PHILIPS

Office lighting

BREEAM guide

Philips lighting guide for BREEAM

Introduction

Different people can have a very different interpretation of sustainability in lighting and the steps needed to address it.

Contents

Rather than leave designers to their own arbitrary definitions, the Building Research Establishment (BRE) has developed an Environmental Assessment Method (BREEAM), which includes the assessment of daylight and artificial lighting. BREEAM is the world's foremost environmental assessment method and rating system for buildings. Some quarter of a million buildings have been certified and a million registered for assessment since 1990.

The premium value attached to energy-efficient properties with a BREEAM rating means that businesses can benefit very directly financially. At the same time, they can demonstrate their commitment to corporate social responsibility and the environment.

BREEAM and Lighting

It is possible to conduct an appraisal for illumination, visual comfort and energy, focusing on the 'triple bottom line' of social, environmental and economic criteria.

This Application Guide summarizes the BREEAM provisions relating to lighting and applies these practices to a typical office building. In the process, it demonstrates how lighting can support both the occupant and the overall performance of the building.

Through our hypothetical demonstration design, Optima (pages 12-27), you can see the lighting approaches taken for five typical spaces – open office, cell office, meeting room, circulation space, and reception. You can also review key lighting and energy performance metrics.

By understanding holistically the role of the lighting designer in a BREEAM assessment, you can ease the process, become more proactive in collaborative tasks and eliminate some of the mystery involved in quite a complex exercise.

This BREEAM guidance is designed to make the process transparent, by distilling a lighting designer's involvement and requirements, while raising other issues you may need to be aware of. The featured example demonstrates how the designer gets involved in each BREEAM credit and in creating more sustainable buildings.

BREEAM overview

BREEAM is a worldwide environmental assessment method and rating system for buildings. It identifies best practice in sustainable building design, construction and operation and has become one of the most comprehensive and widely recognized measures of a building's environmental performance.

BREEAM encourages designers, clients and others to think about low carbon and low impact design, minimizing the energy demands created by a building before considering energy efficiency and low carbon technologies.

Any kind of new or existing building anywhere in the world can be assessed with this rating system. BREEAM is used in a range of formats – from country-specific schemes, adapted for local conditions through to international schemes for the certification of individual projects worldwide. It is used in more than 50 countries, with several in Europe having gone a stage further to develop country-specific BREEAM schemes operated by National Scheme Operators (NSOs). There are currently NSOs affiliated to BREEAM in: Germany, the Netherlands, Norway, Spain, Sweden, Austria, Switzerland, and Luxemburg.

A BREEAM assessment uses recognized measures of performance (or local best practice standards), which are set against established benchmarks to evaluate a building's specification, design, construction and use. The measures used represent a broad range of categories and criteria, as described on page five.

Category	Prerequisites	Credits linked to lighting designers	Total Possible Points and overall contribution weighting (as a percentage)
Management		12	22 (12%)
Health and Wellbeing	Hea 01 Visual comfort Hea 05 Acoustic performance	3-5 depending on building type	10 (15%)
Energy		19-20 depending on building type	30 (19%)
Transport		3-4	9 (8%)
Water			9 (6%)
Materials	Mat 04 Insulation		12 (12.5%)
Waste			7 (7.5%)
Land use and Ecology	LE 05 Long term impact on biodiversit		10 (10%)
Pollution	Pol 03 Surface water run off		13 (10%)
Innovation		3	Additional 10 (10%)

To obtain certification, the scoring system must obtain certain mandatory credits specific to building type and level being sought.

BREEAM rating score percentages:

≥85%	≥70%	≥55%	≥45%	≥30%	<30%
Outstanding	Excellent	Very good	Good	Pass	Unclassified

A brief **history** of BREEAM

The BRE's Environmental Assessment Methodology (BREEAM) for new office buildings was introduced in 1990 and is credited with helping to make sustainability more accountable and transparent. After 'BREEAM for new office buildings', new versions were introduced for other buildings including superstores, industrial units and existing offices.

In 1998, there was a major revamp of BREEAM. New features included weighting for different sustainability issues, annual updates and variations for other building types such as retail premises.

BREEAM for new homes (EcoHomes) was launched in 2000. This scheme was later updated as the Code for Sustainable Homes, developed for the UK Government in 2007.

An extensive update of all BREEAM schemes in 2008 resulted in the introduction of mandatory post-construction reviews, minimum standards and innovation credits. International versions of BREEAM were also launched that year.

In 2011, BREEAM New Construction was launched, and updated in 2014, which is now used to assess and certify new UK buildings. For refurbishment, BREEAM UK Refurbishment and Fit-out 2014 has been launched, replacing the 2008 version.

There is also BREEAM In-Use, to help building managers reduce running costs and improve the environmental performance of existing buildings, which was introduced in 2010. Since adoption, it has become a common planning requirement for non-residential buildings within the UK. Its adoption has also begun across Europe, with the availability of the new BREEAM International 2013.

In the summer of 2014 the BRE updated their assessment scheme, so BREEAM New Construction '2011' became '2014'. You can find a summary of the changes on page eleven.

BREEAM **international**

BREEAM International New Construction (NC) can be used to assess the sustainability of new buildings at the design and construction stages of a project and enables developers to evaluate, improve and demonstrate this consistently across the world. The scheme can be used to assess new commercial buildings (i.e. office, retail, industrial and residential buildings). Those that fall outside of the scope of the standard scheme require the development of bespoke criteria.

BREEAM can also assess Refurbishment, In-Use, Communities and International schemes. BREEAM International NC rewards designs for implementing local best practice codes and standards and those which recognise local context and issues, such as culture and climate. Approved standards are available for each country and the BREEAM Assessor and design team can add to these by proposing local best practice construction codes not yet recognized by BREEAM.

The following countries have a NSO, offering a country-specific local scheme, which should be used in preference to BREEAM International.

Germany

DIFNI (Deutsches Privates Institut für Nachhaltige Immobilienwirtschaft GmbH & Co. KG), are operating BREEAM DE with an initial focus on a German version of BREEAM International In-Use, called BREEAM DE Bestand. **http://www.difni.de**

Netherlands

BREEAM NL is operated in the Netherlands by the Dutch Green Building Council **www.dgbc.nl** under license from BRE Global.

Norway

BREEAM NOR is operated in Norway by the Norwegian Green Building Council (NGBC) **www.ngbc.no** under licence from BRE Global.

Spain

BREEAM ES is operated in Spain by the Fundacion Instituto Technológico de Galicia **www.itg.es** under licence from BRE Global.

Sweden

BREEAM SE is operated in Sweden by the Swedish Green Building Council **www.sgbc.se** under licence from BRE Global.

Austria

BREEAM AT will be operated by DIFNI under licence from BRE Global. The scheme is currently under development.

Other International

Use BREEAM International manual.

