Regulations for lighting in Europe

Paul Littlefair, Dr
BRE, Garston, WATFORD WD25 9XX, UK
Email: littlefairp@bre.co.uk

Anthony Slater
BRE, Garston, WATFORD WD25 9XX, UK
Email: slaterai@bre.co.uk

KEYWORDS

lighting, energy efficiency, building regulations, building energy codes, lighting energy calculation

ABSTRACT

This paper presents a survey of lighting in building energy regulations in European countries. Of the eighteen nations, seven had nothing on lighting in their building energy regulations though most had separate standards on lighting provision. Five more countries had default values for lighting in their building energy calculation procedures, though it was not possible to use more efficient lighting to offset higher energy consumption elsewhere.

Four countries had, or are planning, a detailed calculation procedure for lighting as part of their building energy requirement. In each case the energy consumed by lighting in the building can be estimated and then included in the predicted overall building energy consumption. Installing more efficient lighting will therefore make it easier to achieve the overall building target.

Among the countries surveyed, the UK is unique in having a specific requirement for efficient lighting in its energy regulations. Revised Building Regulations dealing with conservation of fuel and power came into force in England and Wales in April 2002. These introduce some new requirements and tighten existing requirements. For the first time, requirements are introduced for new dwellings. Existing requirements for lighting in buildings other than dwellings are extended to cover luminaire efficiency in offices, industrial and storage buildings.

INTRODUCTION

This paper presents the results of a survey of eighteen European countries that provided information on the lighting requirements in their building energy regulations. These included all the EU countries except Luxembourg, plus Lithuania, Norway, Switzerland, and Yugoslavia.

Some of the national regulations included energy calculation methods with a lighting component. This paper summarises the responses and compares the different national approaches. It also presents the new measures in the 2002 edition of the Building Regulations Approved Document for England and Wales.

RESULTS OF SURVEY

Of the eighteen nations, seven had nothing on lighting in their energy regulations. These were

Austria
Germany
Italy
Spain (although there is a draft standard in preparation)
Sweden
Switzerland
Yugoslavia

In most of the above countries there were separate standards on lighting provision, for example giving recommended illuminances in some types of building. These standards could be mandatory, but they did not form part of the energy regulations.

In Denmark there is a detailed mandatory standard for lighting in workplaces. This contains a short section on energy efficiency which asks the designer whether lighting is

as energy efficient as possible, and whether suitable lighting controls have been installed in different zones of the building. However there are no numerical requirements for energy efficiency; other Danish standards recommend W/m2 maxima in different building types, but these are non-mandatory.

Five more countries had default values for lighting in their building energy calculation procedures. They were

Finland
Ireland (optional calculation for dwellings only)
Lithuania
Norway
Portugal

Typically these default values would depend on the type of building. Lithuania's was the most complex of these; it specified 14 different types of building and the hours of use of the lighting system were included. However in each of the five national procedures, it was not possible to use more efficient lighting to offset, for example, higher energy consumption elsewhere. Thus these do not act as an incentive to install energy efficient lighting.

Within the UK, the building regulations contain a requirement that lighting systems in non domestic buildings be energy efficient. This can be met in a variety of ways, explained later on in this paper.

Finally, four countries had, or were planning, a detailed calculation procedure for lighting as part of their building energy requirement. In each case the energy consumed by lighting in the building can be estimated and then included in the predicted overall building energy consumption. Installing more efficient lighting will therefore make it easier to achieve the overall building target. These countries were

Belgium (Flemish region only, probably from 1 January 2004)
France
Greece (draft, due to come into force in the future)
Netherlands

These calculation procedures are described in more detail below.

CALCULATION PROCEDURES

Each of the calculation procedures estimated an overall average energy or power consumption for the lighting in the building. In the Greek regulations this was in W/m2; kWh of primary energy in France, and MJ of primary energy in Belgium and the Netherlands.

The four national calculation procedures had a number of similarities. Each involved dividing the building into zones. This could be done according to whether the zone was daylit, the type of use of the zone or the type of lighting system. For each zone the energy consumed was found by multiplying an installed load in Watts by the area of the zone, the hours of use of the space and by factors which depended on the type of control system and whether the space was daylit or non daylit.

But there were differences between the different methods. For example in the Greek regulation, only the lamp wattages were taken into account; discharge lamp wattages were multiplied by a default factor of 1.2 to allow for ballast power. In the French calculation, lamp and ballast Watts were used. The Belgian regulations went one step further, including the consumption of sensors used for lighting control as well as the lamps and ballasts. Including actual ballast wattages does give an incentive to install more efficient electronic types.

Although all four methods included daylight, in the Dutch regulations only a crude 'daylit zone' allowance was included. The French calculation was similar, but included an extra factor for climate zone (presumably not required in the smaller nations). The Belgian regulations include a 'daylit zone' procedure, and also an option of a detailed daylight calculation (with a daylight factor of 3% defining the daylit zone). Finally the Greek procedure was much more detailed here, with a full calculation of daylight factor.

