

How small can a house be?

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ABSTRACT: A study about the minimum necessary net internal area of dwellings that should be established by Portuguese building regulations is presented. The following tasks were carried out: selecting the furniture and equipment necessary for each dwelling; determining the size of furniture and equipment and its typical arrangement; conceiving models of functional spaces; determining the net area of functional spaces and dwellings; and comparing results with statistics on housing construction in Portugal and with mandatory area standards used in Portugal and ten other European countries. The conclusions are that the net internal area presently set by Portuguese building regulations should be increased by 5 to 15%. The net internal area figures obtained by the study are similar to mandatory regulations established by some other European countries.

1 INTRODUCTION

Nowadays, there is an overall agreement that building and operation of new houses should have a reduced environmental impact. For that purpose houses should use energy and water efficiently, save materials, have an adequate dimension, be healthy to live in, require low-impact maintenance, and last for a long time. But how do we put in practice these general recommendations? For instance, what is the adequate size of a house?

It is commonly understood that a house should be big enough to meet the needs of the occupants for living, cooking, dining, sleeping, washing and storage of household goods and have a convenient access to adequate residential amenity space. Space standards set the conditions to fulfil this objective and usually regulate minimum conditions of: overall internal floor area, size and dimension of individual rooms, ceiling height and layout of houses.

The building regulations of several European countries include space standards for housing. In Portugal the space standards for new housing were reviewed more than 30 years ago (Decree-Law No. 650/75). No space standards apply to construction work in existing buildings.

The purpose of the study is to investigate the minimum net internal areas that should be established by Portuguese building regulations for existing and new dwellings. Four research questions are addressed:

- What is the minimum net area of dwellings adequate to current Portuguese living standards?
- How does the proposal for a minimum net area of dwellings compare to the requirements set by Portuguese building regulations?
- What would the impact be if the proposal was adopted as the minimum mandatory requirement?

- How does the proposal compare to the area requirements presently enforced in other European countries?

2 THE IMPORTANCE AND DEFINITION OF SPACE STANDARDS

Space standards were introduced to set minimum habitability conditions, but have progressively lost their importance in the building regulations of several European countries. Space standards, for example, have been criticized as being an archaic relic of habitability standards and a symptom of over-regulation that restricts individual freedom. However, they have proved to be positive indicators of housing quality. They are simple to determine and verify and provide valuable information about dwelling space (Sheridan 2003).

Space standards are a measure of the acceptable intensity of dwelling occupation in the context of the prevailing cultural, social, climatic, economic and technological conditions in a particular society (Chowdhury 1985). These conditions change with time, meaning that space standards should be updated regularly.

The study of minimum space standards is important for several reasons (Sheridan 2003, HATC 2006, Wren n.d.):

- There is strong evidence that pressures arising from situations of overcrowding may lead to interpersonal aggression, withdrawal from the family, sexually deviant behaviour, psychological distress or physical illness. Furthermore, small homes which do not support the needs of occupants may lead to social cohesion issues and negative social behaviours.
- Dwellings have a long lifetime, lasting for generations. It is not easy to anticipate the evolution of users' needs and their implications for space standards. A dwelling's flexibility enables its adaptation to the changing needs of users, but depends greatly on its initial spatial characteristics. Smaller dwellings have limited scope for flexibility and do not support the needs of growing families.
- The space characteristics of a dwelling, established during design and construction, are difficult to change during the rest of its lifetime. Spatial changes, when possible, usually require costly construction work.
- Social, economic and technological changes have accelerated in recent years. These changes have implications for the use of the home and consequently for space standards.
- Houses that provide inadequate conditions to dwellers usually require more maintenance and repair works and have a shorter service life.
- Many of the houses of the existing housing stock do not fulfil the space standards of present building regulations. During rehabilitation works it is necessary to decide which dwellings are unfit and are either made fit to live in or demolished.

Relevant studies to establish minimum space standards for housing have been developed in European countries for several decades (e.g. Klein 1980, Parker Morris 1961). The approach has become progressively more sophisticated over the years. Space standards have also been set in numerous design manuals (e.g. Neufert 1970, Tutt & Adler 1979). Later editions have updated some of these manuals. Recently, new studies were conducted to provide space standards which are up to date and adequate to the local context (e.g. Pedro 1999, Boueri 2005, HATC 2006). These studies and design manuals were used as research literature for this study.

3 RESEARCH METHODOLOGY

The study was developed according to the following methodology:

- Select the necessary furniture and equipment for each functional space.
- Determine the size of furniture and equipment.
- Find out the typical arrangement of furniture and equipment.
- Draw models of functional spaces.
- Analyze models to determine area of each functional space.
- Add the area of all functional spaces to determine the area of the dwelling.

