Elevators for Improving Life Safety

by Samson Rajan Babu

Presented at the

Samson Rajan Babu is a vertical transportation engineer for Burt Hill in Dubai. He has more than 11 years of experience in project design, project management and project sales of elevators and escalators, including more than 10 years in the Gulf of Arabia region. His current responsibilities include expert services on project planning, vertical-transportation system design, project execution quality control for elevator and escalator systems and interfacing with other trades (life safety, mechanical, electrical, fire fighting, interiors, and BMS/IT systems). His areas of expertise includes destination controls, double-deck systems, super-high-rise buildings, evacuation elevators and evacuation communication systems. He is a member of the International Association of Elevator Engineers in the U.K. He received his Bachelor of Mechanical Engineering in May 1994 from the College of Engineering (Guindy), Anna University, Chennai, Tamil Nadu, India.

Introduction

Every new high-rise project has a mandatory requirement of life safety assessment by the authority having jurisdiction. An architect has to ensure that the building has been designed to meet the life safety codes as mandated by the local civil defense authorities and municipalities. Though "fire emergency" has meant "life safety" for many years, post 9/11 incidents have resulted in the need for considering other sorts of emergencies. Hence, architects and planners have the responsibility of enhancing life safety features within projects by employing suitable equipment and technology.

The National Fire Protection Association (NFPA) series of life safety codes are followed for all types of occupancies in most parts of the world. For healthcare facilities, additional considerations are made using British Health Technical Memorandum (HTM) codes. The code requirements vary according to the type of occupancy of the planned building. "Life safety scheme approval" is an important phase in the design of a building, wherein, design experts analyze the risk elements and identify the ideal evacuation concept. It incorporates suitably sized means of egress, locating them within easy reach of occupants and considerations for the disabled, all according to the NFPA life safety codes. For specialized buildings (such as high rise, towers, healthcare, amusement parks), this process takes on more importance in that a number of revisions are required.

The architect (sometimes with the help of a specialist) prepares a set of life safety drawings and life safety reports for submission and approval by the local civil defense authorities. Various elements that help in evacuation in case of emergency are highlighted on these drawings. The authorities review the provisions and approve and/or demand more to grant an approval.

In approving any "life safety scheme," the authorities must look for the provision of firefighter elevators. Even though the minimum requirement is one fireman's elevator per building, authorities may demand more fireman's elevators, depending on the floor plate and access conditions.

Evacuation Management

Any professionally managed building should have an in-house team of emergency responders for crisis management. This team should have an evacuation manager, evacuation coordinators, floor wardens and an evacuation plan for different levels of threats. They should also be familiar with the tools and equipment available for evacuation purposes, regularly test such equipment, maintain upkeep records of such equipment and conduct evacuation drills regularly to familiarize the occupants with the egress options available within the building.

Traditionally, occupants have been advised not to use elevators in case of fire. The NFPA codes recommend this in order to avoid occupants misusing them. However, the NFPA codes allow the elevators to be used

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as an "accessible means of egress" for people with disabilities and people having difficulty using stairs. The elevator-assisted evacuations are carried out by fire department personnel after acquiring elevator controls by Phase-2 Firefighter's Operation.

Is it feasible to use the elevators for evacuation by trained personnel within the building? More than feasible, the requirement for "occupant controlled evacuation" is understood to such an extent that the NFPA 5000 safety code now requires at least one first responders' elevator to be provided on high-rise buildings. (Clause 33.3.7)

Occupant-Controlled Evacuation

Occupant-controlled evacuation may be required in both fire and non-fire emergency situations. Once an emergency has been identified, it is critical not to delay response, but instead act. Trained emergency responders within the building should be able to carry out occupant-controlled evacuation in order to save lives. When a fire is located far away from the elevator or elevator lobby, the elevators will not move on to Phase-1 recall and will instead remain in normal operation. These elevators can be used to evacuate the occupants. This scenario is also similar to "non-fire evacuation."