Various defaults were possible, either to avoid doing the calculation or in cases where the actual lighting loads were unknown (for example in a building which was to be fitted out by a tenant at a later date). For example, one option in the Belgian regulations allowed a blanket 20W/m2 to be assumed as the lighting power. This is higher than would normally be installed, and perhaps might mean that extra thermal insulation, or more efficient heating, could be required to meet the overall energy standard for a building. But it would save calculation time for the designer.

Under-installation is a potential problem with this sort of regulation. When built, the building could contain a very basic lighting system, which has a low energy consumption but provides low illuminances. Once the building has been shown to meet the energy standard, extra lighting is installed later on. The French procedure gets round this problem by comparing the building with a reference one where the lighting provides the same illuminance.

The calculation procedures are used for non domestic buildings (in Belgium, offices and schools only), with some exemptions. In Greece, a simplified form of the procedure is proposed for dwellings.

Various forms of lighting are exempt from the procedure in each country. These could include display lighting, portable lighting, external lighting or decorative lighting. Emergency lighting was exempt in all four countries.

NEW REGULATIONS IN ENGLAND AND WALES

In England and Wales, part L of the Building Regulations deals with the conservation of fuel and power. Since the 1995 edition, Part L has included requirements for energy efficient lighting. In the edition due to come into force in April 2002, these requirements have been revised and extended.

The requirements of the Building Regulations are brief and functional performance statements; for example for non-domestic buildings the requirement is to 'provide lighting systems which are energy efficient.' An Approved Document or AD (ref 1) gives guidance on ways of complying with the requirements. The solutions in the Ap-

proved Document do not have to be adopted, but if they are not then compliance must be demonstrated in another way. A similar approach is adopted in Scotland, although the detailed lighting measures are different.

For lighting (ref 2) the changes include

- A requirement for energy efficient lighting in dwellings. The recommendations cover both internal and external lighting. Inside a new house, the Approved Document (AD) suggests installing a minimum number of fittings or sockets that can only take energy efficient lamps such as compact fluorescent lamps. External lighting would comply if it automatically went out in daylight, and when not required at night (for example if it had a presence detector that turned the light on for a limited time). It would also comply if it could only be used with energy efficient lamps, such as compact fluorescent. The aim is to avoid inefficient tungsten outdoor lighting being left on continuously.
- New recommendations for office, industrial and storage buildings. The AD introduces the concept of luminaire efficacy, which includes the light output ratio of the luminaire and corrections for type of lighting control, as well as the efficacy of the lamp and ballast. (The previous AD concentrated on lamp and ballast efficacy, without guidance on luminaires). A potential difficulty is that some luminaire catalogues do not include photometric data and hence light output ratios are not available. However, the AD goes on to say that this guidance need not be applied to up to 500 circuit Watts of installed lighting capacity in the building. For other types of non-domestic buildings, the recommendations in the AD are still given in terms of lamp and ballast efficacy.
- Guidance on energy efficient display lighting (which was previously exempt from Part L) in buildings other than dwellings. For example, tungsten halogen and metal halide lighting would comply. The guidance only covers display lighting that is fixed to the building; portable lighting is exempt.
- Replacing the lighting systems in a non-domestic building has now become controlled work. If the new lighting covers more than 100m2 of floor area, those responsible for carrying out the work are obliged to comply with the new standards.

There are also recommendations in the AD for provision of lighting controls in buildings other than dwellings (refs 1-3).

Exterior lighting (in buildings other than dwellings), and portable lighting that is not fixed to the building, is excluded. Emergency escape lighting and specialist process lighting are also exempt from the lighting requirements. The Building Regulations requirements do not apply to lighting in non-domestic buildings with 100m2 floor area or less artificially lit.

CONCLUSIONS

Lighting represents an important part of building energy consumption in the European Union (around 10% of EU electricity consumption). However most of the countries surveyed did not have measures in their building energy regulations to encourage efficient lighting.

Of those that did, two different types of approach were identified. In the UK there is a requirement for energy efficient lighting which can be met by installing suitable lamps and controls. Four countries (Belgium, France, Greece and the Netherlands) have calculation procedures which enable energy efficient lighting to be used to help meet an overall building energy standard. Importantly, all four encourage the use of lighting controls and daylight, as well as more efficient lamps.

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ACKNOWLEDGEMENTS

This paper was produced under the research programme of the UK Department for Transport, Local Government and the Regions, and the ENPER project coordinated by the Belgian Building Research Institute and funded by the EU SAVE programme. Any views expressed are the authors' own and not necessarily those of BBRI, the European Commission or DTLR.

We would like to thank the representatives of each of the 18 countries for the time and expertise they gave to complete the survey of lighting energy regulations, and in some cases provide extra information. Their help is gratefully acknowledged.