

**SOCIETY OF FIRE PROTECTION ENGINEERS  
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**THE ROLE OF THE FIRE PROTECTION ENGINEER IN  
THE CONSTRUCTION DESIGN PROCESS**

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## **CONTENTS**

- 1.0 Introduction
- 2.0 Background
- 3.0 Description of the Role
- 4.0 The Reviewing Agency
- 5.0 Benefits of FPEs in the Design Process
- 6.0 Conclusion
- Appendix A Additional Readings

### **1.0 INTRODUCTION**

Fire protection engineering professionals (FPEs) are a valuable part of any building construction team. Society demands that the buildings it occupies not have a significant threat from fire. As a result, a significant portion of the cost of modern building construction is devoted to fire protection features. These features may include structural fire resistance, detection and suppression systems, egress systems, alerting systems, secondary power supplies, elevator systems, smoke management systems and limitation of combustibles. These features must all work together as a system to protect life and property, and to preserve continuity of operation.

Furthermore, these features are required to conform to multiple codes, and installation, use and maintenance requirements, which are enforced by various regulatory officials before, during and after construction. Fire protection engineers help assure that these requirements are met in a timely, cost-effective manner. It is important that the construction team {owner(s), designers, reviewers, insurers, code officials and contractors} understand and properly assign responsibility for the coordination of the design, installation and acceptance of these systems.

For many buildings, the application and enforcement of methods described in the codes may be sufficient. These buildings may not require much involvement of a fire protection engineer on the construction team or the review team. However, code and fire protection experience is valuable to verify that important provisions are being incorporated, in a cost-effective manner. Larger buildings, or buildings with more complex features, often require detailed analyses of potential fire hazards and coordination of many fire protection features. In these cases, a qualified fire protection engineer on the team is essential.

Many countries are changing from prescriptive to performance-based codes. With performance-based codes, justification of the engineering design is switched from the code to the designer/owner team. In order to perform a competent performance-based fire protection analysis of a building design, a

comprehensive understanding of fire and the use of the appropriate engineering tools and methods is essential for the designer and the reviewer.

## **2.0 BACKGROUND**

As building codes and fire protection technology evolve, fire protection plays an increasing role in the construction process. The goal of building fire protection changed from primarily one of property protection to protection of life, property and continuity of operations. The myriad of codes, which are written to provide an acceptable level of protection for a typical building, can no longer be applied to the wide variety of uses, designs, and missions of modern construction. Whether a building design employs a “prescriptive”, or “performance-based” design, many of today’s construction projects should include an analysis of the risk and hazards of fire. For unique or complex structures, this analysis is essential.

The roles of the traditional construction team in designing the fire protection system have typically involved the architect for furnishings, finishes, and egress methods; the structural engineer and/or architect for fire resistance; the mechanical engineer for suppression and smoke control systems; and the electrical engineer for fire alarms, secondary power supplies and fire detection systems. The coordination of these efforts has sometimes been assigned to one of these team members, or has been abdicated to others. This approach may work for a typical building where strict application of the code to resolve minor issues is all that is necessary. However, it can lead to problems, either during construction or during the life of the building, if the coordination and design have not been properly considered and documented. This void has led to the introduction of the fire protection engineer in the building construction process; whether working as part of the design team, the construction team, or the review team. The fire protection engineer makes a distinct contribution to the process, just as do the structural, mechanical, electrical, geotechnical and civil engineers.

As part of the investigation into collapse of the World Trade Center, in 2005 the National Institute of Standards and Technology (NIST) released 30 recommendations aimed at improving safety in tall buildings for occupants and first responders. Recommendation Number 28 of this report calls for fire protection engineers should be part of the design team providing the standard of care for buildings employing innovative or unusual fire safety features.

## **3.0 DESCRIPTION OF THE ROLE**

The fire protection engineer (FPE), by education and experience, has developed an understanding of fire science. This understanding can be focused in a variety of areas of fire protection including, but not limited to, water based suppression, waterless suppression, detection or fire alarm system design, or areas such as fire growth and development (fire dynamics). In either case, the FPE uses this knowledge as a basis for fire protection decisions.

