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How to initiate evacuation movement in public buildings

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Abstract

Research and experience show that occupants tend to ignore fire alarm signals and continue their activities in large public buildings. Alternative means to alert the public in the event of an emergency and to initiate evacuation movement are discussed. The use of a standardized Temporal-Three fire alarm signal is advocated to ensure occupant recognition of the fire alarm. Also, a communication system combined with closed-circuit televisions (CCTVs) is recommended to convey precise information to the public. Building managers are considered responsible for developing a fire safety plan, and for ensuring that employees are well trained and that communication among staff is efficient in order to transmit information to the public that will prompt fast and safe evacuation movement.

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The problem

Fire safety plans are required in most public buildings throughout the world. It is often assumed, in these plans, that activating the fire alarm is sufficient to trigger occupant evacuation. It has been observed, however, in numerous experiments and actual fires that occupants were slow in deciding to evacuate. In fact, observations show that the public tends not to not react when the fire alarm goes off in public buildings, contrary to the well-known assumption that occupants panic and rush to the nearest exit on hearing the fire alarm (Sime, 1980; Keating, 1982; Donald and Canter, 1990).

Is there a problem with the fire alarm?

Fire alarms go off regularly in shopping centres and airports, as well as in other large public buildings. In most cases, when the fire department arrives on location most, if not all the, occupants, are still continuing their activities in the building. While some occupants may have hearing problems, fire alarm audibility is not the issue in most public buildings.

One explanation for this lack of reaction is that since there is no standard for the sound of a fire alarm, the public may no longer recognize the fire alarm signal as such. At the moment, fire alarm signals can be delivered through appliances such as bells, horns, chimes or electronic devices. In turn, these devices can emit either a continuous, pulsating, whoop or stutter signal of any frequency and of any pattern. This situation means that a large variety of sounds can be used as a fire alarm signal. Furthermore, there are other types of alarms that can be activated in public buildings, such as burglar alarms in shops, elevator fault alarms, security door alarms, etc. Consequently, the public may have difficulty recognizing the sound of a fire alarm signal. This problem in identifying the fire alarm signal could also explain the public's inertia when a fire alarm goes off. Some research demonstrates this recognition problem with alarm signals. For example, Benthorn and Frantzich (1996) found in their IKEA warehouse experiment in Sweden that only 19 percent of occupants recognized the alarm signal as a fire alarm; in fact, "most

Facilities
Volume 17 · Number 9/10 · 1999 · 331–335

understood the ring signal as something rather unspecified".

The need to identify a unique fire alarm signal that could become universal was acknowledged a long time ago. Since the 1970s, numerous discussions to develop a standard fire alarm signal have taken place in Europe and America (Mande, 1975; CHABA, 1975).

Experts finally agreed not to limit the fire alarm signal to any one sound but instead to support the identification through the use of a consistent sound pattern. The Temporal-Three pattern, described in ISO 8201, is expected to become the standard fire alarm signal in all countries. The Temporal-Three signal was adopted in Canada in 1995, and in the USA in 1996.

With time, it is hoped that recognition of the fire alarm signal will improve with the addition of buildings equipped with the Temporal-Three alarm signal and that more countries around the world will adopt this standard. The question remains, however, whether the adoption of the new Temporal-Three alarm signal will solve the problem of occupants ignoring the fire alarm.

It is important to note that, in certain types of buildings, the existing fire alarms are efficient in encouraging occupants to evacuate. For instance, it was observed that in schools and universities (Fleischmann, 1998; Sime and Kimura, 1988) as well as in government office buildings (Proulx and Pineau, 1996), the response to fire alarms was fast and appropriate. These environments appear to offer some supplementary conditions which contribute to explain the good response to the fire alarm. In most jurisdictions, fire drills are held twice every year in these buildings, in order to train occupants to adopt the fire evacuation procedure planned. These frequent drills familiarize the occupants with both the sound of the fire alarm and the response expected from them.

In addition, there is the presence of fire wardens who are trained occupants who have the duty to instruct and direct other occupants. And, although these frequent drills tend to make the occupants quite casual about the meaning of the fire alarm (which they associate with "another drill" and not with a possible fire), response is fast and occupants know where to go and what to do. Unfortunately, for many public buildings, it is not practical to conduct frequent evacuation drills in an attempt to train occupants.

Is the fire alarm enough?

Indeed, is a fire alarm signal enough to trigger occupant evacuation in public buildings? After studying numerous actual fire situations, false alarms and evacuation drills, it appears that the fire alarm signal alone is not sufficient to prompt people to leave public buildings. Will the new Temporal-Three alarm signal solve the problem of occupants ignoring the fire alarm? Probably not. It is one thing to recognize a signal, it is another thing to act on perceiving a signal.

