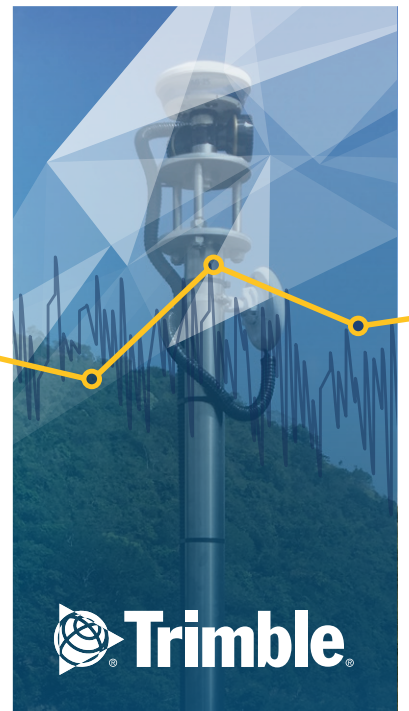


Trimble Monitoring

AUTOMATED MOVEMENT
DETECTION WITH CONFIDENCE





AUTOMATED MOVEMENT DETECTION SUPPORTS INFORMED DECISIONS ABOUT INFRASTRUCTURE FOR SURVEYING AND CONSTRUCTION PROFESSIONALS

Automated Movement Detection with Confidence

Results You Can Rely On

Rely on Trimble products for automated remote monitoring to increase safety onsite and have total confidence in your results.

- ▶ Transportation Infrastructure
- ▶ Buildings and Structures
- ▶ Dams and Mining
- ▶ Landslides and Natural Hazards

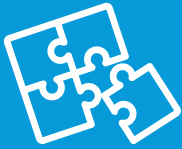
Trimble Monitoring connects geospatial professionals, construction managers, and mining and dam operators to crucial assets, providing up-to-the-minute data on condition and movement of structures or land.

Trimble taps into more than 40 years of experience in the fields of robotics and automation to offer highly effective monitoring solutions.





Trimble Monitoring Advantages



Complete Solution

Total stations, GNSS, geotechnical sensors, and analytical software work together to support movement analysis and visualization. Combine any Trimble geospatial and geotechnical sensors to create a complete monitoring solution for any project.

Automation and Safety

Increase efficiency through automation, resulting in fewer site visits while increasing safety via real-time reporting and alarming.



Flexibility

Scalable solutions meet a range of project requirements from simple to complex installations:

- ▶ Campaign (periodic) monitoring
- ▶ Real-time operations at pre-scheduled intervals

