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IN CONSIDERATION OF ELEVATORS AS PART OF A BUILDING EVACUATION SCHEME

by Philip C. Favro

Use elevators in a fire? Never! The very thought has been anathema among fire professionals; its utterance, blasphemy. Elevators are death traps in a fire. Everybody knows that. The notion of using them for evacuation is ridiculous. Take for example what one fire expert says in a pamphlet on high-rise fire safety: "Most people know only one way to get out of a building, the way they came in. If that was the elevator, they're in big trouble. If there's smoke in the building they should avoid the elevator like the plague."

Firefighters have almost routinely refused to trust elevators for access to fires on the upper stories of buildings. Stories of fires in high-rise buildings are rife with accounts of firefighters lugging hose, tools, and other equipment up flights and flights of stairs to attack fires above the reach of their ladders. And elevator experts have added to this lore by making flat-out statements that elevators are not safe in fire emergencies.

And there have been good reasons for discouraging elevator use in these situations. For example, a person may push a call button and wait for the elevator which, because of automatic recall, will never come, thus costing that person valuable minutes that could otherwise mean survival. Since elevators respond to car and corridor calls, these calls may originate at the fire floor, bringing the car and its occupants to the seat of the problem rather than to safety. Fear and irrational behavior may lead to overcrowding which in turn can cause blockage of the doors rendering the elevator inoperative and the car immovable. During a fire a power failure can occur, trapping occupants in a potentially smoke-filled shaft with no means of escape. Finally, water from sprinklers or even firefighter hoses can short-out motors and cause brakes to dip or fail.

Certainly history tends to support this concern for elevator reliability. Civilians and firefighters have been trapped, injured, and even killed when elevators malfunctioned or failed in a fire. For instance, five guests in a New Orleans hotel attempted to leave the building after being warned of a fire on a higher floor by the front desk. They took the elevator. It started down, went two floors, reversed itself, and went to the fire floor where the doors opened and the passengers died. And in New York City, firefighters responding to a fire on an upper floor of an office building, tried to take an elevator under manual control to the 18th floor, two floors below the fire floor. The elevator passed the 18th, went to the 20th where the doors opened long enough to kill all of the firefighters, then closed and returned to the lobby.

Nevertheless, elevators and their presence in multi-story buildings are a fact of life. Literally thousands of new high-rise buildings have been designed and built throughout the United States in the last 30 years. What was once a phenomena reserved for major cities is now common even in suburbs and out-of-the-way rural areas.

Despite the spotty past performance of elevators in fires, everyone will agree that they remain the most efficient and effective mode of vertical movement in multi-story buildings, buildings which house thousands of people in their vertical interiors who depend almost totally upon elevators as their means of daily transportation from floor to floor. And elevators have saved occupants in real fires, the most notable of which was the tragic Joelma fire in Sao Paolo, Brazil in 1974 during which 300 of the 422 survivors escaped by elevator.

Today, virtually all buildings containing elevators have signs at each floor, near each elevator, which warn against the use of the those elevators in a fire emergency. Nevertheless, most will concede that their use under emergency conditions may be vital

if firefighters and occupants in ultra high-rise buildings are to have a reasonable chance of survival during fires or other emergencies.

The notion that elevators can enhance exiting and thus, building safety is supported by studies from the National Institute for Standards and Technology (NIST) where researchers have developed a computer program called "ELVAC" which can calculate elevator evacuation times. These studies show that in very tall high-rise buildings, those over about 30 stories, evacuation time can be greatly enhanced by use of the elevators. For example in the 36-story Jackson Federal Office Building in Seattle, evacuation time dropped from 26 to 13 minutes when elevators were factored into the evacuation scheme, a reduction of 50 percent.

But still, a hesitancy persists on the part of many fire professionals, as well as many in the elevator industry, to 'sanction" the use of elevators–even under the control of trained firefighters–for use in emergency evacuations even though it may well be that in some fires in multistory buildings, the chances of death in an elevator are not any different from those in stairs. At the Inn at the Park fire in Toronto in 1981, for instance, of the six victims, four died in the stairwells. And in the MGM Grand fire in Las Vegas, nine of the victims were found in stairwells, while five perished in the elevators.

