



# Elevators, Fire, and Accessibility

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## SELECTING STRATEGIES FOR ELEVATOR EVACUATIONS

by Norman E. Groner, Ph.D

Klote, et al (1992) have concluded that it is technically feasible to design and build fire-safe elevator systems. However, there remains the problem of determining how the systems can best be used by building occupants. This paper discusses the use of life safety strategies to design and evaluate emergency plans that use elevators to move people.

### WHAT IS A "LIFE SAFETY STRATEGY?"

A life safety strategy can be defined as "a general plan for protecting building occupants." (Groner, 1985; Groner and Levin, 1992) Life safety strategies can be described using brief sentences that state the actions recommended to building occupants. An example is: "Everyone leaves the building using the nearest exit." An example pertinent to the present topic is: "Everyone leaves the building using the nearest stairs or elevator."

### LIFE SAFETY STRATEGIES HELP TAILOR PLANS TO SPECIFIC BUILDINGS

Life safety strategies help determine the best fit between an evacuation plan and a building. Different life safety strategies can be compared based on their likelihood of keeping people separated from fire and smoke in a specific building. Because strategies have explicit goals and are time-based, this approach is ideally suited to scenario-based computer simulations. Using life safety strategies in qualitative analyses is also very instructive.

### LIFE SAFETY STRATEGIES INTEGRATE ALL TYPES OF COMPONENTS TO FACILITATE A GENERAL SYSTEMS APPROACH

The use of life safety strategies facilitates a systems approach that incorporates all components of an elevator evacuation system, including not only the building occupants, but the building layout and its

fire protection features as well. All types of system components, hardware and procedures, can be evaluated according to the degree to which they obstruct or contribute to life safety strategies. In the pursuit of cost-effectiveness and reliability, system components that fail to significantly contribute to completing the life safety strategy can be altered or removed. Alternatively, life safety strategies can be changed to take full advantage of available system components.

### A SIMPLE EXAMPLE: FAA AIR TRAFFIC CONTROL TOWERS

We recently completed a human and organizational factors study of the potential for using elevators to evacuate air traffic control towers (Levin and Groner, 1994). The study shows how the life safety strategy approach can be applied to a relatively straightforward and uncomplicated situation. Air traffic control towers are tall narrow buildings with a single stairway and a single elevator. Without considering the merit of using the elevator for evacuation versus other fire protection approaches, we determined that only a single life safety strategy was needed as the basis for an emergency plan. This strategy is stated as follows: "Use stairs to leave tower. If stairs are unavailable, then use the elevator."

A single straightforward strategy can be used in control towers because there are few occupants concentrated in only a few locations, thereby avoiding the need to prioritize access to the elevator. The situation is further simplified because visitors are rarely allowed in control towers for security reasons. Also, at present, people unable to use stairs are not employed as air traffic controllers, because elevator service is not provided to the highest cab level of the tower where the "cab" is located. (Elevator service is not provided because the shaft would restrict visibility from the cab.) However, air traffic control towers are atypical; most buildings equipped with elevators require a significantly more complex approach, as examined in the remainder of this paper.

## MOST BUILDINGS ARE COMPLEX ENOUGH TO REQUIRE SETS OF LIFE SAFETY STRATEGIES

Air traffic control towers are unusual in that only one life safety strategy is needed for all the occupants. In other more complicated settings, sets of strategies are required. In most buildings, different occupants are better off using different strategies, depending on a variety of factors. In our examination of the use of elevators to evacuate occupants in hypothetical highrise buildings, we identified several factors that affect the use of strategies. (Groner and Levin, 1992).

