bre

The essential guide to retail lighting

Achieving effective and energy-efficient lighting

Cosmin C Ticleanu, Paul J Littlefair and Gareth J Howlett

IHS

The essential guide to retail lighting

Achieving effective and energy-efficient lighting

Cosmin C Ticleanu, Paul J Littlefair and Gareth J Howlett

The research and writing for this publication has been funded by BRE Trust, the largest UK charity dedicated specifically to research and education in the built environment. BRE Trust uses the profits made by its trading companies to fund new research and education programmes that advance knowledge, innovation and communication for public benefit.

BRE Trust is a company limited by guarantee, registered in England and Wales (no. 3282856) and registered as a charity in England (no. 1092193) and in Scotland (no. SC039320).

Registered office: Bucknalls Lane, Garston, Watford, Herts WD25 9XX
Tel: +44 (0) 1923 664743
Email: secretary@bretrust.co.uk
www.bretrust.org.uk

IHS (NYSE: IHS) is the leading source of information, insight and analytics in critical areas that shape today's business landscape. Businesses and governments in more than 165 countries around the globe rely on the comprehensive content, expert independent analysis and flexible delivery methods of IHS to make high-impact decisions and develop strategies with speed and confidence. IHS is the exclusive publisher of BRE Trust publications.

IHS Global Ltd is a private limited company registered in England and Wales (no. 00788737).

Registered office: Willoughby Road, Bracknell, Berkshire RG12 8FB.
www.ihs.com

BRE Trust publications are available from
www.brebookshop.com
or
IHS BRE Press
Willoughby Road
Bracknell
Berkshire RG12 8FB
Tel: +44 (0) 1344 328038
Fax: +44 (0) 1344 328005
Email: brepress@ihs.com

Printed using FSC or PEFC material from sustainable forests.

FB 56

First published 2013

ISBN 978-1-84806-322-8

The authors are grateful to iGuzzini for permission to use the photograph on the front cover of the Napapijri shop in Milan, Italy.

All URLs accessed [May 2013]. Any third-party URLs are given for information and reference purposes only and BRE Trust and IHS do not control or warrant the accuracy, relevance, availability, timeliness or completeness of the information contained on any third-party website. Inclusion of any third-party details or website is not intended to reflect their importance, nor is it intended to endorse any views expressed, products or services offered, nor the companies or organisations in question.

Any views expressed in this publication are not necessarily those of BRE Trust or IHS. BRE Trust and IHS have made every effort to ensure that the information and guidance in this publication were accurate when published, but can take no responsibility for the subsequent use of this information, nor for any errors or omissions it may contain. To the extent permitted by law, BRE Trust and IHS shall not be liable for any loss, damage or expense incurred by reliance on the information or any statement contained herein.

Contents

BRE will help to make your retail business more profitable, safe, sustainable and energy efficient.

We can help with:

Building solutions

- Use our Independent expertise for technical reviews of standards and specifications for new construction, refurbishment, fit-out and management of your buildings.
- HVAC and lighting design and specification
- Fabric and façade treatment
- Interior fit-out materials performance and sustainability
- Controls, energy management and staff procedures
- Problem solving, including testing and expert witness services.

Corporate social responsibility (CSR)

Boost your brand value and profitability with including:

- Bespoke sustainability policies, targets and implementation plans
- Sustainable retail property frameworks, design guides and information for suppliers
- CSR assessment and reporting.

Safety

Protect people and property from fire and security breaches with:

- Our expertise on building security and fire safety standards, design and operation
- Approved security, passive and active fire safety, and fire detection and suppression, products, systems and services – as listed in the LPCB Red Book – www.redbooklive.com

Sustainability

Our world-leading expertise in built environment sustainability includes:

- Energy efficiency
- We will help you to plan, implement, monitor and continually improve energy efficiency measures and strategies that will reduce your costs and carbon footprint.

BREEAM

Developed by BRE, BREEAM is the international sustainability standard for buildings that is applied to new and existing buildings, refurbishments and fit-outs throughout the retail sector. It is used by developers, investors, clients and occupiers to improve their buildings and the retail environment.

www.breeam.org

Sustainability benchmarking

BRE runs the International Sustainability Alliance which benchmarks the sustainability performance of building assets, and is used extensively in the retail sector in Europe and around the world.

