PERFORMANCE BASED BUILDING REGULATIONS

PeBBu Domain 7 Final Report
Building Regulations
PeBBu Domain 7

Final Domain Report

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Performance Based Building Network (PeBBu) is a thematic network funded under the European Commission’s (EU) 5th framework – Competitive and Sustainable Growth and has been operational from October 2001 till September 2005. This project has been managed by CIBdf, The Netherlands. The PeBBu Network has been facilitating in enhancing the existing performance based building research and activities by networking with the main European stakeholders and other international stakeholders. The network has also been producing synergistic results for dissemination and adaptation of performance based building and construction. More than 70 organisations worldwide have been participating in the PeBBu Network.

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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."

Domain 7 dealt with a critical aspect of the building sector, which is key to making many performance concepts in buildings a reality. Regulations are typically considered a barrier to performance, innovation and trade. Members of the domain were committed to the proposition that by providing regulations that are focused on the outcome instead of prescribing a set of solutions, potential barriers to trade will be reduced and innovation will increase. This particular Domain was able to examine how the regulatory systems are working in both countries that have implemented performance regulations and those that have not. By sharing these experiences through information gathering such as surveys, countries can learn from both the successes and failures. For example, the surveys and also background information from CIBTG37 have shown that in countries that have shifted their regulations to performance there has still been a significant dependence upon traditional solutions. This dependence is related to comfort with current methods, liability and simply lack of technology in certain areas. Accordingly, the need for international cooperation is quite significant. Additionally sharing information across borders also assists in determining the critical areas in need of research whether policy or technical in nature.

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.

Multiple changes in the leadership of the domain created problems of continuity and communication, which adversely impacted the capacity to adequately summarize and express all of the activities and all of the points of view expressed in the various domain discussions.

I wish to thank all the domain participants, members as well as replacements, guests and observers who contributed to the success of the task and especially those who stayed in touch between the workshop meetings, answered the surveys and commented on the material.

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EXECUTIVE SUMMARY

1. Background

Domain 7 of the Performance Based Building Network has promoted international discussion regarding performance based regulations.

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

The first objective of this summary is to provide a synopsis 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 (e.g. gaps and barriers).

The second objective is to present research priorities as they emerged from the Domain discussions. 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. 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.

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

4. 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.

The leading research priorities are heavily weighted toward verification. "Verification methods" are a theme that repeats itself in discussion of performance based regulations.

In order to verify compliance we need to be able to measure performance.

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.

5. 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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Introduction; Scope & Objectives

CHAPTER 1
1 INTRODUCTION, SCOPE & OBJECTIVES

1.1 Introduction

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 ran until September 2005. It involved 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.

1.2 Scope

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.

1.3 Objectives

The regulations domain met for four workshop meetings in the course of the project. These took place in Brussels, Budapest, Manchester and Porto. A final report paper was presented at the international CIB Symposium "Combining Forces" in Helsinki in June 2005.

Domain 7 of the Performance Based Building Network 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 this report 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 (e.g., gaps and barriers).

The second objective of the report 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.
Background Information: Performance Based Building Regulations

CHAPTER 2
2 BACKGROUND INFORMATION: PERFORMANCE BASED BUILDING REGULATIONS

2.1 The State Of The Art

2.1.1 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. Both surveys had a limited response but they, nevertheless, identify various trends, conclusions and insights, which were supplemented by country reports and discussions at the domain meetings.

2.1.2 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.

2.1.3 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 channelled 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.

2.1.4 Survey Performance Based Building - Regulations

1. Preliminary Details:
   1.1 Country Name: _____________________________
   1.2 Other reference for building code:______________________
   1.3 Last published edition (year): _________________________
   1.4 Report submitted by: _____________ (name and e-mail)____________
   1.5 Job title/Affiliation: _________________________________________

2. Background/Contextual Information:
   2.1 Brief description of code context in terms of development implementation. (please attach a separate diagram as per the draft flow chart).
   2.2 Brief description of social, political and legal context as related to above diagram (2.1).
   2.3 Information regarding relevant administrative framework (who is doing what).
   2.4 Information regarding future directions (adoptions, revisions, changes).

3. Key Terms and Definitions
   (please include only keywords used in this from that need clarification` i.e. this is not for terms in the code itself).

