Construction Technology in Europe

ENBRI

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Adaptive thermal comfort for buildings in Portugal

Expectations regarding the thermal comfort of indoor environments in buildings have significantly changed as a result of the generalised use of air conditioning (AC) in both work and public spaces and, from the modification, either justified or not, of the required comfort standards.

Figure 1 Field Surveys

Existing conventional comfort standards, that are largely responsible for the use of AC, are based on complex equations resultant from laboratory research. By the very nature of the laboratory derivation of these conventional standards, adaptive processes found in the real world have been limited or eliminated.

Alternate comfort criteria have been proposed using models based on the so-called adaptive theory of thermal comfort. Adaptive models assume indoor temperature variations which are dependent on outdoor temperatures to stimulate and to enable adaptive opportunities and actions. The final (desirable) results could be the users´ well-being and a reduction of energy consumption without compromising thermal comfort. Nowadays, adaptive models are already incorporated in some international thermal comfort standards. Nevertheless, the implementation of this alternate comfort criterion is dependent upon contextual factors specific to each region.

Like many other countries, indoor thermal reference conditions are defined in Portuguese thermal and energy regulations in a static way: indoor air temperature of 20ºC (heating season) or 25ºC (cooling season).

In this context a study was carried out at LNEC with two main goals:

(1) To evaluate the conditions, both environmental (objective) and psychosocial (subjective), of thermal comfort in indoor environments

(2) To develop an adaptive model for characterising and defining the thermal comfort conditions applicable to buildings in Portugal.

For this purpose, field surveys (Fig. 1) were performed on service buildings (office and educational buildings) and residential buildings (conventional and homes for the elderly). The information was gathered from the measurement of the environmental parameters (indoor and outdoor) and the completion of questionnaires (with the support of social scientists); during summer, mid-season and winter (Table 1).

The study has shown that in Portugal 'ideal' reference temperatures are unrealistic, and in fact people can feel comfortable in a much broader range of temperatures, depending on the local climate and building type construction, thus confirming the results from adaptive

Table 1 Sample building and field survey distribution

Building type		Surveys			Questionnaires
		summer	mid-season	winter	
Service	Office (9)	52	26	52	690
	Educational (6)	7	9	22	945
Residential	Conventional (4)	—	—	32	34
	Elderly homes (21)	34	15	36	698
Total (40)		93	50	142	2367

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In brief

EU Greenhouse gas emission decrease
Greenhouse gas emissions continue to decrease in the EU, according to the Annual European Union Greenhouse Gas Inventory 1990-2008 and Inventory Report 2010 published by the European Environment Agency. The report finds that the EU-27 reduced their emissions by 11.3% compared with 1990, the Kyoto Protocol base year. The EU-15 posted a 6.5% cut in their GHG discharges in the same period. These reductions represent an emissions cut of 627 million tonnes CO_2 equivalents for the EU-27 and 274 million tonnes for the EU-15.

The report notes that 'The overall EU GHG emission trend is dominated by the two largest emitters, the UK and Germany, accounting for about one third of total EU-27 GHG emissions. These two Member States have achieved total GHG emission reductions of 417 million tonnes CO_2-equivalents compared to 1990.'

The report can be found in full on the EEA website at **http://eea.europa.eu/**.

Home buyers remain unconvinced by energy-efficient homes
Results from new EU research show that home buyers are unwilling to buy new, energy-efficient houses. Poor communication between builders and buyers is a big part of the problem say researchers studying the behavioral barriers to better acceptance of energy efficiency. The results are part of the CREATE ACCEPTANCE and CHANGING BEHAVIOUR projects. In the projects, a competition was organised inviting housing manufacturers to produce energy-efficient homes. Potential buyers were involved in stages of the competition and included as members of the competition jury.

House sales generated by the competition were disappointingly low. Some buyers wanted to make modifications that would render the houses no longer energy-efficient, others did not trust the information supplied to them or simply remained unconvinced of the need to be energy-efficient.

For more see CREATE ACCEPTANCE on: **http://www.createacceptance.net/home/** and CHANGING BEHAVIOUR on: **http://www.energychange.info/**

Executive Secretariat ENBRI
c/o WTCB-CSTC
Rue du Lombard, 42
1000 Brussels
Belgium
Tel +32 2 716 42 11
Fax +32 2 725 32 12
Web www.enbri.org

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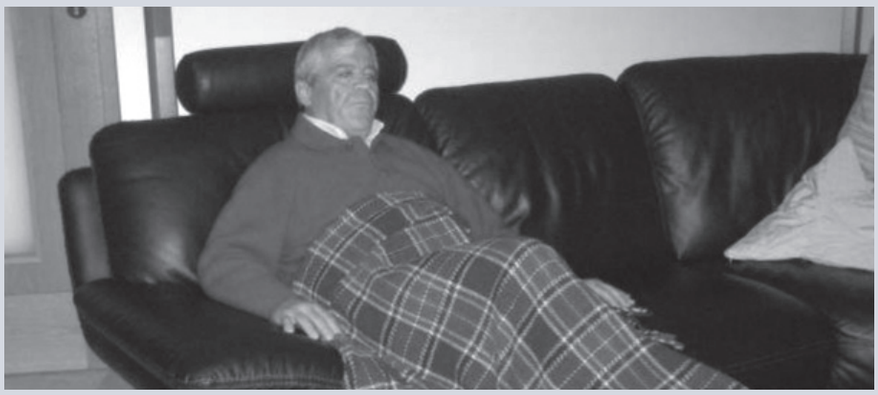

Figure 2 Samples of the 'adaptive opportunities' used by occupants to reach thermal comfort

theory research. Human capacity of adaption, either from interacting with the building and its systems, or from those resulting from social and cultural habits, are essential to reach the thermal comfort conditions (Fig. 2).

An adaptive model was developed based on the results obtained. This model characterises, the acceptable thermal comfort conditions for buildings in Portugal, by taking into account the climate, as well as social and cultural characteristics of the Portuguese population.

The proposed adaptive model intends to estimate the comfort temperature, T_{comf}, against the outside mean temperature, T_{rm}, as defined by the exponentially weighted running mean of the daily mean outdoor temperature over seven days (Fig. 3).

More detailed analysis and new surveys are required, mainly in the residential sector, to support the development of a more consolidated adaptive approach oriented to the definition of indoor thermal comfort requirements applicable to Portuguese buildings.

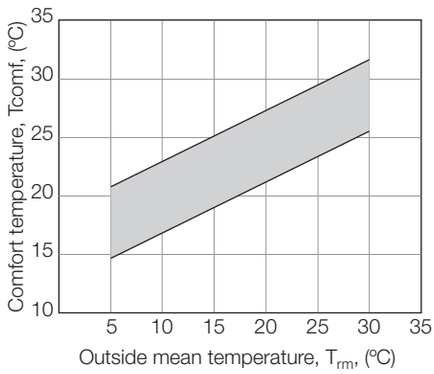

Figure 3 Proposed adaptive model

In the near future, this model is expected to contribute to the development of sustainable energy regulations better suited to Portugal.

For further information please contact:
Luis Matias
Tel: +351 21 8443832
Fax: +351 21 8443027
E-mail: lmatias@lnec.pt