REVIEW ON FIRE SAFETY MANAGEMENT AND APPLICATION TO HONG KONG

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ABSTRACT

Fire safety management is very important in the concept of providing total safety in a building. In this paper, different views on fire safety management were reviewed. For new buildings, fire safety management should be planned at the design stage of fire safety provisions using the 'engineering approach'. The fire safety objectives should be stated clearly in a fire safety manual as proposed. For existing buildings, the fire safety provisions are recommended to be assessed with a ranking system on the passive building design and active fire protection system by comparing with the new fire codes. Fire safety management programme is then worked out with reference to the inadequacy on those hardware provisions. A fire safety plan should be drafted with clear understanding on the fire safety design philosophy and assumptions made. Control by legislation by a single government department is strongly recommended.

1. INTRODUCTION

A good review on fire safety management was presented years ago by Malhotra in 1987 [1]. There, it was reported that the first relevant document on fire safety management seemed to be the Fire Grading Report (Post-War Building Studies No. 29) prepared in 1952 in UK [2]. The following were described:

- Maintenance of all provisions for means of escape.
- Regular inspection of all doors, passages and staircases.
- Concern on the external facilities which might become unsafe due to external exposures.

Advices to management and evacuation procedures in case of fire appeared in the appendices of BS5588 "Fire precautions on the design and construction of buildings", with Part 2 on "Code of practice for shops" in 1985 [3] and Part 3 on "Code of practice for offices buildings" in 1983 [4]. The key points are listed in the appendices of these standards [3,4]:

- Giving valuable guidance to management on using staff for fire safety, training and function, keeping records, preparing notices, calling the fire brigade.
- Taking defined actions in case of fire, evacuation procedures, etc.

A fire safety plan should be worked out by the management by referring to the size of the building and the occupancy.

In implementing engineering performance-based fire codes [e.g. 5-14], fire safety engineers should be involved [15] in formulating the fire safety plan as they are the most qualified persons who know the fire safety design best. Fire safety management should be familiar with the fire safety design philosophy and assumptions made. An obvious example is try the best to keep the heat release rate of fire below the design value.

2. RECENT VIEWS

'Management' was listed clearly in BS5588: Part 11 on "Code of practice for design offices, industrial, storage and other similar buildings" in 1997 [16]. Effective management combined with appropriate staff training are spelled out to be important in taking correct actions and having the occupants evacuated safely. Advices should be sought from the local fire services department. The management should be aware of the statutory requirements regarding the maintenance of both the passive building design such as the means of escape; the active fire protection system which is known as fire services installation (FSI) in Hong Kong including fire warning systems, portable fire extinguishers, emergency lighting; and fire safety instructions to staff. Basically, the following were discussed [16]:

- Management responsibilities.
- Commissioning and hand-over of fire safety installation, and fire safety manual.
- Fire safety and security personnel.
- Staff training.

- Fire routines (basis of fire safety taken into account of the types of activities in the building).
- Emergency procedures (including evacuation management).
- Routine precautions.
- Monitoring and review of fire safety manual.
- Extension and alterations.

From this document [16], two points are brought out for consideration:

- A fire safety manager should be appointed to take overall control of the premises and day-to-day safety management of the building. Since the manager is supposed to be able to direct the firefighters to the affected area, this person should have some training on firefighting. For special buildings involving high occupant loading such as karaokes or tunnels, it is good to consider appointing a fire safety manager from those with practical firefighting experience.
- It is necessary to prepare a fire safety manual which is to be kept in the premises and maintained by a competent person. The following should be included in the manual:
  - explanations on the fire safety planning, constructions and systems designed; and their relationship with the overall safety and evacuation management;
  - documentation produced at the design stage; or after any approved alternations, for using different types of protection system under different circumstances; and the responsibilities of staff;
  - all the record of the building alternation works;
  - a fire routine;
  - updated drawings of the buildings identifying the different smoke control zones, fire detection zones and other relevant information;
  - record of routine maintenance activities; and
  - updated drawings of all fire precaution measures.

