Performance Based Building Thematic Network
Funded by EU 5th Framework Research Programme
Managed by CIBdf

USER PLATFORM
BUILDING & CONSTRUCTION INDUSTRY
PeBBu User Platform 2

FINAL USER PLATFORM REPORT

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September 2005
This work was performed as part of the tasks for the EU-funded Performance Based Building Network.

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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FOREWORD

This task of PeBBu was about linking the results of the project to the people from practice, to obtain some reflection on the workability of the concepts proposed. Indeed, some of these concepts may look rather theoretical to construction practitioners. And after all, these people will have to apply our nice concepts and schemes in their daily professional life. The communication with the stakeholders of the professional community of the building and construction sector was not evident. People who are fully occupied by their day-to-day worries do not have much time available for reflection on something which is not yet very common knowledge in the sector. Therefore I would like to thank all professionals who did free the time needed to complete an extensive list of questions. This work could not be completed successfully without the important input of Rachel Becker from Technion University in Israel who did most of the work in developing the questionnaire. And finally I would like to thank my colleagues Dany Rousseau and Frederik De Pauw from the ICT group at BBRI who developed the web based version of the questionnaire and Delphine Goffinet who assisted in the treatment of the results from the enquiry. And finally I would like to honour the memory of Frans Henderieckx, BBRI's Director of Development and Innovation, the first Task Leader of this User Platform, who unfortunately died before he could see the results of the PeBBU project. We all owe him the spirit and the conviction of working in a performance based approach.

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In order to obtain the views of the relevant industry sector on the Performance Based Building approach, a User Platform was set up with high level representatives of European stakeholder organisations of the building and construction industry. This concept received too little response and therefore the work plan had to be altered. Representatives of the building and construction industry were approached through a questionnaire developed for this purpose. The results are compiled in this final report and a research agenda.

Although the results of the questionnaire were surely not representative for the overall European building and construction industry and that probably only the most interested representatives were found ready to invest a considerable amount of time to complete it, it allowed deriving a certain view from this sector on the usability of the performance based approach in building.

Most professionals are familiar with building regulations, either prescriptive or performance based, if available, in their own country, to a lesser extent in other countries.

There is some, although limited, experience with performance based building in practice. The value of this approach and its advantages are recognised, but a number of difficulties and barriers are identified.

Main problems identified are with the expression of the performances, also non technical performances, with the communication between the professional partners in the construction project and with the liabilities.

Performance based building is recognised as the right track to allow innovation in the building and construction technology. However in practice innovation is still discouraged by the traditional approach and the inertia of the system.

In the various domains, specific applications of performance based regulations and standards are identified in several countries. There is a request for harmonised European procedures and approaches.

A number of suggestions for further research are identified.
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Introduction to the task
1 INTRODUCTION TO THE USER PLATFORM 2

1.1 Objectives

The User Platform is one of the communication means with the major stakeholders in the field, in this case, User Platform 2, the building and construction industry: construction companies, contractors, design and engineering offices, manufacturers of construction products and building components, assessors of innovation, project managers acting on behalf of the client.

The overall objectives are:

- to engage high level representatives of actual PBB stakeholders in decision making and in the evaluation of the results of this programme
- to stimulate and facilitate the input of PBB actual stakeholders’ opinions into the programming and execution of international PBB related research and dissemination projects
- to prepare for the respective stakeholders support to future implementation activities

1.2 Initial work plan

At the beginning of the project, there was no clear work plan for neither one of the User Platforms. The traditional approach of organising meetings was adopted as the best approach for obtaining the views of the relevant professional sector on Performance Based Building. The User Platform would then consist of high level representatives of the major European stakeholders of the target group. After a number of considerations between the task leaders and the PeBBu Coordination team, it was decided to organise a series of meetings in Brussels at the BBRI premises for a number of tasks (regional platform, technical committee, user platforms)of the PeBBu network (29th September – 2nd October 2003). The last day of the series was then reserved for three parallel meetings of the three PeBBu User Platforms:

1. Building Owners, Users & Managers (Task leader: K. Bourke, BRE)
2. Building & Construction Industry (Task leader: F. Henderieckx, BBRI)
3. International Building (pre-)standardization (Task leader: N. Smithies, BRE)

Representatives from the major European stakeholders in the construction community were invited. The invitation for the User Platform ‘Building and Construction Industry’ is attached as Annex 1 and the list of invitees as Annex 2.

However, for a number of reasons, too few people were able or interested to attend. Apparently, it was too difficult to convince highly occupied people to attend a meeting on a concept which at that time was still vague and rather theoretical. The direct interest was not sufficiently clear for them at that time. Due to the little response, the meeting had to be cancelled. This was also the case for the two other User Platforms.

Table 1 Programme for the three parallel User Platform meetings scheduled on 2nd October 2003 in Brussels

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1.3 Modification of the work plan

After the Mid Term Assessment, it was decided to alter the working method for this task. It was deemed more efficient to approach representatives from the different stakeholders in a different way through a questionnaire.

This questionnaire has been developed by the task leader in collaboration with Prof. Rachel Becker of Technion University, Israel.

First try-out of the questionnaire was done with 2 major Belgian building contractors and a consulting engineer.

It proved to be too specific for the respondents. Therefore, it was decided at the Porto meeting (November 2004) to reshape/tailor it to the specific respondents. A request to national contacts to distribute it on a national level was not successful.

Since the questionnaire form was a bit too heavy for handling and for attracting people to commit them to complete it, it was tried to ease the handling by introducing an electronic interactive form, made in Designer and distributed as a pdf file. Even then it was not very successful and only few people took the effort to complete it.

In a last attempt, after suggestions at the regional platform meeting in Delft, 25th August 2005, the questionnaire was transformed into an internet based format, linked to a database to collect the responses. The questionnaire was available via a hyperlink on the PeBBu domain. However, interaction with the national contacts was still very poor and only few replies were received.

The development of the questionnaire is further discussed in Chapter 2, the results of the enquiry in Chapters 3 and 4.
Methodology adopted: communication via a questionnaire
2 Methodology adopted: communication via a questionnaire

2.1 Introduction

The User Platform is one of the communication means with the major stakeholders in the field, in this case the building and construction industry: construction companies, contractors, design and engineering offices, manufacturers of construction products and building components, project managers, assessors of building performances, etc. There is little use of nice theoretical concepts if these aren’t translated to and applied in practice. Learning from the building professionals’ experience was a crucial stage in the PeBBu network’s ability to achieve valid results. Thereto, a questionnaire was considered as the right tool to integrate the professional practitioners’ views and experiences with implementing performance based building concepts. It also aimed at being a vehicle for better understanding the real research needs that still exist in order to improve the implementation of PBB in practice.

