Essentials of Building Life and Fire Safety

Dedicated to the professionals who ensure

life and fire safety with

knowledge of science, design, innovation and commitment

for sustainable safe built environment

for the occupants to fulfil their aspirations and

render service to society with complete sense of wellbeing

Essentials of Building Life and Fire Safety

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Contents

Preface

Essentials of Building Life and Fire Safety is dedicated to the professionals involved in planning and design of a fire safety-compliant built environment. Fire-related events in the built-environment are ghastly, and compare to no other unnatural disaster and death. From Uphaar Cinema (1997), Kumbakonam (2004), AMRI Hospital (2011), SUM Hospital (2016), and Rajkot Hospital (2020), the chronology of fire incidents in the Indian sub-continent underlines an inherent lack of fire safety norms in the built environment. This can largely be associated with the chasm in built environment academia which emphasizes on prescriptive norms rather than performance-based bespoke guidelines that can take into account the uniqueness of every building, hugely concentrated on devising exit strategies rather than eliminating the root cause of fire in built environment.

Buildings are remarkable reminders of creativity; a matter of pride for its builders and occupants, and instills in its users a sense of well-being that extends beyond the obvious aesthetics. Healthy buildings encompass safety aspects including fire and life safety but the critical aspects of fire-related provisions are often reduced to a checklist of codal provisions; one-size-fit-all approach.

Prescriptive codal provisions in India are largely reliant upon the National Building Code (2016), Part 1, Chapter 4: Fire and Life Safety, which itself is reliant on NFPA USA (National Fire Protection Association). However, this one-on-one relationship between the matters of the codal provisions is what starts off the planning process on the wrong foot. Whilst the general physics of fire and basics of fire and life safety can be adopted without amendments, the point from where the design and materials of construction start diverging between the two nations is what at a directionless cross-road currently in India.

The author(s) realized a dire need for developing an interpretational bridge to close the chasm between international perspective-based guidelines to fit the varied design needs of buildings in the nation. The book is based on their cumulative experience of academia and industry inter-linkages that helped them to understand the best pedagogical method to present the technical jargon of fire and life safety more lucidly. Thus, the chapters of the book can be considered as academic interpretations of the science behind fire in built environment. The overlaying intent is firmly routed in the belief that for fire and life safety there is 'zero tolerance' for any slippages in meeting and bettering any and all requirements to prevent fire and save lives.

The core of existing fire and life safety guidelines centralizes on the premise that protecting lives is the guiding principle of any prescriptive norm. Whilst not taking away from this central premise, the author(s) have an extension to this proposition – protect the built environment in its entirety. Thus, larger emphasis is on prevention and

protection strategies than exit strategies. This aspect becomes critical in healthcare, educational, elderly care-homes, disabled learning centres, and other such facilities that bear responsibility of persons who may not be in position to exit the building during a crisis. Bearing such uniqueness of facilities, the interpretational aspect of the book spans across a multitude of topics and presents performance-based visuals to be adapted as required.

The book has no particular target audience, rather encompasses the profession of construction; it intends to be a guiding document that will be useful to all technical persons involved in the sector of planning, design and construction of built-environment. In particular, this book is invaluable as a reference document for students of architecture, construction project management and building services who can build upon their knowledge to enter the professional arena with a sense of confidence apropos averting fire-related disasters. Furthermore, the authors(s) have ascertained that all principles and theories are supported by excerpts from actual cases wherever applicable to demonstrate applicability. This would be beneficial to grasp and assimilate concepts faster and in real-life scenarios.

The structure of the book flows seamlessly from the science of fire, specific to the built-environment, to the hitherto overlooked area of urban fires – more significant current context due to the rapid and continuous expansion of urban sprawls everywhere.

Chapter 1 covers the relevant and important terminologies as well as concepts pertinent to fire safety in buildings. It explains in detail the determinants, interrelationships, risks and challenges of fire safety in enclosed spaces. Such detailed understanding based on scientific facts of complexity in a building enclosure is much needed to analyze potential strategies for mitigation of fire risk.

