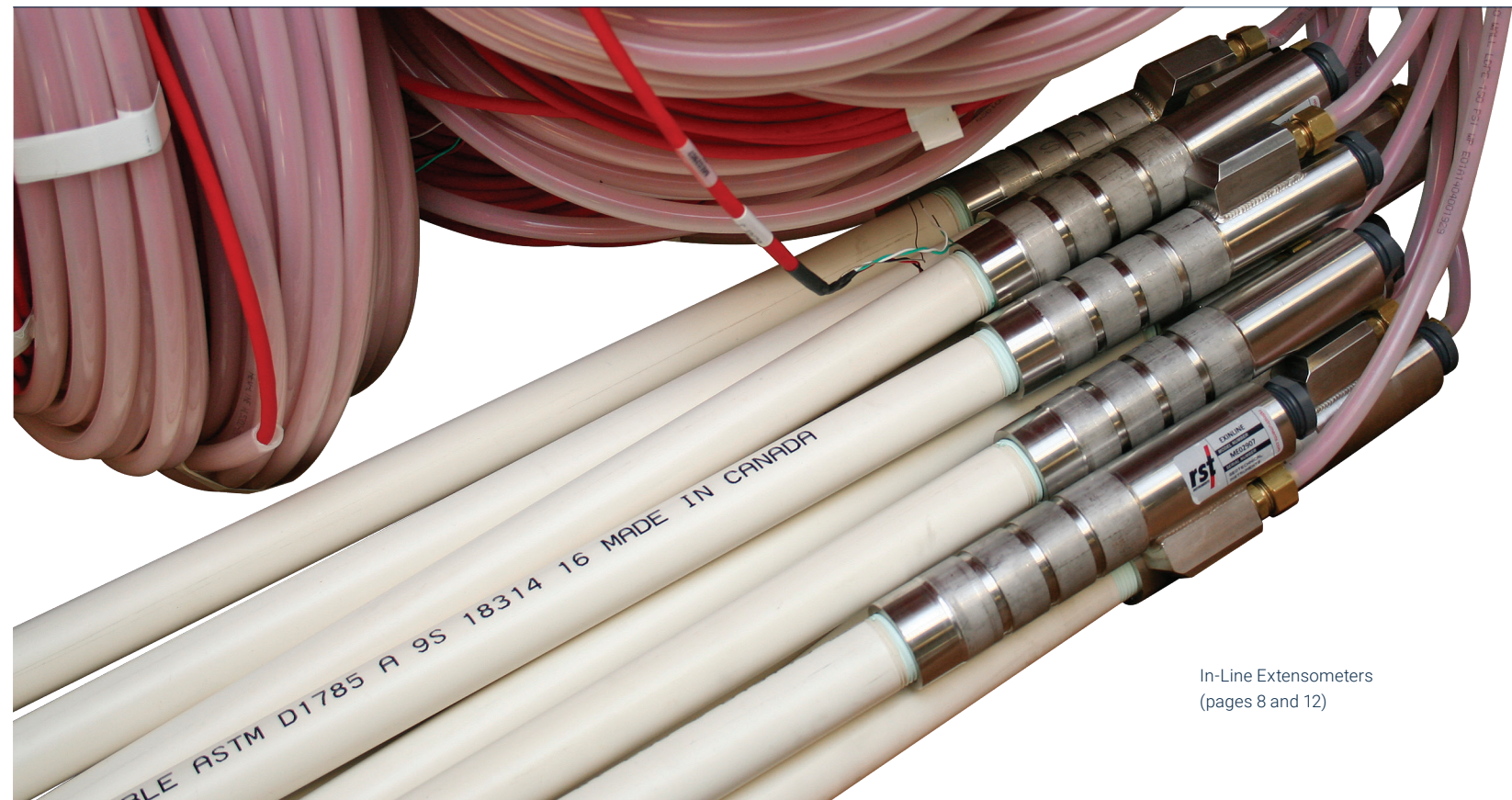
Measures any lateral movement down in the earth, via inclinometer casing. Since 2003, RST's Digital MEMS Inclinometer has traversed a smaller radius bend than all other inclinometer probes available in the industry.



RST Inclinalysis™ Software quickly reduces large volumes of data from the RST Digital MEMS Inclinometer System for analysis and presentation.



GeoViewer is a data viewer that provides flexible console viewing of large data sets from ADAS (automatic data acquisition systems). It features alarm functions and remote, real-time data access.



In-Line Extensometers
(pages 8 and 12)

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- 11 Zoned Earthfill Dams with Clay Core
- 13 Pipeline Slope Monitoring



The La Yesca Dam, completed in 2012, is a 220 m (722 ft) tall and 628 m (2,060 ft) long concrete-face rock-fill dam on the Santiago River in Mexico. The power station produces an estimated annual generation of 1,210 GWh.



Inclinometers and Tilt Sensors

- Measure lateral movement down in the earth; lateral deformation of concrete dams, tall structures and bridge piers; and tilt of structures in either one or two axial planes.
- Provide long term/short term observation with maximum resolution and sensitivity.
- Manual monitoring or remote data acquisition options available.

KEY PRODUCTS:

*Inclinometer Systems
In-Place Inclinometers
Tilt Loggers & Meters
Inclinometer Casing
Tunnel Monitors
Track Monitors*



Readouts and Data Loggers

- Collect data from sensors in dams, tunnels, bridges, mines, natural slopes and other geotechnical applications.
- Manual monitoring or remote, wireless data acquisition with alarm triggering.
- Many sensor types and gauges can be read with these products including vibrating wire, thermistor, TENSMEG, linear potentiometer, strain gauge and MEMS.

KEY PRODUCTS:

*"DT Series" Data Loggers
RSTAR - Array Radio Series
DT LINK Wireless
flexDAQ Data Loggers
VW2106 Vibrating Wire Readout
Ultra-Rugged Field PC²
Custom Data Logger Enclosures*



View the product page for videos and downloadable brochure:
<http://www.rstinstruments.com/PRODUCTS.html>

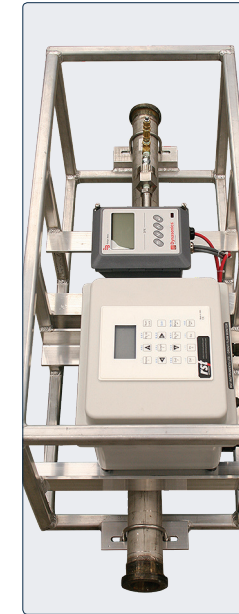


Environmental and Pipe Products

- Measure elevation of groundwater in boreholes, standpipes and wells.
- Complete, custom weather stations.
- PVC wellscreen and pipe products for monitoring groundwater hydrology, drainage, and water wells. HDPE pipe is used for various industrial applications for landfills, waste sites and mining applications.

KEY PRODUCTS:

*PVC Wellscreen, Casing and Pipe
Water Level Meters*



Grout Monitors

- Grout Monitors offer a permanent record of key grouting parameters for quality assurance, quantity documentation, and pressure & flow readings.
- Real-time data viewing available via Wi-Fi communication with grout monitor data logger.

KEY PRODUCTS:

*Compaction Grout Monitor
Permeation Grout Monitor*

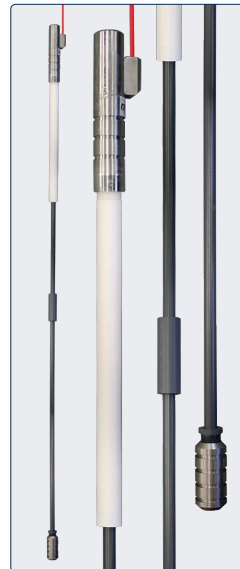


Piezometers and Pressure Transducers

- Measure pore water pressure during fill or excavation. Invaluable in slope stability investigations and for assessing the stability of earth fill dams and embankments.
- Compatible with "DT Series" Data Loggers for remote data acquisition. Alarm triggering can also be utilized.
- The VW2106 Vibrating Wire Readout and the C109 Pneumatic Readout are the main readouts used for reading piezometers.

