Performance-Based Regulatory Systems

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The aim of this chapter is to describe what a performance-based regulatory system is and what elements are necessary before a system can be called “performance based.” Variations on how a performance regulatory system can operate are also discussed. As outlined in Chapter 1, such variations typically depend upon issues such as the legal system, culture, and politics. Another relevant issue is how prescriptive codes, existing standards, evaluation reports, and similar items fit into this new approach. Finally, this chapter explores how the ICC, in particular, relates to performance regulatory systems and how that affects code users on a more local and everyday basis.

General

As discussed in Chapter 1, performance-based codes and their associated regulatory systems have been in use in various countries for some time. In some of these countries, a primary motivator for the development of a performance regulatory system was related to a broader objective of regulatory reform. In some cases, for example, the entire prescriptive code had to pass through parliament (equivalent to passing through the House and the Senate) for approval, or there were so many different acts (building, plumbing, etc) that it was nearly impossible to get any work done. In other cases, the ability to undertake an equivalency, as U.S. building codes allow, was not an option. Another major driver was and is trade. Building codes written in performance terms facilitate an understanding of what is trying to be achieved; thus, making it easier for the exchange of goods between national borders and, in the case of the United States, state borders. As detailed in Chapter 1, the situation is fairly unique in the U.S., as there is not a central government agency that develops or promulgates building regulation. Also, the pressures of international trade are somewhat different than for smaller countries. Regardless of the principal factor, these differences change the dynamics of regulatory systems dramatically and especially affect the motivation for a movement towards performance-based regulatory systems.

In the U.S., there has been the ability to undertake performance design through the “alternate materials and methods” provisions of the building and fire codes. These designs are often called “equivalencies,” as the code requires the designer to demonstrate that the design is “equivalent” to the code. Although not strictly true, developing “equivalencies” has in some cases become synonymous
with the term performance-based design. Performance-based design, in general, has become more widely used as computational analysis tools in various areas, such as fire, structural, and mechanical engineering have become more prevalent in a form suitable for the design office. Discussion on various aspects of performance-based engineering can be found in subsequent chapters.

In many respects, the “alternate materials and methods” clause in U.S. building codes results in a hybrid prescriptive-performance system. The main concern with such a hybrid approach, however, is that “equivalency” can be difficult to define, and if the objectives of the code are not well articulated and defined, it can sometimes be difficult to gain agreement on alternative solutions. Performance-based codes and regulatory systems aim to address this issue by clearly defining objectives and by providing a common basis for design and review. Another difference is that performance-based regulatory systems have forced a cradle-to-grave view. More specifically, the long-term performance of a building or structure is now more of an issue, wherein with prescriptive codes the focus tends to be upon initial design and construction of the building.

Building Regulatory Systems

A building regulatory system contains all elements that facilitate the safe design, construction, and operation of buildings to a level that is acceptable to society. The system typically includes enabling legislation, a building code (or building regulation), and an enforcement mechanism. In most cases, the system is supplemented by a wide range of product, test, and installation standards, a products approval framework, an education system, and certification of professionals (see Figure 2.1).

As noted in Chapter 1, many countries draft and promulgate building regulation at a federal level, with others developing regulations within national government agencies, with adoption occurring at a state, territory, provincial, or local government level. Enforcement, a critical piece of a building regulatory system, most often occurs at a local level. In some countries, enforcement can be either by private entities, as well as (or instead of) the government. In other countries, a large amount of responsibility is placed with the building owner and designers for the design, construction, and long-term maintenance. In the United States, the enforcement mechanism is still very much a governmental activity with some assistance in the way of third-party review, third party and special inspections, and peer review. Maintenance responsibility is legally placed upon the building owners with limited inspections occurring from the fire department.
What is a “Performance-Based” Building Regulatory System?

A performance-based building regulatory system is one in which the performance of a building design must be demonstrated to meet code-based objectives using accepted means of verification (e.g., engineering analysis or tests) or deemed to satisfy solutions (i.e., prescriptive solutions). Whereas, in a prescriptive-based regulatory system there is only a single (or fairly limited) set of solutions (e.g., the International Codes®), a performance-based regulatory system does not limit the number of solutions to achieve the code mandated objectives (e.g., the International Codes® are only one acceptable means of demonstrating compliance), but allows “any” solutions that meet the objectives.

