Title:	**Tall Building Emergency Evacuation: "Time To Think Differently"**
Author:	Jonathan (Yoni) Shimshoni, Escape Rescue Systems Ltd.
Subject:	Fire & Safety
Keyword:	Fire Safety
Publication Date:	2005
Original Publication:	CTBUH 2005 New York Conference
Paper Type:	1. **Book chapter/Part chapter** 2. Journal paper 3. Conference proceeding 4. Unpublished conference paper 5. Magazine article 6. Unpublished

Jonathan (Yoni) Shimshoni, Ph.D.
Escape Rescue Systems Ltd.

Jonathan (Yoni) Shimshoni has a Doctorate of Philosophy in Public Policy from Princeton University. He had a long and distinguished military career in the Israel Defense Forces (IDF) and completed his service as a Brigadier General; he has also served as a managing partner at PricewaterhouseCoopers Consulting (PwC).

For the last two years, Dr. Shimshoni has been CEO of Escape Rescue Systems, a young Israeli company specializing in Platform Rescue Solutions for tall buildings. He has been intensively involved in the codification processes at NFPA and is chairman of E06.77, the ASTM sub-committee charged with developing standards for external evacuation systems.

Tall Building Emergency Evacuation: "Time To Think Differently"

Extreme events such as 9/11 and recent high-rise fires have deepened understanding of particular problems associated with emergency situations in high-rise buildings and the risks and threats facing those who live and work in them. The issue has and is being addressed by the World Trade Center Building Code Task Force, the NIST Building and Fire Safety Investigation of the WTC disaster, within the building code process in New York City, and by NFPA, ASTM, FEMA, and others. The market is offering a variety of evacuation devices, and regulatory processes are in progress.

This presentation will discuss developments in the area of high-rise building emergency evacuation solutions, especially in the categories of Platform Devices, Chute Devices, and Controlled Descent Devices; the need for such devices; the applicability and benefits of the different solutions; the approach taken in a number of other countries; and insight into the process of U.S. codes and standards.

Presentation conclusions will be:

- High-rise buildings and their occupants are naturally vulnerable to events, some of which we cannot predict,
- While new buildings may be made more robust, existing buildings pose a significant challenge to safety,
- High-rise safety should be increased by providing new and additional options for evacuation,
- New technologies, both effective and efficient, exist and are applicable and relatively mature, and
- It is time to implement these technologies, but in a considered, professional manner.

Tall Building Emergency Evacuation: "*Time To Think Differently*"

Dr. Jonathan (Yoni) Shimshoni
Escape Rescue Systems Ltd.

Israel office: P.O.Box 3083, Tel Mond 40600, Israel
Email: yoni@escaperescue.com
Office: +972-9-8992219
Mobile: +972-54-579424

US office: 115 East 57th Street, Suite 1102, New York, NY 10022
Office: +1-646-202-9674

ABSTRACT
Extreme events such as 9/11 and recent high-rise fires have deepened understanding of particular problems associated with emergency situations in high-rise buildings, the risks and the threats facing those who live and work in them. The issue has and is being addressed, by the World Trade Center Building Code Task Force, the NIST Building and Fire Safety Investigation of the WTC Disaster, within the building code process in New York City, by NFPA, ASTM, FEMA and others. The market is offering a variety of evacuation devices and regulatory processes are in progress.

This paper presents developments in the area of high-rise building emergency evacuation solutions, especially in three categories: Platform Devices; Chute Devices; and Controlled Descent Devices, discusses the need for such devices, the applicability and benefits of the different solutions, the approach taken in a number of other countries and insight into the process of US codes and standards.

Paper conclusions:

- High-rise buildings and their occupants are naturally vulnerable to events, some of which we cannot predict,
- While new buildings may be made more robust, existing buildings pose a significant challenge to safety,
- High-rise safety should be increased by providing new and additional options for evacuation,
- New technologies, both effective and efficient, exist and are applicable and relatively mature and
- It is time to implement these technologies, but to do so in a considered, professional manner.

KEYWORDS
Emergency evacuation, egress, escape, tall building

BACKGROUND
High-rise buildings are an ever-growing phenomenon in the skylines of cities—in the US and world-wide. Constructing these buildings (generally, 75 feet [25m]) 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, potentially improved design and construction of future buildings will not, obviously, affect the shortfalls of the existing tens of thousands buildings, with their millions of vulnerable occupants.