### FACTORS AFFECTING SELECTION OF STRATEGIES IN HIGHRISE BUILDINGS

Fire experts consider it to be impractical to totally evacuate larger highrise buildings in a timely fashion. Because stair capacities are limited and travel distances are long, life safety strategies are used to relocate some occupants within highrise buildings. Exactly who is relocated, and where they go, depends on their location relative to the fire and the building layout. The relocation approach applies equally to current buildings and to buildings equipped with fire-safe elevator systems, which are simply more efficient means to move people. Three factors affecting the selection of strategies are listed as follows:

**Abilities of occupants to use stairs.** Much of the impetus for installing fire safe elevator systems comes from the desire to provide better safety to persons with disabilities. Persons who are entirely unable to use stairs would be the most apparent beneficiaries, but there are many other persons who would gain as well. People with arthritis, orthopedic problems, heart problems, temporary disabilities (e.g. broken legs), and pregnancies, can generally descend stairs, but only slowly, and sometimes with considerable discomfort and risk of injury. In a building with a system of fire safe elevators, these persons should certainly be instructed to use them. A fire safety strategy for such people could be stated as follows: "Occupants unable to use stairs go to the elevator lobby where they will be evacuated using elevators."

Elevators can also be used to relocate occupants

who can descend stairs without unusual difficulty. While their access to elevators should receive a lower priority, there are arguments for their use of fire-safe elevators. Reasons include: 1) to speed the evacuation by making full use of all available means of escape; 2) to make stairs more available to responding fire fighters; 3) to avoid burdensome descents using stairs in very tall buildings. *If using an elevator is of some benefit to the overall evacuation of the building, people who can descend stairs could use fire-safe elevators.*

**Proximity of occupants to fire and smoke.** Occupants on the floor where the fire starts will be in the most immediate danger. Occupants just above the fire floor(s) receive the next highest priority. Where using the elevator can speed the departure of occupants from the fire zone, their priority for access is very high. The rapidity and extent to which occupants on floors above, but outside of the immediate fire zone, might become endangered depends on the fire protection features of the building.

Occupants also need to be evacuated from floors that the fire department will use for a staging area, typically just below the fire zone. Although the urgency of moving people from staging areas is less than from floors where people are affected by the fire, the areas should be cleared before the fire department is ready to begin its staging efforts.

**Location of occupants in buildings.** Occupants on floors at grade and close to grade who can use stairs can simply leave the building. However, occupants in upper floors of highrise buildings are often relocated to a level far enough below the fire zone to not interfere with fire suppression operations. By relocating occupants, unnecessary crowding of stairs and burdensome travel distances are avoided. After occupants with more urgent needs to use the elevators have been removed from danger, relocated occupants can leave the building using the elevators.

The accompanying table adapted from Groner and Levin (1992) shows how the access of occupants to elevators can be prioritized base on the factors discussed:

LOCATION	LIFE SAFETY STRATEGIES	ELEVATOR PRIORITY
Floors at grade	All occupants leave the building using the nearest appropriate exit.	not applicable
Floors close to grade	Occupants unable to use stairs use elevators. Occupants able leave the building using the nearest exit.	low unless near fire
Fire floor(s)	Occupants unable to use stairs use elevators. Occupants able to use stairs descend to designated floor below fire floor and wait to use elevators.	highest priority
Floors just above fire floor(s)	Occupants unable to use stairs use elevators. Occupants able to use stairs descend to designated floor below fire floor and wait to use elevators.	second highest priority
Floor just below fire floor(s)	All occupants wait to use elevators.	very high
Floor well above fire floor(s)	All occupants wait to use elevators.	high
Floors well below fire floor(s)	All occupants wait to use elevators.	low

### LIFE SAFETY STRATEGIES HELP TAILOR EMERGENCY PLANS TO SPECIFIC BUILDINGS

The table does not offer a general recommendation; it is only an example. Life safety strategies are best used as a means to tailor a set of strategies to a specific building, or building-type. For example, the designers of the emergency plan may conclude that the capacity of fire safe elevators is not great enough to evacuate all persons from the upper floors of a highrise building. Instead, they may decide to restrict its use only to persons with disabilities.

### SAFETY STRATEGIES ARE LESS COMPLEX THAN THEY SEEM

Although the system described in the table above seems complex, any single building occupant is expected to follow only one life safety strategy. The emergency team members on any given floor need to instruct occupants in only a few strategies. Providing simple straightforward strategies to individuals is important, because people are less

able to process information during the stress of a fire emergency. A control center, equipped with appropriate communications and other equipment, and manned by well-trained building and fire department personnel, can ensure that the overall complexity of plan remains manageable.

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