4. Code Structure and Contents
   4.1 Structure of the code (diagram and/or tables).
   4.2 Contents (outline as in table of contents, but with a short description of the main heading` e.g. 1-3 sentences).
   4.3 Other technical notes.


6. Contacts and References
   6.1 Contacts persons for further information and explanations.
   6.2 Web sites for relevant information.
   6.3 Other printed information that is available.
Prototype Flow Chart: Possible Performance Based Building Code - Development Prototypes for Different Countries

Start

Context:
Setting and analysis, (social, political and legal structure and background).

Case
A  B  C

Revision of whole model to fit national context and system
National introduction and Alignment

Model performance based bldg. Code

Review
Refinements
Amendments

Selected clauses for inclusion to exiting bldg. code
Measured introduction (as amendments, revisions, updates, additions).

Development of technical documents (guides, standards, etc).
Development of social /support system

Yes
Revise/ replace entire bldg.code?

No

Cases - Description
A. Country has desire, resources, capacity to develop own national code.
B. Country has very limited resources and capacity to develop own code, but is prepared to introduce performance based clauses gradually.
C. Country has desire to develop whole performance based code from existing work (eg, model codes from other countries).
2.1.5 Country Reports

This section is based on survey responses, where they were received and reports at the Porto meeting in November 2004. Survey responses and flow charts for each of the countries that responded are included in the annexes.

The Australian model will be discussed separately based on their extensive experience and a productivity commission study recently completed.

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.

Greece has not yet been successful in implementing performance based building requirements. Most of the building sector is unfamiliar with the performance based approach in general. However, discussion is underway between authorities, academics and construction companies regarding a new global and more sophisticated approach. Fire codes are most likely to be the first area in which performance based requirements are adopted. The increasing need for flexibility in building design is likely to create user demands for performance based fire regulations.

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 short-term trend toward withdrawal from mandatory requirements. Hungary remains committed to performance based building requirements. over the long term.

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. Government regulators viewed the fire safety area as too problematic and lacking sufficient fire safety engineers in order to successfully implement performance based fire safety requirements.

Lithuania is seeking to develop an entire performance based code. They will use models and provisions developed and refined in other countries. Selection and revision of the various models to the Lithuanian national context may take as many as seven years to complete.

The Netherlands also has a mixed building regulatory system that has been evolving over the past two decades. The structure of the code is arranged according to the following performance categories: safety, health, usability, energy saving and sustainability. Private standards are referred to determine the performance of a work. Building industry personnel as well as local government building licensing officials often have difficulty properly understanding and interpreting the performance based code, which is also judicially formulated.

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. Warsaw University of Technology has proposed a new structure for the ordinances that will set technical criteria to be met by buildings. The research community has the desire to develop performance based code requirements but for the time being there is insufficient support from decision makers.
Slovakia has a performance based code for the energy performance of building and is focusing regulatory efforts on CPD implementation. Information is lacking regarding other areas building regulation.

The United Kingdom has a 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.

2.1.6 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. Re-examining 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".

2.1.7 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.

1 Productivity Commission, Australian Government "Reform of Building Regulation" Commissioned Study, December 2004
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. 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 them selves 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.

2.1.7.1 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.

2.1.8 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 can not 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.

2.1.9 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.

2.1.10 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 cannot tolerate fuzziness or lack of clarity. Ultimately, the code official or building inspector needs to be able to make compliance determinations that are clean 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 of 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.
Conclusions

CHAPTER 3
### 3 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. There is wide disparity among the countries as to what areas of construction regulation are best served by the performance approach or where to start. Energy conservation and thermal comfort had broad but not universal support for the performance approach. Fire protection on the other hand faced very different points of view. Some countries think that since the largest portion of building requirements are fire safety driven, performance requirements should start in this area. Other countries think that because of the potential risk to life and limb, fire safety should be the very last area to adopt performance requirements.

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.
Literature Review
4 LITERATURE REVIEW

4.1 Performance Based Building Regulations

In the course of project, various publications and articles were brought to the attention of the domain participants. These publications served as background and a basis for domain discussions. Some of the articles are by domain members themselves, others by colleagues at their research institutions or members of other PeBBu domains but related to the regulatory framework. Still others bear no direct connection to the domain participants but constitute important material related to the topic.

