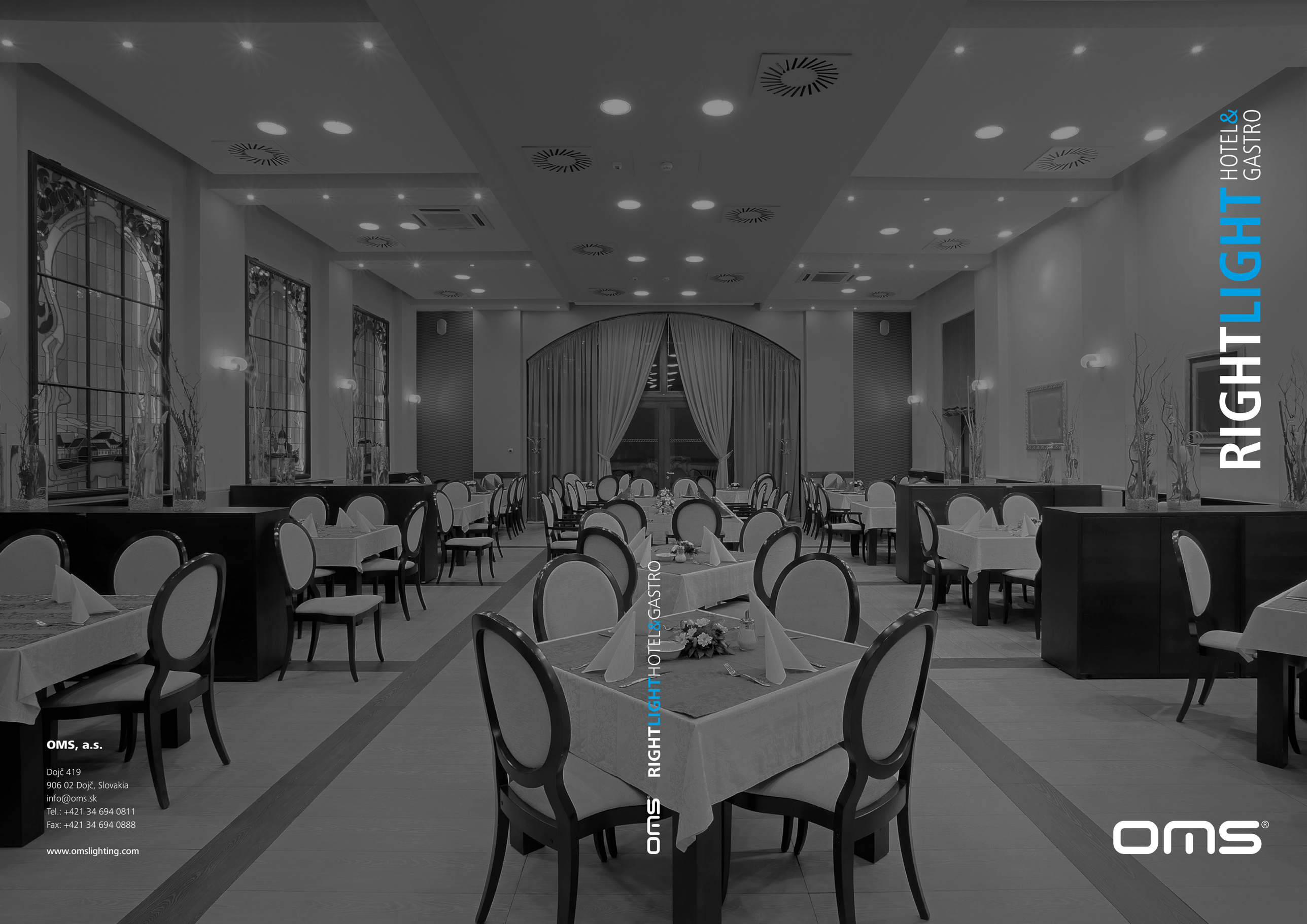

RIGHTLIGHT HOTEL& GASTRO

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The architect Aurelio Vazquez Duran said, "I do not think that when in a hotel you have to feel 'at home', on the contrary, you have to get the feeling that you are definitely elsewhere…"

Often, hotels are designed to make guests feel at home, but we believe that successful hotel design is rather about making the experience better than home. This principle can be extended to restaurants and wellness facilities. By adding elements of luxury or making the visit somehow exceptional, guests will not only have a truly rewarding time, but their lasting impression will be a positive one. Happy customers return to places they have enjoyed and spread the word.

