TRIMBLE MONITORING SOLUTIONS
MEASURING CHANGE
With decades of experience around the world, Trimble’s flexible and scalable monitoring systems meet a wide range of project requirements.

- Bridges and viaducts
- Dams and levees
- Highways and roads
- Rail lines
- High-rise and historical buildings
- Construction sites and power plants
- Landslide and slope monitoring
- Land subsidence
- Crustal movement and plate tectonics
- Tunneling
- Early Warning
- Volcano’s
- Earth Quakes

THE ROLE OF MONITORING
Monitoring—the measurement of change over time—plays a vital role in project safety and management. For infrastructure, construction projects and natural structures, it’s important to understand what is changing, the rate of change and the rate of increase of change. This provides the data needed to detect performance degradation and potential failure of the structure.

STRUCTURAL SAFETY
Ensuring the integrity of a dam, mine, bridge or other structure is critical to the success of a business and safety of a project. A monitoring system can detect change and issue alerts in real-time, enabling you to spot problems before they occur. Rapid notification lets you move people and equipment away from hazardous locations. In some instances, it can even save lives.

INFORMED DECISIONS
Decisions that affect safety, costs and schedules rely on accurate information. Trimble monitoring systems provide up-to-the-minute data on the condition and behavior of land or structures. The information enables project stakeholders to make efficient use of resources to address potential problems.
As the world leader in precision GNSS and total stations, Trimble enables professionals to create a system for projects of any size and scope. You can combine Trimble instruments and software with external geotechnical sensors to create complete, customized monitoring solutions.

**TRIMBLE NETR9 GNSS REFERENCE RECEIVER**
Trimble GNSS provides continuous high precision measurements and rapid updates to monitor over long distances. The Trimble NetR9™ GNSS Reference Receiver includes features and performance designed for scientific and monitoring applications. Compact and rugged, the Trimble NetR9 is capable of tracking all existing and planned GNSS signals. The new Trimble NetR9 Ti-M receiver is now supported for real-time monitoring applications.

GNSS reference receivers often operate unattended for long periods in remote locations. The Trimble NetR9 uses built-in Internet Protocol (IP) to provide robust communications and control. In addition to reliable data transfer, the Trimble NetR9 can be controlled, configured and updated via a built-in Web interface. To provide highest accuracy, the Trimble NetR9 supports the Trimble Ag25, Trimble GNSS Choke Ring, and the Trimble Zephyr™ 2 GNSS geodetic antennas.

**TRIMBLE S8 TOTAL STATION**
Designed to handle demanding jobs and difficult environments, the Trimble S8 Total Station is the most advanced total station solution available. It’s ideal for engineering and monitoring applications that depend on fast, accurate measurements. The Trimble S8 combines Trimble FineLock™ technology with long-range, distance measurement to provide fast, precise monitoring measurements. You can measure to targets up to 2,500 meters away with one-centimeter accuracy. In urban or residential areas, Trimble MagDrive™ Servo technology delivers silent operation that won’t disturb residents or businesses.

**TRIMBLE REF TEK SENSORS**
REF TEK has always been your unshakable source of recording instruments for hazard mitigation and earthquake research. Now, the data can be put directly into Trimble’s Monitoring Solution. Trimble 4D Control now supports peak acceleration using REF TEK hardware. This data is stored in the Monitoring database where alarming and visualization can be controlled through the web interface.
THE MECHANICS OF MONITORING

In a monitoring project, the use of geodetic, geotechnical and other sensors provides periodic observations of objects to detect physical changes such as unusual stress and strain, cracks and other deteriorations which occur due to factors such as loading, corrosion, fatigue, temperature and time. At user-specified intervals, the sensors take measurements to determine any changes in position, length or tilt. When the expansion/contraction properties of a geotechnically instrumented body are known, the additional use of prisms/GNSS to also monitor the position-related changes greatly enhances the quality control of the monitoring system. The data is collected by software that computes and records the results, visualizes the changes and alerts stakeholders when needed.

A WORLD OF APPLICATIONS

Trimble’s monitoring expertise comes from decades of experience in monitoring and measurement technology. Trimble systems are at work around the globe. Every monitoring project has unique requirements in locations, conditions, deliverables and performance. Trimble scalable monitoring systems provide the tools you need to adapt to a wide variety of project requirements.