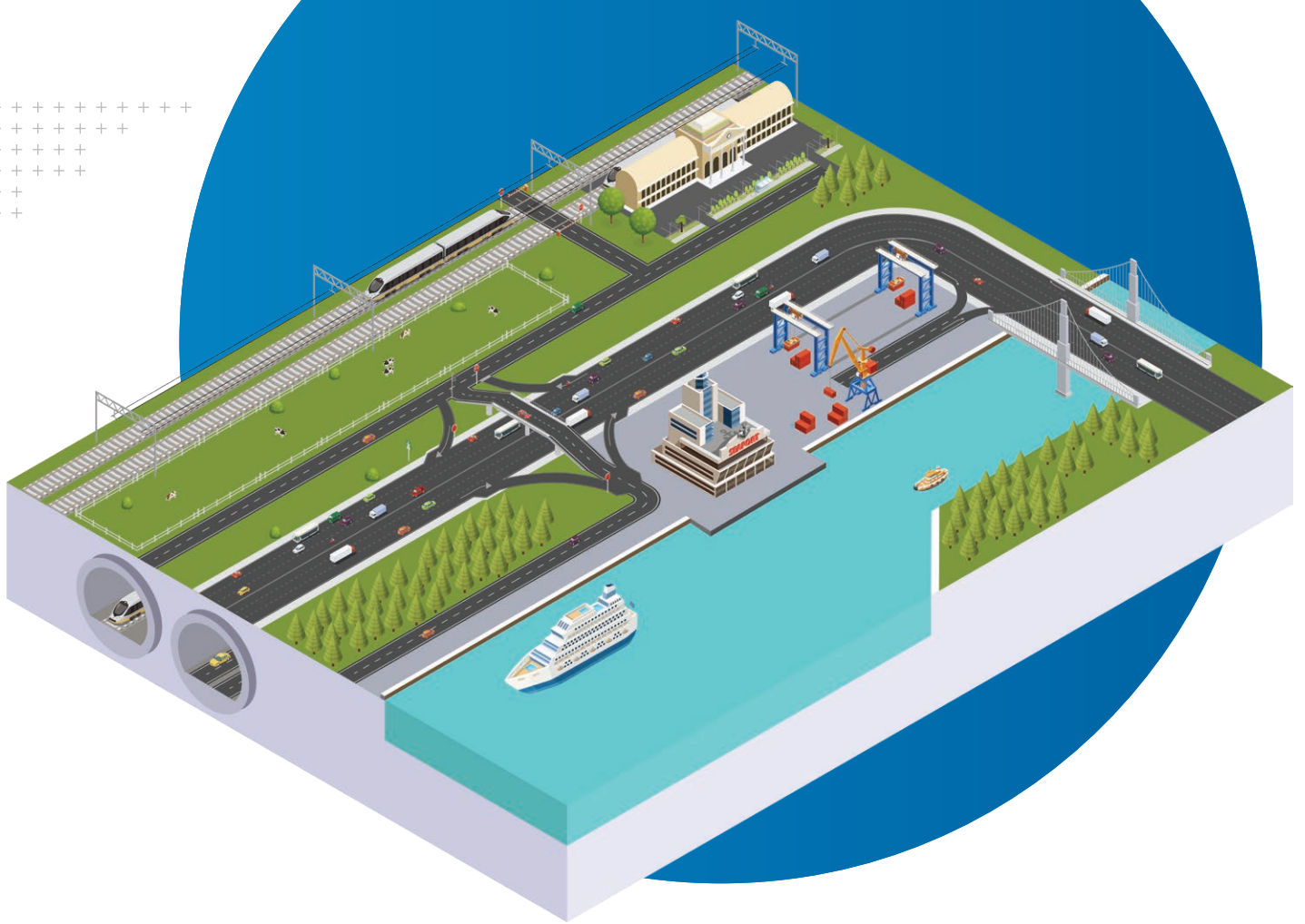
Durable, Resilient Equipment

Trimble total stations powered by MagDrive™ technology offer the best sealed drive solution in the industry to withstand very harsh environmental conditions, such as heavy rain, wind and ice.



Software that Understands Surveyors

Trimble® 4D Control™ (T4D) software is an industry leading platform for automated movement detection. With its history rooted in other Trimble surveying software packages like Trimble Survey Controller™ and Geomatics Office™, T4D is designed to address the monitoring needs of surveyors and construction professionals.



Transportation Infrastructure

Whether it is a highway, metro line, bridge, or a tunnel, the safety of the public and workforce during construction is paramount. An automated monitoring system is crucial for detecting movements to make educated decisions before an issue occurs. Rail monitoring has been streamlined with the introduction of a specialized Rail module, tailored exclusively for the rail industry.



Rail module

- ▶ Seamlessly integrate rail as-builts
- ▶ Leverage geodetic and geotechnical sensors to meet the most demanding rail monitoring project requirements
- ▶ Benefit from rail-specific visualization and deliverables
- ▶ Create real-time alarms to stay informed on the rail track geometry's behavior



Rail Monitoring in Switzerland

Dütschler+Partner AG deployed a monitoring system to continuously monitor rail geometry parameters during a nearby construction. T4D Rail module was used for parameter calculation, data visualization and creating deliverables that aligned perfectly with Swiss rail authority (SBB) requirements.

Christchurch Northern Corridor Monitoring

International Earth Sciences was tasked with monitoring the construction of the Christchurch Northern Motorway. After historic earthquakes in 2011, the area was susceptible to aftershocks and liquefaction. A challenge with this project was consolidating the data from over 2000 geotechnical sensors in one platform.

T4D Control was deployed to provide stakeholders with awareness and notification of significant movements by incorporating all geotechnical and geodetic sensor data with complex analysis and reporting.



Gasworks Tunnel in London

The Central Rail Link Alliance worked with Amey Consulting to monitor 19th century infrastructure during tunnel construction to ensure public safety and construction accuracy.

The cost-effective system provided accurate measurements to detect and verify that movement was within safe engineering tolerances, providing asset owner reassurance for the structural integrity of the tunnel.





Buildings and Structures

Activities associated with construction projects can cause ground movements, vibrations and shocks that affect buildings within the zone of influence of the excavation.