Extreme events, including the World Trade Center disaster of Sept. 11, 2001, and other acts of terrorism, high-rise fires, and even blackouts have deepened understanding of particular problems associated with emergency situations in high-rise buildings, the risks inherent in such structures and the threats facing those who live and work in them. The issue has and is being addressed, by the World Trade Center Building Code Task Force, the NIST Building and Fire Safety Investigation of the WTC Disaster, within the building code process in New York City, by FEMA, NFPA, ASTM and others. Issues and problems brought to public attention in recent years with respect to conventional means of egress include:

- The limited capacity, the physical difficulty and the slow rate of evacuation through stairs;
- The limited capacity, the physical difficulty and the slow rate of responder access through stairs, especially during occupant evacuation;
- The inherent limitations of evacuating persons who are mobility challenged; and
- The lack of alternative when a single event compromises stairs and, where used in emergency situations, elevators.

Modifications of stairwell design have been recommended by the World Trade Center Building Code Task Force, and have been approved at the committee level for the NFPA (National Fire Protection Association) *Life Safety Code* and the *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 NIST report of that agency's investigation of the fires and collapses of New York City's World Trade Center, published in July 2005, recommends that design of tall buildings accommodate timely full evacuation of occupants due to a building-specific or large-scale emergency, that egress systems be designed to maximize remoteness of egress components, that new technologies be evaluated for use to facilitate timely emergency access of responders and to allow all occupants equal opportunity for evacuation, including mobility-impaired persons.

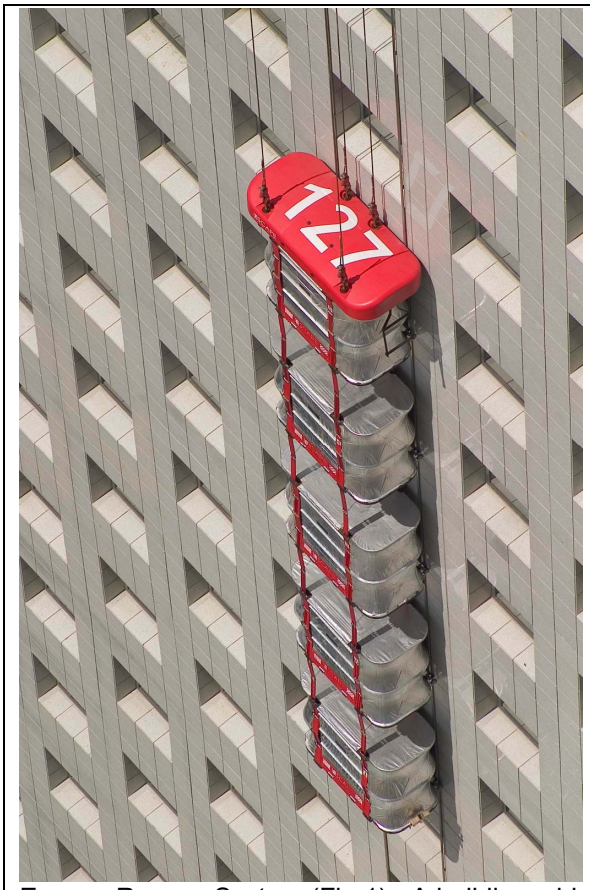
The marketplace is responding to professional and public concern with many innovative devices to aid in emergency egress. These include parachutes, controlled descent devices, powered platforms, chutes and even vertical take-off and landing craft (VTOLs). Some of these may be suitable in the right situations,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

This article focuses on three categories of external solutions: Platform Devices; Chute Devices; and Controlled Descent Devices. These categories are currently being addressed by the ASTM Committee on Performance of Buildings, which has established a sub-committee to prepare specification standards for these families of devices.

PLATFORM RESCUE SYSTEMS (PRS)
A Platform Rescue System (PRS) 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 PRS can be of a permanent type, installed on the building, often in a location obscure from view (e.g. the roof of the building), or a mobile type, brought to the building by responding emergency personnel in time of need.
Some platform devices support emergency personnel in delivering them and their equipment to upper floors of a building. Deployment of the PRS 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” in nature, are building-wide as a solution, and thus
- 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 very tall buildings,
- require no special skills or unfamiliar actions by evacuees, and are
- suitable for evacuees of all ages and physical conditions, including disabled people.



Escape Rescue System (Fig.1) - A building-wide system is 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 PRS then travels upwards until it stops opposite five upper floors simultaneously; enabling 150 occupants to enter through specially configured exit windows. (Thus, 2 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.
Escape Rescue Systems installed the first prototype on 21-story building in Ramat Gan (Israel) in July 2004. It is used for R&D, testing and demonstration. The second prototype is planned for installation on 31-story building in mid-town Manhattan, New-York, in fall 2005. The system is in advanced process of certifying by TUV Munich.