KEY PRODUCTS:

*Vibrating Wire Piezometer
Pneumatic Piezometer
Strain Gauge Piezometer
Strain Gauge and Vibrating Wire Pressure Transducers*

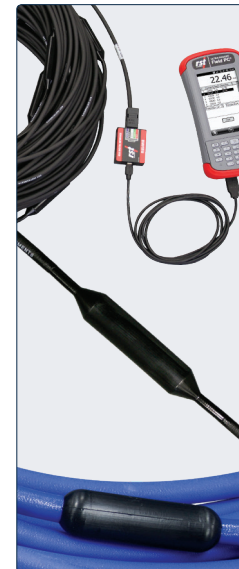


Extensometers and Compressometers

- Measure ground deformation in mining and civil engineering projects, linear displacement of structures, tunnel displacement, and deformation in rock faces or underground workings.
- Manual monitoring or remote, wireless data acquisition with alarm triggering.

KEY PRODUCTS:

*Convergence Monitors
Borehole Extensometers
In-Line Extensometers
Crack Meters
Pivot Laser Extensometer
Tunnel Profile Monitors*



Thermistors and Temperature Systems

- Temperature measurement with simple thermistor integration into certain instruments.
- Custom thermistor/temperature systems, such as the Digital Thermarray System.

KEY PRODUCTS:

*Digital ThermArray System
Thermistor Strings/Systems
TH2016B: Thermistor Readout
Subgrade Temperature Probe*

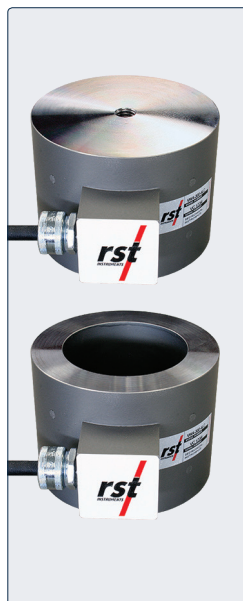


Analysis Software

- Leading-edge software for seamless integration with RST's instruments.
- All software offered by RST is fully backed by a support team of software engineers who are ready to assist you with any questions, and to provide on-going software updates for improved product performance.

KEY PRODUCTS:

*GeoViewer Real-time Monitoring
Inclanalysis™: Inclinometer Analysis Software
Host Software for RST's Readouts & Data Loggers*

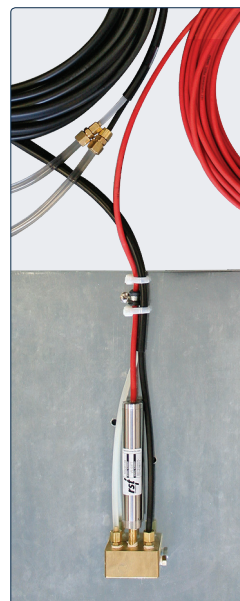


Load, Stress and Pressure Sensors

- Measure load, stress and pressure as it relates to rock, soil, concrete and piling type applications.
- Equipped with sensors that are vibrating wire, pneumatic or strain gauge.
- Manual monitoring or remote data acquisition configurations are available for many instruments in this category.

KEY PRODUCTS:

*Load Cells
Pressure Cells
TENSMEG Tension Measuring Gauge
Rebar Strain Meter/Sister Bar
Vibrating Wire Strain Gauge*



Settlement Systems

- Accurately monitor settlement or heave in soils and man-made structures such as buildings, tunnels, embankments, and earth and rockfill dams.

KEY PRODUCTS:

*Precision Liquid Settlement Array
Vibrating Wire Liquid Settlement Systems
Horizontal In-place Inclinometers
Magnetic Settlement Systems
Vibrating Wire Deep Settlement Systems*



Borehole Packers

- Suitable for a wide variety of applications in open or cased holes and for monitor well sampling, zone testing & monitoring, permeability testing, hydrofracturing of formations, pressure grouting, and sealing off artesian flows.
- Alternate sizes and materials are available for custom applications.

KEY PRODUCTS:

