

Presented By:
Rowland Chen

Trimble Monitoring

Movement Detection with Confidence

Agenda

- 1** **What** is Monitoring?
- 2** **Why** Monitor?
- 3** **Where** is Monitoring Needed?
- 4** **How** to Monitor
- 5** **Automate and Scale** with Trimble Monitoring



What is Monitoring?



What is Monitoring?

temporal
safety campaign automated movement
geodetic real time cost control
protection security
alarming geotechnic
reducing
risk

Monitoring is ...



What is Monitoring?



temporal

automated

movement

safety

campaign

geodetic

real time

cost control

protection

security

geotechnic

alarming

reducing

risk

*Monitoring is all about **measuring change** over time!*



What is Monitoring?

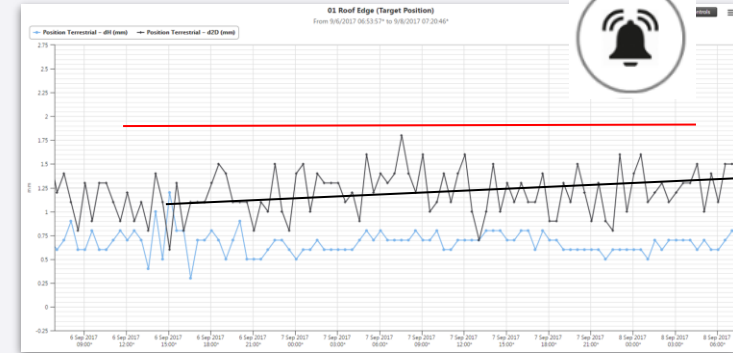
Data/Sensor



Time



Trend



Proactive vs. reactive



Why Monitor?







Why Monitoring?



Trimble Monitoring

Enabling **automated movement detection with confidence** for surveying and construction professionals supporting informed decisions about infrastructure.



Trimble Monitoring Advantage

Surveying automation you can rely on.



Focus on customers success

Hands-on support, installation and local services provided by the best distribution network in the Geospatial industry and the Trimble Monitoring team.



Durable and reliable solutions

Minimize project downtime and lower the cost of ownership with equipment and solutions designed to operate in the most challenging environments.