BREEAM requirements – a summary for

lighting designers

As a lighting designer, you will find there are several credits that will fall directly into your design scope, but if you are proactive and experienced, you can influence other credits too. These are summarized in the table below, based on BREEAM New Construction 2011:

Credit & Title	Credits available	Within Lighting Designers scope	Lighting Designers can support others in obtaining these credits	Lighting Designers should be aware of commitments to these credits
Man 01 Sustainable Procurement	8		●	
Man 04 Stakeholder participation	4			●
Hea 01 Visual comfort	3 - 5	●		
Ene 01 Reduction of Emissions	15		●	
Ene 02 Energy monitoring	1 - 2		●	
Ene 03 External lighting	1	●		
Ene 06 Energy efficient transportation systems	2			
Tra 03 Cyclist facilities	1 - 2	●	●	
Tra 05 Travel plan	1			●
Pol 04 Reduction of night time light pollution	1	●	●	

NB: There are further credits available for innovation, where the team can demonstrate sustainable good practice has been exceeded. This could be a one-off achievement specific to the project, or one of the 'best practice innovation' credits that is improving on the 'normal' targets set in the BREEAM credits.

BREEAM now includes several 'mandatory' minimum standards within credits, which have to be achieved regardless and at no additional score to the assessment. They are noted in the explanations on pages nine and ten. Issues specific to BREEAM International may differ from a standard BREEAM New Construction assessment and are also noted in this summary.

Over the following pages, you'll find details about the credits for which the Lighting Designer is responsible.

Hea 01 Visual comfort

(3 – 5 credits dependent on building type)

Hea 01 is split into five parts:

1. Pre-requisite: All fluorescent and compact fluorescent lamps are fitted with high frequency ballasts.

2. Day-lighting: 1 - 2 credits are available if relevant building areas meet good practice daylighting criteria as required by BREEAM. This is either local best practice when undertaking BREEAM International, or the BRE best practice guidance.

3. Glare Control: 1 - 2 credits are available if the potential for disabling glare has been designed out, through the inclusion of overhangs or brise soleil or the inclusion of blinds.

4. Views Out: 1 - 2 credits are available if all positions within relevant building areas are within 7m of a window or permanent opening that provides an adequate external view.

5. Internal and External Lighting: 1 - 2 credits are available if Illuminance levels and the zoning and occupant controls for internal lighting are specified in accordance with a relevant industry standard, as set out by BREEAM.

In order to demonstrate this as part of the design's deliverables, the relevant information must be incorporated into design drawings, daylight calculations and relevant sections of the building specification or contract.

To obtain the same credit on the BREEAM International assessment, the geographical setting must be taken into account – both to reflect the difference in light levels and also the greater ratio between indoor and external light levels.

Reference local best practice standards: You should follow national daylighting best-practice guides.

For BREEAM International: You can follow national daylighting best-practice guides, but where these are not available, you can adhere to the BREEAM criteria (for BREEAM International). Refer to the BREEAM documentation, which depicts minimum values of average daylight factor required for varying latitudes and for various building types.

Also for the daylighting uniformity criteria for various building types and the minimum values of daylight illuminance required in which both the average illuminance and minimum point illuminance must be met.

The values to include in the consideration should also follow BREEAM recommendations for reflectance at maximum room depths and window head heights.

Ene 03 External lighting

The lighting design must ensure that external energy-efficient light fittings (luminaires) are specified and demonstrate efficiencies in lumens/circuit Watt, depending on the application and lamp type.

As a lighting designer, you must ensure the external light fittings are controlled through a time switch or daylight sensor, to prevent operation during daylight hours. A daylight sensor override on a manually-switched lighting circuit is acceptable.

To demonstrate this credit, you will need to provide design drawings and/or relevant sections of building specification or contract. You must indicate the pertinent information and provide a simple statement outlining the target and confirming that it has been met.

Tra 03 Cyclist facilities

While the lighting designer is not responsible for all elements of obtaining this credit, there is a clear requirement for the lighting of the cycle storage facility to be compliant with the external lighting criteria (and, where relevant, the internal criteria too). The lighting must be controlled to avoid 'out-of-hours' use and operation during daylight hours, where there is sufficient daylight in or around the facility.

To demonstrate this credit, you will need to provide design drawings and/or relevant sections of building specification or contract. You must indicate the pertinent information and provide a simple statement outlining the target and confirming that it has been met.

Pol 04 Reduction of night time light pollution

Your design must ensure the external lighting is concentrated in the appropriate areas and that upward lighting is minimized, reducing unnecessary light pollution, energy consumption and nuisance to neighboring properties. The BREEAM guide gives recommended time clock settings for safety and security lighting and instances in which 24-hour operation can still be compliant.

For BREEAM International: You should be aware of the Commission Internationale d'Eclairage (CIE) guidance, which recommends the setting of a curfew.

Credits requiring lighting designers to support others

The credits identified as needing a Lighting Designer's input recognizes issues such as the value a Lighting Designer can play in attending site after occupation to adapt and adjust their lighting design to better effect, or influence lighting that sits outside of typical scopes such as lighting for lifts and escalators, where additional input may lead to an improved and more coordinated end result.

Credits lighting designers need to be aware of

The remaining credits are ones that a lighting designer may not have seen as part of their brief, but which will have an effect on the lighting design expectations nonetheless, for instance green travel plans or stakeholder engagements. These documents may identify areas where for example, pedestrians are proposed to wait for public transport, electric car charging points need better illumination or future cash point vending machines will be located.

BREEAM
in relation to energy

For BREEAM credits Ene 01, 02, 03 and 06, the lighting design can make a significant impact. The lighting should be optimized for placing the right light, in the right location and operated in a sustainable manner. When you bring together optimal lamps, control gear, luminaires, and controls, you can create a lighting design that satisfies BREEAM criteria. This will be a design that reduces energy consumption, is monitored to adapt to changing needs and creates a pleasant external environment, while also contributing to occupants' happiness, health and productivity.

BREEAM awards credits where the whole building has been assessed through a BRE Compliance Checking process, to determine the Energy Performance Ratio (EPR). This includes the lighting component.

Although lighting is only one of many energy-consuming elements in a building, the choice of lighting fixtures, given that they are found throughout a building, is an important factor in the EPR. You should provide the design team (and energy modeler) the calculated lighting power density (Watt/m2 per 100 lux) to avoid an ambiguity in anticipated performance.

In addition, your lighting control strategy (including any energy saving techniques and inclusion of technology, such as presence or absence detection, daylight linking, etc) should also be issued to the energy modeler.

Failure to do this at design stage can lead to issues of failing to secure appropriate certification for building handover once it is constructed. It is also possible that other areas of the design overcompensate for an 'assumed' lighting performance – regardless of the effective design provided.

BREEAM
New Construction 2014*

BREEAM UK NC 2014 has now been implemented and the other NSO's are to follow in due course. Here are some of the key updates to the New Construction methodology:

HEA01: Visual Comfort

High frequency ballast on fluorescent lighting is not a prerequisite, although a requirement has been added into internal lighting that all systems are designed to avoid flicker and stroboscopic effects.

