

Fire safety management in hotel

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Abstract: Preliminary studies on fire safety management in hotels will be introduced. Safety problems of hotel fires will be outlined. In addition to provide proper training, integration with the building services systems should be watched. Roles of hotel management are proposed.

Keywords: fire safety, management, smoke spreading

1. Introduction

Accident upon fire might happen in a hotel which is difficult to prevent. Fire brigades are called upon, whether it was a real fire or just due to unwanted fire alarm, almost everyday. Some of them were related to hotels or guesthouses. Some fires were quite small but some might be quite big with serious consequences, causing death or injury. There are many possibilities to starting fires [1,2] in hotels, might be special risks, particularly at night with fires spreading through staircases and lift shafts. The following problems arising from, and relating to, the occupants, must be dealt with properly:

Firstly, the guests are children, adults and elderlies in good or not so good health conditions. Occupants who, in the event of fire, are taken by surprise, particularly if the outbreak is at night when they are sleeping. They are not familiar with the environment and do not know where the other occupants, staff and guests are. They might speak languages, especially those staying are of preferential accents. Visitors attending functions such as weddings, sales drives, dances, meetings and conferences, may be even less familiar with the hotel.

Secondly, there are the staffs who are supposed to be well trained, aware of their surroundings and with the opportunity of knowing the hotel perfectly. They are members of a team responsible to their superiors and should know what to do in emergency. This is practicing for five star hotels. However, some staff might be of temporary appointment, particularly during the peak business season. For hotels with high and frequent turnover rates of staff might have more problems. Some staff are not always familiar with the language of the country. Furthermore, the complexity of hotel building services might lead to big fire hazard, such as laundry, kitchen equipment and storage/use of gas and dangerous goods for cooking.

Anyway, the following actions must be taken:

- 1) Guests to be protected from fire as they are not familiar with the environment; and
- 2) Staff to assist in the evacuation of others or in fire fighting.

Proper fire safety management should be worked out beforehand for protecting the guests. Well-planned evacuation pattern in case of fire is one of the key elements in the fire safety plan.

2. Hotel fire safety – responsibility of management

Hotel management [2] is responsible for protecting the lives of guests and staff in the event of fire. This is both a moral obligation and a 'commercial' obligation. Management is also responsible for ensuring smooth operations of the business and for its protection against the direct and consequential effects of a fire. Guests too have a responsibility towards the people and property around them.

Legal responsibilities imposed on hoteliers worldwide make provision for [2-4]:

- 1) adequate means of escape;
- 2) a satisfactory fire warning and alarm system;
- 3) suitable fire-fighting equipment; and
- 4) proper training of staff and including advising guests to take correct procedures.

In order that rescue operations and fire fighting by the fire brigade can be carried out as efficiently as possible, the details have to be planned in advance as requested by the local authority. This pre-planning FSD requirements requires regular consultation and meetings between the hotel management and the local fire brigade. Basically, most international hotel chain and five star hotels over the world would have the following basic fire arrangements:

- 1) identifying the areas which present particular risks [3];
- 2) ensuring that access facilities are adequate; Approach by fire brigade and access for emergency vehicles and equipment (EVA) is not obstructed and immediate use of hydrant, dry risers and foam inlets;
- 3) examining the layout of the hotel building so that fire brigade officers can work out a plan of attack; updated building plan of the premises should be ready for use by the fire brigade, and duplicate plans should be readily available at the hotel; and
- 4) Arranging for employee to assist the fire brigade on their arrival; certain staff should have the duty of meeting the fire brigade, directing them to the fire and informing them of any occupants who may be trapped. Managers and staff dealing with the fire action plan should be trained with firefighting techniques.

3. Smoke spreading

Both fire and smoke spreading within a hotel [4] should be considered in working out appropriate fire safety procedures. Effect of smoke on occupancy is very dangerous.

As a fire develops, gases generated in fire compartment will be heated, raised up by buoyancy, and spread out quickly to the other parts of the hotel.

Before suffering from the physical and chemical effects of heat, toxic fumes and/or asphyxiation as oxygen level dropped, the inhabitants of a burning hotel would be affected adversely by the smoke first [5] through psychological effects.

Instant response of occupant, is not to walk through smoke. This, combined with the reduced visibility and associated obscurity of escape routes [6] exit doors and exit signs, often contributes to panic, especially in unfamiliar surroundings. The toxic effects of smoke are particularly dangerous in hotels when people are likely to be asleep.

4. Total Fire Safety in Hotels

Total fire safety in hotels should be provided by considering the followings:

- 1) Control of risk factor, such as fire load density (FLD) and occupancy load factor (ODF);
- 2) Installation of fire service installation (FSI);
- 3) Provision of passive building construction (PBC); and

- 4) Implementation of fire safety management (FSM).