- Compare results with the mandatory area requirements presently set in Portugal and in 10 other European countries.

The parameters used to set occupants' needs were the number of people expected to occupy the dwelling, a classification of residential functions and two levels of quality.

The needs of households with 1 to 9 occupants were studied. Large households were studied because, although the average size of households in Portugal is 2.8 persons, 45% of the dwellings completed in 2007 were designed for 6 occupants and 17% for 7 or more occupants (INE 2002, 2008).

The use of the dwelling was described by functions: sleeping, cooking, eating, living, play/study/work, clothes care, personal hygiene, circulation, domestic management and being outside in private space. This classification enabled an analysis of user's activities of setting a rigid use for each room. The description of dwellings' use with functions has been used in Portugal since the 1960s for studies of housing space standards and occupants' behaviour.

The levels of quality reflect the degrees of fulfilment of occupants' needs and aspirations. As a fallback for unacceptable situations, two levels were set:

- The basic level ensures that occupants cannot suffer serious physical or mental injury. This level is usually used to evaluate whether an existing building is unfit for human habitation.
- The minimum level ensures that the common needs of users' daily life are fulfilled. This level is used to prevent the construction of new buildings detrimental to user's quality of life.

4 MINIMUM AREA STANDARDS

4.1 Furniture and equipment

To set the *minimum* needs of furniture and equipment it was assumed that:

- A dwelling must enclose spaces to perform all the domestic functions, in order to allow autonomous use.
- A dwelling's spaces must have sizes and shapes that allow placement of the furniture and equipment necessary to satisfy the common daily needs of its occupants.
- Disabled persons must be able to access the dwelling. To assure this, at a minimum the entrance, living room, kitchen and a toilet must be accessible.

To set the *basic* needs of furniture and equipment the programme of the minimum level was used, but only the essential items of furniture and equipment were included. At this level, the quick meals function was not included and dwellings were not required to be accessible by disabled persons.

Figure 1 present the furniture and equipment attributed to each function and number of occupants at the minimum level.

4.2 Area by functional space

The minimum area for each functional space is presented in Tables 1 and 2. The area for each functional space was obtained from the analysis of the models presented in Figure 7.

The area for circulation is 10% to 14% of the total area of the other spaces. These percentages were obtained by analysing the designs of seventy social housing units built in Portugal between 1990 and 1997. The increase in the circulation area is not entirely gradual, because of the need to balance additional spaces for personal hygiene in some typologies.

For the sleeping function three types of spaces were foreseen, with double, twin and single beds. In all dwellings with two or more occupants there is a double sleeping space. In dwellings with an odd number of occupants an additional single sleeping space is foreseen. The remaining sleeping spaces are twin. This distribution enables the possibility of dwellings being occupied by a couple and requires less area for the sleeping function. Different combinations can be created by dividing one twin bedroom into two single bedrooms.

4.3 Net internal dwelling area

The minimum area of the dwelling for each number of occupants is presented in Table 3. There is a gradual variation in the net internal area: at the basic level it increases 7.0 m² per occupant, and at the minimum level 9.0 m² per occupant.

