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Human Factors in Fire Safety Management and Prevention

Fire protection is the study and practice of mitigating the unwanted effects of potentially destructive fires. It involves the study of the behavior, compartmentalization, and investigation of fire and its related emergencies, as well as the research and development, production, testing and application of mitigating systems. Problems still occurred despite of the adequate fire safety systems installed. For most people in high-risk buildings, not all accidents were caused by them. They were more likely to be the victims of a fire that occurred. Besides damaging their properties and belongings, some people were burned to death for not knowing what to do if fire happens in their place. This paper will present the human factors in fire safety management and prevention system.

***Keywords**: fire safety, fire hazards, human, protection, compartmentalization, fire-fighting, evacuation*

1. Introduction

Fire has been a part of our needs in life and we now cannot live without it. It has been of much use now to us since man learned of its potentials and usage. But then again, uncontrollable spread of fire such as in building fire will lead to damage of our properties and worse, loss of life. Fire safety is a field where fire safety designs were designed for the sake of fire prevention and also whenever there is an event of fire; it functions as to control the spreading of fire and also for safe evacuation of the people [1]. Fire safety engineering plays a significant role in the development of cost-effective fire-safety designs for buildings, manufacturing plants and industrial operations as it can provide a systematic approach to assessing fire safety and minimizing the risks associated with fire. Once it was recognized that it is not possible to have 100% safety in any building or with any activity, the task is to develop cost-effective design solutions that will offer high levels of fire safety [2]. In many ways, by comparing with other engineering disciplines, fire

engineering is in its infancy. Furthermore, it requires an understanding of a range of potentially complex areas including fire chemistry, combustion, human behavior, mechanical systems, heat and mass transfer, and structural behavior.

Fire has been a part of our daily needs in life that we now cannot live without it. It has been of much use now to us since man learned of its potentials. Fire gives us heat which can be used in many situations besides giving us light when it is dark and many more. Fire, which is the main concern for fire safety engineering is the fire where they extend beyond the point of origin to cause hurt, damage or nuisance which resulted in the need to call the fire brigade for help. Fire is rarely a priority during the design process or its long-term use and fire safety was usually incorporated to satisfy a building code or an insurance recommendation. While risk awareness is slowly changing these perceptions, decision makers often perceive fire safety costs to be greater than their value, until the fire occurred. Figure 1 shows the elements of fire safety management.

Figure 1. Elements of Fire Safety Management

It is essential to know that fire safety is not dynamics which includes smoke control, sprinkler systems, detection, fire departments, structural fire endurance or fire prevention or risk management. The fire safety measures include all these important features [3].

Proper implementation of fire safety management was costly; hence, attitudes of the building owners, occupants and management staff towards a high quality of fire safety management were the other key factors to the success of a complete fire safety measures. Therefore, clear legal control must be established for successful enforcement of implementing fire safety management in buildings. Besides

that, fire safety management has to play at least three roles in order to ensure all the fire safety provisions are maintained accurately:

- To ensure that the fire safety measures provided were kept in good order.
- To initiate actions in case of fire as this would help the occupants to reach a safe place during emergency situations.
- To review the adequacy of existing fire safety measures whenever there is a change or renovation in the building.
- Change of building use and new technology on fire services installation.

By giving valuable guidance to the management of the building in using staff for fire safety, training and function, keeping record, preparing notices, calling the fire brigade and taking defined actions in case of fire, evacuation procedures and etc., it can improve the fire safety management in that particular building. Figure 2 demonstrates the leading causes of fires, civilian injuries and direct property damage in most countries around the world.

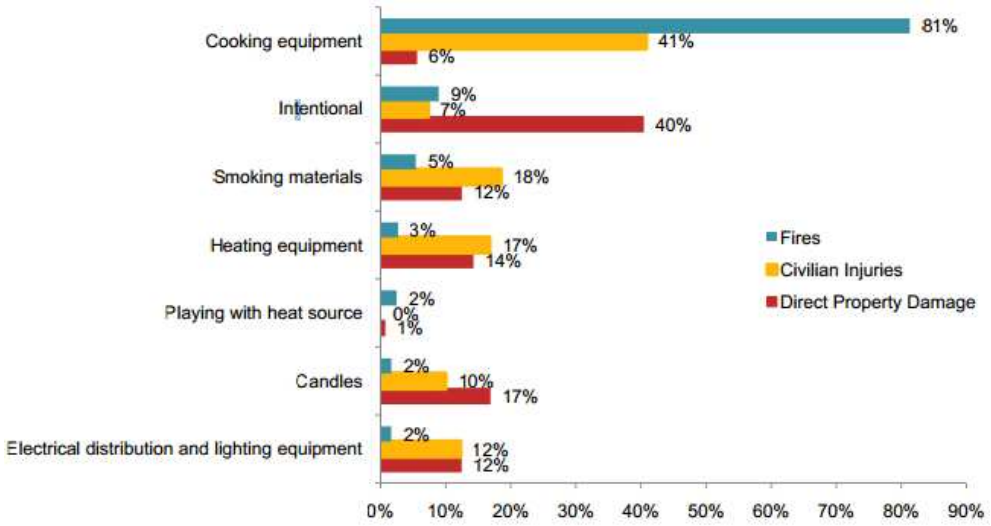

Figure 2. Leading causes of fires, civilian injuries and direct property damage

2. Human Factors in Fire Safety

Most human behaviors are essentially and necessarily resolute and persistent Thus, when a person fails to respond to an alarm signal, he probably has his own reason. When a person chooses one route to escape over another, he or she has a reason to do so. The description of goals as the source of action is the foundation of an intentional systems approach. In addition, people based their purposeful activities on their perceptions on the situations with which they are facing. The aims that they pursue strongly affect what information they extract from their physical environments, and how that information is processed and interpreted. The

quality of available information, and the knowledge-based used to interpret that information, determines the accuracy with which the situation is defined. It is important to note that the use of an intentional systems representation is compatible with the use of physical systems representations. Both mechanism can be used together to explain actions during fire incidents.In general, different individuals respond differently during emergency situation such as fire. Tare three general types of reaction to fire:

- Concern with warning or alerting others, either individuals or the fire brigade.
- Concern with fire-fighting or at least attending the fire.
- Concern with evacuation of the building either by oneself or with others

3. Physical System Representations

Fire safety systems can be described in two different ways:

3.1.1 Physical systems

In a physical systems representation, actions were caused by physical processes. In a physical systems model, events and system states are viewed as being caused in accordance with laws and models that predict physical appearance processes. For example, in fire safety, hydraulic models are used to clarify how the gravity and the buoyancy of heated gas cause smoke to flow through vents at foreseen rates. Such physical models appearances are central to the engineering disciplines, and have generated an extensive body of fire safety research. Recent examples include the computer-based models that predict how fires develop in a defined environment. Example of the responses given by a group of professionals involved in the Delphi Techniques on human factors for educational buildings in Malaysia are given as follows [4].

3.1.2 Intentional systems

In an intentional systems model, decisions or events are driven by the intentions of people pursuing the objectives. Both physical and intentional systems representations are used in fire safety engineering. Reflecting its heritage as an engineering discipline, physical systems representations now dominate the modern fire safety design.

4. Basic Usage of Human Behavior Study in Fire Safety

In the educational establishment, there are several types of occupants. In order to ensure that all the occupants will be safe during a fire event, there are some characteristics of the occupants which need to be considered:

- Occupants predominantly familiar with the building and who are awake (e.g. office, commercial and industrial premises etc.).

- Occupant possibly unfamiliar with the building but are awake (e.g. shops, exhibitions museums, leisure centers, and other assembly buildings).
- Occupants possibly sleeping but predominantly familiar with the building (e.g. dwelling, hostels).
- Occupants possibly sleeping and unfamiliar with the building (hotels etc.).
- Significant number of occupants requiring assistance (e.g. hospitals, nursing homes, disabled or handicapped).
- Occupants held in custody (e.g. prisons or detention rooms).

5. Advantages and limitations of physical systems representations when applied to human behavior

It is not surprising that physical systems representations have dominated the manner in which fire safety engineering has represented human behaviors during fire incidents and in fact, the approach works very well when applied to certain types of problems, most notably the prediction of optimal evacuation times and flow rates where the movements of people are constrained by the presence of building layouts and crowding [5].

There are some advantages in using the physical systems models. Because of their familiarity, such models are easily understood and readily accepted by the engineering community. Another attraction is that all theoretical constructs are observable and measurable.

Representing human behavior as being caused by the physical environment has important limitations when it is applied to human adaptive (i.e. problem-solving) reaction to fire. When dealing with human behaviors, traditional fire safety engineering approaches are often based on naïve physical systems models that fail to accurately represent the real world [6].

Many important human behaviors are inevitably controlled by intentional decision-based processes that can only be accurately modeled by using intentional systems models. Alarm signals do not seem to "cause" people to initiate evacuations and the fact that a building entrance is not marked as an "exit" does not seem to "cause" people to seek alternative routes. The fire safety designs of buildings are not created with the idea that people will rescue strangers, tie bed sheets; stuff towels under doors, together to climb out of windows, fly helicopters to empty the people from roof tops, and use telephones to call for help— yet these adaptive behaviors are not uncommon. In fact, the principal limitation on people's abilities to solve problems during fire emergencies is probably a lack of timely accurate information, as pointed out by a number of researchers [7].

6. Human Factors

Human factors are very significant because the life safety is considered to be the main aim for structural stability and fire resistance requirement, escape design, firefighting and extinguishers installation and smoke movement design. It is best

that human can react with the fire precautions design and the hardware available within their environment to produce high performance result in reducing the rate of loss and damage [8]

The human aspects of the causes and developments of fire must be understood if its disastrous effects are to be minimized and also, the cause of damage caused by fires can be traced more to be human error than to engineering failure. Generally, human factors are not something that can be eliminated in design and evaluation. It is essential to know more about the people who work and deal with the specific building in a specific environment to save human lives which is the grand purpose of fire safety, to reduce the properties damage, to create safer environment, to reduce pollution, to continue the specify mission and also to reduce the loss' effect in terms of economy and other damaging effects [9].

7. Conclusions

Any types of buildings should emphasize different aspects of care, particularly in terms of safety protection equipment, positioning equipment such as furniture, fire prevention, warning signs and so on. This is because the occupants are often complacent and tend to ignore their safety. Placement of protection devices in accordance to the standard fire prevention should be set in accordance with the relevant codes to ensure that the building is safe for people to live in. Fire can occur in a building at any time and from various sources. From the moment of ignition there is a potential of major disaster, and it is just a matter of time before it became fatal. The best defense against injury or possible loss of life from fire lies in a strong fire prevention and life safety programs. Such a program must be fully handled by all responsible authorities, with regard to the following three elements such as education, training and attitude. Proper implementation of fire safety management was costly; hence, attitudes of the building owners, occupants and management staff towards a high quality of fire safety management were the other key factors to the success of a complete fire safety measures. Therefore, clear legal control must be established for successful enforcement of implementing fire safety management in buildings.

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