# Evacuation needs of tomorrow

*by John Ng*

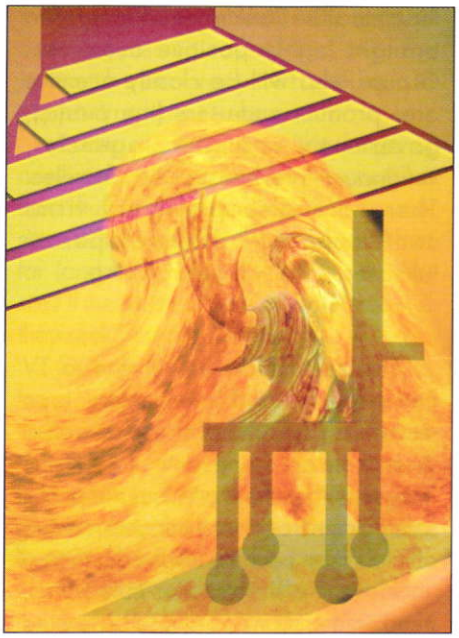
## Introduction

As in many land-scarce nations around the world, living and working in high rise buildings have become part of peoples' everyday lives. Though high rise buildings are fire resistive structures by design, in a fire, height has specific hazards that can make firefighting, evacuation, search and rescue more difficult. This is especially so for high rises that are beyond the reach of aerial ladders.

As Singapore's population ages, many elderly citizens may join the ranks of the disabled when their vision, hearing and mobility begin to deteriorate. Given that the majority of senior citizens live or work in multi-storey buildings, the need to find a quicker means of evacuating them from high rise buildings will become more pressing.

While ladders and staircases are fine for physically fit people, they should not be part of the evacuation system for the disabled, as they do not consider the physiological and psychological characteristics of the occupants. To illustrate, the elderly or disabled will require assistance to descend the stairs. This can be a slow, dangerous, strenuous and painful process that can also jeopardise the lives of those rendering assistance. If the emergency does not harm the less fortunate individuals, there is a possibility the escape will.

The ageing population also brings about new challenges to life safety design for the built environment. This includes increasing difficulties in applying the Code when designing standard egress system of buildings, to meet the evacuation needs of the elderly and disabled. Because emergency evacuation conditions depend largely on the occupant characteristics of a given building, the Code and standards of egress are limited in the information they can provide. Given that the ageing population continues to grow, the question then is, will the existing Code remain adequate to meet the needs of evacuation for protection of specific occupants in buildings due to this change in demographics? The Code prescribes exit staircases as the main means of egress from a building during an emergency, but a caring society should see the need to protect the mobility-impaired individuals during emergency evacuations.



*Government statistics show that the aged and disabled people are no small minority in Singapore. Egress and exit issues are often overlooked for such people who either cannot or should not walk down stairs. However, they have no alternative but to do just that during an emergency evacuation. In an ageing society like Singapore, with more of the disabled joining the work force and the working population continuing to grow older, will existing access and evacuation features in buildings remain adequate?*

## Egress options

A safe and secure environment, in which clients, visitors and staff may work without any fear of harm or injury, is a requirement under occupational health and safety legislation in many countries. This also means that the work place should have adequate, safe egress that allows occupants, including any disabled person, to escape within two to three minutes of detecting a fire in normal circumstances. In other words, all buildings are obligated to give mobility-impaired individuals the same opportunity that able-bodied people have during an emergency evacuation.

Every high rise should be designed such that all occupants can escape from the danger areas to a place of safety without outside assistance, before they are overcome by the smoke and heat during a fire. The places of safety are divided into:

- Holding area: situated on the interim level of a building, it is usually built with an open air concept. It is used to temporarily hold the occupants until further assistance from rescue personnel arrives.
- Comparative place of safety: It is any place which puts an effective barrier (normally with a 30-minute fire resistance) between the person escaping and the fire.
- Ultimate place of safety: an open air area at ground level well away from the building. It is a dispersal area and is large enough to permit all the occupants to proceed to a safe distance away from the building.

Entrances, exits and circulation areas provided in all normal everyday use, and escape routes should be utilised, where possible, for emergency evacuation. It is the norm for two exits to be required for rooms with more than 50 people, the reason being that one exit could, in the worst possible scenario, become blocked by fire.

There will be situations where the minimum number of exits may not be enough to cater for the occupants when one is discounted for fire - even if they are of the maximum

size. In these cases, it will be necessary to add an additional one to the minimum total.