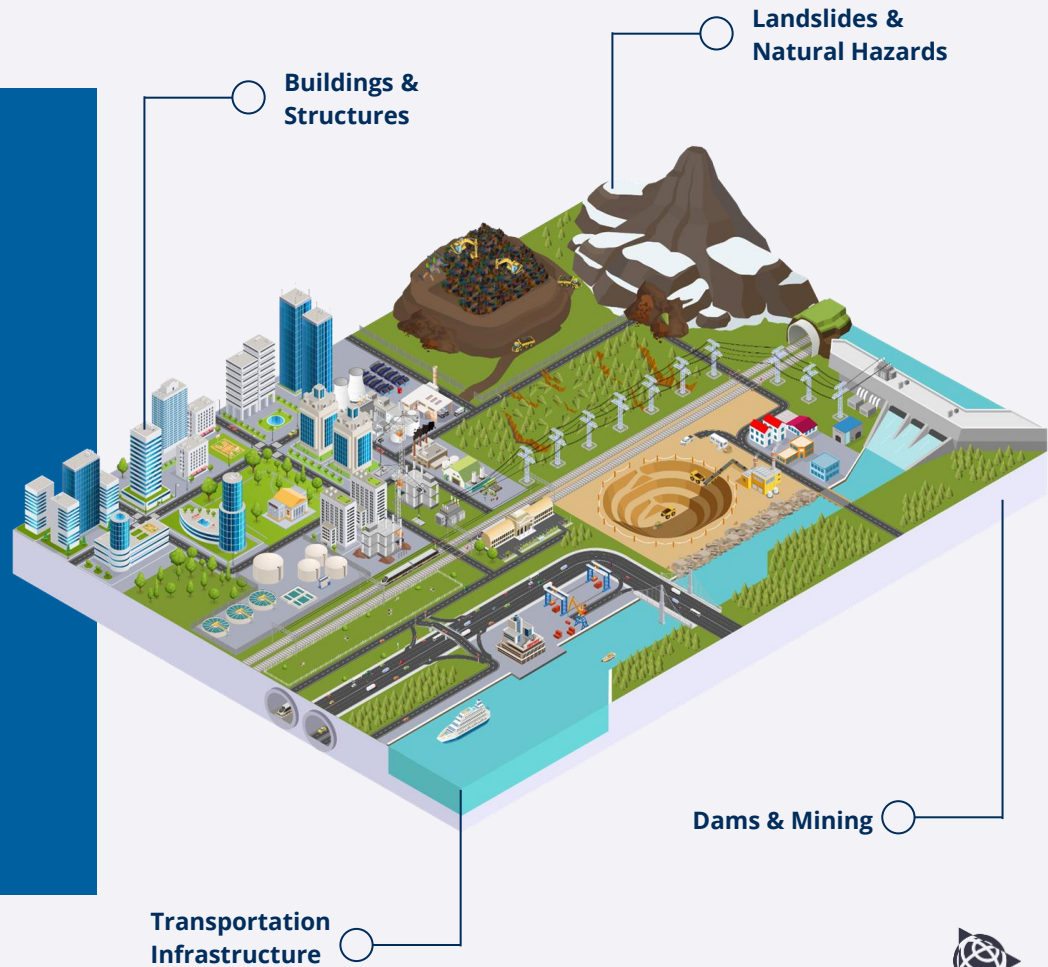


Automate and expand your geospatial services

Grow your business by automating data collection and analysis, reducing errors and costs associated with multiple site visits through the Trimble ecosystem.



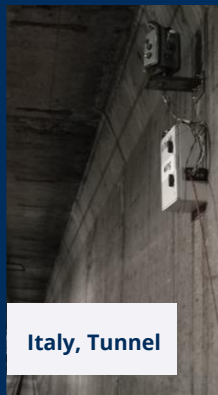
Where is Monitoring Needed?



Transportation Infrastructure



Crossrail, UK, Rail



Italy, Tunnel



Lake Tahoe, US, Road

Rail track monitoring



Road monitoring



Tunnel and convergence



Bridge infrastructure



Biel, Switzerland, Rail



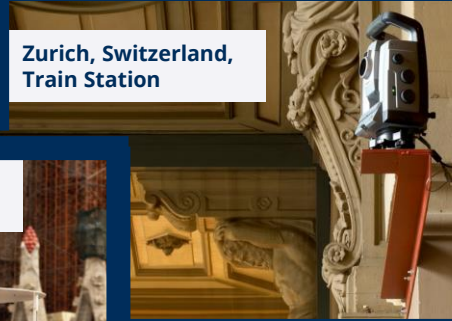
Florence, Italy, Rail

Buildings and Structures

Seattle, US, Deep Excavation



Zurich, Switzerland, Train Station



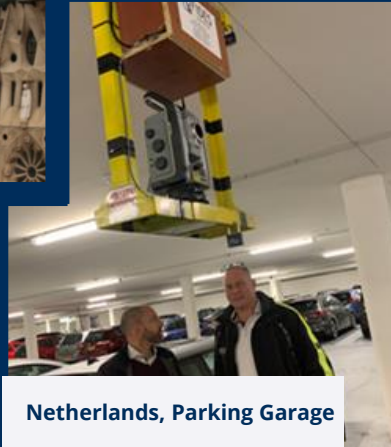
Barcelona, Spain, Construction



US, Earthworks Construction



Netherlands, Parking Garage



Construction management



Excavation and Earthworks



Historical structures and rehabilitation



Dams and Mining



Indiana, Industrial Plant



South Africa, Grootegeluk Mine



DRC, Frontier Mine



South Africa, Dam



Diamond Valley Lake, Dam

Dam wall monitoring



CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD



台湾電力公司
Taiwan Power Company



Open-pit mining and tailings dam stability analysis



Industrial plant operations



Landslides & Natural Hazards

Denali NP, Subsidence



Emilia Romagna, Italy, Slope Monitoring



Cervinia, Italy, Landslide



Landslide monitoring

Geodetski
fakultet
Sveučilište u
Zagrebu



Landfill management

FLORA
SURVEYING ASSOCIATES

WM
WASTE MANAGEMENT

Natural hazard prediction


CAUTUS GEO
surveying for safety



How to Monitor?