Glare Control and Views Out have been split into separate credits. You can only receive daylight credits if you have obtained the Glare Control credit.

For calculating daylight levels, an alternative average daylight illuminance method is now available, with the Optima Project needing to achieve an average 300 lux and minimum 90 lux for 2000 hours per year or more over 80% of the floor area.

The View out credit has been split from the Glare Control credit. In addition, the amount of floor area required to have a view out has been reduced from 100% to 95%.

This effectively makes a greater number of credits available for lighting, increasing HEA 01 from three credits to four credits for an office-type building.

ENE03: External Lighting

The external lighting criterion has been simplified.

There have been no major changes proposed to the other credits falling within the lighting designer's scope.

*Update for the UK only

Application of BREEAM

in practice

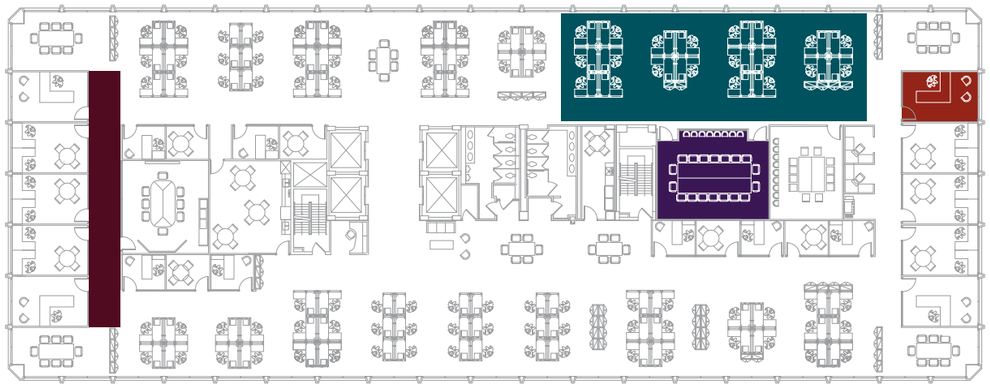
As an example of how BREEAM assesses a lighting design, the Philips Guide has adopted a notional design, comparing both LEED and BREEAM against the similar application of lighting standards.

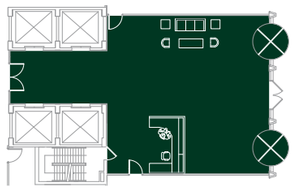
The Optima Project is a virtual open-plan office with cellular spaces, which we use to model lighting solutions. The hypothetical design specifications are as follows:

1. A high-quality built environment with an emphasis on visual comfort for occupants.
2. A cost-effective artificial lighting solution, both in terms of construction and operational costs.
3. Maximization of BREEAM credits, while maintaining the criteria above.

To determine terms such as 'high quality' and 'comfort', you can draw good practice from relevant industry guidance.

Optima office layout





1. Open office
2. Cell office
3. Conference/meeting room
4. Corridor
5. Entrance lobby

The criteria applied to the design includes:

Daylight and views

To be awarded the initial Daylighting Credit, the Optima office must achieve at least 2% average daylight factor in 80% of the areas classified as habitable spaces. Either the uniformity ratio must be of at least 0.4 (alternately assessed as having a minimum point daylight factor of at least 0.8%), or both the 'view of sky from desk height' and the room depth criteria are satisfied.

The daylighting can obtain a second credit where 'exemplary level criteria' are achieved, with 3% average daylight factor in 80% of the aggregate area of habitable spaces, where a minimum point daylight factor of 1.2% is obtained.

Generally, designing for daylight and views begins by siting the building axis to maximize the favorable daylight exposure and minimize the glare and heat gain.

- An elongated footprint allows a daylighted open area up to about 6 meters deep on the North and South sides, depending on ceiling height. Fenestration, glazing, and shading are all critical design parameters for optimizing for daylight while minimizing thermal problems.
- Locating private offices and other enclosed spaces to the East and West ends of the building preserves views for occupants of open-plan offices along the North and South sides. Using glass interior partitions can extend both daylight and view.
- The Optima demonstration design is based on a building footprint and fenestration that follow these principles.

The glare control strategy has incorporated brise soleil and appropriate blinds, providing shading from high-angle summer sun and low-angle winter sun.

Lighting for performance and comfort

The European Standard for Light and Lighting for Indoor Work Spaces (EN12464-1: 2011) sets out recommended and minimum standards.Key EN12464-1: 2011 parameters include:

1. Appropriate task illuminance. The minimum for office work (writing, typing, reading and data processing) is 500 Lux with a minimum-to-average uniformity of 0.6. For circulation and lobby areas, the minimum is 100 Lux.
2. Appropriate ambient illuminance in the near and far surround areas to assure balanced brightness and visual comfort. The minimum uniformity is 0.4 and 0.1.
3. Adequate wall and ceiling illuminance to create a comfortable visual environment. The EN12464-1 recommended minimum values are 75 and 50 Lux, respectively, but still brighter ceilings and walls can create a desirable sense of spatial openness.
4. Generous illumination for facial recognition, as gauged by mean cylindrical illuminance. The minimum recommendation is 150 Lux for work areas and 50 Lux for circulation spaces. Where an organization's effectiveness depends on human interaction, facial lighting is particularly important. For Project Optima, the Cylindrical illumination has been assessed at 1.2m from finished floor level (relevant in the open-plan office and the meeting room for seated occupants).
5. The Unified Glare Rating, which evaluates luminaires in a specific design, is the principal metric. The maximum UGR is 19 for work areas, 22 for the reception area, and 25 for corridors. The Optima Project demonstration is designed to meet or surpass these criteria.

Occupant control zoning

In addition to EN12464-1 criteria BREEAM asks for:

Control zones of no more than four workplaces in office areas.

Where you propose alternate control strategies to improve on this, you must demonstrate how you intend to achieve the results.

Workstations adjacent to windows or atriums and other building areas are to be separately zoned and controlled.

Seminar or lecture rooms are to be zoned to separate presentation and audience areas.

Separate zoning of stacks, reading and counter areas in library spaces.

Separation between activities and spaces in areas such as whiteboards and display screens; teaching spaces; demonstration areas; dining, restaurant and café areas; server and dining areas, bars, activity areas, and seated areas.

Task and ambient lighting

For the Optima demonstration design, the desks use task lighting to add a supplementary level of lighting when appropriate for the occupant. With heavy use of IT in most workplaces, it is more common for occupants to want lower lighting levels, but to have the ability to boost the light locally if, for instance, they start looking at paperwork. This allows them to reduce energy, match light levels to specific tasks and provide individual control to occupants.

Ambient light is also recognized as enhancing the built environment. The Optima demonstration design provides ambient illumination through wall washing, i.e. balancing the surface brightness with the space more effectively than if a single system were applied to increase ambient levels.

