THE NEED FOR CROSS-SECTOR COLLABORATION IN FIRE SAFETY DESIGN

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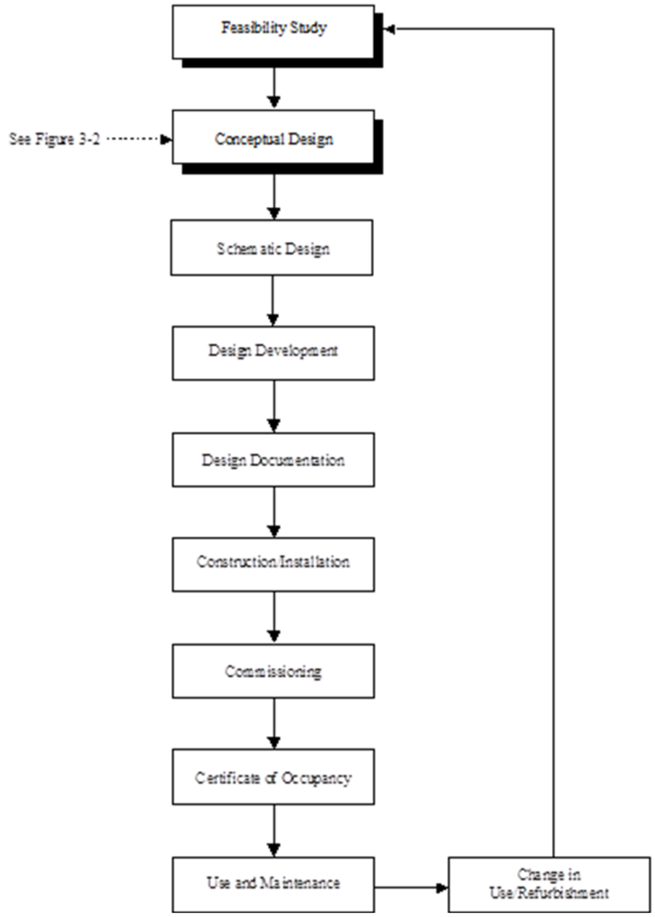
Today, society demands taller, larger, more environmentally friendly, and iconic buildings. As a result, the need for more rigorous approaches to fire safety design has increased significantly. For example, we see a growing trend toward performance-based design and probabilistic methods. At the same time, we are seeing increases in the use of technology, specifically related to modeling capability in compartment fires, human behavior, probabilistic analysis, and structural fire engineering.

With this increase in technology, the public's understanding of our profession decreases. As such, the need for cross-sector collaboration in fire safety design is more critical than ever. This collaboration is essential in all fire safety design and construction projects, whether the design is based on prescriptive, performance-based, or risk assessment methodologies.

Stakeholders

Effective cross-sectional collaboration should include but not be limited to the owner(s), designers (engineers and architects), the fire department, and code enforcement personnel. The responsibility and authority of each stakeholder should be determined in the preliminary stages of the design. As shown in Figure 1, this collaboration should start at the conceptual design phase as a minimum. Together, they should set a framework that will foster honest communication and a clear understanding of the goals and objectives of the fire safety design. A basic agreement should be reached in the initial stages on the fundamental aspects of the fire safety design. This encompasses the setting of goals and objectives. A schedule for meetings, reviews, deliverables, and the permitting and inspection process and associated fees are also essential.