Semi-automated vs. Fully-automated Monitoring



- Multiple visits to site are preferred
- Sensor is not fixed (e.g. tripod)
- Slow and low risk movement
- Small data sets/local storage



- Automated/remote collection and alarming
- Sensors permanently on site (e.g. pillar)
- Time sensitive movement detection
- Large datasets/local or virtual database

Increasing Project Requirements



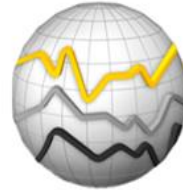
Semi-Automated Monitoring

TRIMBLE ACCESS MONITORING



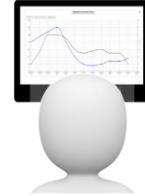
Data Collection and Scheduling
Total station, GNSS,
Level **Trimble Access Monitoring** field software

Office Software



Trimble 4D
Control

Automated Reports and
Alarms



TBC
Monitoring

Data Management,
Processing,
and Reporting



Automated Monitoring

system overview

TRIMBLE S SERIES, SETTOP M1,
NETR9 TI-M, GEOTECHNICAL, ACCESSORIES

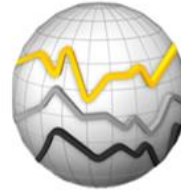


Sensors based on the
project requirements



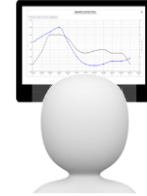
Power and
communication

TRIMBLE 4D CONTROL



Trimble 4D
Control

Configuration, Storage
and Data Management



Trimble 4D
Web

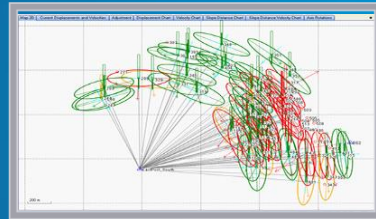
Visualization, Reporting
and Alarming



T4D Control software enables **automated movement detection with confidence** for surveying and construction professionals supporting informed decisions about infrastructure.



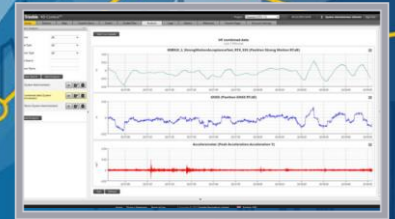
**Sensor Management
and Data Integration**



**Geodetic Processing
and Adjustment**



**Comprehensive
Analysis and
Visualization**



**Conditional Alarming
and Reporting**

T4D Rail module - A **unique** and **intuitive solution** for efficient rail monitoring

Seamless integration of as-builts

Support for different Trimble rail as-built survey solutions provides complete solution

Automated calculations

Immediate availability of offsets between rail heads and prisms and all track geometry parameters

Adherence to rail authority standards

Support for all relevant rail track geometry parameters that can optionally be enabled or disabled

Automatic rail section configuration

Auto-configuration is less error prone and a significant time saver

Rail specific visualization

Charts across epochs and across chainages allowing for powerful analysis in the rail domain

Flexible solution

Solution for both automated and semi-automated workflows in connection with T4D Access and T4D Advanced

