

A comparison of technical requirements for housing in Europe

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ABSTRACT

There is still a broad variety of systems of technical requirements for buildings in the various European countries, despite the existence of the Construction Products Directive of the European Union and the development of Euro Codes. The goals and major subjects are quite similar, and most countries call their regulations 'performance based'. A more detailed look at the formulation and content of the sets of requirements, however shows quite fundamental differences. This paper presents the results and conclusions of a comparative study of the building regulations in Belgium, Denmark, England, France, Germany, the Netherlands, Norway and Sweden. The aim of the study was to place the Dutch Building Decree within the spectrum of the regulations of the other European countries. The systems and formulations of the requirements and the content of some subjects of requirements (for houses) have been compared in detail. In this paper we describe: stairways and ramps, fire safety, noise, daylight, accessibility and dimensions of habitable space and habitable room. Because of the variety in formulation (different interpretations of the performance approach) adequate comparisons of the actual level of requirements were sometimes quite difficult. The abstract formulations of functions and parts of buildings in the Dutch Building Decree are in this respect unique. The conclusion of the study was that the difference in systems of formulation of the building regulations in the European countries forms a major barrier for further harmonisation.

1. INTRODUCTION

The protection of safety and health of their citizens is a major reason for governments to draw up laws, rules and regulations for the built environment. In the course of time other points of departure, such as utility, energy economy, sustainability and economic motives have come to play a part. For these subjects technical requirements are formulated and the regulations procedures have been laid down in laws for checking building plans against the requirements and issuing the building permits.

Internationally-orientated research in the field of technical building regulations and building control is scarce, although there is a growing interest in international comparative studies to support the development of policies in the various countries. Economic Commission for Europe 1985 and Institute of Building Control 1997, provide basic insight in the different systems in the European countries. Bowen 1997, provides basic definitions to understand systems of technical requirements, with a focus on performance-based building codes, such as the Dutch Building Decree. Within this field the OTB Research Institute for Housing, Urban and Mobility Studies has undertaken a range of national and international projects on systems of technical building control. These projects focussed on analysis of the organization of building control in various European countries (Meijer and Visscher 1998) and supported studies for the Dutch government in the search for alternative instruments. Sheridan 2001, analyses a broad range of regulations and financial incentives to promote housing quality in European countries. Most recently, the Dutch Ministry of Housing, Physical Planning and Environment commissioned a comparative study of the Building Regulations in Belgium, Denmark, England and Wales, France, Germany, the Netherlands, Norway, and Sweden, focussed on technical requirements for dwellings and systems of implementation. The project resulted in two publications: Building Regulations in Europe Part 1, A comparison of the systems of building control in eight European

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countries (Meijer, Visscher and Sheridan 2002) and Building Regulations in Europe Part 2, A comparison of technical requirements in eight European Countries (Sheridan, Visscher, and Meijer 2003). This paper reflects on some of the findings of part 2. The study is based on a detailed analysis of the formal documentation of the Building Regulations in the concerning countries and analytic and background literature about the systems of building regulations. A network of contact persons in the various countries supplied the necessary documentation and advice on the translation and interpretation of the regulations.

Section 2 outlines differences in systems of the regulations in the eight countries. Section 3 analyses the structure of information on the technical requirements. Section 4 presents the observations on the level of design freedom the various systems of regulations offer. The findings on the actual comparison of the requirements on some subjects are presented in section 5. The discussion in section 6 points out the limitations of our study and suggests a direction for further research. The final conclusions are worked out in section 7.

2. SYSTEMS OF REQUIREMENTS

2.1 Policy context

The Dutch Building Decree is not alone in expressing the functional requirements as incontrovertible but the scope, levels of requirements, and application of building regulations should be understood as a matter of deliberate government policy. Ultimately, this must explain the variation in regulations between different countries. In practice, requirements are formulated by executive bodies, and are commonly influenced by past practice. Regulations have also developed in response to events, such as energy supply crises, a catastrophic fire or building collapse; or to lobbies, such as disability rights campaigns. In some countries, there are systems of review which incorporate a consultation procedure, so that requirements may be influenced by the opinions of the construction industry. Some requirements are based on experimental or empirical research, which is almost always undertaken by national bodies, most of which are now privatised.