Figure 1 – Basic Building Design Process



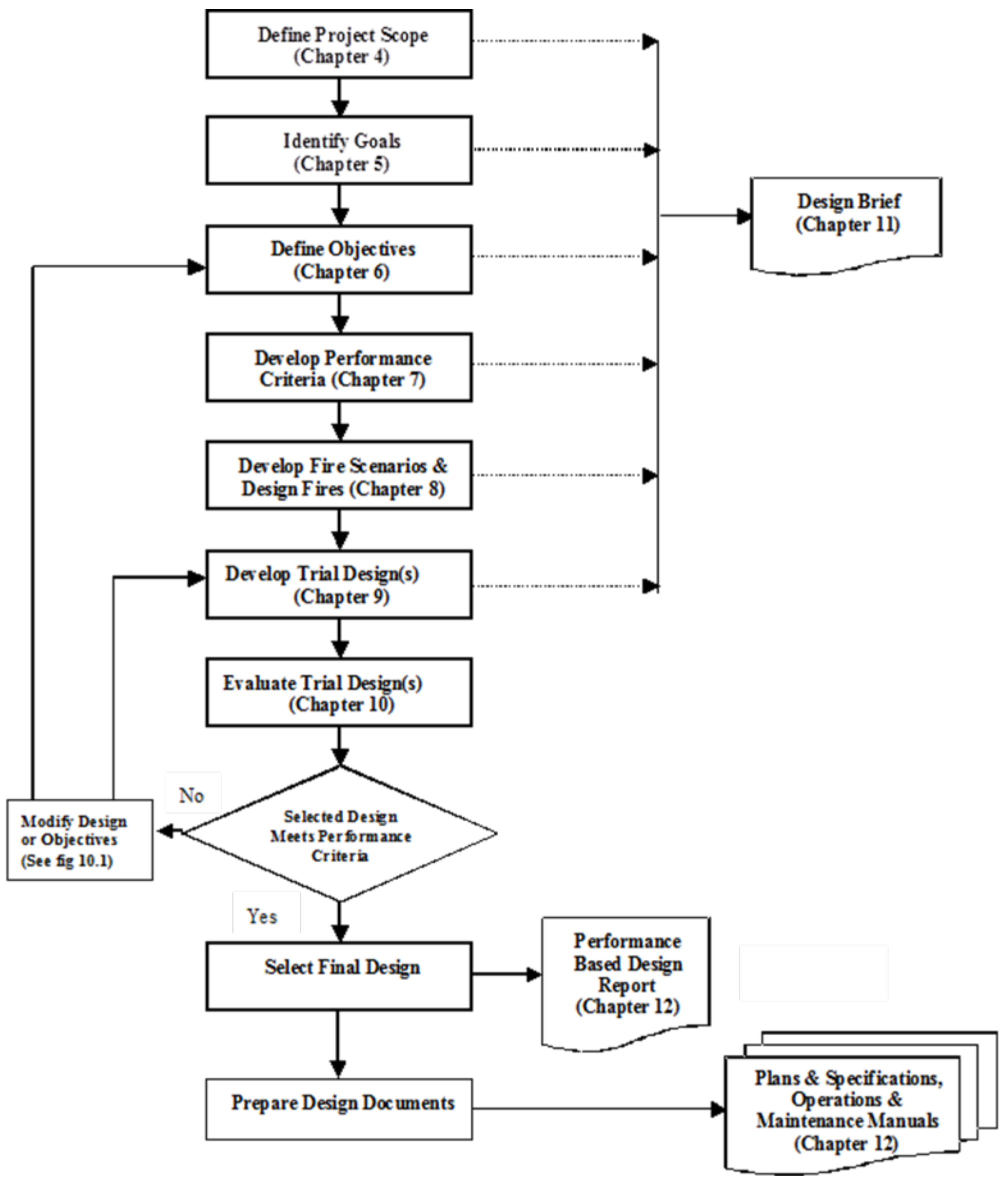
Performance-Based Design

Performance-based design (PBD) can have several meanings in the fire safety engineering community. An interesting definition can be found in the *2016 Issue 4 of SFPE Europe,* where Greg Baker defines PBD as alternative methods of achieving compliance with the fire safety performance requirements in legislation, where the "alternative methods" differ from the pre-accepted (prescriptive) solutions in the building regulations. This definition does an excellent job of explaining the primary premise behind PBD.