In practice though, it is not always possible to provide additional exits or to increase the size of exits provided. It would then be necessary to restrict the number of occupants to that which the exits could accommodate.

In many situations, escape chutes are acceptable by fire authorities as a practical alternative in buildings where it is not possible to provide additional exits or increase the size of existing exits. The distribution of alternative exits is important so as to ensure that they can be effectively used in case one is blocked due to a fire nearby.

An escape plan should not include help or rescue from outsiders, except as a last resort. In most high rise buildings, reliance of escape is placed on structural fire precautions to restrict fire spread, so that those most at risk can evacuate first, while the others are put on standby for later evacuation once the firefighting teams arrive.

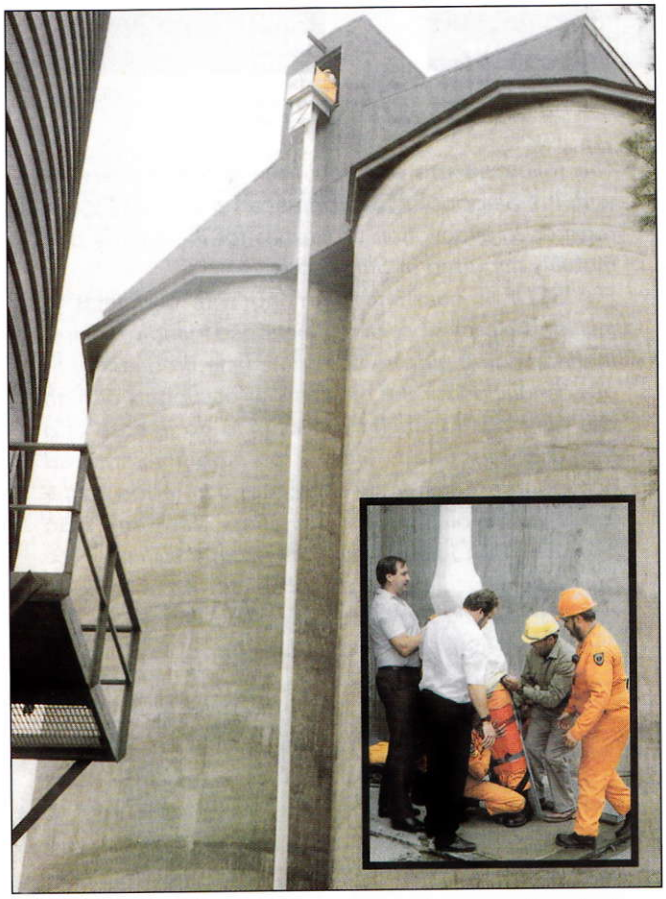
## Methods of evacuation

It may not be practicable or desirable to commence total evacuation, where every occupant need to be simultaneously evacuated out of the whole building. Instead, the design must allow for a phased evacuation. In such a staged or progressive exercise, only occupants in immediate danger (on the fire floor and the floor above) are evacuated first, with progressive extensions to the evacuated area if the fire risk persists.

In more complex buildings where the evacuation is phased, occupants may only be evacuated to a comparative place of safety for refuge on the same level fire compartment (horizontal), or different level refuge floor (vertical):

- horizontal evacuation: the transfer of occupants from the compartment at risk to adjoining compartments at the same level within the building.
- vertical evacuation: transfer of occupants from the compartment at risk to the refuge floors at an upper or lower level within the building.

Generally speaking, the taller the building, the longer the time it would take to evacuate all occupants from a blazing building. It is for this reason that fire staircases are adequately protected from the heat and smoke of fire. An emergency staircase that is enclosed throughout its height by fire resistant structure and doors can be considered to be a place of comparative safety.



**An escape chute being used for vertical evacuation. Such chutes are also safe for use by infirms bound on stretchers.**

## Fire lifts

Some countries have fire regulations that require any building higher than eight storeys to have a fire lift to serve every floor of the building. The fire lift can be used to bring down the mobility-impaired occupants from upper floors during an emergency. However, there is only one fire lift in a building and it will take time to bring down all the physically disabled people at different floors in a possible scenario.