Retail sector clients include:

- Asda
- Audi
- British Land
- Co-operative Group
- Corio
- Cushman & Wakefield
- ECE
- H&M
- International Council of Shopping Centres (ICSC)
- John Lewis Partnership
- Marks & Spencer
- Morrisons
- Redevco
- Waitrose.

www.bre.co.uk

Foreword

The John Lewis Partnership welcomes this new publication from the BRE Trust. It comes at a critical time with energy costs increasingly affecting a store's profitability, and with the price of electricity predicted to increase dramatically, there is increasing interest among retailers in the creation of effective, energy efficient lighting schemes.

Reducing our impact on the environment is a key issue for The John Lewis partnership. Our 2013 Responsible Development Framework sets out our aspiration to design, operate and manage our estate so that it meets the needs of our customers, Partners and the wider community, and has minimal impact on the environment during construction, operation and disposal.

A key feature of the Responsible Development Framework is our desire to focus on trialling new technologies and looking for new ways of working. Successful methods are then applied across our estate.

Against the backdrop of a growing business, we are working to reduce absolute operational CO_2 equivalent emissions by 15% by 2020/21 against a 2010/11 baseline.

Energy is the single largest contributor to our operational carbon footprint. Energy is also a fundamental requirement for us to run our business and rising electricity, gas and oil prices have an impact on the cost of running our business. Developing new solutions that reduce energy consumption, cost and carbon are key to driving sustainability and profits.

Lighting is critically important to retail environments and plays a lead role in reducing energy consumption across all our properties.

The objectives for our retail lighting schemes include attracting customers into our stores, honestly displaying merchandise to its best advantage and to provide a positive customer experience and ambience which aids their navigation and journey through our stores. Factors that need to be taken into consideration when developing a scheme include reliability, maintenance, flexibility, and capital, installation and running costs from energy requirements.

We have been monitoring and testing the technical developments in LEDs for many years but previously found they were not viable for our sales floor lighting due to insufficient output and colour rendering. The availability, affordability and performance of LED lights has advanced at a remarkable pace in recent years due to the multitude of different solutions helping create a greater demand for better technology.

Following successful trials at Waitrose Stratford upon Avon and John Lewis 'At home' Ipswich stores we now specify LED lighting as standard throughout the Waitrose and John Lewis estate for new and refurbished stores. We have proven that LEDs provide significant savings in the electricity required for lighting in Waitrose and John Lewis. We have also completed a successful retrofit of LED lighting which were installed throughout Waitrose Cirencester. This gives us the confidence to roll back this technology across our estate.

Overall, we estimate LEDs will deliver at least a 10% reduction in store electricity demand compared to traditional lighting solutions. It is a great example of how we have worked with our supply chain to pioneer and drive industry to develop new lighting solutions that reduce energy consumption, cost and carbon.

For other retailers looking to develop a low energy lighting strategy we recommend BRE Trust's *The essential guide to retail lighting*. It provides retailers, architects and designers with detailed practical information and guidelines to explain how best to develop energy efficient, cost-effective lighting solutions for new and existing stores.

Nigel Keen

Director of Property Services

John Lewis Partnership

© iGuzzini: Desigual, Capucine, Paris, France

Preface

This guide was produced with the support of BRE Trust as part of its research programme. The survey of retail lighting was originally carried out for the Defra Market Transformation Programme, and the data are reproduced with permission.

The authors would like to thank Feride Sener, who carried out a review of international research on retail lighting, and produced some of the diagrams and photographs.

We would also like to thank Bill Wright of Wright Energy and Environment, who gave a presentation to a retail lighting workshop held at BRE, and to all the participants at the workshop who gave expert views on the subject. Photographs and case studies are printed with permission from retailers, lighting designers and manufacturers as acknowledged within the guide. We would like to thank them for their contributions.

© iGuzzini: Marttiini, Helsinki, Finland

Glossary

Accent lighting

Highlighting of displayed merchandise or the features of a store or building.

