A Towering Concern

Most, if not all high-rise buildings offer routes for escape in an emergency. These measures also help to prevent fire from spreading to nearby buildings, prevent premature collapse of the building and allow firefighters an opportunity to rescue people and extinguish the blaze in the quickest and safest way. However, tall buildings are more difficult to tackle when seeking to evacuate in an effective way one that allows for mass evacuation to take place simultaneously. The use of lifts is not considered unless there are people with impaired mobility that need rescuing. As a result, the time it takes to completely clear a tall building is both augmented and fraught with danger. As buildings grow in both height and complexity, there is growing concern over safety, particularly relating to fire. Such incidents in tall buildings can endanger both the life and safety of countless people. Although rescuers try not to use lifts, members of the public will undoubtedly opt for the fastest means of escape. This decision is both the catalyst and symptom of panic and feelings of insecurity in the minds of those involved. In the past lifts have provided one of the safest forms of vertical transportation. However, despite their successes people have fallen victim to fire while using them to escape. It is precisely because of these instances that many of the world s fire services discourage the use of such equipment as a means of escape. In fact, around the world it is widely understood that lifts should not be used during fires, supported by warning signs in most buildings. As the risk to our cities increases through terrorism, war or accident public expectations to feel safe in buildings are increasingly unrealistic. The improved safety and security measures of taller buildings have become of prime importance across the world. In response to these growing threats, and to the certainty that future emergencies cannot be predicted, all we can do is prepare ourselves for the worst and plan for the need to conduct mass evacuations at some point.
Some suggestions aimed at helping with such processes include wider stairs, multiple stairwells at strategic locations and determined fire service intervention at an early stage. In addition, research into lift safety and the reliability of escape chutes to assist with large-scale evacuations is encouraged. It is hoped that such developments would help provide escape procedures that allowed for the evacuation of a large number of people in a short space of time.

Evacuation Under Extreme Conditions

Following the terrorist attacks on the World Trade Centre (WTC) and the Pentagon in the US almost three years ago, it has become evident that everyone must be able to get out of tall buildings quickly in an emergency. The

lessons that can be learnt from the evacuation of the WTC were that nearly everyone who could physically get out did. Most people kept to the right of the stairwell to allow rescuers to climb up on the left. What about those occupants who were not willing, or able, to walk down long flights of stairs due to impaired mobility or health reasons? It was reported that people with disabilities who could be moved by colleagues and rescuers escaped. But how many of the less capable were still waiting to be rescued when the structures collapsed will probably never be known. Experiences of the WTC evacuation show that people would take risks in attempting to get out of a building fast, such as using lifts if they were still running.

Controlled and Uncontrolled Evacuation

Due to the significant numbers of occupants in tall buildings, evacuation is typically carried out through a controlled process. Also known as staged or phased , the evacuation method, with live voice messages and warden intercom points on each floor, allows for control centre or emergency services personnel to clear a building in a methodical way controlling which floors are evacuated and when. The floor of the fire origin should be the first to be cleared, followed by other adjacent floors. By limiting the number of levels being evacuated at any one time, the process is efficient, especially for those most at risk on the floor of the fire. The governing factor for use of staged evacuation is the reduction in numbers and width of the stairs required, therefore reducing core area and increasing net area for the entire building. This method of evacuation also reduces business interruption within affected buildings. However, phased evacuation may require more time than is available for occupants to exit prior to their safety being threatened. Another method of evacuation is the uncontrolled or simultaneous one. Here, all floors are alarmed at once with all occupants exiting via the stairs at the same time. During the complete evacuation of a taller building, it is likely that there would be significant congestion in the stairwells with a large number of occupants, when compared with occupant numbers during phased evacuations at the same time as firefighters are travelling against the flow. Most low- and medium-rise buildings have a simultaneous evacuation process, as it is simpler and does not require significant warden input or a communications infrastructure.
Though uncontrolled evacuation is often rare today for high-rise buildings there are still some that opt for the simultaneous evacuation method in the case of an emergency. Therefore, are the egress requirements in the codes adequate for addressing scenarios, fire or otherwise, that necessitate the removal of all occupants from the building to a remote location?

