THE PORTUGUESE TOOL FOR THE CLASSIFICATION OF THE WATER EFFICIENCY OF BUILDINGS

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Introduction

- Considering climate change predictions, Portugal is a Mediterranean country that presents a high risk of hydric stress in the short/medium term. For this reason, it is urgent to develop increased water efficiency measures in all sectors.
- The National Program for the Efficient Use of Water (PNUEA) has proposed the development of mechanisms for the evaluation and classification of buildings in terms of their global efficiency in water use, to inform and promote awareness on this issue. The intention is to develop a model similar to that which has already been implemented in Europe in the field of energy efficiency, with mandatory application.

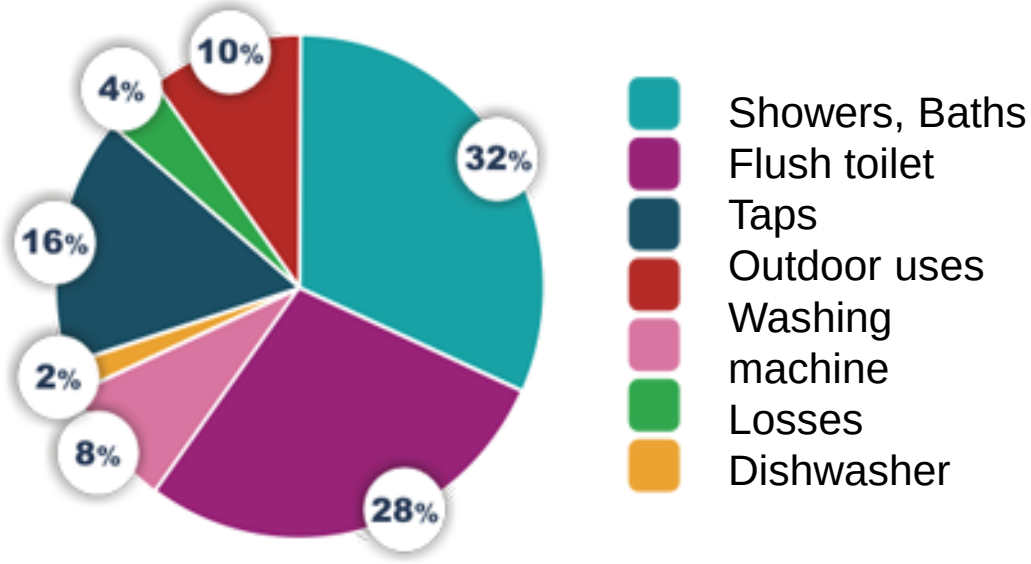
Introduction

- In this context, ANQIP (Portuguese technical and scientific association of universities and companies, which develops activity in the field of water efficiency in buildings) decided to study two methodologies for this purpose and propose their adoption by the Portuguese Government.
- One of these methodologies, which is presented in this paper, is based on a relatively simple and easily generalizable calculator, with analogies in relation to the BRE (Building Research Establishment) calculator developed in the United Kingdom, but also with significant differences in relation to the latter, based on the different realities and habits of the populations.
- The other methodology, more demanding in terms of computational resources, is based on Fuzzy Logic, and is not presented in this paper.

Methodology

- The Portuguese calculator is expressed in a base table, using up to its completion several auxiliary tables; it can be applied either to new buildings or those already in use, and is easily generalized for non-residential buildings.
- Consumption estimated in Portugal in the urban environment is 137 liters per person per day, excluding losses in public networks, and over the past few years this number has been stable. In reality, this value depends on the characteristics of the building and habits of the occupants, and it should be seen in weighted average terms.
- This figure includes losses (household leaks) and outdoor uses with drinking water, which are estimated at about 14%, and which were accounted for in the model separately.

Methodology



Methodology

- Thus, taking a value of 125 L/(person.day) as the average reference consumption, the following consumption categories are established in the model, assuming that this average value is the medium letter (C), and considering increments in a proportion similar to the one adopted in the Portuguese scheme of certification and labeling of products.

