YieldPoint *Sensing the future*

dMPBX

In many mining situations, deployment of an ungrouted borehole extensometer is preferable. For soft rock where mechanical mining is practiced (salt, potash or coal) grouting of an extensometer is not necessary.

d_MPBX is a unique 1 to 6-Point Multiple Point Borehole eXtensometer (MPBX) based on a single rod and dual spring mechanism design. Each anchor is fitted with a pair stainless steel torsion springs that secure the instrument in a 38-54mm borehole. Each anchor is secured under slight tension during the installation process. This creates a positive, secure anchorage to the borehole wall.

The inherently digital nature of the signals eliminates the necessity for expensive analog-to-digital conversion and results in low cost readout unit that reads data directly in real world units (*mm* and ^{o}C).

The sensor output is an ASCII (9600,8,N,1) digital signal which can be read by a low cost readout unit, Bluetooth dataloggers and wireless telemetry for transmission to cloud based servers. The signals themselves are robust and can be transmitted over 500m of lead-wire. If broken, the lead-wire can be twisted and taped together.

Features:

- Up to 6 spring loaded anchors do not require grouting
- Unique dual spring mechanism
- 125, 150mm, 250mm stroke length
- High individual sensor accuracy (0.5%FS) and resolution (0.01mm)
- Output in real world units
- Unique instrument ID
- Calibration Coeffs. in Flash memory
- Smallest electronics head (25mm diameter 150mm length)
- On-board digital temperature compensation
- Suitable for mining methods that do not involved blast vibrations
- Easy to install and maintain—Arrives on site fully assembled.
- Length up to 6m
- Lead wire length up to 500m.
- 38-50mm borehole
- Fully waterproof

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d-MPBX

Technology

The *d*-MPBX design is based on a single rod design (see below) which includes 1 to 6 Inverted LVIT displacement sensors. The (up to) 6 sensors are fully potted in a central plastic tube over which the anchors slide without contact and with minimal friction. The maximum recommended length of the d-MPBX is 6m.

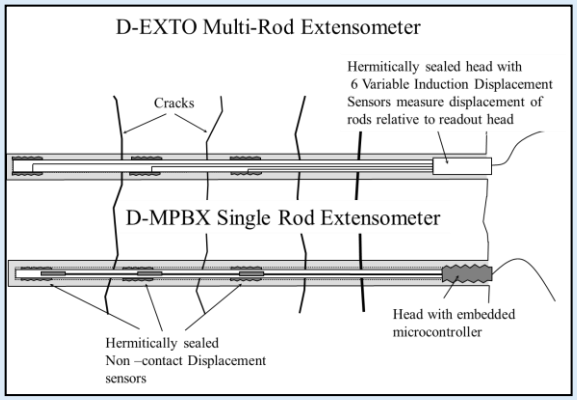


Fig 1: *The d-Exto and d-MPBX principle of operation.*

Each displacement sensor is individually calibrated and the calibration coefficients written to microcontroller memory. The d-MPBX can easily detect and resolve sub-mm displacements with 10μm resolution.

Accuracy is enhanced by an on-board temperature sensor which provides compensation. The displacement sensors use non-contact sensing the design is inherently waterproof. The diameter of the instrument is only 25mm. This includes the electronics head that can be recessed into the borehole for protection.

Readings

IMPORTANT: The d-MPBX should only be deployed for mining situations where the anchors will not be dislodged by blasting activity.

d-MPBX is the simplest possible instrument to install in a 1.375 to 1.75in (35-46mm) borehole. No configuration is required. The anchors are two-way spring loaded to ensure a positive anchorage to the borehole wall.

Lead wires

The lead wire comprises 2 twisted pairs: (i) power (5-24Vdc) and (ii) RS485 differential signal. 10m of additional lead wire is provided with each instrument at no additional cost.

d-MPBX

Installation

Installation precautions

The d-MPBX is probably the easiest of all borehole extensometers to install. It is simply pushed into the borehole and the spring-loaded anchors will hold against the rough borehole wall. The head must be secured in place with the metal washer and then slightly tensioned with the wingnut.

NB: It is not possible to retrieve the instrument once it has been installed.