Furthermore, the same fire lift is also urgently needed by

## Projected elderly population in Singapore

| | 1999 | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| Number of people aged 65 or older (in thousands) | 235 | 312 | 529 | 796 |
| People aged 65+, as proportion of total population | 7.3 | 8.4 | 13.1 | 18.9 |
| Median age of citizens and permanent residents | 33.4 | 36.9 | 39.3 | 41.2 |
| Dependency ratio of people aged 65+ (per 100 of population aged 15 to 64) | 10.4 | 11.6 | 19.0 | 29.5 |

**Source: Singapore Department of Statistics.**

## What the SCDF says...

*The following are excerpts from a faxed interview with the Singapore Civil Defence Force (SCDF) with regards to evacuation provisions for the elderly and mobility-impaired in Singapore:*

*"SCDF is constantly working with architects to include the provisions of handicapped-friendly features in the building plan. At the same time, frequent drills are conducted for the residents or occupants of high rise buildings to teach them what to do in case of a fire. Handicapped, elderly or mobility-impaired occupants are generally encouraged to reside on the lower floors of high rise buildings. They are also advised to be familiar with the escape routes of the building to facilitate any evacuation. Arrangements can also be made with management to use the fire lifts for evacuation for this group of people.*

*In the case of hospitals, hospital staff will undergo special drills for evacuation of patients, in which special attention will be given to the high dependency patients. In this setting, the lateral instead of vertical method of evacuation is practiced. The evacuation takes place to shift occupants affected from one wing of the building to another, thus reducing the hassle for patients to move long distances to reach the ground floor."*

firemen to transport equipment for internal firefighting. The firefighters are required to attack the fire in the fastest possible time to carry out rescue work and minimise damage to the building. However, the Singapore Civil Defence Force (SCDF) said that special provisions can be arranged to bring the handicapped down via the fire lifts.

In the first place, standard evacuation procedures should be drawn up for the mobility impaired, which includes keeping a record of who they are and which floor they are on. Fire safety managers can also hold a key to operate the fire lift instead of waiting for firemen to arrive.

The fire lift consists of the shaft, lift car, the system which operates the lift, and supplemented with safety and fire resistance features to support the whole lift system.

The minimum size of a fire lift car is about 1.44 $m^2$ with a capacity of 544 kg of goods or persons (approximately 17 to 23 passengers at one time). However, depending on the actual size of the lift car, it may transport only up to four wheelchair-bound passengers at any one time. These cars should be travelling at a safe speed of 30 m to 40 m per minute.

The fire lift system is powered by a back-up power supply produced by a generator - the Genset. After five seconds of blackout in an emergency situation, the emergency power supply system (EPS) of the building automation system (BAS) will start up the fire lift system, and illuminate strategic lights within the building for ease of the evacuation or firefighting process. This will enable the fire lift's car to be operational for rescuing activities even when the electricity is shut down. A logic or intelligent surveillance system under BAS will allow the fireman's emergency operation (FEO) to disable all lifts except for the fire lifts, which uses the special key - the fireman switch mode. Firemen will normally obtain these keys from the building owner or maintenance staff. Sometimes they even carry a master key. Rescue operations can only begin when firemen have arrived at the building and when the fireman's lift can be operational in responding to calls during fire. It is imperative that fire lifts are well maintained to ensure they can be relied upon during emergencies.

For normal lifts, the fire emergency return (FER) system will automatically bring all lift cars safely to the ground floor with their doors open. However, in multi-storey buildings with sealed windows, the lift shaft can be transformed into a gigantic chimney, which suck smoke and heat in and up. There are reports that lifts jammed in the shafts because the heat has melted the hoist cables. In many buildings, lifts are equipped with heat sensing devices that cause some of them to stop on floors where there are fires. Water from fire hoses can also damage the electrical system and leave the cab stranded between floors.

### Conclusion

Creating more functional buildings at a reduced cost is certainly a desirable goal, but one must not ignore life safety. Because a building's occupant characteristics dictate potential evacuation hazards, building owners may be required to provide safe evacuation for mobility-impaired individuals during an emergency. Planning and incorporating additional evacuation features in buildings now to meet the evacuation needs of tomorrow will avoid having to correct the egress deficiencies when the building has finished being constructed. It is often easier and cheaper to incorporate evacuation features in a building during the construction stage, than when the building is up and ready.

Justification for additional means of egress, such as escape chutes, in meeting the evacuation needs of tomorrow varies. But the cost of such evacuation features for life safety purposes can sometimes be easily absorbed since it tends to be a small percentage of the total cost of new construction, renovation or building operations. Furthermore, the standard means of egress - staircases for evacuation - that work today may not, and probably will not work tomorrow. **F&S**


## About the author

John Ng has over 20 years of experience in operations, marketing, and general management in various industries, out of which eight years are in the fire safety industry. He is the managing director of Escape Consult Mobiltex (S) Pte Ltd, a regional office for AB Mobiltex OY, which services and develops the Ingstrom Escape Chute system in the ASEAN markets.