As part of the PBD process, seeking the "alternative method" should include some sort of analysis or engineering solution. As defined by the *SFPE Engineering Guide to Performance-Based Fire Protection, 2nd Edition*, performance-based design as an engineering approach to fire protection design is based on: 1) agreed on fire safety goals and objectives; 2) deterministic and/or probabilistic analysis of fire scenarios; and 3) quantitative assessment of design alternatives against the fire safety goals and objectives using accepted engineering tools, methodologies, and performance criteria. The SFPE definition highlights three important attributes distinguishing PBD from prescriptive design. The SFPE methodology for performance-based fire safety is illustrated in Figure 2.

1. In PBD, the building stakeholders identify the critical level of fire safety as opposed to a prescriptive requirement. This is where cross-sector collaboration is essential.
2. The basis for this design is project-specific and focused on the building's construction, occupants, and the estimated design fires.
3. PBD relies on an engineering analysis of the proposed design strategies to determine if the design provides the intended level of life safety. In practice, this analysis is usually deterministic. However, the trend in the industry is moving towards adopting a probabilistic approach.

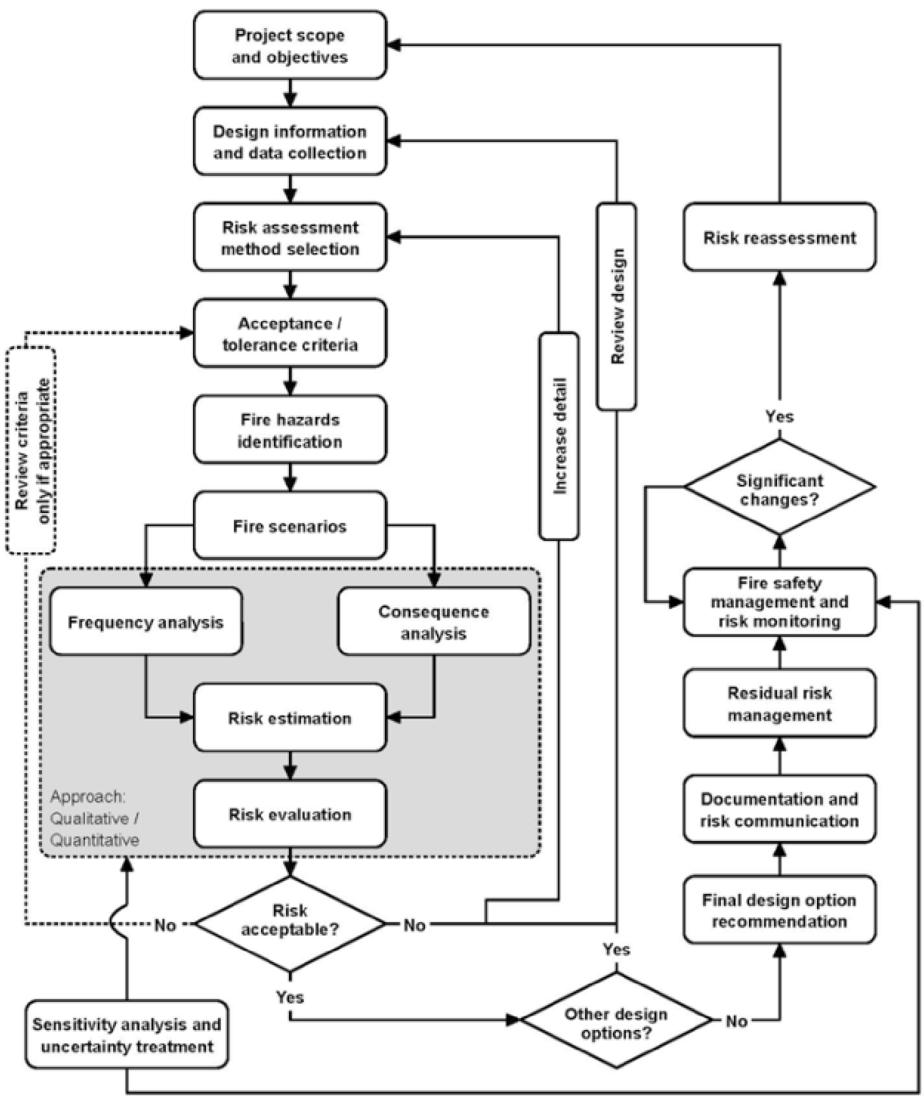
Figure 2 – SFPE Performance-based Fire Safety Design Methodology



