The importance of seismic detection devices

An earthquake, even a light one, can distort or break the precisely-aligned components of an elevator system. Possible damage due to a seismic event includes derailed counterweights (which could collide with the cabs), damaged or unseated wire rope and broken or damaged rails or guide rollers. Even a small tremor could bend a rail bracket that could cause eventual failure of the rail months later.

An intelligent seismic detection system can help passengers by quickly getting the elevator to the nearest stop and prompting the passengers to exit the cab.

(Seismic countermeasures are fully addressed in ASME A17.1 [the safety code for elevators and escalators]. This Tech Tip covers common ways of detecting and dealing with seismic events.)

WHAT IS A SEISMIC EVENT?

A seismic event (or earthquake) happens when a break or slip occurs between the tectonic plates that make up the earth's crust. The force of an earthquake is carried out from the event in waves, just like the ripples in a pond caused by a tossed pebble. Soil compresses, expands and moves up and down just like a water wave.

An earthquake travels as waves through the earth's crust. The primary, or P, wave is a shallow, fast-moving wave. P waves can be transmitted by both solid and liquid materials in the Earth's interior. It is almost always followed a secondary, or S, wave which is slower, deeper and more destructive. S waves travel only through solid material within the Earth and do the heavy damage associated with earthquakes. Since P waves travel twice as fast as S waves, the time between their arrival will increase as they travel from the epicenter of the quake.

HOW CAN AN EARTHQUAKE DAMAGE AN ELEVATOR?

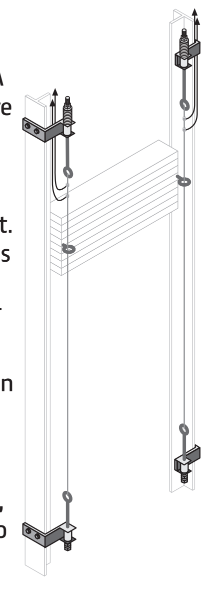
The damage caused by even a strong local earthquake is often not visible. Problems arise from the operation of the elevator AFTER the damage has been done. One major concern is counterweight derailment. A stationary derailed counterweight is a problem; a moving derailed counterweight can be deadly if it swings into the hoistway and strikes the cab. At the very least, a derailed counterweight has large inertial forces that could damage the rails, brackets or guidance assemblies if it moves.

Unseated wire ropes are another concern. It is certainly a problem if the quake unseats ropes that aren't in motion, but if the motor continues to turn, significant damage could result to the elevator system.

HOW CAN I TELL IF I NEED SEISMIC DETECTION EQUIPMENT?

The United States Geologic Survey has divided the US into Seismic Zones with a ratings of 1 (very little chance of earthquakes) to 4 (high probability of earthquakes - see map on page 2). These zones govern building standards for federal projects (such as Veteran's Administration hospitals). Obviously, the San Andreas fault area of California is rated 4, but so is the Mississippi Valley between Tennessee/Arkansas and the area around Charleston, South Carolina.

HOW DO SEISMIC COUNTER-MEASURE DEVICES OPERATE?



Modern elevator systems have a couple of ways to determine if they have sustained damage due to an earthquake. The 'Ring On A String' counterweight displacement hardware is a simple way detect counterweight derailment. Two steel cables run parallel to the counterweight guiderails and pass through a pair of eyebolts located on the counterweight. If an eyebolt contacts a cable (which indicates counterweight displacement), an electrical circuit is completed which tells the controller to stop and redirect the car immediately.

A more exact way to determine if and when an elevator should be shut down is an electronic seismic detector that senses and measures acceleration on all three axis. If this motion, measured in Gs, exceeds a programmed limit, the detector signals the elevator controller to stop the cab at the nearest floor to permit a speedy exit by the passengers.

A fully-featured sensor (like the Draka Event Monitoring Device [EMD] shown here) detects both P and S waves and will act accordingly. When the sensor detects a P wave of sufficient amplitude, it will send a signal to the elevator to stop at the nearest floor and allow the passengers to exit the cab before the more damaging S waves arrive. The elevator will remain out of commission until it is repaired and reset by a qualified technician. As an added bonus, the EMD will also record the date, time, duration, and peak acceleration in each axis for a seismic event that it detects, which can aid engineers in determining the extent of any damage.

Draka EHC

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The importance of seismic detection devices
(cont'd)

TECH TIP 14

WHAT CAN BE DONE TO PROTECT AGAINST SEISMIC DAMAGE?

There are preemptive measures that can be taken to minimize the potential damage of an earthquake. For instance: the counterweight is potentially the most dangerous component in an elevator system and the most likely to be adversely affected by earthquakes. Everything must be done to contain its mass. Use box brackets to reinforce the counterweight rails so as to keep the counterweight from swinging free.