*Borehole Packers
Borehole Packer Accessories*

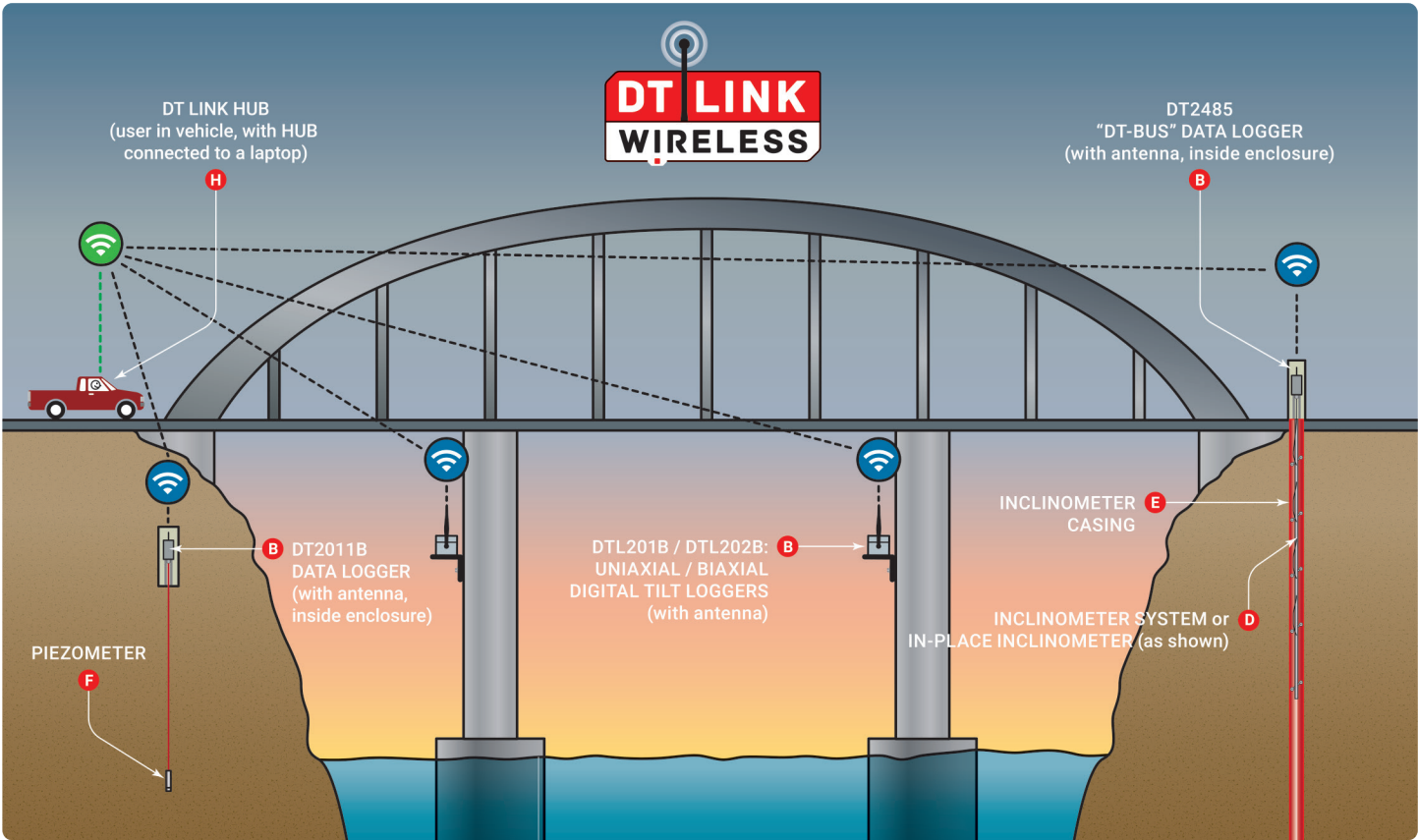
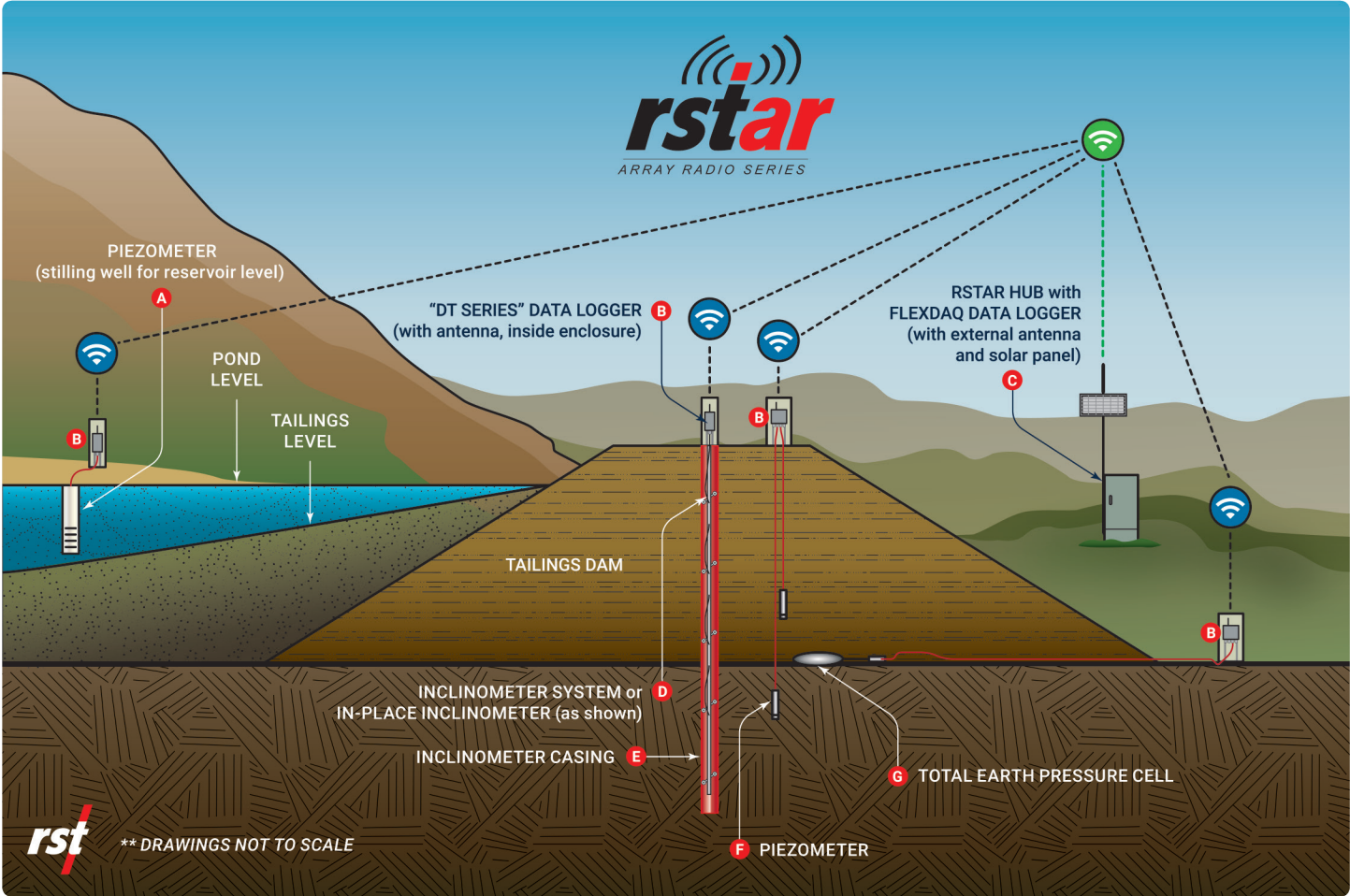


Carlson Instruments

- Used where concrete or similar type structures require geotechnical investigation. Readings can only be accessed by the Carlson MA7 Readout and flexDAQ Data Loggers.

KEY PRODUCTS:

*Carlson Joint + Foundation Meters
Carlson MA7 Readout
Carlson Piezometer
Carlson Reinforced Concrete Meter
Carlson Resistance Thermometer
Carlson Strain Meters
Carlson Stress Cells*



View the product page for videos and downloadable brochure:
<http://www.rstinstruments.com/Wireless-Data-Collection.html>

2 WIRELESS DATA COLLECTION OPTIONS:

Whether collecting geotechnical instrument data on-site or remotely, RST Instruments offers two wireless data collection systems: RSTAR and DT LINK.

Compatible sensor types for both systems are identical and use the "DT Series" Data Loggers from RST Instruments which provide reliable, unattended monitoring of various sensor types: vibrating wire sensors, potentiometers, MEMS tilt sensors, strain gauge (full bridge) sensors, digitally bussed sensors ("DT-BUS"), 4-20 mA sensors, and thermistors. These data loggers at the NODE (data logger & sensor) level require a single lithium "D" cell and provide years of battery life. Both systems provide extensive open-country range through use of a simple dipole or directional antenna.

OPTION 1: RSTAR

The RSTAR Array Radio Series uses wireless technology to provide automated data acquisition. A complete RSTAR L900 System uses RSTAR NODES at the sensor level, deployed in a star topology from a continuously active RSTAR HUB, which consists of an L900 RTU interfaced to an RST FLEXDAQ Data Logger.

The RSTAR system is intended for fully automated scheduled collection and provides remote data access. It uses a fixed central hub with its own data logger, antenna, and power. The range from the sensor node to the hub is up to 14 km and is based on the 900 MHz, 868 MHz, and 2.4 GHz spread spectrum band (country dependent).

OPTION 2: DT LINK

The DT LINK system is a wireless connection to RST data loggers for quick semi-automated data collection performed on-site. The DT LINK system uses a portable hub with laptop connection and host software. The ranges from the sensor node to the hub can be up to 500 m and 800 m and is based on the 900 MHz, 868 MHz, and 2.4 GHz spread spectrum band (country dependent).

DT SERIES

DATA LOGGERS

A series* of rugged data loggers that provide reliable, unattended monitoring of various sensor types and provide years of battery life.



DT Series Data Loggers shown in drawings at left:

- DT2011B - Single Channel Vibrating Wire Data Logger
- DT2055B - 5/10 Channel, Vibrating Wire/Thermistor Data Logger
- DT2485 - Data Logger for DT-BUS Sensors
- DTL201B - Uniaxial Digital Tilt Logger
- DTL202B - Biaxial Digital Tilt Logger

*Contact RST for details on additional "DT Series" data loggers.



A F Piezometer

Monitor pore water pressures in the ground in slopes, dams, foundations, or embankments.



C RSTAR L900 with FLEXDAQ

Allows for precise & reliable data acquisition from various sensor types and gauges including vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR, etc. Ideal for remote data logging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines, and natural slopes.



D E In-Place Inclinator and Inclinator Casing

Installed in a borehole to monitor horizontal displacement of the slope casing. Compatible with all commercially available inclinometer probes, including RST's Digital MEMS Inclinator Probe/System (manual readings) and In-Place Inclinator (automated readings).

