Structural Health Monitoring
TRIMBLE MONITORING SOLUTIONS

SOLUTIONS FOR SAFE STRUCTURES

The Role of Monitoring

Monitoring installations are crucial for buildings which are subject to vibration, ground movement, extreme weather conditions and construction activities.

It is important to detect movements, vibrations, structural changes and responses of buildings to these local conditions in order to identify potential failure modes.

Monitoring provides the information needed to support a safe living and working environment by continuously verifying the ability of buildings to perform their intended function.

The growth in the number of tall buildings and MRT(Mass Rapid Transit) projects requiring the construction of tunnels beneath buildings results in an increased demand for building monitoring.

The Focus of Monitoring

The performance of buildings subject to seismic and micro seismic activity and the influence of adjacent or underground construction can be monitored by the system.

The integrity and stability of a building after a significant seismic event may be rapidly determined using the data captured by the monitoring system.

Lateral movement, inclination, fracturing, heaving, settlement and fatigue resulting from activities such as tunneling, excavation, piling and drilling may be tracked.

Trimble 4D Control

Trimble® 4D Control™ software is the key element of the Trimble Monitoring system. The modular design facilitates an industry specific solution capturing data from GNSS, optical, geotechnical, seismic and metrological sensors.

The data is processed using advanced, state-of-the-art algorithms and presented in a powerful, yet user friendly Web Interface. It provides a variety of visualization and analysis tools to identify potential failure scenarios.

A fully featured computation parser can be used to create customized observables presenting information of specific interest to the analyst.

Frequency domain analysis using Fast Fourier Transforms can be performed to determine changes in the physical characteristics of a building.

Boolean comparators are used to integrate data from GNSS, optical, geotechnical, seismic and atmospheric sensors to create complex Alarm notifications are issued by email and SMS to selected recipients and the system

Designed for Demanding Environments

The Trimble Structural Health Monitoring Solution is designed specifically for the seismic, structural, modal and survey monitoring analyst.

It complies with the building code requirements of cities in seismically active areas in the United States such as Los Angeles, San Francisco.

Intricate data from multiple sensor types is converted into meaningful information from which informed decisions can be made with confidence.

Key Features

▶ Automated, real-time monitoring system
▶ Structural health monitoring
▶ Distributed systems
▶ Centralized systems
▶ Seismic response monitoring
▶ Construction response monitoring
▶ Post disaster structural integrity monitoring

®Trimble

Solutions to Meet Building Codes

Installation of earthquake recording instrumentation in every building over six stories with floor area over 60,000 square feet, or every building over ten stories is required by the Building Codes of several US cities (Los Angeles, San Francisco, etc.). The minimum required instrumentation is three accelerographs, interconnected for common triggering and timing.
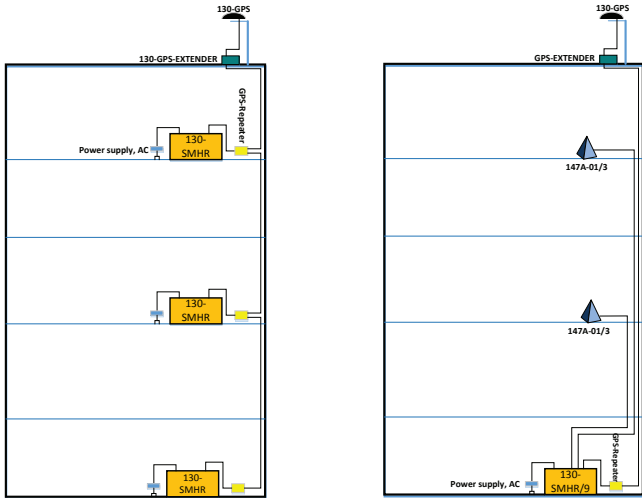
Distributed recording system

Centralized 9-ch. recording system

Centralized multichannel recording system

These are located in the basement, mid-height and near the top of the building. Trimble REF TEK's strong motion accelerograph, model 130-SMHR, is an ideal solution for monitoring different levels in a building. The system is designed to provide different options based on the structure complexity: from distributed three recorders system to a centralized either nine or multiple channels system (130-MC with 12-ch, 18-ch, 24-ch, 30-ch, 36-ch, etc.) The 130-MC with accelerometers located at different levels and connected to the central recording unit is designed to monitor different levels in the building.

Trimble REF TEK's High Resolution Accelerometer, model 147A-01 converts acceleration signal into voltage signals to measure various low and ultra-low frequency motions. Advanced features of the 147A-01 accelerometer include high sensitivity, large linear range, high resolution, and high dynamic range. The 147A-01 accelerometer is available in triaxial and uniaxial configurations.

There are three basic Trimble REF TEK Seismic and Earthquake Engineering System concepts for structural instrumentation:

- Distributed Seismic Recorders
- Centralized Seismic Recorders
- A combination of both distributed and centralized

A distributed recording system is one that deploys multiple 130-SMHR Accelerographs with internally built triaxial accelerometer.

A centralized structure instrumentation system is one that deploys the 130-SMHR/9 Accelerograph with built-in thriaxial accelerometer (147A-01/3) and two input channel connectors to acquire data from external either two triaxial or 6 uniaxial accelerometers. If the monitoring system requires to install more than 9 recording channels, then a Cantral Recording Multi-Channel Accelerograph, model 130-MC is deployed in the structure. The 130-MC Accelerograph is available in 12- or 18-channel configurations. 130-MC Accelerograph can be connected to triaxial, uniaxial or borehole accelerometers.