As discussed earlier in this chapter, although the International Codes® contain the “alternative materials and methods” provision, which allows other solutions, they are in the form of “equivalencies.” The subtle difference is that a true performance-based regulatory system would not regard solutions as an alternative, but rather, would only require compliance with the objectives of the regulations. In other words, “equivalency” would not be necessary. Comparison against performance criteria, which link to the objectives, would be ideal, since comparison back to the prescriptive documents does not necessarily ensure that objectives are met. There is simply an assumption that they provide a level of performance expected by the public.

In most countries that have adopted performance regulations, as will be discussed later in this chapter, there is still a heavy dependence upon the prescriptive solutions. However, their systems are
structured in such a way that the objectives and related intent statements at the very least drive the structure of the prescriptive provisions.

**Performance System Model**

This section is fairly philosophical in nature but sets the tone and describes elements of a complete performance regulatory system. As noted in Chapter 1, most performance regulatory models are based on the Nordic Committee on Building Regulations (NKB) model. This model is a basic framework to embody the objectives and goals of building regulations along with measurable solutions. Many countries have used that framework to create their own regulations with minor modifications to fit the needs of the country. More recently two international committees CIB (International Council for Research and Innovation in Building and Construction) Task Group 37 and the International Regulatory Collaboration Committee [representatives from regulatory drafting bodies – published a guideline document (IRCC, 1998)] have discussed in detail additional needs for a more functional system in a true performance environment. Generally, the prescriptive codes will always be a viable solution. This model is focusing upon truly performance-oriented solutions. Essentially, a link needs to be made between the qualitative statements and the measurable quantitative elements. As modified the model can be divided into two portions, qualitative and quantitative (Meacham et al., 2002). This is seen in Figure 2.2. The qualitative portion is often where the goals, objectives, functions, and level of performance are described in qualitative terms. This portion of the model sets the structure and focal point for the quantitative portion of the model, although it is recognized that both portions of this model can only function along with the other. The bottom line is that concrete realistic solutions must be available. This model is simply trying to create the infrastructure to make a stronger link between what society expects and what the built environment can provide.
Performance-Based Regulatory Systems

Performance System Model

A key to this model is that such quantitative methods and solutions must be specifically linked to the qualitative portion of the model to complete the system. This is critical, because ultimately, when designing and constructing a building, quantitative, measurable methods and solutions are required. Such methods have been available in the form of prescriptive codes, standards, and design approaches in the past. These approaches have generally been successful, but a key communication tool was missing. Without the qualitative level, society, public policy makers, building owners, and users did not understand the full scope and intent of what a particular design or building regulations provide. The NKB approach used to create the qualitative portion of regulations in many countries has helped but still more information regarding the level of performance is needed. Generally, a lack of understanding of this level has led to negative reactions after natural disasters such as earthquakes (Meacham, 1999). This also makes it difficult to justify new and innovative approaches since it is difficult to determine what is expected. In order for the performance approach to be effective, strong communication tools are necessary which link society, public policy makers, building owners, and users to the technical community. Therefore, the importance of the qualitative portion of the model is stressed. It is hoped that the communication tools will be strengthened and more closely link all stakeholders. Again, the purpose of showing this model was simply to clarify the importance of linking the performance language to possible measurable solutions that truly reflect the
goals and objectives established. More detail related to the model development and surrounding issues can be found within Appendix A.

Effect of the Transition to Performance

Current "alternative methods and materials" sections in prescriptive codes allow for performance design, but this approach does not provide the framework or supporting infrastructure that would come with a performance regulatory system. Under the "alternative methods and materials" approach, the focus will tend to be upon prescriptive solutions, which will not encourage changes to our existing regulatory system, especially in areas such as product accreditation, standards, and education. It should be stressed that a dependence upon prescriptive solutions is natural and very cost effective in many circumstances; however, unless the system is structured differently the tools needed for the future will not be generated. This section will discuss various areas in general and how a transition to a more performance regulatory environment might affect these.

What happens to the current prescriptive codes, standards, design guides and other tools?

The current ICC Codes, including the International Building Code® (IBC®), International Fire Code® (IFC®), International Mechanical Code® (IMC®), and International Residential Code® (IRC®), will remain a necessity in the performance environment. As discussed earlier, these documents will be used as acceptable methods (approved documents) to provide at least one viable solution. Likewise, all of the current standards and design guides would be part of the resources available.

