Performance Based Building Regulations

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Abstract

The Building Regulations Domain of the Performance Based Building Network has collected relevant information about progress and difficulties in implementing performance regulations in participating countries. This paper discusses the experiences of the various countries as an amalgam. It then presents the leading research priorities in this field as they emerged from the domain discussions.

Keywords: performance based building, construction regulation, code enforcement.

1. Background

Domain 7 of the Performance Based Building Network has promoted international discussion and exchange of ideas and experience regarding the development, implementation, enforcement and support of performance based regulatory systems.

Building regulations typically seek to ensure the health, safety and well being of people in buildings. Toward this purpose they set minimum design and construction requirements. Building regulations may also promote other objectives, such as energy efficiency, serviceability, quality or value and facilitating the built environment to persons with disabilities.

Historically, building regulations were based on a prescriptive approach which severely limited the available solutions for compliance. Creativity and innovation were stymied or slowed as efforts were undertaken to adapt to or change the prescriptive regulations. These regulations also served to restrict and inhibit international trade.

Performance based regulations are predicated on the intended outcome and seek to encourage a variety of solutions for compliance. This promotes diversity and innovation in an industry that has traditionally been conservative. The performance approach also facilitates international trade. This applies to building products, processes and methodologies in the building design professions.
2. Objectives

Domain 7 of the Performance Based Building Network has collected relevant information about progress in implementing performance regulations in the participating countries. While discussion in the various domains tends to provide a favorable picture regarding performance based building, it may be a case of preaching to the convinced. The status reports in Domain 7 reflect an uneven picture of successes and frustrations in attempts to change the regulatory framework in the participating countries. While almost all of the countries are moving in the direction of performance regulations, most do not yet have a complete or fully integrated performance based regulatory system. In the absence of such a system, it is difficult, if not impossible, to implement fully the various aspects of performance based building.

The first objective of the paper is to provide a summary of those experiences. It includes:

1. Description of the regulatory system.
2. Scope of the regulations.
3. Enforcement and compliance.
4. Satisfaction level of the various practitioners.
5. What is perceived to be lacking or in need of enhancement (eg. gaps and barriers).

The second objective of the paper is to present research priorities as they emerged from the Domain discussions. Obviously there is a strong link to the gaps and barriers discussion of the status report surveys. However, in order for a subject to emerge as a research priority it had to result from the experience and needs of at least several countries.

The leading research priorities were as follows:

1. Verification methods to demonstrate that the required performance was achieved.
2. Risk informed regulations.
3. Methods for addressing acceptable or desirable levels of performance in existing buildings.
4. Creating a systems approach to performance requirements with quantifiable levels of performance.
5. Methods for evaluating the economic impact or feasibility.
6. Development of certification models and other means of approving designs and products.

3. Participation

Task members of the building regulation Domain hailed from the following countries: Belgium, Denmark, Greece, Hungary, Ireland, Israel, Lithuania, Netherlands, Poland, Slovakia and United Kingdom.
In addition, guests or observers from Australia, Canada, New Zealand and the United States participated in one or more of the Domain meetings. The participation and contribution of Australia was particularly significant as Australia operates a parallel network to the European Performance Based Building Network and several members were present at the various domain meetings.

Furthermore representatives from Australia discussed the findings of a productivity commission authorized by the Australian government to examine the contribution that reform of building regulation has made to the construction industry and to economic efficiency in that country. The Australian experience was particularly important as they have been pioneers in performance-based regulation.

Meetings, task members and guest represented a variety of organizations, academia, industry and government. They brought with them a range of professional backgrounds: architecture, code enforcement, engineering, legal, research and public administration.

4. Context

The Performance Based Building Domain is part of a thematic network funded under the European Commission's 5th Framework – Competitive and Sustainable Growth. The program commenced in October 2001 and runs until September 2005. It involves networking various European and international stakeholders to promote performance-based building, research and implementation.

Performance based building regulations need to be viewed within the larger general discussion of performance-based building. The concept put forth by the thematic network is that thinking about building and construction should be oriented to ends rather than means. "The basis of all building activity should be the performance of the building in use rather than the prescription of how the building is to be constructed". The other scientific domains of the network are life performance of construction materials and components, indoor environment, design of buildings, legal and procurement, innovation.