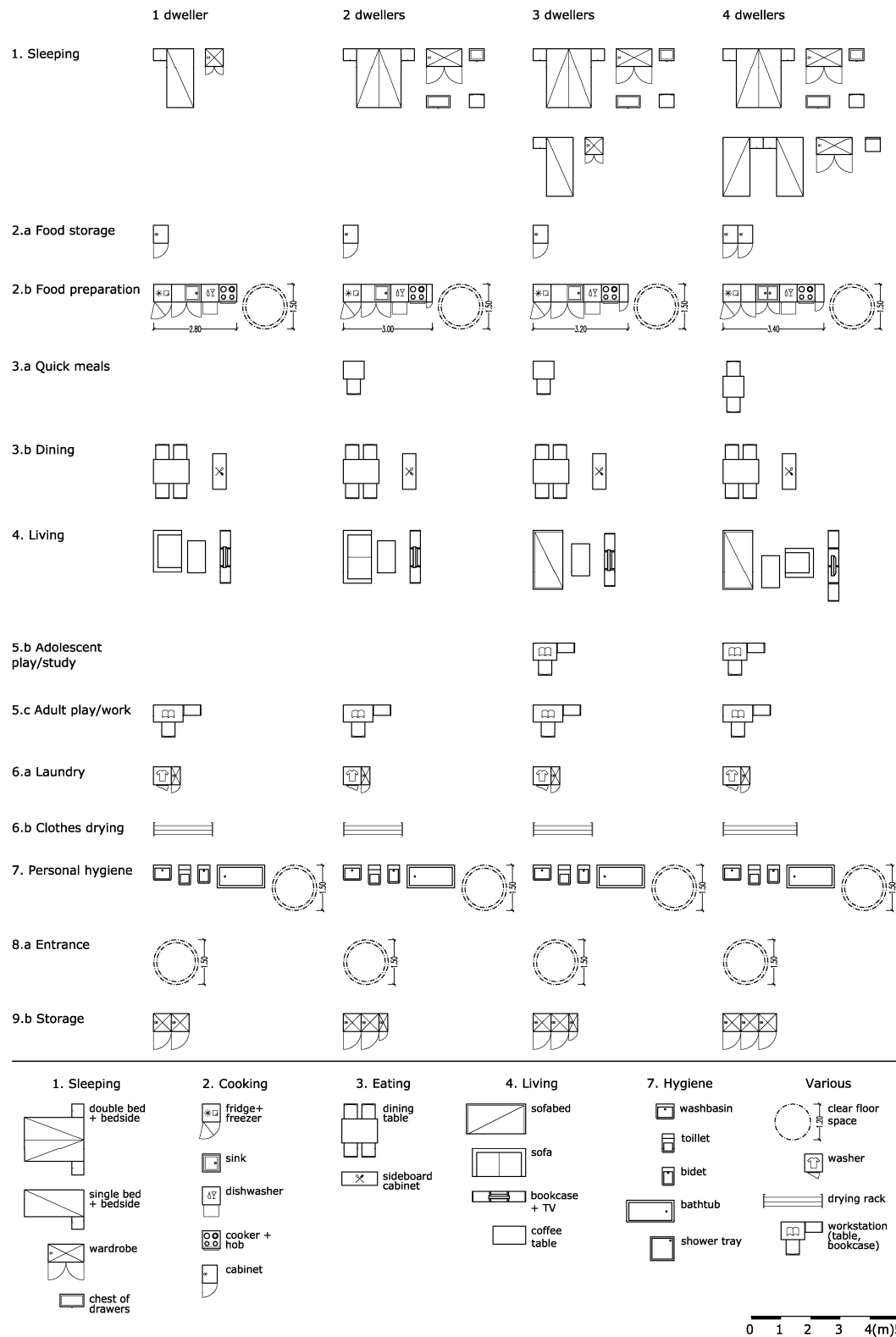


Figure 1. Minimum level – List of furniture and equipment (Part 1).