The major difference is that the current documents used for the design, construction, and maintenance of buildings would be part of a spectrum of possible solutions. It is likely that a large percentage of projects will use the prescriptive codes, as it may not be cost beneficial to do otherwise. It is hoped that the formation of a stronger performance oriented system will simply improve the current prescriptive documents. Potentially more solutions will be codified and available for use as innovation increases.

As noted above, every country that has transitioned to a performance regulatory system has utilized their existing documents as at least one viable means of compliance. A shift seen in some of these countries is a reformatting of the prescriptive codes/solutions to fit with the structure of the performance regulations. For instance, all the chapters dealing with fire protection such as interior finishes, fire-resistance and fire protection systems may all be combined under a single package of solutions. In either case, the benefits of providing at least one solution are seen. Having the codes organized through the objectives will make it easier for new solutions to be generated in the future.
One of the ongoing debates in the performance regulations arena is the dependence upon prescriptive solutions (Bergeron et al., 2001, Bergeron, 2002). There are obvious benefits in keeping the prescriptive solutions as a base, but at the same time it often creates too strong of a dependence upon such solutions, making it difficult to truly come up with innovative approaches. This is due primarily to the fact that the current solutions have never been quantified and to a lack of knowledge in areas such as fire protection. Canada has taken the first step in this process by undertaking a bottom-up analysis to better understand what its current codes were regulating. This provided a basis for Canada to then form its objective-based code.

In short, the existing resources such as design guides, standards, test methods, and product accreditations will not disappear. Instead, they will form the basis of a method of compliance. In some countries, these methods of compliance are required as a minimum, and in others they are only provided as a means of compliance when a performance approach is not required. There are currently various design guides that are more performance based, such as that published by SFPE (2000) and documents prepared by Structural Engineers Association of California (SEAOC), Vision 2000, and Federal Emergency Management Agency (FEMA) as discussed in Chapter 6.

Enforcement

There are several components to enforcement, which range from the initial design (conceptual), construction, maintenance, and changes in use or occupancy. Performance regulations, because they are more systems based, will tend to invoke questions; whereas, in a prescriptive code many issues are simply taken for granted. In the prescriptive code, the focus tends to be on up-front design approval and, to a certain extent, construction, but long-term maintenance is generally addressed simply through enforcement of the fire code. There are some exceptions with elements such as elevators. Performance regulations tend to invoke a cradle-to-grave thinking, as the actual performance of a building is better understood and questions related to reliability and durability over the life of the building begin to arise.

Performance regulations have the tendency to look to issues beyond fire when addressing maintenance, by posing questions regarding qualifications, whether the tests typically used for commissioning are in all cases appropriate, and the affect poor construction/installation has on the performance of buildings. These questions can occur with any design but are more likely to be an issue in a larger and more complex design that requires a more technical approach. These issues will be discussed in more detail in Chapter 3 of this book.

A concern with having to look at a building from cradle to grave is a big concern for building and fire departments as they are already working with so little to keep up with current demands.
There are two issues: (1) they have limited resources and (2) issues beyond those traditionally considered will need to be addressed. An example is a seismic base isolation system that requires maintenance. This particular example is one that is currently a concern. Also, when a building or portion of the building is designed under a performance design, very unique features may exist. Such features will have to be specifically documented in a document titled "Operations and Maintenance Manual" (see Chapter 3 of this book) and become almost like a specific code for that building or element of the building. Such an approach is addressed in the *SPFE Engineering Guide of Performance-Based Fire Protection Analysis and Design of Buildings* (2000) and the *Enforcers Guide to Performance-Based Design Review* (ICC and SFPE, 2003). Generally, it is believed that more dependence on the building owner will occur as this emphasis on long-term maintenance increases. With regard to the cradle-to-grave emphasis, Chapter 9 of this book addresses lifecycle issues.

**Education**

One of the critical elements to the successful implementation of performance regulatory systems and ensuring that they work at a high level is the need to appropriately address the educational needs. There are various levels that such education can occur and in various disciplines. These include the university/college level and continuing education level. Within each of these are various levels of certification, registration, and licensing that occur now and could occur in this new environment. Generally, education is always a relevant issue with regard to building regulations, whether or not the regulations are considered performance based. The normal code revisions will generate the need for education. Performance regulations seem to highlight where education about building and fire codes is lacking in general. This may be a positive thing as a new level of awareness and perhaps a new initiative of change will occur. This section will discuss the current state of education in the university/college level and then will review the state of the continuing education systems, including a brief discussion on the current registration and certification infrastructure.