Trimble solutions provide 24/7 monitoring for buildings and other large structures to keep your sites, and the people on them, safe.



Key Benefits

- ▶ Detect performance of buildings subject to influence of adjacent or underground construction monitoring
- ▶ Analyze integrity and stability of a building after significant events
- ▶ Monitor lateral movement, heaving, and settlement resulting from activities such as tunneling, excavation, and piling



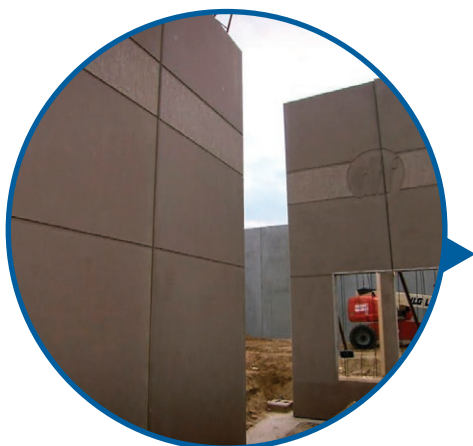
Brisbane Skytower

Because of its proximity to Brisbane International Airport, the Skytower's construction crane could only operate with strict conditions, including continual monitoring of the crane's height. Trimble Distributor UPG, worked with Hutchinson Builders to deploy a real-time monitoring system using T4D Control and Trimble GNSS receivers to alert stakeholders of crane movement and ensure that it did not exceed height restrictions.

Monitoring the Royal Clarence Hotel in Exeter

The Royal Clarence Hotel in Exeter was devastated during a fire in 2016. An effort was undertaken to restore much of the structure for historic and architectural importance. During the construction, it was vital to monitor retained areas to ensure safety of workers on site.

With the help of Trimble Distributor KOREC, Sumo Services deployed T4D Control and an S series total station to monitor the site for movement 24/7. The system proved itself on several occasions by detecting unsafe movement and allowing the construction team to make decisions before continuing, ensuring safety of all team members onsite.



Infrastructure Monitoring in the Northern Territory

Earl James and Associates was tasked with monitoring the subsidence of several critical concrete structures in Australia's Northern Territory. This project required the monitoring to be performed around-the-clock and in all weather conditions. Trimble Distributor UPG deployed a Trimble monitoring system using T4D Control to process, manage, and report on the data while measuring 70 prisms deployed across the site with an S series total station.

Despite harsh environmental conditions, the system was able to continue operating with no down times and the total station can be repurposed once the project is completed to be used on a future project.



Dams and Mining

For mining sites and energy infrastructure, it is important to detect movement, the rate of movement and the rate of increase of the movement in order to identify potential failure modes.

Monitoring provides the information needed to support a safe working environment and efficient mining operations while mitigating the associated risk.



Key Benefits

- ▶ Improve safety and mitigate impact to economic activity downstream through early detection of potential failures of reservoirs, tailings dams, and stock piles
- ▶ Detect movement in dam structure and mine surface relative to environmental factors, including seasonal variations
- ▶ Monitor high walls, excavated faces, and potential unstable slopes to determine hazardous situations



Steenbras Dam in Cape Town

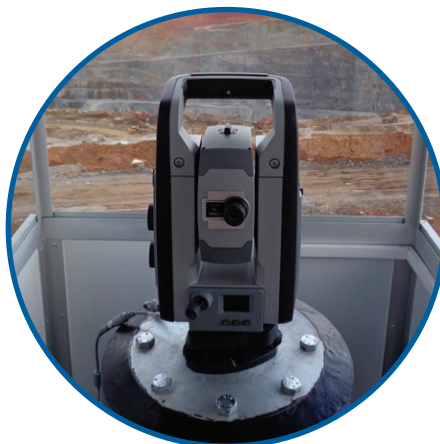
The Steenbras Dam near Cape Town, South Africa is an important resource to the local community. Monitoring the stability and integrity of the dam is crucial as a water and power resource as well as to protect downstream communities.

T4D Control was selected to monitor the dam for its ability to create complex alarming conditions and integrate data from optical, GNSS, and geotechnical sensors. The system has continued to operate since its installation in 2012.