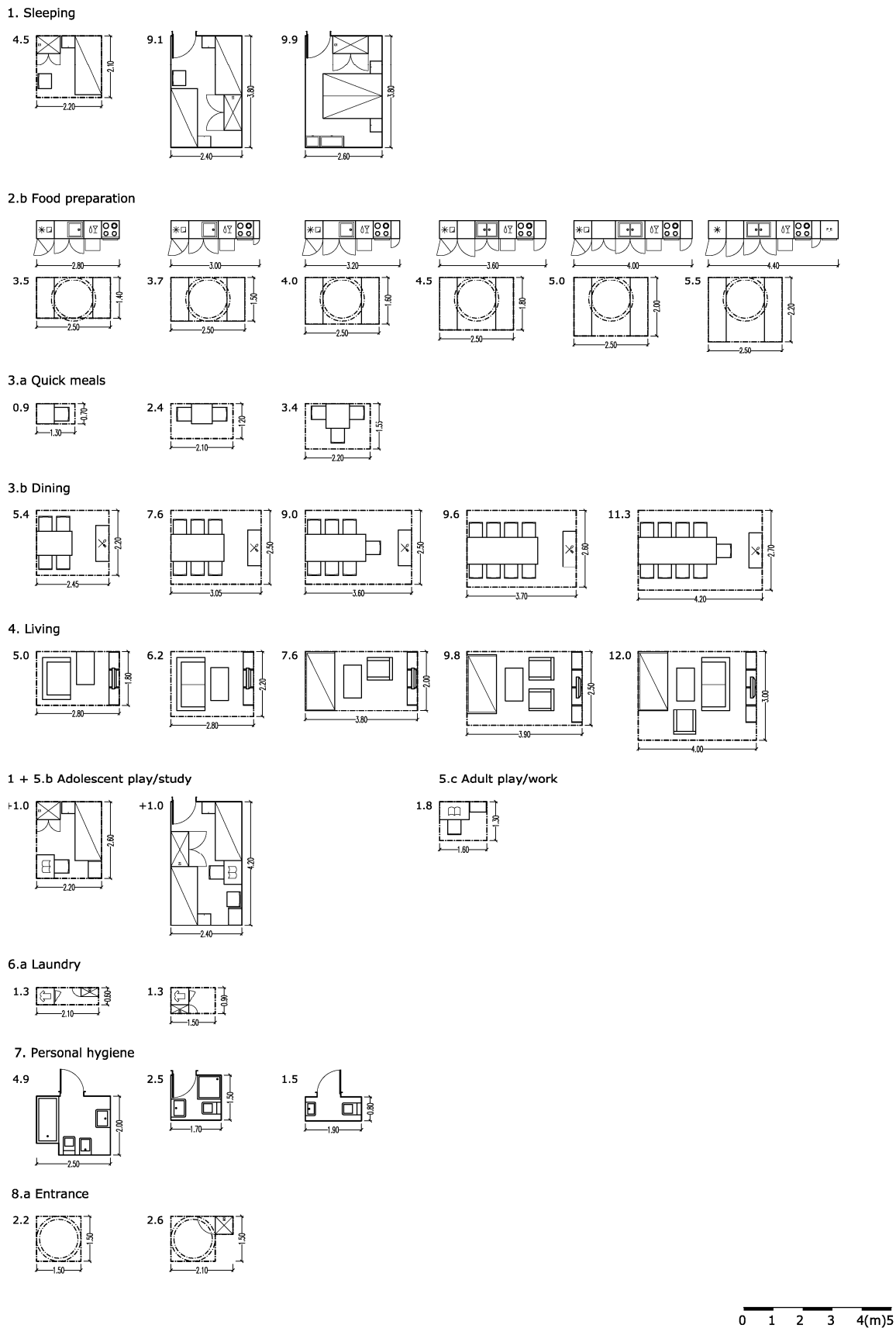


Figure 2. Minimum level – Models of functional spaces and their area (m²).

Table 1. Basic level – Area for each functional space (m²).

Functional space			Number of occupants								
			1	2	3	4	5	6	7	8	9
1	Sleeping	Double		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
		Twin				7.0	7.0	7.0	7.0	7.0	7.0
		Twin						7.0	7.0	7.0	7.0
		Twin								7.0	7.0
		Single	4.0		4.0		4.0		4.0		4.0
2	Cooking	Food storage	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0
		Food preparation	2.5	2.5	3.0	3.0	3.5	3.5	4.0	4.0	4.5
3	Eating	Dining	2.5	3.0	3.5	4.5	5.5	6.5	7.5	8.5	9.5
4	Living		4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
5	Play/study/work	Adult play/work	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
6	Clothes care	Laundry	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Drying clothes	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
7	Personal hygiene	Main	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0
		Second						1.5	1.5	1.5	1.5
8	Circulation	Entrance	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0
		Communication	1.0	2.0	3.0	3.5	4.0	4.0	4.0	5.5	6.0
9	Domestic manag.	General storage	0.5	1.0	1.0	1.5	1.5	1.5	1.5	2.0	2.0

Table 2. Minimum level – Area for each functional space (m²).

Functional space			Number of occupants								
			1	2	3	4	5	6	7	8	9
1	Sleeping	Double		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		Twin				9.0	9.0	9.0	9.0	9.0	9.0
		Twin						9.0	9.0	9.0	9.0
		Twin								9.0	9.0
		Single	4.5		4.5		4.5		4.5		4.5
2	Cooking	Food storage	0.5	0.5	0.5	1.0	1.0	1.0	1.5	1.5	1.5
		Food preparation	3.5	3.5	4.0	4.0	4.5	4.5	5.0	5.0	5.5
3	Eating	Quick meals		1.5	2.0	2.5	2.5	3.0	3.0	3.5	3.5
		Dining	5.0	5.0	5.5	6.0	7.0	8.0	9.0	10.0	11.0
4	Living		6.5	6.5	7.0	8.0	9.0	10.0	11.0	12.0	13.0
5	Play/study/work	Adolescents			1.0	1.5	2.0	2.5	3.0	3.5	4.0
		Adults	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
6	Clothes care	Laundry	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Drying clothes	0.5	0.5	0.5	1.0	1.0	1.0	1.5	1.5	1.5
7	Personal hygiene	Main	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		Second					1.5	2.5	2.5	2.5	2.5
		Third									1.5
8	Circulation	Entrance	1.5	1.5	1.5	2.0	2.0	2.0	2.5	2.5	2.5
		Communication	1.5	3.0	4.5	5.0	5.0	5.5	5.5	6.5	6.5
9	Domestic manag.	General storage	1.5	1.5	2.0	2.0	2.0	2.0	2.0	2.5	2.5

Table 3. Net internal area for basic and minimum levels (m²).