Recent reviews [e.g. 17] stated that fire safety management is related to both hazards to people within and about a building, and to the building and its contents. It is of particular importance to life safety as confirmed by many multi-fatality fires [e.g. 18,19] due to failure in taking correct actions.

In BSI-DD240: Part 1: 1997 "Fire Safety Engineering – Part 1: Guide to the application of fire safety emergency principles" [5], fire safety management is considered as both critical and integral to successful fire safety engineering design. Those responsible for fire safety management should be represented in the Qualitative Design Review (QDR) team. Audits are required, say once a year, to ensure fire safety management is sufficient. Further, an appropriate fire safety manual should be prepared by the QDR team. Items that should be included in the fire safety manual are listed in Annex D (information) of that guide [9].

Fire safety management was also discussed in BS ISO/TR 13387-1: 1999 "Fire Safety Engineering – Part 1: Application of fire performance concepts to design objectives" [6]. There, it was stated that fire safety management procedures have a vital role to play in the prevention and control of fires, the evacuation of occupants and the maintenance of safety system. An independent audit of the fire protection on management procedure should be carried out regularly, say once every six months. Guidance on key aspects is given in Annex C of that guide [6].

A short guide for those responsible for management of fire safety in the work place was presented recently by Dailey [20].

In North America, the following were pointed out [1]:

- Fire codes were added as a complementary document to the building code.
- Maintenance of fire protective measures was specified. Examples included repairing the damaged fire separations, keeping the exits unobstructed, and ensuring the number of occupants does not exceed the permitted capacity.

System approach to fire safety was introduced in the National Fire Protection Association (NFPA) and Fire Safety Concepts Tree [21]. This is similar to the Fault Tree Analysis to show relationships of fire prevention and fire damage control strategies in a 'tree-like' diagram. All fire safety features are examined together and how the fire safety goals and objectives are affected is demonstrated. For example, the box 'fire safety objectives' would have another box 'prevent fire ignition' containing boxes of 'control heat-energy', 'control source-fuel interaction' and 'control fuel'. The box 'manage fire' would have boxes of 'control combustion process, 'suppress fire' and 'control fire by construction'.

A Fire Safety Management Handbook was published by the American Society of Safety Engineers, USA [22], following the fire safety concepts tree. Developing and implementing an effective fire safety management program can:

- Reduce property insurance premiums.
- Prevent business interruptions.
- Boost customer service and public images.
- Foster an efficient work environment.
- Realize quality gains.
- Impact the profitability of an organization.

A fire safety management program should be developed in an organized fashion.

Sequence in an action plan for developing since a program is:

- Access needs and capabilities.
- Analyze facilities.
- Analyze fire hazards.
- Develop and implement life safety, fire prevention and fire protection controls (where NFPA Fire Safety Concepts Tree applied).
- Evaluate effectiveness.

A fire safety management program should be divided into 8 elements:

- Inspections.
- Education and training.
- Fire suppression.
- Emergency service.
- Evaluation of fire possibility.
- Fire prevention.
- Reports and record keeping.
- Communication.

All these are expressed as performance-based objectives. Satisfying the objectives means the organization had achieved its goals.

3. OBJECTIVES OF FIRE SAFETY MANAGEMENT

As explained by Malhotra [1], the main objectives of fire safety management are to ensure that in case of a fire:

- All the fire safety measures provided will be available.
- Occupants will be able to use the fire safety measures.
- Occupants will be assisted to escape to a safe place.

Failing to meet the above, such as reviewed by Malhotra [1] that the management did not do enough to ensure evacuation of occupants staying inside, would lead to life losses. This was clearly demonstrated in the big fires occurred both indoor [18] and outdoor [19].

Therefore, fire safety management has to play at least three roles:

- To ensure that the fire safety measures provided are kept in good order.
- To initiate actions in case of fire which would help occupants to reach a safe place.
- To review the adequacy of existing fire safety measures where there is a change of building, change of building use and new technology on fire services installation.

It is obvious that fire safety management should ensure all fire safety provisions are maintained properly. Examples are replacing broken door closers for fire doors, maintaining fire detection and alarm system and ensuring adequate water supply.