CONTROLLED DESCENT DEVICES (CDD)

A controlled descent device (CDD) is personal equipment that lowers person (or, in some instances, two persons) at a controlled rate of descent, on the outside of a building, from an upper level to the ground or other safe location. The person (or persons) descend(s) wearing an individual harness attached to a rescue line or descent rails that are anchored to the exterior of the building.

Numerous controlled descent devices are available on the market, in many countries around the world.

Controlled Descent Devices enjoy a number of prominent advantages:

- they are simple, affordable and compact, suitable as a personal, family or small-office solution,
- installation in almost any high-rise home or office is easy,
- no power source is required, and they are
- always available for immediate use by trained family members or business tenant employees.

The Spider (Fig.2) - designated for multi self-rescue from high-rise buildings. Spider 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 her self to the descent cable, and then exits the building. The Spider automatically controls the descent at a safe velocity. A redundant friction brake provides additional safety. The Spider is approved by the Standards Institution of Israel and is on the market now.

The “DOUBLEXIT” (Fig.3) device is installed within a customized entrance door of an apartment/office. The evacuation mechanism is hidden in the door cavity, 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. The DoublExit is in advanced process of approval by the Standards Institution of Israel.

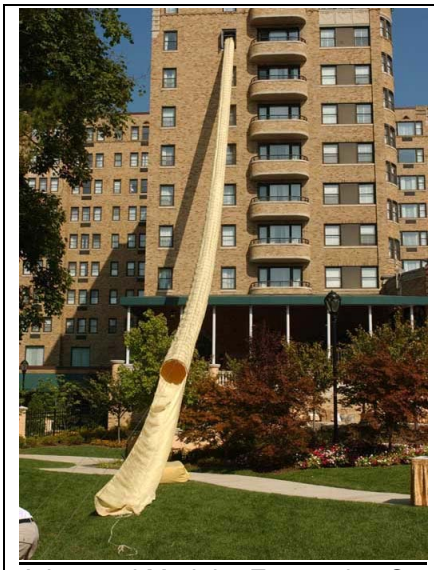
ESCAPE CHUTES

An Escape Chute is a cylindrical or trough shaped device, typically made of fire-resistant fabric or netting. The set-up of the chute 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 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 event. 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 the 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
- some are suitable for injured, disabled, elderly or even unconscious persons.

The Baker Life Chute (Fig.4) 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.



Advanced Modular Evacuation System (Fig.5) – Triggered by the 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 descend is controlled through a series of “steps,’ which occur every five floors.

AROUND THE WORLD

Controlled Descent Devices (CDD) and Escape Chutes have been manufactured around the world for the last 30 years. Web-search has revealed over 20 different brand names and companies claiming sales and/or installations of about 400,000 units around the world, mostly in Asia and Europe--in Japan, Korea, Taiwan, Thailand, China, France, Spain, Germany, Italy, Sweden, Finland, Mexico, Australia and Canada. In Japan and France we know of regulation that mandates installation of evacuation devices in particular buildings under certain circumstances (hotels, control towers and others).

NFPA and ASTM INTERNATIONAL
For the last year and a half, the NFPA Technical Committee on Means of Egress has been developing language that recognizes escape devices and systems as supplemental evacuation equipment and defines criteria for choice and deployment of these technologies.

At ASTM, Committee E06 on Performance of Buildings established, in Mid-2004, a new Subcommittee on High-Rise Building External Evacuation Devices, E06.77; the Subcommittee is in the process of developing 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, improve the ability of evacuating disabled people, and, as described above, in some cases 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 and limited use of elevators. Recent events, such as the 9-11 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 of high-rise buildings provide an alternate escape route and additional evacuation capacity. Some of these systems support emergency forces in accessing higher floors of a building – an advantage that can reduce significantly the time required to reach and gain control of an event (such as fire) in the building and to help evacuees in stress and distress. Some of the systems are personal and are for immediate use by the tenants, without the need to wait for emergency forces, while other systems supply building-wide solution, with vary large capacity. Some have the ability to transport emergency responders and their equipment “up and into” the scene.

Naturally, adopting such technologies is only one dimension of action required to make tall buildings safer, but it is potentially a very cost-effective tool in meeting inherent challenges to safety of the high-rise environment.