2.2 Intention and scope of requirements

Regulations mostly comprise functional requirements, performance requirements or specifications without detailed explanation of the intention that underlies the requirements. For instance, the Building Decree explanatory notes describe the context of regulation, in terms of history, principles, system of regulations, and recent changes, but they do not fully explain the principles that underlie the requirements. One must look to independent guidance (Marinus, 2002) for an explanation of target times to raise a fire alarm, evacuate a building and so on. The English Approved Documents are unusual in explaining the rationale that underlies requirements and relates it to the broader context of quality control mechanisms. It is not usually possible to tell whether certain issues have been considered for inclusion in building regulations and then excluded as a matter of policy, or they have simply not been considered. However, with the more recently introduced issues, such as accessibility, design guidance is commonly available and it is reasonable in such cases to assume that certain requirements have been excluded deliberately, perhaps as the result of representations by the house-building industry. For instance, the provision of clear space to the lock side of doorways is emphasised in design guidance, including the *European Concept for Accessibility*, but is required in relatively few countries. Where housing is built to low space standards, this requirement would almost inevitably add to construction costs, and presumably this is the reason for its exclusion. Systems of consultation and review allow interested parties to influence the scope of requirements. Some insight into the nature of such influence may be derived from the Construction legislation website for England and Wales (www.safety.odpm.gov.uk/bregs).

2.3 Approaches to regulation

Whilst countries may wish to set differing standards, the basic formulation of requirements, for example as performance requirements supported by optional approved solutions, should be common for the sake of harmonisation. However, there are varying shades of prescription between the countries studied. Denmark, Norway, and Sweden adopt a relatively liberal approach, where mandatory performance requirements are supported by general recommendations, which in turn refer to national standards and research documents for detailed recommendations. Although England and Wales has a similar approach, some of the approved solutions that support the regulations are much more elaborate than the Scandinavian recommendations. In each of these countries, alternative solutions are allowed subject to proof by testing. It is not necessary to obtain an exemption, merely to be able to prove compliance. Belgium (Wallonie) and France take a relatively prescriptive approach, with performance requirements supported by specifications. However, some issues are not fully controlled in Belgium, such as noise, where the acoustic performance of buildings relies on the adoption of the recommendations in national standards. Germany (Hesse) recently changed from a prescriptive approach, with far fewer specifications in the 2002 revision of the *HBO*. Germany (Hesse) places considerable reliance on national standards, although it does not cite them directly. Legislation in France is a little more self-contained. The Netherlands takes a hybrid approach, with performance requirements and some specifications, but with a heavy reliance on national standards to interpret the requirements and the possibility of calculations to allow innovative solutions. A survey of outcomes would be needed to evaluate the success or the significance of these different approaches, in terms of the ease with which designers and contractors understand the requirements, the degree to which they rely on external consultants for interpretation, and the design quality of the housing.

2.4 Types of requirement

Any comparative analysis tends to reflect the approach of the commissioning country, but the Dutch Building Decree is a difficult starting point from which to construct an analysis. Although it incorporates all the elements of the Nordic model of systems of building regulations (Foliente 2000 and Scholten 2001) and the recommendations of CIB/TG11 (Bowen 1997), it presents technical regulations in a different format from any other country. Classification of each country's regulations in terms of the types of requirement (functional requirement, performance requirement, specification, etc.) is difficult firstly because commentators vary in their understanding of these terms and secondly because regulations tend to be inconsistent in the types of requirement used for different subjects. A useful comparison can be made between the Swedish Building Regulations and the Dutch Building Decree. Both undertook a fundamental review of building regulations and adopted what they claim to be a performance-based approach. Each has a very different interpretation of the meaning of a performance based approach and both also demonstrate inconsistencies. Generally, the Swedish Building Regulations adopt a formula of mandatory performance requirements supported by general recommendations that sometimes give dimensions; for instance, a *performance requirement* for passage ways to be designed for independent wheelchair access, supported by *recommendations* that include the width of corridors and the gradient of ramps. However, there are also several instances of *mandatory specifications*: for the height of rooms, for the distance of accessible parking spaces from entrances, for periods of fire resistance of protected lobbies and load bearing structure, and so on. Each clause of the Dutch Building Decree is introduced by a functional description which expresses the intention of the subsequent performance requirements. Where relevant, performance requirements identify limit values which indicate the minimum acceptable level of performance. In fact, there are many more specifications than in Sweden. For instance, the requirements for accessibility and stairways are almost entirely dimensional specifications. However, in one instance the opposite is also true! The Dutch section on noxious substances and materials from the ground comprises only a functional requirement, to limit the presence of noxious or hazardous substances, and an enabling statement, to allow the issue of ministerial decrees to address these issues. In contrast, Sweden has detailed specifications for air quality, including limits on levels of ionising radiation. It is

