STRONG MOTION ACCELEROGRAPH

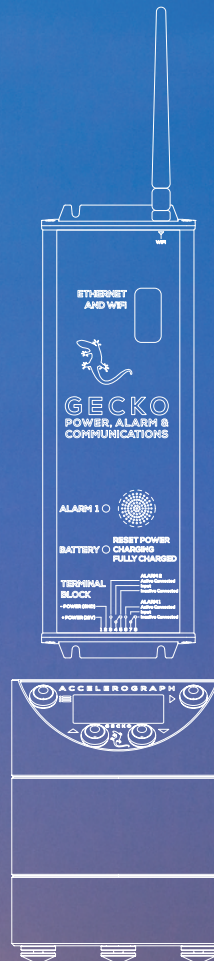## EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS

The image at left shows three Gecko SMA-HR accelerographs in a single building recording the magnitude 6.1 Luzon earthquake that occurred on 22 April 2019.

The accelerographs were installed in the lowest basement, 9th floor, and 18th floor of a building located about 100km east of the earthquake epicentre.

The waveform data shows that the **peak North-South axis acceleration** on the **18th floor** was **over 4x higher** than the input ground motion recorded in the **basement**.

Although in this case the levels of acceleration are well below damage or alarm thresholds, the data can be used by engineers to analyse structural response and performance during earthquakes.

18th FLOOR
EAST-WEST
NORTH-SOUTH
UP-DOWN

9th FLOOR
EAST-WEST
NORTH-SOUTH
UP-DOWN

BASEMENT (6th level)
EAST-WEST
NORTH-SOUTH
UP-DOWN

GECKO SMA-HR

GECKO
POWER, ALARM & COMMUNICATIONS

ETHERNET AND WIFI

ALARM 1
BATTERY — RESET POWER / CHARGING FULLY CHARGED
TERMINAL BLOCK

ACCELEROGRAPH

MADE IN AUSTRALIA

bsi ISO 9001 Quality Management

Structural Monitoring Instrumentation

- Gecko SMA-HR accelerograph
- Power/Comms/Alarm wall box
  - Ethernet-WiFi adaptor
  - Battery charger
  - Alarm relay outputs
- GPS antenna
- 40m GPS cable
- AC plug pack

Technical Specifications

Accelerometer - SMA-HR
- Triaxial Force Feedback
- ±2g full scale range
- DC (200s) to 800Hz bandwidth
- Self noise <1μg over full bandwidth

Recorder
- 3-channel with simultaneous sampling
- 32-bit ADC per channel, dynamic range of 137dB @100sps
- User-selectable rates up to 4000 samples per second (default 100sps)
- 32GB SD card included, larger capacities supported
- Internal GPS receiver for 100 micro-second timing accuracy

Inputs
- LCD and 4-button keypad user interface - no laptop required
- Coaxial GPS aerial connection
- 2-pin 12V input socket (for battery charger)
- 6-pin alarm and comms socket (for alarm and communications)

Outputs
- Continuous MiniSEED format data stored to SD card
- Seismic trigger alert (set to approximately ±0.1g for PEIS 6)
- Instrument alert (on-screen alert for power, temperature, memory)
- Data streaming over Ethernet or WiFi to "Streams" software

Physical - SMA-HR
- Diameter: 136mm
- Height: 185mm
- Weight: 2.7kg
- Protection: IP67: dust-proof, waterproof to 1 metre for 30 minutes
- System power consumption <3W, accelerograph battery backup >12 hours

