A SHORT NOTE ON FIRE SAFETY FOR NEW ARCHITECTURAL FEATURES

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ABSTRACT

Fire safety concerns for new architectural features will be pointed out. Some suggestions were made in dealing with the potential risk behind. The total fire safety concept is introduced with fire safety management emphasized.

1. BUILDING SUSTAINABILITY

As pointed out by Hyett, President of Royal Institution of British Architects (RIBA) in the 2003 conference on building sustainability in Edinburgh, UK [1,2], designers given the responsibility of developing new architecture projects and facility managers of operating systems in existing buildings must have the sense of sustainability.

Saving a small amount of energy for building use will protect the environment to a great extent as the servicing life of a building is very long. As observed [e.g. 3] in the past in temperate countries, large amount of energy was consumed for lighting in commercial buildings and for heating in residential buildings. The situation in the tropical areas [e.g. 4] might be different, as air-conditioning systems are provided for comfort and for giving a more productive environment in the workplace. New environmental control systems using less energy are provided. Even fire protection systems are designed to cope with green or sustainability criteria. Using clean agent [5] in total flooding gas protection systems for substituting halon is a good example.

All these new efforts will protect the environment and help keeping the Earth as a ‘blue planet’, rather than a ‘red planet’ as the Mars.

2. NEW ARCHITECTURAL FEATURES

Again, as summarized by Hyett [1,2], new architectural features include:

- Highrise building
- Deep plan
- Framed structure
- Sealed enclosure

Fire safety of the above four features has to be considered carefully. Taking the first one as an example, there are not yet clear design guides on how to provide fire safety for ultra-highrise buildings.

There are quite a lot of symbolic highrise buildings up to 415 m in Hong Kong. Many residential buildings are higher than 170 m, the tallest one in 2003 is of height 256 m with 75 levels! Numerous problems on fire safety had been pointed out by professionals. There are different views from officers responsible for fire safety, developers, contractors, engineers and building operators. Even the consumers are thinking about the safety issue! It is nice to stay at high positions with good harbour views. But what happens if there is a fire? Symbolic buildings might have the possibility of terrorist attack as at the World Trade Center [6]!

Fire safety problems debated before in ultra-highrise buildings were on the evacuation pattern, design of means of escape and means of access, and sprinkler systems.

3. FIRE SAFETY CONCERNS

New architectural features and new environmental control systems might give fire safety problems [e.g. 7]. This is a concern as the number of fires from accidents, arson, terrorist attacks or natural disasters appears to be increasing [e.g. 8]. There were fires in buildings, transportation vehicles, tunnels and many others. In fact, an arson fire just happened in an underground train compartment [9], and a big old residential building fire occurred several years ago [10].

Note that most buildings are only protected against accidental fires and so fire safety objectives should be reviewed. Basically, the goals [e.g. 11] are for
life safety, property protection, no disturbance to normal operation of business and environmental protection. Therefore, two areas on ‘hardware’ should be provided for safety. New passive construction might be designed through fire engineering approach in Hong Kong [4]. More environmental friendly and effective active fire protection systems [11,12] have to be developed. ‘Software’ fire safety management systems [12] must be provided.

4. CONFLICTS WITH GREEN FEATURES

New buildings are being designed and existing buildings being upgraded with construction elements and environmental control systems designed to improve their sustainability. However, many problems have arisen when designing the fire safety provisions. Some recommended fire safety measures are conflicting with the criteria of green and sustainable buildings. Examples of green architectural features [e.g. 4,7,12,13] requiring more in-depth investigations on fire safety are:

- **Internal building voids** [14].
- **Double-skin facades** [7].
- **Natural ventilation design with airflow induced by wind** [15].
- **Materials with better thermal insulation to reduce Overall Thermal Transfer Values (OTTV) of building envelope.**
- **Glass contribution with steel framework** [16].

Concerning electrical and mechanical systems, using clean agents for firefighting should be justified by full-scale burning tests on local configurations. For example, the performance of water mist fire suppression systems [17] depends on the fire scenarios. Substituting halon by clean agents without good demonstrations might give a mass fire, especially in glass constructions [18].

5. TOTAL FIRE SAFETY

Problems encountered in those architectural features can be overcome by the total fire safety concept. In addition to installing appropriate ‘hardware’ on passive building construction and active fire protection systems, good ‘software’ fire safety management should also be provided. Engineering performance-based fire codes [11,12] might be suitable for fire safety design in new buildings. However, regular upgrading of prescriptive codes [19] is necessary as it takes a long time to train adequate number of fire engineers for the construction industry.

- **Passive building construction**

Passive measures can provide effective fire protection to the construction elements of buildings. Items covered in the local codes [4] include compartmentation, fire-resisting construction, means of escape for occupants and means of access for firefighters. The objective is to reduce the occurrence of accidental fires by making the building materials and components more difficult to ignite. Even if the material is ignited, only a small amount of heat will be given out at the early stage of a fire. It is targeted to confine the fire within the place of origin without affecting the adjacent areas. The spreading rate should be slowed down through compartmentation and protected corridor, lobby and staircase. The building structure should be able to stand the fire for some time so that occupants can evacuate.

- **Active fire protection system**

Active fire protection systems are necessary for detecting a fire; giving early warning; controlling, suppressing or extinguishing the fire; and operating other emergency systems such as stand-by generators.

- **Fire safety management**

Passive building construction and active fire protection systems are hardware to be controlled by good fire safety management software [8,12]. A fire safety plan, which clearly outlines the procedures for maintaining protection equipment, staff training, fire prevention and evacuation procedures, must be provided. Good fire safety management should ensure that, even if a fire occurs, it can be confined to a small area. Occupants can be evacuated within a short time and damages to the building can be minimized. A detailed description can be found in the new versions of BS 7974 [e.g. 12].

6. CONCLUSION

Fire safety in green and sustainable buildings has not yet been considered carefully in Hong Kong. But there are methods that professionals can follow to ensure that the building satisfies the green and sustainable criteria [20] for protecting the environment with less discharge of greenhouse gases, reducing energy use and managing waste more efficiently, while at the same time also ensuring that the building is adequately protected against fire.
Points to consider are:

- Whether so many glass envelopes are necessary as there might be ‘double penalty’ in tropical countries in having high cooling load and utilizing more artificial lighting in sheltering the windows. The glass panels might not give much problems as glazings with quite good thermal resistance are available [21]. The problem lies in the gas system as a whole. Provisions for acoustics effects, water leakages, and sealants might give fire safety problems.

- The use of heat release rate instead of fire load density to quantify contributions due to combustibles.

- Geometrical arrangements of different buildings in complexes in view of natural ventilation provision, evacuation and fire spreading.

- New green and sustainability designs with fire safety considered.

- Selecting appropriate clean agents [e.g. 5] for gas protection systems and fire retardants. Environmental assessment with and without using appropriate agents should be carried out. For example, extinguishing a fire rapidly by halon might be better than discharging gas agents which cannot even control a fire. Much more smoke will be emitted and a mass fire [18] might be resulted!

Anyway, further investigations are necessary and support is requested.

REFERENCES