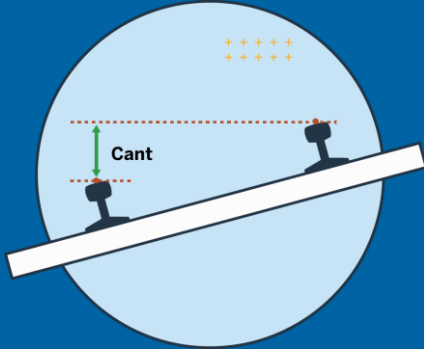




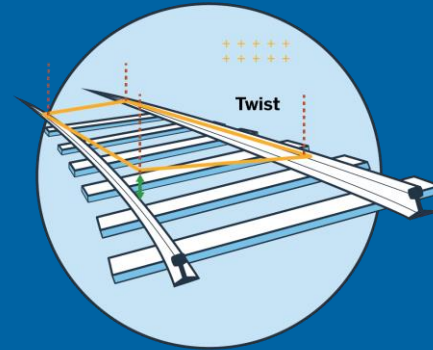
Rail Track Parameters



Cant



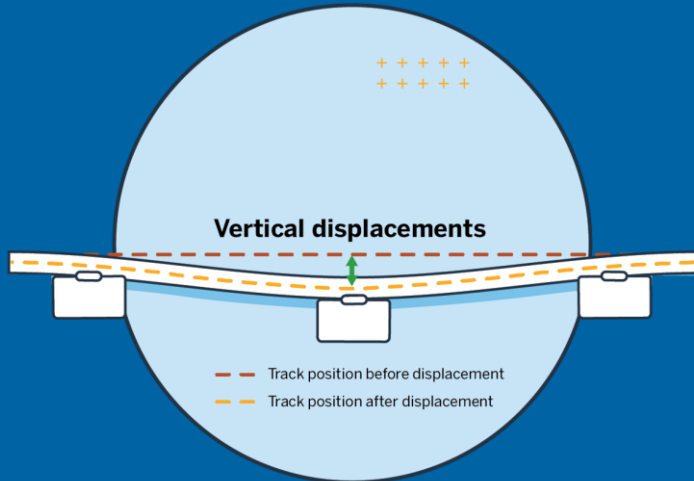
Twist



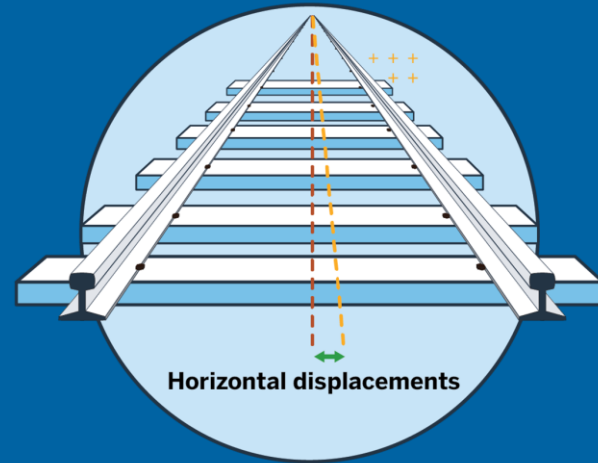
Rail Track Parameters



Vertical displacement



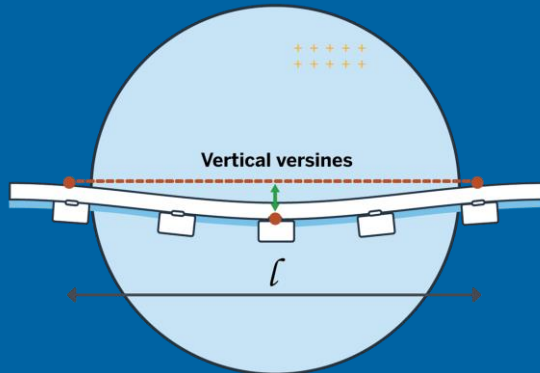
Horizontal displacement



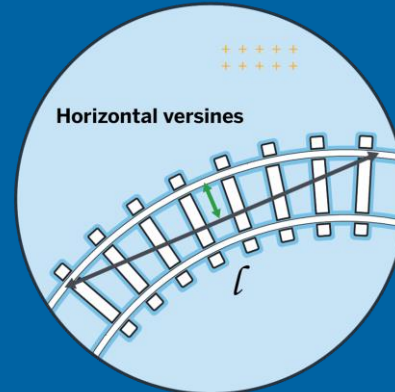
Rail Track Parameters



Vertical versine



Horizontal versine



Monitoring Solutions



Trimble Monitoring Family



Trimble S-Series Provide Durable and Reliable Instruments for Tunnel Surveys



S9 and S9 HP


For **most demanding monitoring applications** with long range option and 0.5" angular 0.8mm EDM accuracy.



