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Why Building Occupants Ignore Fire Alarms

By Guylène Proulx

Why do building occupants so often ignore fire alarm signals? This Update presents some reasons, supported by IRC studies and documentation of real fires.

It has been observed time and time again that building occupants are slow in responding to fire alarm signals. In fact, research shows that in some buildings, occupants tend to continue their activities and completely ignore the signal.

As part of its research on fire-risk management, the Institute for Research in Construction has reviewed the literature extensively and carried out its own studies of major fires in both Canada and the United States. Based on this information, this Update will attempt to explain the behaviour of occupants during fire emergencies. A later Update will present strategies designed to improve occupants' response to alarms and to ensure appropriate action.

The Objectives of a Fire Alarm System

There are four principal objectives for any fire alarm system:

1. Warn occupants of a fire
2. Prompt immediate action
3. Initiate evacuation movement
4. Allow sufficient time to escape

The degree to which these objectives are met varies widely and depends on the building and the occupancy. Schools, for example, appear to have a high degree of compliance to fire safety rules and procedures. When the fire alarm goes off in an elementary school, it is standard practice for all pupils to leave in ranks with their teachers and gather on the playground. In such a situation, it may be concluded that the four objectives of the fire alarm signal are met.

Figure 1. If all occupants heed the fire alarm and move to safety, firefighters can focus on controlling the fire.

Quite a different scenario ensues when a fire alarm sounds in a shopping centre or a highrise office building. Upon arriving on the scene, firefighters often observe that most, if not all, occupants are still in the building, continuing their activities and blissfully ignoring the fire alarm (Figure 1).

Why do Occupants Fail to React?

Occupants may ignore the fire alarm signal for one of three reasons:

- failure to recognize the signal as a fire alarm
- loss of confidence in the system because of nuisance alarms
- failure to hear the signal

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Failure to Recognize the Fire Alarm Signal
One explanation for the lack of reaction may be the occupants' failure to recognize the signal for what it is. They may mistake it for another signal, such as a burglar alarm, an elevator fault warning, or a security door alarm. Interviews by Tong and Canter showed that over 45% of a small sample of building occupants were unable to distinguish fire alarms from other types of alarms.[1]

The need to devise a unique, universally recognizable fire alarm signal was recognized many years ago. Since the 1970s, numerous discussions to develop a standard signal have taken place.[2,3] Experts finally agreed not to limit the signal to any one sound (such as a bell, horn, chime or electronic sound) but instead to support the concept of a specific sound pattern. The Temporal-Three pattern, described in ISO 8201, is expected to become the standard evacuation signal. The requirement for the Temporal-Three signal in all new construction was incorporated into the 1995 edition of the National Building Code of Canada (NBC) and into NFPA 72 in 1996 (Figure 2). While it is hoped that more and more countries will adopt this standard, by itself the pattern is unlikely to solve completely the problem of occupants ignoring the fire alarm.

Loss of Confidence in System because of Nuisance Alarms
The large number of nuisance alarms, such as false alarms, test alarms and fire drills, is another reason why occupants do not take action when a real fire alarm is sounded. The problem with nuisance alarms is that, after a time, occupants tend to lose confidence in the system. They assume that whenever they hear the fire alarm, they can safely dismiss it as a false alarm. During mid-rise residential evacuation studies by IRC researchers, it was found that less than 25% of occupants interpreted the sound of the fire alarm as a potential indication of a real emergency.[4]

The number of nuisance alarms and their deterring effects have to be studied over a period of time. In a given building, three nuisance alarms in one week will have a greater deterring effect than three nuisance alarms over the course of a year. The time of occurrence and the type of building might also play an important role. If a false alarm occurs in the middle of the night in a highrise residential building, it may have a more lasting negative effect on occupants than a nuisance alarm happening in an office building on a warm sunny day.

How many nuisance alarms in one year can be considered too many? Three? Five? Ten? How many will cause people to lose faith in the fire alarm system? No research data have been found to answer these questions. Specialists in the field tend to agree, however, that more then three nuisance alarms in one year can undermine the credibility of the system. One thing is certain: nuisance alarms tend to downplay the sense of danger or urgency that should be associated with a fire alarm signal. Confronted with many nuisance alarms, people are likely to ignore the signal or attempt to disconnect the system.