2.2 Development of the questionnaire

The initial version of the questionnaire was developed by Prof. Rachel Becker of Technion University in Haifa, Israel.
After a number of iterations between Technion and BBRI, the final version (see Annex 3) was used in a try-out version and sent to 3 Belgian professionals.
One industrial buildings construction company sent back the questionnaire without any question completed, because it was too time demanding.
Another building contractor did not want to complete it in writing but was ready to meet for an interview; the results of this meeting were used to complete a questionnaire on behalf of the company. And thirdly, one consultant completed the questionnaire carefully, showing that the questions were pertinent and not too difficult to respond. However it was felt that the effort demanded from the respondents was too heavy to guarantee a reasonable success.
Therefore the simple word document was reworked into an interactive form. Thereto the form was transformed using Adobe Acrobat Designer version 7.0. This indeed allowed working with multiple choice response options, see Figure 1.
The questionnaire document was sent by e-mail in pdf format to the target respondents. These could, after completion, send it back by simply clicking a button integrated in the form. This action generated a xml file with the results of the questionnaire which then is sent by e-mail to the task leader for further treatment. However, the functionality to generate a spreadsheet with the results collected did not work properly and the results had to be processed manually.
Part 1: Overall, General and Integrated Aspects of Performance Based Building

Q1-1. Are you familiar with building regulations and standards that are relevant to your field of activity?
   a) In your country:  ○ Yes  ○ No  
   b) In other European countries: ○ Yes  ○ No  Which countries?

Comments

Q1-2. Are you familiar with performance-based regulations/standards that (or are intended to) replace prescriptive ones?
   a) In your country:  ○ Yes  
      If Yes, please list the more important ones and indicate if their application causes any difficulties.

   b) In other European countries: ○ Yes  ○ No  
      If Yes, please list the more important ones and indicate if their application causes any difficulties.

Q1-3. Did you participate in a building project that used a performance-based brief or performance-based specifications?
   ○ Yes  ○ No  
   If Yes, please give details.
   
   If No, please go to Q1-7.

Q1-4. What were the main difficulties in coping with the parts of the brief that were performance-based?

Q1-5. What were the main implications of the performance-based procedure on the solutions you suggested?

Q1-6. Would you willingly participate again in a project that uses a performance-based brief?
   ○ Yes  ○ No
   Why?

Continue afterwards to Q1-8.
2.3 Structure of the questionnaire

The questionnaire is subdivided in four main parts. The third part again is subdivided in 8 technical domains, for which the respondent can make a selection of those domains he or she is most familiar with.

Part 1: Overall, General and Integrated Aspects of Performance Based Building

Part 2: Building Technology, Innovations and Product Assessment and Evaluation

Part 3: Specific Disciplines and Domains of PBB Activities
   3.1 Structural Aspects
   3.2 Fire safety
   3.3 Indoor Air Quality
   3.4 Acoustics
   3.5 Energy Conservation and Energy Performance
   3.6 Hygro-Thermal Behaviour
   3.7 Sustainable Construction
   3.8 Durability

Part 4: Hierarchical Domains tree and Research Areas

The full questionnaire is included in Annex 3.

2.4 Distribution

The final version of the questionnaire was sent to all national contacts (27 addresses) with the request to find at least 5 persons in their own country from a representative member of the building and construction professional community: manufacturers of building products or systems, building contractors, performance assessors, architects, consulting engineers, project managers, ....

Only few national contacts tried to do so: Belgium (to 15 professionals), the Netherlands (11 addressees), Greece (to 40 contacts, no reply at all), Portugal, Italy where the questionnaire was translated in Italian (which resulted in only one response), ... Several persons tried to complete the questionnaire and found it very complete but too heavy to handle.
2.5 Response

Finally, only 9 questionnaires returned were sufficiently completed to be treated. Responses on the questionnaire came from a limited number of companies from Belgium (3), the Netherlands (2), Portugal (3) and Italy (1). The responses from the UK (1) and from Sweden (1) were too incomplete to be treated.

![Geographical distribution of the responses](image)

**Figure 3**: Geographical distribution of the responses

![Professional background of the respondents](image)

**Figure 4**: Professional background of the respondents
5 respondents are involved in manufacturing of construction materials (1), components (1) or entire building systems (3). There was no one project manager among the respondents.

All but one showed interest in receiving the results of the enquiry. These respondents will receive a copy of the report.

Although the overall response was very poor, the limited number of responses gave quite interesting results. These are detailed in chapter 3.

A number of suggestions for further research were listed. These are compiled in the research agenda of the task, see chapter 4.

2.6 Web based version

Due to the very poor response, and after consultation with the PeBBu Programme Manager and some members of the regional platform at their meeting on 25th August 2005 in Delft, it was suggested to transform the questionnaire into a web based form for easy access. After several contacts with potential developers, the job was executed by the ICT group of BBRI. The form was published on the internet address http://industryquestionnaire.pebbu.nl. The results were then collected in a database stored on the BBRI server.

This action however came too late in the course of the project to attract more respondents.
Results of the enquiry
3 RESULTS OF THE ENQUIRY

3.1 Overall, General and Integrated Aspects of Performance Based building

Q1-1 Are you familiar with building regulations and standards that are relevant to your field of activity?

100% of the respondents are familiar with building regulations in their own country, 67% with building regulations in other European countries.
Cited countries: Belgium, France, The Netherlands, Germany, Spain, UK, Portugal (USA, Australia, Singapore)
Main reason to apply foreign standards and regulations: the advanced state of such regulations and standards and their high level of development.

Q1-2 Are you familiar with performance-based regulations/standards that (or are intended to) replace prescriptive ones?

67% of the respondents are familiar with performance-based regulations/standards in their own country, 33% in other European countries.
Most important performance-based regulations/standards cited from the own country: Eurocodes, fire, thermal, acoustic, ABSW (Algemeen Bestek voor de Sociale Woningbouw) and PPP project in social housing, REBAP, DLS9/99, Decreto – Lei 273/2003, RCCTE (Portugal); from other countries: EN 13830, Breeam, Leed, and some ASHRAE standards in the USA.
Main difficulty caused by the application of these regulations/standards: projects are too expensive.

Q1-3 Did you participate in a building project that used a performance-based brief or performance-based specifications?

56% of the respondents have already participated in a building project using performance-based brief or performance-based specifications.
Details:
- To achieve a fire safety environment based on FSE.
- Many computation and metric systems or bid specifications make reference to DIN or UNI performance standards and requirements even if they are sometimes outdated and unfit for the specifications of construction.
- PDI-shop (for car inspection), Zeebrugge, Belgium. The client was an American company and the quality surveyor was British. We received a client’s brief in which the performance to be obtained was described.
- Airport Garden Brussels: specifications = commercial specs of the project developer.
- Ministry of Finance, Mechelen, Belgium: brief specified in terms of surfaces and comfort criteria.
- Tender for PPP project on social housing using PB specs (in preparation)
- The design and construction of leisure centres using the "Leadership in Energy and Environmental Design”

Q1-4 What were the main difficulties in coping with the parts of the brief that were performance-based?

Main difficulties were performance-based:
- It is difficult to make certified performance levels and investments compete with other systems used in the current building construction system;
- It didn’t specify why certain performances had to be obtained. And if you don’t know why, then you also don’t know how important it is for your client. In some countries certain demands will be easy (read: cheap) to fulfil while in other countries these same demands can be expensive. A performance based brief written by a foreign client may contradict local standards and regulations.
- Special studies, such as structural engineering (concrete) and special techniques (building services) should be optimised. The contract should be not as a percentage of the costs of the special techniques, but as a lump sum combined with an incentive for improved performance (mower energy consumption, shorter execution time, ...)

25
- Modelling of the building for computer simulation to assess the impacts on thermal comfort, energy consumption, etc.
- To prove the actual performance.
- Modelling of the building for computer simulation to assess the impacts on thermal comfort, energy consumption, etc.

