An Integrated Approach to Slope Stability Monitoring

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METASENSING FOR MEGA STRUCTURES

TUNNELS

HYDROELECTRIC

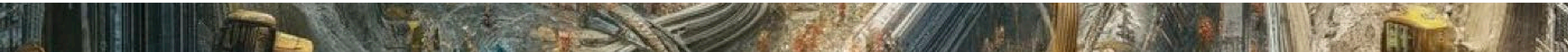
CONSTRUCTION

STRUCTURAL

METRO & RAIL

BRIDGES

MINING



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Metasensing for Mega Structures

Metasensing gives you
Data, Expertise and Technology,
ensuring the safety of your structures, keeping you in control.

50+
Countries

55+
Years

1000+
Worldwide Projects

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How do you get to Total Asset Safety?

What does Total Asset Safety mean?


INFINITUS
The Total Asset Safety Solution

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Get the total assurance of the safety of your asset with a single-point solution converging data acquisition technologies, services, support & software.

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5 Step Process

DATA INTEGRATION

- Seamless data integration
- Co-relation of simultaneous activity
- AI & Machine Learning integration

DATA ANALYSIS & UNDERSTANDING

- Data Reporting
- Data Visualization
- GIS integration
- Digital Twins
- Data Validation

DATA COLLECTION

Multiple technologies covering all parameters:

- **Remote Sensing:** InSAR, Optical, Thermal
- **Surveying and 3D Modeling:** UAVs, LiDAR, Laser Scanning, GNSS
- **Surface and Sub-surface Sensors:** Fiber Optics & Geotechnical Insturmentation

RISK ASSESSMENT AND ALARM MANAGEMENT SYSTEM

- Proqio's Early Warning System
- Integration with Government Risk Assessment Systems
- Control, Safety, Flexibility

INFINITUS

A single point safety solution that provides you with control and assurance.

CONTINUOUS MONITORING

- Predictive Intelligence
- Advanced Visualization
- Automatic Reporting
- Customizable Dashboards

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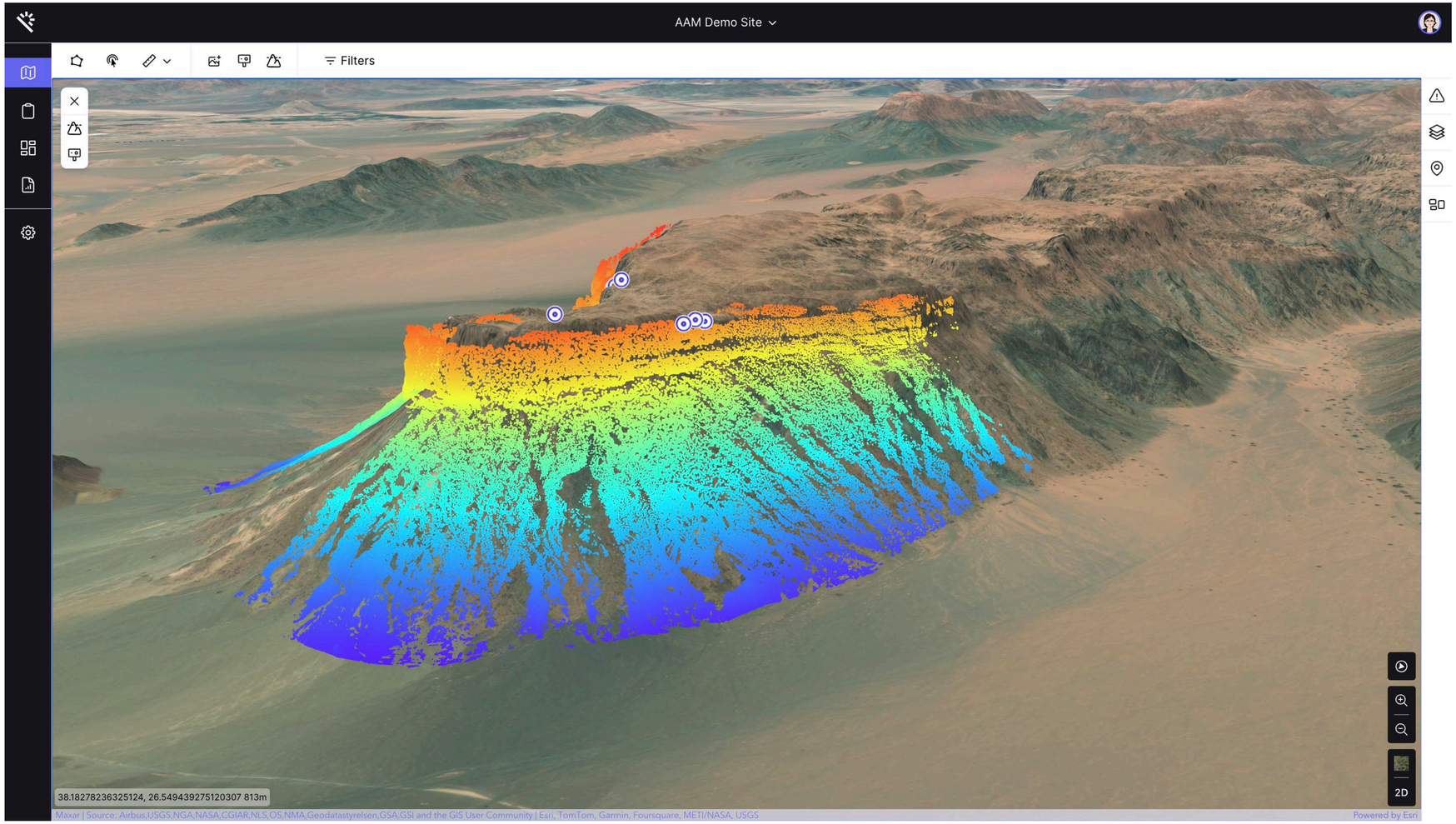
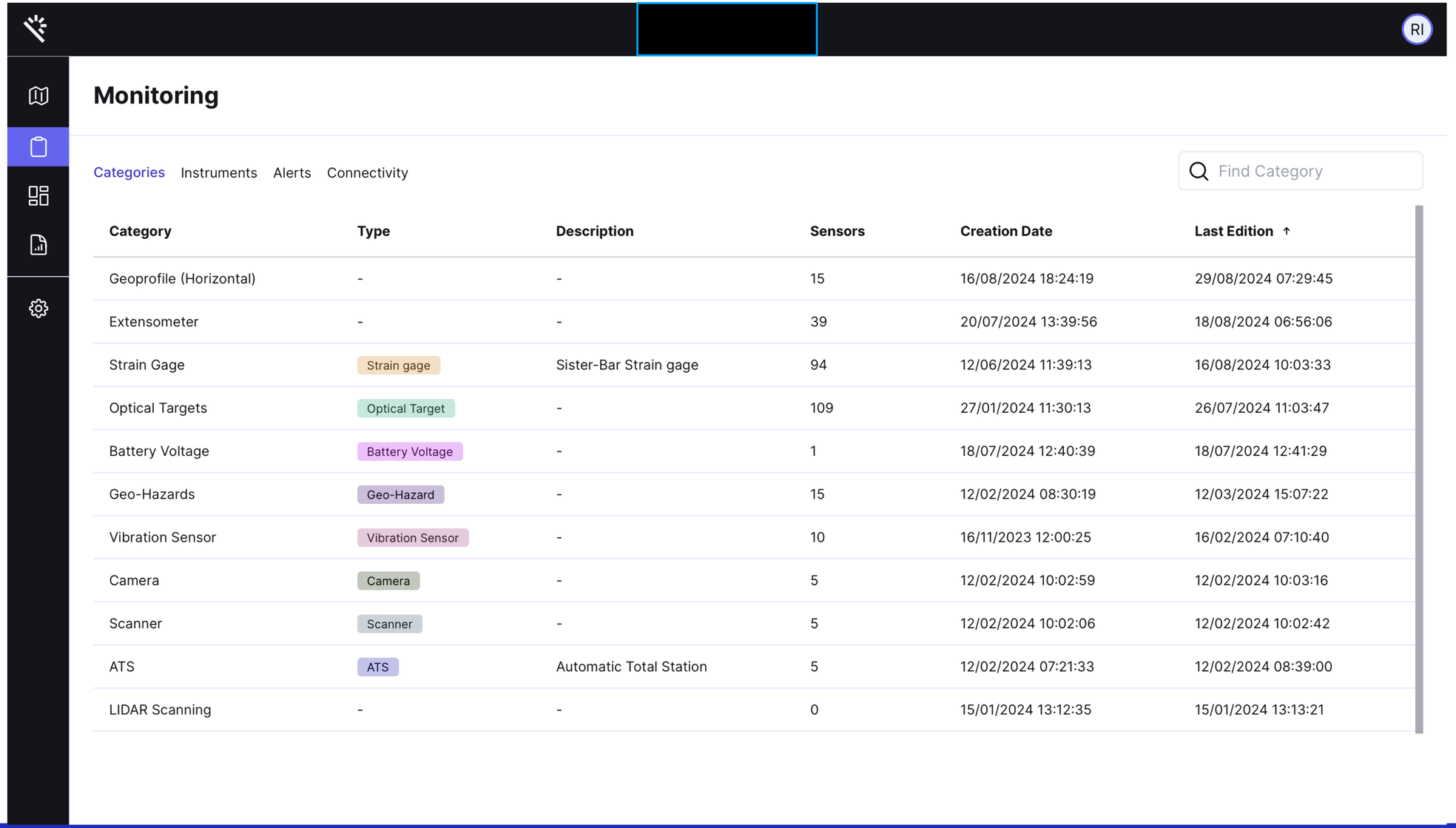
Slope Stability Monitoring during Construction

- This project entails monitoring a monolith while the top is being blasted for the construction of a seven-star hotel.
  - The presentation will focus on the slope stability monitoring part of this project



Data Collection

Data Collection via MetaSensing



Category	Type	Description	Sensors	Creation Date	Last Edition ↑
Geoprofile (Horizontal)	-	-	15	16/08/2024 18:24:19	29/08/2024 07:29:45
Extensometer	-	-	39	20/07/2024 13:39:56	18/08/2024 06:56:06
Strain Gage	Strain gage	Sister-Bar Strain gage	94	12/06/2024 11:39:13	16/08/2024 10:03:33
Optical Targets	Optical Target	-	109	27/01/2024 11:30:13	26/07/2024 11:03:47
Battery Voltage	Battery Voltage	-	1	18/07/2024 12:40:39	18/07/2024 12:41:29
Geo-Hazards	Geo-Hazard	-	15	12/02/2024 08:30:19	12/03/2024 15:07:22
Vibration Sensor	Vibration Sensor	-	10	16/11/2023 12:00:25	16/02/2024 07:10:40
Camera	Camera	-	5	12/02/2024 10:02:59	12/02/2024 10:03:16
Scanner	Scanner	-	5	12/02/2024 10:02:06	12/02/2024 10:02:42
ATS	ATS	Automatic Total Station	5	12/02/2024 07:21:33	12/02/2024 08:39:00
LIDAR Scanning	-	-	0	15/01/2024 13:12:35	15/01/2024 13:13:21

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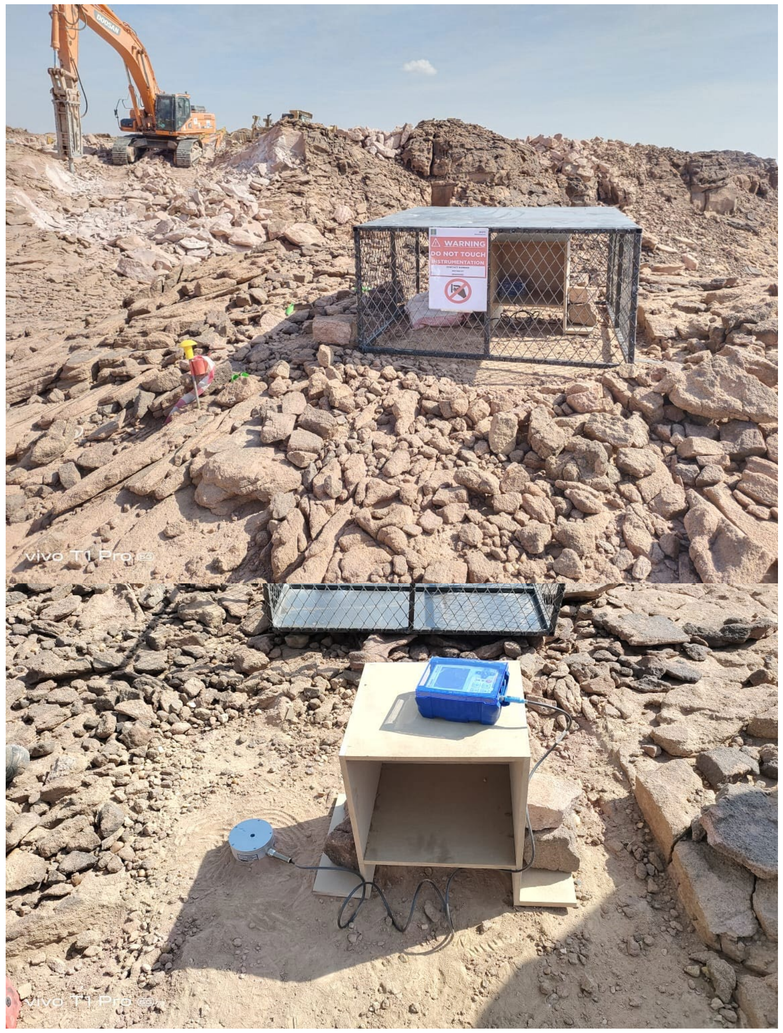

