PERFORMANCE SYSTEM MODEL – A FRAMEWORK FOR DESCRIBING THE TOTALITY OF BUILDING PERFORMANCE[1]

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Abstract

Although performance-based building regulations are in use or under development in a number of countries worldwide, gaps remain in the overarching regulatory systems of many countries. These gaps include aspects of technology, education, implementation, and enforcement, and in part stem from the lack of a framework or model for interrelating the myriad components of a comprehensive regulatory system. This paper outlines a performance system model for describing the integration of components in a performance-based building regulatory system and for helping to establish a common stakeholder understanding of total building performance.

Keywords: Performance, System Model, Building Performance, Performance-Based Regulations

1. Introduction

Performance-based building regulations have been in place or are being developed in various countries. Although these regulations have been relatively successful, they have not yet reached their full potential. In part, this can be attributed to the fact that the overall regulatory system has not yet been fully addressed, and gaps exist in several key areas. For example, the overall regulatory system includes public policy, education, technology, support (infrastructure) frameworks, and overall system management issues.

This totality of the building regulatory system and the associated issues are what groups such as the Inter-jurisdictional Regulatory Collaboration Committee (IRCC) and International Council for Building Research and Innovation (CIB) TG37, Performance Based Building Regulatory Systems, have been focused upon in recent years. One issue in particular that has motivated a closer look at the overall framework of performance-based regulations is the role of standards, performance criteria and verification methods within the overall regulatory system. What has been found by the IRCC, CIB TG37, and regulators not involved in these groups, is that there appears to be a disconnect between the standards, performance criteria and verification methods referenced by regulations and the qualitative performance or functional objectives found within the regulations. More specifically, standards, performance criteria and verification methods often times have requirements that do not match the objectives of the performance (functional or objective-based) regulations. Also, there continues to be a heavy dependence upon prescriptive solutions as a comparative tool when undertaking performance design. This reliance occurs primarily because it has been difficult to quantify the existing prescriptive methods and there is a lack of technological advancement

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in many areas. Combined with these issues is a liability concern. It was felt that in order to move past this dependence more emphasis on a model which shows clear connections to the performance criteria and verification methods is necessary.

As a result of these concerns, it has become clear that a model that addresses all of these components needs to be developed. It was also realized that this model has the potential to address the full spectrum of building performance issues which go from pure regulatory issues to consumer driven or individual building owner expectations. For example many issues addressed by fire protection engineering are regulatory in nature but there are also many issues that go beyond regulations into the area of client expectations such as the protection of historic artifacts found in a museum or mission continuity. Additionally, it is appropriate for a group that deals with regulatory issues to explore such a broad model because in many cases the goals of regulatory systems tend to evolve over time as societies expectations broaden. For instance, sustainability and accessibility are currently evolving into regulatory issues where they were once an individual building owners preference. Having a system that can address a large spectrum of issues encourages a smoother transition when the scope of regulations is broadened. Conversely, some countries are looking at reducing the issues regulated by the building regulations after a review of society's expectations as to what should be regulated. This shift is related to the fact that prescriptive regulations tend to accumulate provisions in areas such as consumer protection that are generally far beyond the intention of minimum building regulations. It is important to note that regulations are only one piece of the overall concept of building performance.

In addressing this need, CIB TG37, Performance Based Building Regulatory Systems, has established a work programme to formalize such a model. The model has been termed a "Performance System Model (PSM)" and originates from IRCC, specifically through the work of Brian Meacham. Meacham (1999) and the IRCC expanded on the NKB model (Nordic Committee on Building Regulations, NKB, 1976; NKB, 1978) by adding varying risk (performance) levels to the model. This revision has created a more solid link between the qualitative and quantitative portions of the NKB model. The contents of the structure will be described later in the paper. The Task Group has several different tasks, which focus on this model which are to be completed by the 2004 CIB World Congress. For more information please access the TG37 Website. (http://www.icbo.org/Code_Talk/Performance_Codes/CIBTG)

This paper and the discussion on the model focus primarily on performance design methods and solutions versus the more traditional prescriptive approaches. It is recognized that in most cases, especially within the regulatory environment, the existing prescriptive solutions will play a strong role and will continue to play a strong role in the future. More on the discussion of the use of the traditional prescriptive solutions within performance building regulatory systems can be found in a paper by D. Bergeron et al. (2001).