Q1-5 What were the main implications of the performance-based procedure on the solutions you suggested?
Main implications of the performance-based procedure on the solutions suggested:
- To prove the performance
- Not much, we always search for an optimal solution (cost versus client’s expected quality versus timing). Even if a material (e.g. concrete) is described (instead of a performance), then we still will propose another material (e.g. steel).
- PBB gives more freedom to the contractor to propose his own solutions.

Q1-6 Would you willingly participate again in a project that uses a performance-based brief?
Only 33% of the respondents would participate again in a project that uses a performance-based brief. The other 67% didn’t answer.
Reactions:
- Seals opportunity
- It depends in which situation. If I can work directly for the client, then I would have no problem. But if I would have to study the project in a no cure-no pay agreement with a global contractor, then I would not be keen on participating. This is because a performance based brief causes a lot more uncertainties when you start studying the project. And if you are not paid unless your client (a global contractor in that case) gets the project, then you prefer less work above more work of course.
- No problem, if good agreement on beforehand. That means that performances should be clear and agreed on before the request for a building permit. And that the responsibilities are clearly described. In practice, the performances are often defined after signing the contract. It is suggested that the PB specs should be part of the tender call.
- Due to the high level of the technical solutions that can be achieved.

Q1-7 Difficulties foreseen:
- Contract and pathology responsibilities in design solutions
- I think there will be a lack of knowledge of the respondents who have to execute the work. They are not familiar with the regulations and scientific backgrounds of it.
- Making a part of the know-how development integrated with design
- Some misunderstandings regarding design
- The communication with the liable persons for the project. It might seem strange in what concerns the aim of PeBBu, but sometimes it is easier to specify technical solutions rather than describing their performance

Q1-8 To what extent do your liabilities change within the building project when a performance-based approach is used in the brief?
Changing of liabilities within the building project when a performance-based approach is used in the brief:
- No experience
- I don’t know
- Checking if the execution of the project meets the performance based specifications will be more difficult.
- Since I collaborate in entering systems (mine) in the computation and metric systems I am responsible for the prescribed performance levels
- The contractor has a new role due to the PB brief: from simple executor of prescriptions, he now is involved in more engineering, more simulations, more coordination,… The communication with the other partners (architect, engineers, project developer, …) in the team is important. This increased liability is translated into financial terms.
- In Portugal the works owners do not use this approach. Until now those used were our suggestion. When a PB approach is used it allows the use of more then one supplier of the same product which can lead to the idea of the use of products from non-reliable manufacturers. If the quality of the products is guaranteed there is no matter for concern.
- It will probably be design and build and fixed price contract which implies that most of the risk will be in the contractor side
- How does it affect your insurance?
- No experience
As a government agency we have a checking and advisory function. The architect and engineer of the project are responsible for ten years and have to be insured. So performance-based prescriptions have no direct implications for our insurance.

My insurance is not very happy with performance-based approach because the responsibility of the engineer reaches a lot further than in a means-agreement (middelenverbintenis tegenover resultaatsverbintenis).

It might affect it if the products used have lower quality. However the designer is only responsible for "prescribing" the performance.

It should increase accordingly with the risk and insurer perception of the new risk

Q1-9 Is Europe ripe for implementing a performance-based approach in the building market?
56% of the respondents think Europe is ripe for implementing a performance-based approach in the building market. 11% didn’t answer.

Minimal size of a building project:
- There isn’t any minimum size
- 2-5 Mil
- It depends on the state of development of design and on the different situations
- I think that performance-based building can only work if you have a very good quantity surveyor that can link the client’s budget with his desires of performances, and all that before the project is too far elaborated by all kinds of parties (architect, engineers, contractors, …)
- I do not think that there is a need to define a minimum size. It can be easily applied to dwellings. However it might be more cost effective to apply it to larger buildings.

Q1-10 Topics that need further research and elaboration before a general performance-based building market can be implemented in Europe:
- Standards and regulations
- Correlation between different countries in relation to building methods
- Support of the executers of projects to learn them how the performance-based specifications can be achieved
- Approximation and harmonization of laws
- Coordination with existing local regulations and standards. Insurances and liabilities
- Physical, measurable performances: no problem, but there is a need to normalise the non-technical aspects:
  o who is responsible?
  o what are the rules of the game?
  o How to deal with aesthetics? Not quantifiable. Expressed as 'one class higher than reference building Y'
- IAQ issues, materials emissions and labelling, building energy consumptions and their disaggregation, etc.
3.2 Part 2: Building Technology, Innovations and Product Assessment and Evaluation

Q2-1 Are you involved in introducing innovations into the building market?
67% of the respondents are involved in introducing innovations into the building market.
Details:
- Organic Prestressing System - www.organicprestressing.com
- Fire safety concepts, natural ventilation concepts
- New products and systems
- **Since 10 years the VHM (Vlaamse Huisvestingsmaatschappij) compels the implementation of the Belgian standard NBN D 50-001 with regard to ventilation for all social housing projects. We also imposed severe isolation regulations (K45 instead of K55) and the use of HR-heating. That is why the social housing sector is already ready for the implementation of the EPB.**
- Design of curtain wall systems by using as few working processes as possible (holes, cuts) by making use, for instance, of release accessories
- Assessment of energy performance good practises in the building project design by using detailed thermal simulation

Q2-2 Have you faced any difficulties in introducing innovations into the building market in your country?
67% of the respondents faced difficulties in introducing innovations into the building market in their own country.
Details:
- Inertia of the building market to absorb innovations
- Acceptance
- Normal difficulties (timing, acceptance etc.) relating to introducing new products
- It takes some time to convince people of the benefit of new regulations. We invested in training of architects and social housing companies.
- It is difficult to penetrate a market which is for the most part traditionalist
- Due to the lack of information that our customers have in what concerns this approach
22% of the respondents have faced difficulties in introducing innovations into the building market in other European countries (in this case, 56% of the respondents didn’t answer).
Details:
- Normal difficulties (timing, acceptance etc.) relating to introducing new products
- The same as in Italy

Q2-3 Are you familiar with the CPD (Construction Products Directive (89/106/EEC))?
67% of the respondents are familiar with the CPD.
How does it affect professional activity:
- Selection and quality control of materials
- Positive
- CE marking products
- All our regulations for social housing projects are geared to the CPD
- It is a valuable reference
- We check if the fabricant of certain materials has the necessary technical approvals and if he can produce the necessary calculation notes (if needed, for example in France where a controlling organism as Veritas or Socotec is involved)
- It does not. However for designers it should be seen as a good way to apply materials complying with minimum quality levels

Q2-4 When selecting materials, products and components for a given building project, do you take account for: CE-mark, Keymark, Other national certificates (technical approval,...)
When selecting materials, products and components for a given building projects, 67% of the respondents take account for the CE-mark, and 67% for other national certificates. Nobody takes account for the Keymark.

Q2-5 Do you see such labels as a guarantee for quality, or do you require more explicit evidence of technical performances?
44% of the respondents see such labels as guarantee for quality, and 22% require more explicit evidence of technical performances. 33% didn’t answer.
For 67% of the respondents such labels are an impetus for quality control. 33% didn’t answer.