Even when a fire is located closer to the elevator or elevator lobby, the working condition of the elevators can still be maintained in normal operation by means of "hardening" the elevator and its surroundings. "Hardening" means improvement of various elements such as:

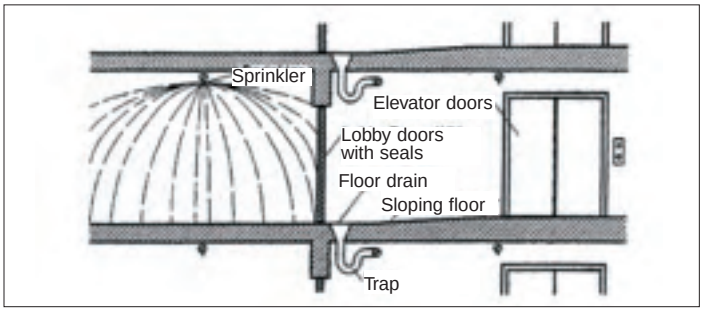

Figure 1: Water protection features for elevator surroundings

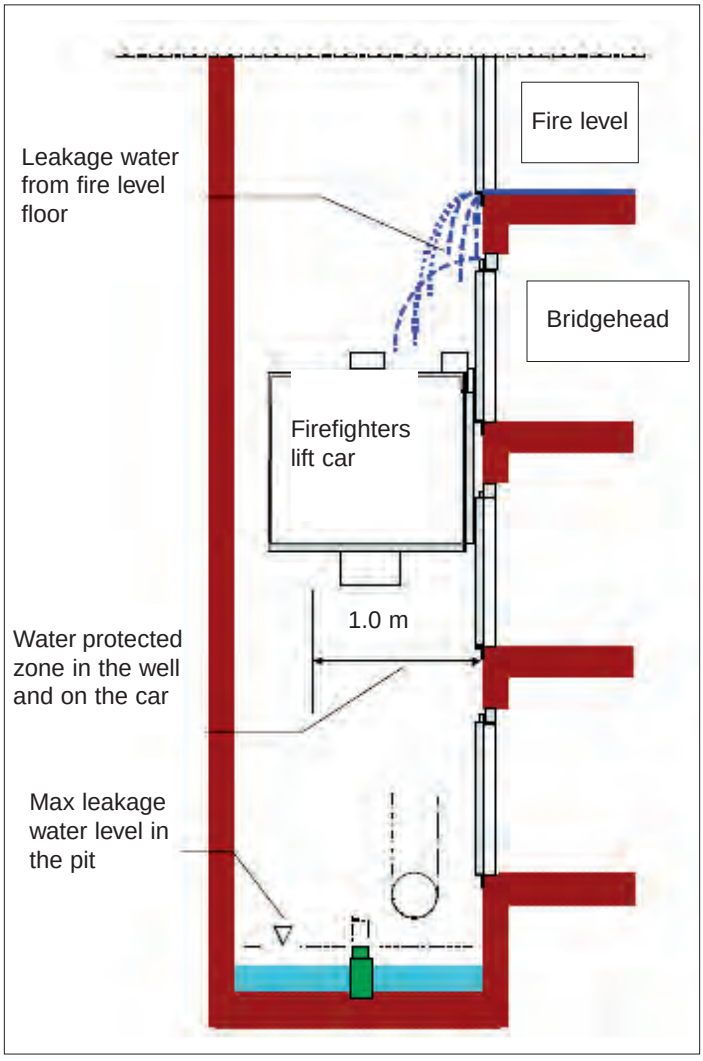

Figure 2: Water protection elevator equipment inside hoistway

1) Protected elevator lobbies and elevator machine rooms
2) Pre-action type sprinkler system inside elevator machine rooms
3) Fire rated elevator landing doors with flame guards
4) Water protection
5) Limit water level inside pit not more than level of compressed buffer
6) Deflecting water away from elevator entrance
7) Trench drains near the lobby door
8) Standby power to the elevator
9) Standby power to the machine room air conditioning.