intended that each requirement of the Building Decree should be an unambiguous legal statement that is measurable and verifiable. At the same time, the expression of requirements is intended to minimise constraints on design freedom and innovation. However, one might question whether design freedom and innovation are significantly prejudiced by requirements in other countries, and whether the high degree of specification in certain sections of the Building Decree are themselves fulfilling this intention. From a simple reading of each document, it appears that the Swedish formulation allows more design freedom (or asserts less control) than the Dutch. It would take a study of the practical implementation of each system to decide whether the differences are significant. It would be interesting to extend such a comparison to France, which has one of the most prescriptive systems, but appears not to specify constructions or present any significant restrictions, in excess of the requirements of the Building Decree. Generally, there are few limitations on the sub-division of space. For instance, there do not appear to be any requirements in other countries that prevent an open-plan living room and kitchen, although there are some limits on travel distances and the location of the kitchen in the fire safety requirements in England and Wales. There is one instance of a requirement that might be seen to impede design freedom – but surely promotes safety: in England and Wales, there are limits on sleeping galleries, whereas in the Netherlands there is no mention of escape from such mezzanine spaces, so the only relevant limit would be travel distance. One issue that might have a significant influence on the appearance of housing is the limitation on fire spread between terraced houses. It is possible that in some countries there are limits on windows within a certain distance of a party wall, or requirements for the projection of the party wall, in order to limit spread between neighbouring facades, but unfortunately, because the analysis was based on the formulation of the Building Decree this was not fully explored.

2.6 National standards and the specialisation of information

There are subtle differences in the attitude to national standards. For instance, in England and Wales, compliance with British standards as a means to meet the requirements is optional, at least in theory. In contrast, in the Netherlands, compliance with NENs is a mandatory part of some requirements. Curiously, although the building ordinance in Germany (Hesse) must rely on *DIN* standards for the interpretation of its performance requirements, it does not directly refer to any *DIN*. Some topics, such as acoustics, rely heavily on national standards for the detailed explanation of requirements, yet these are not freely available. Indeed, national standards can be expensive. This reliance on secondary sources suggests that designers may not have easy access to information and consequently, they may not understand technical requirements in detail. Design for compliance with requirements, beyond the use of constructions known to comply with requirements, is increasingly the preserve of specialist consultants.

3. STRUCTURE OF INFORMATION

For most topics, there are hierarchies of information, but the location of each level of information varies between countries, from legislation through to independent guidance. Indeed the structure of information may vary within a country, for different topics, but at some point a designer must be told how to satisfy the requirements.

For instance, in England and Wales, there is a notable difference between the structure of information for fire safety and noise. Government guidance does not include examples of constructions that satisfy the requirements for fire resistance of load-bearing structure. Instead, *Approved Document B* (2000) states that load-bearing structure should either be designed to specifications in independent guidance (a report by the Building Research Establishment *Guidelines for the construction of fire resisting structural elements*), or to national or European standards, 'a relevant British Standard or Eurocode.' Performance is to be determined by reference to a national standard (*BS 476: Part 21: 1987*). In contrast, examples of constructions satisfying the requirements for acoustic performance are given in *Approved Document E* (2003).