Rather than use a code or standard as the primary basis for decisions, the FPE may use the code or standard as a benchmark in evaluating the building and establishing design parameters. By changing the emphasis to performance, the FPE can: analyze the specific issue and identify alternatives; consider the implications in terms of cost, user needs, flexibility and effectiveness; and make recommendations.

Where the solution does not specifically meet prescriptive code requirements, the basis for the decision must be clearly documented. Assuming that the solution provides an equivalency to the code or standard, the reviewing agency has the authority to approve it. The solution must also be acceptable to all stakeholders. This process brings creativity and value to the construction team and may also result in a higher or lower overall cost of construction. If the cost is higher, it may be attributed to a specific fire protection need that was identified and determined to be necessary to achieve conceptual goals. If the cost is lower, it may be due to the application of an innovative method or material that produced another way of providing the same overall level of fire safety.

As the design and construction processes become more sophisticated, the need for a qualified fire protection engineer to perform these analyses becomes more crucial to the goals of safety and value.

#### **4.0 THE REVIEWING AGENCY**

When innovative fire protection approaches are used, it is important for the reviewing agency to be able to adequately review the proposal. One way to accomplish this is through the use of FPEs by the reviewing agency. Over the past several years, many jurisdictions have added FPEs to their staffs – both in building departments and fire departments. In some cases, the reviewing agencies have employed the services of FPEs on a contracted third-party basis. In the insurance industry, fire protection engineers have been employed for years to review fire protection features in proposed and existing buildings.

As performance-based codes and engineering methods are developed and implemented, the approving authorities, in order to fulfill their important role will need the expertise to understand the engineering methods and processes in order to fulfill their important role.

#### **5.0 BENEFITS OF FPEs IN THE DESIGN PROCESS**

Having the guidance of a qualified and experienced FPE on the construction team, early in the process, can save time and expense in the design development, construction and post-construction phases of a project. The following are some benefits the FPE can add to the process:

**5.1** The FPE can coordinate the fire and life safety aspects of the design disciplines (architectural, structural, civil, mechanical, and electrical), focus the design team's attention on solving appropriate fire and life safety issues, and save time and expense. This is possible because:

- a. An FPE can help develop goals with an understanding that designs are intended to limit the threat to life safety for both the public and emergency responders and reducing potential property loss.
- b. An FPE can interpret a variety of applicable codes and standards with an understanding of how the building and its components function as an integrated fire and life safety system. This enables the FPE to recommend cost effective solutions that provide safety from fire to the overall design.
- c. An FPE focuses specifically on scientific and engineering methods for fire and life safety analysis and design where as engineers from other disciplines focus on other unrelated building systems and features. This can include computer modeling, such as but not limited to, Computational Fluid Dynamics and Human Behavior Modeling.
- d. An FPE can produce a set of fire protection design documents that anticipate the details of a fire protection installation, based on an integrated systems approach. This can help yield tighter construction bid prices.
- e. If a problem is discovered during construction, the FPE can recommend corrective actions that can minimize change orders and associated cost increases.
- f. An FPE can develop a plan to commission and accept fire and life safety systems.

**5.2** Having a qualified and experienced FPE on the construction team can minimize the potential for conflicts from the outset of the project, and help ensure that expertise is available to resolve fire and life safety issues that may arise between conflicting building and fire regulations.

**5.3** As codes incorporate additional performance criteria and more performance based fire safety design alternatives are used, the acceptability of risk and cost based fire safety design alternatives by FPEs will increase. The respective knowledge of the code official will also increase. The fire protection expertise of the construction or review team must be able to address the concerns of the code official.

## **6.0 CONCLUSION**

In the rapidly changing environment of building and fire regulations involving, and the building design and construction process, there is a growing need to have specialized fire protection expertise on a project. This need is filled by qualified and experienced fire protection engineers.

The FPE on the construction or review team will provide expertise, aiding society's expectation of keeping people and structures safe from fire, to provide well designed protection that is appropriate to the hazards and risks; to increase the creativity and value added components to the project and to provide cost-effective solutions.

### **Appendix A -- Additional Readings**

*SFPE Engineering Guide to Performance-Based Fire Protection*, 2<sup>nd</sup> Edition.  
National Fire Protection Association. Quincy, MA.

*The SFPE Code Official's Guide to Performance-Based Design Review*,  
International Code Council. Falls Church, VA.