Another area is on assisting the fire brigade when they arrive on site. It is good that firefighters are informed of the available fire protection systems and be guided to the site. A bigger management establishment such as that in a tunnel company might even have a team of well-trained staff who can deal with smaller fire incidents. Before agreeing to include this part, management staff should have adequate training and relevant practical experience on firefighting. Otherwise, it is dangerous to allow people without sufficient knowledge to be at the fire site.

4. FIRE SAFETY PLAN

A fire safety plan should be prepared in fire safety management [1]. There should be at least three components:

- Maintenance plan for proper keeping of fire safety system.
- Staff training plan encompassing training schemes for staff.
- Fire action plan with well-defined actions to take in case of fire.

In the maintenance plan, the following should be included:

- Maintenance (including repairing damages) of passive systems such as escape routes and fire doors.

- Maintenance of active systems such as detectors, sprinklers, extinguishers, hosereels and fire hydrants.
- Re-verification of system performance and of the integrity of system interfaces at regular intervals.
- Information and drawings on layout, escape routes and information signs for occupants.
- Good housekeeping such as proper disposal of rubbish and proper use of heat sources like gas cookers. Note that rubbish and garbage bags used to be placed in staircases at night and picked up by cleaners in the next morning for highrise residential buildings of Hong Kong! This is extremely dangerous in case of emergency evacuation in putting in additional combustibles, and obstructing people's movement.

The staff training plan should include:

- Description of staff duties.
- Fire wardens.
- Use of equipment.
- Guiding occupants to safe places.
- Training on general knowledge on fire dynamics for special buildings such as tunnels and terminals with huge occupancy flow rates.

The fire action plan should include:

- Report to the fire brigade.
- Assemble occupants and lead them to safe places.
- Attack the fire.
- Assist the fire brigade.
- A roll call at the assembly place for special buildings such as schools or karaokes.

In addition to the above three plans, a "fire prevention plan" is suggested to be considered [17]. That would identify the use and maintenance of items which could be an ignition source, or restrict the use of combustibles which can lead to rapid fire spreading upon ignition. Examples are taking care of electrical appliances, waste materials and rubbish. In other words, 'housekeeping' should be done properly. This might be good for bigger organizations such as karaokes, tunnel management companies, railway companies or the airport authority. For instance, the railway companies have tried their best to prevent a fire occurring in a train vehicle by taking measures such as regular checking of electrical circuits, because such a fire had happened several years ago.

In fact, there should be two modes of operation as proposed for local karaokes and tunnels [e.g. 23]:

- Normal mode of operation including:
  - Maintenance plan
  - Staff training plan
  - Fire prevention plan
- Emergency mode of operation:
  - Fire action plan

All items listed in above are only the minimum requirement. There should be development to include more management elements if necessary.

5. NEW BUILDINGS AND INTEGRATION WITH THE 'ENGINEERING APPROACH'

The importance of integrating fire safety management into fire safety engineering or engineering approach in Hong Kong [24,25], or engineering performance-based fire codes in overseas [e.g. 5-14], during the concept and design stages was raised in the literature. Advanced techniques such as fire models [26,27] should be used at the design stage with awareness on the management aspect. Recent advances on the role of fire safety management in fire safety engineering were discussed [15]. As fire safety provisions might not be maintained, it is essential that a fire safety engineer understands how the effectiveness of the safety systems design will be influenced by fire safety management. The duties of a fire safety engineer are basically taking care of the passive building designs, active fire protection system; and consider to include the determination of the role to be played by the fire safety management while designing fire safety. A fire safety manager is proposed to carry out the tasks designed in both the normal mode and emergency mode of operation in case of fire. If the building management team is too big, an 'intermediate' level of staff should be delegated by the fire safety manager to carry out part of those duties.

In practice, the work of the fire safety manager is determined by the fire safety engineer in three aspects [15]:

- Inspect regularly that the passive building designs are not made ineffective. Failing to do so would lead to disaster. An example is the removal of lift doors while replacing lifts in the big old highrise building fire in Hong Kong in 1996 [28].
- Have the active fire protection systems properly maintained and tested.

