FIRE SAFETY REQUIREMENTS IN KARAOKES: COMMENTS ON THE NEW KARAOKE ESTABLISHMENTS BILL

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ABSTRACT

Consequent to a big arson fire in a karaoke, a new Karaoke Establishments Bill is to be implemented for providing a safer indoor environment for karaoke activities. A long list of fire safety provisions is specified. There are concerns from the local industry as it has not been demonstrated that following the new requirements will ensure fire safety. For example, fire safety objectives were worked out from an arson fire, not for an accidental fire. This would divert the issue from solving a safety problem to a security problem. As there would be significant cost on the construction works for providing fire safety; and disturbance to the normal business operation, the following building refurnishment works are of the most concern:

- Increasing the corridor width from 1.05 m to 1.2 m;
- Eliminating all 'dead-ends'; and
- Providing fire resistance construction on the partition wall.

Preliminary studies show that those three points are not critical. However, key items on providing fire safety are missed out:

- Flame spreading over the internal corridor wall.
- Heat release rate of a karaoke fire.
- Smoke management in the corridor.

Further investigational works must be carried out as soon as possible. The possibility of using fire safety management as an alternative should be considered.

1. INTRODUCTION

Citizens in Hong Kong enjoy going to karaokes for entertainment, spending hours inside. Fire safety aspects in karaokes were not concerned until an arson fire happened. People are starting to become more aware of the potential fire hazards in a karaoke. Those places are typically partitioned into many boxes, with long corridors, and are usually crowded with people during weekends and holidays. Most of them are located in shopping malls, hotels and highrise commercial buildings. Fire safety provisions in those karaokes are now watched carefully by the government. However, no particular license was designated for karaokes, apart from having licenses for restaurants or bars.

"Karaoke Establishments" are now clearly defined by the Authority [1-3]. Licenses will be issued to those satisfying various requirements with fire safety to be a main concern. A consultation paper was distributed for comments in 1998, with the proposed Karaoke Establishments Bill read the first time in the Legislation Council on 7 February 2001. The karaoke business is a very big sector of the service industry in Hong Kong and safety must be provided to the public. Objective of the Bill is to establish a statutory licensing scheme for regulatory control of karaoke establishments to improve their fire safety provisions. If allowed to read the third time, it will be implemented.

Karaoke means an activity in which one or more persons chant, intone, sing or vocalize in association with or in company with any music or other sound, or any visual image or other information is produced, distributed or conveyed by a film, laser disc, video tape or other audio-visual device; and/or displayed or exhibited on a screen or any surface; and/or blended or mixed with the music or other sound or the visual image or other information by amplifier, microphone speaker, or other amplifying device. "Karaoke Establishments" means any place, used for karaokes by ways of trade or business on its own account or in connection with other trade or business activity, whether or not the place is a place to which the public have or permitted to have

access. A unique characteristic of karaokes is the layout of small clustered cubicles accessed through long and narrow passages which might pose problems in escape when there is a fire.

In that Bill, a very long list of fire safety requirements with due reference to those required by the Buildings Department (BD) [4-6] or Fire Services Department (FSD) [7] was described.

2. THE PROPOSED BILL

The list of fire safety requirements in the Bill [2,3] include:

- On passive building design
  - Karaoke establishment should not be located at basement level 4 or below.
  - Use of combustible materials for false ceiling partitions or wall furnishing, carpets, upholstered furniture with polyurethane foam are proposed to be watched, though there are no specifications on which testing standard, or even parameters, such as ignition time, or peak rate of heat release, should be used.
  - Exit routes plan.
  - Structural stability.
  - Minimum width of exits including internal corridors.
  - Exit from every karaoke box to have at least two directions of travel.
  - Internal exit corridors protected by fire-resisting construction.
  - Building safety should follow the local Means of Escape (MoE) [6], Means of Access (MoA) [4] and Fire Resisting Construction (FRC) [5] codes issued by the Building Authority.
- On active fire protection systems basically following the local Fire Services Installation (FSI) Code [7]
  - FSI provisions including sprinklers.
  - Fire safety requirements for ventilation systems with automatic cut-off devices.
  - Emergency lighting and low-level direction signs.
  - Alarm bells.
  - Adequate fresh air supply.
  - Audio-visual advisory system to interrupt musical system in case of alarm.
  - Showing a short fire safety film before starting the karaoke activity.
  - Fire safety training for staff.