Average illuminance

The illuminance averaged over a specific area. In practice, this may be derived either from an average of the illuminances at a representative number of points on the surface, or from the total luminous flux falling on the surface divided by the total area of the surface. Measured in lux (lx).

Ballast or control gear

Part of the control equipment of fluorescent or discharge lamps, used to stabilise the current. The older, traditional mains-frequency ballast can consume up to 20–25% of the total lamp current. A modern electronic ballast working at high frequency consumes about 30% less current, and can be used to regulate or dim the lamp output.

Colour appearance

Visual sensation correlated with the 'warmth' or 'coolness' of the light emitted by a lamp. The metric used to characterise the colour appearance of the light emitted by a light source is the correlated colour temperature, expressed in Kelvin (K). Warm white light is produced by lamps having a colour temperature below 3000 K (reddish hues), whereas 4000 K and above (bluish) is cool and cold white light. The colour appearance is quite separate from the colour rendering of the lamp.

Colour gamut

A measure of how colourful a scene will appear under a given light source. Sources with a high colour gamut generally make objects appear brighter and more colourful.

Colour rendering

The ability of a light source to show surface colours as they should be, usually in comparison with a tungsten or daylight source. Measured on the colour rendering index (CRI) scale. A value of 0 means it is impossible to discern colours at all, and a score of 100 means no colour distortion. For most indoor lighting applications a value of at least 80 is recommended.

Compact fluorescent lamp (CFL)

Type of fluorescent lamp, designed to replace incandescent lamps. CFLs use less power, and have a longer rated life.

Correlated colour temperature (CCT)

See colour appearance.

Dichroic reflector

Lamp reflector used for display lighting that allows heat to pass through while reflecting the light in a cool beam that does not heat the display.

Directional lighting

Lighting that uses lamps or luminaires with reflectors that direct and control the light so that the light on the area or object of interest comes predominantly from a particular direction.

Discharge lamp

Lamp that produces light by discharging an electric current through a gas (neon, argon, krypton) or a gas/metal vapour mixture (mercury, sodium). For some types of discharge lamp, such as fluorescent tubes, the electrical discharge generates ultraviolet radiation, which is converted into visible light by a phosphor coating on the inner face of the glass. The type of coating determines the spectrum of the light emitted.

Driver

Device that converts supply power into the current and voltage that the semiconductor material contained in LEDs requires to emit light. The driver may also sense and correct for changes in intensity (dimming) and colour (tuning) during operation.

Efficacy

A measure of the effectiveness of a lighting installation in converting electrical power to light. Units are lumens per Watt (lm/W).

Emergency lighting

Lighting provided as a separate system for use when the main lighting fails.

Enhanced capital allowances (ECAs)

ECAs are available for the installation of energy-efficient equipment, including lighting.

Extra-low-voltage lamps

Small tungsten halogen lamps producing two or three times the light output of conventional filament lamps. Normally powered from a separate 12 V source. Apart from increased efficiency and lamp life, the heating effect is lower, which is preferable for display lighting.

Fibre optic lighting

Type of luminaire that uses a fibre optic cable to transmit the light from a lamp to a point of use. The lamp is therefore remote from the application, allowing ease of access for maintenance etc.

Flicker

Visible oscillation in the luminous flux.

General lighting

Substantially uniform lighting of an area without provision for special local requirements.

Glare

Discomfort experienced when lighting is excessively bright when viewed against the surroundings. Often the result of inadequately shielded lamps.

Illuminance

The level of light on a surface; measured in lux (lx). Previously called the illumination value. Can be used as a reference measurement of the performance of a lighting system as related to the activity. (See lux and maintained illuminance.)

Incandescent lamp

Lamp in which light is produced by a filament heated to very high temperature by an electric current.

Induction lamp

Electrodeless lamp in which an induced electromagnetic field, generated by induction coils, excites the mercury atoms in the glass tube, causing them to emit ultraviolet (UV) radiation, which is converted to visible light by the phosphor coating on the inside of the tube.

Indirect lighting

Lighting used to illuminate an area by reflection from other surfaces. The fraction of the emitted luminous flux reaching the working plane directly, assumed to be unbounded, is 0–10%.