Accessories included in structural monitoring bundle
- Gecko Power, Alarm & Communications wall mounted box with cables
- 100-240V 50/60Hz AC power supply with US input plugs and 12V DC output
- M8 DynaSet drop-in anchor and punch
- 10mm masonry bit
- M8 threaded rod with acetal Gecko lock nut
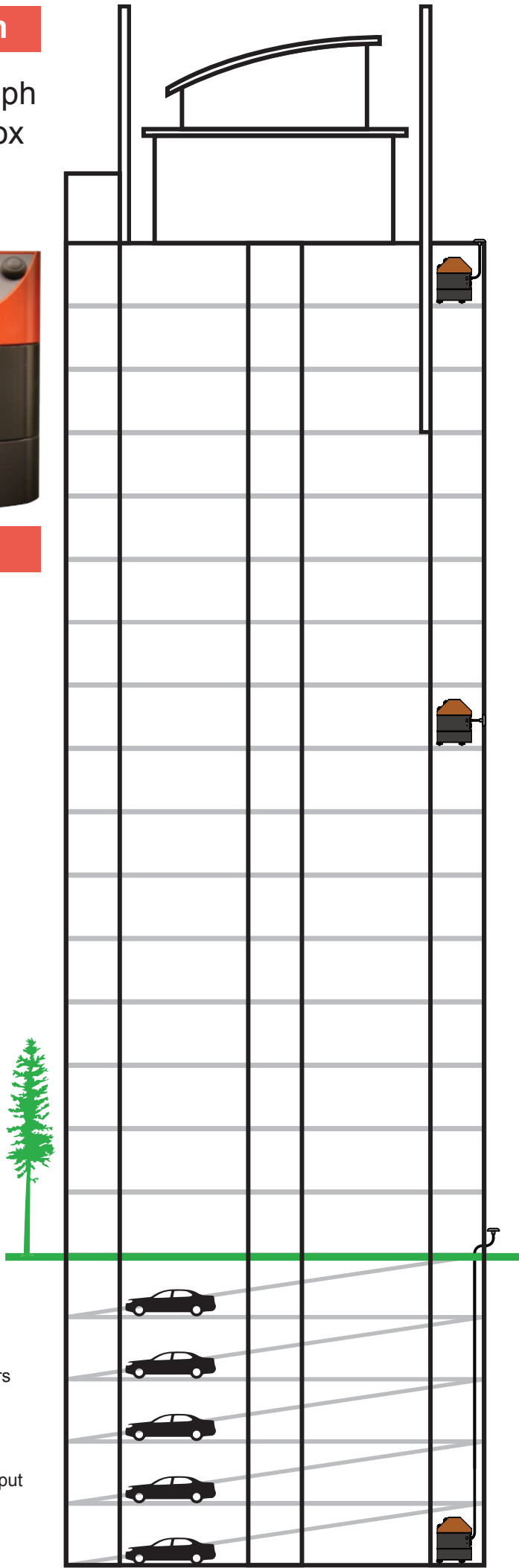
GECKO SMA-HR
The affordable professional accelerograph

The Gecko SMA-HR accelerograph is the ideal solution for structural monitoring of buildings. With its earthquake-observatory grade sensor, you can detect the natural frequency of your building from small, non-damaging earthquakes, as well as perform highly accurate dynamic analysis of the structure after the largest of earthquakes.
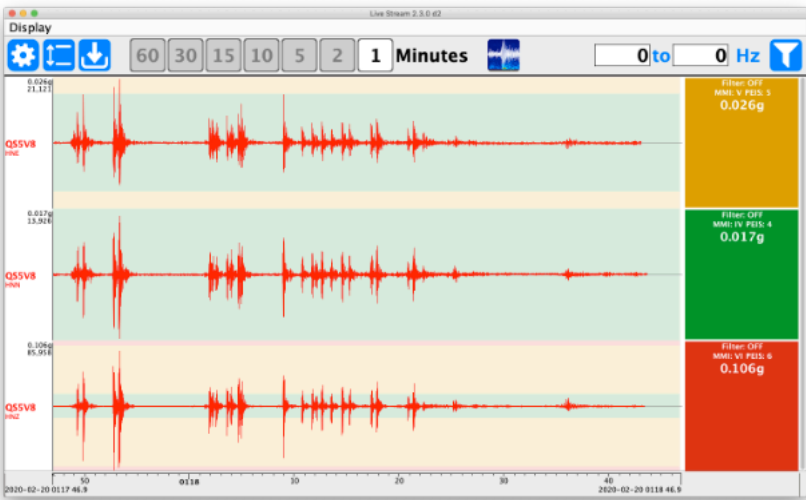
The acceleration sensor is sensitive enough to record earthquakes that are not detectable by human perception, so it is certainly capable of recording the motion of any earthquake that may be large enough to be of concern to building safety.