Q2-6 While developing a building innovation, do you use in-house research or do you outsource most of the R&D work?
44% of the respondents use in-house research and 33% outsource most of the R&D work.
No examples of case studies were given.
Topics that need further research and elaboration in the field of technological innovation in building and their approval: Indoor Air Quality monitoring systems, hygro-thermal behaviour of construction elements, etc.

Q2-7 When introducing innovations, are you focussing on the main (target) performance of the development? Or taking care of the overall performance of the development including all aspects?
When introducing innovations, only 11% of the respondents are focussing on the main (target) performance of the development. 66% are taking care of the overall performance of the development including all aspects.

Q2-8 Is there an approval system in your country, which ensures that only adequate innovations are put into the market?
According to 33% of the respondents, there is an approval system in their country which ensures that only adequate innovations are put into the market.
According to 11%, it covers entire buildings systems as well (55% didn’t answer).
According to 22% it addresses improvements to existing products (55% didn’t answer).

Q2-9 Web links to assessment bodies
- www.lnec.pt
- www.vrom.nl
- www.kiwa.nl or www.intron.nl
- www.butgb.be
- ITC-CNR: www.itc.cnr.it

Q2-10 The innovations’ investigation
According to 33% of the respondents, innovations’ investigation is carried out on the basis of existing regulations and standards. For 22%, it is done with a more general performance-based scope.

Q2-11 Are you satisfied with the way investigation of innovations’ performance is handled?
22% of the respondents are satisfied with the way investigation of innovations’ performance is handled. 33% are not.
Only 11% usually rely on the outcomes of the procedure and can be sure that the approved innovation is free of faults. 33% do not.

Q2-12 Has the innovations’ approval body any liability in case that the building’s performance does not meet the promise?
According to 44% of the respondents the innovations’ approval body has no liability in case that the building’s performance does not meet the promise. 55% didn’t answer.

Q2-13 List of topics that need further research and elaboration in the field of technological innovation in building and their approval.
Only one answer: Indoor Air Quality monitoring systems, hygro-thermal behaviour of construction elements, etc.
### 3.3 Part 3: Specific Disciplines and Domains of PBB Activities

This part of the questionnaire is subdivided in eight different subsections, corresponding with the main disciplines in the building science and technology.

1. Structural Aspects
2. Fire safety
3. Indoor Air Quality
4. Acoustics
5. Energy Conservation and Energy Performance
6. Hygro-Thermal Behavior
7. Sustainable Construction
8. Durability

The respondents were requested to complete only those sections they were familiar with in their professional activity. Therefore, the number of respondents per discipline is rather limited.

#### 3.3.1 Structural aspects

(7 respondents)

**Q3-1 Did you implement a performance-based approach in earthquake resistant structural design?**

Nobody implemented a performance-based approach in earthquake resistant structural design.

**Q3-2 What are still, if any, the main barriers to implementing a full performance-based approach in this domain?**

Main barriers to implementing a full performance-based approach in this domain:

- (only 1 respondent) Cfr part 1: link between budget and performance asked + are the client’s desires correctly translated into performances (for example a distributed load on an industrial floor is not at all the same as a set of point loads (racks) + does the client think of all the performances he needs?

**Q3-3 Where and when would you prefer to use a performance-based approach in this domain?**

Preferences to use a performance-based approach in this domain (only 3 respondents):

- **Construction type:**
  - (1) for housing
  - (1) possibly, but how do you link all aspects (not only constructional), for example: the beams in a building have an impact on several domains: free height, accessibility for technical pipes, fire resistance, flexibility, assembly, construction time, budget, life cycle cost, …

- **What stage:**
  - (1) prefers the design stage
  - (1) the development stage
  - (1) the sooner the better, I think you can change your way of working from performance based to prescriptive based almost any time you want before construction starts (read: before a contract is signed with a contractor in case of a lump sum agreement, unless of course you are working in an open book system for example), but changing from prescriptive to performance-based is not easy, certainly if the project is already further developed.

- **Other:** (2 responses)
  - Building size can be performance based for industrial complexes. It is more difficult for offices: for example how will you describe in a performance way that you, as client, are willing to spend more money on good architecture (which can imply a slightly bigger building because your entrance is bigger?
  - Projects in earthquake-sensitive regions with a high occupancy
Q3-4 Where and when would you prefer to use prescriptive standards in this domain?
No answer

3.3.2 Fire safety

6 respondents gave some answers for this domain.

Q3-5 Did you implement a performance-based approach with regard to any aspects of fire safety in buildings?

2 respondents implemented a performance-based approach with regard to fire safety in buildings (55% didn’t answer).

Details:
- The prevailing standards concerning fire safety in Belgium are partly performance-based by postulating Rf-values for construction components. How to achieve this is not described.

Q3-6 What are still, if any, the main barriers to implementing a full performance-based approach in building fire safety?

Main barriers to implementing a full performance-based approach in building fire safety:
- Knowledge

Q3-7 Where and when would you prefer to use a performance-based approach in building fire safety?

Preferences to use a performance-based approach in building fire safety:
- Building size: (3)
  - > 1000 m²
  - > 10000 m²
  - any size
- Occupancy type: (2)
  - Housing
  - Not specified
- Construction type: (2)
  - special constructions deviating from the norm
  - not specified
- What stage:
  - Design stage + Development stage
  - Development stage

Q3-8 Where and when would you prefer to use prescriptive standards in building fire safety?

Preferences to use prescriptive standards in building fire safety (2 respondents)
- Building size: (1)
  - Any size
- Construction type: (1)
  - simple housing constructions with a highly repetitive character
- What stage: (1)
  - Design stage

Q3-9 When coping with issues of fire safety in buildings do you use external expertise?

3 out of 4 respondents use external expertise when coping with issues of fire safety in buildings. One does not. One respondent found it easy to find an expert with the adequate professional knowledge, two others did not.

Q3-10 Did you perform extensive analysis or measurements regarding fire safety in buildings?

2 out of 3 respondents performed extensive analysis or measurements regarding fire safety in buildings (6 didn’t answer)

Main trigger to do it:
3.3.3 Indoor air quality

Q3-11 Are you familiar with the European standards in this field (e.g. EN 13779 “Ventilation of buildings: performance requirements for ventilation and air conditioning“)?
Only one out of six respondents is familiar with the European standards in the field of Indoor Air quality. (55% of the respondents didn’t answer)
But four of them are familiar with national regulations.
These national regulations are prescriptive, according to 4 respondents, performance based according to one respondent (although 2 respondents from the same country declare the opposite).

Q3-12 Did you implement a performance-based approach with regard to indoor air quality in buildings?
Only one respondent implemented a performance-based approach with regard to indoor air quality in buildings. The others didn’t answer.
Details:
- The work started by defining quality levels for indoor air in order to state the building status towards this subject. The building owner decided that the HVAC system needed a refurbishment and the rating defined in the beginning of the work was used to define the future indoor air quality.

Q3-13 What are still, if any, the main barriers to implementing a full performance-based approach in this domain?
Main barriers to implementing a full performance-based approach in the domain of indoor air quality:
- The uncertainty and different approach philosophies. The sensibility of customers to indoor air quality issues and the willing to improve it.