Surface finishes

Light reflects off light surfaces and is absorbed by dark surfaces, a phenomenon known as 'albedo' or reflectance co-efficient. The Optima demonstration design adopts high reflectance; low gloss finishes to improve the energy-efficiency of the lighting system. We use finishes of 85% for the ceiling, 60% for the wall, and 30% for floor reflectance in the modeling. This reduces consumption by nearly 10%, compared to finishes with the minimum reflectance set out in EN12464-1, illustrating the importance of selecting figures that match the design.

Maintenance factor

The scheme has been designed with an overall maintenance factor (MF) of 0.72 following evaluation of lighting equipment, environment (cleanliness of environment and surface reflectance) and a suggested maintenance schedule.

Guidance on the calculation of MF for artificial lighting systems can be found in CIE 97-2005: Guide on the maintenance of indoor electric lighting systems.

The maintenance factor is a multiple of four factors: Lamp lumen maintenance factor (LLMF); Lamp survival factor (LSF); Luminaire maintenance factor (LMF); and Room surface maintenance factor (RSMF). (Please note that the LSF for this installation is 1, as it is assumed that all failed lamps will be replaced.)

Description of schemes developed in **Project Optima**

1 Open office

Lighting design

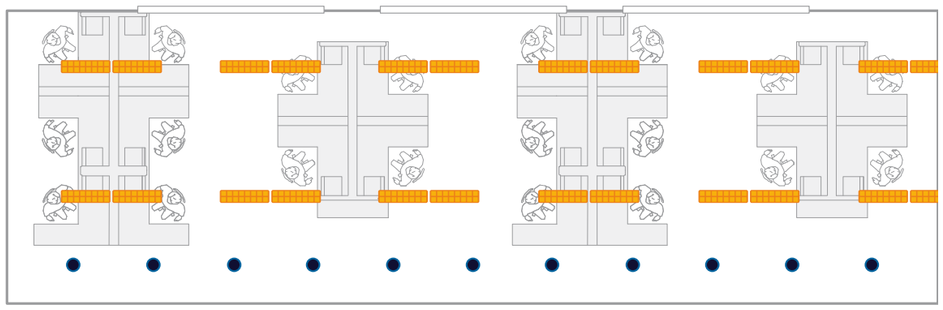
With energy efficient design in an open-plan office, you will locate luminaires so that the primary working areas are appropriately illuminated and the circulation spaces around them can receive less light (and so use less energy). For effective daylight harvesting, luminaires need to be arranged into separately controlled zones, corresponding to the penetration of daylight into the area.

Three typical schemes are shown here:

Recessed fitting scheme

In the recessed scheme, PowerBalance 300mm x 1200mm LED luminaires, shielded by white smart pyramid louvers, provide the primary illumination

Floor Plan



Luminaires

PowerBalance 300 x 1200mm recessed
LED 29W | 4000K | 3400 lm

LuxSpace Mini Round recessed downlight
LED 12W | 4000K | 1076 lm

Results

Lighting scheme	Area avg Lux Task = desk	Uniformity Task = desk	Area avg Lux surroundings	Uniformity surroundings	Cylindrical illumination avg Lux	Cylindrical / horizontal illuminance
Recessed scheme	544	0.85	543	0.66	214	0.39

Pendant fitting scheme

In the pendant scheme, Smart Balance direct/indirect luminaires use efficient LED lamps (4000K) with a 77% direct / 23% indirect distribution and micro lens optic. This background lighting is then supplemented with desk mounted task lighting, such as TaskFlex LED table luminaire 8W LED 370 lm 3000K

Floor Plan

Luminaires

SmartBalance suspended LED*
42W | 4000K | 4000 lm

LuxSpace Mini Round recessed downlight
LED 12W | 4000K | 1076 lm

TaskFlex LED table luminaire
8W | 3000K | 370 lm

*with micro lens optic (fitting suspended at 2.3m)

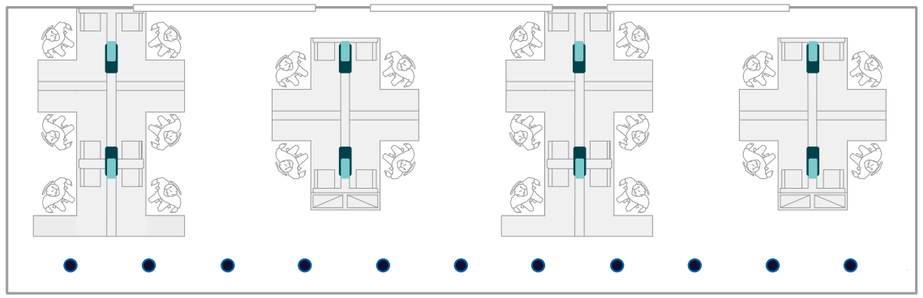
Results

Lighting scheme	Area avg Lux Task = desk	Uniformity Task = desk	Area avg Lux surroundings	Uniformity surroundings	Cylindrical illumination avg Lux	Cylindrical / horizontal illuminance
Pendant scheme	566	0.70	415	0.63	182	0.32

Floor standing uplighter scheme

The Uplighter scheme has used the SmartBalance floor standing luminaires with 80% uplight and 20% downlight distribution and micro-lens optic. This provides a flexible solution if desks are moved around the space at some point in the future.

Floor Plan:



Luminaires

SmartBalance free floor standing*
106W | 4000K | 11800 lm

LuxSpace Mini Round recessed downlight
LED 12W | 4000K | 1076 lm

*(80% up/ 20% down) with micro lens optic

Results

Lighting scheme	Area avg Lux Task = desk	Uniformity Task = desk	Area avg Lux surroundings	Uniformity surroundings	Cylindrical illumination avg Lux	Cylindrical / horizontal illuminance
Floor uplighting scheme	667	0.66	505	0.46	242	0.36

Overall Results

- In each scheme the lighting is designed to deliver over 500 Lux (average, maintained) to the desktops, with excellent desktop uniformity.
- Option 2 has individual task lighting, which adds about 200 Lux to the task when used and contributes to the BREEAM Credit for controllable lighting. The pendant scheme therefore provides over 350 Lux as a background light level, with an additional contribution from the users' desk lamps, when necessary. The combination of task and overhead illumination exceeds the EN12464-1 minimum illuminance recommendation.
- Wall lighting exceeds standards for illuminance and uniformity and provides effective balance to day-lit windows.
- Cylindrical illuminance has been calculated in sample areas at 1.2m height in four different directions. These are described as an average in the results table above.
- Occupancy and daylight controls reduce energy use even further.

Additional Information:

In each of the schemes, the luminaires form two rows parallel to the window wall. This provides excellent task coverage and uniformity for flexible location of the workstations, while allowing for daylight control.