Data logging and telemetry

Instruments can be wirelessly enabled using BluLink loggers which provides a Bluetooth 5.0 connection with a range of 20 to 100m LOS. BluLink can store 30,000 readings. Wireless download is also possible with Android devices and the free BluPoint app. BluLinks are now available in “cylinder” and “replaceable battery” form

Telemery

BluLink

The loggers require no configuration and are fully interchangeable with any other type of YieldPoint instrument. They have encapsulated batteries and will run for 2 to 3 years. Clusters of instruments can be easily implemented.

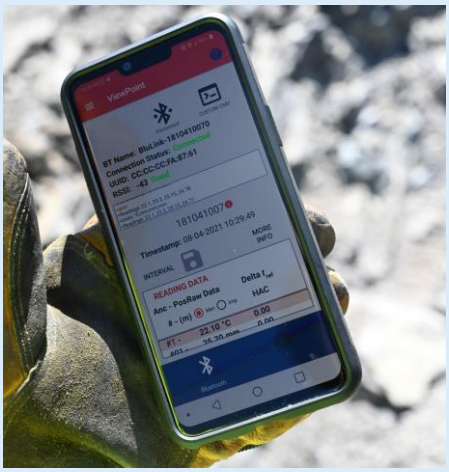
BluLinks can transmit data to BluGateways which are WiFi or LTE-M enabled and upload data to a local or cloud database such as the VantagePoint data aggregation and visualization tool.

d-MPBX

Data logging

BluPoint for Android

The BluPoint App, available at the Play Store transforms a Smart phone or tablet into a geotechnical data management tool.



The BluPoint App

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Data Backhaul

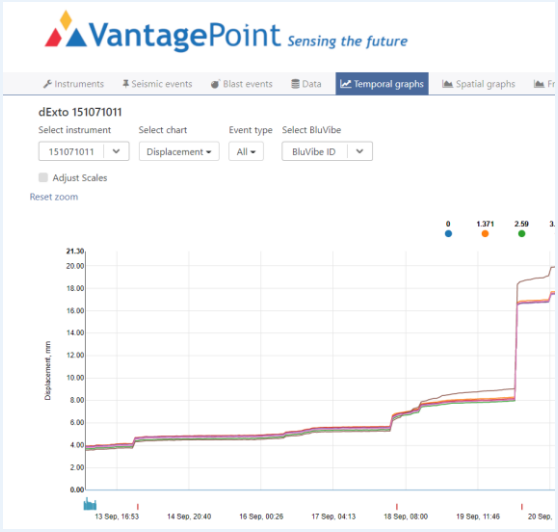
BluGateways: WiFi and LTE-M

Data back haul to the cloud or an on-site server involves a BluGateway with either (i) a WiFi modem (ii) an LTE-M modem or (iii) a Min Sat modem. All models are battery powered typically with a 2 year battery life (1 reading/hour)

The AccessPoint activity, part of the BluPoint App, is used to configure the Gateway.

VantagePoint

YieldPoint's browser based cloud platform, VantagePoint, based on a robust time series database, provides a powerful data storage visualization tool.



d-MPBX

Applications

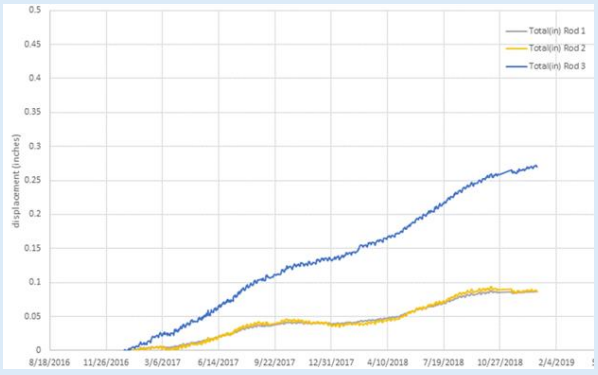
The ***d*-MPBX** is designed to be a user-friendly ground movement monitoring solution that will enhance safety and improve excavation design. It can be routinely deployed within the production environment.

The device is most popular in soft rock mines e.g. Potash and salt mines.