Recognition of the Evacuation Problems

No one wants to have to contemplate the possibility of a high-rise evacuation. However, training for egress in evacuation drills should occur as part of a structured risk management plan. Fire drills have two functions:
" To rehearse evacuation so that people become familiar with the procedures
" To provide feedback to see how effective fire training has been and

highlight things that should be better. The speed of egress can vary greatly depending on many factors, including the number of occupants, their mobility, dimension of the egress components and the distance they must travel. Staged evacuation, considered a valid egress strategy in the past, is now showing gaps in terms of situations planned for. Stakeholders are aware of the significant importance to include emergency response plans for the potential total evacuation of a building s population from unpredictable events that were previously deemed unlikely . Lifts and exit stairs provide access and egress for inter-floor transportation during normal situation. But in a fire emergency situation, lifts are often shut down automatically, so exit stairs are the only way of escape. Since the tragic events at the WTC, building operators are requesting that fire safety engineers and building regulators investigate different methods of simultaneous evacuation. One option is to increase the number or width of the stairwells an extremely expensive solution, especially for existing buildings. In addition, descending the stairs is not something that all individuals can do with many struggling if the floor that they started on is above 100m. Therefore it is necessary for them to get down using other means. A viable option but one that is also expensive is to design lifts that are both fireproof and impact proof, capable of providing a safe exit route for occupants and safe access for firefighters. Another possible option, less expensive to adopt, is the concept of evacuation by chute. This can provide additional escape routes without having to add fire escape stairs, hence saving a great deal of time, effort and space. This approach is similar to providing more lifeboats on a ship to increase the level of passengers offered the chance to escape in an extreme event. If an existing building one designed for staged evacuation is to be re-assessed for simultaneous evacuation, the most logical method of ensuring faster overall evacuation is to utilize the lifts and escape chutes with stairs; it is now clear that a rapid yet orderly evacuation process should include the use of all of these methods. The question we ask is whether such a combination of egress methods would have had any impact directly after the attack on the WTC?

Building Egress (Exit Stairs)

In the aftermath of 11 September 2001, much attention was paid to creating better and safer building egress, in particular exit stairs. Structural modifications such as increasing the width of doors and stairs, the number of exits, introducing safety way guidance systems and improving emergency lighting and smoke control will not help to speed up the process of evacuation in the case of taller buildings and when fatigue becomes a factor.

Fact Stack

History has taught us that however big buildings become, there will more than likely soon be one that beats it in one way or another. Man's desire to push the boundaries of construction is unwavering and looks set to be that way for many years to come as technology continues to develop and assist us. So how tall are the world's tallest buildings, how many floors do they have to navigate and where in the world are they? Below is our list of the top ten.

Building	Location	Height	Floors	Built
1.Petronas Tower1	Kuala Lumpur	452m	88	1998
2. Petronas Tower 2	Kuala Lumpur	452m	88	1998
3. Sears Tower	Chicago	442m	108	1974
4. Jin Mao Tower	Shanghai	421m	88	1998
5. Two International Fin	Hong Kong	415m	88	2003
6. CITIC Plaza	Guangzhou	391m	80	1997
7. Shun Hing Square	Shenzhen	384m	69	1996
8. Empire State Building	New York City	381m	102	1931
9. Central Plaza	Hong Kong	374m	78	1992
10.Bank of China Tower	Hong Kong	367m	72	1990

It is important to remember that whilst these buildings are huge and tower hundreds of metres above the ground. They are set to be dwarfed during 2004 with the completions of Taipei 101. The building will stand 101 floors above the ground and tower over its nearest competitor by almost 200ft, standing at 509m.

Lifts for Evacuation

There is a present trend in

countries, such as Australia, US and the UK to investigate using lifts to rapidly increase evacuation speed. Several research groups, charged with looking into the possibility of using lifts as a means of evacuation have concluded that the use of protected lifts is feasible.
A lift system, intended for evacuation, must offer protection against heat, flames, smoke, water, overheating of machine room equipment and loss of electrical power. A further concern is seismic activity. Attention needs to be paid to earthquake design in areas deemed to be at high risk.
Concerns over the continued operational abilities of a lift system in the event of such a disaster have meant that lifts are not generally viewed as an acceptable tool for evacuation. Though technological advances now appear to have improved performance levels under these conditions, further research is still needed to make it safer for use in real fire situations.