Initial light output

The luminous flux from a lamp after 100 hours of operation.

Installed load

See power density.

Kilowatt-hour

The standard measurement of electrical consumption; equivalent to one kilowatt of electrical demand for one hour (kWh). Also known as a 'unit' of electricity.

Lamp efficacy

The ratio of the light output from a light source to the power consumed; measured in lumens per Watt (lm/W). The higher the efficacy value of a lamp or lighting system, the more energy-efficient it is. For example, the efficacy of a 60 W incandescent light bulb 12 lm/W, and of an 11 W CFL is 55 lm/W. For a 36 W fluorescent tube it is 91 lm/W. This last figure is a lamp efficacy; it excludes the power consumed by the ballast that is needed to run the discharge lamps.

Lamp lumen maintenance factor (LLMF)

Ratio of the luminous flux emitted by the lamp at a given time in its life to the initial luminous flux. Measures how the output of a lamp decreases with time.

Lamp survival factor (LSF)

The fraction of the total number of lamps that continue to operate at a given time under defined conditions and switching frequency.

LED lamp

Lamp containing a semiconductor LED that converts electrical energy into light and a driver that converts supply power into the current and voltage required by the semiconductor material to emit light.

Light output ratio (LOR)

Basic measure of the efficiency of a luminaire; the ratio of the light emitted by the luminaire to the light output of the lamps contained within it. Depends on the quality of the materials used, as well as on the basic design of the luminaire.

Light pollution

Many older luminaires serving roads and car parks lose light skywards, causing night-time sky glow. Apart from wasting energy, the appreciation of the night sky is lost and astronomical observation is more difficult. Luminaires with a cut-off have a much reduced effect on the night sky. Light pollution can also take the form of unwanted spill light to neighbouring properties and gardens.

Louvre

Open grid attached to a luminaire to control the light output, the prime purpose being to prevent the lamp being seen from normal viewing angles.

Lumen (lm)

SI unit of luminous flux, describing the quantity of light emitted by a lamp or received at a surface.

Luminaire

Light fixture or fitting; an electrical device used to create artificial light and/or illumination, by use of an electric lamp.

Luminaire efficacy

Light output of an entire luminaire (light fitting) divided by the total power consumed by the lamps and ballasts. Equal to the lamp efficacy multiplied by the light output ratio of the luminaire. Units are lumens per Watt (lm/W).

Luminous flux

Amount of light produced by a lamp; usually measured in lumens.

Lux (lx)

SI unit of illuminance or amount of light on a surface. One lux is equal to one lumen per square metre (lm/m^2).

Maintained illuminance

Illuminance at the time when maintenance is expected to take place. Most values of illuminance that are quoted as applicable to a store, eg 500–1000 lx, refer to this value. The time taken to reach the maintained illuminance level would depend on the lamp types and application.

Normalised power density

Power needed per m^2 of floor to achieve an illuminance of 100 lx on a horizontal plane with general lighting. Units are Watts per m^2 (W/m^2) per 100 lx.

Power density

Installed power of a lighting installation per unit area. Units are Watts per m^2 (W/m^2).

Power factor

A measure of the phase difference between the voltage and current in an alternating current (AC) supply. For lamp types other than incandescent, the voltage and current waveforms are not exactly in phase with one another: thus the volts multiplied by the amperes in the circuit may be higher than the Watts. In such cases, the Watts represent the active power, and the volts multiplied by the amperes represent the apparent power. The power factor is the ratio of the absolute value of the active power to the apparent power. Ideally, the power factor should be as close to unity as possible. A low value of the power factor increases the current load and the energy consumption. Most high-wattage lamp circuits are designed to have a power factor greater than 0.85.

Restrike time

The time period between switching a lamp on and its achieving full brightness from a 'hot start', ie the lamp has just been switched off.

Run-up time

The time period between switching on a lamp and its achieving full brightness from a cold start. The time can vary between seconds for a tungsten filament lamp to several minutes for a mercury vapour lamp.

Service period

The average lifetime of tungsten lamps, or the period by which replacement is due for fluorescent or discharge lamps.