Pictured Left: In-Place Inclinator (D) and Inclinator Casing (E)



G Total Earth Pressure Cell

Measure stress acting on plane surfaces. Ideal for earth embankments, dams, foundations, retaining walls, piles, pipelines & culverts, railroad bases, beneath raft foundations, tunnel linings, and mine backfill monitoring. Available with pneumatic, strain gauge, or vibrating wire transducers.



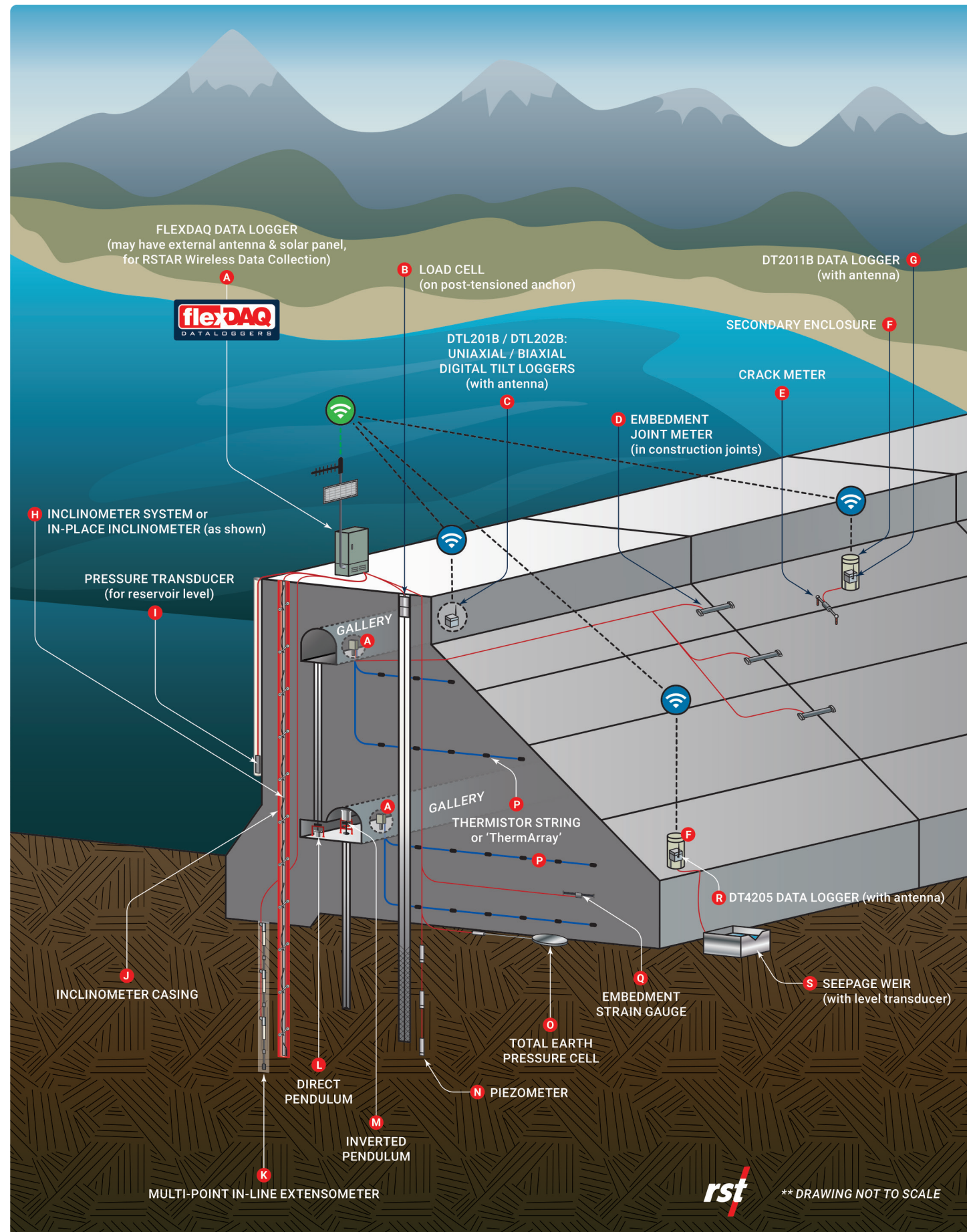
H DT LINK HUB

A portable hub that connects to DT LINK NODES for wireless data transmission. The DT LINK HUB connects via USB to a laptop for its power and it uses DT LINK Host Software for viewing & downloading the collected data.



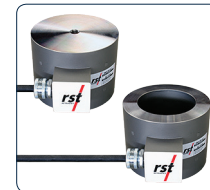


3D Submersible Crack Meter installed on perimeter joint of a concrete-face rock-fill dam. Inset photo shows protective cover being placed over the sensors.
(page 10)



A FLEXDAQ Data Logger Systems

Allows for precise & reliable data acquisition from various sensor types and gauges including vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR, etc. Ideal for remote data logging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines, and natural slopes.



B Load Cell

Measure loads in tie-backs, struts, ground anchors and rock bolts. Also for measuring loads during the testing of piles. Typical sensors include strain gauge and vibrating wire.



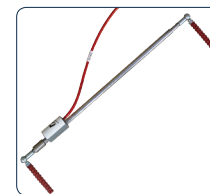
C DTL201B / DTL202B Uniaxial / Biaxial Digital Tilt Loggers

Battery powered, radio enabled, unattended monitoring of tilt in either uniaxial or biaxial planes.



D Embedment Joint Meter

Monitor joints on mass concrete structures. Ideal for joints of concrete arch, gravity and buttress dams; concrete-faced, rockfill dams; concrete retaining walls and slabs.



E Crack Meter

Measure movement (separation or convergence) across surface cracks, joints, or concrete structures.



F Secondary Enclosure

A secondary enclosure used to house select "DT Series" Data Loggers. The cover can be removed to allow easy access to the internally housed data logger.



G DT2011B - Single Channel Vibrating Wire Data Logger

Battery powered, radio enabled, unattended monitoring of a single vibrating wire sensor and thermistor.



I Pressure Transducer

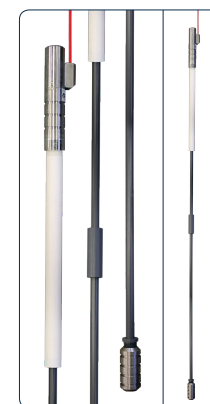
For uplift measurement in the foundation of concrete dams, overflow settlement measurement in earthfill and rockfill dams, and all other applications for measuring fluid pressure in closed circuits. Available in vibrating wire or strain gauge.



H J In-Place Inclinometer and Inclinometer Casing

Installed in a borehole to monitor horizontal displacement of the slope casing. Compatible with all commercially available inclinometer probes, including RST's Digital MEMS Inclinometer Probe/System (manual readings) and In-Place Inclinometers (automated readings).

Pictured Left: In-Place Inclinometer (H) and Inclinometer Casing (J)



K In-Line Extensometer

Determine extension or compression behavior of soil, rock, and concrete structures. The sensor housing is waterproof and can be installed flush with the borehole collar so it does not protrude.



P 'ThermArray'

Provides precision thermal gradient information in geotechnical, geothermal, and marine applications. Can be used to detect seepage.



Q Embedment Strain Gauge

Designed to be embedded in concrete structures for monitoring strain of concrete.



L M Pendulums

Monitor internal lateral deformations of concrete dams, dam foundations and abutments, tall industrial buildings and bridge piers. Available as both direct and inverted systems.



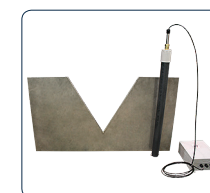
R DT4205 - 5/10 Channel 4-20mA Transmitter Data Logger/ Thermistor Data Logger

Battery powered, radio enabled, unattended monitoring of up to 10 channels which may be any mix of 4-20mA sensors or thermistors.