- Manage the building to conform to the assumptions made on fire safety design, such as controlling the fire load and occupancy loading. An obvious example is to keep the heat release rate of a fire (if occurred!) to be less than the design fire (say 0.5 MW for railway terminal) within a certain time. This can be done, say by keeping the fire load density to be low in some special regions. Good knowledge on fire dynamics is expected.

6. EXISTING BUILDINGS

Buildings constructed at different times would be expected to comply with the fire safety regulations at that time. In Hong Kong, there are basically four codes with three on building passive design including the Means of Assess (MoA) Code [29], Means of Escape (MoE) Code [30] and the Fire Resisting Construction (FRC) Code [31]; and the one on active fire protection system is the Fire Services Installation (FSI) Code [32].

There are three critical periods in implementing the fire codes [33]:

- Before 1972
  The fire safety codes were very crude and even the building occupancies were not clearly identified. For example, commercial buildings were not distinguished from residential buildings. Buildings built in this period are regarded as old buildings.

- 1972-1987
  There were much more requirements on fire safety provisions such as specifying the minimum corridor width.

- After 1987
  The fire safety provisions have been enhanced. For example, sprinkler systems are required in almost all non-residential highrise buildings.

A fire safety ranking system [23] based on the current codes [29-32] would be useful for assessing the fire safety aspects, on the passive building design and active fire protection systems, in existing buildings. From the results, appropriate fire safety management schemes can be worked out by pinpointing on the deviations of the fire safety provisions from the expectations in the new codes. Even so, it is still difficult to satisfy all requirements stated in the new codes. An alternative solution is to apply engineering performance-based fire codes on designing appropriate fire safety provisions. But this will take time to develop the codes and the cost might not be low.

7. CONCLUSION

To give total safety to buildings, fire safety management must be properly implemented. However, it is not controlled by local buildings regulations. Note that fire codes used to deal with fire safety provisions for new buildings are not yet in use. It might be suitable to include fire safety management in the regulations for existing buildings such as the Fire Safety Precaution Act [34] in UK. It was proposed to place statutory responsibility on responsible persons in 'designated premises' to achieve and maintain a reasonable standard of fire safety [34,35]. The reason of having that change was to reduce the workload of the fire brigade under certain conditions. Consequently, the building management would be more actively engaged in fire safety matters. Recently, the Fire Precautions (Workplace) Regulations was implemented in 1997 [36] in UK with part of the items in fire safety management included.

Local government is also concerned about building management and fire safety [37]. The concept of effective building management could be provided by the Home Affairs Department. But further research should be carried out before proposing any workable fire safety management schemes.

For local practice, taking karaokes as an example, the Buildings Department, Fire Services Department, the licensing section of the Food, Environment and Hygiene Bureau, and even the Health and Safety Office of the Labour Department are possible departments to take care of fire safety management. In fact, an overall fire safety system, or a total safety system, including design, construction and management of the fire safety provisions should be worked out. At this transition period of clarifying which are the fire safety management schemes, a fire safety manager should be appointed and responsible for taking actions in the two modes, normal and emergency, of operation. Areas of concern are:

- Karaokes [23].
- Old highrise buildings [28].
- Airport and railway terminals.
- Tunnels: both for trains and vehicles.
- Higher education institutes.
- Shopping malls.

Perhaps, it is worthwhile to consider assigning one 'authority' to take care of all the fire safety, though

it is very difficult to train such persons for carrying out the duties.

Finally, people used to criticize that a fire safety manual is something prepared just for record keeping. It will not be executed seriously. This situation can be changed if there is 'tighter' legislative control on fire safety management so that the fire safety manual is not like a 'Peacock Feather'* (孔雀翎)! Perhaps, regular inspection should be carried out for ensuring proper fire safety management.

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* Peacock Feather (孔雀翎) is a powerful weapon described in a well-known Chinese swordsman fiction (武俠小說), locked but not used in the safe.

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