Q3-14 Where and when would you prefer to use a performance-based approach in this domain?
2 answers:
- Building size
  - > 1000 m²
  - Not specified
- Occupancy type
  - Not specified
- Construction type
  - Not specified
- What stage:
  - Design stage
  - Development stage

Q3-15 Where and when would you prefer to use prescriptive standards in this domain?
2 answers
- Building size
  - < 1000 m²
  - Not specified

Q3-16 Did you perform extensive analysis or measurements of indoor air quality in buildings?
One out of 4 respondents performed extensive analysis or measurements of indoor air quality in buildings. The trigger to do so was clients needs, accommodation of future legislation, health and safety issues.

3.3.4 Acoustics

(4 respondents)
Q3-17 Did you implement a performance-based approach with regard to building or room acoustics?
One of the respondents implemented a performance-based approach with regard to building or room acoustics.
Details:
- The prevailing national standards on acoustics are mainly performance-based. As social housing company we formulated a list of prescriptive rules how the performance-based requirements can be achieved.

Q3-18 What are still, if any, the main barriers to implementing a full performance-based approach in building or room acoustics?
Main barriers to implementing a full performance-based approach in building or room acoustics:
- The lack of knowledge with architects and contractors (3)

Q3-19 Where and when would you prefer to use a performance-based approach in building or room acoustics?
Preferences to use a performance-based approach in building or room acoustics:
- Construction type:
  o In highly specialised projects
  o Theatre
- At what stage:
  o Design stage

Q3-20 Where and when would you prefer to use prescriptive standards in building or room acoustics?
Preferences to use prescriptive standards in building or room acoustics:
- Other: (1)
  o In standard housing projects

Q3-21 When coping with issues of acoustics in buildings do you use external expertise?
Three respondents use external expertise when coping with issues of building or room acoustics.
Two of them declare it is not easy to find an expert with the adequate professional knowledge. The other one found it easy.

Q3-22 Did you perform extensive acoustic analysis or measurements in buildings?
Nobody performed extensive acoustic analysis or measurements in buildings (2 replies).

3.3.5 Energy conservation and energy performance
(5 respondents)

Q3-23 Are you familiar with the new EU directive on Energy Performance of Buildings (2002/91/EC)?
4 out of the 5 respondents are familiar with the new EU directive on Energy Performance of Buildings, the other one is not.
Implications in business:
- Project conformity and technical audit for certification
- Growth of the market
- In most cases our social housing projects already fulfil the requirements of the EPB. No big problems are expected.
- It will be transposed to Portuguese legislation so it will affect in a good way our business since we are already working under some of its requirements.

Q3-24 Did you implement a performance-based approach with regard to energy conservation in buildings?
2 out of 4 respondents implemented a performance-based approach with regard to energy conservation in buildings.
Details:
- We compelled an insulation level of K45 and the application of the ventilation standard NBN D 50-001
Q3-25 What are still, if any, the main barriers to implementing a full performance-based approach with regard to energy conservation in buildings?
Main barriers to implementing a full performance-based approach with regard to energy conservation in buildings:
- Knowledge and new building details/design
- Firstly the necessary investment and the need for a specialized person.

Q3-26 Where and when would you prefer to use a performance-based approach with regard to energy conservation in buildings?
Only one reply on preferences to use a performance-based approach with regard to energy conservation in buildings:
- Building size: not specified
- Occupancy type: not specified
- Construction type:
  - Housing
  - not specified
- Design stage + Development stage

Q3-27 Where and when would you prefer to use prescriptive standards with regard to energy conservation in buildings?
Only one answer:
- Building size: > 1000 m²
- Development stage

Q3-28 When coping with energy conservation in building issues do you use external expertise?
3 out of 4 respondents use external expertise when coping with energy conservation in building issues.
One of these persons finds it easy to find an expert with the adequate professional knowledge, the two others consider it not easy.

Q3-29 Did you perform extensive energy analysis or measurements of buildings?
Two of the 4 respondents performed extensive energy analysis or measurements of buildings.
Main trigger to do it:
- To have a guidance for specific measures for refurbishment of social houses
- Legislation, minimizing costs and client needs both towards energy efficiency and energy conservation.

3.3.6 Hygro-thermal behavior
(5 respondents)

Q3-30 Did you implement a performance-based approach regarding moisture and hygric performance of buildings?
One out of 4 respondents implemented a performance-based approach regarding moisture and hygric performance of buildings.
Details:
- We compelled the implementation of the ventilation standard NBN D 50-001 to achieve a healthy indoor air quality so condensation can be prevented.

Q3-31 What are still, if any, the main barriers to implementing a full performance-based approach in this domain?
Only one answer:
- Knowledge and technology

Q3-32 Where and when would you prefer to use a performance-based approach in this domain?
Only one answer:
Q3-33 Where and when would you prefer to use prescriptive standards in this domain?  
No answer

Q3-34 When coping with hygro-thermal issues in building do you use external expertise?  
Three of the four respondents use external expertise when coping with hygro-thermal issues in building.  
One finds it easy to find an expert with the adequate professional knowledge, three others disagree.

Q3-35 Did you perform extensive hygric, thermal or hygro-thermal analysis or measurements in buildings?  
Nobody performed extensive hygric, thermal or hygro-thermal analysis or measurements in buildings.

3.3.7 Sustainable construction  
(5 respondents)

Q3-36 Did you implement a performance-based approach in any area of sustainable construction?  
Three of the respondents implemented a performance-based approach in sustainable construction.  
Details:  
- Waste management (the company is ISO 14000 certified)(2 replies)  
- We have several pilot projects with new technologies to enhance the sustainability of our social houses. These projects are monitored to judge the suitability for generalisation. See also our website www.vhm.be

Q3-37 What are still, if any, the main barriers to implementing a full performance-based approach in this domain?  
No answer

Q3-38 Where and when would you prefer to use a performance-based approach in this domain?  
Preferences to use a performance-based approach in this domain:  
- Other: (1)  
  - If non common technologies are intended to be used

Q3-39 Where and when would you prefer to use prescriptive standards in this domain?  
No answer

Q3-40 When coping with issues of sustainable construction do you use external expertise?  
Three of the respondents use external expertise when coping with issues of sustainable construction.  
One finds it easy to find an expert with the adequate professional knowledge, the others do not.

Q3-41 Did you perform extensive analysis or measurements in the area of sustainable construction?  
Nobody performed extensive analysis or measurements in the area of sustainable construction. (3 replies)

3.3.8 Durability  
(5 replies)

Q3-42 Did you implement a performance-based approach regarding durability aspects in building?  
Three of the respondents implemented a performance-based approach regarding durability aspects in building.  
Details:  
- Concrete durability
- e.g. the requirements for the choice of materials are sometimes listed on a performance-based way to achieve the desired durability

Q3-43 What are still, if any, the main barriers to implementing a full performance-based approach in building durability?
No answer

Q3-44 Where and when would you prefer to use prescriptive standards in building durability?
No answer

Q3-45 When coping with issues of durability do you use external expertise?
Three of the respondents use external expertise when coping with issues of durability.
One finds it easy to find an expert with the adequate professional knowledge, two others don’t.