While this hesitancy is understandable, given some of the tragic experiences that have occurred with elevator use in fires, it once again points out the reliance that is placed on the sanctity of specific code requirements without the payment of equal attention to occupant behavior and how people tend to act in real fires.

Studies in human behavior show clearly that people in emergency situations will tend to do what they are familiar with. And in tall buildings, where elevators are the normal mode of travel–the familiar means of transportation, if you will–persons tend to gravitate toward them, *even* when warned not to. Keating and Loftus have found that under heightened anxiety, people's attention becomes narrowly focused and they are aware of only the most obvious aspects of their environment. Peripheral cues, which are usually easily processed, remain unobserved. For example, people who regularly enter and leave a building by elevator cannot be expected to abandon their habitual route during emergency evacuation. Studies conducted in England have found that if an emergency escape route is **not part** of the normal circulation pattern, it may well have significant negative consequences on an occupant's ability to reach safety. In fact there may be fundamental problems with the whole concept of emergency escape routes that are designed to be used only in an emergency, e.g. stairs in a high-rise building, because of a person's reluctance, unwillingness, ignorance, and fear in using them.

To add to this dilemma, something new has been added to the equation. Over the last quarter century, a social phenomena has occurred that has forced many well-meaning professionals and others to rethink their position on building evacuation. Culminating with the passage of the Americans with Disabilities Act in 1990, great strides have been taken towards eliminating the barriers that have hindered and prevented access to public buildings by millions of Americans who are physically and intellectually challenged or disabled. Now, these citizens, who make up about three percent of the general population, are able to access buildings as never before. In the future, virtually all new public buildings will be accessible to persons with disabilities. That means that if a building is more than one story, it is likely to have an elevator. And if it has an elevator, that elevator will be used. Not as a special tool for those who are confined to wheel chairs or who are otherwise unable to negotiate stairs, but by just about everyone who enters and leaves the upper floors of those buildings.

And once individuals with mobility limitations are present in buildings, how will they get out if there's a fire or other emergency that requires evacuation? At last fall's NFPA meeting in Toronto, a speaker related how one women figured she would do it. Confined to a wheel chair and working on the 14th story of an office building, she knew not to use the elevator. But she said she was not concerned because she would go to her office window where firefighters could use ladders to carry her to safety. Silly? Maybe, but probably not too far from the norm among people who know there are limitations on what they can do for their own safety in an emergency if the elevator is unavailable.

There has been much written and much spoken about in the last several years that in today's modern sprinklered buildings, evacuation, or even relocation, is unnecessary. This assumption that in

sprinklered buildings smoke is not hazardous and therefore movement of occupants is not required (because there is no specific threat) is naive and not supported by empirical evidence or scientific research. People, disabled or not, when faced with a threat, real or perceived, will attempt to flee. And it will likely be impossible to convince them that they are not in danger when they see what they consider to be an obvious problem such as smoke. Witness what happened at a 1975 fire in the World Trade Center in New York, a fire that involved a waste basket confined to a single room. The occupants of eleven floors, 9 through 22, evacuated even though the smoke was light, was not lethal, and the occupants were told that evacuation was unnecessary.

One thing is certain in all this, and that is that with the current move throughout North America to performance-based codes, it is even more critical that the way people actually behave in real fire situations be considered as part of a building's overall performance evaluation. And there is a need to start integrating elevator evacuation into the general evacuation or relocation scheme. The model building codes and NFPA's Life Safety Code seem to have moved in this direction. The creators of these documents have worked diligently to address the challenge of providing access and egress for persons with disabilities.

Technologically, however, there is still a way to go. All of the potential elevator failure eventualities cited above and more were taken into consideration when the so-called "Firemens elevator was designed, making at least those elevators with their three-phase operational switch more safe and reliable. And while the knowledge and technology is there to solve the recognized problems with elevators in fire situations, there persists a pervasive problem that continues to plague designers and theoreticians alike, and that is how to maintain a clean environment, one free of water and smoke, so that the elevator can function as intended.

