

Human and Mechanical Aspects of Effective High-Rise Fire Safety Programs

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As corporations flourished in cities across the United States, the need to accommodate urban workers led to the development of large-scale high-rises, such as the Empire State and the Chrysler Buildings. Given that people do not behave predictably in emergencies, the safety and security of these workers were the driving force behind the establishment of formal fire codes intended to prevent tragic outcomes. Today, the National Fire Protection Association (NFPA) is the industry leader in fire and life safety codes.

In New York City, Local Law 5 of 1973, Fire Safety in High-Rise Buildings, introduced a series of actions to ensure tenant safety, and city codes have evolved to address both human and mechanical factors that property owners and managers must adhere to.

Human Aspects: The Fire Safety Team

A fire safety team consists of a director, a deputy director, a warden, searchers and a fire brigade that includes engineering and building services personnel.

Fire Safety Directors

Fire safety directors are responsible for managing the fire safety program in high-rises, and their commitment is paramount to the program's success. They should know the program members on a first-name basis and interact with them regularly. They must also understand human behavior in fire emergencies and be active participants in training seminars and fire drills.

Their certification process—which is the same for deputy directors—encompasses

three phases, with a prerequisite of five years of related experience, including involvement in fire drills, inspection of fire safety devices and fire guard services. Fire department inspectors dedicated to high-rises are responsible for extending certification to interested parties, reviewing their applications and rendering decisions.

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Accepted candidates attend a fire safety directors' course at an approved academic institution, such as the Fire Science Institute at John Jay College of Criminal Justice. This comprehensive 20-hour course is administered over a period of five weeks and includes both classroom training and a hands-on session involving fire safety devices found in high-rises. At its conclusion, candidates must pass a written exam.

The second phase is also a written exam, administered by the fire department. It is a difficult exam that requires candidates to be well versed in fire safety in the built environment. The questions are based on the course material, and the passing grade is 70. Candidates who do not pass can take the exam a second time within a specified period.

The final phase is an on-site examination that explores candidates' knowledge of the fire safety plans for the high-rises

where they are employed. On the exam date, the inspector asks the candidate for the fire safety plan. After reviewing it, the inspector escorts the candidate throughout the property. The candidate is questioned about the location of areas containing fire-related equipment and the functions of alarm-transmitting, fire-detecting and fire-suppressing devices.

Fire Safety Wardens

Fire safety wardens are volunteers selected by the fire safety director. Candidates are typically recommended by employees who oversee a corporation's day-to-day facilities operation and are familiar with their colleagues.

Fire safety code requires that each occupied floor has a warden familiar with the fire safety plan, the location of emergency exits, and the functioning of fire-announcing, detecting and suppressing devices. Each tenant must provide a deputy fire warden, so a floor that has multiple tenants will have more than one deputy. All wardens are required to sign in at the beginning of the workday so that directors can account for their presence in the building; some high-rises use card-swipe systems that generate a printout, while others use pen-and-paper systems. Like all fire-related documents, these sign-in records must be retained for a minimum of three years.

Fire wardens are responsible for ensuring that all members of the fire safety team are present on their designated floors. Any changes in personnel must be communicated to the director so that organization charts can be revised and new team members trained.

Searchers

Male and female searchers assist the warden by checking restrooms, private offices, storage and file rooms, lounges, and other remote areas of the office where occupants might not hear a fire alarm. During an evacuation, they direct occupants to the nearest uncontaminated emergency stairwell

and inform them to proceed to their predetermined place of assembly.

Fire Brigades

The brigade usually consists of personnel from the engineering and building services divisions. Brigade members respond to the floor below the fire floor and to the stairwells and other key locations, and assist in ensuring that occupants are evacuated safely. They are trained by and follow the commands of the fire safety director.

Mechanical Aspects

Stairwell Doors

These emergency exit doors are approved by a certified association such as Underwriters Laboratories. They are rated at different time levels and equipped with automatic door-closers to prevent smoke from entering the stairwells. To allow unimpeded evacuation, doors must open by being pushed from the office side.

Since 9/11, many occupants opt to evacuate rather than remain in the building. Fire safety team members should allow those occupants to continue descending beyond the reentry floor.