It is important to emphasize that no comprehensive or systematic literature search or review were undertaken.

Accordingly, this listing should not be regarded as a complete or exhaustive review.


15. National Research Council Canada, "Objective – Based Codes At a Glance,” 2005

   d. Szigeti, F. and Davis, G. "What is Performance Based Building (PBB); in a Nutshell", June 2005.


Annexes
# Annexes

## Annex 1: Domain Members

### Contacts Domain 7: Regulations

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<th>Country</th>
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Annex 2: Performance Based Building – Regulations Domain (D7) Surveys

1. Survey: Australia

Reference for Building Code: Building Code of Australia (BCA)
Last published (edition): BCA 2005
Report submitted by: Steve Hudson
Job title and affiliation: Manager – BCA Strategy & Support, Australian Building Codes Board (ABCB)

1 BACKGROUND/CONTEXTUAL INFORMATION

1.1 Brief description of social, political and legal context (include diagram of code context or relationships during [a] development and [b] implementation)

The ABCB's mission is to achieve community expectations of safety, health and amenity in design, construction and use of buildings through nationally consistent, efficient and cost effective technical building requirements and regulatory systems.

The goals of the BCA are to enable the achievement and maintenance of acceptable standards of structural sufficiency, safety (including safety from fire), health and amenity for the benefit of the community now and in the future.

These goals are applied so that the BCA extends no further than is necessary in the public interest, is cost effective, easily understood, and is not needlessly onerous in its application.
1.2 **Administrative framework (i.e. who/which agency is doing what)**

The ABCB is established by agreement between the Australian Government and each State and Territory Government. It is a co-operative arrangement between the signatories, Local Government and the building industry.

The Board comprises—
(a) the Australian, State and Territory Governments’ principal officer responsible for building regulatory matters; and
(b) a representative of the Australian Local Government Association (ALGA); and
(c) industry representatives.

The Building Codes Committee (BCC) is the peak technical advisory body to the ABCB, with responsibility for technical matters associated with the BCA.

The ABCB main role is to develop, manage and maintain the BCA to provide consistent building regulations across Australia.

The BCA is given legal effect by building regulatory legislation in each State and Territory. This legislation consists of an Act of Parliament and subordinate legislation which empowers the regulation of certain...
aspects of buildings and structures, and contains the administrative provisions necessary to give effect to the legislation.

1.3 Information regarding future directions (planned revisions, direction, changes)

The BCA is revised every 12 months. The future direction of the BCA is continuing improvement of the Performance Based BCA by working towards quantifying the Performance Requirements and introducing improved Access and Energy Efficiency provisions into the BCA.

2 KEY TERMS AND DEFINITIONS

Alternative Solution means a Building Solution which complies with the Performance Requirements other than by reason of satisfying the Deemed-to-Satisfy Provisions.

Assessment Method means a method used for determining that a Building Solution complies with the Performance Requirements.

Building Solution means a solution, which complies with the Performance Requirements and is—

(a) an Alternative Solution; or

(b) a solution which complies with the Deemed-to-Satisfy Provisions; or

(c) a combination of (a) and (b).

Deemed-to-Satisfy Provisions means provisions which are deemed to satisfy the Performance Requirements.

Expert Judgement means the judgement of an expert who has the qualifications and experience to determine whether a Building Solution complies with the Performance Requirements.

Functional Statement means a statement which describes how a building achieves the Objective.

Objective means a statement contained in the BCA which is considered to reflect community expectations.

Performance Requirement means a requirement which states the level of performance which a Building Solution must meet.

Verification Method means a test, inspection, calculation or other method that determines whether a Building Solution complies with the relevant Performance Requirements.

3 CODE STRUCTURE AND CONTENTS

3.1 Structure of the code (diagram and/or table)
The BCA is split into 2 Volumes. Volume 1 mostly deals with commercial building and Volume 2 mostly deals with domestic buildings. Both volumes are drafted in a performance format to provide greater flexibility for the use of new and innovative building products, systems and designs.

A user may choose to comply with the Deemed-to-Satisfy Provisions or may use an Alternative Solution that satisfies the Performance Requirements.