Low-wattage, desk-mounted TaskFlex luminaires provide individually controllable lighting to suit people's personal preferences, as well as for more difficult visual tasks on the pendant-fitting scheme in Option 2.

A line of low wattage LuxSpace LED downlights illuminate the interior wall, balancing window brightness and enhancing the primary circulation path.

In any large, open work area, you should divide your ceiling lighting into smaller zones for occupancy-based control – no larger than approximately four workstations (or 40sqm). Each row of luminaires closest to the windows is on a separate daylighting control zone and independently dimmed so that the target illuminance is maintained on the work surfaces when daylight is available.

Specific connected loads:

Recessed Fitting Scheme:
5.63 W/sqm = 1.06 W/sqm/100 lx

Pendant Fitting Scheme (with task light):
5.62 W/sqm = 1.35 W/sqm/100 lx

Floor Standing Uplighter Scheme:
6.21 W/sqm = 1.30 W/sqm/100 lx

Description of schemes developed in **Project Optima**

2 Cell office

Lighting design

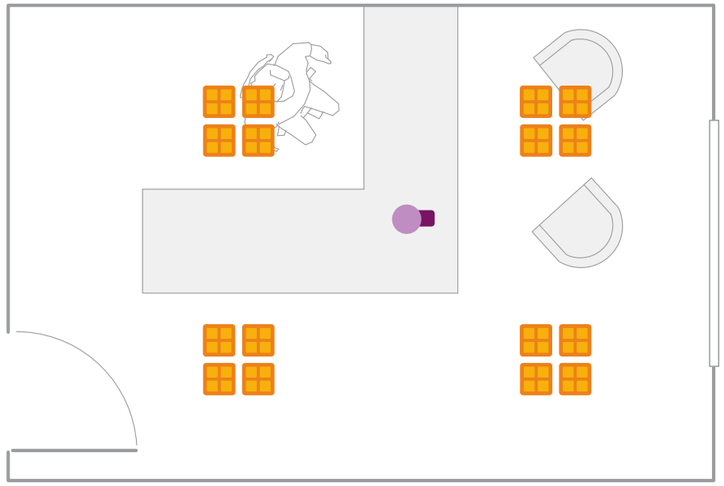
Maintaining a bright feeling in a cellular office improves comfort and satisfaction for users. A major challenge, however, is arranging luminaires in a regular pattern so they provide appropriate illumination with minimal energy use. This design uses PowerBalance 600mm x 600mm luminaires, which incorporate high efficiency LED modules.

Low-wattage, desk-mounted TaskFlex luminaires provide individually controllable lighting to suit people's personal preferences, as well as for more difficult visual tasks.

Ceiling lighting is controlled in two zones: the two perimeter luminaires dim in response to daylight, and all luminaires turn off when the office is unoccupied.

The design approach is also ideal for small meeting rooms of similar size.

Floor Plan



Luminaires

PowerBalance LED 600 x 600mm
recessed 29W | 4000K | 3400 lm

TaskFlex LED table luminaire
8W | 3000K | 370 lm

Results

Lighting scheme	Area avg Lux Task = desk	Uniformity Task = desk	Area avg Lux surroundings	Uniformity surroundings
Recessed scheme	517	0.64	474	0.77

- Overhead lighting delivers over 450 Lux (average, maintained) to the work surfaces, with excellent uniformity.
- Individual task lighting adds about 200 Lux to the task when used and contributes to the BREEAM Credit for controllable lighting.

The combination of task and overhead illumination exceeds the EN12464-1 minimum illuminance recommendation.

- Wall lighting exceeds standards for illuminance and uniformity, provides effective balance to daylighted windows and brightens the enclosed space.
- Specific connected load: 6.53 W/sqm = 1.31 W/sqm/100 lx
- Absence detection and daylight controls reduce energy use still further.

Description of schemes developed in **Project Optima**

3 Conference/meeting room

Lighting design

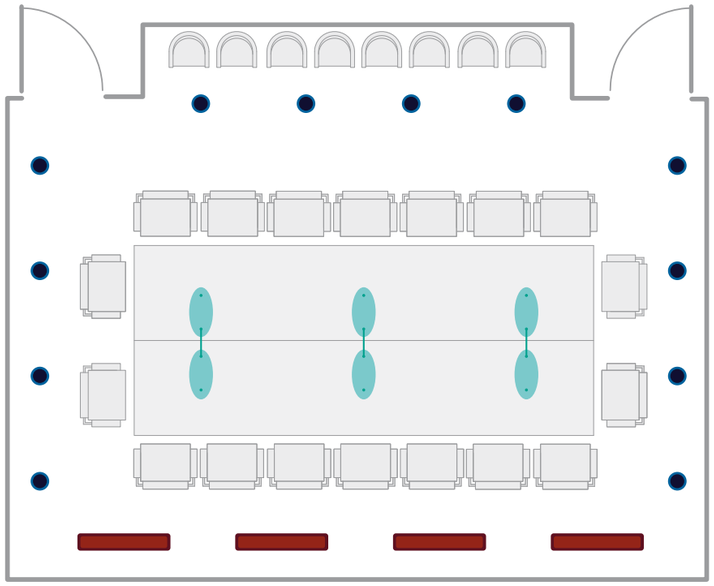
Meeting rooms are designed to allow people to interact face-to-face, as well as well as to perform visual tasks, which can be on both horizontal and vertical surfaces. These spaces also provide a diversion from everyone's routine work areas.

The design lights the main conference table using three distinctive LumiStone LED pendants with a 75% direct/25% indirect light distribution. SmartForm T5 fluorescent wall washers illuminate a feature wall, while LuxSpace downlights highlight the other three walls.

All fluorescent and compact fluorescent lamps specified are to be fitted with high-frequency ballasts.

A multi-scene dimming control provides five distinct control channels for the central pendants and each wall. An occupancy sensor, integrated with the multi-scene system, turns lights off when the space is no longer occupied.

Floor Plan



Luminaires

LumiStone Suspended LED*
29W | 4000K | 3000 lm

SmartForm recessed wall-washer T5
25W | 4000K | 2450 lm

LuxSpace Mini Round recessed downlight
LED 12W | 4000K | 1076 lm

*fitting suspended at 2.3m

Results

Lighting scheme	Area avg Lux Task = desk	Uniformity Task = desk	Area avg Lux surroundings	Uniformity surroundings	Cylindrical illumination avg Lux	Cylindrical / horizontal illuminance
Recessed scheme	546	0.66	456	0.66	199	0.36

- Overhead lighting delivers over 500 Lux (average, maintained) to the work surfaces, with excellent uniformity.
- Facial and wall lighting values are also very good, supporting various types of meeting activities. Cylindrical illuminance has been calculated at 1.2m height for the entire room (excluding the wall area) and added to the results table above.
- Specific connected load: 7.52 W/sqm = 1.66 W/sqm/100 lx
- Occupancy Detection and multi-scene control reduce energy use still further and contribute to the BREEAM Credit for controllable lighting.