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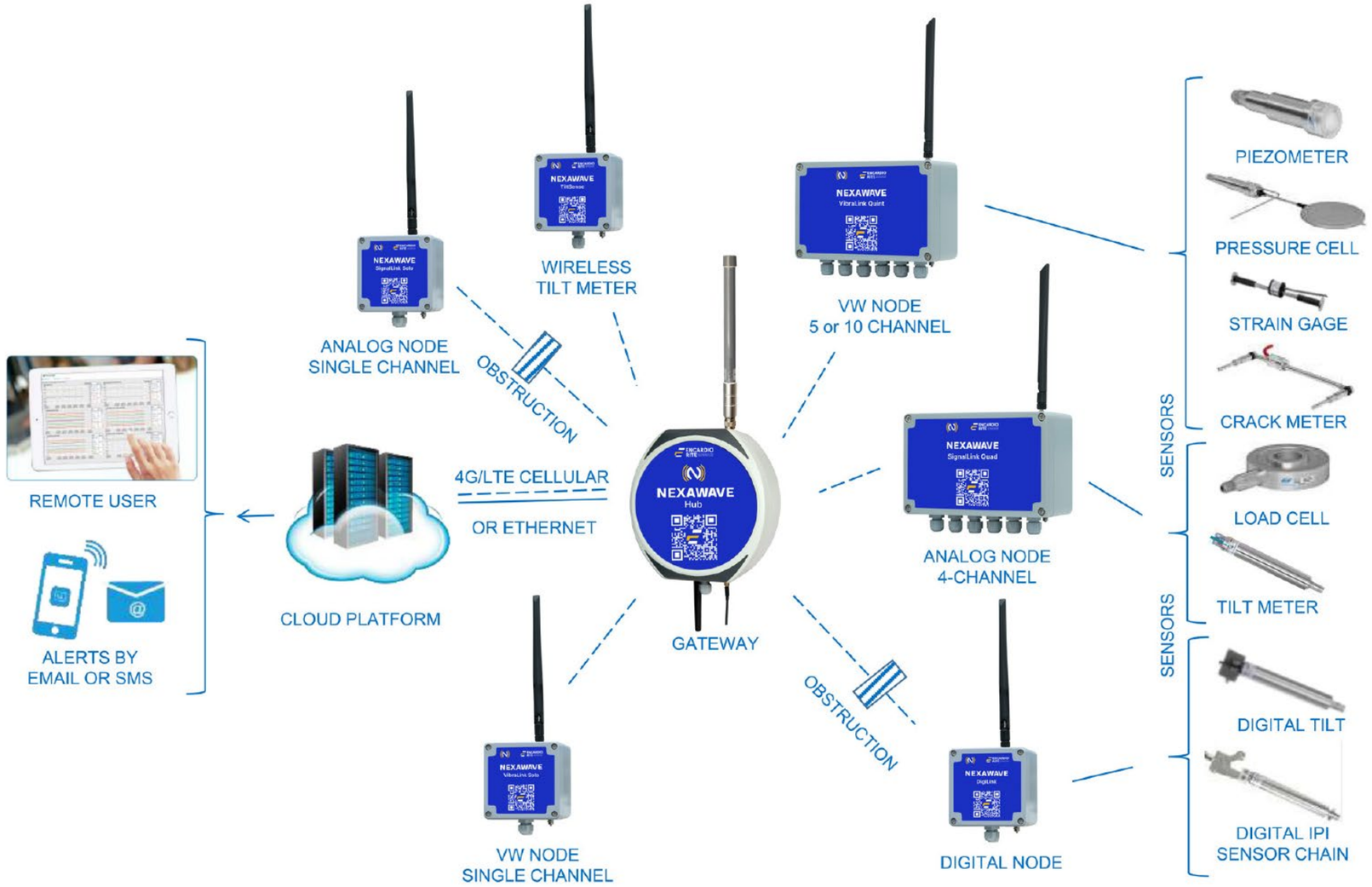

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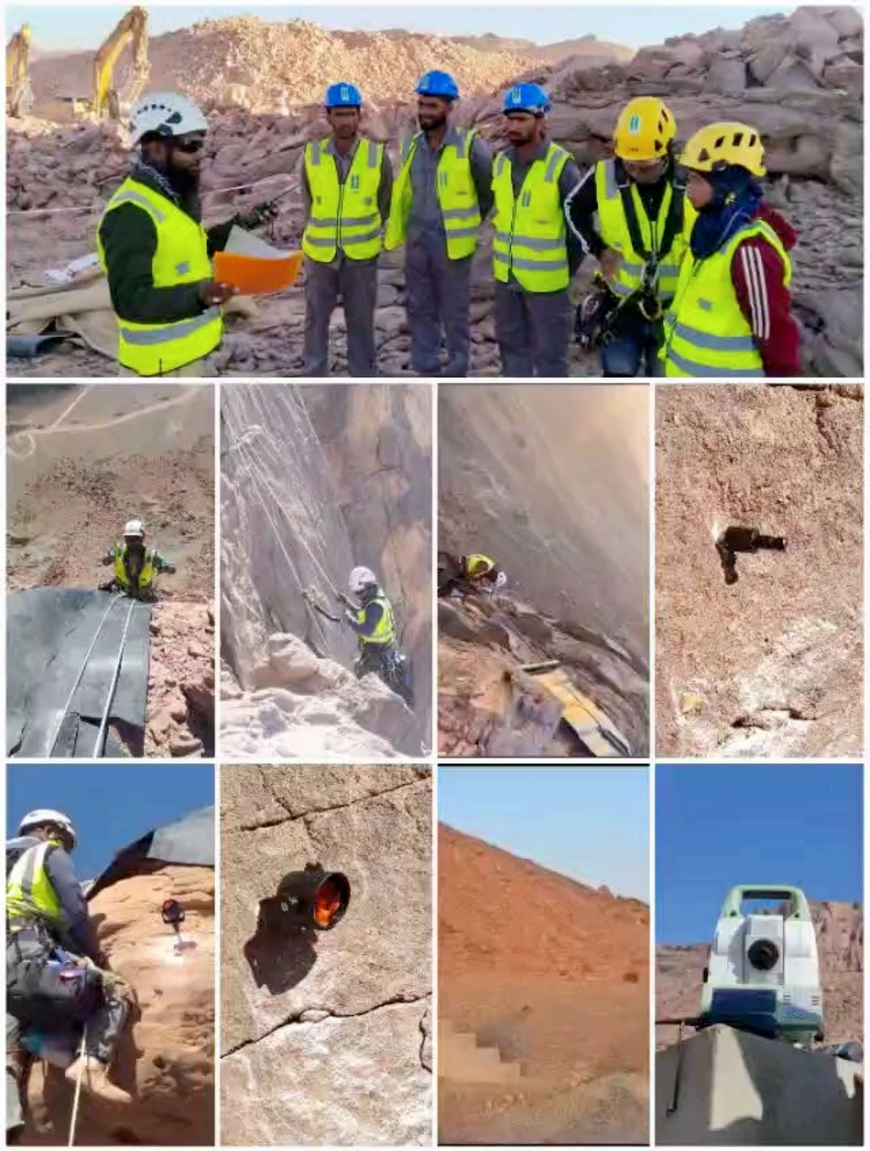

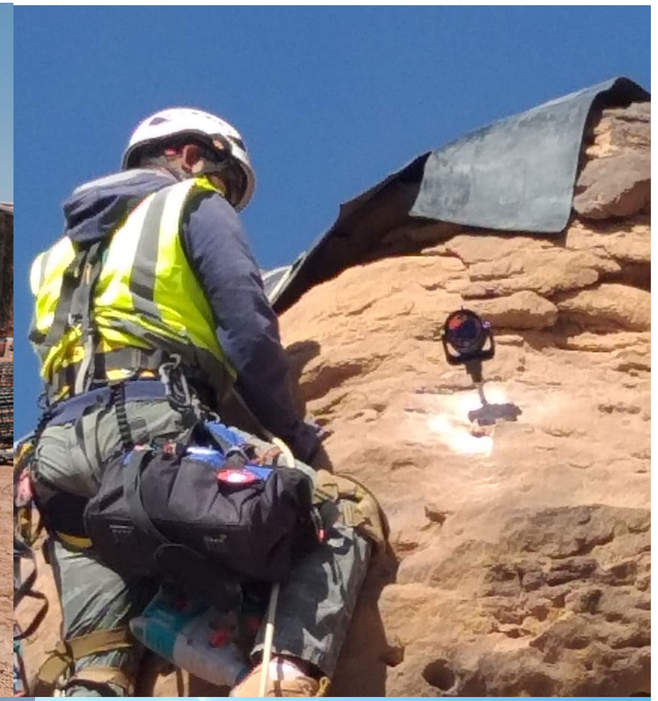

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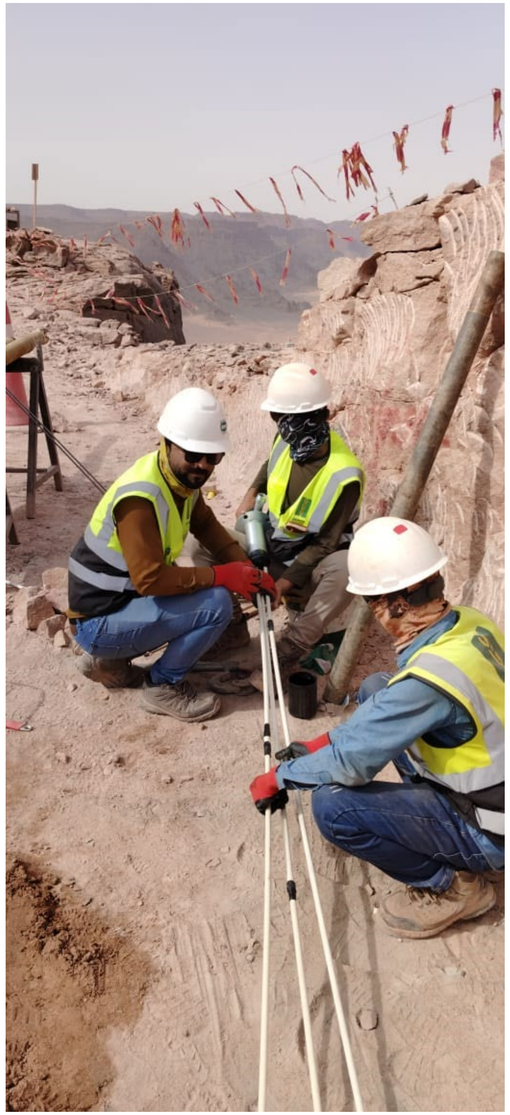

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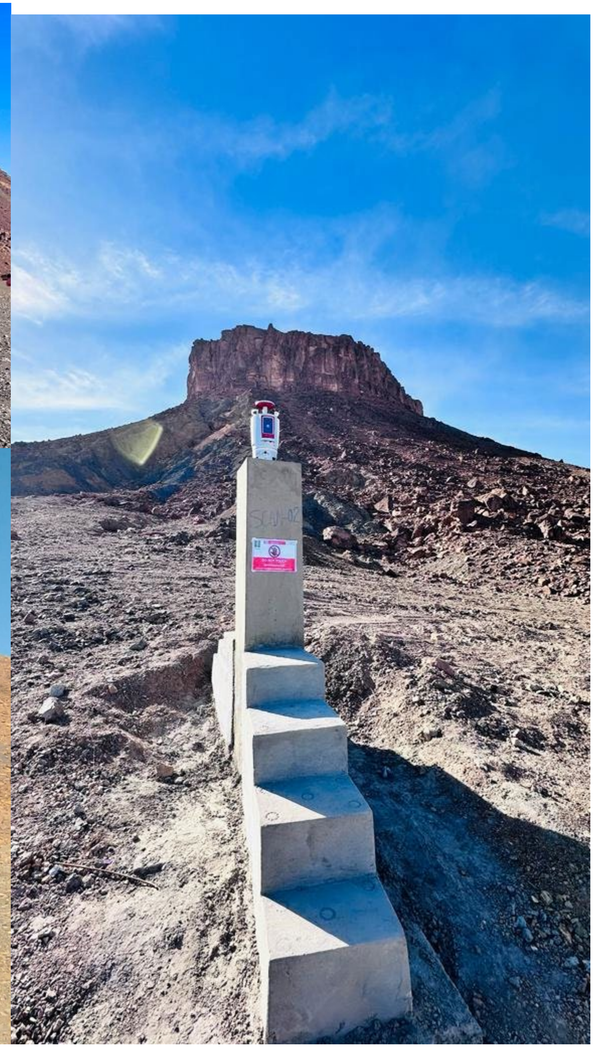