3.2 Contents (i.e. outline as in “Table of Contents” of the code, but with a short description of the main heading only, e.g. 1-3 sentences)

The Contents of Volume 1 are:

Section A: General Provisions
Section B: Structure
Section C: Fire Resistance
Section D: Access and Egress
Section E: Services and Equipment
Section F: Health and Amenity
Section G: Ancillary Provisions
Section H: Special Use Buildings
Section J: Energy Efficiency

4 KEY LESSONS/COMMENTS ON DEVELOPMENT AND IMPLEMENTATION OF THE CODE

Ongoing maintenance and improvements of a building code is required to meet community expectation.

5 CONTACTS AND REFERENCES

5.1 Contact person for further information and explanations

Steve Hudson, Manager, ABCB
5.2 Websites for relevant information

www.abcb.gov.au

5.3 Key printed information that may be available

Substantial information is available on the ABCB website www.abcb.gov.au
2. Survey: Greece

Greek Building Regulations

- General Building Act (rev. 2000)
- Building Regulations (1989)
- Fire Regulations (1987)
- Thermal insulation Regulations (1979)
- Earthquake Regulations (rev. 1995)
- Reinforced Concrete Design Code (rev.1995)
- Concrete Technology Code (rev.1997)

Greek Fire Regulations

- General Provisions
- Structural fire design
- Means of escape
- Active fire protection measures
- Categories of buildings
  - (Residential, Industrial, Storage, Shops, Educational, Hotels, Hospitals, Assembly, Car parks, etc.)
- Annexes
  - Fire resistance of building elements (deemed to satisfy)
  - Classes of internal linings
  - Existing hotels
  - Introduction of European Classification System (under development)
  - Translation and adoption of European Standards and Classification-(ELOT-Ministry of Environment)
  - Revision of Building Regulations taking in mind the new standards and classification (fire resistance, fire reaction-Euroclasses-Eurocodes etc.)
  - Transitional period

Performance Based Building - The state of the art in Greece

The information on the status of performance-based design in Greece is generally insufficient. It seems that only few attempts have been made by the Authorities and the designers towards this approach.

The term Performance Based Building is almost unknown to the majority of Greek Construction Industry, to the Greek Building Authorities and to the main Greek stakeholders.

However, somebody could discover performance based design in some building construction projects, especially in those cases where no specific prescriptive codes and regulations exist. The continuous increase of flexibility needs in building design and of the various users requirements in the European Construction field, should have an influence to the development of performance building design. At the moment there is not enough practice in Greece.

On the other hand, few Greek Universities (among them the School of Technology of Aristotle University in Thessaloniki) have since many years developed research and other scientific activities in the fields of Building Physics, Building Materials, Environmental issues, Regulations etc. Especially in Acoustics, Energy Saving (Hygrothermal Insulation, Passive Solar Systems, Thermal Comfort etc.), Fire Protection, Building Valuation, Safety and Health on Construction etc.
A discussion has arisen recently among authorities, academics and Construction companies about the need of a new global and sophisticated approach in the Building studies, research and construction. As a start point, the Performance Approach will be introduced in Fire Codes and other Building Regulations.

Fire Regulations, which are now in a revision stage, and especially the part referred to the existing buildings, is the most characteristic example for a potential performance based application in Greece. It follows a short description of some Greek Building Regulations, which are this time in force.

The introduction of the European Classification System has started, since the country is a EU member. Responsible authorities for the translation and adoption of European Standards and Classification system are mainly the Greek Standards Organization (ELOT) and the Ministries of Environment and Industry. An attempt for revision of Building Regulations appears, which is taking in mind the harmonized European Standards, classification and the Eurocodes.

Conclusively, it seems that there is a difficult transitional period, when performance based approach could play a significant role both to the design and the Regulations of Buildings.

**Status of PBB in Greece**

In Greece, PBB is mainly present in research and regulations/ legislations, although there has been little implementation. PBD is exercised through architecture, structural engineering and service engineering. Architecture usually includes the performance-based philosophy. It is also included in various fields of structural and service engineering (fire, earthquake, analytical calculations etc).

**Fire safety & engineering**

Fire Regulations, which are now in a revision stage, is the most characteristic example for performance-based application in Greece.

**Energy & water management**

The energy consumption of buildings and their impact on the environment is becoming a more and more important issue in Greece, and regulations in these areas are currently being developed and deployed.