CONCLUSION

The importance of a seismic detection system in high-risk regions cannot be understated. A modern electronic seismic detector is highly recommended for the capabilities it offers for detecting and measuring an earthquake. For Zone 2 applications, use of seismic-rated rail brackets or a Ring On A String detector is necessary (the ring system is much less expensive). For Zone 3 and higher, a Ring On A String is required and an EMD sensor or a similar device is recommended. In all cases, do what is required to meet all local and national codes.

EVENT MONITORING DEVICE (EMD) SEISMIC DETECTOR

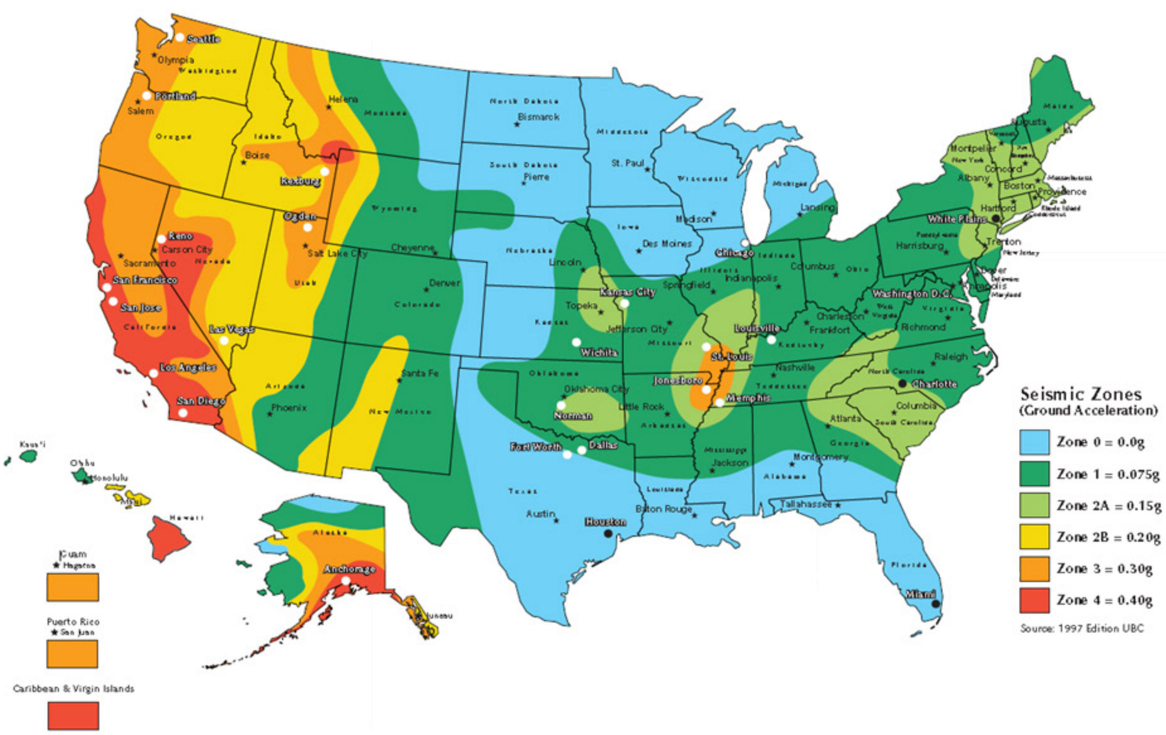
Part Number	Description
DRK-S701-ROHS	EMD seismic detector with relays for external sensors - AC or DC power

COUNTERWEIGHT DISPLACEMENT KIT ("RING-ON-A-STRING")

Part Number	Description
CDH-R8	Counterweight displacement kit, mounts to T89 (81 lbs.) guide rails - Cable (CDH-L500, CDH-L1000 or CDH-L1500) is ordered separately - see below
CDH-R12	Counterweight displacement kit, mounts to T127 (12 lbs.) guide rails - Cable (CDH-L500, CDH-L1000 or CDH-L1500) is ordered separately - see below
CDH-L500	Cable, 500 ft • 152 m length, 1/16 in. • 1.6 mm diameter, with 4 thimbles and 8 clips - (use for up to 250 ft • 71 m of rise)
CDH-L1000	Cable, 1000 ft • 304 m length, 1/16 in. • 1.6 mm diameter, with 4 thimbles and 8 clips (use for up to 500 ft. • 152 m of rise)
CDH-L1500	Cable, 1500 ft • 456 m length, 1/16 in. • 1.6 mm diameter, with 4 thimbles and 8 clips (use for up to 750 ft • 223 m of rise)

Order one kit and one cable per elevator - the kit attaches to BOTH counterweight rails (as shown). Note that the kit is specified for the rail size and the cable ordered should be at least twice the rise of the elevator - the cable will be cut in half and installed on both rails.

UNITED STATES SEISMIC ZONES MAP



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