Note: Many of the above items are covered in EN 81-72: Firefighter's lifts.

To facilitate occupant-controlled elevator evacuation, the requirement is to have real time information on the following:

a. Location and severity of fire – can be obtained from addressable fire alarm systems

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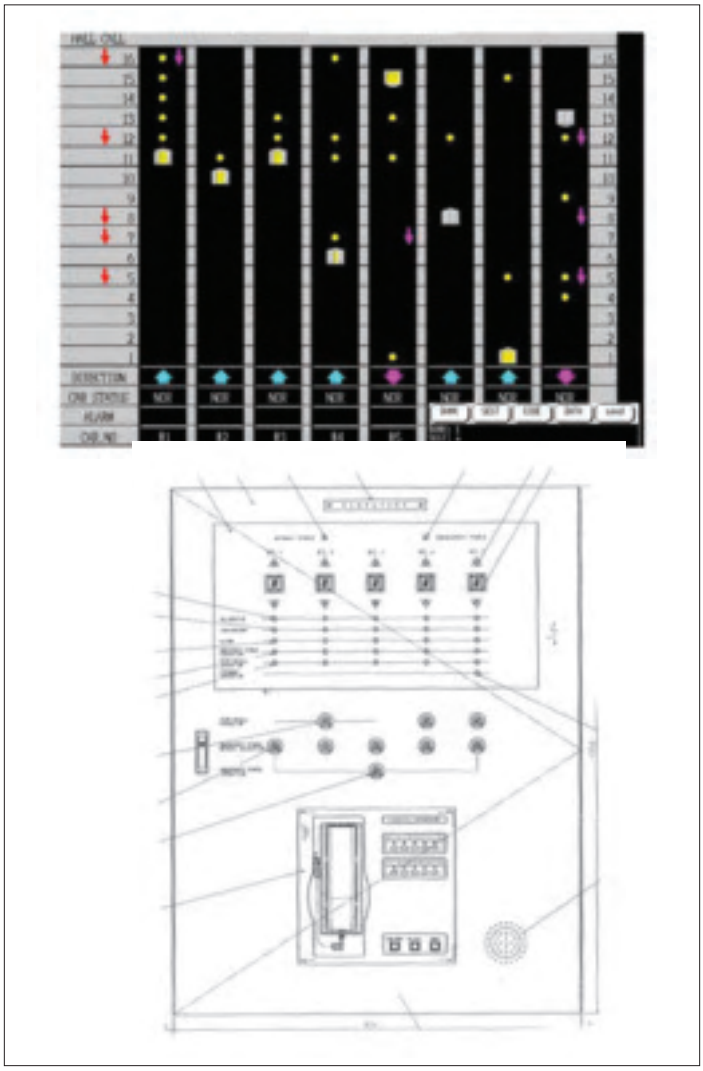

