Concepts of a Performance-Based System for the United States

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ABSTRACT

A number of countries around the world are using or developing performance-based regulations. To provide a forum for discussion on the transition to a performance-based regulatory system in the United States, the Society of Fire Protection Engineers convened a focus group of representatives from the United States' building and fire communities. A conceptual model, terminology and definitions were distributed to the focus group participants as the basis for discussion, and a two-day meeting was convened to facilitate discussion and gain consensus on the future direction for the United States. The conceptual model and the focus group consensus are presented.

INTRODUCTION

The transition from a prescriptive-based regulatory system to performance-based regulatory system has begun in the United States. The National Fire Protection Association (NFPA) was amongst the first organization to indicate their direction in the report "NFPA's Future in Performance-Based Codes and Standards."[1] Since then, the International Code Council (ICC)* has begun a project to develop goals and objectives for the new International Building Code that is currently under development.

However, this transition has not been without growing pains. Given the current lack of a single building code in the United States, and the fact that the building regulations are not promulgated by the Federal Government on a national basis (as in most other countries), there is concern that a non-unified approach to a performance-based regulatory system would result in confusion, lack of confidence and ultimately failure of such a system.

* The International Code Council is an umbrella organization of the three model building code organizations in the United States [the Building Officials and Code Administrators International, Inc. (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International (SBCCI)], whose mission is to develop unified, national building, fire, mechanical and plumbing codes for the United States.

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To address these concerns, the Society of Fire Protection Engineers (SFPE), under a grant from the National Institute for Standards and Technology (NIST), convened a focus group of representatives from the building and fire communities to discuss concepts, terminology and definitions for a performance-based system for the United States. The purpose of the focus group was to gain consensus on the fundamental features and components of a performance-based system, and to gain insight as to the roles of the many participants in the development, implementation and use of performance-based building and fire codes and standards.

To initiate discussion amongst the focus group participants, the SFPE prepared and disseminated the paper "Concepts of a Performance-Based System for the United States."[2] The focus group participants were given the opportunity to comment on the paper. The comments were then distributed to each of the focus group participants. A two-day meeting was then held on 25-26 April 1996, in Arlington, VA, to discuss the concepts outlined in the paper, identify concerns, and identify consensus on the direction of a performance-based system for the United States.

CONCEPTS OF A PERFORMANCE-BASED SYSTEM

The current prescriptive- (specification-) based building regulatory system in the United States consists primarily of a collection of codes and standards that describe how buildings should be designed, built, protected and maintained with regard to the health, safety and amenity of the general public. For the most part, this is accomplished using documents that specify both what is required for health, safety and amenity, and how these requirements are to be met.

Although the approach of specifying both what is required by the code and how the requirements are to be met may be appropriate for a prescriptive-based system, it may not be appropriate for a performance-based system (where the how may be met in a number of ways). As an alternative approach, a three-component *performance-based system* was suggested:

1. The Code, which through societal goals, functional objectives and performance requirements reflect society's expectations of the level of health and safety provided in buildings (e.g., items such as acceptable access, egress, ventilation, fire protection, electrical services, sanitary services, etc.);

2. Standards and Practices, which are separate documents, adopted by reference, that describe accepted methods for complying with the requirements of the code(s); and,

3. Evaluation and Design Tools, which provide accepted methods for assisting in the development, review and verification of designs in accordance with engineering standards and practices.

If such a model is adopted, there will be a clear differentiation between:

1. The requirements of the code (the what),

2. The acceptable means for complying with the requirements of the code (the how), and

3. The acceptable means for demonstrating that the proposed solutions comply with the requirements of the code.

At a minimum, the code would explicitly state societal goals, functional objectives and performance requirements. Standards and Practices would then provide *acceptable methods* for meeting the requirements of the code. Although these may be included in the code, they may be more appropriately referenced by the code. Acceptable methods will likely include both prescribed solutions (e.g., deemed-to-satisfy), or engineering standards, practices, tools and methodologies that can be used in an accepted manner for both design and verification of compliance (a performance-based option).

FOCUS GROUP DISCUSSION AND CONSENSUS

The first meeting of the SFPE Focus Group on Concepts of a Performance-Based System for the United States convened on 25-26 April 1996 at the Doubletree Hotel in Arlington, VA. The goal was to bring together a wide cross-section of the United States' building and fire communities to discuss the transition towards the use of performance-based codes, standards and fire safety engineering and design methods in the United States.

Group Discussion and Consensus

The following summarizes the consensus of the focus group on those issues discussed.[3] Unless otherwise noted, the text reflects the consensus as recorded at the meeting (the text in parentheses is additional commentary added to provide clarification). No significance should be placed on the order in which the discussion appear.

Topic 1: Why does there appear to be such a strong movement towards performance-based codes in the United States?