Q3-47 Did you perform extensive analysis or measurements with regard to durability?
Nobody performed extensive analysis or measurements with regard to durability.
Research agenda

CHAPTER 4
4 RESEARCH AGENDA

4.1 General

In the final section of the questionnaire, the respondent was invited to complete a table presenting a hierarchical tree of the various sub-disciplines and research domains in the field of Performance Based Building. The request was to insert in the appropriate sections regarding the domains or sub-domains the respondent is most familiar with, suggestions for research areas that, according to the respondent’s experience, need public funding and coordinated research endeavours. This resulted in a number of interesting suggestions for further research, as listed in the following section.

4.2 Research agenda

4.2.1 Integration and overall performance of buildings

In the general field of the overall performance of buildings and its integration there were several requests, mainly from contractors who participated in the enquiry, for more research or knowledge on the responsibility of the contractor and the financial implications when applying performance based approach in their projects. They feel a need for re-organization at the levels of entrepreneurship and contracting.

Thereto a valuable support would be the availability of good interactive communication tools to improve the understanding between the project partners, especially when working in a partnering contract formula. A correct expression of the expectations of the building owner or of his project manager into a well developed programme of requirements would ease the mutual understanding of the project partners and avoid misunderstandings at the planning and design stage which may lead to wrong interpretations of the instructions given. We consider the development of the PeBBu Decision Making Toolkit (new task) as a good step into that direction.

A need was identified for research into methodologies for application of risk analysis in the various sub-disciplines, e.g. in case of no preliminary study of the soil, or of the environmental impact of a new construction. Can the liabilities be limited and are there appropriate insurance systems developed for such purpose?

There is further need to normalise the non-technical aspects of performance based approaches in the construction works, e.g.:
- Who is responsible?
- What are the rules of the game?
- How to deal with aesthetics? This is hardly quantifiable. It may be expressed as ‘one class higher than reference building Y’, but are there other ways to express the aesthetic performance of a building?

Some respondents feel a need for better co-ordination with existing local regulations and standards. Others stress the need for a better correlation between different countries in relation to building methods.
4.2.2 Hygro-Thermal and Energy Performance of Buildings

Research on better understanding of the energy consumption of the building.

4.2.3 Indoor Air Quality

Research in simplified monitoring of the Indoor Air Quality with an increased number of IAQ parameters to be measured at the same time by more powerful, yet simple equipment.

4.2.4 Sustainable Construction

No suggestions received

4.2.5 Acoustics

Research in better knowledge of the acoustic comfort and how to achieve it.

4.2.6 Fire Safety

No suggestions received.
Conclusions

CHAPTER 5
5 Conclusions

Despite this task encountered a difficult trajectory and faced many problems in defining the right track to approach the building and construction industry, it was possible to derive some valuable inputs from their experience. Thereeto the development of a questionnaire was a good tool. Although the results of the questionnaire were surely not representative for the overall European building and construction industry and that probably only the most interested representatives were found ready to invest a considerable amount of time to complete it, it appears that the following conclusions may be drawn.

- Most professionals are familiar with building regulations, either prescriptive or performance based, if available, in their own country, to a lesser extent in other countries.
- There is some, although limited, experience with performance based building in practice. The value of this approach and its advantages are recognised, but a number of difficulties and barriers are identified.
- Main problems identified are with the expression of the performances, also non technical performances, with the communication between the professional partners in the construction project and with the liabilities.
- Performance based building is recognised as the right track to allow innovation in the building and construction technology. However in practice innovation is still discouraged by the traditional approach and the inertia of the system.
- In the various domains, specific applications of performance based regulations and standards are identified in several countries. There is a request for harmonised European procedures and approaches.
- A number of suggestions for further research are identified; These are collected in the research agenda of chapter 4.
Annexes
LIST OF ANNEXES

Annex 1: Invitation and programme of the User Platform meeting scheduled on 2nd October 2003 in Brussels
Annex 2: List of invited stakeholders
Annex 3: Questionnaire
Annex 1: Invitation and programme of the User Platform meeting scheduled on 2\textsuperscript{nd} October 2003 in Brussels

Ref. nr.: DO/14.973/FH/LV/YV

Brussels, September 2, 2003

Invitation:

Dear Sir,

PeBBu is a EU funded Thematic Network project led by CIB and involving a large number of internationally renowned research institutes.

The objective of the PeBBu project is to stimulate and pro-actively facilitate the international dissemination and implementation of Performance Based Building in building and construction practice. A brief introduction to the PeBBu project, its organisation and the main principles of Performance Based Building can be found in the enclosed information package.

The BBRI is organizing a so-called User Platform workshop for the building and construction industry, meant for the main European stakeholders from the sector. The aim is:

\begin{itemize}
  \item to engage high level representatives of actual PBB stakeholders in decision making and in the evaluation of the results of this programme
  \item to stimulate and facilitate the input of PBB actual stakeholders’ opinions into the programming and execution of international PBB related research and dissemination projects
  \item to prepare for the respective stakeholders support to future implementation activities
\end{itemize}

Thereto we would like to invite you, as one of the main representative professional sector organisations, to participate in this important event. The user platform is organized in parallel with two other User Platforms of PeBBu. The series of meetings is taking place on 2\textsuperscript{nd} October 2003 in the BBRI offices in Lozenberg 7, Sint-Stevens-Woluwe (at the outskirts of Brussels, very close to the Zaventem airport, see map enclosed). The provisional programme is also enclosed.
We would like you, or a representative of your organization, to give a reflection on the role and possibilities of performance based building in your practice, now and in the future. There is ample possibility within the session to give a presentation of your point of view. If you should not be able to attend, you may delegate this invitation to another representative person from your organisation, preferably someone with a direct link to the construction practice.

Please let us know your interest by returning the enclosed form.

For more information you may contact directly the undersigned person or one of the next persons:

Luk Vandaele, Senior adviser, luk.vandaele@bbri.be, Phone +32 2 716 44 10
Johan Parthoens, Senior adviser, johan.parthoens@bbri.be, Phone +32 2 716 44 22

Looking forward to hearing from you,

Yours sincerely,

Frans Henderieckx
Director Development and Innovation
frans.henderieckx@bbri.be
Phone +32 2 716 42 11

Encl: Programme
    Registration form
    BBRI location map
    Invited persons
    PeBBu information package
# Programme

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<th>Thursday</th>
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<td>2. Building and Construction Industry</td>
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<td>3. International Building (pre-)standardization</td>
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<td>Welcome Carlo De Pauw, General director BBRI</td>
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<td>Common introduction for 3 user platforms:</td>
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<td></td>
<td>- What is PBB?</td>
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<td>- Objectives and structure of the thematic network PeBBu</td>
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<td>- Aim of the user platforms Wim Bakens/Jack Bramwell, CIB</td>
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<td>The EU thematic networks, PeBBu &amp; the role of the stakeholders community George Katalagaraniakis, EU DG Research</td>
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<td>General synthesis of the 9 domains of PeBBu</td>
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<td>10:45 – 11:00</td>
<td>Coffee break - Split into 3 parallel sessions</td>
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<td>11:00 – 12:30</td>
<td><strong>User platform: Building and Construction Industry</strong></td>
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<td>Introduction of the members of this User Platform</td>
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<td>Specific findings from the domains:</td>
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<tr>
<td></td>
<td>- Design of buildings Dick Spekkink, EGM Architects, NL</td>
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<td></td>
<td>- Innovation Prof. Peter Barrett, Univ. Salford, UK</td>
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<td>12:30 – 13:30</td>
<td>Lunch</td>
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<td>13:30-15:45</td>
<td>Input from participants:</td>
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<td>- Building contractors FIEC</td>
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<td>- Designers ACE</td>
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<td>- Building materials and components CEPMC</td>
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<td></td>
<td>Discussion</td>
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<td>Conclusions and recommendations for further work F. Henderieckx</td>
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<td>15:45 – 16:00</td>
<td>Break</td>
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<td>16:15 – 17:00</td>
<td>Plenary for 3 user platforms:</td>
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<td>Report from 3 platforms Task leaders</td>
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<td></td>
<td>General conclusion Wim Bakens, CIB</td>
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</table>