Reentry Floors

Reentry floors allow evacuating occupants to enter non-affected floors. High-rises may elect to have all their floors serve as reentry floors; they may also designate every other floor, every third floor or, at a maximum, every fourth floor.

Doors to reentry floors must unlock from the stairwell side to allow unimpeded reentry. To avoid a stampede when they reach the reentry floor, evacuating occupants must keep in mind that the door will open in on the stairwell side. Once the occupants reach a reentry floor, the warden conducts a head count and communicates the information to the director. Evacuees

must remain on the reentry floor until the fire department authorizes the director to inform the tenants to return to the affected floors.

Since 9/11, many occupants opt to evacuate rather than remain in the building. Fire safety team members should allow those occupants to continue descending beyond the reentry floor. It is suggested, however, that those individuals inform the director and the warden that they have decided to seek refuge in an area other than the designated reentry floor.

Most modern high-rises currently use electromechanical and electromagnetic fail-safe systems to automatically unlock reentry doors from the stairwell side. Because security is a concern, especially in corporate high-rises, fail-safe systems allow the reentry doors to remain locked at all times, except in fire emergencies. The doors, including those leading to tenant spaces, are connected to the fire command station and unlock the moment an alarm activates.

Sprinkler Systems

Sprinkler systems have proven to be the most effective means of fire suppression. Fully sprinklered high-rises have sprinkler heads located throughout all floors. The heads are rated at a predetermined temperature level. When that level is reached on any particular head, a seal melts and the head activates. The Hollywood movie image of all sprinkler heads activating concurrently is inaccurate; they activate independently so that they can discharge water where necessary, which prevents water damage in areas not directly affected by the fire.

The disadvantage of sprinkler systems is that the director is notified only of the floor of activation. The fire safety team must then search for the particular sprinkler head(s) that activated, which could be a time-consuming process.

Manual Pull Stations

Manual pull stations are devices located near entrances, exits and emergency stairwell doors. They can be manually activated when there is a known fire emergency not yet detected by

automatic devices. A diagonal inch-wide white stripe indicates that the fire department is contacted automatically when the manual pull station is activated. The fire command station is similarly equipped with a manual trip designed to transmit a signal to the fire department via the central station. When informed of a fire condition, the director may activate this trip.

To avoid a stampede when they reach the reentry floor, evacuating occupants must keep in mind that the door will open in on the stairwell side.

The signal from an activated alarm is normally transmitted to the building's fire command station and to a contracted central station that notifies the fire department. When there is a high probability that a fire alarm might activate as a result of construction or maintenance work, a building is taken off-line; the alarm terminates at the central station to prevent the fire department from responding to nuisance and false alarms; and the fire safety director must call 911 Emergency to report a fire.

In some high-rises, manual pull stations do not activate door release because of security concerns.

Public Address Systems

When a fire alarm activates, the public address system automatically opens the speakers to the fire floor and the floor above. The fire safety director can then make an announcement to these floors by simply pressing the "push-to-talk" button on the microphone at the fire command station. This action supersedes the alarm siren so that occupants can hear the voice communication. When the button is released, the siren resumes. Command stations have a secondary channel that allows the director to make independent announcements to other floors as necessary, based on the threat level and what is known about the hazard.

Designed for people who are deaf or hearing impaired, strobe lights flash ▶

concurrently with the activation of a fire alarm. The rapidly flashing lights are located throughout the floor and inform those with hearing disabilities that a fire emergency is in progress. It is recommended that people suffering from hearing loss carry a small flashlight to allow them to read lips in areas that are completely dark due to electrical power outages or dense smoke conditions.

Smoke, Duct Smoke and Heat Detectors

There are a variety of smoke/fire detection mechanisms. Area smoke detectors are found in mechanical equipment rooms, telephone closets, electric closets, elevator machine rooms, freight areas and passenger elevator lobbies. Duct smoke detectors are located inside the ductwork of heat, ventilation and air-conditioning systems. When smoke passes through the ductwork, they automatically close the dampers, which are normally open to

provide fresh air intake. Heat detectors are usually mounted in restaurants that occupy the street-level retail spaces of high-rises. Their use reduces the frequency of nuisance alarms, which would be likely to occur if smoke detectors were used where there is constant cooking.