**Education & training**

Construction professionals are not very acquainted with the concept of PBB, and the subject is currently being included in the national research agenda. There are, however, attempts to introduce this topic/project to the Scientific Committee of the Technical Chamber of Greece (TEE) which is the national Organization of all Greek Engineers (architects, civil, electrical, mechanical, chemical engineers etc.), the Ministry of Environment and at Aristotle University.

**Opportunities & barriers for widespread PBB Greek adoption**

The most prominent national barriers for implementing PBD in Greece are:

- Conservative mentality
- Uncertainty about risk and liability
- Lack of experience

Liability and responsibility, together with third party certification would be the key trigger to make PBD feasible in Greece. In addition, the recent demand for flexibility in buildings is driving change in the design process, and the various user requirements in the European Construction field, is ideal for the promotion and inclusion of PBB practice.

**Contact**

Prof. Kyriakos Papaioannou, Dept. of Civil Engineering, Lab. of Building Construction, & Building Physics, ARISTOTLE UNIVERSITY, THESSALONIKI-HELLAS
3. **Survey: Israel**

1.1 Country Name: Israel.
1.2 Other reference for building code: Planning Building Regulations – Permit Application, Conditions and Fees, Addendum II.
1.4 Report submitted by: David Pilzer, davidpi@moin.gov.il.
1.5 Job title/Affiliation: Director, Division of Planning Building Guidelines and Regulations, Ministry of the Interior.

2. **Background/Contextual Information:** See accompanying diagram

2.1 Brief description of code context in terms of 1. development 2 implementation. (please attach a separate diagram as per the draft flow chart).
2.2 Brief description of social, political and legal context as related to above diagram (2.1).
2.3 Information regarding relevant administrative framework (who is doing what).
2.4 Information regarding future directions (adoptions, revisions, changes).

3. **Key Terms and Definitions**

(please include only keywords used in this from that need clarification i.e. this is not for terms in the code itself).

All of the code requirements are in Hebrew.

4. **Code Structure and Contents**

4.1. Structure of the code (diagram and/or tables). New code follows a building use classification format.

4.2. Contents (outline as in table of contents, but with a short description of the main heading e.g. 1-3 sentences). See attachment.

4.3. Other technical notes.

5. **Key Lessons/Comments on Development and Implementation of the Code.**

There is considerable difficulty in the phased adoption of different building requirement due to their interdependency.

6. **Contacts and References**

6.1. Contacts persons for further information and explanations. David Pilzer, as above


6.3. Other printed information that is available.

2004-14904

**Israel (Performance Based) Building Code (see next page)**
1. Democratic Setting: Minister of the Interior is responsible for enacting Building Regulations after various obligatory consultations.
2. Government Inquiry Commission after social hall collapse and loss of life that created the social and political will to upgrade the building code.

Selection and revision of various models to fit national context may take up to 7 years to complete.

Yes

National Standards, primarily as "deemed to satisfy provisions" are being developed.

No

New fire safety provisions to be introduced this year.

Training courses for architects, engineers and code enforcement officials to be undertaken.

In a phased process over several years, the building code will be revised.

Various performance based codes are being consulted; the Australian model is used extensively.

Elements of all 3 cases, A, B + C are part of the Israel context with greatest similarity to C.

Fire protection requirements are being modeled after the American NFPA 101 Life Safety Code which is primarily prescriptive.

Review, Refinements, Amendements and Monitoring as a continuing and ongoing process.
Daft text available in Hebrew for portions I, II, III & VI.

I. General
   A. Definitions
   B. Procedures
   C. Classification and Use

II. Outside the Building

III. Performance of the Building
   A. Measures and Dimensions
      1. Objectives
      2. Requirements
   B. Stability
   C. Safety
      1. Means of Egress
         a. objectives
         b. requirements
      2. Fire Safety
         a. objectives
         b. requirements
      3. Physical Safety
         a. objectives
         b. requirements
   D. Accessibility for Persons with Disabilities (to the building and within).
      1. objectives
      2. requirements
   E. Thermal Performance
      1. objectives
      2. requirements
   F. Acoustic Performance
      1. objectives
      2. requirements
   H. Illumination
      1. objective
      2. requirements
   I. Enclosure (sealing – weather protection)
      1. objectives
      2. requirements
   J. Materials and Components
      1. objectives
2. requirements