STRONG MOTION STRUCTURAL MONITORING, CANADA

Areas with extreme seismic activities can cause devastating effects to communities and infrastructures. In British Columbia, a strong motion state of health seismic instrumentation network is installed on the new Port Mann Bridge. The system comprises a complex array of ground and down hole stations, accelerographs, cable and structure accelerometers, displacement transducers, wind, temperature and humidity sensors, extensometers, piezometers, gauges and software for real-time monitoring of ground motions and structural responses resulting from seismic activity, traffic activity or any other extreme loading conditions.

HIGH SPEED RAIL TUNNELS, SPAIN

Projects that require frequent measurement are ideal for automated monitoring. An automated system measures points repeatedly, often many times each day. In Barcelona, where a new railway tunnel is constructed beneath the city, project engineers needed to guard against damage to historic structures on the surface. A network of 31 Trimble S8 Total Stations made continuous measurements to 2,800 prism targets along the tunnel’s route. As construction progressed, the instruments could be relocated to monitor new sections of the projects.

COAL MINING, THAILAND

Monitoring large project areas call for precise measurements, reliable data transfer and low-maintenance sensors. In Thailand’s largest opencast coal mine, a Trimble S8 Total Station uses Trimble Long-Range FineLock to monitor more than 50 targets in the enormous mine. Wireless data links connect the instrument to the Trimble 4D Control server, where engineers manage the system and conduct analyses using the SQL database. Using automation and remote control, Trimble monitoring systems can reduce the need to enter difficult or hazardous areas.
TRIMBLE 4D CONTROL SOFTWARE

Software is the core of a monitoring project. It triggers alarms based on user defined thresholds as well as controls the measurements, manages data and compiles and analyzes the results. From campaign monitoring to real-time, multi-sensor operations, Trimble 4D Control can handle the challenge of complex monitoring applications. The latest version of Trimble 4D Control software is built on the PIVOT™ (Progressive Infrastructure via Overlaid Technology) concept. This allows for rapid deployment, simplified configuration, comprehensive reporting and real-time alarms.

HIGH RISE APP
The High Rise App is intended to monitor high rise structures during construction using GNSS and inclination sensors. The app delivers precise and reliable coordinates on demand.

TRIMBLE 4D CONTROL SITE SETUP APP
Trimble 4D Control software supports full integration in a site setup. A user can now do a site setup standing next to instrument utilizing all communication layers (USB, Bluetooth, radio, etc.) including the video capabilities in the vision instrument. This allows the user to create, enhance and modify a site setup and import the job into the software.

SEISMOGEODETIC APP
The SeismoGeodetic App in Trimble 4D Control allows for strong motion and high frequency data to be integrated into the software. This allows for the combined processing of accelerometer and GNSS data using a Kalman filter to deliver the below features:

- Data processing in Real-time and Postprocessing engines.
- REF TEK’s MRF and Passcal integration for full support of all REF TEK products.
- Advanced alarming.
- ERYO version 2.21 data storage and data streaming.
- Peak detection and database storage.
- Web visualization of high frequency data.
- Integrated storage for high frequency data.

KEY FEATURES

COLLECT AND MANAGE DATA
A Trimble monitoring system automatically manages measurement cycles, communications and the flow of incoming data. In addition to Trimble optical and GNSS sensors, Trimble 4D Control supports a wide variety of geotechnical instruments.

COMPUTATIONS AND ANALYSIS
Trimble 4D Control provides tools for rigorous analysis on your monitoring data. Your results arrive quickly and easily. And because the raw information is stored in an SQL database, it’s easy to extract your data for use in external applications.

VISUALIZATION AND MAPPING
Use Trimble 4D Control to create visual results using maps, charts and graphs. You can import photographs and aerial images to provide basemaps and backgrounds for real-time data on sensors and project status.

AUTOMATED ALERTS AND ALARMS
You can define sets of conditions for alarms, including tolerances for displacement at any point. When needed, Trimble 4D Control sends alarms via SMS and email to specified stakeholders.