**University/College Level**

At the university/college level the main areas of interest are likely in architectural and engineering programs. Currently, there are very few who address the topic of performance building regulations or who touch upon building regulations at all. The focus is usually on more technical design guides, and often a fairly prescriptive approach to building design and construction is fostered, especially in the area of fire regulations. It is also understood that there is a constant struggle to keep such programs of a manageable size for students to complete in a reasonable amount of time. This is
very true in the area of architecture. Over the years, new areas of knowledge are being added to the curriculum, such as computer aided design (CAD).

Fire engineering programs are very few and far between. There are only a handful of universities that offer such degrees, with only two offering master and doctoral degrees. In areas such as structural engineering, as noted above, the focus is primarily upon technical design standards and not on the building regulations themselves and how those design standards and methods link to regulations.

As noted the focus tends to be upon the architectural and engineering programs, but there are other university and college programs that are relevant to building regulations. For instance, there are various degree programs dealing with public administration, public policy, etc. Fire fighters often receive associate degrees in fire prevention/fire science. The fire prevention programs likely spend the most amount of time addressing regulations but primarily focus upon fire prevention requirements, which are mostly found within prescriptive fire regulations. In other words, performance design review is not a large part of the curriculum.

Continuing Education/ Seminars

Continuing education is the primary avenue where building and fire regulation related education exists. There are a variety of groups who perform such services, including industry and technical associations, the model codes and standard organizations, state and local enforcing agencies, and state and local associations, such as building official organizations. Continuing education is critical to the building regulatory framework and in the short term can prove most effective in understanding, implementing, and using performance regulations. Generally, the only major change is that the course materials provided would need to reflect such codes and approaches. The downfall in this country is that there is not a federal mandate for such education. Responsibility for what education occurs is left to state and local government as well as industry and professional organizations. Therefore, not all those that should attend such programs are able to attend. Primarily, the reason is related to the financial and time commitment. In more recent times, many more education tools are becoming available with various modes of distance learning (online courses, audio virtual seminars, etc).

Qualifications

Qualifications are often measured in the U.S. through the number of registrations or certifications one holds. Often, certain registrations or certifications are required as a baseline for work on various projects. Of course, this spans into all areas of professional practice such as
medicine, finance, and construction. In the construction industry, building safety and use registrations and certifications are normally required by state and local governments. The federal government does not address such issues. Therefore, the requirements tend to vary from state to state. There are also various certification programs, both industry and enforcer related, available and are usually offered by private organizations. These certifications provide an infrastructure that has elevated the level of professionalism in various areas.

This current infrastructure is critical to the success of performance building regulations, as the need for such qualifications will only increase. If addressed, two critical issues will make such programs more beneficial. First, they must be adapted to address issues relevant to performance regulations. Secondly, there is a concern that we have become too focused upon registrations and certifications and have put little emphasis on experience in combination with these qualifications. For instance, having a structural engineering certification does not necessarily mean someone is qualified to conduct a structural performance design. Though if the requirements on the registration and certifications were more properly adapted to performance regulations this concern may lessen. Adapting to performance regulatory systems may mean the creation of new certifications and registrations. In countries such as Australia, performance regulatory systems have essentially created a registration and certification infrastructure where there was not one before. Qualifications are discussed further in Chapter 3.

Evaluation Services/Product Testing and Accreditation

Another extremely important element to any regulatory system in modern times is evaluation services/product testing and accreditation. Such services can come from a variety of organizations including state and local government agencies and not-for-profit organizations (industry, model codes and standards organization, public interest groups, etc). Such services have generally become essential to the design and construction of buildings. More specifically, it has become a mechanism for industry to get a product or system listed to be used within a larger market with little effort. Having such resources such as the UL Fire Directory (2003) make the design and construction process much faster. Essentially, such approval programs grew out of the need to approve a product on a larger scale rather than jurisdiction by jurisdiction and to provide a variety of options to designers and builders.