A fundamental part of the design of any hospitality environment is the lighting, which has time and again proven to be a highly emotive medium by which to positively influence the mood, impression and experience of both guests and employees using the space. It is important to ensure that they are good places to work by the provision of physically and physiologically beneficial light, as friendly and positive employees pass on their enthusiasm to customers and create a favourable perception. And nowadays, as technology has advanced to offer us seemingly limitless possibilities, lighting can be used in any way we can imagine; to stimulate the senses, evoke desired reactions and entertain. Furthermore, the areas of hospitality environments open to guests do not fall under strict normative guidelines, meaning that lighting designers can create distinct spaces using dramatic accent lighting, ambient mood lighting and impressive RGB colour mixing.

However, creativity need not be limited to the obvious areas, but used in an intelligent way to provide necessary illumination for safe navigation both inside and outside and the reinforcement of a corporate identity. And, let's not forget, that the best light for both physical and psychological wellbeing, vision and perception, is daylight. In such places as restaurants, hotel rooms and wellness centres, it is best to make use of natural light to as great an extent as possible. This also means you can save energy… a win win situation.

If you need practical and creative inspiration and knowledge about how best to implement your ideas, look no further than the following pages of this book.

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CONTENT

LIGHT AND US

BRINGING ORDER TO THE LIGHTING WORLD

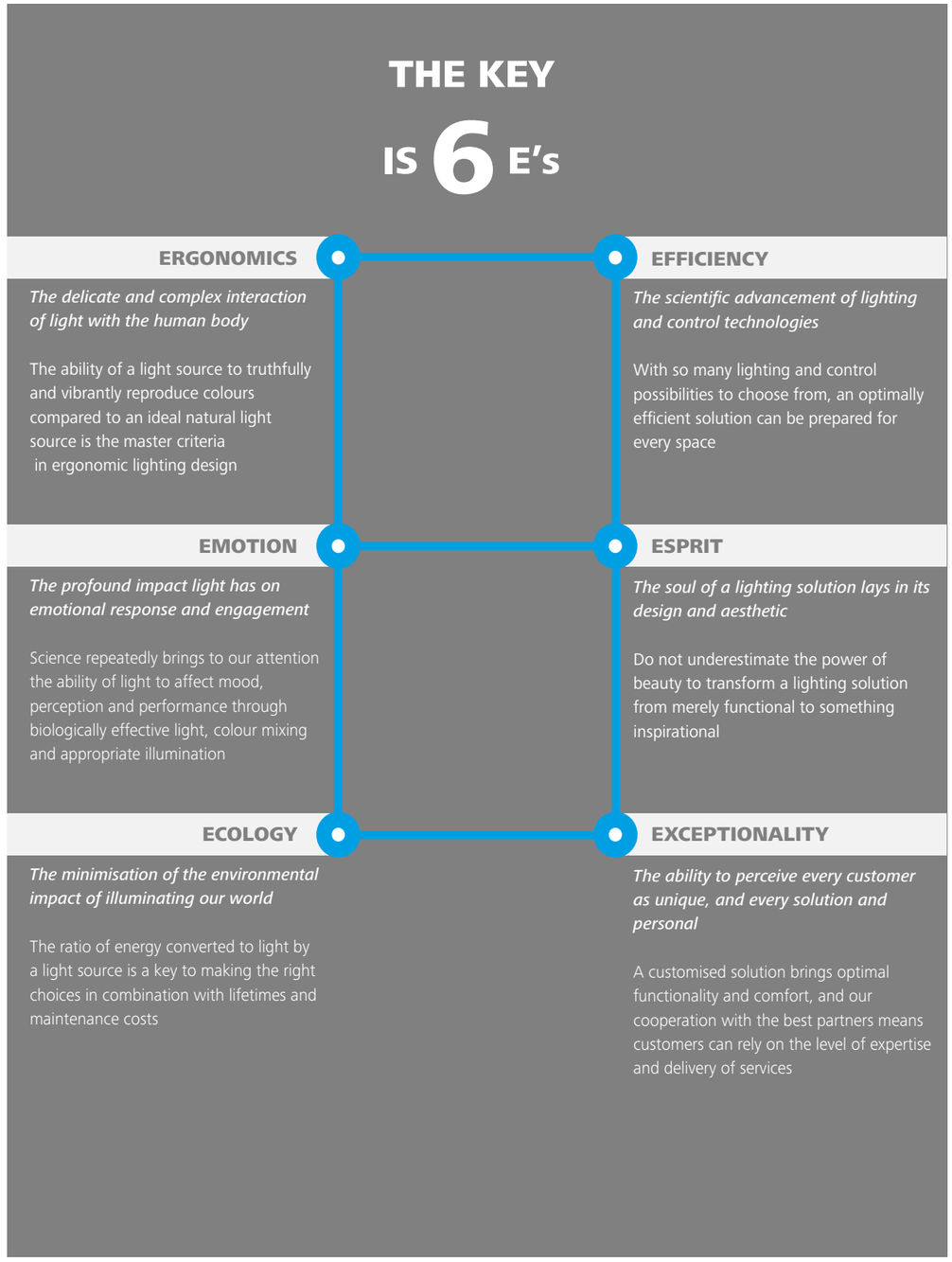
When designing the lighting system of a hotel the lighting designer has to take into account, besides the legal standards, also other parameters which are no less important and affect the quality of the lighting solution for the whole building. Until recently, the combination of these many factors was chaotic, and criteria incomprehensible. At OMS we realised that the lighting industry needed a regulated and systemised lighting assessment tool that would enable simple, fast and effective evaluation of lighting solutions. A system that would help not only the designers, but also the customers, supporting them to work together in choosing the best options to meet their needs. That system is the Lighting Quality Standard.