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Data Integration

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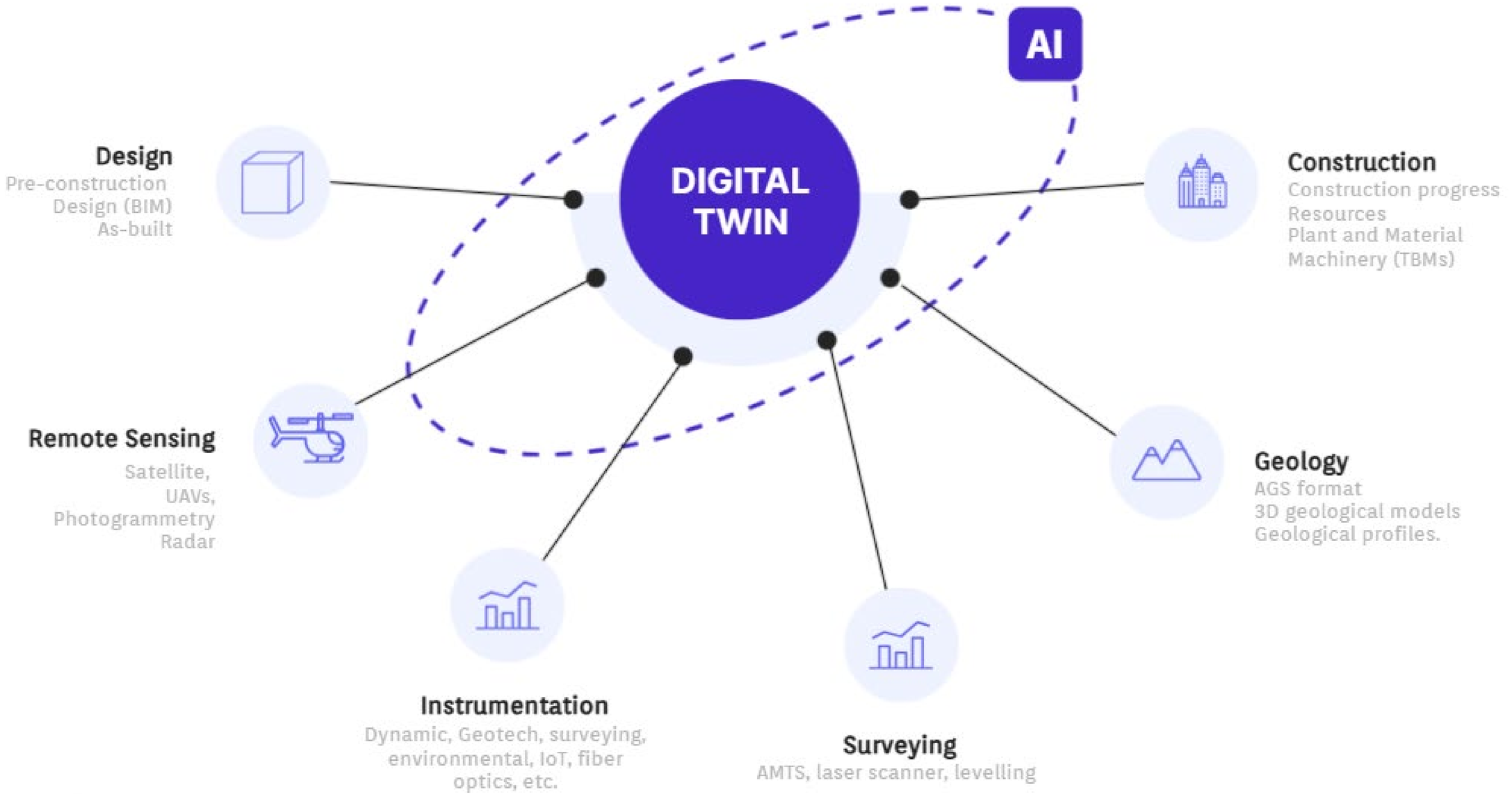

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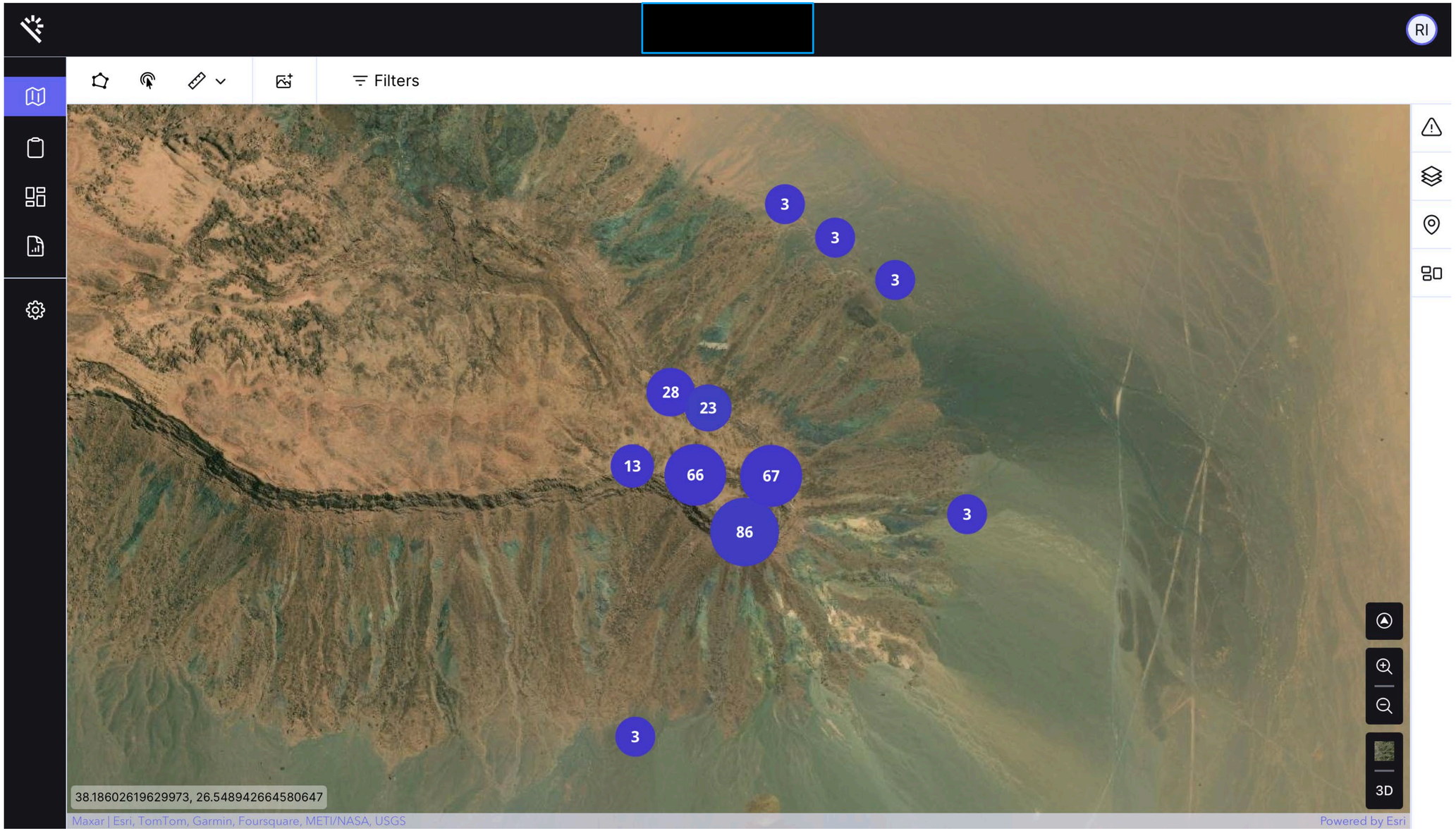
ENCARDIO RITE METASENSING FOR MEGA STRUCTURES



Case Study on the Power of Integration

- A detailed analysis of an emergency monitoring event for the Project. It uses both laser scanning and Automated Total Stations (ATS) to monitor structural movements and identify issues in specific sections (Section 5 and Section 6) of the monolith

Case Study on the Power of Integration

- Identify a significant issue in the upper region of the monolith, where parts of the rock have been removed or displaced. The missing parts are detected by comparing point cloud data from laser scanners taken on June 13 and June 30. The laser scanner identified the missing sections in the upper monolith, revealing areas where no point cloud data could be gathered, indicating the absence of rock.

Point Cloud

- In Section 5, laser scanning detected that a large portion of the monolith’s upper section is missing. A cloud-to-cloud comparison indicates that there is no rock left in the scanned area, signaling a critical incident.

- Specific points in Section 5, such as JH195, JJ223, LH154, LR334, and others, showed no significant 3D movement. The report highlights stable graphs, with movements recorded as minimal (ranging from 0.0455 to 0.1056 in 3D movement), confirming no major changes occurred after the rock removal.

- However, two points (MH334 and SG263) near a deflected area showed more movement, with an average 3D movement of 0.2871 and 0.0934, respectively. MH334 displayed outward movement, suggesting rock disturbance, while SG263 pointed to rock removal.

ATS Measurements

- The ATS was employed to provide detailed zone-by-zone measurements, corroborating the laser scanner’s findings. The Δx, Δy, and Δz values across different zones (upper, middle, and lower zones) remained stable, indicating no significant movement except for the upper zone where the rock removal occurred.

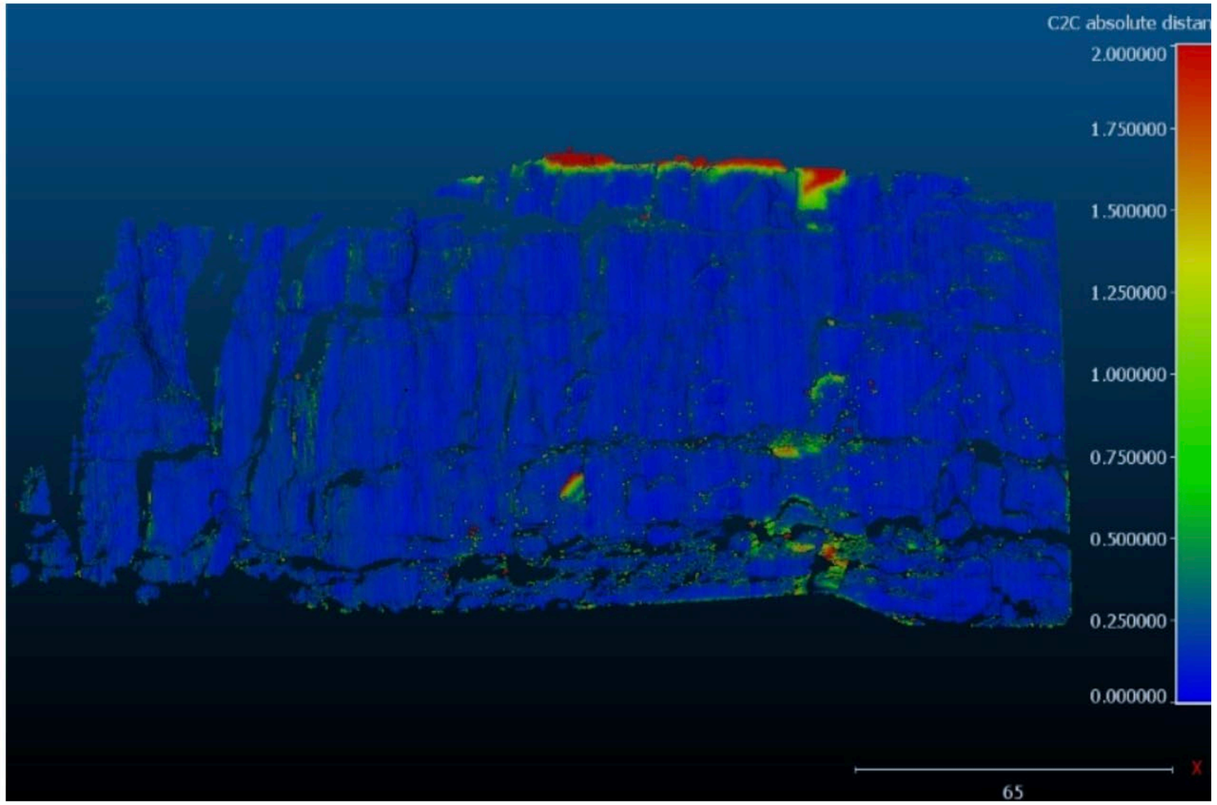
- These stable values suggest that apart from the identified rock removal, the rest of Section 5 remained structurally stable and within monitoring limits.

Section 6 (Point Cloud and ATS Comparison):

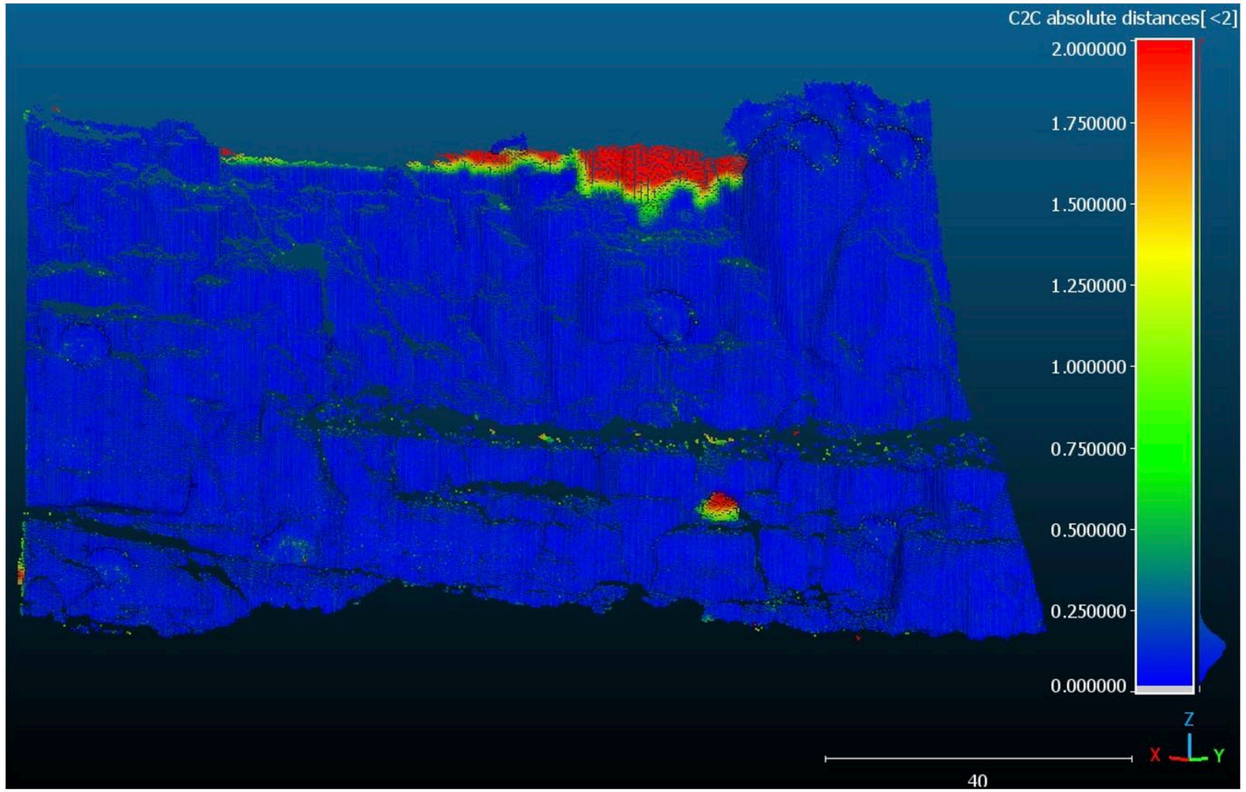
- Similar to Section 5, Section 6 showed overall stability in most areas. Points such as AA158, AE97, FW208, and others showed minimal 3D movement, ranging from 0.0022 to 0.0486, with stable graphs confirming no major changes.