Figure 3: Elevator monitoring system/supervisory panel

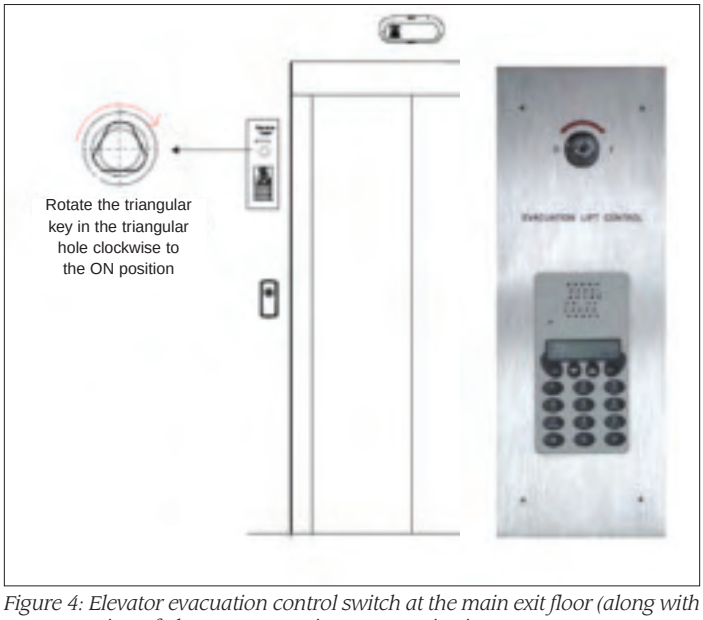

Figure 4: Elevator evacuation control switch at the main exit floor (along with master station of elevator evacuation communication system) (Courtesy: Drucegrove, the U.K.)

b. Elevator operational status – can be obtained from monitoring system/supervisory panel (Figure 3)c. Elevator lobby and machine room condition – can be obtained through closed-circuit television cameras
d. Power supply status – can be obtained from building-management system (BMS) panel

With all of this information, the building management team and the emergency responders on each floor can decide the evacuation strategy (total evacuation or progressive evacuation or fractional evacuation).

Evacuation Elevator Control Switch

In order to gain exclusive control of the elevator for occupant-controlled evacuation, NFPA5000 -Annex E recommends manually activating the phase-1 recall. (Using phase-2 operation for occupant-controlled evacuation is to be understood, though not detailed, within Annex E.) Further guidance on occupant-controlled evacuation elevators can be taken from HTM05-03 Part-E "Escape lifts in healthcare premises." This code recommends an "evacuation control switch" located at the evacuation control point (i.e., the main exit floor) (Figures 4 and 5a).

Evacuation Elevator Voice Communication System

At this point, human behavior during an emergency evacuation should be considered. Unless reliable information is provided to occupants by authoritative persons, there will most likely be misconception, panic and rumors. The occupants will be uncertain of their status; whether to wait for an elevator, whether the elevators are in good working condition, etc. NFPA72 recommends a suitable means of communication (a public addressing system) for each floor as a part of the fire alarm system. This includes communication with elevator lobbies. It may be noted that this is only a one-way communication from the command center to selected floors and/or lobbies. An occupant cannot initiate a call to the command center.

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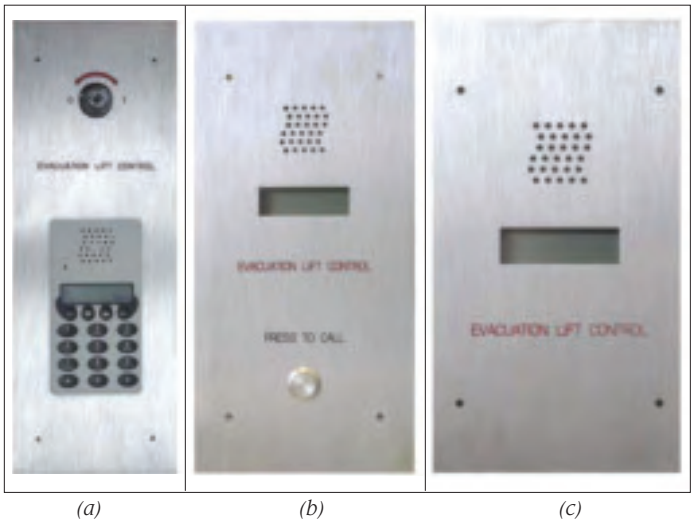


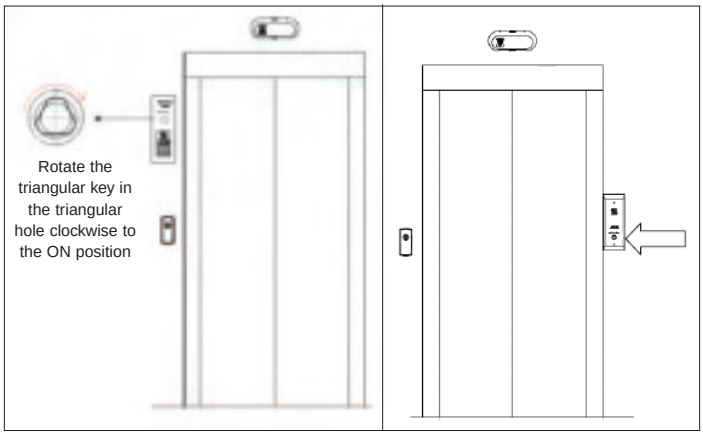
(a) (b) (c)