Category	Consumption of drinking water from public network
A^{++}	$0 < c \leq 60$
A^{+}	$60 < c \leq 80$
A	$80 \leq c \leq 90$
B	$90 < c \leq 115$
C	$115 < c \leq 145$
D	$145 < c \leq 180$
E	$c > 180$

Methodology

- We assume the possible use of alternative sources, recycling or reuse, in particular with regard to categories A + and A ++. We can also consider in the future a category A +++ for "regenerative" systems with excess production of drinking water from alternative local sources (such as rainwater or saltwater).

- For application of the model, the losses are distributed in percentage terms, adopting the same criteria in relation to outdoor uses, which are accounted for separately.

Methodology

- In respect to the baths, it is known that the use of the shower tub as an alternative is not relevant in Portugal. So the tubs equipped with a shower system will be considered as showers for the purposes of the model.
- For some outdoor uses, such as green areas or pools (evaporation), there is an auxiliary table with the values to consider.

Methodology

- Since products labelled in water efficiency category D are the most common in Portugal, according to audits of ANQIP (except in the case of showers, where the letter C is more common), the minimum consumption for category D (or C in the case of showers) is taken as a calculation of consumption for the purpose of determining the “usage factor”.
- Two corrections are introduced in the model, one to consider that maximum opening of the taps is not always practiced, for comfort reasons, and the other to consider the reduction in the times of opening when there is return circuits.

Methodology

- Based on the value of 125 L/(person.day) and established assumptions, the following values for use factors are obtained:

- Flushing cistern (category D = volume of 7 liters):
  - $0{,}33 \times \frac{125}{7} = 5{,}9$ uses/(person.day)

- Showers (category C = flow of 9 L/min):
  - $0{,}37 \times \frac{125}{9} = 5{,}1$ min/(person.day)

- Washbasin taps (category D = 9,0 L/min):
  - $0{,}06 \times \frac{125}{9} = 0{,}8$ min/(person.day)

- Kitchen taps (category D = 12,0 L/min):
  - $0{,}12 \times \frac{125}{12} = 1{,}3$ min/(person.day)

Methodology

- The so-called "fixed uses" of taps, which are considered, for example, in the BRE model to include some consumptions that are independent of the number of residents (the filler of the sink for dishwashing, basin filling, etc.) are not considered in this model, as a correction factor can be established to cover these situations, as referred to later.
- The unit values of reference for the flow rates or volumes to adopt the model for the various categories of products were based on ANQIP's Technical Specifications 0804, 0806, and 0808 for the labelling of products. For dual flush cisterns, for example, we have considered a volume of calculation in the proportion of two reduced discharges and one complete discharge.

Methodology

- In the case of certification of old buildings with devices that are not labeled, consumption or volumes can be locally measured.
- The correction factors that are indicated in the base table calculator take into account the existence of consumption not encompassed in the model (bidets, fixed use, etc.) which are not considered viable for intervention to reduce consumption, as well as the necessity of setting the results of the model application to the proposed classification for the buildings, as explained below.

Methodology

- The correction factors have a multiplicative component and additive components for the washing machine and dishwasher.
- As regards the multiplicative component, the value was set at 1.1, trying to match the current dwellings equipped only with devices with the label A with a rating of the building also in Category A. Obviously, this correction factor will be different for non-residential buildings, and will need a preliminary study in each case.
- With regard to washing machines and dishwashers, the value to be used in the calculation can be corrected with machine efficiency, as shown in the base table of the calculator.

Methodology

- As regards the use of rainwater and reuse of grey water, the model has auxiliary tables for their weighting.

