



Monitoring & Services

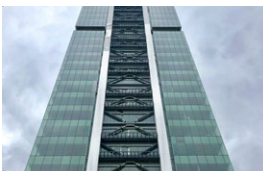
Infrastructure | Buildings | Industrial structures

ROBO[®]QUAKE – earthquake monitoring, alarm and protection system



ROBO[®]QUAKE for buildings

reliable, smart, modular



mageba



Earthquake monitoring system

Concept

ROBO®QUAKE is a fully integrated structural health monitoring system (SHMS) that provides assessments and deep insights about the structural behaviour before, during and after seismic related activity. This system is comprised of multiple interconnected electronic components that work as a system.

Accelerographs: Ultra sensitive acceleration measurement and recording devices which are designed to detect strong ground motion resulting from earthquakes as well as other kinds of acceleration anomalies.

Main data unit: An assembly of sophisticated hardware with integrated software and special algorithms responsible for the acquisition, processing, recording, transmission and reporting of data.

Add-ons: A series of add-ons are available that extend the functionality of the ROBO®QUAKE system. These add-ons extend from additional sensors of any kind, instrument control channels based on event intensity, voice alarms and many others.

Key features

- Modular extendable system
- Easy to use with plug & play features
- Low cost and low maintenance
- Allows control of electronic instruments
- Broadband and 4G enabled
- Mobile accessibility through a web interface
- Real-time insights with secure web log-in
- Real-time event intensity identification
- Automated event reports
- Notifications (SMS, Email, APP and within installation site)
- Accepts any kind of sensor
- Wired and optionally wireless data transfer

The main unit is placed in a dedicated location within the structure and is connected to the accelerographs as well as other measurement devices through wired or wireless transmission protocols depending on the structural conditions and code specific requirements.

Hardware

All hardware used within the ROBO®QUAKE system is compliant with international codes as well as communication & safety regulations such as European Conformity CE and Federal Communications Commission FCC. Multiple internationally required directives are also covered, such as “Low Voltage Safety”, “Electro Magnetic Compatibility” and “Potentially Explosive Atmospheres”.

Connectivity

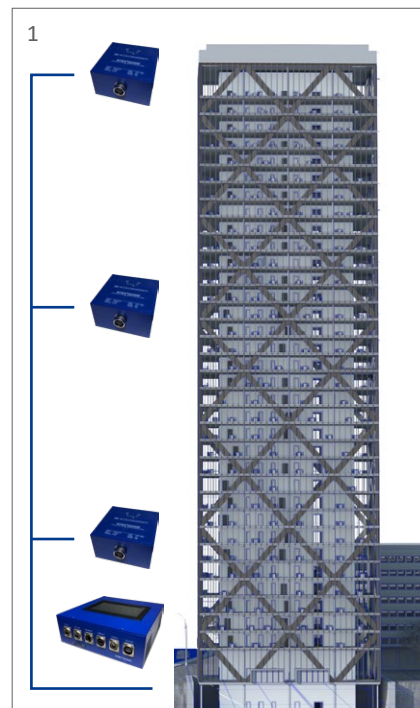
The main data unit is able to access mageba’s Internet of Things (IoT) through the building’s broadband connection or through standalone cellular network connectivity. The cloud then takes all data for storage, further processing and visualizations.

A web application allows users to access their projects where they can securely login to a dedicated dashboard, showing real-time data, historic records & insights about the measurements. Additionally, a log of events is also available.

Analysis, reporting and notification

A series of easy to understand charts and graphs are designed to allow experts and non-expert users to gain a clear understanding of the measured structural characteristics. Data is also available for download in a tabular form. An event report is automatically generated when a trigger setting (e.g. equivalent to a moderate seismic event) is exceeded. In addition, on-demand reports can be generated for further use for post-event assessment purpose.

Further, events also trigger automatic notifications in multiple forms, such as SMS, APP notification, voice alarms and emails.



1 Typical configuration for high-rise building
2 ROBO®QUAKE control LCD
3 ROBO®QUAKE local software dashboard

Flexibility to meet end-users' needs

ROBO®QUAKE Acceleration Monitoring

The acceleration monitoring package allows for structural monitoring through connectivity to accelerographs installed in predefined locations in a building allowing capturing of any anomalies in structural responses during earthquakes or other acceleration events.

