

An investigation of the appropriateness of current methodologies for energy certification of Mediterranean housing



Alan Abela^{a,1}, Mike Hoxley^{a,*}, Paddy McGrath^a, Steve Goodhew^b

^a Nottingham Trent University, Nottingham, UK

^b University of Plymouth, Plymouth, UK

ARTICLE INFO

Article history:

Received 4 April 2016

Received in revised form 23 June 2016

Accepted 25 July 2016

Available online 20 August 2016

Keywords:

Energy certification
Mediterranean region
Dwellings
Methodologies

ABSTRACT

The Energy Performance of Buildings Directives (EPBDs) are political initiatives taken by the European Union to tackle the problems of climate change and security of energy supply. One of the key measures of these directives is the use of Energy Performance Certificates (EPCs) to model the energy performance of housing. This research investigates whether the current calculation methodologies in use for the generation of EPCs in the Mediterranean are appropriate. The analysis was carried out by comparative testing using different national methodologies from Cyprus, Italy, Malta and Spain on four test case study dwellings. The test results were validated against the output from dynamic simulation software and against monitored temperature and energy data from the test case properties. Considerable differences in the outputs from the various national methodologies currently in use were found. It was concluded that several of the EPC calculation methodologies have not been calibrated against the energy profile representative of the national or regional building stock; accurate definition of the operating parameters for the heating and cooling system is particularly significant if a more precise prediction of the energy performance of the dwelling is required; and the underlying assumptions made by the national application of the EN ISO 13790 standard for the calculation of the energy use for space heating and cooling have a greater influence on the outputs from the certification methodology than the choice of calculation method. It is quite clear that calibration of the EPC methodology is essential for the certificates to provide an effective means of achieving the aims of the EPBD. However, at a conceptual level, the results from this research have also shown that the mild Mediterranean climate with its inherently low energy demand for residential space heating and cooling could justify a different regional approach to tackle the EPBD goals of reduction in carbon emissions and dependency on imported fuels.

© 2016 Published by Elsevier B.V.

1. Introduction

This research investigated the methodologies implemented for energy certification of housing in the Mediterranean region of Europe, specifically Cyprus, Italy, Malta, and Spain. The methodologies were applied to four test case properties, which were also modelled using the dynamic simulation software IES-VE. Actual internal conditions and energy consumption of the test case properties were metered and analysed. The predicted energy performance generated by the methodologies was compared to the dynamic simulation models generated by IES-VE and the metered data from the test case properties. The objective was to determine whether the

certification methodologies provide an accurately calculated value of energy demand in Mediterranean housing.

The Energy Performance of Buildings Directives (EPBDs) form part of the initiatives taken by the European Community in relation to climate change and the security of energy supply. The first directive 2002/91/EEC [14] was intended to counteract the increasing dependence of the European Community on external energy sources, as well as to meet commitments made under the Kyoto Protocol to cap and to reduce greenhouse gas emissions. The energy certificates calculated by the methodologies are one of the main outcomes of the EPBD. According to the results of the European Commission's Internal Market Scoreboard, the EPBD was the worst performer in terms of transposition before the deadline date of May 2006 with nine countries (Belgium, Greece, France, Cyprus, Luxembourg, Hungary, Malta, Austria, Slovenia) failing to fully transpose the directive as at May 2008 [13]. A comparative analysis of progress towards implementation in the member states

* Corresponding author.

E-mail address: UKmike.hoxley@ntu.ac.uk (M. Hoxley).

¹ HVAC Consultant at BRE (Building Research Establishment), Watford, United Kingdom, UK.

revealed significant diversity and found that only some member states managed to fully implement the directive with most countries still at the half way point [3], and a small number still in the early stages of implementation [2]. Whilst the first EPBD was clearly a step in this direction, it became necessary for the European Commission to implement more concrete strategies to achieve the great unrealised potential for energy savings in buildings and to reduce the large differences between Member States' results in this sector [15]. The recast directive was approved on the 19th May 2010, and was intended to strengthen the energy performance requirements and to clarify and streamline some of the provisions from the 2002 Directive it replaced. One of the key features introduced by the 2010 recast directive was the introduction of a requirement for property advertisements to include the energy performance certificate.