In life, rules are important. When it comes to creating an effective, efficient and safe lighting solution, one that enables visual comfort and acuity as well as performing a stimulating and emotionally engaging role, there are defined guidelines and parameters to follow. These things do not act to limit, but to lead and inform the creative and technical processes behind the conception of a perfect lighting solution. The Lighting Quality Standard (LQS) forms a logical framework within which both the objective and subjective aspects of a solution can be judged, helping everyone involved in the realisation process stay on track and achieve the best results.

It was not so long ago that every producer of light sources and luminaires had their own system of assessment. It was impossible for customers to judge the quality and suitability of different products, and therefore compare and assess complex solutions. We offer LQS to the lighting world as a tool for all to use and benefit from. It is not merely an aid, it is a significant step forwards for the lighting industry.

LQS is comprised of twenty objectively quantifiable criteria that enable the intuitive assessment and evaluation of everything from individual lighting fixtures to complex lighting solutions. Each criteria is scored on a scale between 0 and 5, with five representing the highest and most beneficial result. An overall rating is given once the process is complete, allowing for the simple comparison of one solution with another.

The whole assessment is categorised into six areas, the 6 E's: ERGONOMICS, EMOTION, ECOLOGY, EFFICIENCY, ESPRIT and EXCEPTIONALITY. The first four are objectively assessable, forming the so-called walls of an ideal structure. The last two are subjective, providing the roof of the structure, completing it and perfecting it. Each category cannot be effectively assessed separate from the others. The fullest and most advantageous result can only be achieve when all elements are viewed as a holistic whole. That is the philosophy of LQS, where the structure of the world we live in is crystal clear.



ERGONOMICS

The right light in the right place. That is the ergonomics of light. But what defines the right light? To answer this question we must understand how light affects the human eye. Only by doing so can we respect the principles that govern our visual world and consequently create a visual harmony that ensures comfort and acuity.

When designing lighting systems, lighting designers need to adhere to ergonomic principals and normative technical requirements.

