evacuating high-rise buildings

BY JONATHAN (YONI) SHIMSHONI, Ph.D.

High-rise buildings have long been a phenomenon in city skylines worldwide. Constructing these buildings (generally, 75 feet [25m] minimum) so that they are absolutely safe in cases of major fires, explosions, terror attacks, earthquakes or other natural and human-created disasters is extremely difficult, if not impossible or infeasible. Furthermore, the potentially improved design and construction of future buildings will not, obviously, affect the shortfalls of the existing tens of thousands of buildings, with their millions of vulnerable occupants.

Various events, including the World Trade Center disaster of Sept. 11, 2001, and other acts of terrorism, high-rise fires, and even blackouts bring into focus the particular vulnerability of people occupying multi-storied buildings. Occupants, owners and employers of those buildings are now seeking alternate and redundant means of safe evacuation. Issues and problems brought to public attention in recent years with respect to conventional means of egress include:

- The limited capacity of stairs for occupant egress;
- The limited capacity of stairs for emergency responder access during occupant evacuation;
- The inherent limitations of evacuating persons with mobility impairments; and
- The lack of alternatives when a single event compromises stairs and, where used in emergency situations, elevators.

Modifications to stairwell design have been recommended by the World Trade Center Building Code Task Force, and have been approved at the committee level for the National Fire Protection Association's *Life Safety Code* and

An Escape Rescue System is a building-wide system composed of two or more devices; each is an array of five collapsible cabins. The system is permanently stored on the roof in a folded position. Upon deployment, each array is lowered to the ground. It then unfolds, enabling emergency responders to board the cabins. The SRP then travels upward until it stops opposite five upper floors simultaneously; enabling 150 occupants to enter through specially configured exit windows. Thus, two arrays will evacuate 300 people simultaneously. Each array is then lowered to the ground and the evacuees exit as it refolds. The system repeats this cycle, transporting responders up and into the building and evacuating tenants as required.

The automatic rescue climber comprises a device having a crane component and monorail elevator component for extending an arm to a desired location on the building. The elevator component incorporates a telescopic pole for adjusting the distance to a cabin on the other end of the pole. The cabin can be used for lifting firefighting and rescue personnel into the building and to evacuate occupants from the building to ground level.

Building Construction and Safety Code; however, these actions will not affect existing construction. What's more, evacuation from high floors through numerous flights of stairs, which is very difficult even for healthy individuals, is nearly impossible for people with physical limitations. Many buildings do incorporate features for persons with physical limitations, such as "areas of refuge," yet they provide little for the ready evacuation of these persons from the building or to other, safer floors within the building.

The marketplace is responding to the public's concern with many innovative devices to aid in emergency egress. These include parachutes, controlled descent devices, powered platforms, chutes and even vertical take-off and landing craft. Some of these may be suitable in the right situation, but others are ineffective or downright dangerous.

The challenge is to devise and design the most creative and effective solutions and methods, and to ensure their effectiveness and reasonable safety through world-class standards so that these systems can provide the requisite additional, or alternate means of evacuation for occupants of high-rise buildings around the world.

Indeed, if the use of such devices is to be sanctioned, then criteria for the acceptability and application of such equipment must be established. Recognizing that appropriate standards are in the best interest of public safety, both the National Fire Protection Association and ASTM International have initiated the process of developing codes and standards for several classes of devices, described below.

SUSPENDED RESCUE PLATFORM SYSTEMS

A suspended rescue platform system is defined as an enclosed platform (cabin) or set of enclosed platforms, moving along guides or other means, on the exterior of a building, intended for the evacuation of multiple occupants from a building. The SRP can be of a permanent type, installed on the build-

The Spider is designated for multi self-rescue from high-rise buildings. It can be permanently installed on the floor or on a wall and is always ready for immediate use. The occupant puts on a harness, attaches him- or herself to the descent cable, and then exits the building. The device automatically controls the descent at a safe velocity. A redundant friction brake provides additional safety.

The Doublexit device is installed on the customized entrance door of an apartment/office. The evacuation mechanism is hidden in the door cavity, and an automatic descent system is used to control the descent of an evacuee at a fixed speed. The evacuee descends wearing a harness connected to a steel fiber reinforced cable of appropriate length. He or she exits the building through a window or balcony; after one evacuee reaches the ground, another evacuee can exit the building and descend immediately in the same way.

ing, often in a location obscure from view (e.g., on the roof of the building), or a mobile type, brought to the building by responding emergency personnel in time of need.

Some SRPs support emergency personnel in delivering them and their equipment to the upper floors of a building. Deployment of the SRP and the evacuation process is normally controlled by the responding rescue force.

Platform-based systems enjoy a number of prominent advantages:

- Many occupants can evacuate with each rescue cycle;
- They are "systemic" (building-wide) solutions;
- They enable rescue personnel to control the evacuation process;
- They have the ability to transport emergency responders and their equipment up and into the scene;
- They are effective for all building heights;
- They require no special skill or unfamiliar actions by evacuees; and
- They are suitable for all ages and physical conditions of evacuees, including disabled people.

CONTROLLED DESCENT DEVICES

A controlled descent device is defined as equipment designed to accomplish the withdrawal (emergency egress) of occupants from a building and transporting them from a dangerous area to a safe area. CDDs may be either automatic or manually operated. One or two persons may descend simultaneously using individual harness assemblies that attach to the end of the rescue line by which persons are lowered, at a specified controlled and limited velocity, from a high position to a lower position. Persons may use CDDs, acting by themselves or with the assistance of others. CDDs are permanently installed, usually near a window, on a balcony or near another exterior exit point that may be used for egress in an emergency. Some CDD models are capable of transporting emergency response personnel to the upper floors of a building, to the area of the emergency.