The Building Decree tends to be more consistent in the structure of information, due to the comprehensive nature of the review, rather than the cycle of revisions for the various Approved Documents in England and Wales. So, to make the same comparison, the Building Decree does not give any examples of constructions satisfying the requirements for acoustic insulation or fire safety, either in the regulations themselves or the explanatory notes. There are references to national standards, but these describe characteristics, rather than giving examples of constructions. There are no references to Dutch Practical Guidelines (NPRs) for either topic. Indeed there is only one reference to an NPR in the Building Decree, which gives examples of measures to counteract reverberation. There is no clue within the Building Decree as to how to interpret these issues in practice. In fact, guidance is given in publications and training courses by Stichting Bouwresearch (SBR), an organisation sponsored by partners in the construction industry which acts as an intermediary between government and practice. Unfortunately SBR publishes only in Dutch (see www.sbr.nl). The apparent inscrutability of the Building Decree is shared by the approach of the Building Regulations in Sweden. There is similarly no indication in Sweden of any sources that offer examples of constructions that satisfy the requirements, only references to levels of performance given in national standards for acoustic performance, or methods to test fire resistance in advisory publications by *Boverket*, and further regulations regarding load-bearing capacity in case of fire, the Design Regulations of the Board, BKR. (BFS 1998:38). In the case of the Netherlands and Sweden, it appears that the practical implementation of requirements relies on an initiation into supplementary sources of information. Newcomers to the Dutch construction industry who do not speak Dutch or Swedish presumably must rely on the assistance of consultants. One must question the advisability of reliance on specialist advice or an induction process in order to understand legislation.

One of the most notable contrasts to the Building Decree is the explicit, informative approach in England and Wales. The Building Regulations were first rewritten as functional requirements plus guidance in 1985, in order to allow flexibility in design. For instance, both the requirements and the guidance are presented in *Approved Document B Fire Safety*, which includes: information about the principles and assumptions that underlie the requirements; description of parts of buildings using everyday language; definitions of specialised terminology; diagrams to demonstrate the application of requirements to common configurations in buildings; separate sections, where appropriate, for domestic and non-domestic buildings, including differentiated requirements for houses and flats or maisonettes, for different heights of houses and blocks of flats, and for house conversions; discussion of detailed implementation, including diagrams to illustrate key conditions. The approach in England and Wales means that Approved Document B works autonomously, as a basic design tool. The requirements and guidance on housing should be understood by designers with relatively little reference to secondary texts and without recourse to specialist advisors.

4. DESIGN FREEDOM AND GENERIC DESCRIPTION

Although juridical in format, the Building Decree has the liberal intent of avoiding prescription in design and promoting the innovative use of materials, whilst establishing minimum levels of requirements and methods of calculation. It does not tie itself to existing design solutions or offer detailed official guidance. The Building Decree attempts to describe requirements in terms that can be applied across a range of 'user functions,' as can be found in mixed-use buildings. However, the confusion that arises from generic description and the use of 'navigator' look-up tables seems to outweigh the benefit of identifying such requirements for mixed use buildings, which is the justification given in the explanatory notes. The earlier subdivision of the Building Decree, into housing and other types of buildings, allowed a much simpler expression of requirements. The use of the term 'user function' is confusing because it is not related to tenure or physical boundaries. User function is defined as "the parts of one or more construction, plot or site, which share the same intention of use or which together form a user unit." So, "the lift in a block of flats forms part of each user function (flat) which relies on the lift." Therefore it is particularly confusing when the explanatory notes say, with regard to space for the future