It should also be noted that there have been other international and regional cooperative efforts aimed at promoting performance based regulations. The most prominent of these is the Inter-jurisdictional Regulatory Collaboration Committee (IRCC). Furthermore, CIB has been active in this realm and sponsored a Task Group known as TG 37 which presented several papers at the CIB World Building Congress in Wellington, New Zealand in April 2001. This Task Group issued its final report in December 2004.
5. Scope of the Regulations

There are however distinctions between regulations and other aspects of performance based building. Performance based building is an encompassing approach related to the design, operation and maintenance of a building during its entire life cycle; essentially its general performance. The purpose of regulations is far more limited. Regulations seek to establish minimum standards of compliance. The generally stated purpose of most building codes is to ensure public safety, health and welfare insofar as they are affected by building construction. They typically regulate structural strength, adequate means of egress facilities, sanitary equipment, light and ventilation, and fire safety.

Just what else they regulate may vary in different jurisdictions. There is often confusion around consumer driven requirements that may or may not be authorized in the enabling legislation for a building code. In recent years the purview of many building codes has broadened, to include issues such as energy conservation and the needs of special population groups, particularly persons with disabilities. The extent to which, building regulations protect property or limit its potential damage is also a fuzzy issue. Their purpose is first and foremost life safety.

6. Description of the Regulatory Systems

As noted, all of the participating countries have some level of involvement with performance based building regulations. Obviously, there is a level of self selection as participation in the building regulatory domain was voluntary.

Members decided to undertake two surveys of the participating countries, both in order to understand the subtleties and differences between the regulatory systems, and to gauge and compare progress in implementing performance based regulations. The first survey was undertaken early in the network and domain activities, the second approximately four years later towards the conclusion of the project. The first survey had a limited response and the second is yet incomplete. An effort will be made to complete the survey and present its results at the CIB Congress in Helsinki in June and in the final report of the domain.

Nevertheless, various trends, conclusions and insights can be drawn from the incomplete survey results which are supplemented by country reports and discussions at the domain meetings.

6.1 An International Performance Based Building Code

Discussion was undertaken as to the possibility of a common shared international or pan-European performance based building code. The idea was resoundingly rejected for the foreseeable future.
Discussants noted the widely variable social, political, economic, administrative and legal contexts among different countries that make a common code impractical. Certainly there are also differences related to climatic conditions, building materials and building traditions. However, the intensity of the negative response may indicate additional underlying, less transparent, factors such as national, regional or even local pride and concerns about a loss of autonomy. All of this is not to say that the domain members did not see a broad basis for international cooperation. In fact there was full consensus on the benefits of cooperation and the opportunity to learn from the experience of other countries.

6.2 Prototypes for Performance Based Building Code Development

The Domain developed three prototypes for performance- based building code development that are described in the flow chart and survey form that follow. They constitute the second survey. Essentially for purposes of simplification and comparison, the pathways for performance based building code development were channeled into three prototypes that were designated cases A, B and C.

A represents those countries with the political will, the economic resources and the technical capacity to develop their own national model code.

B represents those countries at the opposite end of the spectrum in terms of very limited resources, internal technical capabilities, and perhaps lesser commitment to performance based regulations. These countries are generally prepared to phase in various performance based building requirements into an existing regulatory system at a gradual and graduated pace.

C represents those countries that are prepared to revamp their building regulatory system to one that is performance based but from existing work carried out in other countries that can be adopted with minor adaptations or alterations.

All of the cases A, B and C involve some simplification and generalization and make various assumptions that obviously vary in the extent of their accuracy in the different countries. Probably the most important assumption is that in all the cases key stakeholders in the building regulatory process have been engaged performance based regulations and are supportive. The point is that changing a building regulatory system requires a broad base of support. It cannot be imposed top down as it will encounter resistance in the field. Neither will it evolve bottom up, as the field levels are unlikely to invest the time and resources or enlist the political clout to effectuate the change.

6.3 Country Updates

This section is based on reports at the domain meeting in Porto, Portugal in November 2004. Its content will be supplemented when the results of the second survey become available.
Belgium has a building regulatory system that is partially performance based. Local authorities continue to use prescriptive requirements. Performance based regulations are viewed as a means and not an end. Representatives see a combined system of prescriptive and performance based regulations evolving over time.

Hungary’s building regulatory system is primarily prescriptive. There is an energy survey requirement in place. That is performance based but not widely used. Representatives see a trend toward withdrawal from mandatory requirements.
Israel currently has primarily prescriptive requirements. However a government commission appointed after a social hall collapse recommended a substantial overhaul of the regulatory system including a comprehensive performance based code, and a process for evaluating new building technologies. Preparation of the performance based code is well underway. Fire safety requirements will remain mostly prescriptive.