Implementation of these four key elements of total fire safety in hotels will be discussed in the following sections.

5. Risk factor

The FLD is regarded as a critical factor as it would affect duration of the fire and hence the fire resistance required. The calculation of fire load in a hotel of a given geometry is important and related to the relative values of the fire resistance period (FRP) and the fire severity. Whether the hazard level is structural endangering or not can be determined. In the standard licensing conditions issued by the Home Affairs Department[7], no storage of dangerous goods in excess of exempted quantity is permitted without statutory approval. Moreover, no storage of any description, combustible furniture or portable heaters are to be allowed within any part of the escape routes. These must be kept clear for evacuation. There is also control on the use of furniture foam materials, such as BS7176[8]. FLD is very important in the local codes with an upper limit of $1135 \text{ MJ}\cdot\text{m}^{-2}$ [9,10].

Another important risk factor in a hotel is ODF. There is sleeping risks in the hotel building and transient visitors are usually unfamiliar with the general environment and layout of the hotel. If a fire developed, it is likely that the guests may get panic and difficult to evacuate without any assistance. There is various fire precaution and evacuation procedures that the hotel may take in order to minimize the above scenario. This is particular obvious and effective in hotels with efficient fire safety management practiced. The hotel building is usually not crowded, unless it has certain major function in its ballroom or convention halls. However, the additional fire risk due to the kitchens, basements, high rise buildings and different race and occupancy pattern may need more detailed consideration on fire safety. Usually, two to four guests in each guestroom or apartment is allowed in the design. The occupancy load in the public area is usually limited under the means of escape (MOE) code. Generally speaking, the occupancy load factor is not a critical factor to be considered in hotel fire safety.

6. Fire Service Installation

In order to satisfy the hotel licensing requirements[7], a hotel must have installations including, audio/visual advisory systems, automatic actuating devices, deluge

systems, drencher systems, smoke extraction systems, emergency generators, emergency lighting, exit signs, fire alarm systems (MFA), fire control center, fire detection systems, fire hydrant/hose reel systems, fire shutters, fireman's lifts, fixed foam systems, gas detection systems, hose reels, portable fire extinguishers, pressurization of staircases, sprinkler systems, supply tank, ventilation air conditioning control system, water spray systems and water supplies, etc.

Basically, a fire warning system consists of detectors and manual call points must be provided throughout a hotel building. All these are connected to a control indicator panel. In modern addressable systems, the location of the actuated detector or break glass point can be indicated by automatic liquid crystal display (LCD) at the control panel. A hard copy of the record can be obtained by connecting a printer to the system.

In addition, the fire warning system may also include the connection of relay contacts, regarded as the interface between the warning system and the main building services, such as lifts, air condition systems and dampers. Operation of the warning system will cut these services or will change their mode of operation. For example, lifts will automatically go to lobby level and stop at there. Air conditioning systems will be switched off and dampers will close down all open ducts or orifices, in order to prevent the spread of fire or smoke throughout the building.

Not responding to smoke, heat detectors are not suitable for most areas in a hotel as they are only installed in areas where smoke detectors use to give unwanted alarms such as in kitchens.

Ionization detectors are less liable to be activated by steam than optical detectors and so suitable for guest bedrooms.

Optical point detectors detect an obscuration and/or scattering of a focused light beam by the smoke particles. Ambient light conditions must be considered for the sitting and use of these detectors. In contrast to ionisation smoke detectors, optical systems respond more effectively to dense, heavy particulate smoke.

Manual call points are the square "break glass" appliances strategically located around the hotel. Generally, call points in a hotel should be separated by longer than 30m. This distance might be reduced where there are specific fire hazards.

The signals – bells, sirens, hooters, public addresses, etc – incorporated into the electrical alarm system should be distinctive. The warning devices are sited to

ensure that a common warning signal is perceptible throughout the hotel.

As a guide, the minimum sound level at any point in the premises should be 65 dB(A), or 5 dB(A) above the ambient noise levels. In guest rooms the sound level should be increased to higher than 75 dB(A).

In the event of a false alarm, it is important that the cause and extent of the problem is determined as quickly as possible. This is especially important where there is disruption to the fire warning system resulting in a substandard level of protection.

Common causes of false alarms [11] are:

- 1) mechanical and electrical faults, resulting from the effects of vibration, impact or corrosion;
- 2) ambient conditions such as heat, smoke or flame from cooking or work processes, fumes from engine exhausts, or high air velocities due to strong winds outside the building;
- 3) work being carried out in a protected area without knowledge of, or in neglect of, the necessary precautions;
- 4) communication faults arising from servicing or testing work carried out without prior notification to the fire brigade or central alarm station or arising from activities of the public telecommunications operator;
- 5) electrical transients or radio interference;
- 6) inadequate servicing;
- 7) the building up of dust or dirt within a detector, or the entry of insects;
- 8) change of use within the hotel; and
- 9) accidental or malicious operation of manual call points or detectors.