Description of schemes developed in **Project Optima**

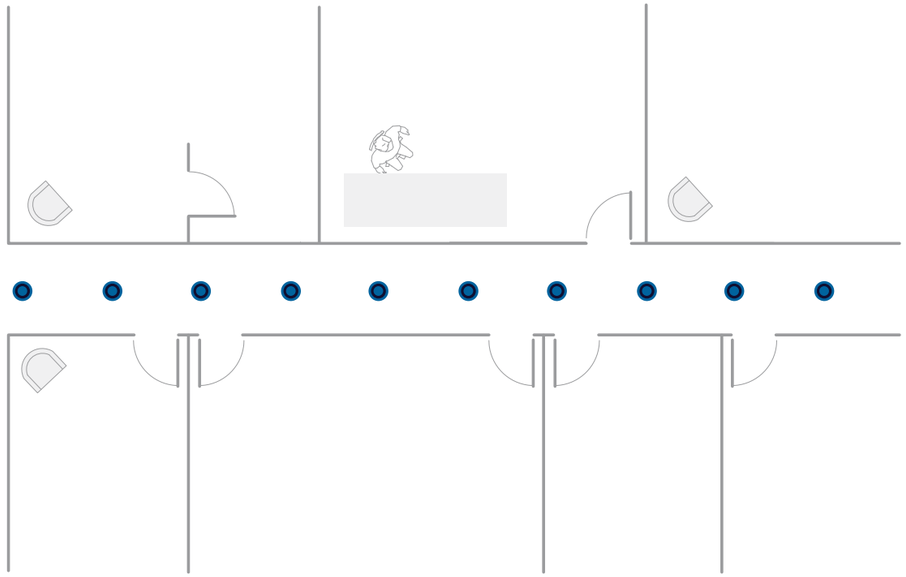
4 Corridor

Lighting design

This design uses simple LuxSpace LED downlights, fitted with a decorative glass disk below the aperture. Although the decorative element reduces the average illuminance by about 20%, the glowing disk creates a more interesting environment, increases light on faces and walls, and meets EN12464-1 standards. As a result, the circulation space serves as a brief respite from ordinary work areas as office workers move through it.

A time switch keeps corridor lights turned on during normal business hours. After hours, an occupancy sensor linked to the adjacent spaces maintains lighting at a dimmed level until all linked spaces are no longer occupied.

Floor Plan



Luminaires

LuxSpace Mini Round recessed downlight LED with drop down diffuser
12W | 4000K | 1076lm

Results

Lighting scheme	Area avg Lux	Uniformity
Recessed scheme	118	0.79

- Ambient lighting of 100 Lux meets standards while providing balanced illumination for facial recognition and sufficient wall illumination to maintain a pleasing transient space.
- Specific connected load: 3.70 W/sqm = 3.15 W/sqm/100 lx

Description of schemes developed in **Project Optima**

5 Entrance lobby

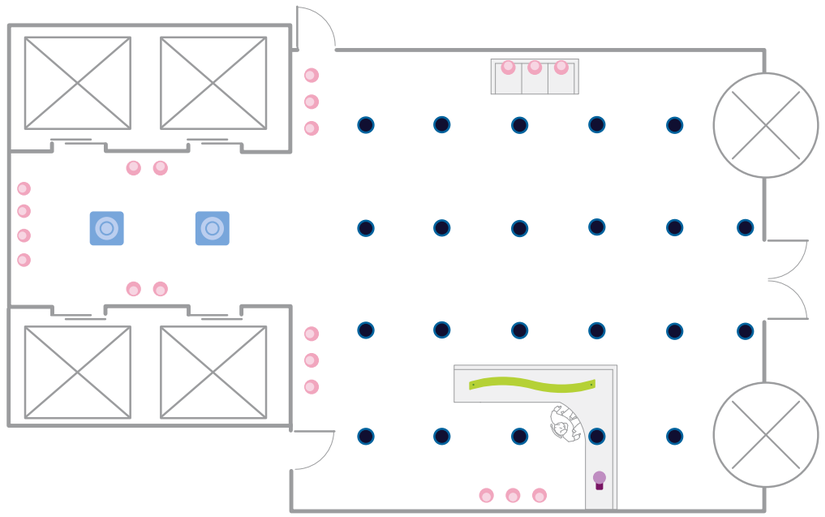
Lighting design

Reception lighting welcomes visitors and helps them to orientate themselves around the building. It also establishes the forward-looking image of the Optima organization. This design uses luminaires that are both decorative and functional to serve as way-finders. The prominent, undulating DayWave LED downlight pendant clearly highlights the reception desk for visitors.

Supplemented by a TaskFlex desk mounted adjustable luminaire, the DayWave pendants also provide ample task lighting for the receptionist. A pair of DayZone LED luminaires, with a 'circle-in-a-square' design, locate and illuminate the lift lobby. Simple LuxSpace LED downlights fill in with ambient illumination, while adjustable accent StyliD LED luminaires light up corporate art in key locations.

Multi-scene dimming control, with an integral time switch, allows for different lighting arrangements for primary and after-work hours, as well as night-time security.

Floor Plan



Luminaires

DayZone recessed
LED 29W | 4000K | 2000 lm

StyliD semi recessed spotlights
LED 23W | 4000K | 1329 lm

LuxSpace Mini Round recessed downlight
LED 12W | 4000K | 1076 lm

DayWave*
LED 150W | 4400 lm

TaskFlex Table luminaire
LED 8W | 3000K | 370 lm

*note that fittings are running on 50% output to avoid over-lighting the space, while also improving efficacy and overall efficiency.

Results

Lighting scheme	Area average Lux Task = reception	Uniformity Task = reception	Area average Lux surroundings	Uniformity surroundings
Recessed scheme	527	0.60	248	0.44

- Ambient lighting of 200 Lux meets standards while providing effective vertical illumination for facial recognition.
- Substantial wall illumination enhances the sense of spaciousness and invites visitors to enter in comfort.
- Specific connected load: 7.53 W/sqm = 2.95 W/sqm/100 lx

Environmental assessment

results

HEA 01 Visual Comfort

Prerequisite:

All fluorescent fittings are complete with high-frequency ballast. You can find evidence of this in luminaire schedules or specifications.

Daylight:

Evidence confirming the achievement of 2% average daylight factor in over 80% of the occupied area can be found on the design drawings and supporting daylight calculations. The calculations report confirms the uniformity ratio has been met in the spaces, or both the view of sky and the room depth criteria have been met.

Based on this evidence, the Optima Project would be awarded one credit.

A further credit is available for achieving average daylight levels of 3% and above, together with improved uniformity.

Glare Control and View Out:

The window schedule identifies the application and extent of brise soleil and appropriate blinds. Design drawings showing fenestration treatment confirm the appropriateness and extent that high and low angle sun will be shaded from the building occupants. Clauses in the specification may confirm any further studies that are required and report appropriate mitigation resulting from these studies.