2. Model Description

As noted earlier, the concepts embodied within this model originate from the NKB model, with modifications to reflect the need for more quantitative guidance (Meacham, 1999). One of the key elements of understanding provided by IRCC has been the need to appropriately recognize the relationship between policy issues and technical issues. The technical community needs to understand they are working within a larger system, which must ultimately relate to qualitative goals and functions of buildings. These qualitative goals may or may not be regulatory in nature.

This model can conceptually be divided into 2 portions, qualitative and quantitative (Figure 1). The qualitative portion is often where the goals, 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 should be noted that the qualitative portion of this model recognizes that a performance system is only useful if quantitative methods and solutions are provided. The key to this entire model is that such quantitative methods and solutions must be specifically linked to the qualitative portion of the model to complete the system.

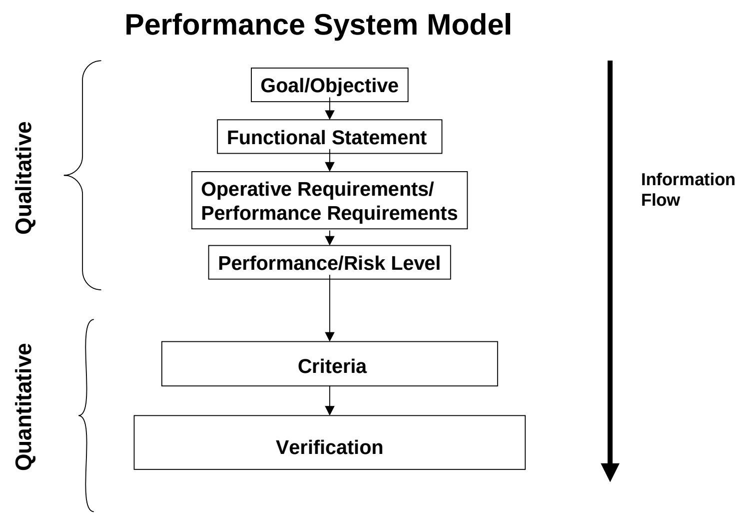

Figure 1. Performance System Model

One should be able to view this model from the top down or the bottom-up. In other words, one should be able to start with a goal statement and be able to ultimately link to a specific quantitative requirement. Inversely, one should be able to look at a specific quantitative requirement and link to a top-level qualitative goal. If such linkages cannot be made then there is a disconnect. Generally, it should be remembered that the top-level policy/user need oriented portion of the model sets the scope for the quantitative portion.

Ultimately, when designing and constructing a building, quantitative, measurable methods and solutions need to be used. 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 and 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, 1999a). 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 and 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.

2.1 Qualitative

2.1.1 General

As noted this is the top level of the performance system model and focuses on more general statements of intent which express the needs of society or consumers. Detailed numerical or specific designs methods and solutions are not provided in this portion of the model since that has the tendency to stifle innovative approaches from occurring.

This portion of the model is critical since it provides a mechanism for policy makers and building owners to communicate their expectations in a method that is more familiar and understandable. Presenting technical performance criteria, such as a critical heat flux or specifying Standard XYZ will not be a successful communication tool. Conversely, a qualitative goal and functional statement must be able to link to a measurable approach to be practical.

2.1.2 Goals/Objectives

This is the top level of the performance model. Goals (also termed objectives), with respect to regulations, are intended to reflect societal expectations of minimum building performance. Goals also can apply to non-regulatory issues such as "efficiency in the workplace." Such issues would be considered individual client expectations but in either case a goal must be drafted to ensure that the solution addresses the building owners needs.

These goals should be the driving force for the entire system. These goals set the stage for the evaluation of what functions the building must provide to accomplish these goals. Also these goals set the scope of issues that are of importance to address when determining to what extent a building shall perform, which will be discussed later in this paper.

2.1.3 Functional Statements

Functional statements answer the question, how does the building need to function in order to meet the demands presented by the goals? The functional statements generally should contain a reference to or link to an appropriate measure of performance. A reference to or a link to an appropriate measure of performance is necessary since the functions of a building ultimately need to be quantified to be constructed. Therefore, it needs to be understood to what degree a building must meet this functional statement.

2.1.4 Operative Requirements (Performance Requirements)

Operative requirements, sometimes called performance requirements, break the functional statements down into more measurable components. For example, an operative requirement would more likely look at fire resistance of a structure versus simply stating a building must withstand fire. These statements will also need to link to a measure of performance to ultimately construct the building.

