Emergency evacuation elevator systems guideline

CTBUH taskforce publication 2004
What is CTBUH?

CTBUH

- Council on Tall Buildings and Urban Habitat
- Non-Profit organization
- Cross-scientific

Mission:
- Disseminate information on tall building technology and healthy urban environments
- Maximize international interaction of bldg pro’s
- Communicate latest knowledge in useful form
CTBUH publication

The guideline publication was made by the CTBUH on initiative of KONE and was chaired by KONE

Mission:
- Identify key issues that a design team must consider in the development of elevators for use in egress systems

Contents:
- Marketing considerations
- Three generic evacuation types
- Design approaches for generic emergency evacuation types
- Performance requirements concerning tenability and robustness
- Capacity calculation using elevators and stairs; case study
- How to use emergency evacuation elevator systems
- How to implement emergency evacuation elevator systems in the design and construction process
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- **Security Consulting**
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Generic evacuation types

- **Total emergency evacuation** means that the total building population is evacuated immediately.
- **Staged emergency evacuation** means that a part of the building population is immediately evacuated.
- **Fractional emergency evacuation** means that only a very small group or fraction of the building population is evacuated/rescued.

- Different design for different capacity needs
Design approaches

Standard elevator
1. Elevator car in standard hoistway
2. Unenclosed elevator lobby

Enhanced elevator
1. Hoistway improved with sensors, heat and water resistance of electrical components.
2. Lobby provided with smoke stop doors.

Protected elevator
1. Pressurized elevator car in a hoistway improved with sensors, heat and water resistant electrical components, pressurization and blast resistant walls.
2. Lobby provided with two-hour rated fire doors.
3. Fire pressurization shaft and direct access to emergency stairs within a separate fire and blast protected compartment.
4. Standpipe and hosracks would be in the lobby.
Typical protected elevator

Protected elevator

1) Protected emergency elevator car
2) Protected emergency elevator lobby
3) Emergency stairs vestibule (can be part of elevator lobby)
4) Pressurization shaft
5) Emergency stairs
General
- Elevator recall functionality
- Monitoring systems, also communications

Emergency Power System
- Standby power for 100% of the protected/enhanced/standard elevator(s)

Elevator Vestibules
- Heat detectors, smoke detectors,
- Permanent firefighters’ communication system,
- Emergency supervised communication system for occupant’s use
- CCTV camera connected to a video switch & monitor system in the Fire Control Center (FCC) should be provided.
- Dedicated smoke exhaust and/or pressurization systems
Elevator Machine Room

- Equipment and electrical systems should be protected from discharge of the sprinkler system within the room.
- Automatic smoke and heat detectors
- Ventilation and/or air-conditioning system installed within a hardened and fire protected enclosure.
- Room should be configured to prevent water intrusion or provided with electrical systems that are listed for use in wet locations.
- Dedicated smoke exhaust and/or pressurization systems should be provided.

Hoistways

- An automatic smoke detection system
- Hoistway should be configured to prevent water intrusion or provided with electrical systems that are listed for use in wet locations.
- Dedicated smoke exhaust and/or pressurization systems
Elevator Car
- Permanent firefighters’ communication system
- Supervised emergency communication system for occupant’s use
- Lighting fixtures and exit signage that are provided with integral battery backup units and connected to the emergency power system.

Protected/Enhanced/Standard elevator vestibules
- Automatic smoke detectors
- Permanent firefighters’ communication system
- Supervised emergency communication system for occupant’s use,
- CCTV camera connected to video switch & monitor system in the Fire Control Center
- Dedicated smoke exhaust and/or pressurization systems should be provided.
Automated systems now present in the typical high-rise building environment, that could enhance the FSD’s capability during the evacuation process, but which he/she does not typically have access to include:

- Building Automation System
- Security Access Control & Alarm Monitoring Systems
- Security Closed-Circuit Television Surveillance Systems
- Intercom Systems
Additional information that may be provided to the FSD by the other building systems include:

- Status of smoke exhaust and pressurization in the stairs, elevator hoistway & vestibules
- Occupant assembly processes pre-evacuation
- Presence of injured parties
- Power failures
- Emergency power generation operation
- Loading of the elevator
- Environment of the elevator vestibule, hoistway and car
- State of electrically locked doors in the path of egress
- Status of evacuation process: prompt and orderly vs. panic among evacuees
Down-peak vs up-peak efficiency

- Elevator system has 1.6 times greater efficiency in down peak traffic
Total evacuation by elevators is faster when building height exceeds 20 floors
Assumption: Stairs designed to same width throughout the building
Case study

Case study building assumptions:

- **Number of Floors:** 47
- **Floor to floor height:** ~ 4 m
- **Travel Height:** 200 m
- **Population:** 3 300 pers, ~ 70 pers. per floor
- **Total Floor Area:** 55 000 m²
- **Desired evacuation time:** 25 min. (Total, Staged, Fractional)

- 1 protected elevator
- 3 x 2 enhanced elevators
- 12 standard passenger elevators
- 19 elevators in total

Diagram:
- Standard elevators, stops at assigned floors
- Protected service elevator, stops at all floors.
- Enhanced passenger elevator, stops at assigned floors.

Total evacuation:
(Bomb threat): All elevators and stairs are used.
Case study conclusions

- One protected elevator for evacuation of disabled and injured that can handle necessary traffic within 26 minutes (3% of the population).
- Design the rest of the elevators as standard elevators, because total evacuation is manageable within roughly 25 minutes using either stairs or elevators.
- Based on calculations and set evacuation time criteria, the enhanced elevators are judged to be unnecessary. For a staged fire evacuation the low number of occupants per floor and the existence of a protected elevator is regarded as a satisfactory solution.
- Buildings with higher populations per floor and a higher number of floors than the case example discussed here, gain substantially from emergency evacuation elevators that enable a total evacuation of the building.
Using elevators in evacuation

“Elevators are always primarily used by those who need them the most”

Procedure

1. The floor warden or a member of the Fire Safety Team on the affected floors will supervise boarding of the elevator and select the floor as directed by the Fire Command Center.

2. On arrival at the designated floor and discharge of the occupants, the car will return to its first stop to pick up additional occupants to evacuate.

3. This will continue until the original floors are fully evacuated and then the elevator cars will move to the next group of floors and so on until the building is fully evacuated.

4. As each group of tenants is discharged at the evacuation floor a report will be given to the fire command station indicating the number of people who have evacuated and the number of floor occupants yet to be evacuated.

   • This information can be transmitted via the elevator intercom, two-way radio or in person to the FCC.
Thank you!

Johannes de Jong
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and on behalf of the CTBUH.