Accommodating the large scale needs of today's market, the 130-MCs, with fully featured network capabilities, can be installed in and around the structure, whether it be a campus, a single building, a bridge or a dam. The design of the structure and the engineering preferences determine which system to select.
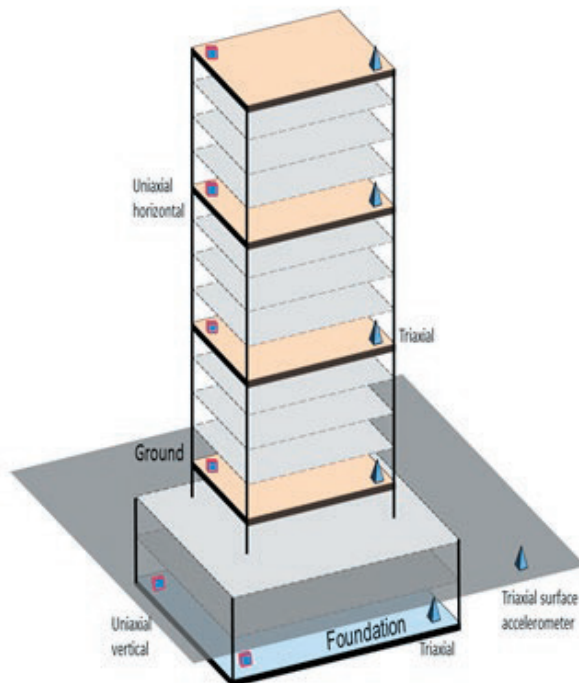
TRIMBLE REF TEK 130-SMHR

A strong motion 24-Bit Strong Motion Accelerograph that combines the third generation broadband seismic recorder and an advanced low-noise, force-feedback accelerometer.

TRIMBLE REF TEK 147A

A triaxial force balance accelerometer that converts acceleration signals into voltage signals to measure various low frequency and ultra-low frequency motion.

TRIMBLE REF TEK 130-MC

Offers a singular solution for multiple applications with built-in communication facilities to allow for real-time and on-demand data collection. The 130-MC is available in a 12 or 18 channel recording scheme with advanced telemetry built-in for real-time data collection for every channel.

TRIMBLE S7, S9 TOTAL STATIONS

Advanced total stations that combine Trimble FineLock™ technology with long-range, distance measurement to provide fast and precise monitoring measurements.

TRIMBLE NETR9® TI-M GNSS RECEIVER

A full-feature, top-of-the-line receiver with an industry-leading 440 channels for unrivaled GNSS multiple constellations tracking performance intended for monitoring applications.

TRIMBLE 4D CONTROL MONITORING SOFTWARE

A powerful monitoring software that integrates GNSS, optical and geotechnical sensors to collect and manage data, provide computation and analysis, visualization and mapping and alerts and alarms.

TRIMBLE COMPASS DATA PROCESSING SOFTWARE

The interactive Compass program works with distributed and centralized systems. It makes initial and quick analysis of seismic waveform data and creates reports and graphic displays. Advanced seismic signal processing algorithms include: offset removal, reverse sign, apply filters, apply smoothing functions, perform integration and differentiation, FFT, etc.
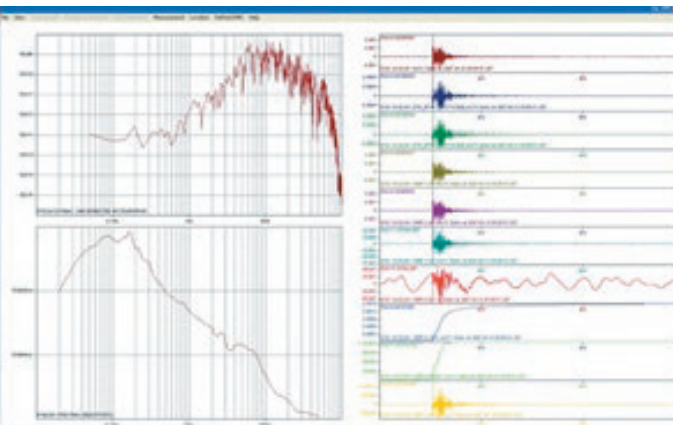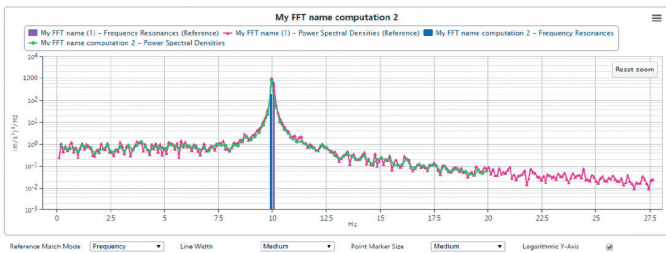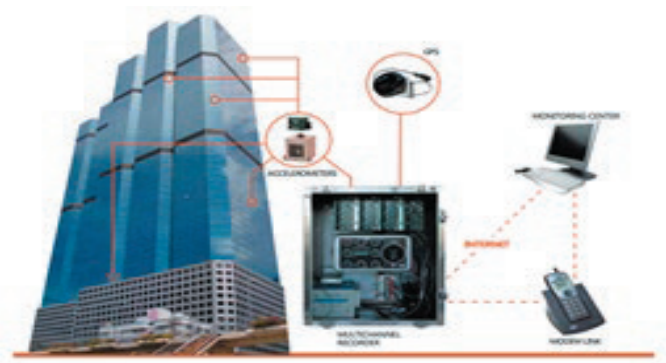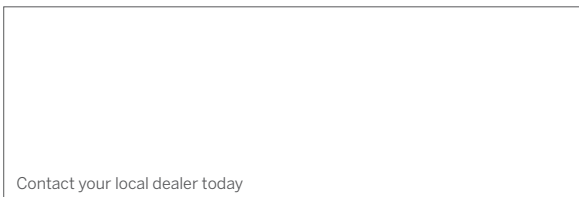
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