The public often assumes that false alarms are largely the work of mischievous teenagers. Through the use of surveillance cameras it was found that pranksters could indeed be teenagers, but they were also younger children and adults, even senior citizens. Further, the assumption that nuisance alarms are usually prank alarms is not true. In fact, most nuisance alarms are due to system malfunction. In 1999, fire departments in the United States received over 2 million calls that turned out to be false alarms. Of these, 44% were system malfunctions, 30% were well-intentioned calls that turned out not to be fires, 15% were mischievous false calls, and 11% were other types of false alarms, such as bomb scares.[5]

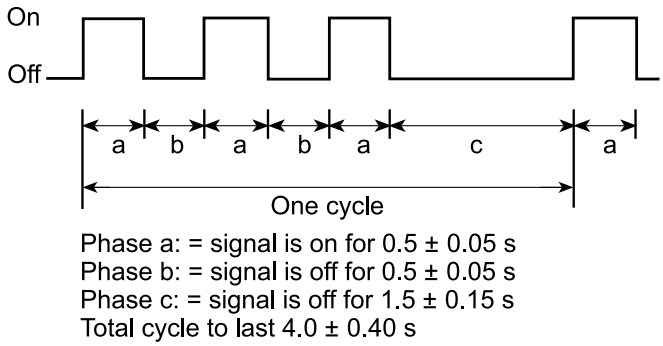

Figure 2. Temporal-Three pattern for fire evacuation alarm signal

Building managers should always strive to reduce the number of nuisance alarms to a minimum. Communication is also important. Opportunities to reinforce occupants' confidence in the alarm system are lost when managers do not inform occupants about the causes of nuisance alarms or the action they are taking to rectify the problem.

Failure to Hear the Alarm

A third explanation for occupants' lack of response to a fire alarm signal is the audibility of the signal itself. Studies in midrise and highrise residential buildings have shown that in some instances occupants could not hear the signal from inside their apartments.[6,7] This audibility problem was typically observed in apartment blocks where the alarm appliances were located in the common corridors. Even though the alarm signal was very loud in the corridors, the signal was not audible inside dwelling units, especially in rooms located furthest from the corridor. Further, the ambient sounds of everyday life, emitted by televisions, audio units, air conditioning systems or human activities, can easily mask the sound of the alarm signal.

People cannot be expected to evacuate a building if they are not aware of a fire in the first place. In an effort to ensure alarm audibility, the NBC requires minimum sound levels. In most multi-dwelling buildings, the levels required can be met only by locating the alarm signal device inside the dwelling unit. In fact, locating an alarm signal device in each unit is probably the best way to ensure that all occupants will hear the alarm.

The traditional practice of locating alarm signal devices in corridors and stairwells not only tends to create areas where the alarm is not audible, but also results in another, more serious problem. Locating appliances in common areas can be counter-productive because the loudness of the signal prevents communication between occupants as they prepare for evacuation. It was observed during evacuation drills, and reported after fires, that once occupants have been notified of the fire and decide to leave their apartment units, they often go into the corridor to discuss with others the best course of action. This is a perfectly reasonable thing to do in an emergency. Communication with neighbouring occupants or others in the same dwelling unit becomes paramount in order for them to decide what to do and where to go, to confirm decisions and, most of all, to ensure that everyone is accounted for. Very loud alarm signals in corridors and stairwells can prevent these essential exchanges from taking place. Once in the corridor or stairwell, occupants do not need to be notified of the fire anymore; what they need is the opportunity to obtain and exchange information. Corridors and stairwells are also locations where occupants might receive instructions from wardens, staff or firefighters, so the fire alarm signal should be not be so loud as to jeopardize efficient communication in these locations.

While the fire alarm signal should be low enough to allow verbal exchanges, it should not be so low that occupants might think that the fire alarm signal has been switched off. During an evacuation study, the alarm was turned off after five minutes to facilitate walkie-talkie communication between firefighters.[7] It was observed, using video cameras, that most occupants who had started to evacuate stopped and returned home when the alarm signal was disconnected. Because the fire alarm signal was switched off, occupants assumed the emergency was over. This reaction explains why it is very important to maintain the alarm signal activated until the emergency has been dealt with.

Continuing Need for Fire Alarm Signals

It should not be concluded that we might as well get rid of fire alarms since occupants tend not to respond to them. In fact, although response to fire alarms is usually not what is expected, this signal is still a good means to provide warning to the public. Such a signal gives people a cue that something is going on. Consequently, later on, during the incident, if people perceive additional cues from the fire, such as smelling smoke or seeing staff running around, they will be more likely to conclude that there is indeed something serious happening and they should do something about it.

Summary

Research findings show that a fire alarm signal by itself is usually not sufficient to initiate occupant evacuation from buildings. The problem of recognizing the fire alarm for what it is, is fundamental to the fact that people fail to respond as expected to this signal. The number of nuisance alarms and the observation that fire alarm signals are sometimes not audible throughout buildings are further explanation for the delay in occupant response.

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