It is not clear whether including only all the above would ensure fire safety [e.g. 8-13]. The objectives for protection against an "accidental fire" or an "arson fire" are not too clearly spelled out. There is neither indication that the requirements can really enhance safety in case of a fire, nor evidence that the proposals are supported by research and development works. If the proposed rules are implemented, very few existing karaokes can pass. A Karaoke Requirement Concern Group was then established immediately after releasing the consultation paper in 1998 to oversee how these are implemented. Note that there are over 100 karaokes with some kind of licenses, each with an investment of at least HK$10 million, giving a total of over HK$1,000 million!

A general response is that fire safety should be enhanced so that the public would have more confidence to have entertainment in a safe karaoke. However, there is concern about the targets being over-set because there were no big accidental karaoke fires occurred in the past. Most of the recommendations on fire protection systems are acceptable and in fact, have been implemented once the consultation paper was released. But there are reservations on three main points:

- Increasing the corridor width from 1.05 m to 1.2 m;
- Eliminating "dead-ends" of corridors; and
- Imposing fire resistance requirements [5] on the partitions.

For the first two points, preliminary studies [e.g. 8-12] illustrated that changing the corridor width from 1.05 m to 1.2 m would not make much differences on both the fire environment predicted from fire zone models; and the emergency evacuation pattern predicted [10,13] by evacuation software [14-16]. For the presence of dead-ends, due to the relatively small size in each karaoke, again there are not much differences in the simulated total evacuation time, say within 80 s for typical karaokes. A more important point is on the occupant loading. There had been lots of arguments on the use of evacuation software, particularly for the human response [17]. However, the simulated results can test whether the evacuation design can meet the fire safety objectives [18]. The third point is more critical and its importance would be pointed out later.

Following a series of meetings and debates in the past years, the government has agreed to relax slightly on the imposed requirements for existing karaokes, with the understanding that this might not be fair for existing buildings to follow the new codes. Refurbishing the building would imply not only the investment cost, but also the loss in normal business operation due to the perturbation induced while carrying out the construction works. In an article [3] summarizing the comments from the Security Bureau to the Concern Group on Karaoke Establishments Bill, relaxations include:

- Corridor width can be less than 1.2 m, if there are additional fire safety provisions.
- "Dead-ends" will be assessed individually.

But there are clear indications on:

- Requirement of one-hour fire resistance period (FRP) [5] for each of the karaoke establishment.
- There are no substitutes on the "software" side of improvement and on the hardware side of passive fire safety requirements in the control of fire spread and provision of adequate means of escape.

There are reservations on the above two points which are to be discussed later in this paper. However, a fundamental question was not asked [19]:

How big is a fire?

There was too much emphasis on the post-flashover fire in the new code and so long FRP is required [20,21]. But for life safety, safe and fast evacuation of occupants at the early stage should be considered first. There is no clear demonstration that including all the items proposed can really assure fire safety. Those points should be addressed individually.

3. FIRE RESISTANCE AND FLAME SPREADING

The term "fire resistance" is normally referred to the ability of a structural element to perform its function under a fire [e.g. 22]. This is evaluated by subjecting the element concerned to a standard test [e.g. 23]. To quantify this property, the structural element under the condition of application (e.g. carrying out the loading bearing function) will be tested in a furnace with the temperature increased with time following a specified curve. The loading condition might or might not be tested, depending on the requirements. For British Standards BS 476 on fire resistance testing [23], the building component such as a door or partition wall, there are three parts to be assessed:

- Stability
  Whether the structure can stand a certain loading under a fire.

- Integrity
  Whether the component can remain as a whole, without smoke, heat and flame spreading across it.

- Insulation
  Temperature not exceeding the value of 139°C on the other side of the component not exposed to the fire.

Basically, the requirement is on assessing the behaviour of the building element under a post-flashover fire.