Controlled descent devices enjoy a number of prominent advantages:

- They are simple, affordable and compact, suitable as a personal or family solution;
- Installation in any high-rise home or office is easy;
- No power source is required; and
- They are always available for immediate use by trained occupants.

ESCAPE CHUTES

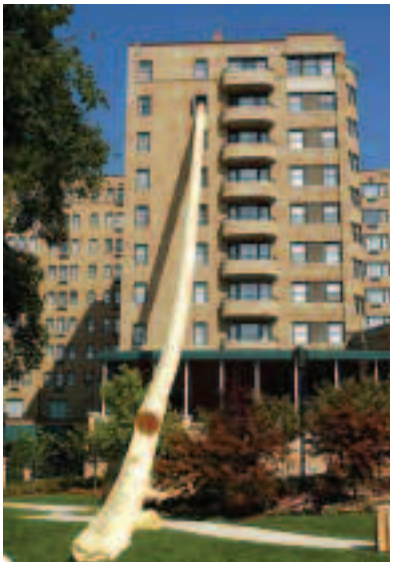
An escape chute is a cylindrical or trough-shaped device, typically made of fire-resistant fabric or netting. The set-up of the slide can be either outward sloping or vertical, and each chute solution has it own design to control the descent speed of the evacuee. The sloping solution is usually attached to, and serves, a specific floor, while the vertical solution may have the ability to enable evacuation from a number of floors through the same chute.

The chute device can be of a permanent type, installed in a hidden place inside (or on) the building, connected to a specific exterior access point, or of a mobile configuration that can be moved to different evacuation locations in an incident. Chutes may also be configured on vehicles, and brought to the building by responders in an emergency.

Escape chutes also enjoy a number of distinct advantages, as they:

- Are quick and easy to deploy;
- Protect evacuees from fire, smoke and heat, while (in the case of the sloping solution) moving them quickly away from the building;
- Can transport a continuous flow of evacuees;
- Require little or no instruction for use;
- Require little physical exertion in sliding down the chutes; and

The Baker Life Chute is a self-contained unit that can be stored inside or on top of a structure and can be moved by hand to the safest exit locations, including windows, balconies, or roofs. It is triggered by the fire alarm and unfolds automatically from the structure; escape is accomplished by sliding down the chute, slowing as appropriate by outward pressure of feet and with hands held above the head.



The advanced modular evacuation system is triggered by a fire alarm; the chute unfolds automatically from the structure. The user enters the chute through automatic doors and slides down, landing on a cushioned landing pad. Acceleration during descent is controlled through a series of "steps," which occur every five floors.

- Some are suitable for injured, disabled, elderly or even unconscious persons.

NFPA

The National Fire Protection Association has made significant progress in the process of recognizing escape devices and systems as supplemental evacuation equipment; the NFPA Technical Committee on Means of Egress has recognized and defined criteria for this equipment. In the coming months, its recommendations will be reviewed by the Technical Correlating Committee and the NFPA membership, with likely inclusion in the next editions of the NFPA *Life Safety Code* and the *Building Construction and Safety Code.*

ASTM INTERNATIONAL

ASTM Committee E06 on Performance of Buildings has established Subcommittee E06.77 on High-Rise Building External Evacuation Devices to develop standards for the three families of devices described earlier, all designed for external evacuation. These standards should aid building owners, occupants, authorities and emergency responders to better define and evaluate device suitability.

Devices covered by these standards are intended for use in emergency situations, and are designed to maximize the number of occupants that can be evacuated safely. Importantly, nothing in the ASTM standards or the NFPA codes being developed changes the currently required means of egress. Rather, the intention is to provide building owners/occupants either with an alternate escape route if the primary and secondary routes are determined to be unavailable, or *additional capacity when some, or all, of the means of egress remain available.* And, as described above, some devices support emergency forces in delivering personnel and equipment to upper floors of a building.

IN CONCLUSION

Heretofore, the only significant means of evacuation from high-rise buildings and for access of rescue forces to higher floors have been the stairwells. Recent events, such as the Sept. 11 World Trade Center disaster and others, indicate that this is problematic and insufficient. Furthermore, it is clear that significantly improving the internal means of egress, especially in existing construction, can be prohibitively expensive and downright infeasible.

Systems for external evacuation from high-rise buildings provide an alternate escape route and additional evacuation capacity. Some of these systems support emergency forces in delivering personnel and equipment to upper floors of a building — an advantage that can reduce significantly the time required to access and subdue an event (such as fire) in the building and to help evacuees in stress and distress.

Systems for external evacuation challenge inventors and manufacturers, standards organizations, authorities having jurisdiction, research institutions, rescue forces, and building owners and occupants. The challenge is to devise and design the most creative and effective solutions and methods, and to ensure their effectiveness and reasonable safety through world-class standards so that these systems can provide the requisite additional, or alternate means of evacuation for occupants of high-rise buildings around the world. //

JONATHAN (YONI) SHIMSHONI, Ph.D., is the CEO of Escape Rescue Systems, a young Israeli company specializing in suspended rescue platform solutions. He has been intensively involved in the codification processes at NFPA and is chairman of Subcommittee E06.77 on High-Rise Building External Evacuation Devices.