2.1.5 Performance/Risk Level

This level is one that is not within the NKB structure. This element has been realized, as being essential to qualify to what level a building must address the functional statements and operative requirements to ultimately achieve the goals. Additionally, this level serves as the link between the qualitative goals, functional statements and operative requirements and the quantitative performance criteria and verification methods.

The establishment of a performance/risk level takes into account several characteristics of the building and the approach used in a regulatory system versus an individual building owner's expectations will vary. This portion of the structure will be discussed later in the paper as it pertains to both regulatory and individual client expectations. It should be noted that currently this portion of the model is found within the qualitative section of the model but its location may be debatable. More specifically it may sometimes be a combination of both qualitative and quantitative aspects. This is an issue that must be discussed further. It can be seen within the client expectation portion of the paper that this level is often a combination of both qualitative and quantitative information.

2.2 Quantitative

2.2.1 General

This portion of the model is where the building design occurs. There are two important aspects in the quantitative portion of the model that include the criteria level and the verification level. The performance criteria (or simply criteria) sets the acceptability range and the verification level (assessment or indication of performance) ensure that the design does in fact fall within the acceptability range through various methods of assessment. Standards also play a strong role in the quantitative portion of the PSM in that, in many cases, standards contain verification methods in the form of test standards or design methodologies that enable an assessment against performance criteria.

2.2.2 Criteria

The criteria level, often called Performance criteria, create the measure of pass/fail or range of acceptability for performance design and can also set the baselines for the development of standards. Typically in the past such technical criteria has originated from the technical community with little interaction with the policy makers or understanding of the consumer's needs. Frankly without a performance-based system in place the technical community often has had little choice but to be placed in this role. At the very least, in each project, the designers (technical community) should have as many relevant stakeholders together to discuss the needs of everyone involved to derive performance criteria that is most relevant and appropriate for the situation (Custer and Meacham, 1997; SFPE, 2000).

This model intends to formalize the need to relate the goals of both building regulations and individual building owner's expectations with performance criteria to ensure when a design meets the criteria that the goals have actually been achieved. These criteria as will be seen specifically in the non-regulatory applications refer to such criteria is indicators.

2.2.3 Verification Methods

Verification methods are intended to play the role of verifying that performance has been met. These methods are generally the design tools and measurement techniques. Essentially, a proposed design is taken through the process of verification, on a systems and more detailed level, to ensure that the criteria for acceptance is met. This verification can be through the use of assessment and design methods.

2.2.4 Standards

Standards play the role of providing a consistent approach. Such consistency facilitates trade and also can have the tendency to improve the quality of life as it increase compatibility and improves designs. There are several different kinds of standards, for example there are test standards, procedural standards and standards which focus on detailed specifications of products. Many standards organizations exist on a national and international level. Standards cover a wide spectrum of subjects and in some cases are specifically related to the building regulatory systems.

These standards have the potential to play a strong role in the verification of performance against a set of criteria. The application may be related to an overall methodology or the measurement of a single component. Currently, such standards are not closely linked with the top-level goals of a performance approach since in many cases the top-level goals and objectives have not been available when standards have been developed. More discussion on some of these issues is being pursued by TG37 (Bukowski et al., 2001).

3. Regulatory Use of the Performance System Model

This portion of the paper will explore the relationship of the performance system model to the regulatory portion of building performance. In particular the interaction of the performance criteria and verification levels with the qualitative portion of the model will be discussed.

It should be noted that the discrepancies described above are not new to performance regulations; it is simply more obvious since the intent of the regulations are intended to be clearly stated. The need for clear framework in this area is becoming more and more important with the ever-increasing global market place. Without a structure, standards, performance criteria and verification methods may be used which are not reflective of the different cultures and levels of expectations in building regulations. If levels of performance are implicitly included that cannot be directly linked with the qualitative portion of the regulations, inappropriate levels of performance may be used that are inconsistent to the cultural or climatic conditions of different areas of the world. The portion of the performance regulatory system which is mandatory will vary from one country to another (Beller et al., 2001).

3.1 Qualitative

3.1.1 Performance/Risk Level

In most performance regulations in existence currently, qualitative intent statements are often provided in the form of goals (sometimes called objectives), Functional Statements (functional requirements), and operative requirements (performance requirements). The Performance System Model takes this structure one step further and provides a mechanism to create a more measurable link to the quantitative portion of the model. This level is called the performance or risk level. This portion of the model addresses several components that include the use of a building, the importance, risks, expectations of users and the types of hazards likely to impact the building. This approach allows the user to better understand the different levels of performance desired from one building over another based on the particular factors addressed above and to take that understanding and form quantitative information for design.