However, the 'view out' requirements fail to meet the 7m rule-of-thumb distance from a workstation to a wall with a window. Some workstations are further away. Consequently, an extract from Table 1 of BS 8206, together with a scaled drawing, showing the percentage of the glazed area to wall and distance from the wall, would confirm this criterion is met.

Based on this evidence the Optima Project would be awarded one credit.

Internal and External Lighting:

Evidence similar to that illustrated above is required, in the form of design drawings, room data sheets, luminaire schedules and pertinent calculations such as the uplighter illuminance on the ceiling.

The BREEAM guide refers to CIBSE Code for Lighting 2009. However, as this is known to be aligned with EN 12464-1, the reference to illuminance levels meeting EN 12464 is sufficient. CIBSE Lighting Guide 7 provides further specific uplighter recommendations for luminance of the lit ceiling and recommendations for direct lighting, ceiling illuminance and average wall illuminance. The evidence provided needs to support and communicate to what level this has been achieved.

Similarly external lighting (identified as any external lighting within the construction zone), is to be included in the same way, preferably with a statement clearly identifying the appropriate standards it will meet, such as BS 5489-1 & A2:2008.

In addition, you can demonstrate zoning and occupant control through specification, illustrations or drawings.

Based on this evidence, the Optima Project would be awarded one credit.

In summary, the evidence seen by the BREEAM assessor would lead to an award of a full three credits for the Optima Project for HEA01. The Assessor will review the information with professional respect, as this is not a verification of the accuracy of the calculations or design. It is only establishing that the design can evidentially support the claim that it is maintaining industry guidance.

ENE01 Reduction of Emissions

The BREEAM assessor will review energy calculations from the project, in the form of Energy Performance Certification (EPC). The lighting design should be assessed in terms of its lighting efficiency as outlined above.

Based on notional building efficiencies linked to the EPC software – and with Building Regulations in the UK moving from 55 Lumens/Watt to 60 Lumens/Watt – the lumen efficacy used within a design has to high to offer a perceivable impact on the overall EPC outcome. Typically, the results on the Optima Project provided an average of 20% improvement over the whole floor area on energy associated with lighting. This was before daylight linking and occupancy detection were factored in. Over the life of the building, this will have a significant reduction on operational costs.

BREEAM 2014

Under the proposed BREEAM New Construction 2014, the Optima Project will score four credits rather than three, due to the separation of the Glare Control and Views Out criteria.

Luminaire schedule

Luminaire type	Philips catalogue series	Location	Luminaire image	Luminaire Description	Fixture Code*	Light Source	UGR	System Light Output (Lumens)	Input Wattage (Watts)	Efficacy (Lumens Per Watt)**
	PowerBalance RC461B	Open office		Recessed LED micro-lens optic 300mm x 1200mm recessed Dimmable	RC461B W30L120 1xLED34S/840*	LED 4000K, 80+ CRI	15	3400	31	110
	PowerBalance 461B	Cell Office		Recessed LED smart pyramid optics 600mm x 600mm Dimmable	RC461B W60L60 1xLED28S/840*	LED 4000K, 80+ CRI	14	2800	25	112
	LuxSpace Mini Round	Public Areas Conference Room		Recessed LED downlight 150mm Dimmable	BBS481 LLED-4000 PSE-E C CLII	LED 4000K, 80+ CRI	22	1076	12	90
	LuxSpace Mini Round with drop down diffuser	Open office Circulation Corridors		Recessed LED downlight Decorative glass accessory 150mm Dimmable	BBS480 1xLLED-4000 M +ZBS480 SG-O	LED 4000K, 80+ CRI	22	830	12	90
	SmartBalance suspended	Open office		Suspended LED micro-lens optic 240mm x 1340mm	SP482P LED40S/840 PSD ACC-MLO SM2	LED 4000K, 80+ CRI	19	4000	42	95
	SmartBalance free floor standing	Open office		Free Floor Standing LED micro-lens optic	FS484F 1xLED118S/840 MLO	LED 4000K, 80+ CRI	14	11800	40	106
	TaskFlex FS400D	Open office Cell Office Reception		LED adjustable desk lamp	FS400D 1xLED5/830	LED 3000K,80+ CRI	n.a.	370	8	46
	LumiStone SP522P	Conference Room		LED pendant 75% direct/25% indirect 330mm x 1500mm Dimmable	SP522P 2xLED20S/840*	LED 4000K, 80+ CRI	15	4000	38	105
	SmartForm TBS411	Conference Room		Recessed linear fluorescent asymmetric wall wash optic 90mm x 1200mm Dimmable	TBS411 1xTL5-25W HFD A*	TL5HE/Eco 4000K, 80+ CRI	n.a.	2179	30	73
	DayWave PBS800	Public Areas		Decorative LED pendant 150mm x 1450mm Dimmable	BPS800 1xLXML/NW AC-MLO*	LED 4000K,80+CRI	15	4000	166	24
	DayZone BBS560	Public Areas Elevator vestibule Reception		Recessed LED micro-lens optic 600mm x 600mm Dimmable	BBS560 1xLED20S/840 AC-MLO-C*	LED 4000K, 80+ CRI	14	2000	29	69
	StyliD ST502B	Public Areas		Recessed LED accent light adjustable optic 150mm Dimmable	ST502B 1xSLED 1200/930 MB*	LED 4000K, 80+ CRI	n.a.	1279	30	43

* Verify that ballast or driver is compatible with selected control system.
** Luminaire efficacy is based on initial luminaire lumens and input watts.

Glossary

Ballast
Electrical gear necessary for the operation of discharge light sources (fluorescent or HID) and typically provided in the luminaire. Ballasts must be electrically compatible with the lamps they operate. Dimming ballasts are needed to be able to dim fluorescent luminaires and High Frequency (50Hz) are a mandatory requirement for BREEAM.

BREEAM
The Building Research Establishment (BRE) have developed an Environmental Assessment Method (EAM) and created a world recognized scheme for assessing the sustainability within the built environment that can be applied to all building types in any geographical region, called BREEAM. This report has been based predominantly around BREEAM New Construction 2011 (3.0) and also influenced by BREEAM International 2013.

Commissioning
Commissioning is the process of assuring that a lighting control system (and other adjustable equipment in a building) performs as expected. Commissioning includes establishing design criteria (expectations), fine-tuning the final installation (typically, calibrating and programming), and verifying that it meets the criteria. Basic commissioning is a BREEAM prerequisite; additional points are available for enhanced commissioning practice.

Connected Load
Total installed wattage (of luminaires) before consideration of switching or dimming control.

Control Zone
A group of luminaires controlled together. A zone may represent an area or a type of luminaire or lighting effect.

Credit
In BREEAM, a credit relates to a target being sought, prior to the BREEAM 'weighting factor' being applied to convert it into a percentage score. One credit does not equal one percent. It is topic weighted.