- Notably, Point JK193 showed significant movement toward the instrument, indicating a rock disturbance with a nearly 1-meter displacement. This is one of the few points that exhibited such significant movement.

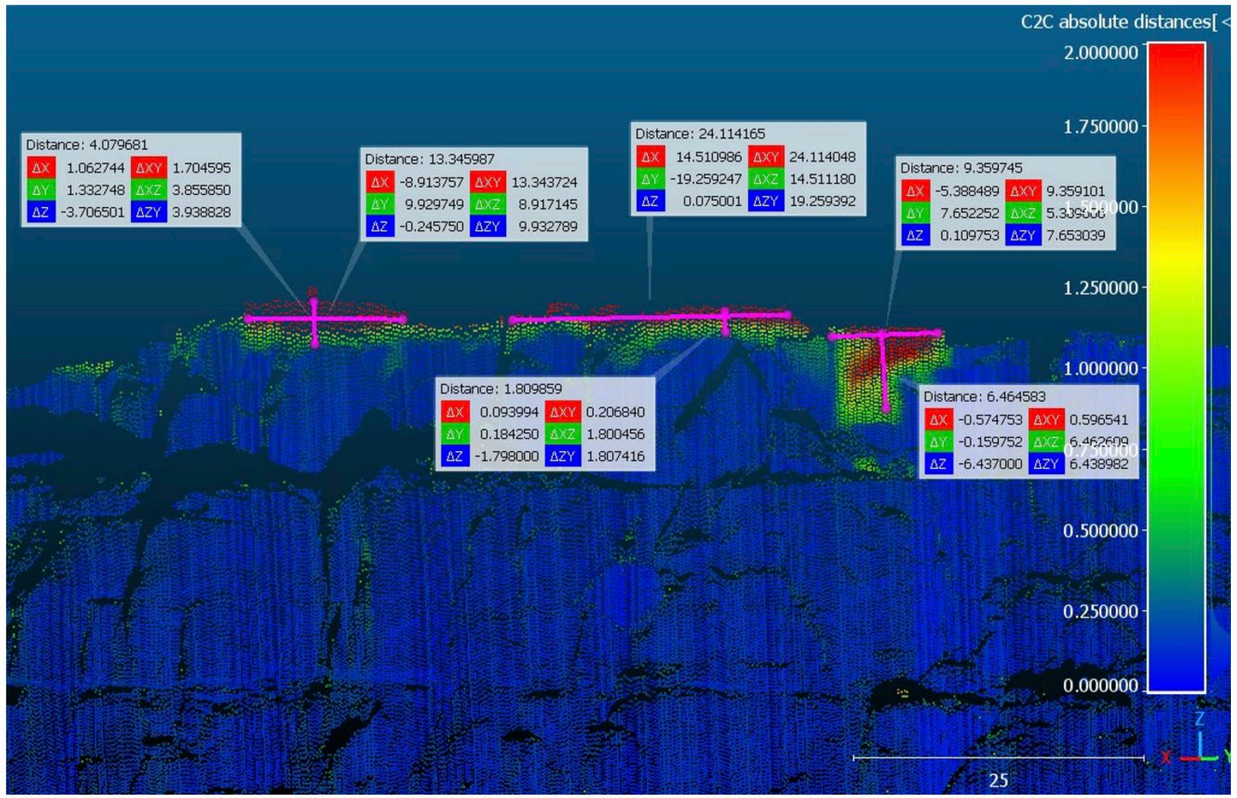
- ATS measurements for Section 6 were also largely stable, reinforcing the findings from the laser scanning data. The Δx, Δy, and Δz values for the various zones remained within acceptable limits, except for the disturbed areas near the top of the monolith.



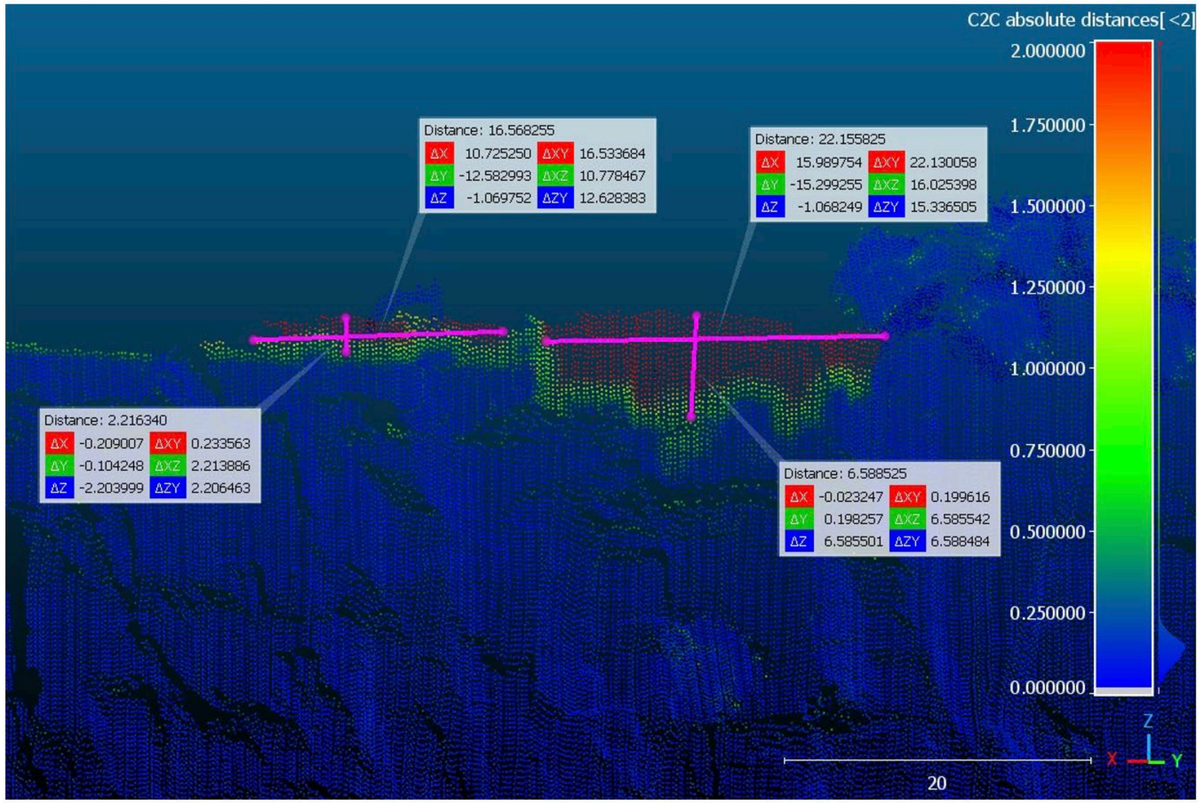
Section 5- Comparison between June 13 and June 30



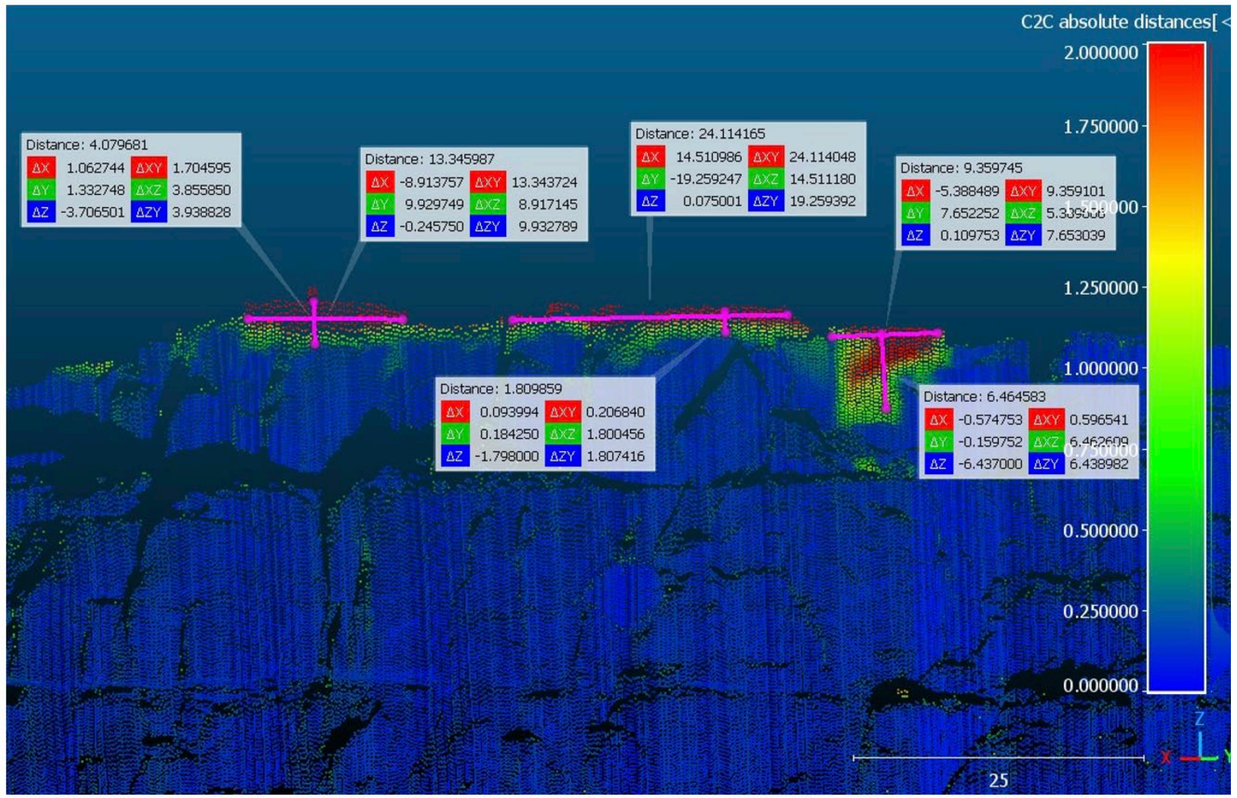
Section 6- Comparison between June 13 and June 30