Currently, ICC has a product and systems approval subsidiary called ICC Evaluation Services Inc. (ICC ES Inc.) and an accreditation service called International Accreditation Service. These entities have existed in various forms for years within the model building code organizations. Other countries have similar services available. It was created under the premise of allowing alternate
means of code compliance on a more global basis. A manufacturer can go to ICC ES and get a product or construction system approved, and such approvals can be accepted by many local jurisdictions (jurisdictions are not obligated to accept but generally do).

In the performance regulatory environment, such services are essential to the success. It creates an infrastructure that reduces the burden on local jurisdictions and essentially creates an avenue for products to be more quickly introduced into the marketplace before being codified. The current structure of such services will likely need to evolve to address products on a broader performance level. This may mean linking compliance more specifically with objectives, functional statements, and performance requirements. It is important to note that since many products evaluated are only minor differentiations from the prescriptive code, the current method of evaluation will likely be needed.

A performance regulatory system may drive the need for the evaluation of overall designs versus simply a product or system. It may also require the generation of new testing standards that more appropriately measure actual performance versus a simple relative ranking of materials. When approaching a design in a performance manner, it is often difficult to compare back to the prescriptive material as the designs become more complex. There has also been discussion that in a performance-regulatory environment general methods of design and computer models should be evaluated and approved under such services. There is some debate and concern as to how this would be accomplished and whether such evaluations would be useful to the approving authorities as methods and models need to be used appropriately to be effective.

**Drivers for a Performance Code**

In many countries, the reason performance codes have been implemented was due to the need for regulatory streamlining. In some cases, there was no method available to allow designs that differed from the prescriptive codes. There were often multiple acts within a country that conflicted with one another. Prescriptive codes generally take longer to review and revise and were severely hampering technology progress and the level of pressure a country had with regard to trade. Performance approaches are thought to make it easier to trade products from one country to another as the objectives of the regulations are more clearly stated, leading to a smoother approval process. Each country has different factors that went into the movement towards performance. International trade is not likely the motivating factor for state and local government. Influence from industry may play into the trade issue. The largest motivating factor is the need to provide a tool to deal with unique and complex designs. Jurisdictions that used to refuse to deal with anything outside the
prescriptive will not have the ability due to political pressures on a local level. More and more are looking to this type of approach to address design, construction, and maintenance issues.

It should be noted that as the United States sees itself as more vulnerable to acts of terrorism and other safety hazards, the prescriptive approach as traditionally developed and adopted might not continue to be the only appropriate approach. Building owners and users will demand more information regarding individual buildings and overall risks.

**Technology Limitations**

It was discussed earlier in this chapter that there is a strong dependence internationally upon the existing prescriptive solutions. This dependence has the tendency to slow the creation of more innovative solutions, as there is a desire to compare back to the prescriptive solution in all cases. This tendency is also heavily related to technology limitations in certain areas. In areas such as fire protection, there is still much to be learned; therefore, there are concerns related to depending solely upon a purely performance approach in this arena. In a true performance regulatory system, new solutions would be compared against performance criteria and not compared back to the prescriptive solutions. Therefore, as technology increases so will the creation of innovative solutions. Of course, this is a bit of a Catch 22 as our current system of prescriptive codes makes it difficult to see the need to invest in research that will increase our knowledge in various technologies such as building fire protection. Performance building regulations have the tendency to create a framework where gaps are more clearly realized.

**Summary**

In summary, the purpose of this chapter was to provide an understanding as to what elements make up a performance regulatory system. Such systems go well beyond the code itself and include enforcement, product approval, standards, and the political and legal environment. As discussed in many areas, the United States is unique from other countries in terms of what is driving the need for performance codes and the associated regulatory system changes. Codes and the related infrastructure is not addressed upon a federal level but is a combination of industry, associations, state and local government, and code users that are responsible for this system. Our current “building regulatory system” could be considered performance based due to the use of the “alternate materials and methods” provision, but many elements of that approach are focused on a prescriptive system. Since the ICC has published the *Performance Code™ for Buildings and Facilities* (ICC PCTM), there is movement in the evolution of our regulatory system, but many elements still need to be addressed to make the process more truly performance based while providing a higher level of confidence in the
design and construction of buildings. More details on elements such as building owner and designer responsibilities and the future of performance-based codes and regulatory systems in the United States will be addressed in later chapters.