The Netherlands also has a mixed building regulatory system that has been evolving over the past decade.

Poland has mandatory norms and standards, some prescriptive and others performance based that now constitute a building code of approximately 70 pages. Ordinances increase from year to year and the code grows.

Slovakia has a performance based code for the energy performance of building and is focusing regulatory efforts on CPD implementation.

The United Kingdom has an regulatory system based on 15 "approved documents" that are essentially performance based. "Deemed to satisfy" provisions are prescriptive but allow for equivalents. Experience shows private enforcers have resisted and complicated the use of performance based documents.

Figure 1: Possible performance based building code development prototypes for different countries
6.4 Reform of Building Regulation in Australia

In 1994 the Australian government established the Australian Building Code Board that vigorously pursued a performance based code. While the Board had no regulatory powers in and of itself, the code was adopted and used by the states and territories. This past year, 2004, the government of Australia undertook an extensive examination of the contribution of building regulation reform to economic efficiency and the construction industry.

The report found that the reform was successful in encouraging skill acquisition, reducing costs and encouraging and enabling innovation. It constitutes a strong endorsement of performance based building requirements.

However the report found that regulatory reform is far from complete. The report recommended:
1. further reducing, jurisdictional variations and reducing the, erosion of the codes uniform application by local planning decisions.
2. better articulation of the performance based requirements.
3. seeking ways to enhance local administration and enforcements.
4. reexamining the approach to property protection from fire.
5. better incorporating environmental requirements in the code.

As described in a PeBBu news article from February 2005 the report further found that:

The majority of the performance: requirements contained in the Code do not provide readily measurable outcomes nor specify verification methods. The standards are more accurately described as "principle" based, specifying broad, but not measurable, targets or objectives for building. For instance, for structural provisions, the Code does not specify precisely the loads that must be withstood by any building (such as wide-speed loads or dead loads)--rather it requires that the building must withstand "actions to which it may reasonably be subjected". This means it is not possible to judge whether objectives have been met and gives little guidance to building practitioners.

The report advocated resolving this issue and several other weaknesses in performance aspects of the code as part of the future work program. Overall the examination endorsed the performance based approach as "having the capacity to deliver significant benefits to the building industry and consumers".

7. Enforcement and Compliance

Enforcement and compliance are essential to the efficacy of any building regulatory system be it prescriptive or performance based. Generally, enforcement and compliance are based on the requirement for a building permit for any construction activity. It is the request for a permit, from the
authority having jurisdiction, usually the municipality. That sets the system in motion. Plans are submitted usually as part of the permit request. Plans are reviewed and approved before a permit is issued. This is most often where the public and various building practitioners interact with the regulatory officials regarding the code and its requirements.

Once a permit is issued and construction begins there are likely periodic inspections in the course of the work. Once completed the construction is again inspected for full compliance of the work with the code before a certificate of occupancy or completion is issued. If work is not in accord with the code it must be corrected or done again. There are of course numerous possible variations on the process, but these are its essentials for almost all building work. Without a system of enforcement and compliance. The code is of little or no significance. Having said that, there are never the less wide differences in the extent and degree of enforcement in different countries and in some instances in different areas of the same country. In remote, rural and agricultural regions and areas where people tend to build themselves rather than employ an architect, engineer and building contractor, municipalities are less likely to have effective code enforcement and compliance. Even in these areas public buildings, schools, large commercial buildings and factories are more likely to employ building professionals and will try to conform with some level of code compliance even if there is no enforcement system.

Other significant differences in enforcement and compliance revolve around the type or extent of work that is enforced. Wherever there is any enforcement it addresses first and foremost new construction. Here too there is the greatest relevance to the type of code requirements. The building regulation system likely also addresses additions, alterations and repairs to existing buildings. Generally maintenance work is not regulated but any other work involving change to exterior facades structural alterations or change to the electrical, plumbing, mechanical or fire protection systems of the building is likely to be officially regulated. The way in which minor work is defined and the extent to which it is regulated varies widely. Occasionally a functional distinction is whether the work is carried out by the owner/occupant or a building professional. Electricians, plumbers and heating ventilation and air conditioning contractors in places where these occupations are licensed are more likely to comply with permit requirement even though it is the owner occupants who are more in need of the supervision of their work and its code compliance.

Historic buildings are likely to be exempted from compliance with portions of the building code. Performance based regulations are more likely to provide the flexibility that will enable compliance.