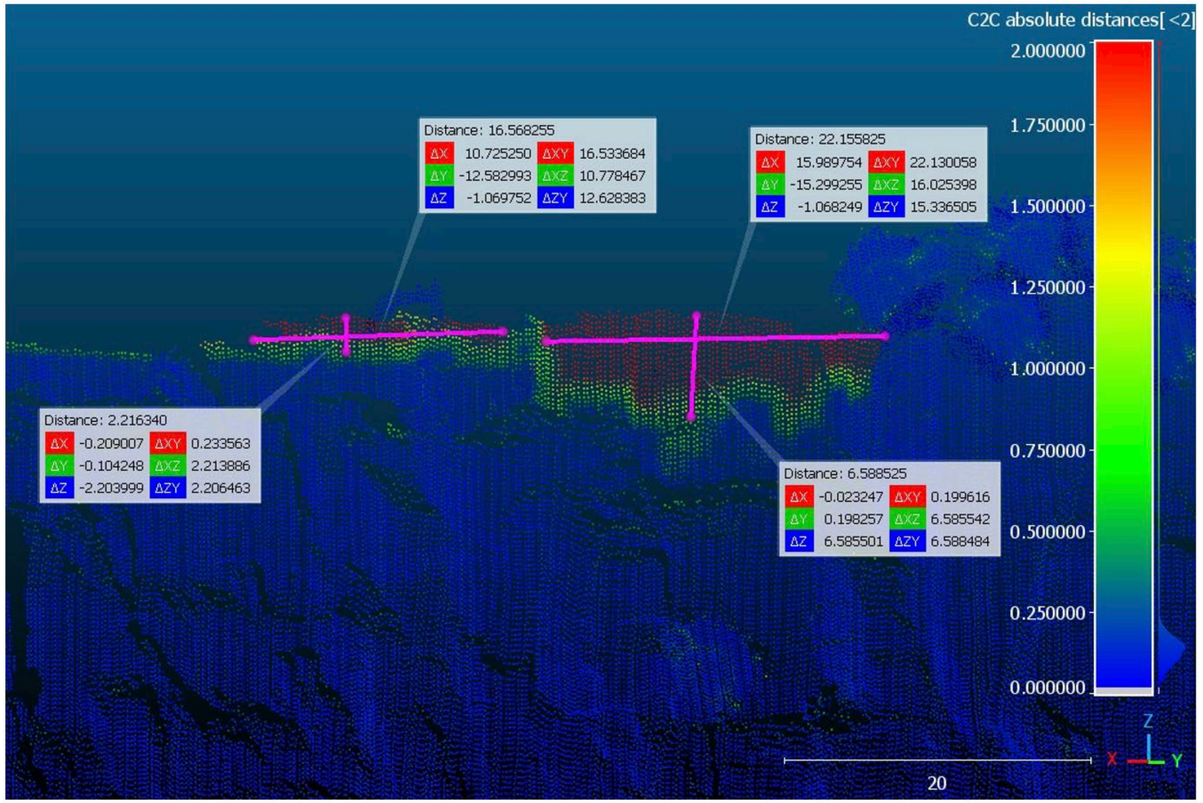
Section 5- Missing parts dimensions



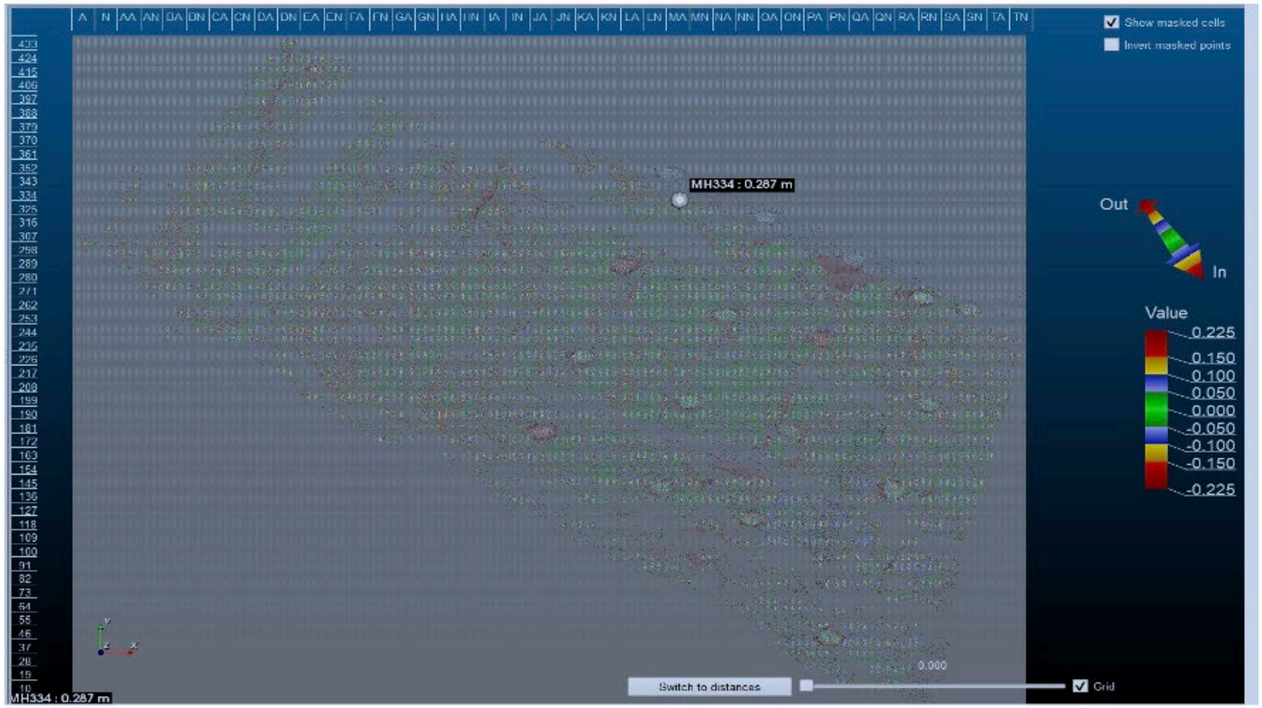
Section 6- Missing parts dimensions



Section 5- Missing parts dimensions



Section 6- Missing parts dimensions

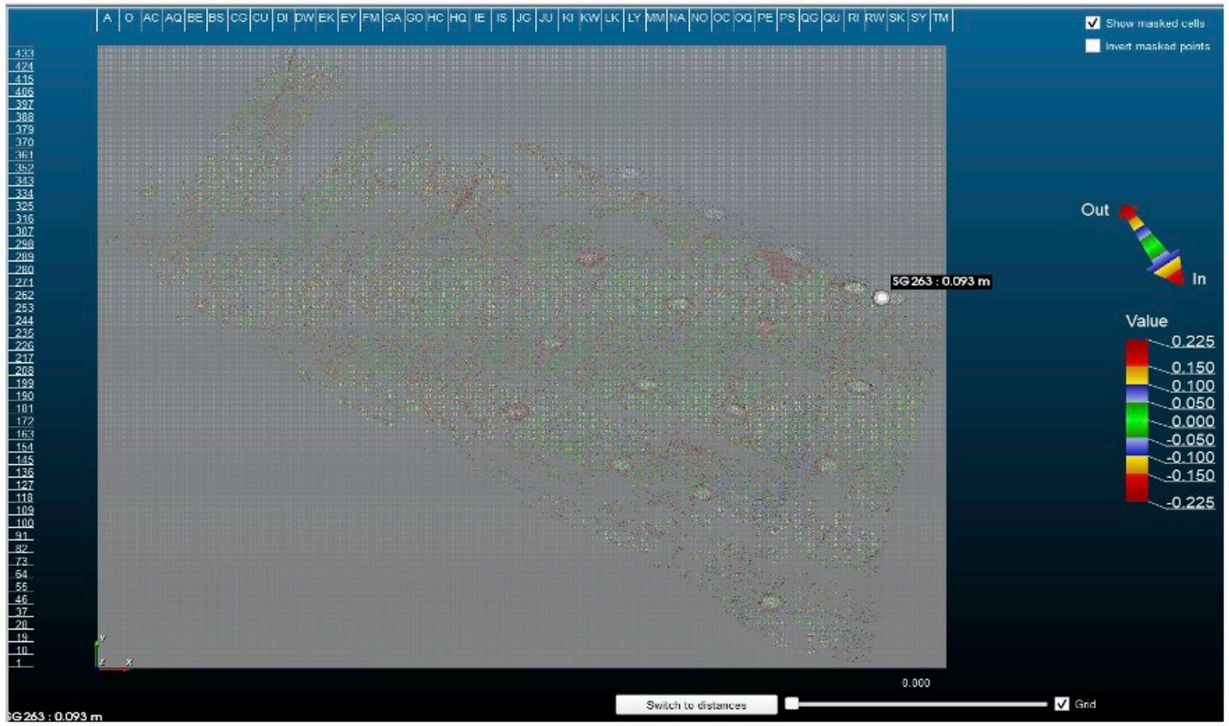


Points go Out. Rock disturbance

Additional properties	
Cell	MH334
Deviation	0.0508
Points count	2
Average Distance	0.2871
3D centroid	210.768, 70.203, 41.477
Volume of deformation	0.0081

Average 3D movement : Out 0.2871

Graph MH334-Deflected Area



Point SG263-Deflected Area

Graph SG263-Deflected Area

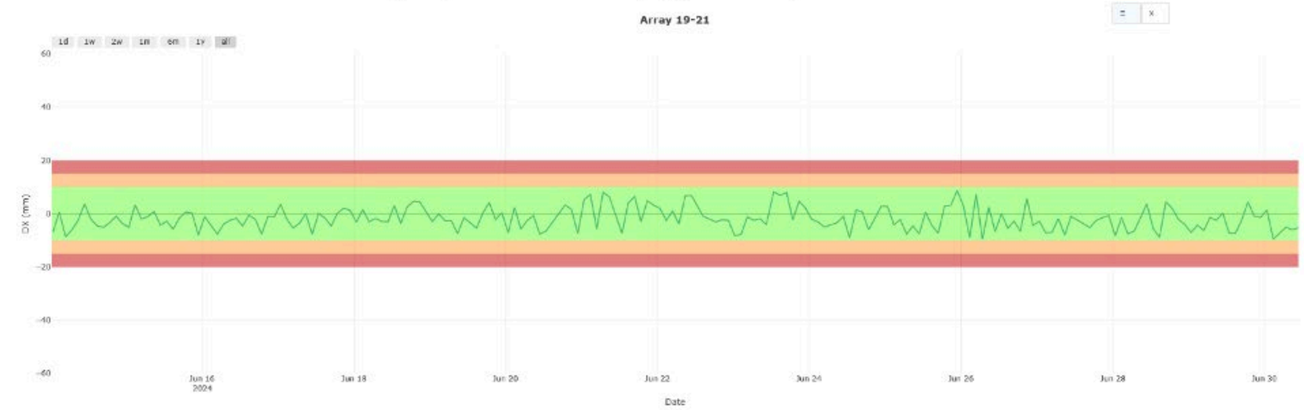
Points go In. Rock Removal

Additional properties	
Cell	SG263
Deviation	0.0000
Points count	1
Average Distance	0.0934
3D centroid	166.954, 122.388, 39.220

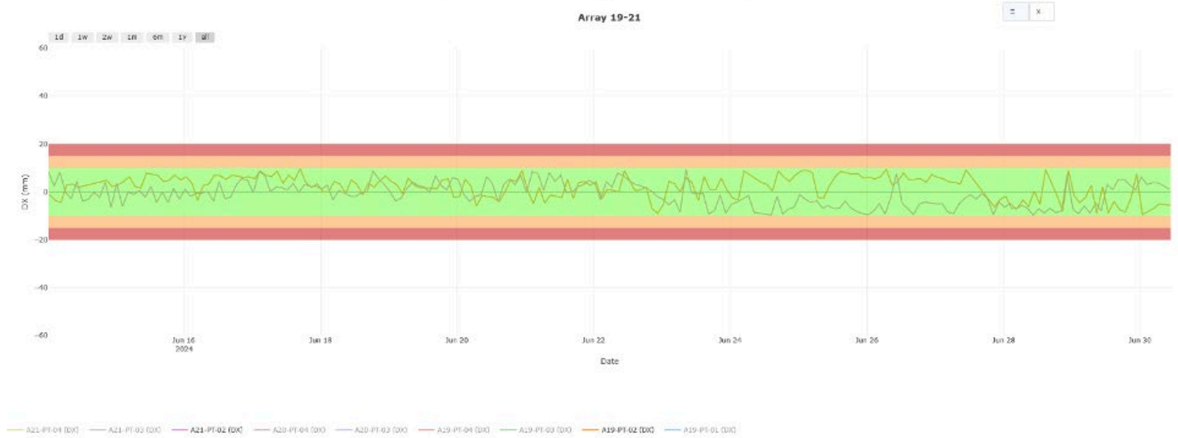
Average 3D movement : Out 0.0934

The results from the ATS for the same area zone by zone are showing below

Δz Array 19, Point 19-PT01(Upper zone) June 13 to June 30



Δz Array 19 to 21, Points PT02 (Middle zone) June 13 to June 30



Δx Array 19 to 21, Points PT02 (Middle zone) June 13 to June 30

Data Understanding and Analysis

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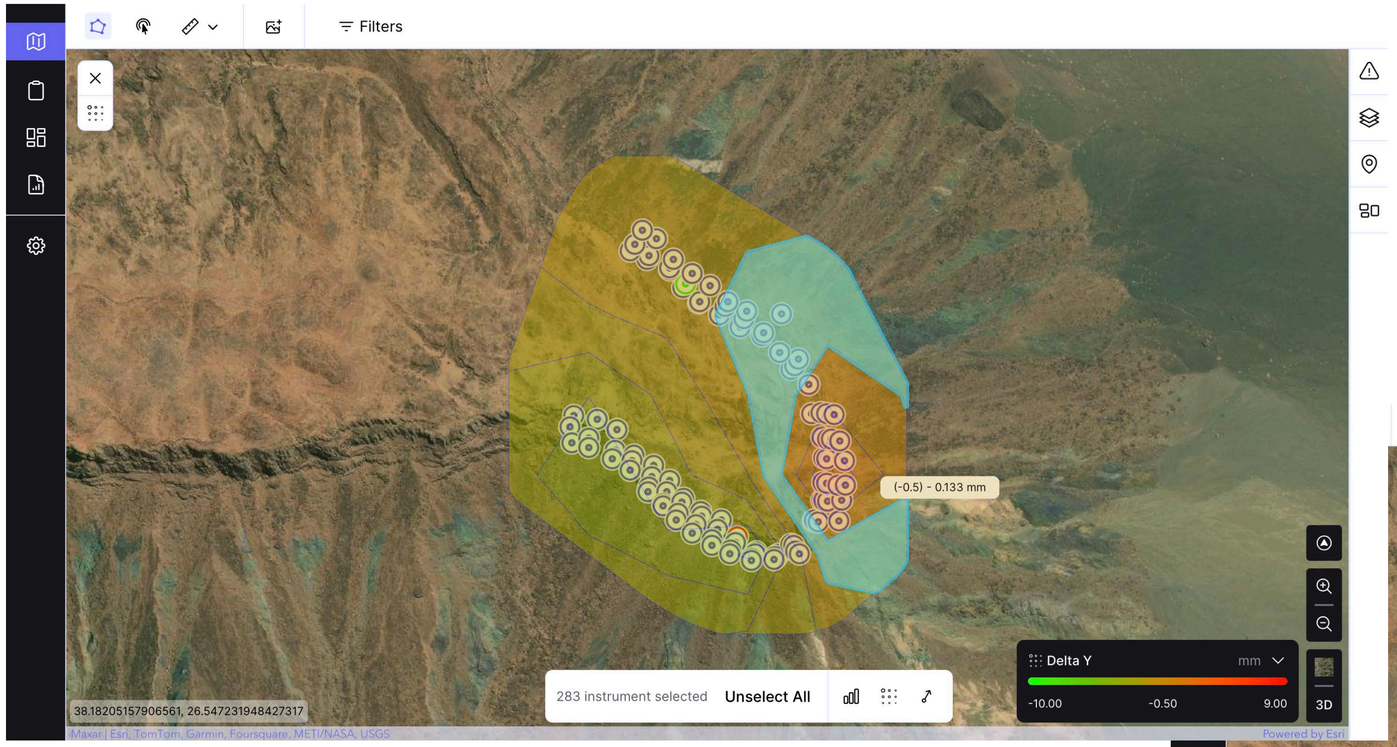