ROBO®QUAKE Measurement Add-ons

From a structural dynamics standpoint, acceleration responses are also accompanied by many other variations in structural physical properties. Such properties include story drifts (displacements), rotations, inclinations, vibrations, cracks and others. Additional sensors can be integrated into the ROBO®QUAKE system to capture these properties, which allow the user to get more out of the monitoring system in case of events as well as non-event conditions. A series of sensors and algorithms are available to allow ROBO®QUAKE to act as a full structural health partner to structural engineers.

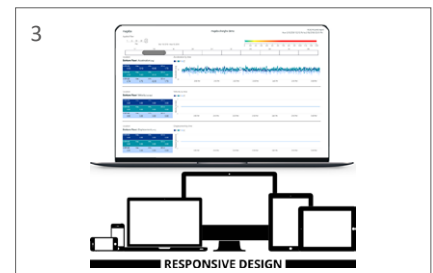
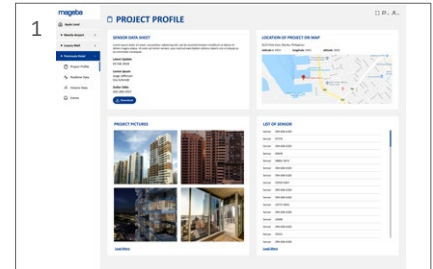
ROBO®QUAKE Control Add-ons

Immediate post-trigger actions are often the main factor in seismic hazard mitigation. Structural monitoring insights provided by ROBO®QUAKE are crucial for understanding the structural condition during and after an earthquake. The ROBO®QUAKE control add-ons allow taking seismic hazard protection to the next level by giving the ability to control virtual structural instrumentation such as local voice alarms or hazard warning systems, shut-off valves for gas, water and others. Based on the insights available from either the acceleration monitoring or structural health monitoring packages and relying on state of the art algorithms as well as a “two out of three” error control mechanism, the ROBO®QUAKE control add-ons play an important role in structural seismic protection.

ROBO®QUAKE subscription plans

Multiple flexible subscription plans are available to address different end users' requirements levels.

- 1 Web dash board
- 2 Generated report insights
- 3 Responsive design inclusions



ROBO®QUAKE subscription plans

Section	Item	ROBO®QUAKE Basic Tier	ROBO®QUAKE Bronze Tier	ROBO®QUAKE Silver Tier	ROBO®QUAKE Gold Tier	ROBO®QUAKE Titanium Tier
Management	Number of accounts (Log-in Credentials)	1	1	1	2	4
	Multi-Project Dashboard	No	No	No	No	Yes
Real-time	Real-time Cloud Session period [hr/day/account]	-	-	1	2	3
	OR Real-time Cloud Session period [hr/day] for 1 account only	-	-	1	4	12
Historic	Historic data view	Yes	Yes	Yes	Yes	Yes
	Historic data refresh rate	Daily	Daily	Daily	Hourly	Per minute
	Storage and insights of historic non-event data	Temporary (1 day)	Temporary (1 week)	Temporary (6 months)	Temporary (1 year)	Permanent
	Storage and insights of historic event data	Temporary (1 hour)	Temporary (1 day)	Temporary (1 week)	Permanent	Permanent
Alarm Notifications	APP Notifications	Yes	Yes	Yes	Yes	Yes
	EMAIL	1	1	2	4	8
	SMS [Cell Phone Numbers]	-	-	2	4	8
	AUTOMATED CALL [Cell Phone Numbers]	-	-	2	4	8
Add-ons / Peripherals	Special Channels (FDAS, Central Alarms, Monitors)	-	Possible	Possible	Possible	Possible
	Additional Measurement Channels (Sensors)	-	-	Possible	Possible	Possible
	Control Channels (Equipment Control)	-	-	Possible	Possible	Possible
Reports	Event reports	Yes	Yes	Yes	Yes	Yes
	Hardware error reports	-	Yes	Yes	Yes	Yes
	Periodic status reports	-	-	Yes, Quarterly	Yes, Monthly	Yes, Monthly
Maintenance	Software updates	Manual by user	Manual by user	Remote	Remote	Remote
	Remote Inspection and software maintenance	No	No	Yes, Quarterly	Yes, Monthly	Yes, Monthly