Table 2 Programme user platform 2
Annex 2: List of invitees for the User Platform meeting scheduled on 2\textsuperscript{nd} October 2003 in Brussels

FIEC - European Construction Industry Federation  
Mr John Goodall, Secretary General  
Avenue Louise 66 1050 Brussels Belgium

EBC - European Builders Confederation  
Mrs Patrizia di Mauro, Secretary General  
Rue de Spa 8 1000 Brussels

ACE – Architects’ Council of Europe  
Mr Alain Sagne, Secretary General  
rue Paul Emile Janson 29, 1050 Brussels Belgium

CECODHAS - European Liaison Committee for Social Housing  
Mrs Claire Roumet, secretary general  
59b Rue Guillaume Tell, 1060 Brussels Belgium

CEMBUREAU - The European Cement Association  
Mr. Lars HJORTH Technical Director  
Rue d’Arlon 55, 1040 Brussels

CEPMC - Council of European Producers of Materials for Construction  
Mr. Ph. BENNETT, Secretary General:  
Guledelle 98 B- 7, 1200 Brussels Belgium

ECBP - European Council for Building Professionals  
Mr. Peter C. Vangucci, Secretary General  
Rue de la Tourelle 23, 1040 Brussels

ECCE – European Council of Civil Engineers  
Mrs. Diana Maxwell, Secretary General  
Great George Street, Westminster SW1P 3AA London United Kingdom

EFCA - European Federation of Engineering Consultancy Associations  
Mr. Jan Van der Putten, Office manager  
Avenue des Arts 3-4-5, 1210 Brussels Belgium

ENCORD - The European Network of Construction Companies for Research & Development  
Mr. Stefan Lindsköld, Secretary General ENCORD  
ENCORD Secretariat  
NCC AB S- 170 80 Solna Sweden
EOTA - European Organisation for Technical Approvals
Mr Paul Caluwaerts, Secretary general
Avenue des Arts 40, 1040 Brussels Belgium

EFBWW – European Federation of Building and Woodworkers
Mr Harrie Bijen, Secretary General
Rue Royale 45 box 3, 1000 Brussels

UEPC - European Union of Developers and House Builders
Rue de la Violette 43, 1000 Brussels

Régie des Bâtiments
Mr Jean Nouwynck
Mr Luc Vercruysse

VHM
Mr Bernard Wallyn

Invited PeBBu Domain leaders:
Mr. Dick Spekkink, EGM Architects, the Netherlands
Prof. Peter Barrett, University of Salford, UK
Annex 3: Questionnaire

USER PLATFORM 2
Building and Construction Industry

Questionnaire

Update November 2004
BBRI (Luk Vandaele) in collaboration with Technion (Rachel Becker)
What is PeBBu?

PeBBu is a European Thematic Network project devoted to furthering knowledge, dissemination and application of Performance Based Building (PBB) worldwide. See www.pebbu.nl for details.

Performance Based Building (PBB) aims at using performance requirements to define a building's or building product’s fitness for purpose as the basis for all communication between practitioners and their clients, amongst practitioners, as well as within the regulatory framework. Performance Based Building means orientation on ends rather than means. It describes buildings and building products on the basis of the target performance and prevention of faults rather than in terms of solutions and technical specifications. This includes the use of performance requirements, as opposed to prescriptive requirements.

Why this questionnaire?

The User Platform is one of the communication means with the major stakeholders in the field, in this case, User Platform 2, the building and construction industry: construction companies, contractors, design and engineering offices, manufacturers of construction products and building components.

The questionnaire is aimed at integrating the professional practitioners’ views and experiences with implementing performance based building concepts. It also aims at being a vehicle for better understanding the real research needs that still exist in order to improve the implementation of PBB in practice. We believe that there is little use of nice theoretical concepts if these aren't translated to and applied in practice. Learning from your experience is a crucial stage in this network's ability to achieve valid results. We hope that despite the imposing demand on your time, you will be willing to assist in enhancing the practical validity of the PeBBu project by responding to the relevant questions in this questionnaire.

We truly appreciate your readiness to take part in this International European endeavour.

The questionnaire consists of 4 parts:

Part 1: Overall, General and Integrated Aspects of Performance Based Building 58
Part 2: Building Technology, Innovations and Product Assessment and Evaluation 61
Part 3: Specific Disciplines and Domains of PBB Activities 63
  3.1 Structural Aspects 63
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  3.3 Indoor Air Quality 65
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  3.5 Energy Conservation and Energy Performance 68
  3.6 Hygro-Thermal Behavior 69
  3.7 Sustainable Construction 70
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Part 4: Hierarchical Domains Tree and Research Areas 72

This questionnaire may be the basis for an interview with you, depending on the national PeBBu representative in your country.
**Details of Industry:**

<table>
<thead>
<tr>
<th>Field of activity</th>
<th>(please specify)</th>
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<tbody>
<tr>
<td>Company Name:</td>
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<tr>
<td>Address:</td>
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<tr>
<td>Field of activity:</td>
<td>Manufacturing (materials, components, entire building system)</td>
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<td>…………………………………………………………………</td>
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<tr>
<td>Performance assessment</td>
<td>…………………………………………………………………</td>
</tr>
<tr>
<td>Construction (housing, offices, industrial buildings, everything)</td>
<td>(please specify)</td>
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<td>(please specify)</td>
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<tr>
<td>Project manager (technical representative of the client)</td>
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<tr>
<td>Contact Person:</td>
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<tr>
<td>Contact person or interviewer:</td>
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<td>I’d like a copy of the summary of the findings – Yes  No</td>
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The questionnaire will take around 15 minutes to complete but it could be longer if you have time to give fuller answers. The findings will be used to develop a 'road map' for future research in the area of performance based building. We will be very happy to send a copy of the findings to you.

Note that the text boxes will increase in size as you add your answers – so don't feel limited by the space available!

Please email completed forms to: Luk Vandaele, BBRI (luk.vandaele@bbri.be)
Rename your file before e-mailing it: UP2_Your initials_ddmmyy.doc (e.g. UP2_LV120405.doc)
Part 1: Overall, General and Integrated Aspects of Performance Based Building

Q1-1. Are you familiar with most building regulations and standards that are relevant to your field of activity (in your country, in other European countries)?
................................................................................................................................................................