Public buildings are unique. Most occupants are visitors or patrons who may not be familiar with the premises and as visitors, they expect to be taken care of. If a fire alarm is activated, there are social interactions taking place: people will be looking at what others are doing. Therefore, if others are not paying attention to the fire alarm signal, occupants become reluctant to take any action that would make them appear out of place or over-reacting to an insignificant situation. Individuals tend to conform to the general behaviour. Furthermore, visitors to a public building do not feel that it is their responsibility to do anything about the fire alarm signal, even if they have recognized the signal as a fire alarm signal. They expect that someone will tell them what to do if something serious is really happening. Despite constant efforts to educate the public as to the meaning of the fire alarm signal, i.e. "fire alarm signal = leave immediately", the message has not been properly learned or is not associated with public buildings.

Nevertheless, it should not be concluded that we should get rid of fire alarms because occupants do not respond to them. In fact, even though the actual response to fire alarm signals in public buildings is not what is usually expected in fire safety plans, this signal is still a good means of providing warning to the public. The fire alarm signal gives people a cue that something is happening, even if building occupants do not act on it. Consequently, later on during the incident, if they perceive other signs to add to the fire alarm cue, such as the smell of smoke or staff running around, they are more likely to conclude that there is, indeed, an emergency and that they should do something.

Stop the show

It could be seen on television that during the Bradford stadium fire in 1985, spectators sitting

Facilities
Volume 17 · Number 9/10 · 1999 · 331–335

close to the fire were not moving, even though they had noticed something: they were watching the football match that was taking place on the field. This event taught building managers an important lesson: once a fire has been discovered and public evacuation is required, it is paramount to stop the current activities.

This would be facilitated in shopping centres by turning off the music; in a cinema the movie could be stopped and the lights turned on as soon as the fire alarm goes off. In a discotheque or restaurant, the music could be stopped and full lighting should flood the space. Initial protests from the crowd should recede as occupants receive new information. This kind of atmosphere change will help occupants to understand that something is going on and will facilitate the occupants' attention shift from their current activities to the emergency situation.

This ambience change is essential to ensure that occupants pay attention to the emergency. Occupants in public buildings are usually committed to specific activities such as eating, shopping, watching a show, participating in a sports event, etc. As long as the show continues, people focus their attention on this activity and are very reluctant to shift their attention to an unexpected or ambiguous event. It is, therefore, critical to have a sharp change in the environment to alter the behaviour of occupants.

This change in the environment would also help occupants to hear the fire alarm signal. Since the alarm by itself, as explained earlier, is unlikely to make occupants move, additional means of conveying information are necessary to trigger an evacuation movement, such as the use of a voice communication system.

Use of a voice communication system

Most modern public buildings are equipped with a voice communication system that is used daily to broadcast music and specific messages directed to the public or the staff on location. In the past, managers have been reluctant to use this means to provide information to the public during fire emergencies. This is unfortunate because a voice communication system is probably one of the best ways to provide essential information to the public.

Building managers' reluctance to use the voice communication system to provide information to the occupants is due to the false idea that occupants will "panic" if they are told that there is a fire. In fact, being told the truth is more likely to trigger the appropriate reaction than dysfunctional behaviour. Research and actual fires demonstrate that receiving information through a voice communication system is one of the best ways to ensure that occupants will react immediately. Telling occupants that "there is a fire on the third floor, please leave immediately" makes it easier for occupants to decide what to do: contrary to some beliefs, occupants tend to immediately obey instructions given through the voice communication system (Proulx and Sime, 1991; Proulx, 1998).

It would be beneficial to equip all public buildings with a voice communication system, so that information could be provided through this means during a fire emergency. Voice messages will confirm the meaning of the fire alarm signal and instruct occupants on the best course of action.

As soon as the situation has been assessed as a fire emergency, there should be no delay in using this means to deliver messages to occupants. On site, management should be prepared to rapidly make the decision to evacuate the building or to direct occupants to a safe location in accordance with the fire safety plan. Waiting for the arrival of the fire department and for their assessment of the situation to deliver messages could be counterproductive. In fact, when the fire department arrives on location they expect all occupants to be in a safe location, in most cases standing outside away from the building. This way, firefighters can focus their efforts on controlling the fire instead of spending their manpower on search and rescue activities. Furthermore, when the fire department arrives on location, five to ten minutes, if not more, have passed since the fire was first detected. By that time, the situation could be lethal in some locations; if occupants are required to evacuate at that time they may have to move through smoke-filled areas to reach the outside (Proulx, 1998).

Pre-recorded vs live messages

Some large public buildings are equipped with a voice communication system which delivers pre-recorded messages. Although such a system saves staff time, the use of pre-recorded messages has proven ineffective and even dangerous in some situations. A field study demonstrated that a pre-recorded message could not be precise enough to help occupants locate the nearest exit. During the

Facilities
Volume 17 · Number 9/10 · 1999 · 331–335

evacuation of an underground station where the main escalator was blocked, occupants did not know where to go because the pre-recorded message could not provide information as to the location of an alternative way out (Proulx and Sime, 1991).