Figure 5: (a) Master station at main exit floor; (b) Slave station (with call button) at upper floors; (c) Slave station (without call button) inside car (Courtesy: Drucegrove, the U.K.)

HTM05-03 part-E recommends an independent two-way communication system, which facilitates communication between each elevator lobby, elevator car and the main exit floor. A typical "elevator evacuation communication system" is described as follows:

"The system consists of one or more stations having master stations (with dialing pads) and the other stations (slave stations) which have push-to-call single buttons. A slave station inside a car usually does not have a push-to-call single button. All stations have built-in speaker grills and microphones to allow two-way communication between any two stations." (Figures 5a, 5b and 5c)

"Typically, a master station is provided at the main exit floor for an evacuation elevator. Slave stations are provided at each elevator landing and machine room. Slave stations (without push-to-call buttons) are provided within the car." (Figures 6a and 6b)



(a) (b)

Figure 6: (a) Elevator evacuation control switch at the main exit floor (along with master station of elevator evacuation communication system) (Courtesy: Drucegrove, the U.K.); (b) Slave station of elevator evacuation communication system at upper floors.

"The master stations have a display panel above the keypad that displays "caller identification" (programmable name-up to 13 characters) when receiving a call or the "station identification" when making a call. Alarm calls can be made using the intercom system from any landing to the master station(s). If more than one station makes an alarm call at the same time, their initiation will be memorized and queued. Information is displayed giving the number of alarm calls and their priority on a first-come/first-serve basis." (Figures 7 and 8)

Note it is not possible to listen and talk at the same time (i.e., when pressing "talk" the speaker will not allow the incoming conversation to be heard).

When the alarm button is pressed and held for one second, the master stations will emit the alarm tone and display the name and number of the alarming station. The word "alarm" will also be displayed above the left key. When the left key is pressed, voice communication is made to the alarmed station and "alarm" is replaced by the word "talk" (Figure 7). By pressing the left key, the master station can immediately talk to the calling station. The person at the calling station needs to do nothing in order to hear the master station. The calling station will produce a beep tone every 20 seconds to indicate that a call is in progress and that the microphone is "open" or "live." If further alarm calls are made, they will be held in a queue.

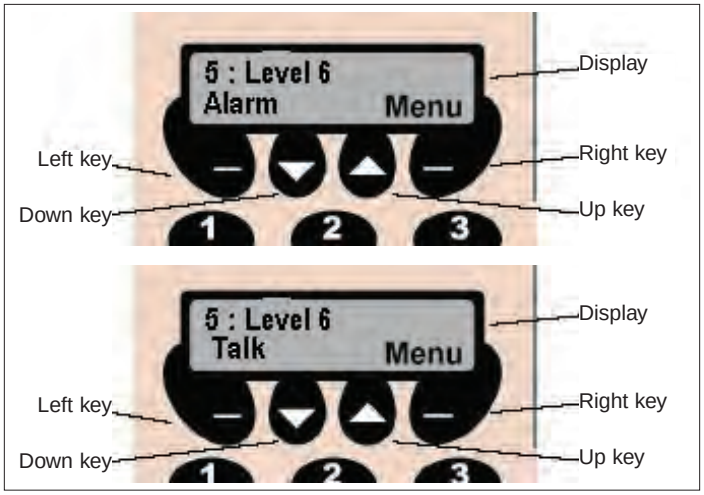


Figure 7: Making/receiving calls between master station and slave stations (landing)

To call the lift car, simply use the up and down keys to scroll through the list of programmed levels until the desired recipient is found and press the left call key. It will then be possible to talk to the lift operator in the lift car by pressing the left hand key for "talk" (Figure 8).