This discussion was intended to capture the essence of why the participants felt that the United States is moving towards the inclusion of performance-based codes, standards and fire safety design methods in its building regulatory system. These comments reflect the general feeling of the group as to what seems to be the motivating factors, what the resulting system might look like, and what remains to be done.

Why are "we" doing this? What will be achieved?

- To provide a better framework for communication between the policy makers and the people who purchase fire protection (services, systems & materials), and the people who deliver fire protection (services, systems & materials).
- For cost effectiveness: there is a perception of undue redundancy and cost in the present system, and it is felt that a performance-based system would provide improved value by providing clear explanation of fire and life safety objectives.
- As a means to promote cost/benefit analyses and decision making for building design and construction.
- To build safer buildings that last longer, and to provide better definition of what is being delivered for the cost: sustainable development.
- To encourage development of tools and techniques to evaluate building performance and to evaluate prescriptive requirements.
- To target sectors of the built environment where the risk is higher, and to target sectors that currently deter growth and innovation in services, systems & materials.
- New and innovative materials could be used if the methods were available to evaluate them.
- To maintain global competitiveness: as global corporations look to locate, the regulatory environment will be an important factor, and there is a need to be competitive with design and construction globally.
- To gain recognition of fire protection engineering as a true engineering discipline (in the same way as civil or mechanical engineering, for example), and to achieve better fire protection engineering.

How do we get there?

- Expand concept of using equivalency by introducing objective statements first, then transition to a "total" performance-based system.
- Do not throw away what works ...make better and allow a performance-based option.
- Provide an "integrated" system that retains the prescriptive and includes performance.

What do we have to do, have, develop and consider?

- Examples of economic benefit would be useful.
- The development of an analytical tool to demonstrate the economic benefit would be useful.
- The development of tools and techniques to evaluate performance and to evaluate prescriptive requirements are needed.
- There needs to be a linkage between those objectives extracted from our current prescriptive requirements and those that may be developed independently under a performance-based structure (i.e., the "bottom-up" objectives and the "top-down" objectives). If this is not done, there may be incompatibilities.

Topic 2: Basic Components and Structure of a Performance-Based System

This issue focused on the "model" for a performance-based regulatory system. Items that were considered under this issue included: Is a performance-based system needed? Does the SFPE "model" achieve the intent of such a system? If not, what is missing? Should societal goals, functional objectives, performance requirements and accepted methods be specified in a single document or reside in separate documents? The following constitutes the consensus reached by the entire focus group on this topic.

- A performance-based system needs to be pursued. (As discussed in the *why* session, this would be an integrated system, maintaining what we have, and introducing the performance-based concepts listed below.)
- Such a system would include goals, objectives, requirements and methods. (These terms are based on the concepts of goals, functional objectives, performance requirements and accepted methods outlined in the SFPE paper.[2])
- The term societal goal should be replaced with the term policy goal.
- The system will have a variety of (goals and) objectives.
- To start, objectives need to be extracted from the existing prescriptive codes and quantified. (Quantification is critical for evaluation/verification purposes.)
- Accepted methods need to include an engineering guide for undertaking performance-based solutions, and accepted/deemed-to-satisfy solutions. (The accepted solutions are likely to be the currently accepted prescriptive requirements).
- A "roadmap" for implementation of the system needs to be developed. (A regulatory/regulator's tool for transition and implementing.)
- A "users guide" for the system needs to be developed. (For general use: now that we have this system, how do we use it?)
- Work is needed on the definitions. (As proposed in the SFPE paper.[2])

Topic 3: Prescriptive Codes and Performance-Based Codes

This topic focused on the differences between prescriptive codes and performance-based codes. Items that the group considered included: Do the current codes clearly identify measurable goals and objectives? If not, how should they be developed, and by whom? Who determines the required performance (to meet the objectives)? The following constitutes the consensus reached by the entire focus group on this topic.

- Current prescriptive codes seldom have explicit fire and life safety goals and objectives.
- Goals and objectives need to be developed by all affected interests.
- Performance requirements need to be developed by consensus of those experienced individuals/professionals/organizations who are qualified to translate verifiable goals and objectives into quantified terms.

Topic 4: (Engineering) Standards and Practice Documents (Methods)

This topic focused primarily on engineering standards and practice documents (methods) that would be used for describing a process to be followed in achieving a solution. These are the analysis and design guidance documents (the "how is it done" documents), and do not include the evaluation and design tools (e.g., models) that are used within the analysis or design process. Items that the group considered included: Who develops engineering standards and practices? Who evaluates them on their ability to perform their intended function (who "validates" them)? How are they included in the system such that they can become readily used? The following constitutes the consensus reached by the entire focus group on this topic.

- Engineering standards and practices (methods) need to be developed by, and gain a broad professional consensus of the scientific and engineering community. (*In essence, the scientific and engineering community not only develops the methods, but must agree to their validity before they can become widely accepted.*)
- Acceptance of engineering standards and practices (within the regulatory system) can be gained in one of two ways:

  (1) By having a critical peer review (within the scientific and engineering community) and a "reality check" by a broader community (such as might be gained through a broader consensus process similar to the NFPA process.)