Alternative Means of Escape

Technology always advances faster than the development of codes, specifications, and standards. One potential means of rapid emergency egress that can be used by everyone is the escape chute. Chutes allow all occupants to slide down to the ground quickly and in relative safety. Such equipment was developed more than 100 years ago and has advanced quite significantly since then, although the concept remains the same. The latest versions, capitalizing on advances in technology, are being patented around the world and permit evacuation from highrise structures during an emergency.
There are several types of escape chute installations and applications currently on the market with most being permanently fixed at one location. The single-entry chute can be mounted on the rooftop, balcony, corridor or window and allows occupants to gain access from that floor. The multi-entry chute is slightly different in that it allows occupants to gain access at each floor, meaning that several levels can be simultaneously evacuated. A portable rescue chute is being used by fire services around the world for high rescue operations whilst others are being used for industrial applications and installations. Currently there are no standards for the design and construction of escape chutes or similar devices, nor are there mandatory requirements for placing them in structures for aiding rescue or evacuation purposes. However, if current fire regulations do not require buildings to provide escape chutes, should they be used? Given the opinion held on lifts and that stair travel is taxing and potentially dangerous for the aged and disabled, evacuation via escape chutes provides the answer to make means of egress available to all. While the idea of a chute evacuation may not be very appealing to some, it is slowly gaining popularity. With frequent practice, occupants will even feel safer descending down the long chute than negotiating the long flight of stairs during mass evacuation in emergencies. The escape chute is a near failsafe operation. Even if the electrical supply to a building is lost during a fire, it will continue to operate. The chute is designed to act as an alternative escape route, providing back up to those that are there already. This means that if lifts are not working or stairs are impassable because of smoke, heat or flames, chutes can be deployed offering an opportunity for occupants to escape. In

Europe, safety chutes are commonly used on tall structures or heritage buildings that cannot have outside fire escapes added. It is suggested that fire services worldwide have no objections to the installation of escape chutes at buildings. If an evacuation is required the chute can support other means of escape essentially meaning that the building can be cleared in a fast and effective way whilst providing an opportunity for firefighters to get in and deal with the event. Such evacuation plans would not only give people with disabilities the best chance of survival but also rescue workers who would not have to put themselves at undue risk to conduct a search for victims when conditions do not permit safe entry. Even without regulatory changes for buildings, escape chute systems are gaining a following through demand from stakeholders. Property owners and facility managers in many countries have provided chutes for emergency egress as a preventive programme to enhance their building s emergency preparedness. Most owners of chute installations have either seen or experienced a mass evacuation incident. Measuring the success of a preventive programme is difficult; nevertheless prevention is the key objective rather than adopting a reactive approach.

Conclusions

Presently, there are no codes around the world which permit the use of lifts in an evacuation caused by fire. Neither are there codes that require buildings to have escape chutes as a secondary means of emergency egress for all occupants. However, it is evident that they do offer an additional means of escape in instances where an extreme event is imminent and rapid, simultaneous evacuation is warranted. It is also clear that many opportunities exist to enhance the role of lifts and the use of escape chutes to minimize the time taken for occupants to leave buildings in such situations. Given that the potential for building emergencies is worldwide, it is therefore appropriate to address these evacuation issues at a global level, such as the International Standards Organization. Further, if concerted action is taken by the codes and standards developing bodies, it will lead to a major improvement in safety on a global scale. The building industry will also have to address the issues surrounding evacuation for taller buildings. It must look at what needs to be done in order to improve the physical means of egress in an effort to raise the level of occupant safety in the event of a mass evacuation. The planning for such events and the methods to be used must be accessible to everyone in the early stages of a building s design. This would reduce the risk of having to further adapt a building at a later date By designing accessible emergency evacuation methods into the basic structure of a building, the emergency action plan can work with the building, taking advantage of various design features. Often, when egress features are added as an afterthought to correct the egress deficiencies, it is like fitting a square peg into a round hole. A significant amount of effort and cost is spent to make it fit, even then it does not fit quite right.

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