IV. Building Systems

V. Protected Areas

VI. Special Buildings
   A. swimming pools
   B. parking structures
   C. boiler rooms
   D. steam rooms

VII. A. objectives
     B. requirements

VIII. Construction Site Safety

IX. Demolitions.

4. Survey: Netherlands

1. Preliminary Details:

1.1 Country Name: Netherlands

1.2 Other reference for building code: Housing Act, Building Decree

1.3 Last published edition (year): 2003, amendment expected September 2005

1.4 Report submitted by: Nico Scholten, N.Scholten@bouw.tno.nl

1.5 Job title/Affiliation: coordinator building regulations TNO Environment and Geosciences

2. Background/Contextual Information:

2.1 Brief description of code context in terms of 1. development 2. implementation.

2.2 Brief description of social, political and legal context as related to above diagram (2.1).

2.3 Information regarding relevant administrative framework (who is doing what).

2.4 Information regarding future directions (adoptions, revisions, changes).

3. Key Terms and Definitions

All code text is in Dutch; wording and modeling are not quite normal for Dutch building industry

4. Code Structure and Contents
4.1. Structure of the code (diagram and/or tables). Structures follow aspects arranged by safety, health, usability, energy saving and sustainability. Regulations are given for newly built works and existing stock.

4.2. Contents (outline as in table of contents, but with a short description of the main heading e.g. 1-3 sentences). See annexes.

4.3. Other technical notes. Private standards are referred to determine the performance of a work.


Building industry and civil servants are not capable to understand well the performance based and judicially formulated Building Decree in a correct way. On the ministry we have the same problems related to the technical content of the Decree.

6. Contacts and References

6.1. Contacts persons for further information and explanations.
Dr. N.P.M. Scholten as above

6.2. Web sites for relevant information.
www.minvrom.nl in Dutch

6.3. Other printed information that is available.
See the site; also computer applications are available also by a web application but only in Dutch.
**Netherlands (Performance Based) Building Code**

- Democratic Setting: Minister of the Spatial Planning and Environment is responsible for enacting Building Regulations after various obligatory consultations.
- The Minister, the Parliament and the building industry can take the initiative for upgrading the Decree, after consultation of all involved parties.

For the Netherlands mainly case A is the basis.

Selection and revision of elements may take up normally take 2 years to complete.

In a phased process over several years parts building code will be revised. Small steps in 2006 and a big one in 2007.

National Standards are referred to as determination methods for performances of works.

In 2007 total renewing of permit system; different permits will be brought together in one permit.

Training courses for architects, engineers and code enforcement officials to be undertaken by market parties. Written information is published; Internet Helpdesk is available.

New provisions introduced this year for child care and also deregulation of school buildings. In 2006 provisions for energy performance of existing buildings and for tunnels will be given (European obligations).

For the Netherlands mainly case A is the basis.

Own Dutch development has been followed, see my PhD-study, May 2001, presented in Toronto 2004.

Own Dutch modeling, described in my PhD-study and in presentation Toronto CIB world congress 2004; see also publication in BR&I, April 2005.

Review
Refinements
Amendments and Monitoring as a continuing and ongoing process.

Yes

No

Selection and revision of elements may take up normally take 2 years to complete.
5. Survey: Poland

Institution: Warsaw University of Technology
Country Name: POLAND
Other reference for building code:
Last published edition of Construction Law (year): 2003
Report submitted by: Aleksander Panek, apanek@nape.pl
Job title/Affiliation: Adjunct Professor

Background/Contextual Information:

Brief description of code context in terms of existing and proposed performance oriented structure.
Brief description of social, political and legal context as related to diagram
Information regarding future directions (adoptions, revisions, changes): legislation will follow European requirements stated in directives and other acts. Adaptation of European Norms will form a basis for changes.

Key Terms and Definitions
(Include only keywords used in this form that need clarification i.e. this is not for terms in the code itself).

Code Structure and Contents

Construction Act is a general legislation which refers in details to Ordinances among them the most important is Technical criteria to be met by built structures and their localization. Below the expert proposal of changes of the ordinance is provided. These changes are introducing performance concept into the legislation.