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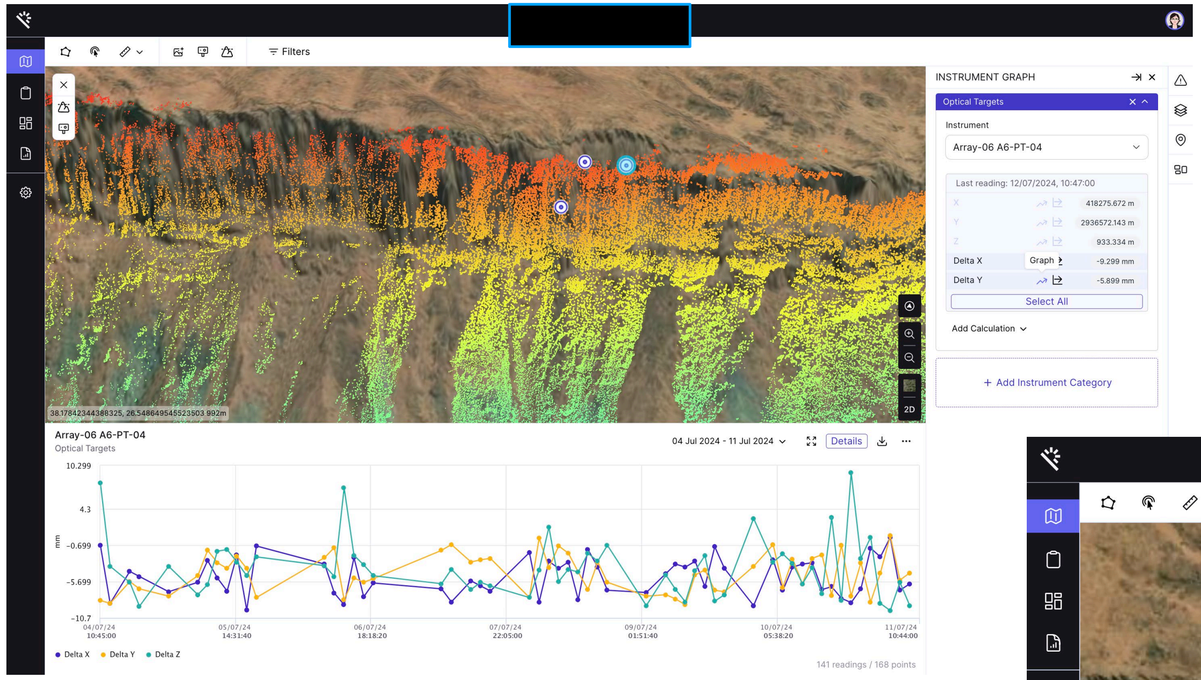

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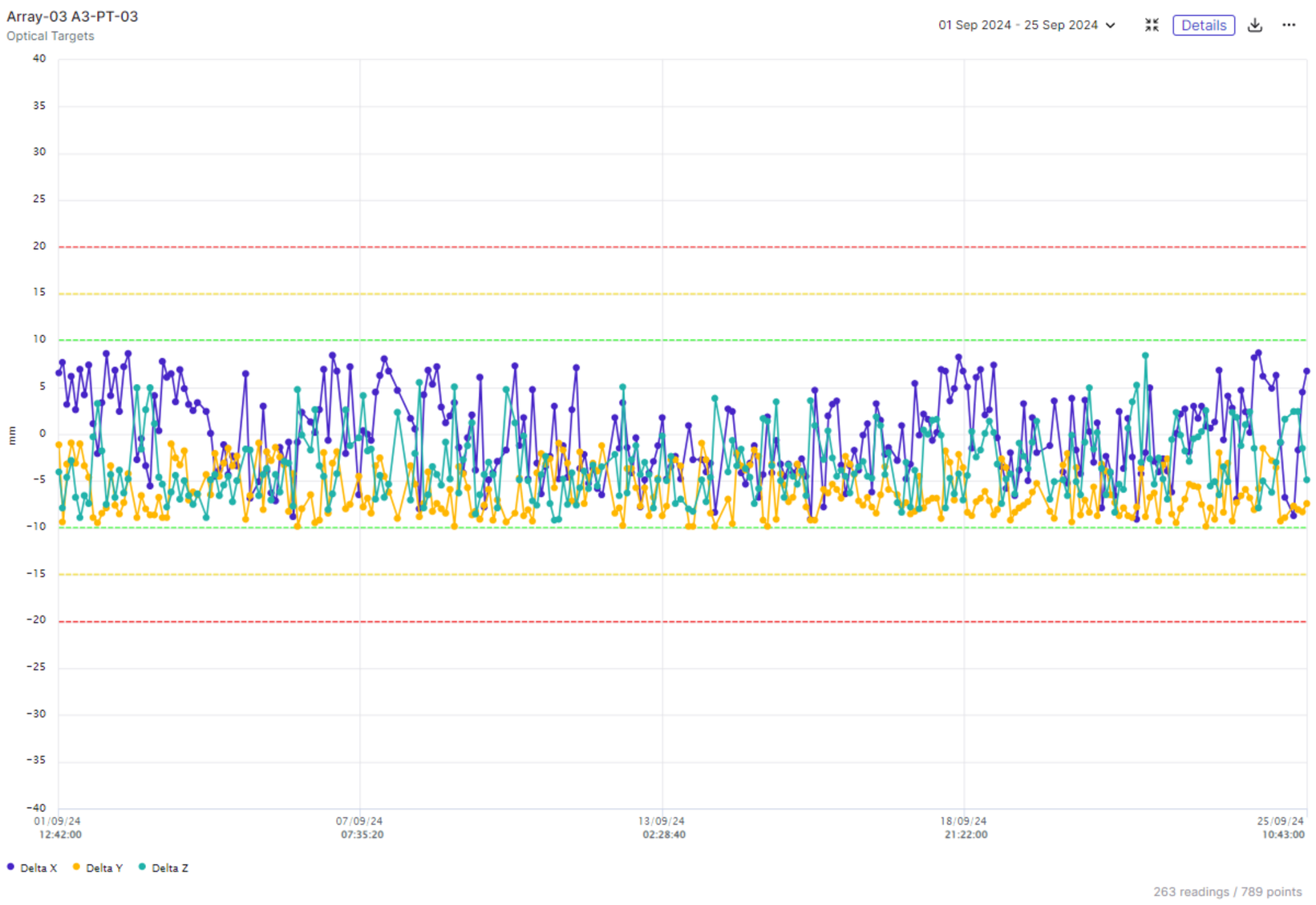


INSTRUMENT GRAPH

Optical Targets

Instrument

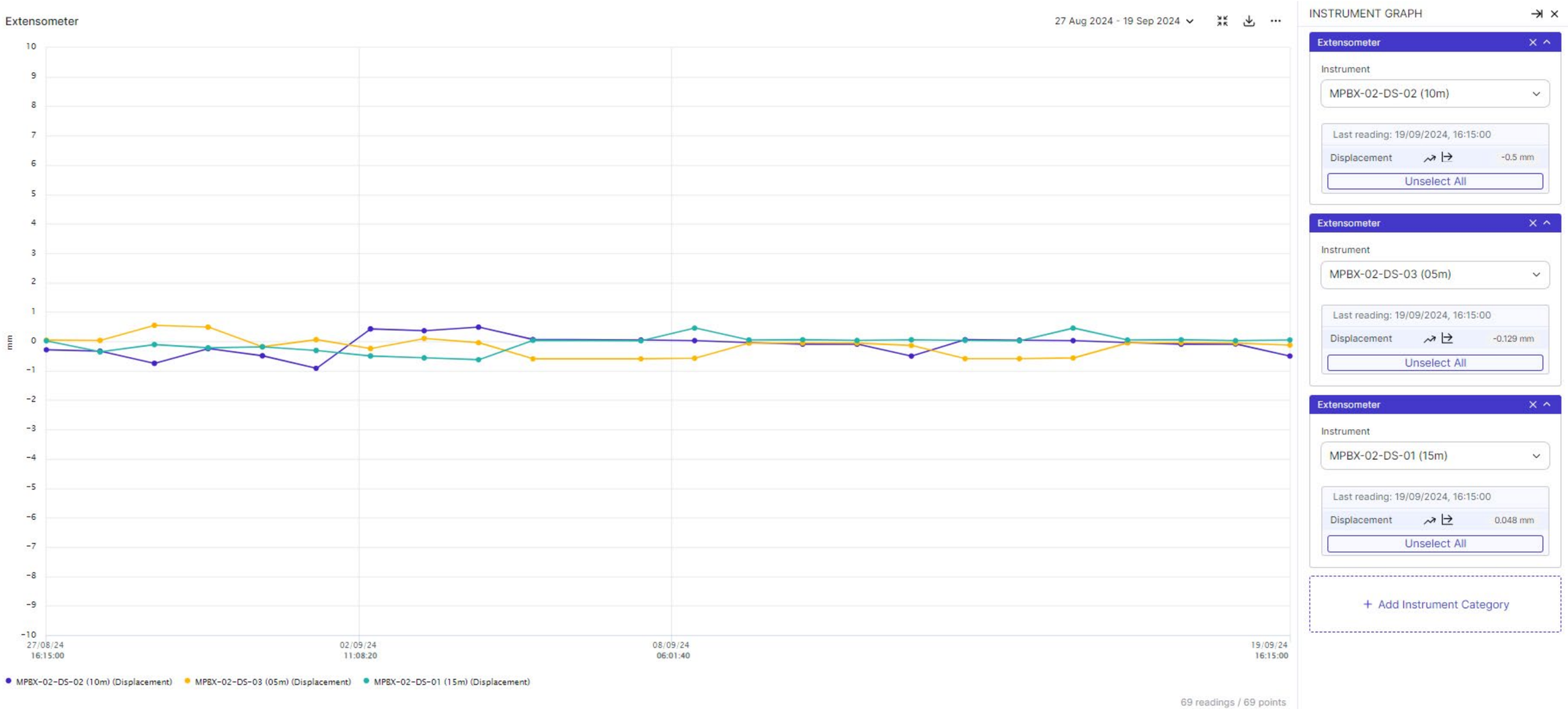
Array-03 A3-PT-03

Last reading: 25/09/2024, 10:43:00

Y	2936625.5783 m
Z	938.5342 m
Delta X	6.699 mm
Delta Y	-7.4 mm
Delta Z	-4.899 mm

Select All

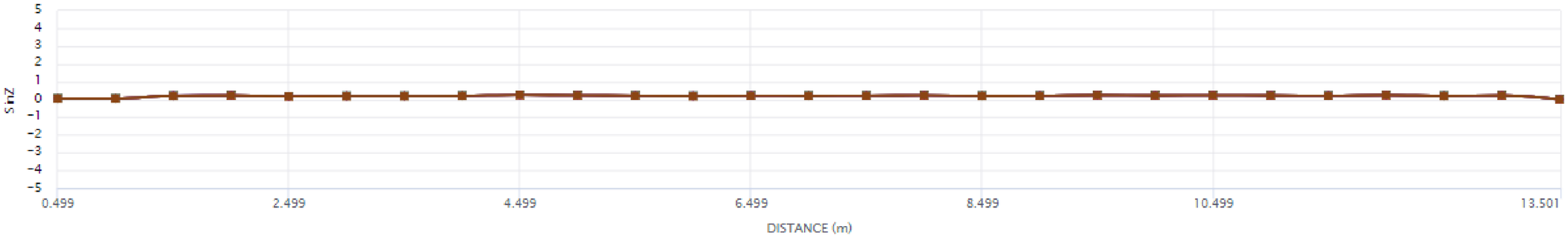
+ Add Instrument Category


Extensometer
27 Aug 2024 - 19 Sep 2024
mm
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
27/08/24
16:15:00
02/09/24
11:08:20
08/09/24
06:01:40
19/09/24
16:15:00
MPBX-02-DS-02 (10m) (Displacement)
MPBX-02-DS-03 (05m) (Displacement)
MPBX-02-DS-01 (15m) (Displacement)
69 readings / 69 points
INSTRUMENT GRAPH
Extensometer
Instrument
MPBX-02-DS-02 (10m)
Last reading: 19/09/2024, 16:15:00
Displacement
-0.5 mm
Unselect All
Extensometer
Instrument
MPBX-02-DS-03 (05m)
Last reading: 19/09/2024, 16:15:00
Displacement
-0.129 mm
Unselect All
Extensometer
Instrument
MPBX-02-DS-01 (15m)
Last reading: 19/09/2024, 16:15:00
Displacement
0.048 mm
Unselect All
+ Add Instrument Category

Geoprofile (Horizontal)

15 Sep 2024 - 19 Sep 2024

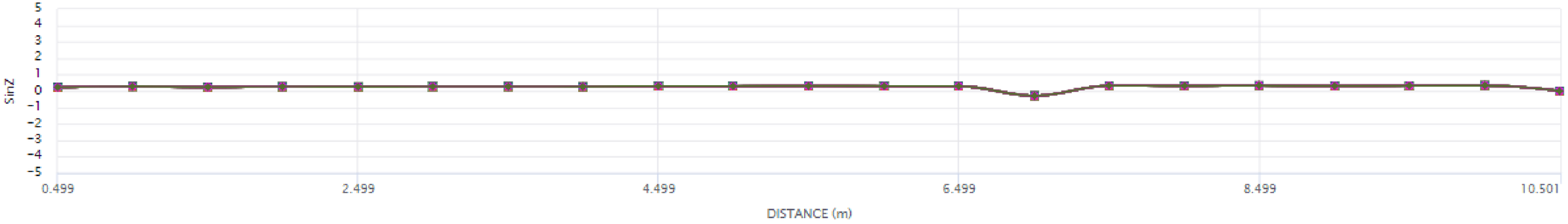
Axis-Z Tilt



Axis-Z Tilt (19/09/2024 11:00:00) Axis-Z Tilt (18/09/2024 14:00:00) Axis-Z Tilt (18/09/2024 12:00:00) Axis-Z Tilt (18/09/2024 11:30:00) Axis-Z Tilt (18/09/2024 11:28:00)
Axis-Z Tilt (18/09/2024 11:26:00) Axis-Z Tilt (15/09/2024 14:00:00) Axis-Z Tilt (15/09/2024 12:00:00)

