

Performance Based Design

Historically, fixed fire suppression systems have been designed in accordance with a very specific list of prescribed requirements such as those found in NFPA 13 or other recognized installation codes. While using these prescriptive rules to design fire suppression systems has proven to be successful, this approach does not readily provide for protection schemes that are tailored to the specific purpose and operation of the protected facility. The use of engineering tools to develop fire protection solutions that take into account the unique aspects of a facility or operation in the development of an overall fire protection strategy within the context of a specific performance objective is known as Performance Based Design [PBD]. The practice of PBD requires that any proposed solution provide a level of safety and dependability that is equivalent to that anticipated if the prescriptive solution were followed. However, when PBD is employed these objectives can be achieved in a more flexible manner that may better meet the needs of building owners, Authorities Having Jurisdiction, and Insurers.

Performance Based Design is a major subset of the broader method of allowing flexibility within the design and installation codes known as “equivalency” methods or “alternate methods and materials” (note that NFPA-13 refers to this as “New Technology”)(AMM). Alternate Methods and Materials is a broad category of design options that includes the application of Performance Based Design, but also more restrictive deviations from the prescriptive codes. An example of this is the substitution of listed components that are recognized by the prescriptive code with listed components, which have not yet been incorporated into the code. Many, if not most of the alternate materials and methods that are employed do not take full advantage of the flexibility allowed through the practice of Performance Based Design.

Prescriptive codes usually reference “equivalency” or “alternate materials and methods” (**AMM**) clauses that permit designers to utilize alternative approaches than those specifically recognized by the code. These clauses permit the application of Performance Based Design as a means of rigorously applying engineering principles to provide alternative methods to the “cookbook” approach.

Examples of AMM references in widely used building and fire codes are as follows:

1. From the International Fire Code; 2003 edition, Section 104.9 “Alternate Materials and Methods”: “The provisions of this code are not intended to prevent the installation of any material or to prevent any method of construction not specifically prescribed by this code, provided that any such alternative has been approved. The fire code official is authorized to approve an alternative material or method of construction where the fire code official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability, and safety.”
2. From NFPA-13; 2002 edition, Section 1.5 “Equivalency”: “Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior

quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the Authority Having Jurisdiction.

3. From NFPA-13; 2002 edition, Section 1.6 “New Technology”: “Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered.”

Ongoing research into understanding fire-related phenomena continuously improves the capability of the engineering community to analyze and predict the performance of structures and/or protection systems when subject to a fire event. The use of analytical tools such as empirical models, finite element analysis, and computational fluid dynamics, in conjunction with bench top and full scale testing has greatly improved the ability of fire protection professionals to develop Performance Based solutions to challenging fire protection problems. Any proposed PBD solution requires acceptance by the Authority Having Jurisdiction and frequently the insurer, building owner, and other stakeholders as well. Ensuring that all participants understand and agree to the performance and limitations of any proposed design requires clear, regular communication by the responsible fire protection professional.

Performance-based design is rarely simple, and never easy, particularly given the diversity of viewpoints arising from the involved stakeholders. However, for challenging fire protection problems the application of this process can result in solutions that provide performance superior to the prescriptive solution, while eliminating undesirable or unworkable features arising from strict adherence to the prescribed design. These improvements are usually achieved by integrating all of the fire protection systems rather than designing each piece in isolation.

The practice of PBD requires skilled individuals with a thorough understanding of fire protection principles. For this reason the application, evaluation, installation, and acceptance of Performance Based Design alternatives should be accomplished only by qualified professionals.