  (*This discussion included the commentary that the scientific and engineering communities have the expertise necessary to develop engineering methods, but that they should not "operate in a vacuum" and develop methods that cannot be readily used or understood by the broader building and fire communities.*)

  (2) When an engineering method has not received critical peer review by the engineering and scientific communities, nor a "reality check" by the broader community, the burden of demonstrating the "acceptability" of the method is on the proposer of the method. Criteria for demonstrating the acceptability of an engineering method is to be provided in the code.

  (*The discussion around this option focused on the need to allow engineers the flexibility to engineer solutions for which guidance documents may not exist, and on cases where the engineer wants to use an alternative approach that has not yet been peer reviewed. This option will only be truly effective, however, if there are acceptability criteria/factors in the code to assist enforcement officials in the review of such a method.)*

In essence, the consensus was that the fire protection engineering community must be the driving force behind development and "validation" of fire protection engineering methodologies (much the same as development and validation occurs in other engineering disciplines).

Topic 5: Evaluation (Verification) and Design Tools

This topic focused primarily on the evaluation and design tools that would be used within an engineering standard or practice document (method). These include such items as models, computer models, empirical equations, correlations, test methods and data. Items that the group considered included: Who develops these evaluation and design tools? Who deems them to be acceptable? Who "validates" them? Who can/should be expected to properly utilize these tools? How do we fill needed gaps? The following constitutes the consensus reached by the entire focus group on this topic.

- Evaluation and design tools are to be developed by those with the expertise, e.g., the profession, academia and research organizations.
  Validation means different things to different people, and for this reason, perhaps should not be used: **the critical factor is confidence.** (*There are many parts to this issue, including the validity of the fundamental equations [correlations, assumptions, etc.], the validity of the software [in the case of a computer model], and the relationship to reality [does it accurately reflect what happens in "real life"]. However, the bottom line seemed to be that the validity of any tool is a function of the confidence level of the developer, the user and the marketplace. If the developer can transmit a feeling of confidence in what the tool can do, the tool will be used. If the tool can be used with confidence in solving a problem, the marketplace will have confidence in its use. As with many parts of the transition to performance-based codes and fire safety design, education and communication will play a critical role in the acceptance of any tool as being valid for its intended use.*)
- Acceptance of evaluation and design tools is a process that includes acceptance by the profession (critical peer review and professional acceptance), acceptance by the users (of the tool's use, application and limitations), and ultimately, acceptance by the marketplace, with the bottom line being confidence. (*As with the discussion on validation above, the real issue with acceptance is one of confidence.*)
- Before the professional community and the broader community can identify where the gaps are, we need to know what we have. As the first step, it would be extremely useful to compile a complete inventory of all of the tools (in this case, primarily computer-based tools) that are currently available for evaluation and design. Such a list should include all pertinent tools, including fire science, engineering (of all types), medical, physiological, psychological, toxicological, etc. (*The intent here would be to compile a complete list of what is available, and perhaps, provide some indication of use, application and limitations of each. It was suggested that this endeavor might be an appropriate role for the SFPE. Exactly what information would be included about the tools in such an inventory was not discussed.*)
- One existing gap is the lack of data (specifically for the models). (*Although there was no consensus on what we should do, it was clear that the shortage of data is a critical factor in the "confidence" issue. It was suggested that this problem is bigger than any one group or organization, and that national or international policy/initiatives may be necessary to adequately address this shortcoming.*)

SUMMARY

A model for a performance-based regulatory system for the United States was proposed and discussed. Consensus was reached on a number of items, including the need to pursue a performance-based building regulatory system for the United States. Such a system would likely spawn from the present system, would include explicit policy level goals, functional objectives and performance requirements in the codes (to describe the level of safety that is desired), and would utilize both prescriptive solutions and performance-based solutions as acceptable means to provide the desired level of safety.

The first steps towards achieving such a performance-based system will likely include:

- Extraction and quantification of goals and objectives from the current codes (primarily by the codes- and standards-making organizations),
- Development of policy level goals (by all interested parties),
- Development of tools and techniques to measure performance (the responsibility of many professionals, including the SFPE),
- Development of an engineering guide for developing performance-based solutions (a task the SFPE will initiate),
- Development of a common vocabulary and acceptable definitions, and
- Increased education for everyone in the building and fire community.

It was also clear that the United States has a long way to go and change will not occur over night. Issues such as "qualifications" have yet to be addressed, and consensus has yet to be reached on many of the items discussed in the first meeting. It is anticipated that the focus group will continue to address remaining issues in the coming years.

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REFERENCES

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[2] Meacham, B.J., "Concepts of a Performance-Based System for the United States," prepared for the SFPE Focus Group on Concepts of a Performance-Based System for the United States, SFPE, Boston, MA, February 1996.

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