Elevator Recall

Earthquakes threaten 1 in 4 Americans. Earthquakes currently cannot be predicted, but people can act beforehand to reduce the harm when earthquakes occur. One way to do that is to implement earthquake early warning, which refers to a system that rapidly detects earthquakes just after they begin, quickly calculates how strongly the ground will shake, and notifies people or systems just a few kilometers or tens of kilometers from the epicenter before the shaking arrives. With a few seconds' warning, people and systems can take useful protective actions. The next few pages answer key questions for people deciding whether and how to adopt earthquake early warning to recall elevators before strong shaking arrives. This material was written by leading earthquake engineers, seismologists, emergency managers, and other pioneers of earthquake early warning, including people who developed, implemented, and use earthquake early warning in real life.

This is one of seven guidelines for different ways to use earthquake early warning. Find the full set at http://www.sparisk.com/pubs/Porter-2020-EEW-Set.pdf

Essence of the Practice

In a large urban daytime earthquake, 20,000 people could be riding in elevators with the doors closed and the elevator in motion between floors when power is lost, trapping them until power is restored or until firefighters can extricate them, which could be days in either case (Porter 2018; Figure 1). To reduce this problem, elevator cars connected to the earthquake early warning system receive a warning signal, automatically stop at the closest floor, and open the doors, enabling passengers to safely exit the elevator before shaking occurs or power is lost. If desired, the elevator can be returned to normal operation after a temporary hold, e.g., after a few minutes.
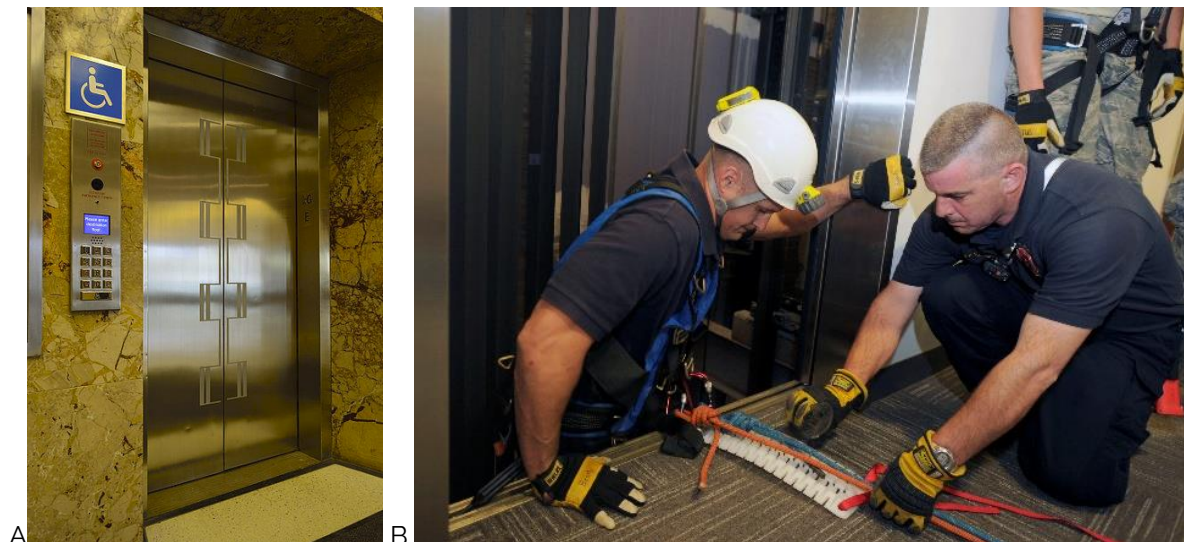

Figure 1. A. Elevators can lose power in earthquakes, trapping occupants. Automated recall moves elevators to a nearby floor and open doors. B. In a large urban earthquake, it may take days or more before urban search and rescue personnel can extricate all occupants trapped in stalled elevators (Image credit: A. Raysonho @ Open Grid Scheduler/Grid Engine, 2015, Creative Commons CC0 1.0 Universal Public Domain Dedication; B. Public domain).

Context in Which the Use Case Would Work

In elevators over 10 floors, works with traction elevators that comply with current fire code. Under 10 floors, earthquake early warning seems to be cost prohibitive because of current code requirements, permitting, and mechanical integration. Works only in regions with an earthquake early warning network: California, Oregon, Washington, Mexico, Japan, Turkey, Romania, China, Italy, and Taiwan.

Realistic Expectations

For the best system and elevators with emergency power, if the elevator successfully receives earthquake early warning alert, expect successful recall for most elevators, even if the elevator is close to the epicenter.

Clear Behavior

No human behavior is involved. Elevators automatically move to a nearby floor and open their doors.

Potential Vulnerabilities

Power could be lost before the signal can reach the elevator or before the elevator can reach the nearest floor and open the doors. The upstream alerting system's application programming interface (API) can change and the earthquake occurs before the elevator warning system is adapted to the new API. Some vendors are more sensitive to API changes than others.

Implementation Costs

Cost is on the order of $10,000s for the first elevator plus $1,000s per additional elevator.

Hardware and Software Requirements

In some cases, the elevator control software in the building is updated to receive earthquake early warning messages via the Internet and through application programming interface (API) in the control software. In other cases, a new hardware interface that is connected to a vendor's earthquake early warning system is added to the elevator control equipment in the building and activates elevator recall. At least one vendor requires that elevator recall be paired with audible notification within the building and within the elevator to instruct occupants how to behave, e.g., to drop, cover, and hold on, and to leave the elevator.

Training Materials, Requirements, and Frequency of Training

At least one vendor suggests distributing a brief handout to every occupant and employee explaining the nature of the earthquake early warning system and adding signage for visitors similarly explaining the system.

Maintenance Requirements

At least one vendor requires annual testing. The vendor performs all software updates.

Examples of Past Use

Seismic Warning Systems installed elevator recall to four elevators at the San Francisco headquarters office of Pacific Gas & Electric (PG&E) Co. See Business Wire (2017) for details. Early Warning Labs is updating that system for PG&E. For more information, contact info@earlywarninglabs.com, 1-424-238-0060.

References

Business Wire (2017). PG&E Adds Earthquake Early Warning System to Some Elevators at its Headquarters. September 28, 2017, https://www.businesswire.com/news/home/20170928006112/en/PGE-Adds-Earthquake-Early-Warning-System-Elevators [accessed April 7, 2020]

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