N Piezometer

Monitor pore water pressures in the ground in slopes, dams, foundations, or embankments.



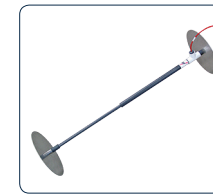
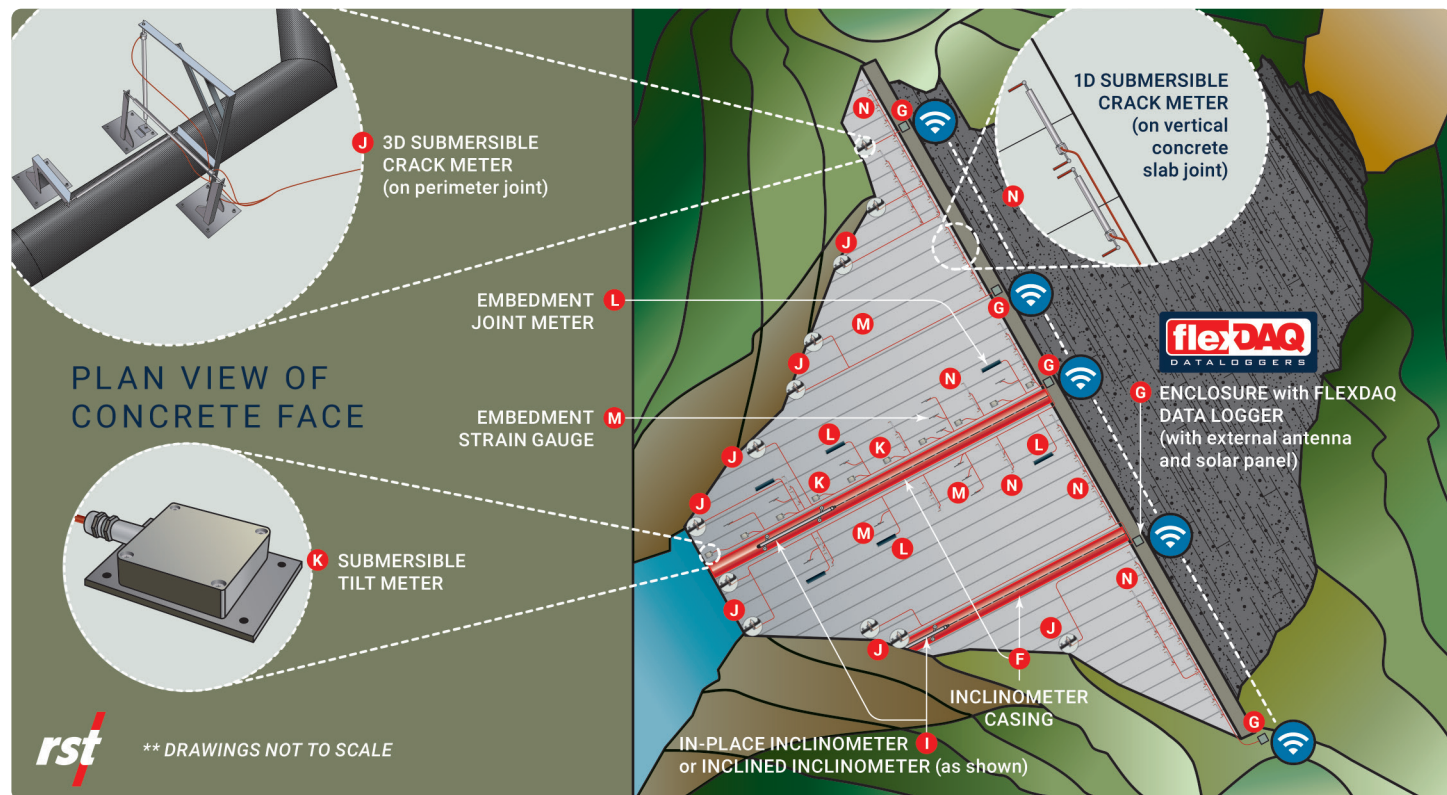
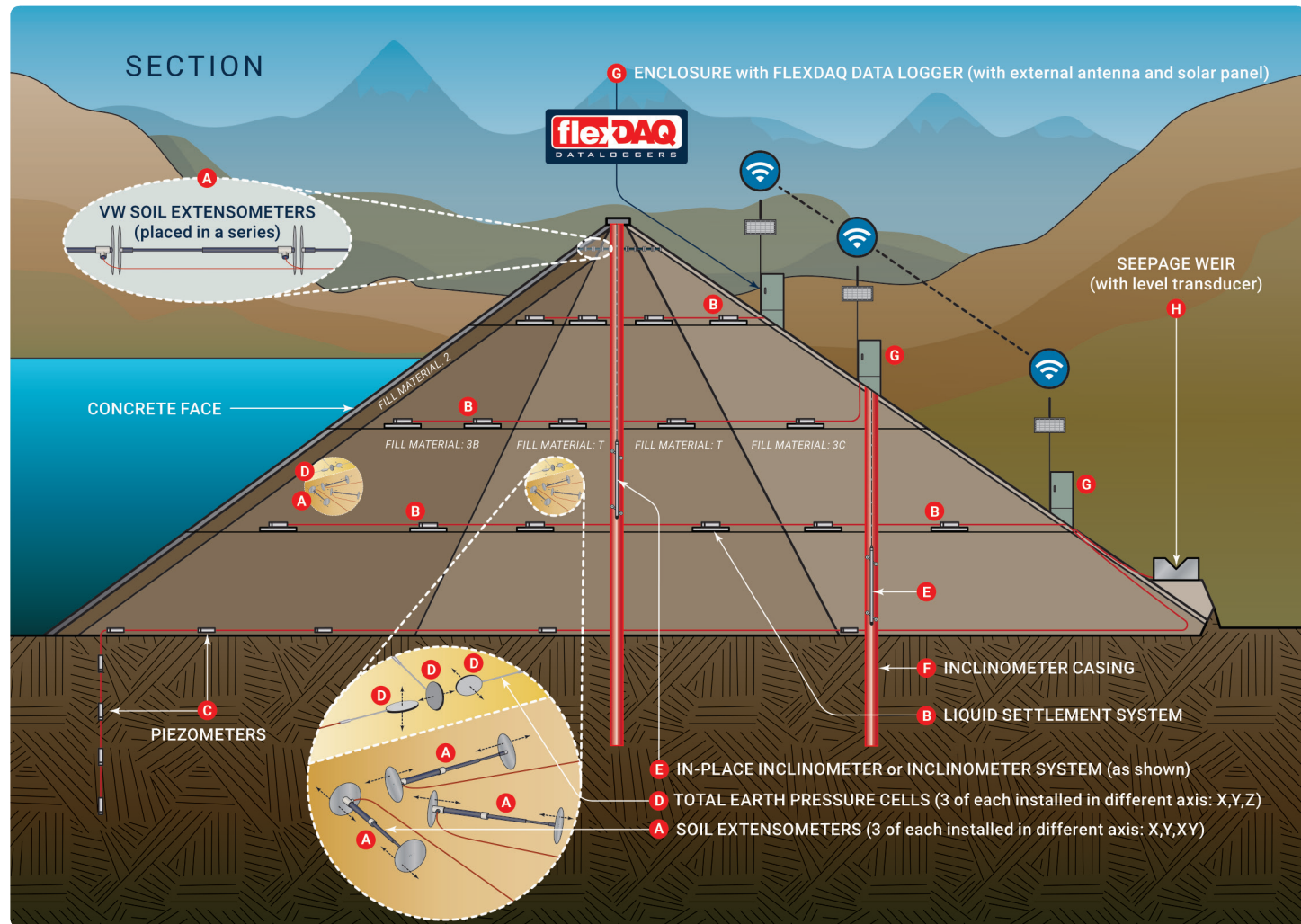
S Seepage Weir

Precision system for accurately monitoring water levels through dam seepage channels.