Elevator Recall

Elevator recall protects occupants by a series of actions that automatically engage when a smoke detector or sprinkler head is activated in an elevator machine room or lobby. One of its functions is to disable the call buttons throughout the lobbies served by the affected bank so that occupants are forced to use the emergency stairwells. Another function sends ascending elevators to the street floor (or to the lowest landing) so that elevator occupants cannot exit onto the fire floor.

During Phase I of elevator recall, all the buttons on the passenger panel

are disabled, automatically forcing the elevator occupants to the street level, where the doors open. Occupants will be alerted to this phase when the circular fire-helmet logo inside the elevator passenger panel illuminates. Phase II begins once the elevators reach street level. By inserting a key into the elevator panel, firefighters can then use the elevators on manual mode to begin fire suppression and rescue activities.

Phones

Fire codes require the installation of at least one fire warden phone near the emergency stairwell exits on each floor. Although there are minor variations, these phones do not require dialing; they are activated simply by removing them from their cradles. They are the primary means of communication between the fire wardens, who are reporting from the fire floor and the floor above, and the fire safety director, who is activating the fire safety plan from the command station. ▶

High-Rise Fire Safety Q&A

Why do we need a fire safety program?

It has been shown that, unless there is a program in place, a fire emergency without guidance and protocol will likely compromise occupant safety.

Are fire drills necessary?

Absolutely. Fire drills familiarize the occupants with evacuation procedures. The locations of emergency stairwells are reviewed, and all participants learn the path of egress to those stairwells from their work areas. This reiteration is of paramount importance because, in emergencies, people tend to evacuate by the most familiar exits, rather than designated emergency exits. Although only semiannual drills are required, a productive fire safety program would execute at least three fire drills annually.

Why isn't a building always evacuated during a fire?

To evacuate an entire high-rise, possibly thousands of people, is usually counterproductive because it hinders the fire department's attempt to attack and suppress the fire. Simply evacuating the fire floor and the floor above initially suffices in fully sprinklered high-rises. Other floors are evacuated as needed, based on the directives of the fire department commanding officer or the fire safety director.

Why didn't the alarm go off when there was a fire in my office building?

Fire alarms in New York City high-rises activate only on the fire floor and the floor above, which are considered the two most at risk in fire emergencies.

The fire safety director makes announcements to other areas of the building as necessary. For example, it is impractical to set off the fire alarm on the 80th floor of a high-rise and evacuate it when there is a trash bin fire on the 10th floor. This action is likely to lead to widespread confusion and fear among occupants on the 80th floor, who are not in proximity to the hazard.

What is a fire safety plan?

It is an educational program designed to make all occupants aware of the procedures to ensure a fire-free working environment and the actions to consider in a fire emergency. Each high-rise has a unique plan that includes specific information required by fire codes. ■

From "Fire Safety for Your Office Building: Answers to Commonly Asked Questions About Fire in High-Rise Office Buildings"

Fire Extinguishers

These portable canisters are designed to extinguish fires perceived to be small and controlled. While there are several types, non-water fire extinguishers, referred to as ABC fire extinguishers, are common in high-rises because they are appropriate for use on paper, wood, grease and electrical fires. They are positioned at designated locations and near the emergency stairwell exits on every floor. Although they are simple to use, it is highly recommended that people read and follow the operating instructions described on the labels.

Although many occupants are reluctant to participate in these drills, fire safety directors must stress their importance; those who decide to remain at their desks pass up a crucial educational opportunity.

Fire Drills and Evacuation

To ensure that tenants are educated about how to react in fire emergencies, fire drills must be performed semiannually in New York City high-rises. These exercises inculcate evacuation procedures and familiarity with the floor and stairwell structures.

Although many occupants are reluctant to participate in these drills, fire safety directors must stress their importance; those who decide to remain at their desks pass up a crucial educational opportunity. Directors who excel in public speaking are able to make fire drills attractive to the occupants.