8 readings / 216 points

Axis-Z Tilt



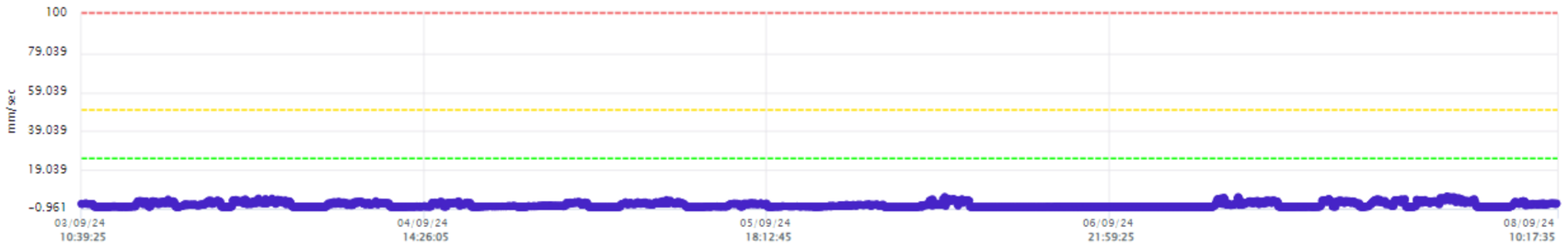
Axis-Z Tilt (19/09/2024 10:00:00) Axis-Z Tilt (19/09/2024 08:00:00) Axis-Z Tilt (19/09/2024 06:00:00) Axis-Z Tilt (19/09/2024 04:00:00) Axis-Z Tilt (19/09/2024 02:00:00)
Axis-Z Tilt (19/09/2024 00:00:00) Axis-Z Tilt (18/09/2024 22:00:00) Axis-Z Tilt (18/09/2024 20:00:00) Axis-Z Tilt (18/09/2024 18:00:00) Axis-Z Tilt (18/09/2024 16:00:00)
1 / 8

37 readings / 777 points

VM-06

Vibration Sensor

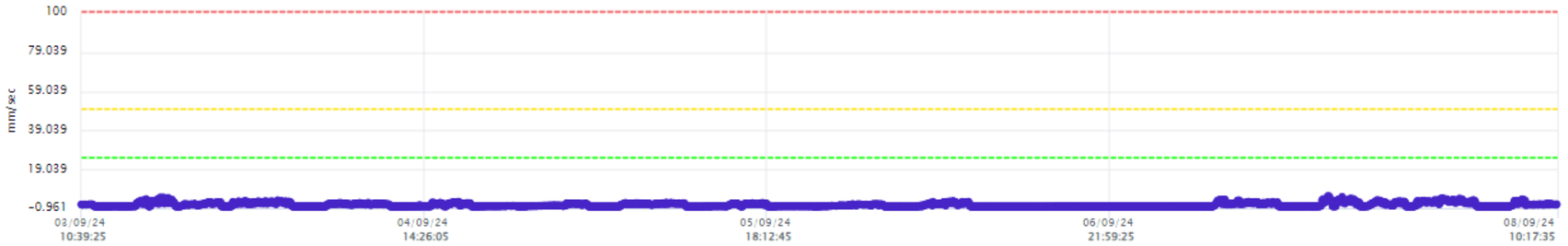
03 Sep 2024 - 08 Sep 2024 Details



PPV-Long

3589 readings / 3589 points

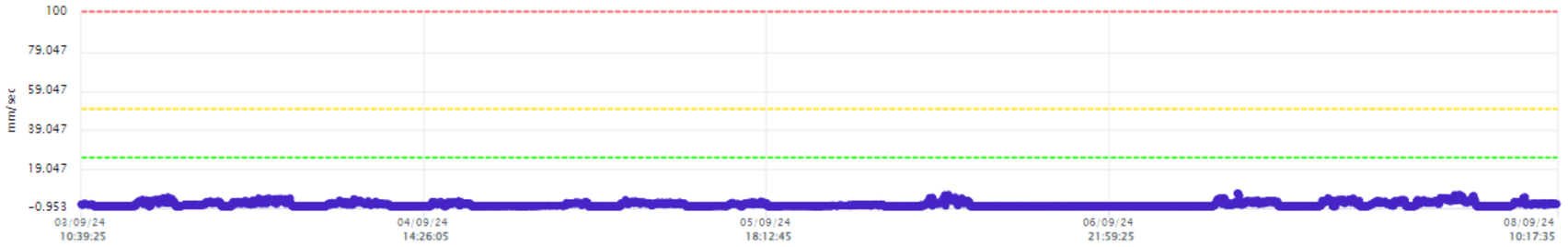
PPV-Tran



PPV-Tran

3589 readings / 3589 points

PPV-Vert



PPV-Vert

3589 readings / 3589 points

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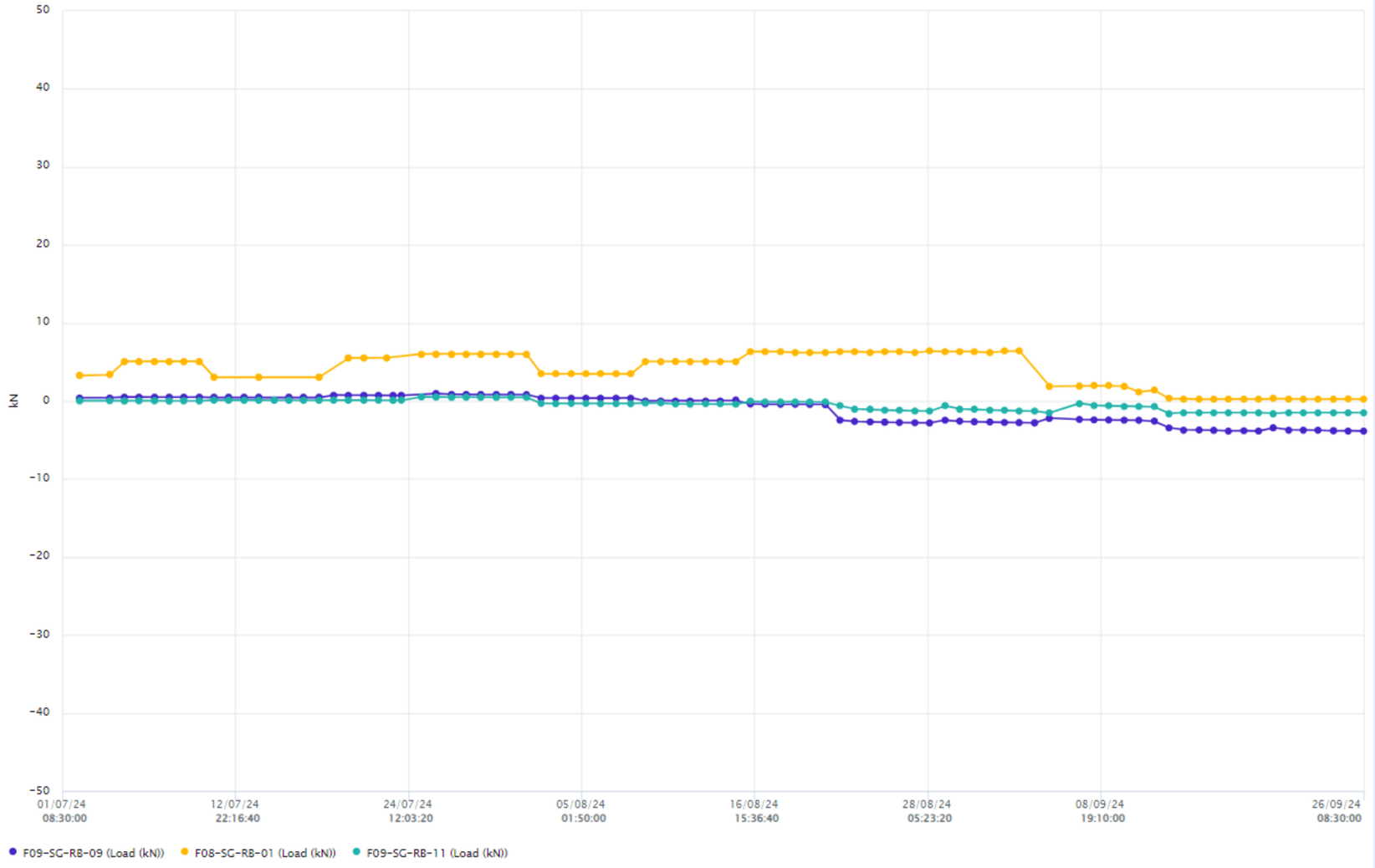
Filters

Strain Gage

01 Jul 2024 - 26 Sep 2024



244 readings / 244 points

INSTRUMENT GRAPH

Strain Gage

Instrument

F09-SG-RB-09

Last reading: 26/09/2024, 08:30:00

Load (kN) -3.84784 kN

Unselect All

Strain Gage

Instrument

F08-SG-RB-01

Last reading: 26/09/2024, 08:30:00

Load (kN) 0.21154 kN

Unselect All

Strain Gage

Instrument

F09-SG-RB-11

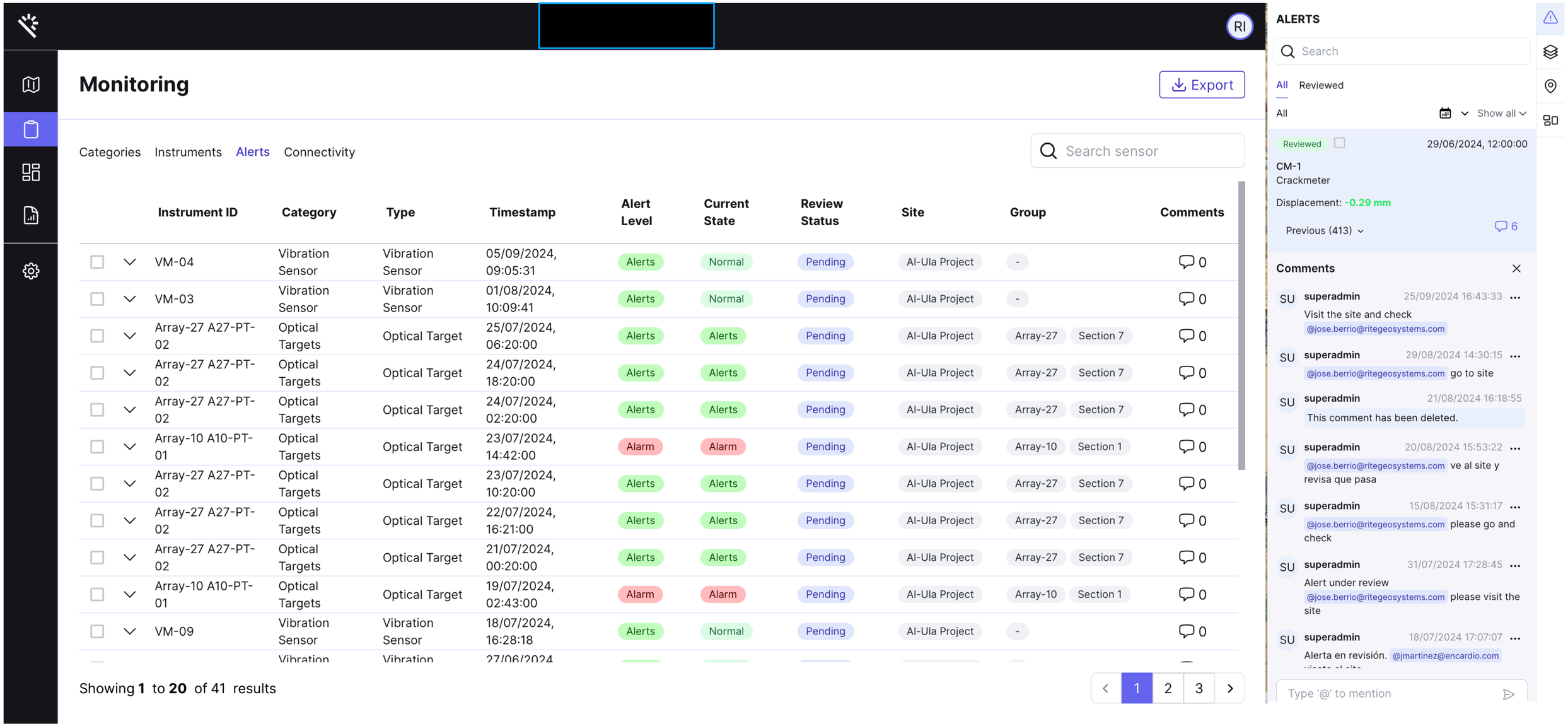
Last reading: 26/09/2024, 08:30:00

Load (kN) -1.49531 kN

Unselect All

+ Add Instrument Category

Risk Assessment and Early Warning System


RI
Monitoring
Export
Categories
Instruments
Alerts
Connectivity
Search sensor
Instrument ID
Category
Type
Timestamp
Alert Level
Current State
Review Status
Site
Group
Comments
VM-04 Vibration Sensor Vibration Sensor 05/09/2024, 09:05:31 Alerts Normal Pending Al-Ula Project - 0
VM-03 Vibration Sensor Vibration Sensor 01/08/2024, 10:09:41 Alerts Normal Pending Al-Ula Project - 0
Array-27 A27-PT-02 Optical Targets Optical Target 25/07/2024, 06:20:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-27 A27-PT-02 Optical Targets Optical Target 24/07/2024, 18:20:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-27 A27-PT-02 Optical Targets Optical Target 24/07/2024, 02:20:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-10 A10-PT-01 Optical Targets Optical Target 23/07/2024, 14:42:00 Alarm Alarm Pending Al-Ula Project Array-10 Section 1 0
Array-27 A27-PT-02 Optical Targets Optical Target 23/07/2024, 10:20:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-27 A27-PT-02 Optical Targets Optical Target 22/07/2024, 16:21:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-27 A27-PT-02 Optical Targets Optical Target 21/07/2024, 00:20:00 Alerts Alerts Pending Al-Ula Project Array-27 Section 7 0
Array-10 A10-PT-01 Optical Targets Optical Target 19/07/2024, 02:43:00 Alarm Alarm Pending Al-Ula Project Array-10 Section 1 0
VM-09 Vibration Sensor Vibration Sensor 18/07/2024, 16:28:18 Alerts Normal Pending Al-Ula Project - 0
Showing 1 to 20 of 41 results
1
2
3
ALERTS
Search
All
Reviewed
All
Show all
Reviewed
29/06/2024, 12:00:00
CM-1
Crackmeter
Displacement: -0.29 mm
Previous (413)
6
Comments
SU superadmin 25/09/2024 16:43:33
Visit the site and check @jose.berrio@ritegeosystems.com
SU superadmin 29/08/2024 14:30:15
@jose.berrio@ritegeosystems.com go to site
SU superadmin 21/08/2024 16:18:55
This comment has been deleted.
SU superadmin 20/08/2024 15:53:22
@jose.berrio@ritegeosystems.com ve al site y revisa que pasa
SU superadmin 15/08/2024 15:31:17
@jose.berrio@ritegeosystems.com please go and check
SU superadmin 31/07/2024 17:28:45
Alert under review @jose.berrio@ritegeosystems.com please visit the site
SU superadmin 18/07/2024 17:07:07
Alerta en revisión. @jmartinez@encardio.com
Type '@' to mention