In Hong Kong, it is a legal obligation [7] to provide a means of fighting fire and ensure adequate maintenance. This requirement may be supported by a condition of insurance imposed by the insurance company. Fire extinguisher is a key element with the following points to note:

1) Quantities and type

Before deciding on the numbers and type of fire extinguishers that are required for a particular risk, reference should be made to local legislation and advice should also be sought from the fire service department.

Fire blankets should be provided in high or special risk areas, i.e. all kitchens and workshops.

2) Suitability

Extinguishers are made in a number of sizes; the heaviest that can be considered portable weights 23 kg. The physical ability of those persons who are most likely to use them must, therefore, be

considered. If the allocation of water extinguishers is to be based on the criterion floor area, then one 9 litre extinguisher should be provided for every 200 m² of floor area.

Hose reels are strongly recommended particularly where the attendance of the local fire brigade is doubtful and where floor areas are in excess of 800m². They are effective extinguishing system, depending on the class of fire. Once they are put in action, a substantial volume of water can be provided. This is equivalent to operating several extinguishing system at the same time. The water supply may also be controlled.

For ease of operation, it is normally convenient to limit the length of hose on one reel to 30m internal bore hose of 19mm diameter.

Water sprinklers are comprised of a system of pipework, pumps, control valves and heat sensitive valves in the sprinkler heads which release water onto the seat of a fire. In larger hotels, sprinkler systems are divided into "installations" which are separate from other sprinkler installations, each operating by their own control valves.

A clear space of at least 0.3m should always be maintained below the level of the sprinkler head throughout the room.

For high-piled combustible stock, increased clearance of 1m or more should be provided.

Roof trusses should at all times be accessible to water discharged from sprinklers.

Changes in the structure, or in the occupancy, heating, lighting or equipment of a hotel may require alternations to the sprinkler installation.

Closed, or the premature closure of, control valves account for many sprinkler system failures and it is of considerable important that regular checks to confirm the valve status are incorporated into the daily routines of security or other responsible personnel. The discovery of valves closed for no apparent reason should automatically lead to an increased awareness and the introduction of contingency plans, in order to maintain a satisfactory level of protection against fire.

When the electricity supply to the normal lighting fails, emergency lighting is required to fulfill the following functions:

- 1) to indicate early and unambiguously the escape routes and associated exit signs;
- 2) to provide illumination along such routes allowing safe movement towards and through the exits provided;
- 3) to ensure that fire alarm call points and fire fighting

equipment provided along escape routes can be readily located; and

- 4) to ensure that changes of direction and levels are identified.

Emergency lighting is required not only on complete failure of the normal power supply but also on a localized failure if such a failure would present a hazards, e.g. failure of a single subcircuit on stairways.

Any new emergency lighting system should conform with the provisions of local legislation. The normal standards require that emergency lighting should maintain an adequate level of illumination for three hours, although in small hotels, e.g. those lower than three stories, one hour is sufficient.

7. Passive building construction

This is governed by the various statutory regulations, mainly from fire service department, building department and the Home Affairs department [7]. In hotel, the fire compartments are enclosed by fire barriers on all sides, including concrete walls, door and shutter etc. The fire resistance period (FRP) of the building construction material should be big enough to limit fire spread, restrict fire severity by limiting the available oxygen amount and let the guests to have enough time to arrive at the escape route safety.

Every hotel should be separated from any adjoining building by an external wall having an FRP of not less than 2 hours. No openings should be made in such external walls that are within a distance of 900mm of any part of any building on the same site or within 450mm of the boundary with an adjoining site. Openings may however be made in external walls within a distance of 1.8m of any part of any building on the same site or within 900mm of the boundary with an adjoining site provided that these openings are protected by fixed lights with fire resisting glazing.

All the additional partitions or walls should be constructed of light weight material, otherwise, a structural justification prepared by an authorized person or a registered structural engineer should be submitted to the Licensing Authority for the effects of the additional load on the existing members. Failure to produce this justification may result in the additional partition or wall being required to be demolished or removed.

Elements of constructed in any basement and the separation between the basement and any adjoining storey should have an FRP of not less than 4 hours.

Where different occupancies are formed within the same use of a hotel, separation should be made

between them by walls and floors capable of resisting the action of fire for a period of not less than that required for the elements of construction of the compartment in which it is situated, subject to a maximum of 2 h [7].

Every hotel should be divided into compartments by walls and floors such that no compartment exceeds 28 000 m³.