S7

Premium all inclusive model perfect to use in monitoring and general surveying.





INSTRUMENT:
Trimble S-Series Total Station

Communication and Control - Settop M1

INTEGRATED
SURVEYING
IN ONE
SIMPLE
DEVICE



Settop M1 - Turning a Total Station into a 24/7 System has never been easier

- **Controls the instrument** - acts as a total station controller providing power and watchdog capability to ensure your instrument never stops working.
- **Flexible connectivity options** - communication via cellular (4G) with SIM card support, satellite data or via Ethernet to local LAN network with support for radio connections and mesh configuration.
- **No loss of data. Ever!** - with onboard storage your system keeps working and all the data is saved in case of communication link down.
- **Powerful WebUI** - connect to your instrument on a desktop or mobile from anywhere in the world and see what instrument using Trimble Vision.





R750 MON Monitoring GNSS Receiver

Dedicated receiver for automated monitoring with Trimble 4D Control

One configuration for high frequency and accuracy monitoring

Up to 50 Hz position rate, one hardware kit with all accessories

Flexible Communication using Cellular or Ethernet

Connects seamlessly to T4D for automated monitoring; no additional modem needed

Automated reporting, analysis, and alarming

Configure multiple real-time and post-processing engines simultaneously in T4D



Extremely accurate and reliable with the Trimble R750 MON

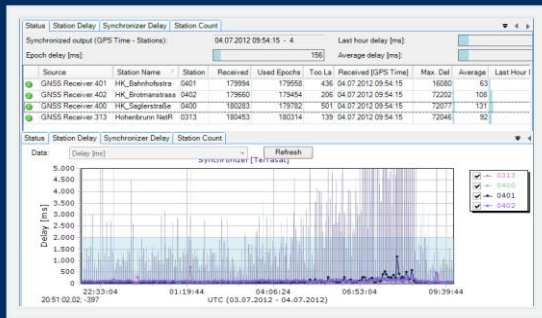
- **Extremely reliable** - support for applications requiring high frequency updates (20Hz) providing mm-level accuracy for most demanding applications with Advanced Maxwell 7 board
- **Highly accurate** - paired with T4D Control software, get the most out of the any project scenario by a number of processing options and adjustments available
- **Deploy on any project** - Utilize built-in cellular modem to connect with T4D or one of the various other communication methods such as included UHF radio and ethernet.
- **Flexibility in T4D** with additional GNSS Receiver options: Trimble R12, Alloy, R750



GNSS Processing with T4D

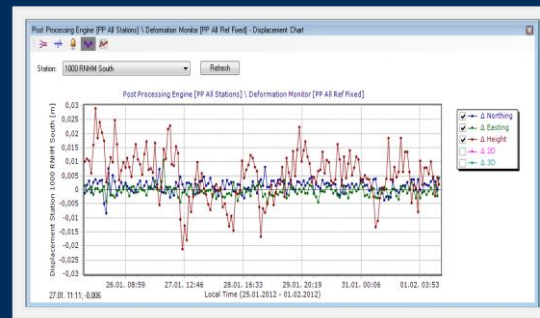
Powerful and flexible

Real-time



Baseline or VRS mode.
High frequency (sub-second).

Post-processed



Processing of stored raw
with precise ephemeris.



Geotechnical Sensors



Geotechnical monitoring introduction

How?



Data Logger Sensor Compatibility




Diagram of a piezometer showing components: Signal Cable, PCC Placement Pipe, Bentonite Cement Grout, and Piezometer Tip.