The focus, until now, with regard to the concept of performance/risk levels has been upon event oriented risks such as fire, earthquake and hazardous materials releases. It is recognized that there are other regulatory issues with building regulations that are not event oriented and instead are related to everyday use of a building such as slip hazards, plumbing and access to those with disabilities. These issues will likely be areas of discussion in the future as to how they can be dealt with regard to multiple performance levels.

3.2 Quantitative

3.2.1 Performance Criteria

In terms of performance criteria, there is a concern, in some cases, that the criterion chosen for design do not coincide with the goals (objectives) of the regulations. In other words, the criteria do not address the issues that the objectives intend, or perhaps are too high or too low for the regulatory expectations. Due to the lack of direction provided, in many cases, the technical community is placed in the role of determining performance criteria with regard to the intent of the regulations. This decision, however, is a policy decision, and should not be left to the technical community alone.

An example of this problem is found with the limit states that a structural engineer chooses: What if they do not match what society expects? This is not necessarily the fault of the structural engineer, but rather is a function of inadequate communication between the technical community and the policy makers. The Northridge earthquake in California, United States was a perfect example of the mismatch between society and the technical community. As far as the technical community was concerned generally buildings performed as expected and within acceptable ranges. Whereas society was not satisfied that buildings needed extensive repairs or had to be rebuilt completely (Meacham, 1999a).

3.2.2 Verification Methods

Verification methods have shortcomings as well, as in many cases they do not provide data relevant to the objectives. The standard fire resistance test such as ASTM E119, for example, simply provides a relative ranking of fire resistance based upon an unrealistic fire conditions. More specifically, a wall rated one-hour in the standard fire resistance test does not directly correlate to an hour in an actual fire. There are many fire test standards that have similar pass-fail criteria. Such information is not useful for performance design and does not relate to the objectives of the regulations. These discrepancies are primarily related to the lack of framework provided by the regulatory systems and the difficulty in understanding the intent of the existing prescriptive methods. If the regulations do not state what is expected, in terms of performance, it is very difficult to determine which tests and corresponding results will help demonstrate this performance. Also, a large gap exists in the ability to communicate the technical aspects of building regulations to the public policy makers. This gap was not as well understood when adopting prescriptive codes since the public policy makers were implicitly adopting a level of safety. In a performance environment the level of safety becomes more explicit and needs to be specifically addressed.

There are currently hundreds of test methods available in many different subjects some regulatory and some focused on consumer goals. Generally most tests currently are structured in a manner that focuses on a pass/fail criteria that does not relate to real world conditions. Instead they tend to provide a relative ranking system. An example would be a standard that measures the char length of cigarettes in upholstered chairs when exposed to a lit cigarette. The standard is looking at ignitability but only as it relates to one chair to specific ignition scenario. A particular fire exposure is used and the length of char is measured. While it is important to have an idea as to which chair is less ignitable than another such data is of little use to someone conducting a fire protection analysis of a building.

It should be noted that over time a demand for tests that provide more relative information for design has grown. This is likely due to the fact that engineers are trying to conduct performance design and are finding little in the way of resources. Also, this may be related to failures experienced in buildings, which generally complied with the building regulations. For example some newer fire tests have focused upon actual heat release measurements or other more relevant measures of performance.

3.2.3 Standards

Standards generally support verification methods by providing testing standards and methodologies to demonstrate compliance with performance criteria. In some cases, standards exist that may exceed the minimum levels of the regulations. For instance, a manufacturing association may have a standard for a particular building component. This standard provides many specific requirements that are related to the demands of the consumer in addition to the requirements related to the regulatory minimums. This standard is therefore inconsistent with the minimum regulatory requirements.

Standards are generally not adopted directly by the building regulations but instead mandatory references to the standard are made within the regulations. Therefore they become the law indirectly and should, in theory, be held to the same due diligence as the regulations themselves. These standards and verification methods at present are designed to work primarily within a prescriptive system where the standards, generally, are not written in such a way which identifies what they are ultimately trying to achieve. Until the more recent trend towards performance regulations and design internationally there have not been the specific goals in which to link to. Therefore, like the prescriptive codes and other design solutions it is often difficult to determine the performance level provided by the standards. As noted earlier in this paper this level it is sometimes higher or lower than what the regulations that reference such standards require.