8. Fire safety management

Fire safety management was pointed out systematically years ago by Malhotra in 1987 [12]. The means of escape maintenance, doors/passage/staircases maintenance and concern on the external facilities which might become unsafe due to external exposures were all discussed.

Recently, topics including management responsibilities, staff training emergency procedures, fire safety manual and routine precautions are also discussed in BS5588: Part II on "Code of Practice" for design office, industrial, storage and other similar building in 1997 [13]. Developing and implementing an effective fire safety management progress is published in the fire safety management handbook by the American Society of Safety Engineer [14].

As pointed out by Malhotra [12] the main objectives of fire safety management are to ensure that in case of a fire:

- 1) all the fire safety measures provided will be available
- 2) occupants will be able to use the fire safety measures
- 3) occupants will be assisted to escape to a safe place

It is necessary to develop a fire safety plan, particularly in a hotel [12]. It consists of:

- 1) Normal mode of hotel operation including
 - a) maintenance plan of all the passive building construction and fire service installation in a hotel. Good housekeeping practice and detailed preventive maintenance schedule are needed;
 - b) staff training plan which will be discussed in detail;
 - c) fire prevention plan. This would need the care of electrical equipment and proper maintenance and housekeeping [15]. This is a very important plan in hotels.
- 2) Emergency mode of hotel operation:
fire action plan and relation with the local fire Brigade.

Hotel staff training and procedures are usually offered by hotel management all over the world. It is vital that adequate provision is made to ensure all full

and part time hotel employees and shift workers on shift duties are trained. They should know what to do in case of fire so that quick and safe evacuation can be achieved properly of themselves and guests.

Hotel staff should be instructed and trained in matters which will be their particular responsibility in the event of a fire. These include, department heads, supervisors, deputies, house service/reception staff and engineering and maintenance staff.

In order to ensure the continuity and effectiveness of the training programme, which should be based upon written instructions and notices, it is important that records are kept of all training.

The staff should be well trained concerning actions on discovery a fire [6]. Raise the alarm at once by the appropriate operation of the nearest fire alarm system call point. Notify reception/switchboard of the fire location.

If the fire is considered small enough to be easily and safely extinguished, e.g. a waste bin fire, attempt to do so with the nearest correct type of fire extinguisher, but do not take personal risks and always call for assistance.

Never attempt to fight fires alone.

If the fire is considered too large, or if it should get out of control, or if the escape route is threatened, leave the hotel quickly and calmly by the nearest available escape route, wherever possible assisting in evacuating guests and shutting windows. Do not stop to collect personal belongings and do not use the lifts.

Report to the fire assembly area.

Switchboard operators or other persons responsible for calling the fire brigade – should be known and accessible to all staff, and identified at the initial induction session. The training of the above persons must include:

- 1) when to call the fire brigade, i.e. immediately on hearing the fire alarm;
- 2) how to call the fire brigade;
- 3) what information to provide, i.e.:
name and address of premises;
any missing persons;
location and type of fire; and
location and involvement of hazardous materials;
- 4) confirmation that the details have been received and correctly repeated back by the fire brigade.

Fire Evacuation drills, which should not involve guests, are recommended to take place at least once a year and preferably once every six months.

Evacuation training should form part of the fire precautions training discussed previously and should include; knowledge of the fire alarm signal, knowledge

of the nearest escape routes and fire exits, the knowledge to help disabled persons, including an understanding of different disabilities, i.e. physical, mental, hearing, sight disabilities and possible reactions in the event of a fire, the location of the fire assembly area, the importance of ensuring attendance at the roll call, and if necessary reporting any persons missing or known to be still in the hotel, the dangers of re-entering the evacuated hotel unless authorized to do so, work shift identification, extent of drill, optimum evacuation time, date, total evacuation time, approximate number of participants, date of next drill.

9. Conclusion

To achieve total fire safety in a hotel, fire safety management cannot be neglected. Usually, due to cost constraint and staff manning reduction nowadays, fire safety management in hotel will be at risk. This is not sensible and affecting the reputation of the hotel group if fire really occurs. Measurement of heat release rate (HRR) for installation/equipment set up in kitchen is crucial as there is high fire risk in the hotel kitchen. Although there are regulation and rules governing the fire safety in hotels, it is necessary to review again the current system. Bringing in engineering performance based code into the design, construction and management of fire safety in hotel [16-19] is critical. Possibly, fire safety ranking [20] should be developed in hotels. Results would indicate which fire safety arrangement should be worked out. In this way, hotel owners, executive and employees will have a proper guidance and procedures in all matters related to fire safety management. The problem might be more complicated when the hotel is in green or sustainable buildings[21]. Fire safety management should be worked out more carefully.

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