Key Lessons/Comments on Development and Implementation of the Code

Contacts and References

Contacts persons for further information and explanations: Aleksander Panek, as above.
Web sites for relevant information: www.mi.gov.pl
Other printed information that is available: Construction Code and Technical Criteria in English
ACT OF POLISH PARLIAMENT of 7 July, 1994
CONSTRUCTION LAW
(consolidated text, amendments as of 27 March, 2003 included)

Chapter 1
General provisions
Art. 1. The Act – Construction Law, hereinafter referred to as “act”, regulates the activities covering issues of designing, construction, maintenance and demolition of the building structures and determinates the principles for operation of public administration authorities in these areas.

Chapter 2
Independent technical functions in building industry

Chapter 3
Rights and duties of participants of a building process.

Chapter 4
Procedures preceding the commencement of construction works

Chapter 5
Construction and putting of building structures to use

Chapter 6
Maintenance of building structures

Chapter 7
A building catastrophe

Chapter 8
The authorities of architectural-building administration and building control

Chapter 9
Penal provisions

Chapter 10
A professional liability in construction

Chapter 11
Transitional and final provisions

Ordinance is a secondary legislation which regulates details of general provisions established by the Act. The ordinance described below is the most important among the building regulations.

Ordinance on the technical criteria to be met by built structures and their localisation - contents:

<table>
<thead>
<tr>
<th>Table of content of Existing Ordinance</th>
<th>Table of content of Proposal - reflecting performance idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>I General provisions</td>
<td>I - General provisions</td>
</tr>
<tr>
<td>II Building plot’s development and management</td>
<td>II - Conditions of implementing the principal safety requirements</td>
</tr>
<tr>
<td>III Buildings and rooms</td>
<td>II.1 - General principles</td>
</tr>
<tr>
<td>IV Technical outfit of buildings</td>
<td>II.2 - Structure safety</td>
</tr>
<tr>
<td>V Structure safety</td>
<td>II.3 - Fire safety</td>
</tr>
<tr>
<td>VI Fire safety</td>
<td>II.4 - Safety of use</td>
</tr>
<tr>
<td>VII Safety of use</td>
<td>II.5 - Hygiene, health (environmental protection)</td>
</tr>
<tr>
<td>VIII Hygiene, health, and environmental protection</td>
<td>II.6 - Noise and vibration protection</td>
</tr>
<tr>
<td>IX Noise and vibration protection</td>
<td>II.7 - Energy saving and thermal insulation</td>
</tr>
<tr>
<td>X Energy saving and thermal insulation</td>
<td>II.8 - Principles of checking whether the main principles have been implemented</td>
</tr>
<tr>
<td>XI Transition and final provisions</td>
<td>III - Building plot’s development and management</td>
</tr>
</tbody>
</table>
IV - Buildings and rooms  
V - Technical outfit of buildings  
VI - Transition and final provisions  

Annexes:  
A - Fire protection of buildings  
B - Requirements of compartments’ thermal insulation  
C - Principles of air exchange in the interiors  
D - Other requirements related to rational use of heat and power

In the proposed structure of Ordinance special attention was paid to follow the sequence of definitions:  
- **principles**,  
- **assumptions**,  
- **conditions** of the implementation of safety requirements and annexes comprising the detailed description of the issues which must be addressed by virtue of law.
Possible Performance Based Code Development in Poland

Cases - Description
A. Country has desire, resources, capacity to develop own national code.
B. Country has very limited resources and capacity to develop own code, but is prepared to introduce performance based clauses gradually.
C. Country has desire to develop whole performance based code from existing work (e.g., model codes from other countries).
D. Research community has desire to develop performance based code but there is no support from decision makers.

Context:
1. There is a framework which enables amendments or changes as the government, parliament or public initiative.
2. Existing building regulations have a structure and form that facilitates adaptation of standards and new concepts.

Warsaw University of Technology has proposed new structure of Ordinance about Technical Criteria to be met by buildings.

The efforts are focused on performance formulation of six basic requirements according to CPD Directive 89/106.

Several seminars and publications, and questionnaire have been prepared to acquaint stakeholders with performance idea.

Formulation of proposal for Ministry responsible for buildings and construction depends on human and financial resources.

Some help in a process is provided by implementation of energy performance directive.

The further research is needed to change technological approach of regulation to user oriented.

Performance Based Building PeBBu project was a think tank for the researchers interested into development of performance regulation in a country. However lack of support from decision makers even in regards to energy is a serious obstacle of development.