Continuous Monitoring & Services

- Ongoing Surveillance and Predictive Intelligence
- Benefits
  - Enhanced Awareness
  - Proactive Risk Management
  - Informed Decision Making
- Ensuring Reliability and Accuracy
- Services
  - Project Management
  - Installation and Supply
  - On-Ground Engineer Support
  - Solution Provider with Manufacturing Capabilities
  - Surveying
  - Proqio
  - Data Reporting

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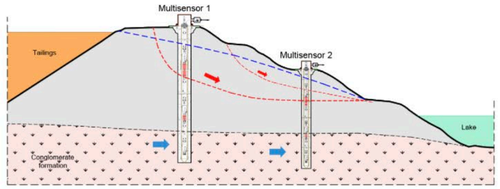
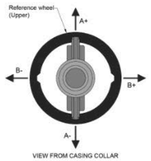
Tailing Dams

Dashboards > DASHBOARD_MULTISENSOR_TAILING DAM

+ Add Widget

DEMO TAILING DAMS



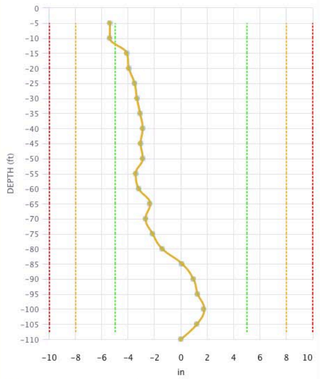


*(+A) Water Side (Downstream Side). The downstream side is opposite the tailing side and faces away from the mine. This side is often exposed to the natural environment and is crucial for the structural stability of the dam.

** (+B) +90 deg. Towards Water Side (Downstream Side)

* INCLINOMETER_Axis-A

Displacement (in)



Cummulative Deviation A (18/03/2024 12:00:

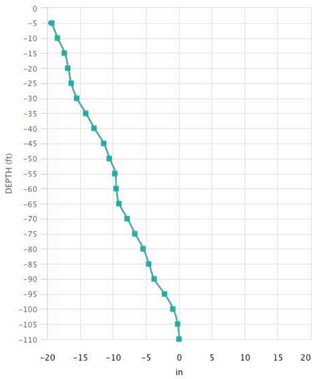
Cummulative Deviation A (18/03/2024 06:00:

Cummulative Deviation A (18/03/2024 00:00:

3 readings / 66 points

**INCLINOMETER_Axis -B

Displacement (in)



Cummulative Deviation B (18/03/2024 12:00:

Cummulative Deviation B (18/03/2024 06:00:

Cummulative Deviation B (18/03/2024 00:00:

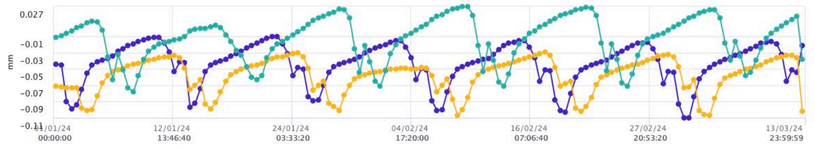
3 readings / 66 points

PIEZOMETER- VIBRANTING WIRE

VWP_03 (VW Pressure) VWP_04 (VW Pressure)

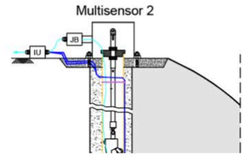
292 readings / 292 points

BOREHOLE EXTENSOMETER



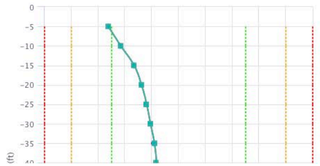
EXT_01 (Displacement) EXT_02 (Displacement) EXT_03 (Displacement)

438 readings / 438 points



*INCLINOMETER_Axis-A

Displacement (in)



**INCLINOMETER_Axis-B

Displacement (in)

PIEZOMETER-VIBRANTING WIRE

Tailing Dams

Dashboards > DASHBOARD_TOPOGRAPHICAL_SURVEYING

+ Add Widget

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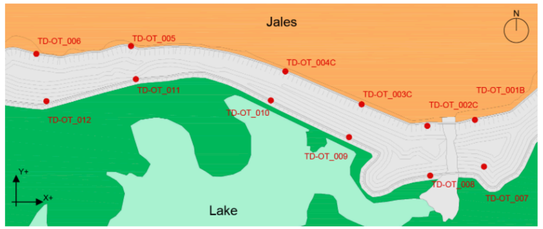
Infrastructure Data Intelligence Platform

TOPOGRAPHICAL_SURVEYING

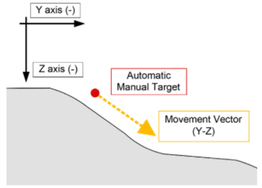
DEMO_TAILING DAMS



* Optical Target /3D prisms

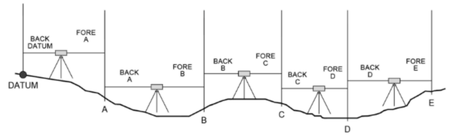
- Parameter X Eastings
- Parameter Y Northings
- Parameter Z (-) Settlement (+) Heave

MOVEMENT VECTOR
Description

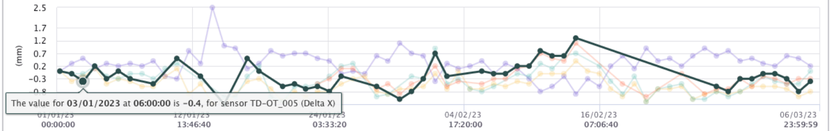


** Precise levelling (usually is a nail attached the control surface).

- Parameter Z (-) Settlement (+) Heave

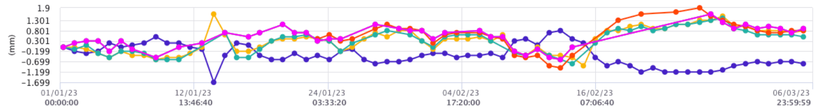


* 3D Prisms
(mm) Eastings (+) Towards East



TD-OT_001B (Delta X) TD-OT_002C (Delta X) TD-OT_003C (Delta X) TD-OT_004C (Delta X) TD-OT_005 (Delta X)
265 readings / 265 points

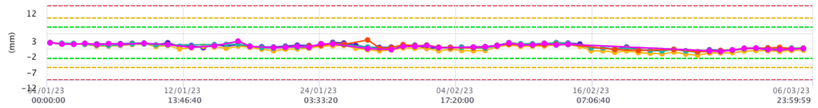
* 3D Prisms
(mm) Northings (+) Towards North



TD-OT_001B (Delta Y) TD-OT_002C (Delta Y) TD-OT_003C (Delta Y) TD-OT_004C (Delta Y)
TD-OT_005 (Delta Y) TD-OT_006 (Delta Y)

308 readings / 308 points

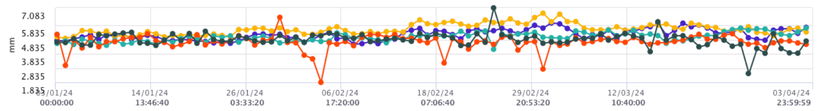
*3D prisms
Settlement (mm)



TD-OT_001B (Delta Z) TD-OT_002C (Delta Z) TD-OT_003C (Delta Z) TD-OT_004C (Delta Z)
TD-OT_005 (Delta Z) TD-OT_006 (Delta Z)

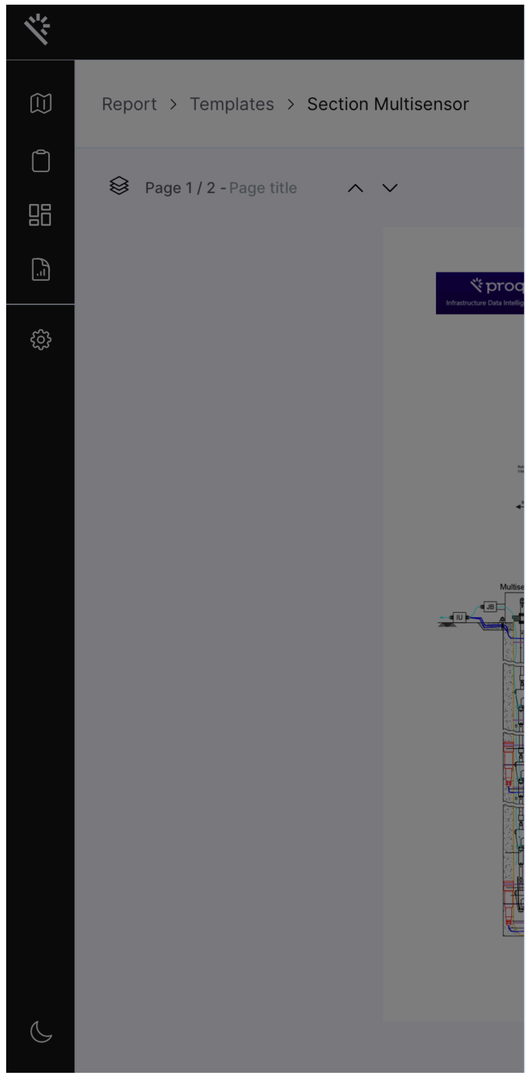
308 readings / 308 points

Movement Vector (Y-Z)
Displacement (mm)



TD-OT_001B (Vector (Y/Z)) TD-OT_002C (Vector (Y/Z)) TD-OT_003C (Vector (Y/Z)) TD-OT_004C (Vector (Y/Z))
TD-OT_005 (Vector (Y/Z))

460 readings / 460 points



Schedule Report

Enable Schedule

General Settings

Report Title: Section Multisensor

Description (optional): Inclinometer/Piezometer-Vibranting Wire/E

Schedule

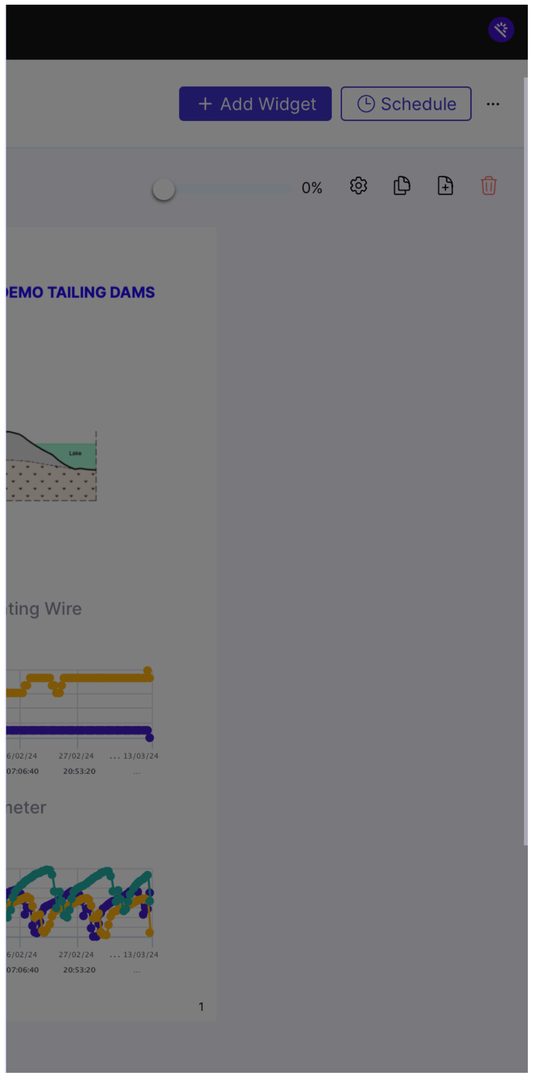
Time: 31/03/2024 12:30:00

Repeat: Custom...

Custom Periodicity

Every 2 Week

Monday	12:30 PM	+
Tuesday	12:30 PM 12:30 PM	+
Wednesday	12:30 PM 12:30 PM	+
Thursday	12:30 PM	+
Friday	12:30 PM	+
Saturday	12:30 PM	+
Sunday	12:30 PM	+



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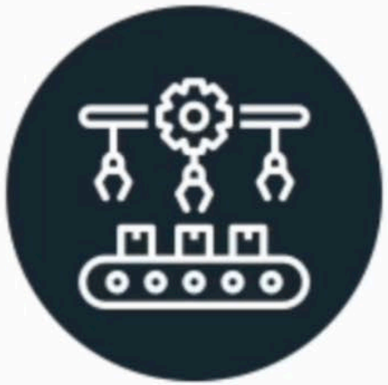

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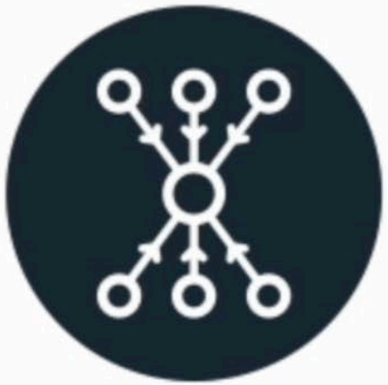

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Thank you!