Gecko accelerographs will store over a year of continuous time series data on its memory card, will generate alarm signals when a major seismic event is detected, and will operate for 12+ hours without mains power should an earthquake interrupt the mains AC supply.

Gecko data is streamed in real time to a local PC running our **Streams** software that will display the data on the screen with a colour-coded visual indicator of intensity for rapid response when an earthquake has been felt.

Waves, our data analysis program, and **Streams** are available for Windows, macOS, Ubuntu and Raspberry Pi.

Download free at **src.com.au**

Structural monitoring guidelines:

Requirements	Compliance
Accelerograph	**Accelerograph**
• Seismic qualified as tested by recognized international testing laboratory	• Tested by University of Technology Sydney, University of Melbourne, ISO 9001:2015
• Stores seismic activity information as gathered by the attached accelerometer	• Records triaxial data from integrated accelerometer continuously to SD card storage
• Equipped with fault detection	• Fault detection - SD card full/error, low power, high temperature
• Provides real-time alarm information (either audio, visual or both) during an earthquake event.	• Real-time alarm output to relay circuit during earthquake - buzzer, and visual on Gecko LCD
• Equipped with internal battery back-up power to ensure continuous operation during a power fluctuation.	• Internal battery, charge regulator, and locally compatible AC plug pack included
• Minimum design life: 10 years and should be demonstrated and certified to have a 40,000-hour (minimum) mean time between failures	• Designed for minimum 10 year operation. SRC-made SMAs used in structural monitoring have operated for over 20 years, producing an aggregate MTBF of greater than 5 years
• Minimum of three components (vertical, longitudinal and transverse)	• Three aligned accelerometer components: vertical, longitudinal and transverse
• Natural Frequency: Above 50 Hz	• Flat response to 800Hz
• Damping: Approximately 60-70 percent critical	• Sensors have critical damping of 100%
• Sensitivity: 2g	• Sensitivity is 15V/g with ±30V range, giving ±2g range
• Bandwidth: DC to 100 Hz	• Bandwidth is DC (200s) to 800Hz
• Environment: IP 67	• Compliant with IP67 for dust and water ingression
Recording	**Recording**
• Sampling Frequency : Minimum of 100 samples per second	• Sampling rates up to 4000 samples per second available
• Time: From at least 20 seconds before the ground shaking begins until 30 seconds after the last triggering level motion	• Data is stored continuously before and after trigger time, meaning that any number of seconds of data from before or after the trigger time can be retrieved
• RMS Noise: System noise shall be less than 40μg measured over 0-30 Hz	• System noise <1μg over 0-50Hz
• Media :Memory Card	• Media: 32GB SD Memory Card standard
• Continuous Recording : capable of continuous recording	• Continuous recording is always enabled
• AD Converter : 16 bits	• AD Converter: 32 bits (i.e. <1μg noise with ±2g full scale)
Timing	**Timing**
• Interval: Half a second or less	• Data storage interval at 100sps is less than 0.5 seconds
• Accuracy: Plus or minus 0.2 second per 100 seconds	• Time accuracy: 0.00001 seconds, synchronised every second
• Type : GPS or NTP Server	• GPS used for timing and position
Triggering	**Triggering**
• Method: Pendulum or other device using earthquake motion as an exciting force	• Force feedback circuit (solid state sensor). Earthquake motion provides excitation
• Level: Accelerograph: 0.5 to 100 gals nominal velocitimeter: 5 μm/s to 1 mm/s	• Level triggering for accelerograph can be set at any value from 0.2 to 1980 Gal
• Time: Full operation of accelerograph/velocity in not over 0.1 second after activation.	• Full recording operation 100% of time, regardless of trigger activation
Power	**Power**
• Battery maintained by charger	• NiMH battery maintained by AC charger
Communication	**Communication**
• Ethernet: 10 base –T or 100 base-TX	• 10/100 Ethernet and WiFi adaptor in wall box
• Protocol: TCP/IP FTP/SFTP	• Serial streaming over TCP/IP