O Total Earth Pressure Cell

Measure stress acting on plane surfaces. Ideal for earth embankments, dams, foundations, retaining walls, piles, pipelines & culverts, railroad bases, beneath raft foundations, tunnel linings, and mine backfill monitoring. Available with pneumatic, strain gauge, or vibrating wire transducers.



A Soil Extensometers
Monitor lateral and longitudinal deformation of soil and different types of embankments and embankment dams. Can be chained together in a series to monitor incremental deformation across structures.



B Liquid Settlement System
Monitor settlement or heave in soils and different types of man-made structures such as embankments, and earth and rockfill dams. Also ideal for preload consolidation monitoring and subsidence monitoring.



C Piezometer
Monitor pore water pressures in the ground in slopes, dams, foundations, or embankments.



D Total Earth Pressure Cell
Measure stress acting on plane surfaces. Ideal for earth embankments, dams, foundations, retaining walls, piles, pipelines & culverts, railroad bases, beneath raft foundations, tunnel linings, and mine backfill monitoring. Available with pneumatic, strain gauge, or vibrating wire transducers.



E F I In-Place Inclinerometer and Inclinerometer Casing
Installed in a borehole to monitor horizontal displacement of the slope casing. Compatible with all commercially available inclinometer probes, including RST's Digital MEMS Inclinometer Probe/System (manual readings) and In-Place Inclinerometers (automated readings).

Pictured Left: In-Place Inclinerometer (E) and Inclinerometer Casing (F)



designed to your exact specifications
flexDAQ DATA LOGGERS
READY TO RUN
pre-assembled
pre-wired
pre-tested
pre-programmed

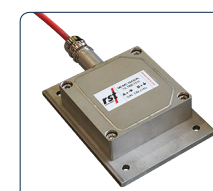
G FLEXDAQ Data Logger Systems
Allows for precise & reliable data acquisition from various sensor types and gauges including vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR, etc. Ideal for remote data logging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines, and natural slopes.



H Seepage Weir
Precision system for accurately monitoring water levels through dam seepage channels.



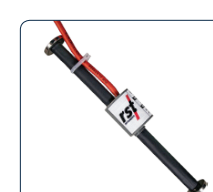
J N Submersible Crack Meter
Measure movement across surface cracks and joints, including underwater locations. Ideal for installation on the upstream perimeter joint of CFRD dams. 1-D, 2-D and 3-D versions available.



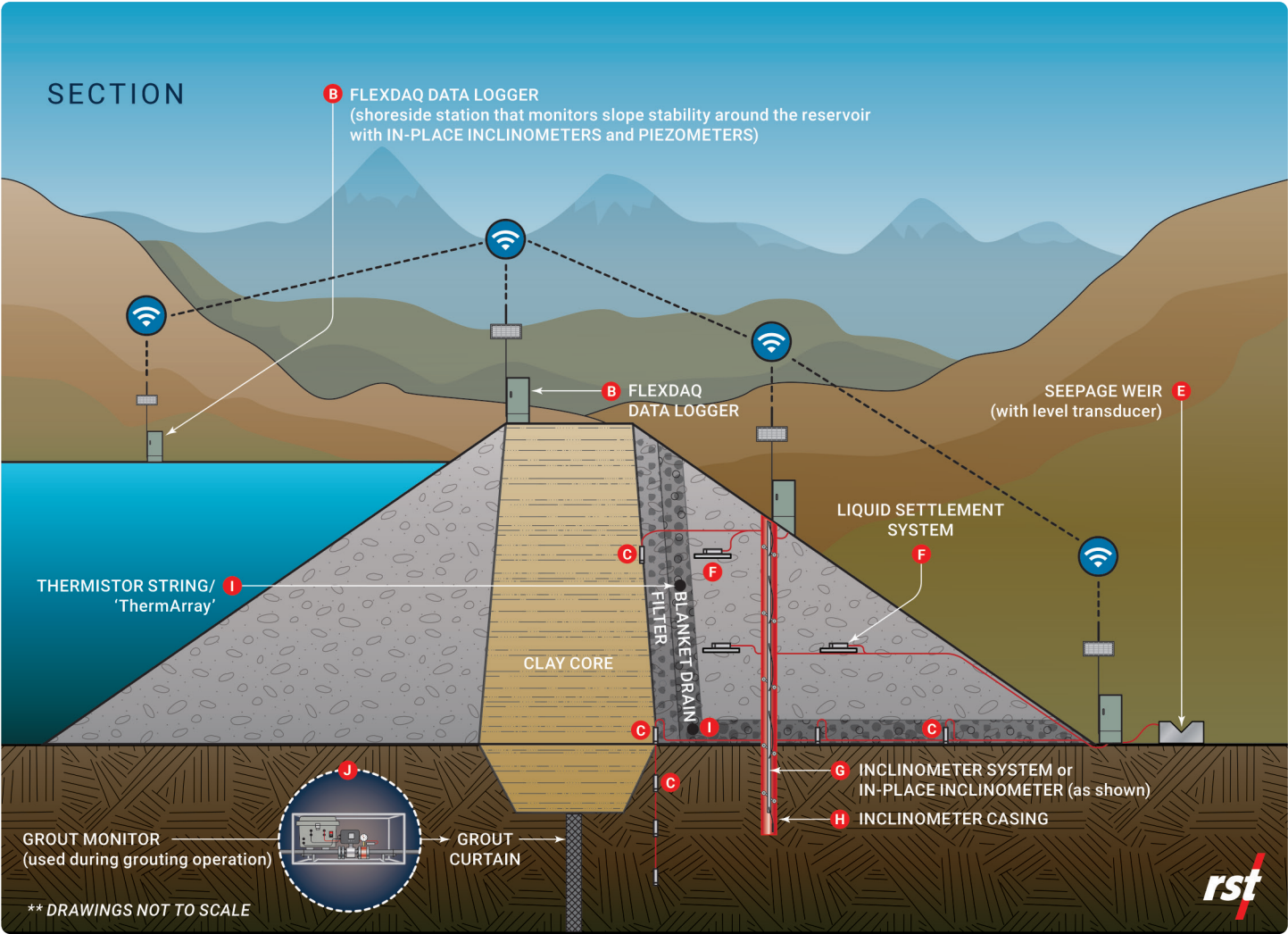
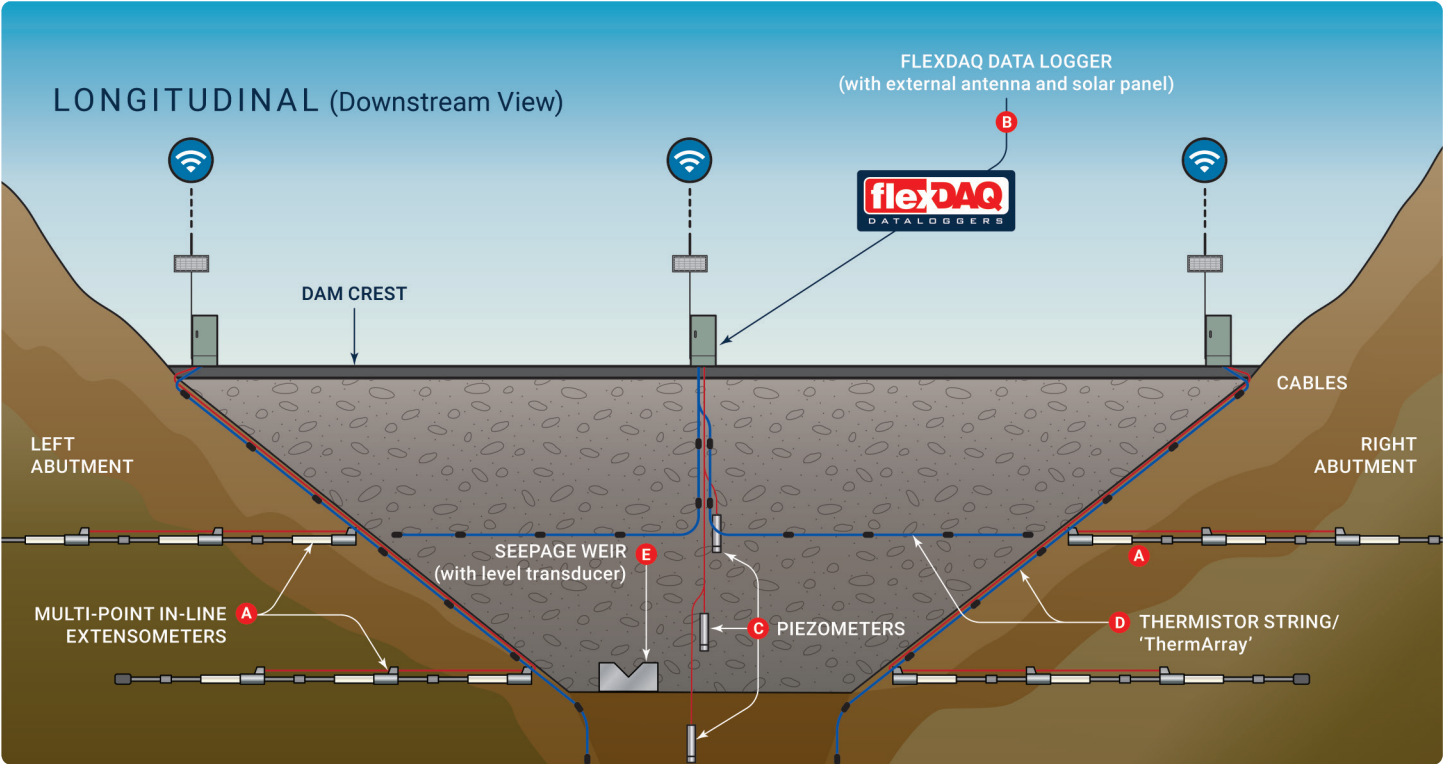
K Submersible Tilt Meter
Monitoring of tilt of submerged structures, such as inclination of concrete-face rockfill dam slabs and concrete dams. Ideal for retaining walls, piles, bridge piers, offshore structures, and submerged pipelines.