The information content of a pre-recorded message is always limited since it needs to be general enough to cover all situations of an alarm activation. There are some new systems that can deliver different messages according to the location of the detectors activated but this technology has not proven totally efficient yet. During the Düsseldorf Airport Fire in 1996, pre-recorded messages in different languages were transmitted; unfortunately, the information delivered during the initial ten minutes was erroneous, directing passengers towards the most dangerous areas of the airport (NFPA, 1998).

Evidently, the best approach is to broadcast live messages. Live messages allow the flexibility of altering the messages as new information is relayed to the officer delivering the information. The tone of live messages can convey the urgency and importance of the information. Occupants are more receptive to live messages because they consider this information more likely to be genuine.

Messages delivered to the public during a fire emergency should contain three essential pieces of information:

(1) identification of the problem;
(2) location of the problem;
(3) instructions.

If managers expect occupants to react correctly, it is essential for occupants to understand the situation. Attempting to minimize the situation or using technical jargon to disguise the real situation could confuse people and prevent them from reacting appropriately. Instead, it is important to identify the problem in common terms such as "we suspect a fire" or "there is a fire". The second important piece of information is to identify the location of the problem. The occupants will want to know if they are at immediate risk and knowing the location of the problem will help them in their decision-making process. Finally, the message should clearly explain what is expected from the occupants: in some cases, it might be best for the occupants to remain on location; otherwise, they can be directed through a specific route and to a specific exit with the aid of live messages.

The availability of closed-circuit televisions (CCTVs) to broadcast useful and precise messages becomes a must for the officer issuing messages. Since most public buildings are equipped with CCTVs for security purposes, these tools are an incomparable source of information to deliver the most precise messages during an emergency. Strategically placed CCTVs allow the officer to overview conditions in different areas of the premises. Messages can then be tailored to the crowd movement and the developing situation.

Well-trained staff

Occupants are reluctant to respond to a fire alarm by itself but are very likely to respond to members of staff. Staff members are regarded as knowledgeable: they are expected to know what is going on, what is the best course of action and where is the nearest exit. In uniform or wearing a name tag, staff are likely to be listened to. Evacuations of Marks & Spencer's stores in the UK demonstrated that customers, even though the fire alarm had been ringing for some time, were only prompted to evacuate when requested to do so by the staff: they complied right away with instructions (Shields *et al.*, 1998).

Proper staff training should include regular classroom training sessions as well as evacuation drills. An evacuation drill is a valuable occasion for staff to be able to put into practice ideas learned in the training class, and for management to assess the application of the fire safety plan. Changes and other adjustments might be required after an evacuation drill; feedback from staff will help to identify areas for improvement. An assessment is also advisable after false alarms or actual fires in order to improve the fire safety plan.

If staff are expected to play an important role during the evacuation of the public, it becomes essential to train and educate them. Each staff member, whether part-time or permanent, should be educated about the content of the fire safety plan. Staff should not be allowed to begin work before having received proper fire safety training. The lives of hundreds of people could be in the hands of a few staff members. Employees need to be made aware of the importance of their role and of their responsibility to look after the public in case of an emergency.

When dealing with large spaces or with large crowds, it is not practical to rely entirely on staff to direct occupants to safety as the

Facilities
Volume 17 · Number 9/10 · 1999 · 331–335

number of employees required would be too large. For such situations, it is more efficient to rely on a few well-trained staff members, the voice communication system and CCTVs. With CCTVs, the officer issuing information will have an overview of the situation which will contribute to the delivery of precise messages. Staff on location will then be able to assist with the evacuation in conjunction with the instructions being delivered through the voice communication system.

Conclusion

A fire alarm signal by itself is not sufficient to initiate occupant evacuation from public buildings. This observation does not imply that fire alarms should be removed since fire alarms are good at warning occupants that something is happening. Building managers, however, should not expect the fire alarm to trigger a massive evacuation movement.

In public buildings, since it is not practical to carry out regular fire drills to train occupants about the meaning of the fire alarm signal and the appropriate evacuation procedure, it becomes essential to use other means to convey the urgency of the situation and the need to react appropriately. Well-trained staff aware of the fire safety plan is one means by which evacuations can be initiated. In large buildings, however, it is difficult to deploy enough staff to cover all areas. It is also difficult to ensure that staff directives to occupants will be heard and understood by a crowd. The use of a voice communication system is an excellent means by which all occupants can receive information on the current situation and instructions as to what is expected from them. If the building is equipped with CCTVs, the communication officer will then be able to provide precise and accurate information to the occupants, ensuring fast and safe movement towards safety.

To ensure people's safety in public buildings, management must take the responsibility of informing the public of the situation. A fire safety plan with effective evacuation procedures, regular staff training, efficient communication among staff, as well as providing truthful and precise information to building occupants during a fire emergency, are the best way to ensure the public's safety.

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