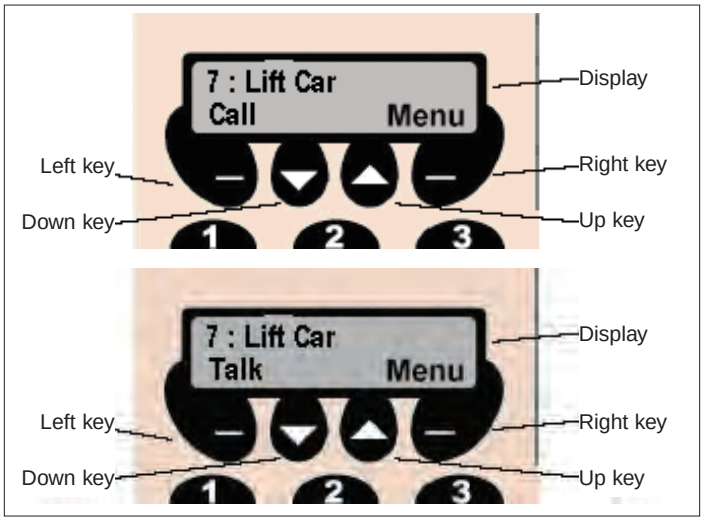


Figure 8: Making/receiving calls between master station and slave stations (car)

Evacuation Elevator Status Indicators

In order to improve the clarity of information sent to or from the intercom stations, suitable visual indicators have also been recommended by the above codes. These indicators convey the following information to occupants and evacuation staff:

- The elevator is available for evacuation use (at each landing)
- The elevator is not available for evacuation use (at each landing)
- The elevator landings at which occupants wait for evacuation (at main exit floor)

NFPA5000-Annex E recommends color-coded lights along with the above illuminated displays to confirm the status of the elevator at each elevator landing as follows:

Message Displayed Color Code

- "Elevators available for occupant evacuation" – Green light
- "Elevators out of service, use exit stairs" – Red light
- "Elevators are operating normally" – No light

Conclusion

Information on-hand is crucial in evacuation scenarios to decide for and to execute evacuations successfully. Through many years of technological development and analytical thinking focused on the "elevator assisted evacuation" subject, we now have available workable concepts, technology and equipment to collate real time information and to share it for the benefit of users. Though there is no mandatory requirement by the codes, so far, it is not an idle subject. All the code organizations are busy developing a regulation on this subject, which should soon become a mandatory requirement.

Architects and planners should start using such novel concepts more on their new projects voluntarily. "Elevator assisted egress" could help as a standby feature to the primary egress concept should any of the primary egress components become redundant. When incorporated, these features bring a great level of satisfaction to the designer of having increased the safety features of his project multifold. The authorities would appreciate the main egress and alternate egress features, which should speed the approval process. Only when put into practical usage, further clarity and refinement on this concept and equipment can be achieved.

References

1) Klote, J.H., Levin, B.M., and Groner, N.E. (1995), *Emergency Elevator Evacuation Systems, Proceedings of the 2nd Symposium on Elevators, Fire and Accessibility*, Baltimore, Maryland, April 1995.
2) *BS EN 81-72:2003 Safety Rules for the Construction and Installation of Lifts – Particular Applications for Passenger and Goods Passenger Lifts – Part 72: Firefighters Lifts*
3) *NFPA 5000 Building Construction and Safety Code – Annex E "Elevators For Occupant Controlled Evacuation Prior To Phase I Emergency Recall Operations"*
4) Big Voice Evacuation Intercom System by Drucegrove Ltd. – www.drucegrove.com
5) ELVIC monitoring & control system by Fujitec – www.fujitec.com