8. Satisfaction Level of the Various Practitioners

The issue of performance based versus prescriptive regulations pertains primarily to architects and engineers and to a lesser extent to building contractors. It also pertains more to large, unusual and sophisticated buildings than to residential, low rise, standardized building and construction.
Manufacturers of building materials and products are also relevant clients of the performance based code.

The satisfaction level of these practitioners with performance based regulations tends to vary. All desire fast building review approvals. The extent to which they themselves and the local regulatory officials are familiar and comfortable with the performance aspects of the codes is a function of time and willingness to learn and innovate.

In general there will be a segment of the building community that is resistant to change and will constantly pose the question:

"What do they really want?" Accordingly it is helpful that a new, performance based requirement be accompanied by deemed to satisfy provisions that are also prescriptive.

9. Gaps and Barriers

Given that the introduction of performance based regulations is often a gradual process, the new regulations may not address what some building professionals regard as the most important issues or those that most interest them. Similarly when they are partial or fragmented they cannot comprehensively address all code requirement issues. There may be a need to merge performance requirements with prescriptive ones for various building systems or materials. Performance requirements by their nature often require greater effort by the practitioner to demonstrate compliance. In addition because they are new the performance requirements are less familiar and have not yet stood the tests of time and use by the various building professionals. Most of all it is difficult to verify compliance with performance based regulations. This last issue will be discussed more extensively in another section.

10. Leading Research Priorities

Each of the performance based building network domains was requested to recommend research priorities in their field. For the building regulations domain this proved not to be a difficult task. The experience of the various countries at various stages and with different degrees of success in implementing performance based regulations provided a convenient platform for the discussion of research priorities.

There was wide agreement on the importance and benefits of network and the potential for sharing the results of research in a number of areas. The subjects that emerged as research priorities were agreed upon based on the needs and wants of at least several of the participating countries:
These were as follows:

1. Verification methods to demonstrate that the required performance was achieved.
2. Risk-informed regulations.
3. Methods for addressing acceptable or desirable levels of performance in existing buildings.
4. Creating a systems approach to performance requirements with quantifiable levels of performance.
5. Methods for evaluating the economic impact or feasibility.
6. Development of certification models and other means of approving designs and products.

10.1 Verification Methods

The leading research priorities are heavily weighted toward verification. In order to verify compliance we need to be able to measure performance.

In this list of research priorities verification repeats itself with different, emphasis in four of the six priorities. Only risk informed regulations and methods for addressing performance in existing buildings address the objectives part of performance. Verification methods reflect a level of involvement and understanding of the performance approach that go beyond the declaratory stages about the advantages of the performance approach. Performance requirements, as noted, are usually stated as objectives. Objectives are generally qualitative.

However enforcement and compliance obligate verification that is quantitative. Herein perhaps lies the Achilles heel of performance based regulations; i.e. the difficulty in evaluating and ascertaining compliance. Qualitative matters, by their nature involve a large degree of subjectivity. Requirements as stated in building regulations can not tolerate fuzziness or lack of clarity. Ultimately the code official or building inspector needs to be able to make compliance determinations that are clear cut, consistent and defensible under administrative review and legal challenge.

Quantitative requirement can be matched to qualitative objectives of performance based building regulation but it is difficult if the advantages of the performance approach are not to be lost in the process. Key performance indicators are a promising approach that may be able to bridge the gap. They need to provide simple yet coherent criteria that set the acceptable level or range of performance in ways that can be verified by tools at the disposal of the regulatory community. Generally key performance indicators involve benchmarking a given situation so that targeted performance can be assessed and compliance determined.

While technical performance criteria and verification methods have been proposed in a number performance based regulatory areas, particularly energy conservation, domain members
demonstrated their keen interest in the expansion of verification methods as research priorities, the results of which can be shared internationally.

This is a significant challenge that will impact the future success of the approach.

11. Conclusions

Performance Based building regulations have broad support in the international arena. Different countries are proceeding according to separate prototypes and at varying paces in incorporating performance based regulations into their building codes. Most are not doctrinaire in their approach and are prepared to mix performance based regulations with prescriptive ones according to their understanding and experience as to which will best serve them.

While the idea of an international performance based building code was resoundingly rejected, there was full agreement regarding the advantages of international cooperation and shared research. The strongest future research priorities revolved around verification methods that provide quantitative indicators for qualitative objectives. International cooperation should continue and these and other research priorities should be aggressively pursued.

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