installation of a lift, "This space may be within the user function or outside it." It is puzzling, and not particularly helpful, that car parks and remote storage rooms in apartment buildings are treated as separate user functions, distinct from dwellings. Sometimes, the nature of housing means that there are requirements specific to the 'living' function, so that the lower half of the look-up tables is blank and the formulation of requirements is unnecessarily complex. For instance, Article 4.17, which specifies limits on the difference in heights of floor surfaces and thresholds at entrances, only applies to the 'living' function, but the structure of requirements means that it needs an explanatory notes to clarify that it "is intended to ensure that a wheelchair user can enter a dwelling or block of flats independently." The Building Decree apparently tries to avoid assumptions in spatial design, and describes categories of space, rather than using familiar names for rooms or spaces. This attempt at generic description sometimes breaks down, and familiar terms are used. Other countries with performance-based requirements share the ambition of design freedom, but do not ally themselves to a similar degree of abstraction. It seems unlikely that the process of harmonisation would accept that design freedom is imperilled by using the expression 'kitchen or kitchen area' instead of 'staying [habitable] room with an installation point for a cooking appliance,' particularly when this is translated in the Building Decree's own explanatory notes as 'kitchen.' In general, the Building Decree would be much easier to understand if it was split into domestic and non-domestic buildings, and everyday words were used to describe rooms and other spaces. This is of particular significance in the section on Fire safety. It may seem reasonable to expect that, although the expression of requirements in the Building Decree is differently worded to those in other countries, the practical outcomes are similar. However, characteristics of Dutch housing such as the extensive use of glazing, suggest that there are significant differences in principles and standards of fire safety and conservation of energy. This would best be tested by a comparative evaluation of building designs based on the regulations in different countries.

5. COMPARISON OF REQUIREMENTS

5.1 Stairways and ramps

The Netherlands has replaced some of its earlier very low standards for straight stairways, with increased minimum goings and reduced maximum rises. The standard for private stairs is now less steep than in England and Wales, but the standard for common stairs is still the steepest. The concomitant increase in the floor area needed for the stairway will probably encourage the already widespread use of private stairs with tapered treads, which are more common than in other countries. The changes for common stairs are also significant. However, the Building Decree perpetuates poor safety standards for the guarding of stairways and ramps. It compares unfavourably with requirements in most other countries for guarding to extend the full length of stairways and ramps, and for the height of guardings. Also, it does not require handrails for ramps and has very few requirements for detailing, which means that ramps may be more difficult to negotiate than in other countries. Lighting has been identified as a contributing factor to accidents on stairs, but none of the building regulations studied countries addresses the issue of the daylighting or artificial lighting of stairways.

5.2 Fire safety

A harmonised European system to classify the reaction to fire of construction products was approved in 2002, but there is great diversity in the regulations of the studied countries in the description of fire safety strategies, classification of buildings, or description of parts of buildings. Mostly, fire safety strategies are similar if differently expressed, but there are some significant differences in levels of requirements. The Building Decree is unusual in its concepts of sub-fire and smoke compartments, its definition of permanent fire load density, and its control of the smoke production of internal surfaces, but it is difficult to tell whether these create significant differences from other countries in practice. Although the description of compartmentation is different in the Netherlands, the strategy that each dwelling constitutes a compartment is similar to that in Denmark, England and Wales, Norway and Sweden. The only difference is that the

entrance door to a flat needs not to be self-closing, an omission that may prejudice compartmentation in the event of fire. The Netherlands is also unusual in not having requirements for the fire resistance of doors on escape routes, and instead relies on early warning by smoke alarms. Only two other countries require fire or smoke alarms for general needs housing. There are very few controls on single family housing, and there is no national or federal fire safety legislation for houses in Belgium. The greatest diversity in strategies lies in the provision of means of escape. Several countries allow rescue as a second route, and all allow a single escape route in various circumstances. The only absolute requirements for two independent escape routes for housing are for tall buildings in Belgium and Denmark. The issues of maximum travel distances, and the number and location of exits are common to most countries, but expressed quite differently and with varying levels of requirements. Each country limits characteristics of internal surfaces of escape routes, but only the Netherlands limits the rate of smoke production of surfaces. Only Denmark and England and Wales control internal surfaces of private areas of single family housing. The scope of requirements for external surfaces varies widely. None of the building regulations studied specifies materials or constructions deemed to satisfy the requirements. Each country refers to national standards for background information, but the Dutch Building Decree is unusually reliant on national standards for the interpretation of strategic issues and it is not possible to understand the scope of requirements from the main document alone.