Type of installation		Units	Volume/ Flow (average) (a)	Factor of use (b)	liters/(person/day) (c)= [(a)x(b)]
Flush Cistern		liters			
Sink taps		liters /min			
Showers		liters /min			
Kitchen taps		liters /min			
Total consumption calculated = sum of column (c) = (1)		L/(person.day)			
Correction factors	Multiplicative (2)				1,1
	Washing machine	L/wash	L =		
		L/(person.day)	(3)	10 x L/45=	
	Dishwasher	L/wash	L' =		
		L/(person.day)	(4)	2,5 x L'/10 =	
Contribution of grey water recycling = (5)		liters/(person.day)			
Contribution of rainwater harvesting = (6)		liters/(person.day)			
Total water consumed = [(1)x(2)+(3)+(4)-(5)-(6)] = (7)		liters/(person.day)			
Outdoor uses (8)		liters/(person.day)			
Total reference consumption (c)= (7) + (8) = (9)		liters/(person.day)			
Building rating of water efficiency					

Results and Discussion

- The following case study illustrates the application of the model and the results obtained. This case study is based on an existent house with about 100 m^2, with the devices listed in the following table.

Device	Number	Category of water efficiency (Label ANQIP)	Consumption (L/min) or (L/wash)
Flushing cistern	2	A	-
Shower	2	-	7,5 (average)
Sink tap	2	-	4,0 (average)
Kitchen tap	1	-	7,0 (average)
Washing machine	1	(Energy efficiency A^+)	39,0
Dishwasher	1	(Energy efficiency A^+)	12,0

Results and Discussion

- The result obtained with the calculator application appears in next Table.

Type of installation		Units	Volume/ Flow (average) (a)	Factor of use (b)	liters/(person/day) (c)= [(a)x(b)]
Flushing cistern		Liters	4,0	5,9	23,6
Sink taps		liters /min	4,0	1,6	6,4
Showers		liters /min	7,5	6,1	45,8
Kitchen taps		liters /min	7,0	2,4	16,8
Total consumption calculated = sum of column (c) = (1)		liters/(person.day)			92,6
Correction factors	Multiplicative (2)				1,1
	Washing machine	L/wash	L =	39	
		L/(person.dia)	(2)	10 x L/45 =	8,7
	Dishwasher	L/wash	L' =	12	
		L/(person.dia)	(3)	2,5 x L'/10 =	3,0
Contribution of grey water recycling = (4)		liters/(person.day)			0
Contribution of rainwater harvesting = (5)		liters/(person.day)			0
Total water consumed = [(1)x(2)+(3)+(4)-(5)-(6)] = (7)		liters/(person.day)			113,6
Outdoor uses (8)		liters/(person.day)			0
Total reference consumption (c) = (7) + (8) = (9)		liters/(person.day)			113,6
Building rating of water efficiency				B	





Results and Discussion

- The result obtained in this case study (B) reflects a reasonable level of water efficiency, but also reveals potential increase of this efficiency, especially in terms of the installation of more efficient devices (showers and kitchen taps have flow rates equivalent to category B of the ANQIP labeling system), and even the possibility of installation of a sanitary hot water return circuit.
- Rainwater harvesting and the reuse of gray water are difficult to implement in an existing building of the type analyzed, with no significant technical economic feasibility.

Conclusions

- In Portugal, the need for increased efficiency in water use in the urban water cycle corresponds to an environmental imperative and a strategic necessity, given the risk of water stress in the country, and has justified the development of a specific framework to evaluate the water efficiency of buildings, adapted to Portuguese reality.
- The model assesses the global water efficiency in buildings, in relation to the water cycle, as well as analyzing and providing guidance on measures that can be implemented to improve their performance.

Conclusions

- With the proposed model, a set of procedures and criteria is established in order to standardize the assessment of water efficiency in buildings, assigning an indicative rating of this performance and also creating a methodology to integrate water resources within a more comprehensive framework for the environmental sustainability rating of buildings.
- The methodology has been recognized and is expected to be implemented in a short time by the governmental entity that currently manages the certification system of energy efficiency in Portuguese buildings.

Thank you very much for your attention!

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