L Embedment Joint Meter
Monitor joints on mass concrete structures. Ideal for joints of concrete arch, gravity and buttress dams; concrete-faced, rockfill dams; concrete retaining walls and slabs.



M Embedment Strain Gauge
Designed to be embedded in concrete structures for monitoring strain of concrete.



A In-Line Extensometer

Determine extension or compression behavior of soil, rock, and concrete structures. The sensor housing is waterproof and can be installed flush with the borehole collar so it does not protrude.



B FLEXDAQ Data Logger Systems

Allows for precise & reliable data acquisition from various sensor types and gauges including vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR, etc. Ideal for remote data logging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines, and natural slopes.



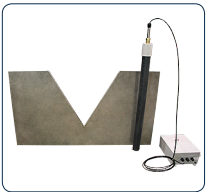
C Piezometer

Monitor pore water pressures in the ground in slopes, dams, foundations, or embankments.



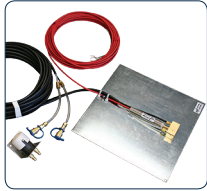
D Thermistor String

For accurate and reliable long-term temperature measurements under demanding geotechnical conditions. Can be used to monitor seepage.



E Seepage Weir

Precision system for accurately monitoring water levels through dam seepage channels.



F Liquid Settlement System

Monitor settlement or heave in soils and different types of man-made structures such as embankments, and earth and rockfill dams. Also ideal for preload consolidation monitoring and subsidence monitoring.



G H In-Place Inclinator and Inclinator Casing

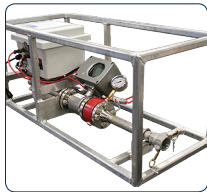
Installed in a borehole to monitor horizontal displacement of the slope casing. Compatible with all commercially available inclinometer probes, including RST's Digital MEMS Inclinometer Probe/System (manual readings) and In-Place Inclinator (automated readings).

Pictured Left: In-Place Inclinator (G) **DT-BUS** and Inclinator Casing (H)



I 'ThermArray'

Provides precision thermal gradient information in geotechnical, geothermal, and marine applications. Can be used to detect seepage.