Q1-2. Are you familiar with performance-based regulations/standards that (or are intended to) replace prescriptive ones (in your country, in other European countries)? If Yes, please list here the more important ones and indicate if their application causes any difficulties.
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Q1-3. Did you participate in a building project that used a performance-based brief or performance-based specifications? If Yes, please give details (if No, please go to Q1-7):
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Q1-4. What were the main difficulties in coping with the parts of the brief that were performance-based?
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Q1-5. What were the main implications of the performance-based procedure on the solutions you suggested?
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Q1-6. Would you willingly participate again in a project that uses a performance-based brief? Why? (continue afterwards to Q1-8)
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Q1-7. Would you willingly participate in a building project that uses a performance-based brief? If no, why?
If yes, do you foresee any difficulties?
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Q1-8. To what extent do your liabilities change within the building project when a performance-based approach is used in the brief? How does it affect your insurance?

Q1-9. Is Europe ripe for implementing a performance-based approach in the building market? What is the minimal size of a building project for such approach to be considered?

Q1-10. Please list any topics that in your opinion need further research and elaboration before a general Performance-Based Building market can be implemented in Europe.
Part 2: Building Technology, Innovations and Product Assessment and Evaluation

Q2-1. Are you involved in introducing innovations into the building market? If Yes, please give some details.

Q2-2. Have you faced any difficulties in introducing innovations into the building market (in your country, elsewhere in Europe)? If Yes, please give details.

Q2-3. Are you familiar with the CPD (Construction Products Directive (89/106/EEC))? If yes, how does it affect your professional activity?

Q2-4. When selecting materials, products and components for a given building project, do you take account for CE-mark, Keymark or other national certificates (technical approval, …)?

Q2-5. Do you see such labels as a guarantee for quality, or do you require more explicit evidence of technical performances? Are such labels an impetus for quality control or rather a hinder for innovation?

Q2-6. While developing a building innovation, do you use in-house research or outsource most of the R&D work?

Q2-7. Innovations are usually introduced in order to achieve some main targets. How do you make sure that the overall performance of an innovation you have developed (or decided to use) is well taken care of, and that, being preoccupied with the main targets of its development, no other aspects have been neglected?
Q2-8. Is there an approval system in your country, which ensures that only adequate innovations are put into the market? Does it cover entire building systems as well? Does it address improvements to existing products?

Q2-9. Please supply a web link to the assessment body (bodies) in your country?

Q2-10. Is the innovations' investigation carried out on the basis of existing regulations and standards, or is it done with a more general performance-based scope?

Q2-11. Are you satisfied with the way investigation of innovations' performance is handled? Do you usually rely on the outcomes of the procedure and can be sure that the approved innovation is free of faults?

Q2-12. Has the innovations' approval body any liability in case that the building's performance does not meet the promise (please bring examples of case studies)?

Q2-13. Please list any topics that in your opinion need further research and elaboration in the field of technological innovation in building and their approval.
Part 3: Specific Disciplines and Domains of PBB Activities

Please respond to the questions in the domain/s that is/are relevant to your area of activity.

1. Structural Aspects

Q3-1. Did you implement a performance-based approach in earthquake resistant structural design? If Yes, please detail.
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Q3-2. What are still, if any, the main barriers to implementing a full performance-based approach in this domain?
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Q3-3. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in this domain?
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Q3-4. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in this domain?
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2. Fire Safety

Q3.5. Did you implement a performance-based approach with regard to any aspects of fire safety in buildings? If Yes, please detail.

Q3.6. What are still, if any, the main barriers to implementing a full performance-based approach in building fire safety?

Q3.7. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in building fire safety?

Q3.8. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in building fire safety?

Q3.9. When coping with issues of fire safety in buildings do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3.10. Did you perform extensive analysis or measurements regarding fire safety in buildings? If Yes, what was the main trigger to do it?
3. Indoor Air Quality

Q3-11. Are you familiar with the European standards in this field (e.g. EN 13779 “Ventilation of buildings: performance requirements for ventilation and air conditioning “)? With national regulations? Are these prescriptive or performance based?

Q3-12. Did you implement a performance-based approach with regard to indoor air quality in buildings? If Yes, please detail.

Q3-13. What are still, if any, the main barriers to implementing a full performance-based approach in this domain?

Q3-14. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in this domain?

Q3-15. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in this domain?

Q3-16. Q3-37. Did you perform extensive analysis or measurements of indoor air quality in buildings? If Yes, what was the main trigger to do it?

Q3-17. When coping with issues of indoor air quality do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

4. Acoustics

Q3-17. Did you implement a performance-based approach with regard to building or room acoustics? If Yes, please detail.

Q3-18. What are still, if any, the main barriers to implementing a full performance-based approach in building or room acoustics?

Q3-19. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in building or room acoustics?

Q3-20. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in building or room acoustics?

Q3-21. When coping with acoustics in buildings do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3-22. Q3-56. Did you perform extensive acoustic analysis or measurements in buildings? If Yes, what was the main trigger to do it?
5. Energy Conservation and Energy Performance

Q3-23. Are you familiar with the new EU directive on Energy Performance of Buildings (2002/91/EC)? What will be the direct implications for your business?

Q3-24. Did you implement a performance-based approach with regard to energy conservation in buildings? If Yes, please detail.

Q3-25. What are still, if any, the main barriers to implementing a full performance-based approach with regard to energy conservation in buildings?

Q3-26. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach with regard to energy conservation in buildings?

Q3-27. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards with regard to energy conservation in buildings?

Q3-28. When coping with energy conservation in building issues do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3-29. Did you perform extensive energy analysis or measurements of buildings? If Yes, what was the main trigger to do it?
6. Hygro-Thermal Behavior

Q3-30. Did you implement a performance-based approach regarding moisture and hygric performance of buildings? If Yes, please detail.

Q3-31. What are still, if any, the main barriers to implementing a full performance-based approach in this domain?

Q3-32. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in this domain?

Q3-33. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in this domain?

Q3-34. When coping with hygro-thermal issues in building do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3-35. Did you perform extensive hygric, thermal or hygro-thermal analysis or measurements in buildings? If Yes, what was the main trigger to do it?
7. Sustainable Construction

Q3-36. Did you implement a performance-based approach in any area of sustainable construction? If Yes, please detail.

Q3-37. What are still, if any, the main barriers to implementing a full performance-based approach in this domain?

Q3-38. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in this domain?

Q3-39. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in this domain?

Q3-40. When coping with issues of sustainable construction do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3-41. Did you perform extensive analysis or measurements in the area of sustainable construction? If Yes, what was the main trigger to do it?
8. Durability

Q3-42. Did you implement a performance-based approach regarding durability aspects in building? If Yes, please detail.

Q3-43. What are still, if any, the main barriers to implementing a full performance-based approach in building durability?

Q3-44. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use a performance-based approach in building durability?

Q3-45. Where and when (building size, occupancy type, construction type, design stage, development stage, etc.) would you prefer to use prescriptive standards in building durability?

Q3-46. When coping with issues durability do you use external expertise? If yes, is it easy to find an expert with the adequate professional knowledge?

Q3-47. Did you perform extensive analysis or measurements with regard to durability? If Yes, what was the main trigger to do it?
Part 4: Hierarchical Domains Tree and Research Areas

The following tables present a hierarchical tree of the various sub-disciplines and research domains in the field of Performance-Based Building.

i. If there are any Domains or Sub-Domains you find missing - please add them.

ii. Please insert in the last column (of the domains or sub-domains you are most familiar with) required research areas that (according to your experience) need immediate public funding and coordinated research endeavours.
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