On the other hand, flame spreading over surface lining materials or partition materials should be watched carefully [24,25]. A partition wall can still stand the structural loading and remain stable, but with flame spreading over the surface if it is made of combustible materials such as timber product without fire-retardant. For flame spreading upward (i.e. a "concurrent flow" problem), unburnt materials above can be ignited easily to give more heat. Horizontal spreading under the ceiling would lead to flashover in the room within a short time. In fact, configurations such as horizontal orientation like ceiling, and vertical orientation such as wall, will affect the flame spreading rate. A combination of both configurations will make the situation even worse.

Information on pre-flashover fire is important as occupants are expected to evacuate before flashover occurs. To answer the question "How big is a fire?" [19] raised earlier, the heat release rates of burning the combustibles have to be estimated.

A recent survey on surface lining and partition wall materials indicated that timber products were used extensively [26] for buildings older than five years when fire-resistant gypsum plaster boards were not commonly used. Full-scale burning tests on both the surface lining materials [27-29] and the entire karaoke arrangement [e.g. 30,31] should be carried out.

4. ESTIMATION OF HEAT RELEASE RATE

Combustibles in a karaoke box are surveyed to include furniture such as polyurethane sofa, cushion, coffee table and chairs; partitions and surface lining materials; floor coverings or carpets; and audio-visual equipment. Note that even paint surfaces might aid in fire spreading [e.g. 32]. Burning furniture of heat release rate Q_{furn}, surface lining materials of heat release rate Q_{surf} and carpets of heat release rate Q_{cap} were considered before. The total heat release rate in the karaoke Q_K at time t [11,33] can be estimated by:

$$Q_K = Q_{furn} + Q_{surf} + Q_{cap} \quad (1)$$

A 'design fire scenario' is one of the primary uncertainties in fire safety engineering. A design fire depends on the use of the building and the materials used and stored. Scenarios considered before, using database from Swedish data on furniture and surface lining materials, are:

- Scenario 1

  Partitions or surface lining materials used are timber products without fire-rated. Q_{surf} would be similar to a fast t^2-fire when the furniture gives out heat release rate higher than 100 kW to ignite it.

  The carpet would burn with Q_{cap} like an ultra-fast t^2-fire when the heat release rate is 500 kW. The total heat release rate Q_K of the karaoke is shown in Fig. 1.

  It is observed that once the surface linings and carpet are ignited, the heat release rate in the karaoke box is mainly contributed by burning those two combustibles. The resultant heat release rate might be high enough to cause flashover.

- Scenario 2

  The partition materials and surface linings are classified as class I surface linings in the Sweden system [33]. The floor covering is made of PVC with slow flame spreading, and so Q_{cap} is neglected. The total heat release rate of the karaoke box for scenario 2 is shown in Fig. 1 as well.

  Note that the peak heat release rate is much less than that in scenario 1, indicating that flashover is not likely to occur for bigger rooms. Therefore, the choice of partition materials is important.

Further studies on flame spreading of partition materials, and the requirements and specification of choosing them should be carried out as soon as possible. Results will be useful in implementing the new generation of building fire safety codes such as the engineering approach [34].