Quality level	Number of occupants								
	1	2	3	4	5	6	7	8	9
Basic level	21	28	35	42	49	56	63	70	77
Minimum level	32	41	50	59	68	77	86	95	104

5 COMPARISON

5.1 Comparison with area standards established in Portuguese building regulations

The resulting net internal dwelling areas were compared with the minimum requirements set by *General Building Regulations* (Decree-Law No. 38 382). The conclusions are that:

- The area set for the basic level is 15% to 20% lower than the area established by the *General Building Regulations* for new dwellings. This decrease is understandable since the basic level is intended to verify whether existing dwellings, many of which were built before the current space standards came into force, meet minimum habitability conditions.
- The area set for the minimum level is 5% to 15% higher than the area established by the *General Building Regulations*. This increase is due to two main changes: the toilet and bathroom include clear space for a disabled person to move, and there is additional area for the play/study/work function, which increases the area of the bedrooms.

5.2 Comparison with Portuguese statistics on housing construction

The evolution of the area of new dwellings in Portugal from 1996 to 2007 was analyzed. It was verified that the average habitable area of a dwelling increased gradually throughout the analyzed period, from 81.0 m² in 1996 to 95.2 m² in 2007. When comparing the total habitable area of the licensed dwellings with the total habitable area of the same dwellings according to the minimum requirements set by the *General Building Regulations*, it was verified that in 1996 the first were on average 192% of the second, and that this percentage increased to 221% in 2007 (INE 2008).

The conclusion is that, on average, dwellings are twice as big as the minimum requirements. Therefore, if the minimum level was adopted as a mandatory standard for the construction of new dwellings the impact would be small.

5.3 Comparison with area standards in other European countries

In Belgium, Spain, Finland, France and the Netherlands there are space standards included in the mandatory technical regulations. In Ireland, England and Wales Norway, and Sweden there are no quantitative area standards for dwellings in mandatory technical regulations. However, in some of these countries there are area standards that apply only to some types of developments (e.g. Ireland, England). Table 4 presents the internal net area of dwellings for several European countries.

Table 4. Net internal area set in several European countries (m²).

Country	Number of occupants								
	1	2	3	4	5	6	7	8	9
Proposal: basic level (existing housing)	21	27	35	42	49	56	63	70	77
Proposal: minimum level (new housing)	32	41	50	59	68	77	86	95	104
Spain (new and existing housing)		20	30	40	48	56	64	72	80
Finland (new housing)	20								
France (new housing)	14	28	42	56	66	76	86	96	106
The Netherlands (existing housing)		24							
The Netherlands (new housing)		43.6							
England (new housing)*	37	44	57	67	81	92	105		
Ireland (new housing)*		39	54	63	74	81	91		

* Adapted values and not mandatory

The conclusions are that there is a strong similarity of the basic level with the requirement in Spain, both applying to existing dwellings; in France similarity between the minimum level and the requirement is also strong, but only in dwellings for more than 3 occupants; the floor area guidelines in England and Ireland are greater than the requirements of other countries, which is reasonable since they are not mandatory for all developments.

6 CONCLUSIONS AND DISCUSSION

6.1 Conclusions

There should be an increase of 5% to 15% of the net internal area presently established in the Portuguese building regulations for new dwellings. The building regulations should also set a minimum net internal area for construction on existing dwellings, which can be 15% to 20% lower than what is presently established. If these proposals were adopted, the impact in the construction industry would be small. The proposals are similar to the mandatory net area requirements set in France and Spain.

6.2 Discussion

The paper focuses on the overall internal floor space of the dwelling. This parameter enables to study and compare the total size of a dwelling. However, other space standard parameters are also important to ensure a functional dwelling.

Area standards were established in order to meet the needs of occupants in contemporary Portugal. These needs are determined in part by social, cultural and economic factors. Therefore, the area standards should not be applied to different contexts without adaptation.

The area standards are a 'safety net' intended to prevent the development of dwellings with inadequate space, which raise significant concerns about long-term sustainability and suitability for the designed level of occupancy. The area standards are not 'good practice' guidelines.

The increasing amount of diversity in the composition of households and acceleration in the changing ways of life justify the need for dwelling flexibility. Flexibility discourages dwelling mobility and renovation work, and contributes to extending the service life of buildings. Neither the change in needs of occupants nor an increase in area to allow greater flexibility was anticipated.

The area standards drew upon a function-based and user-oriented approach. User satisfaction with existing dwellings and stakeholder views were not investigated. Should the proposed standards be used to replace the mandatory *General Building Regulations* requirements, they should be critically assessed in terms of these two sources of information.

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