The director selects the format of the drill, which will vary depending on the high-rise, the number of occupants, the occupant profile (for example, elderly people, children or patients), and the type of program in place. One format involves a director informing

the occupants via the public address system to line up near the emergency stairwells, followed by a public address system presentation. This approach is not recommended because there is no control and no encouragement or incentive for occupants to focus on the content, or even to participate.

Another approach involves a minimum of two certified individuals: a fire safety director and a deputy fire safety director. The director remains at the fire command station, and the deputy gathers and meets with the occupants on the floor where the drill is being held. The deputy conducts a presentation that explains how occupants are expected to respond to fire alarms and emergencies; the ideal response will vary depending on the characteristics of the fire. Most important, occupants are made aware of the location of emergency stairwells on their floors and the stairwells' points of discharge. This format is more effective than the first because it allows occupants to ask questions and interact with the deputy.

During an evacuation, the fire safety director repeatedly informs occupants to remain calm, not to run to the emergency stairwells, to stay low to the floor in extreme smoke conditions, not to bring food and beverages into the stairwells, and not to return to their workstations, among other instructions. The director makes announcements to the floor instructing the warden to communicate vital information about the fire characteristics to the command station. Evacuations must be prioritized, and emergency stairwells that are not contaminated with smoke should be chosen as the means of egress. The warden, assisted by searchers, maintains a head count of occupants to ensure that they are all accounted for.

Occupants must evacuate to a minimum of two levels below the fire floor. If possible, they should avoid the stairwells used by firefighters to reach the fire floor. Congestion on the stairwells can impede the goals of ensuring human safety and minimizing property damage.

In New York City, the alarm automatically activates on the fire floor and the floor above because they are considered the most at risk. Both floors should respond the same way. The fire wardens must ensure that the director, who is required by code to respond to the fire command station and to remain there throughout the duration of the emergency, knows what is occurring on both floors. Communication devices installed on the floors allow the warden to share information with the director. Elevators must be avoided unless circumstances make them the most effective and efficient means of evacuation; firefighters on the scene must approve their use and accompany occupants.

A list of occupants who have impairments that prevent them from descending the stairs must be available in the plan. These individuals are usually assigned to a designated colleague who will assist them in a fire emergency. During hazardous situations, a feeling of teamwork often emerges, so even if the "buddy" is not present, other colleagues will generally step forward to help. It is useful to ask those with disabilities how they could best be helped during an evacuation.

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Local Law 26 (LL26) of 2004

Known as the Emergency Action Plan (EAP), LL26 provides further components to fire and life safety systems in high-rises. It is designed for fire safety directors, who soon will take on the formal title of Emergency Action Plan Directors (EAPD) and assume the responsibilities of evacuating high-rises during non-fire emergencies. This law ▶

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introduces four concepts to protect occupants by separation from the hazard:

- “Shelter in Place,” when the director decides that occupants will be safest if they remain at their offices and workstations;
- “In-Building Relocation,” when occupants are moved from one area to another, even if on the same floor; and
- “Partial Evacuation” and “Evacuation,” which in effect remove occupants from the building.

A new and separate certification process is in place in New York City to address the EAP mandates.

Although fire and life safety codes are an excellent formal means of addressing fire emergencies, they are of little significance if the occupants of high-rises dismiss them. Fire drills, seminars and training sessions attempt to inculcate the importance of knowing how to respond to fire emergencies, and occupants should be mindful of the importance of participating in these programs. It is the responsibility of fire safety directors to make every effort to address human behavior in fire and other emergencies, while convincing high-rise occupants of the importance of understanding fire safety and evacuation concepts in the built environment. ■

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Resources

Fire Safety Directors Course for Office Buildings, Hotels and Motels Manual, John Jay College of Criminal Justice.

Local Law 5 of 1973: Fire Safety in Office Buildings.

Local Law 26 of 2004: Office Building Emergency Action Plan (EAP).

National Fire Protection Association (NFPA), *Fire Safety on the Job*, BR41C, 2004.

National Fire Protection Association (NFPA), *The Great Escape Challenge*, BR47, 2002.

National Fire Protection Association (NFPA), *High-Rise Evacuation*, BR29J, 2004.

National Fire Protection Association (NFPA), *Firesafety in High-Rise Buildings*, BR29B, 1991.

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