☹☹☹


Piezometers



Load cell sensor.

✖


Load cells



Water level sensor.

↑


Water level Sensor



Pressure cell sensor.

✖

Pressure Cells



Strain gauge sensor.

✖

Strain gauges



Extensometers Rods sensor.

↔

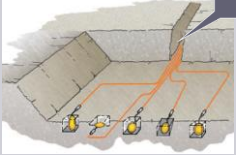
Extensometers Rods



Load cell sensor.

✖

Load cells



Settlement Cells sensor.

✖


Settlement Cells



Crack meters sensor.

✖

Crack meters



Tilt Meters sensor.

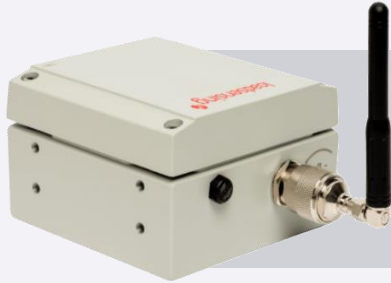
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Tilt Meters



Geotechnical wireless sensors

Sensor connected - Tiltmeters



LS-G6-INC15

Wireless tiltmeter
With an external
antenna



LS-G6-INC15-I

Wireless tiltmeter
With an internal
antenna

Application

Railway track monitoring

Building response to tunneling and excavation-induced ground movements.

Foundations and deep excavations

Landslides and slope stability.

Bridge and structural health monitoring.

Embankments

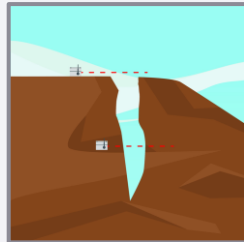
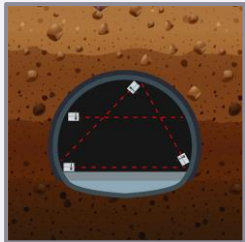


Geotechnical wireless sensors

Sensor connected - Laser distance



LS-G6-LASER
Laser Distance Meter



Application

Tunnel and mining convergence monitoring

Deformations in underground excavations

Remote monitoring of slope movements

Fracture and faults surveillance

Bearing and expansion joint movements

Monitoring displacement in structures and buildings



Syscom Vibration Sensor Support

Often **mandatory per regulatory requirements**; especially in transportation infrastructure and structural monitoring projects



Device name	MR3000C	ROCK
Key characteristics	<ul style="list-style-type: none">● 4G embedded modem● Embedded web server● FTP transfer (no need cloud)	<ul style="list-style-type: none">● Requires subscription to Syscom Cloud Software● Integrated battery● Integrated modem● Cloud based solution● Solar version



Accessories



One stop shop for all your monitoring needs

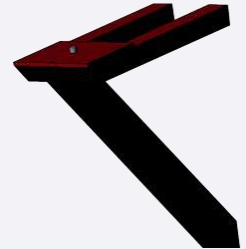
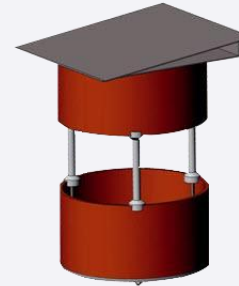
Prisms and targets

- Small 25 mm prisms (box 25)
- Special tunneling and asphalt prisms
- Large prisms for greater distances



Power and cables

- Solar panels
- Backup battery options



Mounts and enclosures

- Instrument shelters
- Box enclosures



Specialized Accessories

Total Station Auto-level

AD12 auto-level to ensure instrument is always level in situations where it can move



Weather Station

Fully configured weather station to incorporate real-time environmental data



Scaling Your Business



Scaling your monitoring business

- Scale to meet different project demands
 - Add more sensors to an existing site
 - Add more sites - T4D offers flexible and scalable licensing to meet any new project needs
- Move into new markets
 - T4D integrates geospatial and geotechnical data
 - Bespoke data analysis for each project site
- Add more value to existing projects
 - Using multiple data types adds value for stakeholders



☰ Thank you!