This gets more complicated when standards developed internationally are applied to cultures that are very different from those involved in drafting the standard. Standards and regulations, especially when drafted in a prescriptive manner, have the tendency to force certain types of construction methods, such as wood frame construction or concrete construction due to the fact that many standards are based upon construction practices in specific locations. These prescriptive standards tend to create a standard of practice to the exclusion of other types of construction found in other countries that have not been heavily involved in the standard writing process. An example of such construction may be bamboo or perhaps rammed earth. It should be noted that there is a movement internationally to address these other building methods in various countries including but not limited to New Zealand, United Kingdom and the United States. Also, different countries and cultures regulate different issues. A standard, which heavily addresses property protection, would be inappropriate to be referenced in a country where building regulations are not intended to address property protection.

Standards which set out certain test methods to verify compliance such as the fire resistance test or perhaps a strength test are not necessarily reflective of real world conditions and the data generated during such tests is generally not the type of data needed for an engineering analysis.

This model is proposing that future standards must be more closely linked into the objectives of regulations in order to more closely understand what the standard is addressing and to fit more closely with the regulations. Essentially, standards need to be more straightforward in there contents as to what the standard addresses. This does not necessarily mean that standards need to be written in performance language. It may simply mean that the provisions need to be sufficiently justified in there contents. In order to assist in the more appropriately linked standards performance criteria needs to be developed in order to form a basis as to which standards can be written.

4. Non-Regulatory Use of the Performance System Model

4.1 Roots of the Performance Concept

The performance concept in building, as used by client organizations outside the regulatory system, has roots before World War II in Canada, the United States, and overseas. In the United States in the 1950s and 1960s, the Public Buildings Service (PBS) of the General Services Administration (GSA) funded the National Institute of Standards and Technology (NIST, then the National Bureau of Standards) to develop a performance approach for the procurement of government offices, resulting in the so-called Peach Book publication (NBS, 1971).

Starting in the early 1980s, the performance concept was applied to facilities for office work and other functions by the American Society for Testing and Materials (ASTM) Subcommittee E06.25 on Whole Buildings and Facilities. Worldwide, in 1970, the International Council for Building Research Studies and Documentation (commonly known as CIB) set up Working Commission W060 on the Performance Concept in Building. In 1982, the coordinator for that commission defined the concept in those terms: "The performance approach is, first and foremost, the practice of thinking and working in terms on ends rather than means. It is concerned with what a building is required to do, and not with prescribing how it is to be constructed" (Gibson, 1982). CIB W060 complements the work of TG37. In 1998, the CIB launched a proactive program for the period 1998-2001 focused on two themes: the performance-based building (PBB) approach, and its impact on standards, codes and regulations, and sustainable construction and development.

Why use the Performance Concept for non-regulatory purposes? For the some of the same reasons that are driving the changes in building regulations: increased flexibility, reduction in the barriers to innovation, greater ability to integrate processes, delivery, services and products, overall cost reductions, and added range of suppliers.

4.2 How Does the Non-Regulatory Use Fit In?

The Performance System Model applies also to non-regulatory uses (Figure 2). In their "Statement of Requirements (SOR)", clients need to state their objectives and goals in broad terms. These can then be broken into "aspects", "topics" and "functional elements", expressed as Functional Statements that are more and more precise (granularity).

The difference between the regulatory and non-regulatory parts of the Performance System Model is that one is mandated by codes and regulations that have the force of law, whereas those other functional requirements, that are included in Statements of Requirements and defined by a client for a project, are part of what the client requires and is willing to pay for. Functional requirements mandated by Codes and Regulations are included in the Statement of Requirement for a project, at a level of performance either explicitly or implicitly at least equal to the level mandated by the code.