Tubular fluorescent lamp

Fluorescent lamp in a tubular form. Light is produced when electricity excites mercury vapour, which in turn produces short-wave ultraviolet light that causes a phosphor to fluoresce, producing visible light.

Tuneable LED

LED lamp capable of varying the colour of the emitted light.

Tungsten filament lamp

Incandescent lamp with a tungsten filament that emits light when it is heated.

Tungsten halogen lamp

Incandescent lamp with a tungsten filament contained within an inert gas and a small amount of halogen. The tungsten and halogen cause a chemical reaction that increases the lifetime of the lamp, and prevents the darkening seen in tungsten filament lamps.

Watt (W)

Measure of the electrical power that a light source consumes. Part of the power input is transformed into light (visible radiation), and the rest is considered as loss (heat and electricity). For example, incandescent lamps transform 95% of the electric power input into heat and only 5% into light, whereas fluorescent lamps and LEDs typically transform 80% of the electric power input into light, with 20% lost as heat and ballast losses.

© iGuzzini: Simulation based on Colonys Shop, Zurich, Switzerland

1 Introduction

This guide reviews typical current practice in retail lighting, and gives advice on how to achieve effective and energy-efficient solutions, providing retailers, architects and designers with practical guidelines both on refurbishing existing lighting systems and on developing new lighting solutions for their stores.

A checklist is included in the Appendix at the end of the guide to provide quick guidance when carrying out refurbishment of existing lighting schemes, particularly when the existing installation is more than 10–15 years old.

Lighting is critically important in retail environments. Light attracts customers, creates atmosphere, and defines image. Good lighting makes a store inviting from the outside and creates the right atmosphere for the selling process, showing the products at their best and stimulating impulse buying. It also improves the way the space is used and the time that people spend in the store, and provides good working conditions for the staff.

However, the retail sector consumes more lighting energy than any other commercial sector. Based on data published by DECC[1] in July 2012, in 2011 retail lighting consumed 35% of the energy consumption for lighting in the entire service sector, and 43% of the electricity used in the retail sector.

Although lighting products are becoming more efficient, longer opening hours and higher light levels have increased the energy used for retail lighting. Also, inappropriate control strategies and improper choice of light sources result in energy being wasted.

There is substantial potential for energy saving and carbon reduction. Reducing the energy consumed by retail lighting can directly increase profitability and reduce environmental impacts. Modern lighting techniques and equipment, and more efficient light sources, provide opportunities for significant reductions in the use of energy, while achieving a greatly enhanced level of illumination and improved visual appeal[2]. Cutting wasted energy for lighting can reduce overheating in a store, and therefore cut the high cost of air conditioning.

Quality should not be neglected when implementing measures to increase lighting efficiency, and therefore attention should always be given both to the effectiveness and the quantity and quality of lighting in retail spaces. For best results in specific retail spaces, a lighting professional should be consulted, ideally in the early stages of project development.

This publication has been funded by BRE Trust

The essential guide to retail lighting

Lighting is critically important in retail environments. Light attracts customers, creates atmosphere, and defines image. Good lighting makes a store inviting from the outside and creates the right atmosphere for the selling process, showing the products at their best and stimulating impulse buying.

This guide, written by BRE lighting experts, reviews typical current practice in retail lighting and gives advice on how to achieve effective and energy-efficient solutions, providing retailers, architects and designers with practical guidelines both on refurbishing existing lighting systems and on developing new lighting solutions for their stores.

From the Foreword by Nigel Keen, Director of Property Services, John Lewis Partnership:

"For other retailers looking to develop a low energy lighting strategy we recommend BRE Trust's The essential guide to retail lighting. *It provides retailers, architects and designers with detailed practical information and guidelines to explain how best to develop energy efficient, cost-effective lighting solutions for new and existing stores."*

Related titles from IHS BRE Press

LED lighting: A review of the current market and future developments
FB 40

Office lighting
BR 415

Selecting lighting controls
DG 529

Available from www.brebookshop.com

IHS BRE Press, Willoughby Road
Bracknell, Berkshire RG12 8FB
www.brebookshop.com
FB 56

ISBN 978-1-84806-322-8