Technical specifications

Data acquisition	
General principle:	Continuous real-time mode acquisition
ADC Resolution:	16 bits
Sampling rate:	From 0.01 to 1500 SPS
Max. possible sampling rate:	200 kSps
Number of channels:	16 channels (acquisition), 7 Digital outputs (control and alarms), 1 voice output.
Channel skew:	Simultaneous sampling on all input channels
Data filter:	Anti-aliasing filters
Trigger filter:	Digital IIR filter: 0.5 – 15 Hz band-pass (Strong Motion Applications)
Triggering mechanism	
Level:	0.1 % to 100 % F.S.
Selection:	Independent trigger per channel
Post trigger:	10 seconds prior to event and 10 seconds post-event data is available at maximum sampling rate
Post trigger automation:	Automatic self-adjustment from 20 times to 1000 times depending on event magnitude
Trigger delay:	0.5 ms
Data logging and processing	
Principle:	Real-time processing (PGA, PGV and PGD)
Processor:	Dual core 1.4G
RAM:	8 GB DDR SDRAM
Timing:	Internet NTP
Raw data:	Binary form. Available in tabulated form from the web APP
Database:	mageba SQL Server with replication back-up
Max. recording time:	Unlimited
File format:	Downloaded as CSV with headers
Storage	
Local storage:	32 GB (Accelerographs) 500 GB SSD HD (main unit)
Cloud storage:	Unlimited
Removable storage:	N/A
Environmental	
Temperature:	-20° to 70°C
Operational Humidity:	0-100 % RH (non-condensing)
Enclosure rating:	Accelerographs: IP67 Main unit requires external IP67 enclosure

User interface	
Main interface:	Online interface through secure login on home page
Local interface:	Direct connection to mini-pc operating system and local user interface
Visualizations:	Real-time sessions upon login, historic records, peak values, trigger readjustment recommendation through cloud machine learning algorithm
Alarms:	Synchronized with trigger and optionally independent
Alarm setting:	Factory setting and optionally through web interface
Alarm methods:	Email, SMS and optionally pre-recorded voice announcement
Alarm connectivity:	Optionally can be connected to separate alarm system through a dedicated output channel
Reporting:	Downloadable situation report showing full event insights (in case of event) and showing normal service situation (otherwise)
Report file format:	PDF
Connectivity	
NET (wired):	10-BaseT, TCP/IP, UDP/IP, FTP, RTP
NET (Wireless):	300 Mbps 300 M 802.11b/g/n Wireless WiFi or 4G LTE
Sensors:	9 enabled analogue port (optionally up to 16 channels)
Control / output:	1 enabled digital output port (optionally up to 5 digital channels)
Power supply	
Power:	24 V DC IN
Supply voltage:	100 - 240 V AC, 50 - 60 Hz, internal AC/DC
Internal battery:	Optional 12 V, 20 Ah
External battery:	Optional up to 120 Ah
Power cut-off mechanism:	System sleep @ 10% battery level. Auto wake-up on recharge state.
Over voltage protection:	Reverse voltage, over/under voltage, self-resettable fuses
Accelerograph	
Type:	Triaxial force balance accelerometers (X, Y & Z)
Frequency range:	Typ. 100 dB @ 200 sps
Dynamic range:	Electronically selectable range: ±4 g, ±2 g (nominal), ±1 g, ±0.5 g, ±0.25 g, and ±0.125 g
Sensitivity:	< 1.25 %
Orientation:	Horizontal or vertical mounting (adjusted upon request)
Minimum measured intensity:	25 mg "LIGHT" for ±2 g (nominal) setting accelerograph

mageba ROBO®CONTROL systems



"Portable"



Permanent "BASIC" & "ADVANCED"



"SMART"



"QUAKE"



engineering connections®