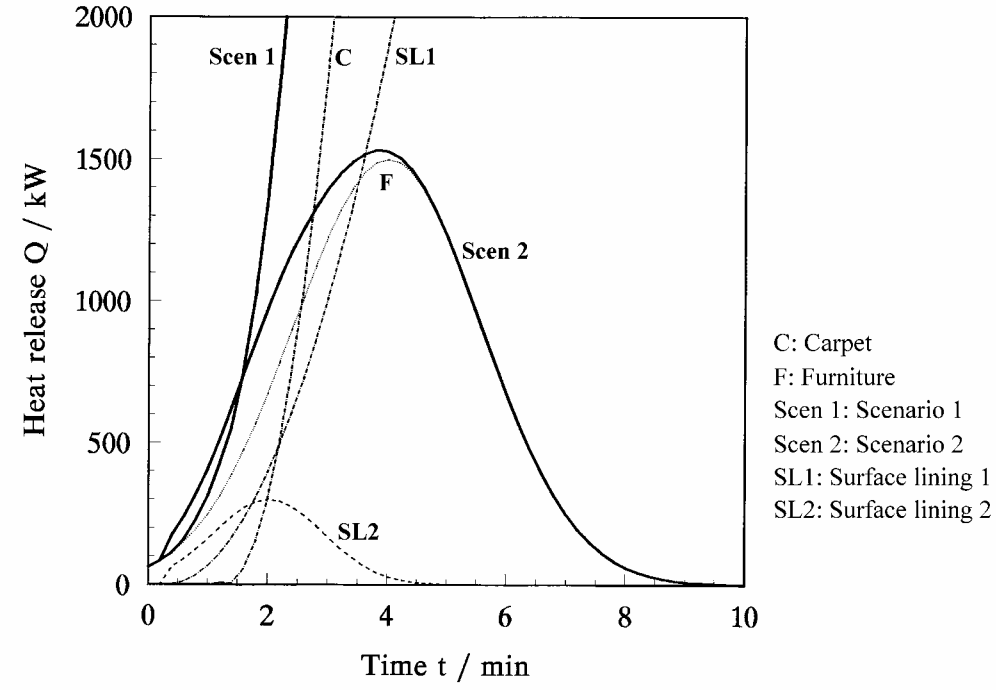

Fig. 1: Total heat release rate in a karaoke fire

5. POSSIBILITY OF FLASHOVER

As surveyed, typical karaoke boxes can be roughly divided into 3 groups as A, B and C with length L (in m), width W (in m), and height H (in m) as shown in Table 1. The door is usually of width 0.8 m and height 1.8 m.

An equation on estimating the minimum heat release rate Q_{mf} (in kW) causing flashover proposed by Thomas [35] was used for a room of an opening of area A_v (in m^2) and height H_v (in m):

$$Q_{mf} = 7.8A_t + 378A_v\sqrt{H_v} \quad (2)$$

where

$$A_t = 2\,[LW + (L + W)\,H] - A_v \quad (3)$$

Values of Q_{mf} for the three groups of karaoke boxes with the door opened are shown in Table 1. It is very easy to burn furniture and other combustible items stored in a karaoke to give this value for flashover.

Table 1: Groups of karaoke

Group	No. of persons	L (m)	W (m)	H (m)	Q_{mf} (kW)
A	≤ 5	2.5	2	2.6	980
B	6 to 10	3.5	3	2.6	1100
C	> 10	5	3.5	2.6	1340

6. FIRE SAFETY MANAGEMENT

As explained by Malhotra [36], 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 the management did not do enough to ensure evacuation of occupants staying inside as reviewed by Malhotra [36], would lead to life losses as demonstrated in the big fires occurred. 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.

A fire safety plan should be prepared in fire safety management. 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) 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 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.

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 karaokes of partition walls without adequate FRP and flame spreading rating.

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 karaokes.

In addition to the above three plans, a "fire prevention plan" is suggested to be considered [37]. 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' in karaokes should be done properly.

In fact, there should be two modes of operation as proposed for local karaokes [e.g. 38]:

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

All items listed above are only the minimum requirements. There should be development to include more management elements if necessary [39].

There are lots of criticisms [39] on saying that fire safety plan is just a manual kept in the safe. Nobody would care about taking the appropriate action. The government should consider implementing inspection schemes for ensuring fire safety management is carried out properly. Such management elements should be updated whenever there are building alternations or new fire safety technology developed.

7. CONCLUSION

It is not yet clear what fire safety provisions should be specified for karaokes. Following the suggested items [1-3] might not necessarily guarantee fire safety. If the FSI is not designed and operated properly, adverse effects like producing a large volume of hot steam in a sprinkler fire might happen. More important items such as flame spreading [24,25] over partition walls and surface linings [26,28] have not yet been specified. Smoke management system [40] should also be installed in the internal corridors if necessary.

As a summary, the following should be carried out as soon as possible:

- Full-scale burning tests on karaoke boxes to investigate the heat release rate [e.g. 30,31].
- Studying fire safety for partition materials, particularly flame spreading over those materials.
- Selecting appropriate tests [29] for specifying flame spreading over partition and surface lining material.

Unfortunately, full-scale burning tests cannot be performed at the moment. Immediate application to the Services Support Funding of the government for such support (say HK$10 million) was declined several times. Further, the local service industry does not show interest in supporting the items financially. Note that the total cost for local karaokes might be over HK$1,000 million! HK$10 million is just a very small amount.

It might take years before such 'dreams' can happen. At this transition period, fire safety management [39] should be worked out and monitored properly for individual karaokes.

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