Comprehensive Monitoring of Victoria Dam

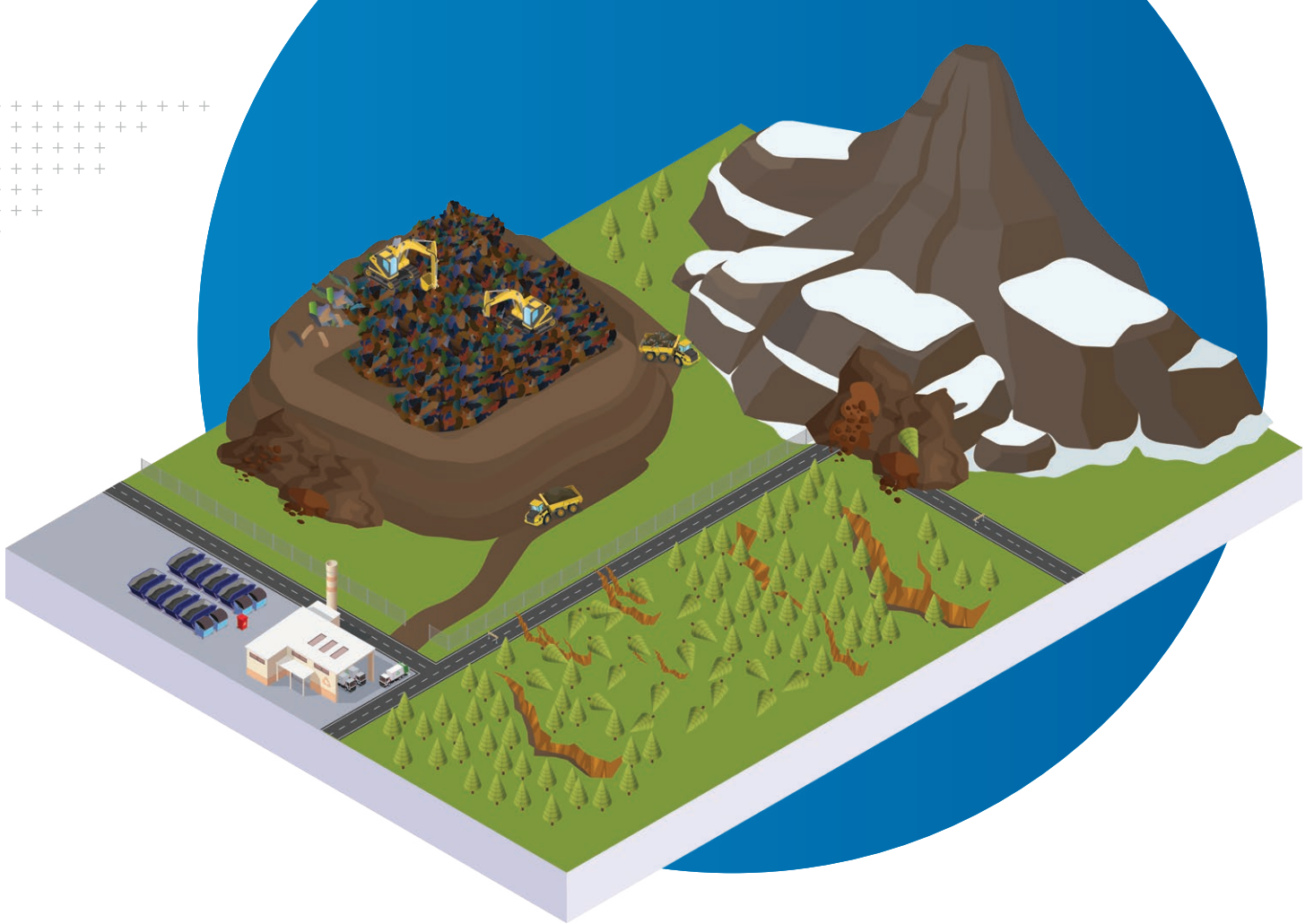
The Victoria Dam is the tallest dam in Sri Lanka and is vital to local agriculture and hydroelectrical power provision. Due to the age of the dam (over 25 years), the Mahawell Authority upgraded their monitoring system to continuously monitor and analyze the structural integrity.

T4D Control along with Trimble GNSS and S series total stations were deployed to provide continuous geodetic measurements of the dam structure. T4D also provides integration of various geotechnical sensors and complex alarming conditions to alert stakeholders whenever movement outside of tolerance is detected.



Frontier Mine

The Frontier Mine in the Democratic Republic of Congo required monitoring of the mine surface for critical movements during blasting operations. Trimble real-time monitoring was deployed using T4D Control and S series total stations to provide reliable and continuous monitoring of the mine surface to alert stakeholders of significant movement resulting from mine operations.