CRI
Color Rendering Index. A standard method for evaluating how well a light source illuminates object colors. CRI is often shown as Ra; the scale runs from 0 to 100. CRI of 80 or higher is recommended for good quality office environments.

Cylindrical Illuminance
Illuminance measured in the vertical plane at either seated or standing height. Mean cylindrical illuminance is the average of measurements from multiple directions. Useful for evaluating the lighting of faces or objects.

Efficacy
Luminous efficacy – expressed in lumens per watt and abbreviated to LPW – commonly measures the energy efficiency of lighting. It is the ratio of lumens emitted by a light source or luminaire to the input power. In this guide, the efficacy values shown are based on initial luminaire lumens and system input power, including driver or ballast.

Facial Recognition
Used here, facial recognition means adequate and sufficiently diffused illumination so that faces appear natural and their expressions can be clearly seen in an office context. Also called facial modeling.

Habitable Space
A habitable space has been defined in BREEAM as one occupied for 30 mins or longer.

Illuminance
Total luminous flux incident on a surface, per unit area. Unit of measure: Lux (one lumen per m^2).

Light Emitting Diode (LED)
A semi-conductor device that emits visible energy. LEDs enjoy high (and increasing) luminous efficacy and long life. LED performance, color quality, and life depend on the design of the LED chip, the driver, and the luminaire in which it is used.

Light Pollution
Light Pollution generally refers to exterior lighting or light emitted from buildings at night, and includes light trespass on neighboring property, light directed upward into the sky (called sky glow), and excessive levels of illumination.

LPW
Lumens per watt, a measure of luminous efficacy.

Lumen
Measure of luminous flux, the flow (quantity) of light from a light source or luminaire.

Lumen Maintenance
Control strategy that dims the "excess" lighting provided to compensate for light loss over time.

Luminaire
Complete lighting device, including light source, auxiliary gear (ballast, driver, etc), optics, housing, mounting attachments and electrical connection.

Luminance
Photometric brightness of a surface in the direction of view. Unit of measure.

Lux
Measure of illuminance. 1 Lux = 1 lumen per square meter.

Maintained Illuminance
The initial illuminance from luminaires, adjusted by a light loss factor (LLF), to represent the expected illuminance after several years of use. Losses include depreciation of lumen output by aging, effects of dirt accumulation on luminaire surfaces and room surfaces, ballast factor, and other factors that reduce illuminance.

Minimum Illuminance
Lowest Lux value among calculation points in the relevant area.

Occupancy control
The combination of a sensor and a switch or relay. The sensor detects human presence through motion (either changes in the thermal image received by the sensor – passive infrared or PIR – or in the reflection of ultrasonic waves). As long as the sensor detects motion, the lighting will stay on; after the sensor no longer detects motion, lighting will be turned off. An auto ON/auto OFF device turns on automatically as soon as presence is detected. A manual ON/Auto OFF device turns on only when an occupant operates a switch. Both devices turn off automatically when presence is no longer detected. Occupancy control can refer to either absence or presence detection.

Photosensor
A meter that measures light and sends a signal to a controller that will either turn lighting on or off or dim according to a program.

Preset
Setting of a lighting "scene" that is programmed into the dimming/switching control and can be recalled as desired. Presets are typically user adjustable.

Target Illuminance
Illuminance setting for daylight linking control, lumen maintenance, and task tuning control strategies. Without daylight, the system maintains electric lighting at the required design level. As daylight increases, the system typically dims the electric lighting so that the combination of electric and daylight is about 30%-50% higher than the electric lighting alone (based on experience with user comfort).

Task Illuminance
Light falling on the principal work surfaces. In the Optima design, task illuminance is calculated on a 100mm x 100mm grid.

Time Switch
On/Off switch connected to a clock for time-of-day control.

Unified Glare Rating (UGR)
Unified Glare Rating (UGR) evaluates the direct glare produced by a specific arrangement of luminaires in a specific space. Lower values indicate less glare. UGR requirements vary by application. UGR is also calculated in standard tables for specific luminaires.

Uniformity (of Illuminance)
Uniformity measures the consistency of illuminance across the task area, between the task and other areas, and across other surfaces. Under EN12464-1, uniformity is generally calculated as the ratio of minimum to average illuminance, with 1.0 indicating perfectly even illuminance. For office task areas, a minimum uniformity of 0.6 is needed.

For further information on Lighting for BREEAM, please contact Philips via **www.lighting.philips.com**

Appendix A

Man 01 Sustainable procurement

(8 credits available)

[Lighting Designer's potential input level: Lighting Designer to be aware of]

The lighting design is recommended to be reviewed at three, six and nine month intervals after initial occupation, either by measurement or occupant feedback.

The lighting design team may be required to review or refine the lighting design depending on feedback.

Provide documentation of collaboration, relevant sections of building specification or contract, and be aware of the commissioning responsibilities schedule.

Reference local best practice standards: Commissioning will require a local agency.

Man 04 Stakeholder participation

(4 credits available)

[Lighting Designer's potential input level: Lighting Designer to be aware of]

The lighting design must be accessible, functional and inclusive and be based on consultation with current and future building users and other stakeholders.

The lighting designer should be available to an independent third party hired by the building owner to carry out a Post Occupancy Evaluation (POE) one year after building occupation.

Provide a consultation plan and relevant sections of building specification or contract.

Ene 02 Energy monitoring

(1-2 credits dependent on building type)

[Lighting Designer's potential input level: Lighting Designer to contribute to]

The design must ensure the installation of energy sub-metering that facilitates the monitoring of operational energy consumption with a pulsed output for remote monitoring for the lighting.

The lighting designer should collaborate with engineers on sub-metering diagrams to ensure the lighting design meets and exceeds the agreed levels of relevant codes and guidance.

For evidence, the assessor will require relevant sections of building specification or contract.

Ene 06 Energy efficient transportation systems

(2 credits available)

[Lighting Designer's potential input level: Lighting Designer to contribute to]

The design specification should include, where lifts are required, that lighting could switch off when the lift has been idle for a prescribed length of time and energy efficient lighting is used.

The lighting design is to ensure energy efficient lighting (>55 lamp lumens/circuit watt) is specified.

Provide relevant sections of building specification or contract and/or lighting energy calculations.
This should typically be done through the lift manufacturer and specification of the lift.

Tra 05 Travel plan

(1 credit available)

[Lighting Designer's potential input level: Lighting Designer to contribute to]

The lighting design must ensure that a pleasant and safe visual environment is provided at a range of travel options for building users, to encourage the reduction of user reliance on forms of travel that have the highest environmental impact.

The lighting designer should collaborate with the architect to ensure that bicycle lighting, landscape lighting and shelter lighting create pleasant pedestrian and public transport waiting areas.

Provide design drawings demonstrating measures implemented in support of travel plan's findings.

www.lighting.philips.com