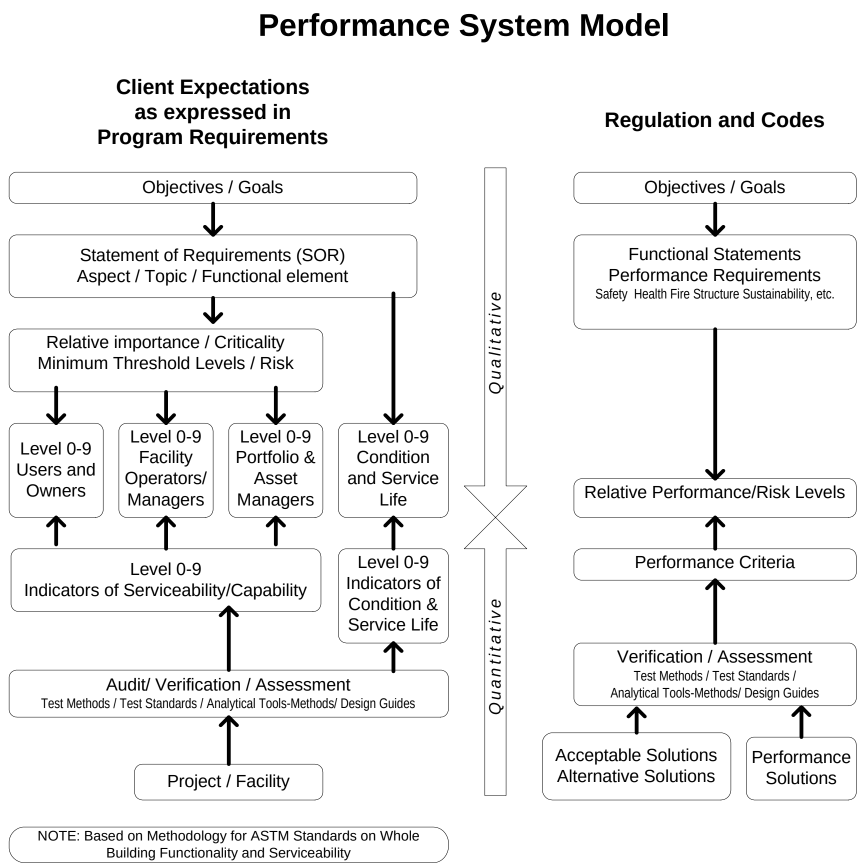

Figure 2. Regulatory and Non-Regulatory Use of the Performance System Model.

Bergeron (2002) notes that "Tools will need to be developed for the purpose of determining the implicit expectation of performance of the acceptable solutions and to transcribe it into quantitative and measurable performance criteria." In the non-regulatory world, "Design Guides" play a role similar to "acceptable solutions." "Prescriptive Request For Proposals", "Bid" documents which include design concept and specifications, "Solicitations for Offers" are also part of the traditional prescriptive system. Appropriate tools such as the ASTM Standards described below have been used to assess the implicit level of performance of such documents. A similar approach might be usefully applied to assess the implicit performance levels of acceptable solutions.

5. ASTM Standards for Whole Building Functionality and Serviceability

The ASTM standard scales (ASTM 2000) provide a broad-brush methodology, appropriate for strategic, overall decision-making. The scales deal with both occupant requirements (*demand*) and serviceability of buildings and facilities (*supply*). They can be used at any time, not just at the start of a project. In particular, they can be used as part of portfolio management to provide a unit of information for the asset management plan, on the one hand, and for the roll-up of requirements of the business unit, on the other.

The ASTM standard scales include two matched, multiple-choice questionnaires and levels. One questionnaire is used for setting workplace requirements for functionality and quality. It describes customer needs—*demand*—in everyday language, as the core of front-end planning. The other, matching questionnaire is used for assessing the capability of a building to meet those levels of need, which is its serviceability (range of performance over time). It rates facilities—*supply*—in performance language as a first step toward an outline performance specification. Both cover more than 100 topics and 340 building features, each with levels of service calibrated from 0 to 9 (less to more). These standard scales are particularly suitable to set the requirements as part of the front end for a design-build project, to compare several facilities on offer to buy or lease, or to verify if requirements have been met during the contracting process, design reviews and commissioning. The scales can also be used to compare the relative requirements of different groups.

This set of tools was designed to bridge between "functional programs" written in user language and "outline specifications and evaluations" written in technical performance language. Although it is a standardized approach, it can easily be adapted and tailored to reflect the particular needs of a specific organization or the particular features of a specific facility. For organizations with many facilities that house similar types of functions, the functionality and serviceability scales capture a systematic and consistent record of the institutional memory of the organization. Their use speeds up the functional programming process and provides comprehensive, systematic, objective ratings in a short time.