5.3 Noise

Most countries specify levels of requirements within the Building Regulations or associated guidance documents, but Belgium, Germany (Hesse) and Sweden rely on recommendations in national standards. Despite reference to EN-ISO standards, there are important differences between countries in the criteria used to describe acoustic performance, including methods of measurement and the application of different reference curves or spectrum adaptation terms. Belgium and the Netherlands use indices that are not used in any of the other countries, but each is gradually adapting to EN-ISO 717. The varied acoustic criteria mean that it is difficult to compare requirements, but many of the differences are probably barely perceptible. The greatest differences are in levels of requirements for impact sound. Low frequency components of airborne sound often contribute to domestic noise nuisance but only England and Wales, France, and Sweden currently address this issue. The Netherlands is one of the few countries to require acoustic protection between spaces within the same dwelling. Otherwise, the scope of requirements is broadly similar, with the exception of England and Wales which lacks specific requirements regarding noise from equipment. Pre-completion testing of buildings is the most demanding and expensive implementation procedure but only Denmark and England and Wales require such testing. In practice, noise control must rely on the use of constructions that are known to satisfy the requirements, but this does not guarantee as-built performance. Even in England and Wales, the house-building industry is being given an opportunity to develop standard details as an alternative to testing. In future, *EN 12354* may be adopted as a way to justify the choice of construction. Noise control is a topic that is relatively impenetrable to non-experts, and it appears that the design standards are increasingly the domain of specialists.

5.4 Daylight

Daylight openings are regulated in each of the countries studied, except for England and Wales. However, the nature of requirements is relatively unsophisticated and would not necessarily provide an appropriate standard of daylighting. The requirements for the size of daylight openings are not directly comparable. Only Norway sets targets for the level of daylighting, rather than the size of openings. Only Denmark and Sweden address issues of sunlight. Daylighting is treated as a basic amenity in building regulations, but it might be more appropriate to link requirements with energy performance, so that design for daylighting could be seen as making a contribution to reductions in CO₂ emissions.

5.5 Accessibility

“Accessibility enables people to participate in the social and economic activities for which the built environment is intended.” (European Concept for Accessibility) There is striking divergence from the ECA, not only in terms of standards, but in the scope of accessibility legislation. The expression of requirements also varies, so that direct comparisons are not always possible. The Netherlands has generally lower standards of accessibility requirements than Sweden, Denmark, or England and Wales, and a lower standard for blocks of flats than France, or the DIN standard in Germany. The limited application of requirements, the lack of some requirements, and the form of expression of others mean that the Building Decree does not guarantee the accessibility or visitability of environments and dwellings. There are considerable differences in the application and levels of requirements. Overall, the highest standards should be generated by the performance requirements in Sweden, which constitute a nearly comprehensive accessibility and usability standard for dwellings on one storey and the entrance storey of other dwellings. None of the countries studied has particularly extensive standards of provision for people with visual impairments, and there is very little mention of the needs of people with other types of sensory impairment.

5.6 Dimensions of habitable space and habitable rooms

Floor area is a key determinant of amenity and accessibility, but space standards are no longer a central consideration of most European building regulations. The Netherlands has more extensive space standards and dimensional requirements for rooms than the other countries studied, but requirements for ceiling heights have been retained in each country except England and Wales. The Building Decree asserts that its requirements are necessary to ensure a functional design and it would be interesting to discover whether the working of the market achieves this in other countries. The removal of controls in England and Wales resulted in reduced space standards, but it is difficult to evaluate whether or not the designs are functional. It is also difficult to demonstrate whether the flexibility afforded by higher space standards makes a significant contribution to the sustainability of housing development, but it seems sensible to protect the space standards of the housing stock by building regulations, rather than market forces.

6. DISCUSSION

In this section we should make some remarks of the limitation of our findings due to the necessary limitation of the approach. We took the Dutch Building Decree as a point of departure. And in fact not the whole document, but a selection of requirements and only for buildings with a housing function. From there we analysed the equivalent regulation documents in the other countries. The focus was on national (or state) mandatory regulations. It might be possible that in the studied countries additional quality regulations on a municipal level via local bye-laws play a considerable role. Furthermore, the study did not consider the role of incentives, such as the conditions of subsidy, in the promotion of housing quality. However, the existence of incentives can be a useful indication of current concerns, which are either not addressed in building regulations, or for which the minimum levels of requirements in the building regulations are not necessarily best practice. For instance, there are various subsidies to promote the use of renewable energy sources, whereas there is currently little consideration in building regulations of their contribution to reducing energy demand. There may also be incentives to achieve ‘lifetime homes’ provision beyond the levels of accessibility required by building regulations. The level of government regulations should further be considered in relation to (minimal) quality of the realized buildings and the existing private law quality regulations, instruments and quality assurance schemes.