- Monitoring ground movement in tunnels, drifts and roadways.
- Intersections monitoring
- Pillar monitoring
- Depillaring

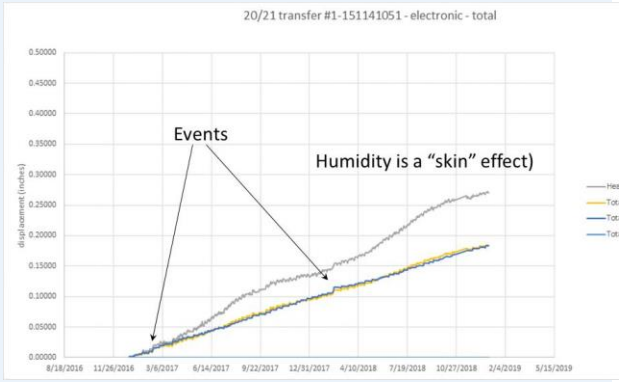
CASE STUDY: Effect of humidity in a salt Mine.

In soft rock mines the skin of the excavation is susceptible to humidity driven deformation which manifests as a seasonal acceleration of movement rate. For a HAC d-MPBX this affects all anchors.

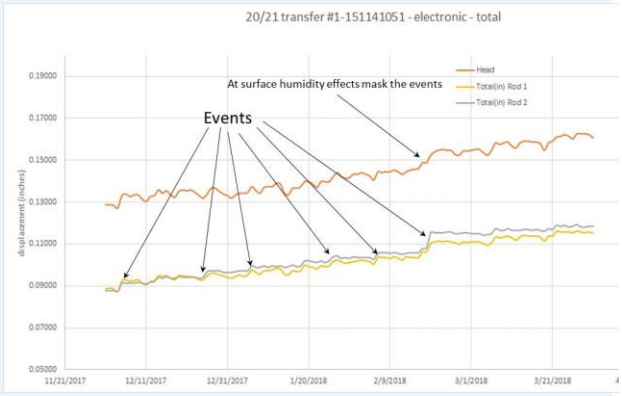


However, if the results are properly referenced to the toe (Anchor or Rod 3) then the fact that this is a skin effect becomes evident. The deeper anchors move with constant velocity.

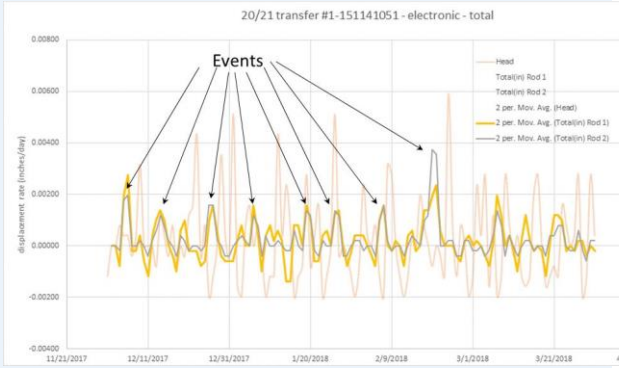
Applications



Furthermore, zooming in at great detail, once the humidity effect is removed it can be observed that the detailed rate of movement involves distinct events (higher velocity) related to mining activity.



These can best be observed from a plot of displacement rate or velocity.



d-MPBX

Specifications

- **Core Technology:** Temperature compensated Eddy Current displacement sensor. Temperature sensor
- **Output Signal:** RS485 with transmission up to 500m over 2 x tp.
- **Displacement Range (F.S.):** 0-150mm.
- **Displacement Resolution:** 0.01mm.
- **Displacement Linearity:** Typ. 0.1% F.S.
- **Total Accuracy** – typically better than +/- 0.25%F.S. or 0.5mm
- **Temp. range:** Temp: -40 to 125°C
- **Temp Resolution:** 0.1°C
- **Temp Accuracy:** +/- 2°C Temp
- **Temp. coeff for Disp:** Typ. <+/- 0.02%FS / °C

To order, please specify:

- Desired instrument length.
- Desired borehole diameter.
- Borehole length.
- Number of anchors: 1 to 5.
- Custom anchor locations with minimum anchor spacing of 5ft/150cm.
- Custom lead wire length.
- Choice of HDPE polyethyelene or stainless steel armored lead wire cover.

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