In efforts to deal with this and other problems, much work has been done in North America and abroad which explores objectively, and in detail, the use of elevators for emergency evacuation. Studies dealing with smoke control, smoke movement, and evacuation have been done at NIST and there is currently a test project underway which deals with the very issue of water protection for elevator shafts. And, in fact, a recent NIST study sponsored by the Federal Aviation Administration (FAA) to look at the feasibility of elevator emergency evacuation at air traffic control towers concludes that such evacuation is feasible for new construction. This conclusion has led NIST to make a formal proposals to the NFPA's Life Safety Code to integrate elevators as part of the means of egress system.

Elsewhere, the United States Architectural and Transportation Barriers Compliance Board commissioned a study, Egress Procedures and Technoloaies For People With Disabilities, which recommends the use of elevators as part of the means of egress for disabled persons. Abroad, the British have adopted, as part of their Standard on Fire Precautions in the Design and Construction of Buildings, a Code of Practice for People with Disabilities, in which protected elevators are accepted as part of the means of vertical escape. The result of this kind of work has been a recognition of the concept by the code-making bodies, and the establishment, within the codes, of accessible means of egress provisions which include the elevator as part of that accessible path.

But that's only half the answer. More than simple elevator improvements must be made. Beyond its compliance with standards for automatic retrieval and firefighter override, the elevator must be protected, along with its shaft, from the rest of the building. And this is true even in sprinklered buildings. That is, it must be contained in a separate compartment, perhaps an elevator lobby, which encloses the elevators at every floor, creating an area that is protected from fire and smoke; or, conversely, which protects the rest of the building from fire and smoke which may be contained within the compartment. Further, the elevator should be sewed by a protected route, and should lead to an area that provides level evacuation through a protected route. Finally, accessible stairways are essential even in buildings which rely on elevators for evacuation, as a last resort if all else fails.

when viewed objectively, this concept is neither as radical nor as risky as it may first appear. Nor is it anything that is overwhelmingly innovative. The concept of compartmentation and horizontal evacuation upon which it is based has been an integral part of fire safety in health care occupancies for more than 30 years. In these occupancies, building and fire/life safety experts have long agreed that the patient room floors on acute care

hospitals, nursing homes, and similar facilities--even with supervision and control of these patients by nurses and other staff–are virtually impossible to evacuate in any conventional manner because the patients may be totally incapable of any form of self-evacuation, and many may be unable to be removed from their beds without grave risk.

To deal with this reality, the evacuation strategy has been simply to sub-divide each floor into at least two compartments with sufficient protection between those compartments (smoke barriers or horizontal exits) to allow movement of patients across the barrier from an unsafe to a safe *area* where they can be adequately cared for; or, if necessary, evacuated via elevators from the building without removal from their beds.

It is this concept, and variations of it, that is the basis for all the work that has been done regarding effective use of elevators in fire emergencies. Taking a page from this philosophy, buildings and their evacuation capability, must be judged as "use specific" rather than occupancy specific. That is, they must be judged individually and not as some anonymous *entity* lumped into an occupancy chapter of the building code. A departure from the norm perhaps but a critical element in performance based codes and in rational and reasonable judgements by the authorities having jurisdiction.

Separation of the elevators from the fire threat is the surest way to make them effective. It is a practical solution that can provide safe egress for persons with disabilities, as well as others, by acknowledging their behavior rather than trying to modify it, and by taking advantage of their natural tendency to use a familiar route. And it meets the challenge of behavioral experts to incorporate into all of our buildings the predictable changes in people's normal behavior that can be expected during emergencies.

Do **elevators** have a role in this scheme of emergency evacuation? Most certainly they do. Unquestionably not as the sole means of egress from multi-storied buildings, but as a viable part of that egress system to allow for safe evacuation of those who are disabled, injured, stricken, or ill–as long as they are separated from the remainder of the building by barriers that render smoke and fire a less threatening foe.

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