Chapter 2 delves on the physiological aspects and behavior of the occupants to determine specific responses during the evacuation in a fire emergency and the ability to negate untenable conditions that may be faced during the building fires. Tenability is essential to determine the time for egress, i.e. travel time is dependent on tenability and hence the travel distance must be assessed or interpreted accurately.

Chapter 3 focuses on smoke management in buildings; major fire related deaths are associated with asphyxiations rather than burns making this aspect critical to design considerations. The options of compartmentation, dilution, airflow, pressurization and buoyancy are key determinants of the management of smoke, and have been elaborated through visual examples.

Chapter 4 is focused on the challenges of egress; codal provisions related to the egress often present varying compliance requirements which may appear to be prima-facie irrational, and it is these complexities that have been considered in the context of the technological advancements, competencies, support systems, implementation of such codal prescriptions, and, above all the psyche of the occupants. This chapter covers strategies for both new and existing facilities.

Chapter 5 is based on the engineering principles of fire containment and compartmentation, including certain fundamental concepts related to providing a safe separation distance. Containment and compartmentation are referred to as passive or

proactive measures and are inherent design solution or design capability to limit the spread of fire. The theories of containment and compartmentation have evolved over decades as being the fundamental fire protection strategies and most codal provisions lay considerable emphasis on them as being primary prevention measures.

Chapter 6 goes back to the extended premise that buildings need to stand strong in fire to primarily protect occupants, but also offer resistance to prevent the spread of fire and smoke and exhibit structural integrity, stability, and temperature transmission thereby preventing structural collapse in the event of an uncontrolled fire. This chapter also elaborates all the analysis steps, design procedures, and international codal provisions present for RCC (Reinforced Cement Concrete) structures for fire safe design, an aspect obvious by their absence from Indian codes.

Chapter 7 is a dedicated understanding of the evacuation challenges of disabled persons. At any point of time, most of us can be rendered disabled by mild to temporary sickness, thus all recommendations in this chapter are more or less mandatory compliances for every facility; new or existing. The chapter presents comprehensive recommendations based on the fire safety issues of the disabled occupants involving the combination of two components: the life safety of occupants with disability and the inability to evacuate buildings independently; and the obligations of building owners and occupiers to ensure provision of fire safety features, for the disabled occupants.

Chapter 8 is wholly dedicated to fire and smoke control in basements – a challenge different from other spaces due to its confined nature where the connection with the outside is very limited. This adds to tenability issues and an immense dependence on the mechanical systems having reducing effectiveness during the progress of a fire. The geometry only adds to the accumulation of heat, leading to smoldering and back draughts. It was essential to treat the fire safety aspects as a chapter on specifics of basement fire safety design parameters separate to other spaces as increasingly basements are becoming more than just car parks.

Chapter 9 is a new addition which has largely been unexplored in terms of design and material selection, building envelope. As skyscrapers rise to high in cities, it presents two-fold challenge, escape/exit and 'leap frog flares' spread of fire to external façade overwhelming firefighting strategies. Vulnerability of the envelope is demonstrated by the case study of Grenfall Tower (2017), where 87 persons are trapped to death, and is one the decade's most catastrophic events.

Chapter 10 is another new addition that focuses on urban fire risk. This is a perilous area given uncontrollable urban sprawls everywhere. For urban areas, the challenge can be explained in three contexts, namely life safety, fire safety, and urban fire safety. Codal provisions may or may not be mandatory depending upon the Authority Having Jurisdiction (AHJ). Hence, the risk mitigation of urban fires needs to rely on measures beyond codes, involving people, communities, and the constraints of existing developments.

The author(s) hope that the book would be perceived as a leading document in the field of fire and life safety, and will set a precedent as being technically accurate yet coherent and unified.

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One never realized that being passionate about the subject of Life and Fire Safety is far simpler than the hard work required for writing a book. A subject that is so vast and involves many specializations requires not only an understanding of its technicalities but also the precise articulation from the perspective of the target audience. So, every discussion and interaction that we have had with our colleagues from the fraternity of Fire Safety has been immensely significant to bring about the synergy of ideas, content assimilation, and preparing a structure that matured as this book. And, I, on behalf of my co-authors, would always be grateful to everyone who shared their perspective, provided critique to our standpoint, supported our passion, enriched our understanding, and allowed us to enlarge our comprehension on the subject.

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