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Introductory Chapter: Fire Prevention Strategies

Anujit Ghosal and Fahmina Zafar

1. Brief introduction

A few decades back, the incidents of fire were regarded as natural calamity and were treated as such with very little thought on other aspects. However, in-depth analysis of most of the recent accidental fire tragedies indicates the human fingerprints such as deforestation, cigarette, firecrackers, static fire in forest at night or other similar incidences [1–3]. The frequency and extent of loss in life or economic damages have been increasing along with the population growth. So, to check the catastrophic misfortunate instances of fire and controlling the after-effects, stringent rules must be followed [4–6]. Broadly, the rules can be divided in three categories as shown in the **Figure 1**.

In most of the places, fire safety and management protocols are common with slight modification based on the environmental conditions. These systems are adopted throughout the world, however, more strictly followed at flammable industries (oil, gas, paint, paper, etc.) while considered being little lenient at household vicinities [7, 8]. The increased population with constant high pressure on the economic backbone of numerous countries has altered the previous protection protocols [9–11]. The high cost of living has resulted in a more congested neighborhood *i.e.* population density particularly in the urban areas is constantly increasing [12, 13]. A collective approach is needed to avoid mistakes via., focusing on the fundamental area of management and planning. **Figure 2** represents the basic blocks involved in planning and management section for any construction.

Any small mishap such as an electric short circuit, heating system malfunction, barbeques, candles, or similar incidences at one place will affect the entire or adjacent community other than environmental contamination. Apart from the prevention of fire incidence, defined safety measures can save lives after the occurrence of such accidental events. Various approaches have been followed for the management of fire preventions at the fundamental level. A few of them are presented below:

- i. Planning escape route
- ii. Routine inspections of doorways and exit passages
- iii. Conducting regular practice drills for fire evacuations
- iv. Maintenance of sprinklers or other extinguishers
- v. Keep track of the exact number of occupants
- vi. Avoid cluttering the areas which can inhibit the fire extinguish mechanisms.
- vii. Recording alteration, submission, and safekeeping of building/factory blueprints

Figure 1.
Three broad categories of the fire protection activities.

Figure 2.
Basics steps involved in fire protection of any construction.

2. Comprehensive views

Although numerous prevention and fire safety manuals have been developed but with modernization redefining fire prevention protocols with time is mandatory [14–16]. However, the process of change is ever dynamic for the inclusion of new information. Incorporation of the output from upcoming research studies for avoiding miss-managements during a fire outburst and remodeling the evacuation strategies are important. The architectural improvements which can further assist the evacuation process and ease the smoke exhaustion process should always be considered. The new engineering strategies based on recent active research should be adopted in the construction of housing societies, particularly in highly populated areas [17, 18]. The implementation of fire safety protocol in pre-build structures

via., virtual, mathematical, or numerical modeling and studies would improve the durability as well as safety of the area. Simulation of possible fire incidences or previous fire case-studies has been known to improve the overall understanding of the incidents and pre-planning strategies [19–21]. Development of such post evacuation strategies would minimize the materialistic loss as well as can zero the causalities under such events.

Other than the planning of construction and infrastructure skeleton, consideration of the use of specific materials in and around any place is also need to be checked [22]. Utilization of flammable materials such as plastics, oil based paints, use of cotton or storage of highly volatile chemicals seem to be a cause in many instances. Alternatively, non-flammable paints, coatings, fabrics, and construction materials like nanocomposite materials should be used [23–25]. Research on flame retardant materials and nanocomposites are also considered to be one of the alternatives against fire protection and evacuation management systems. Like coating over wooden furniture and cotton fabrics would render them less prone to fire and thus, can act as barrier during incidence of fire [26, 27]. Superhydrophobic and flame retardant tiles in kitchen and heating areas would result in reduction in possible accidents [28, 29]. Further, designing of fire-fighting robots and other engineered bots are required to be brought in lime light for protection and prevention against tragic incidences [30].

Finally, the strategies which can assist in improving pre, on-going, and post-fire incident management system are more pivotal in creating a fail-safe fire protection mechanism. The research encircling different views with building modeling, escape route planning in heritage buildings and mines, construction material used and prevention protocols are critical in safe keeping future generation including wild life as well as plants. The difficulties which are created due to the excessive urbanization and population boom in addition to poor engineering or planning of residence and work places particularly near forest or wood stock areas are to be addressed. Virtual *in silico* studies and numerical simulation in analyzing as well as recreating previous fire hazardous cases would provide additional benefits in visualization of the mistakes in following then existing protocols and to further improve fire safety measures.

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