The certificates themselves, and the data contained therein, constitute a measure of the energy efficiency of the certified buildings. The generation of energy certificates which bear no relationship to the actual or the typical energy use of the national building stock is detrimental to both the effectiveness of the certificates and the aims of the EPBD. Whilst there are a number of mature certification schemes in north and central Europe, the concept of energy efficiency in relation to building performance, particularly in the residential sector, is relatively recent in southern Europe. Furthermore, the energy performance of housing in south Europe has to consider air-conditioning in summer and heating in winter, whereas in the north and central Europe, the focus is exclusively on winter heating. The effect of the summer air-conditioning load can clearly be seen in Fig. 1 which compares data from Malta and Cyprus.

2. Theory

The first part of this study examined the state of existing research into the validity of the EPC as a tool to accelerate the transformation of the existing housing stock into low-energy dwellings, within the context of Mediterranean housing. It was found that the effectiveness of EPCs was restricted and that the expected impact on energy and financial savings had not been attained, mainly due to difficulties in implementation, monitoring, and quality control of the energy certification of buildings [40,3,11]. Insofar as research into Mediterranean housing is concerned, the focus is on the differences between north and south Europe, and the increasing use of air-conditioning [43,29]. Several researchers have regarded traditional housing as a reference model for energy efficient design [10,27,44,50,17], while others have investigated new and innovative techniques and materials for low energy housing [47,48,36,18].

The main emphasis is on research into the effects of insulation, thermal mass, ventilation, and shading [35,9,12], but examples of the development and construction of high performance energy saving buildings in the region are clearly limited [23,41,17]. Some work has been done on the analysis of the certification methodologies in the region [19], but the amount of published research which includes both cooling and heating performance is limited [5]. The majority of residential certification methodologies are based on the quasi steady state method proposed by EN ISO 13790, and researchers have often compared the results obtained to those produced by a dynamic simulation model generated by TRNSYS, EnergyPlus, IES VE, or similar programs [4,30,34,20,37]. Analyses of the implementation of the EN ISO 13790 steady state methodology have generally found that this required calibration in order to produce results significantly close to those obtained by dynamic simulation [24,8,33,45,25,46]. The parameters requiring calibration are the utilisation factors, the building reference time constant and the numerical coefficient. Comparisons of the output from EPC calculations to the measured energy are rather less frequent, but the few published studies generally identify significant differences between the measured and the calculated cooling loads [7,28]. These differences have generally been attributed to discrepancies between the assumptions made by the calculation methodology and the actual occupants' behaviour and lifestyle [6]. In north and central European countries, where the domestic energy profile is dominated by space heating, and cooling is practically non-existent, studies comparing certificate values and actual energy use found significant differences between the two. When the EPC data is extended to calculate the projected savings from energy performance improvements to the building, it was found that the actual savings would probably not exceed 50% of the value of the calculated savings [42,49]. These differences between actual and calculated energy performance are at the heart of widespread criticism of the EPC, and could also be part of the cause of general reluctance to adopt and implement the energy performance certification system for buildings.

3. Research approach

Following the literature review, the principal and subsidiary research questions (a-c) were formulated:

To establish whether the current certification methodologies used in South Europe (Malta, Italy, Spain, Cyprus) provide an accurately calculated value of energy demand in Mediterranean housing.

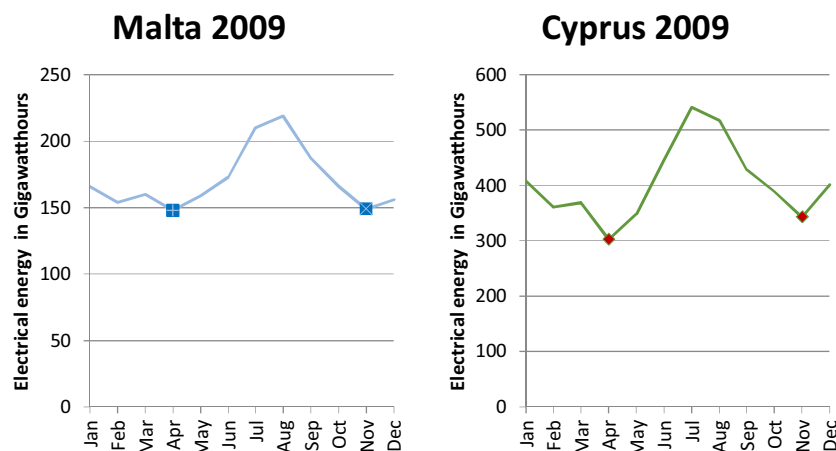


Fig. 1. Monthly electrical energy available for Malta and Cyprus 2009 [16].

Download English Version:

<https://daneshyari.com/en/article/4919588>

Download Persian Version:

<https://daneshyari.com/article/4919588>

[Daneshyari.com](https://daneshyari.com)