Landslides and Natural Hazards

Natural hazards such as landslides, volcanoes and floodplains are often located in remote areas, making it difficult and time consuming to properly monitor the status.

With an automated monitoring system, the durable equipment can be set up once and relied on to transmit updates to the office for analysis and reporting.



Key Benefits

- ▶ Improve public safety through early detection of landslides and other natural hazard risks
- ▶ Examine movement trends along natural features such as slopes and glaciers to predict long term effects and anticipate issues before they happen
- ▶ Provide early warning system for nearby communities when high levels of movement are detected



Kostanjek Landslide Monitoring

Activated by mining activities in 1963, the Kostanjek landslide is the largest in the Republic of Croatia. Located in the hilly capital city of Zagreb, it is a reactivated, deep-seated, large translational landslide with an area of about a square kilometer. High precision and frequency measurements were required to estimate and predict future landslide movement

Trimble NetR9® TI-M GNSS reference receivers and Trimble 4D Control were deployed to monitor the slope, making use of T4D's multiple GNSS processing options. Daily monitoring of movement with high precision enables measurements of small displacements, which is particularly important for the analysis of slow moving landslides.

Denali Slope Subsidence Monitoring

The US National Parks Service deployed a real-time monitoring system after a landslide occurred during the spring season blocking traffic on a popular road.

A Trimble real-time monitoring system was deployed with T4D Control and an S series total station to detect any future movements in the slope to alarm stakeholders of movement. This assists the decision making process to ensure the visitors using the road are safe and that access is maintained. One primary challenge on this project was the remote location and harsh climate. Trimble hardware is proven in tough climates to handle long periods of exposure between maintenance cycles.



Landslide in Åkerneset

The Åkerneset area contains many large, steep mountain slopes that have potential to cause tsunamis from landslides, which can drastically impact nearby communities. Cautus Geo was employed to monitor a large mountain landslide in the Åkerneset area of Norway. This involved deploying T4D Control, a Trimble S series total station, GNSS, and a variety of geotechnical sensors. This system continues to keep a close eye on the steep fjord landscape to alarm stakeholders when movement is detected and make informed decisions.



Solution Components

Trimble 4D Control Software



The Trimble 4D Control real-time monitoring software provides movement analysis and visualization so you can easily manage one or multiple monitoring sites. It is the core of a monitoring project because it controls the measurements from optical, GNSS, and geotechnical sensors, manages and analyzes the data and alerts, delivering the data you need to make timely decisions.

Settop M1 Communication Box



The Settop M1 total station controller allows you to stay connected and transfer data continuously to the office. In case of power outages or interruptions, the Settop M1 ensures the data is safely stored on a local disk.

Trimble Access Monitoring Field Software



The Trimble Access™ Monitoring field software provides streamlined workflows to set up, monitor and report on deformation surveys. Improve efficiency by saving measurements for subsequent visits and review reports of displacement above specified tolerances in the field. Import the JobXML file into Trimble office software such as Trimble Business Center or Trimble 4D Control for further processing in the office.

Trimble R750 MON Monitoring GNSS Receiver



The Trimble R750 MON is ideal for automated monitoring projects. The integrated 4G LTE modem allows the receiver to work seamlessly with Trimble 4D Control software to create real-time analysis, reporting, and alarms for movement detection.

Trimble Total Stations



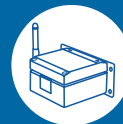
Designed to handle demanding jobs and difficult environments, Trimble total stations withstand harsh conditions over long periods of time. Built on proven Trimble MagDrive technology, Trimble total stations are the most durable optical instruments in the market, providing silent operation that will not disturb residents or businesses. The S-series models are ideal solutions for monitoring applications where accuracy and reliability are paramount.

TBC Monitoring Office Software



The TBC Monitoring module enables surveyors to process, manage, and report on manual monitoring projects using survey data from GNSS, total station, level, and scanning sensors. Visualize displacements in 3D and in comprehensive reports to provide clients with a complete picture of movement across the project.

Trimble Geotechnical



The Trimble-branded geotechnical product line, powered by Worldsensing, provides a fully automated wireless monitoring solution that helps minimize field visits and increase on-site safety to obtain manual readouts. The automated measurements generate real-time notifications and automated reporting through the new Trimble 4D Control software Geotechnical Edition.

Contact your local Authorized Trimble Distribution Partner for more information

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