Fire Risk Assessment

As defined in the SFPE Engineering Guide to Fire Risk Assessment, risk is the potential for the realization of unwanted adverse consequences, considering scenarios and their associated frequencies or probabilities and associated consequences. Risk analysis is the in-depth evaluation undertaken to understand and quantify the adverse unwanted implications. Risk analysis aims to analyze what could go wrong, the likelihood of occurring, and the event's consequences. It involves the identification of hazards, identification and specification of scenarios for consideration, estimation and analysis of probability and consequences, combining likelihood and consequence to obtain an estimate of risk, evaluation of the risk in terms of risk acceptance targets, and taking steps to manage the risk through reducing the probability or consequences of the event, transferring the risk via insurance, or avoiding the risk. The process for fire risk analysis is illustrated in Figure 3.

Figure 3-- SFPE Fire Risk Assessment Methodology



Establishing the design's risk acceptance (tolerance) level is a significant challenge for any risk analysis. The stakeholders typically set these. Without cross-sector collaboration, it will be difficult to determine the appropriate risk acceptance level. For any complex process, a complete risk characterization process is suggested. The aim is not to address the issues of what can go wrong, how likely that is, and the resulting consequences but, more specifically, which consequences and at what levels are tolerable. This must address challenging issues of tolerable fire size, tolerable losses of people, property, and mission, and the circumstances of such losses.

Emerging Issues

Having a competent workforce that meets the demands of the design and construction industry has always been a challenge for our profession. The demand for fire protection engineers far outpaces the supply. There are not enough competent engineers to fill all the open positions. This offset in demand often results in underqualified individuals practicing fire protection engineering.

Another challenge is keeping up with the emerging technical trends in the design and construction industry. Many of these challenges result from materials and technologies that are developed to facilitate sustainability in the built environment, which have introduced unintended fire hazards and risks. These include fire safety issues related to mass timber construction, the building envelope, transportation, and energy storage systems, to name a few. Other emerging problems that our profession faces are the mitigation of wildland-urban interface fires, cybersecurity for fire protection systems, and the increasing role of digitalization and artificial intelligence.

Peer Review

The concept of peer review can be defined as the independent and unbiased evaluation of sound engineering principles, judgment, and their proper application in the conceptual approach and technical basis of an engineering work product. It is often used by code officials/authorities having jurisdiction (AHJ) to judge the merit of a design, assess a design for its likelihood of achieving the intended objectives, or ensure that an adequate level of life safety is provided.

Because the practice of fire protection engineering significantly impacts society’s health, safety, and welfare, peer review plays a vital role in fire protection design. This is where cross-sectional coordination with the stakeholders is important, as a regulator may not have the resources to complete an adequate review. By implementing a peer review, the regulator has a tool to get their job done more efficiently.

SFPE has published a free Guide for Peer Review in the Fire Protection Design Process to assist in this effort. It is available on the SFPE website at www.sfpe.org. As stated in this guide, the purpose of this document is to guide the fire protection engineering community concerning the peer review process of a fire protection engineering work product. This includes any stakeholder interested in a fire protection work product that requires a peer review, such as fire protection engineers, project engineers of other disciplines, architects, code officials/authorities having jurisdiction, fire department representatives, building owners or owners representatives, and insurance interests. Specifically, this guide addresses the initiation, scope, conduct, and report of a peer review of a fire protection engineering work product.