5.1 Benchmarking and comparisons

The ASTM standards include two sets of scales in recognition of the need for comparison between what is required and what is provided, and to allow for the audit and verification that what is provided to the client in fact meets the stated requirements. Such scales include "statements of functional requirements" in order to make explicit these so-called "non-measurable" requirements. In order to measure the levels of serviceability, "indicators of capability" are included in the second set of scales, and matched to the levels of functionality.

The scales include 9 levels from LEAST to MOST (0-9), or Hazardous to NEW (0-9), because, as is pointed out by Bergeron (2002), functional requirements are not "absolute, and differ from one situation to the other. Equivalent levels between the stated requirements and the solution provided, or the indicators of performance, is one of the hallmarks of the ASTM standards. These levels can be graphed as bar charts and used to create a "Requirement Profile" or a "Rating Profile". Profiles can be compared to each other. Facilities can be compared to each other. They can be compared to "generic" profiles of requirements (Figure 3).

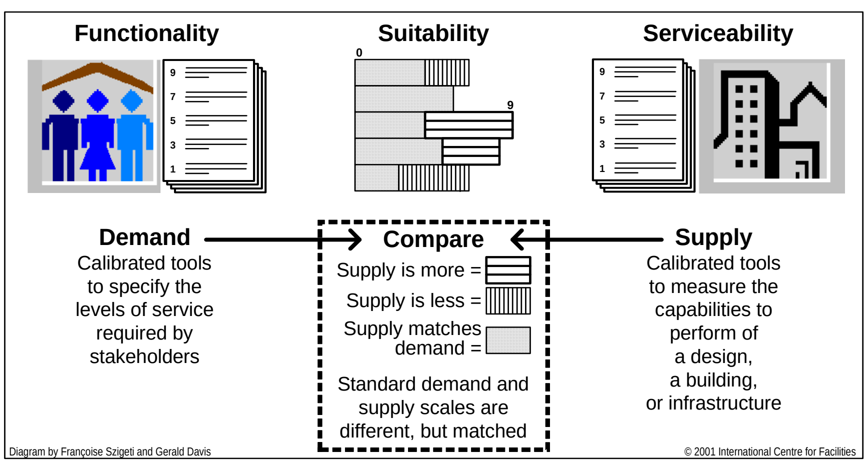

Figure 3. ASTM Profile Development.

5.2 Trade-offs

Different situations can have a different "profile of requirements" for the same occupancy category. If a requirement cannot be met by a design or existing facility, the profile of requirement includes "threshold" and relative importance/criticality, so that trade-offs can be proposed, analyzed and costed, as a basis for informed decisions. This is particularly important when dealing with historic structures which cannot be brought up to code without destroying their unique qualities (ICC, 2000). It is also useful when there is a need for budget adjustment and during value engineering reviews.

The methodology used to create the ASTM scales is currently being balloted in ISO under the authority of Technical Committee 59 / SC3. A new WG14 has been established within SC3 to further develop related standards. For further information about this methodology, readers can refer to the papers and documents listed (Ang, 2001).

In the broadest sense, performance-based analysis and design is a process of engineering a solution to meet specific levels of performance, where performance may be stated in terms of qualitative or methods, resulting in a design that best fits all parameters – a performance-based design solution.

6. Conclusions

This model is the next step forward in the evolution in the performance of buildings. The Performance System Model (PSM) is now officially introduced. This model is the result of a combination of the NKB model with a risk/performance levels by Meacham and the IRCC. It is hoped that this introduction will lead to a better communication tool to those involved with both performance based building regulations but also with performance based design in general. Also, this model clearly points out a problem with general references of criteria, verification methods and associated standards from one regulatory system to another and from one project to another. It is hoped that this model and an explanation of these discrepancies will provide direction for standard development in the future

Additionally looking at the full spectrum of performance from the basic regulatory minimums to the area of client of expectations shows how performance regulations are simply one aspect and the applicability of the model to all areas of design. This understanding should provide more insight to disciplines such as structural engineering and fire protection engineering related to regulatory minimums. Such design disciplines in many ways have had the primary focus on regulatory minimums for compliance without a greater understanding of the overall level of performance and how such design should look deeper than minimum compliance.

In exploring both the regulatory and non-regulatory issues different approaches were presented. In the regulatory environment there is a push to compare directly to technical performance criteria to show that the goals/objectives are met. Whereas in the non-regulatory arena, the use of scales to indicate the serviceability (performance over time) are used. The scales are a relative measure of performance where the technical performance criteria tend to provide a more specific independent indication of performance.

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