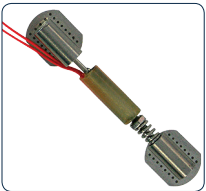
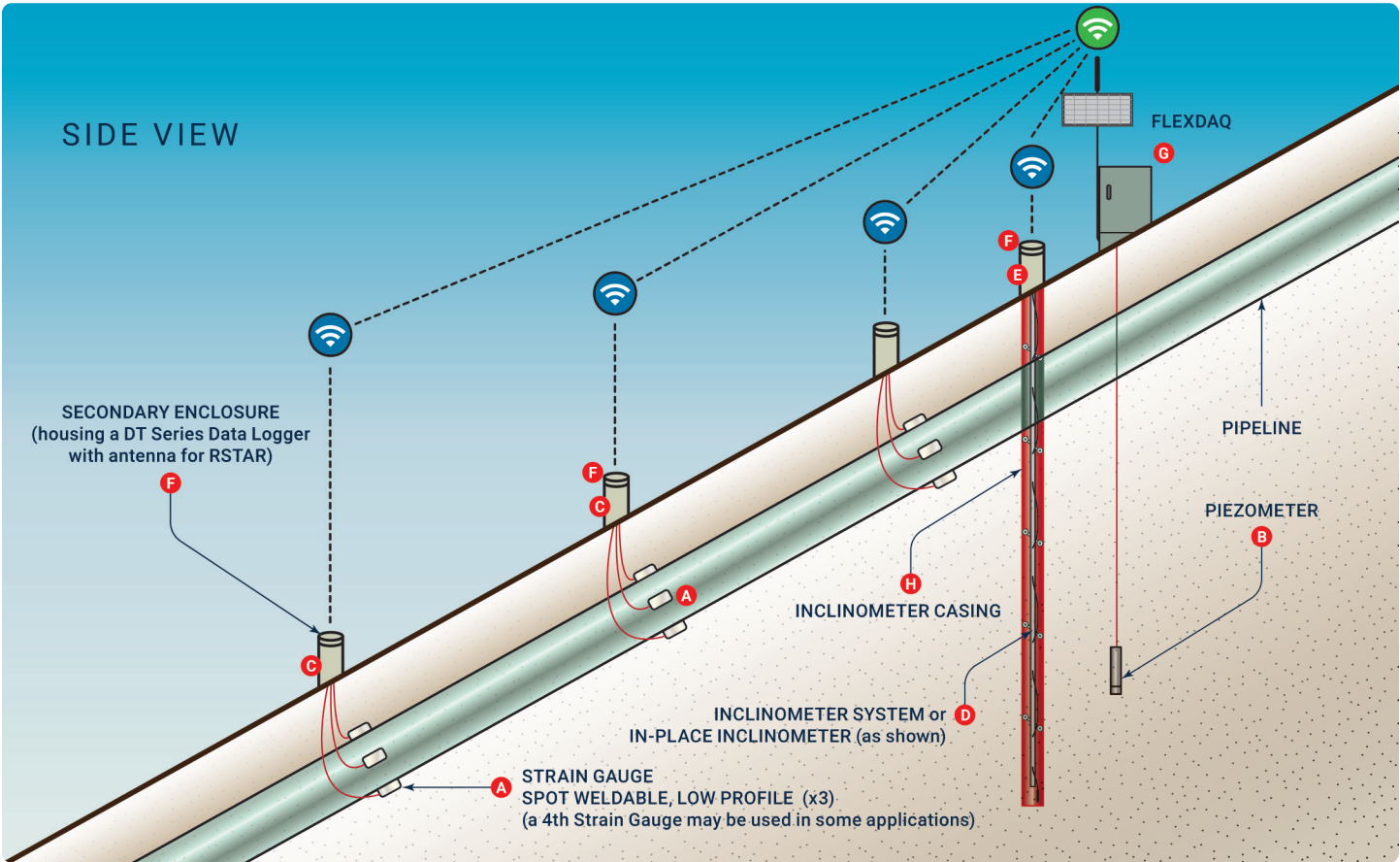
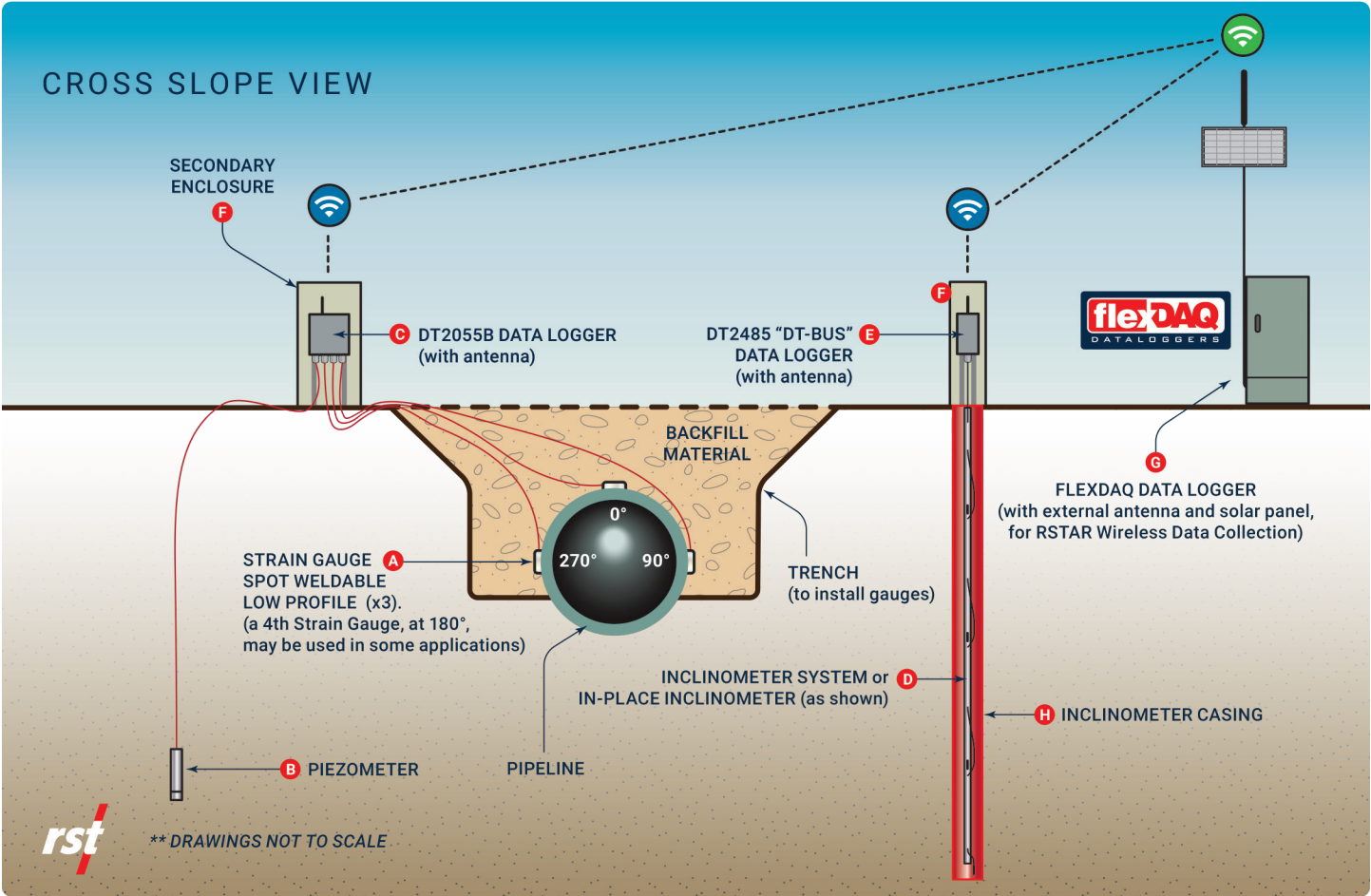


J Permeation Grout Monitor

A real-time display of key grouting parameters during permeation grouting to provide a record of pressure and flow readings for quality control.

Panoramic view of an earthfill dam under construction.





A Low Profile Spot Weldable Strain Gauge
Designed to be spot welded to various steel structures, such as tieback anchors, rebar and pipelines. Effectively monitors strain.



B Piezometer
Monitor pore water pressures in the ground in slopes, dams, foundations, or embankments.



C DT2055B - 5/10 Channel Vibrating Wire/Thermistor Data Logger
Battery powered, radio enabled, unattended monitoring of up to 10 sensors which may be any mix of vibrating wire sensors and thermistors, typically 5 vibrating wire sensors with their associated thermistors.



D H In-Place Incliner and Incliner Casing
Installed in a borehole to monitor horizontal displacement of the slope casing. Compatible with all commercially available inclinometer probes, including RST's Digital MEMS Inclinometer Probe/System (manual readings) and In-Place Inclinometers (automated readings).

Pictured Left: In-Place Incliner (D) and Incliner Casing (H)



E DT2485 Data Logger for DT-BUS Sensors
Battery powered, radio enabled, unattended monitoring of In-Place Incliner Strings and other digital bus (DT-BUS) sensors.

DT-BUS



F Secondary Enclosure
A secondary enclosure used to house select "DT Series" Data Loggers. The cover can be removed to allow easy access to the internally housed data logger.

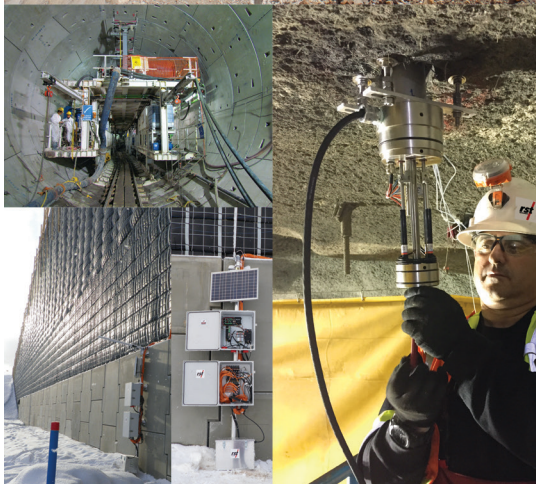


designed to your exact specifications
fileDAQ DATALOGGERS
READY TO RUN
pre-assembled
pre-wired
pre-tested
pre-programmed

G FLEXDAQ Data Logger Systems
Allows for precise & reliable data acquisition from various sensor types and gauges including vibrating wire, thermistor, MEMS (analog and digital), Tensmeg, linear potentiometer, strain gauge, LVDT, TDR, etc. Ideal for remote data logging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines, and natural slopes.



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