A next step in research on this issue would be to examine the effectiveness and efficiency of the sets of regulations in the various countries (see Visscher 2000). Such a project would have to stretch out from the formal regulations, the systems of building control, an investigation of other forms of regulations (public and private law) and the level of professionalism of the various

actors in the building process, such as the principal, the architect, technical advisor and the construction firm. This is a very complex matter. A possible approach would be to focus such a research on a single topic that is issue of public building regulations in all countries, such as for instance fire safety. The effectiveness and efficiency of the regulations should then be examined at the hand of a few reference building plans. The project should monitor the way the regulations are implemented and controlled through the whole building process.

6. CONCLUSIONS

The level of requirements of the Dutch Building Decree can probably be described as 'average' amongst the countries studied, with a few particularly high or low standards. One of the most valuable strengths of the Building Decree are the requirements for the size of habitable rooms. A particular weakness is the lack of controls on the accessibility of external routes to buildings and the incomplete application of accessibility requirements in smaller flatted buildings. It is difficult to judge whether the formulation of the Building Decree does promote innovation in practice, because that must rely on other factors, including the implementation of building control, the culture of the construction industry, and the education of professionals. The Building Decree appears to be highly structured, but this appearance may be skin deep, for there is inconsistency between the sections studied. It adopts a generalising, generic approach and sets out to eschew prescription, but in some aspects it is one of the more prescriptive of the mechanisms studied. Despite the intentions underlying the review, it is difficult to agree that the revision is particularly accessible, due to the convoluted expression of requirements and use of unusual terminology. A few measures adopt terminology or parameters that are unique to the Netherlands. As such, they represent a barrier to harmonisation. In the case of the definition of acoustic parameters, harmonised standards are available, but the Netherlands continues to use the slightly different approach of a national standard. The quality of technical building control in the Netherlands cannot be understood if the Building Decree is seen in isolation from the context of the national standards (NENs), the associated Dutch Practical Guidelines (NPRs), and the support offered by Stichting Bouwresearch's guidance and training. A designer from another country would have considerable difficulty in understanding how to interpret the requirements, and the translation of NENs, NPRs, and SBR guidance documents into other languages would be a great assistance to inter-national practice.

The formulation of technical regulations varies between the countries studied. Apart from Belgium, there is a general trend towards performance-based requirements, but the concept of performance requirements is interpreted differently and in most of the countries the technical regulations include specifications. There is a common pattern of verification by reference to national standards, but some countries also refer to other sources. The practical implementation of technical regulations often relies on guidance that are not cited in regulations. The grouping of subjects is different, in all cases, from the criteria of the CIB-TG 37 model. Despite the intentions underlying the revision of the Dutch Building Decree, England and Wales offers clearer distinctions between functional requirements and guidance, and conforms more closely to a performance-based model.

In the long term, one would hope that Model European Building Codes would be evolved to cover the descriptions of strategies, as well as product standards. Potential difficulties in international working caused by the lack of harmonisation were mirrored in the difficulties of the comparative analysis. This was particularly true of fire safety requirements for which, without a common framework of strategies and tactics it was difficult to confirm the absence of requirements, and without common terminology or criteria it was difficult to compare levels of requirements. Important issues for harmonisation include the classification of buildings and the description of parts of buildings, which are used to describe the application of fire safety requirements. The generic description of spaces that is found in the Dutch Building Decree is probably unhelpful in practice, and it should be possible, in a code describing requirements for housing and for mixed use buildings, to establish common terminology in a series of annotated diagrams of typical configurations of blocks of flats, or single-family houses, without threatening the independence of designers or opportunities for innovation.

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