Suitable lighting is a fundamental part of our perception of the world around us. Although the representative and accommodative areas of hotels and restaurants are not subject to strict standards, it is important to ensure the correct illumination of work areas according to the European standard EN 12464-1 for interior workspaces. Additionally, it is of course vital to provide visually and psychologically comfortable light in all areas of the premises to encourage customers to relax and enjoy their visit, and promote wellbeing and a positive impression that will cause them to return.

By following the correct principles, lighting designers can choose exactly the right light source, optical system and light distribution for each individual space. This covers all lighting parameters: Colour Rendering Index, glare prevention, illumination levels of task areas and their surroundings, lighting uniformity and harmonious distribution of brightness. Each individual parameter must be viewed as part of a holistic whole, ensuring the perfect light for both customers and employees.

SEELLER TRACK and SEELLER ADJUSTABLE are excellent examples of luminaires suited to such application, with excellent colour rendition across the whole colour spectrum, ensuring that all colours appear natural. The fixture itself is chic and will look good in even the most style-conscious setting. Highly flexible, with an optional asymmetric version providing exceptional illumination of vertical surfaces, SEELLER not only provides the perfect illumination, but also directs it exactly as needed.

For the served meal to look its best, suitable light must be provided in the preparation area and at the table.

COLOUR RENDERING INDEX

We perceive visually before we sense by smell, taste or touch. Sight is therefore a crucial aspect of gastronomical establishments. A good chef can work wonders with even this simplest ingredients, a fundamental part of which is colour. Colour, however, does not exist without light, thus what light we use in gastronomical environments in absolutely key.

Each light source displays colours differently, be it daylight or the light emitted from a fluorescent lamp. Colour rendition refers to how colours are displayed under different light sources, with the Colour Rendering Index (CRI) acting as the quantifiable measure of colour rendition.

In order to define the CRI of a given light source it must be compared to a neutral control light source, most commonly daylight. Both the control and test light source must have the same Correlated Colour Temperature (CCT) properties for the comparison to be accurate, as CCT is one of the key determiners of CRI. The more accurate the colour rendition of a light source, the higher its CRI value, with daylight having CRI = 100. To assess colour rendition, fifteen test colours are compared, each receiving an individual rating with the average of the first eight referred to as the Ra value, the standard expression of CRI used throughout the industry.

Excellent colour rendition is essential, enabling those preparing food to pick the freshest ingredients and present them in the best way, as well as meaning that customers can practically taste the succulent steak, crisp vegetables and colourful dessert with their eyes. A visually stimulated diner will surely have a healthy appetite.
EN 12461-1 stipulates that kitchens must be equipped with light sources that provide CRI = 80 or higher, however, we recommend using CRI ≥ 90 both in the kitchen and at the table, in order that all see the foods in the most honest and appetising light.

The best LQS rating is given to light sources with CRI = 90 or higher.

Comparison of colour rendering indices – CRI. Left CRI 70. Right CRI 93

LQS VALUE

Colour Rendering Index

CRI	LQS Value
≥ 90	5
80 ≤ CRI < 90	4
70 ≤ CRI < 80	3
60 ≤ CRI < 70	2
40 ≤ CRI < 60	1
CRI < 40	0

Soft, diffused light is visually comfortable and reduces both physical and psychological disturbance.

GLARE PREVENTION

Nobody is a fan of glare, it hurts our eyes and gives us headaches. It is not only uncomfortable but also potentially dangerous as it restricts and distorts visual perception. In hotels and restaurants it is important to minimise any glare, whether it be from sunlight or artificial light sources, in order to ensure visual comfort for employees and customers alike.

Glare can be both direct, such as when the light for a lighting fixture shines directly in the eye, and indirect, such as the reflections from a monitor, table or magazine. Indirect glare is the most harmful as it enters the eye from below at an angle to which our eye is most sensitive. Soft, diffused light is visually comfortable and reduces both physical and psychological disturbance.

In hotels and restaurants the requirements are quite relaxed, but we recommend that glare be kept to a minimum in order that customers are not visually disturbed. For work areas, again, glare must be reduced in order that employees can comfortably and effectively perform their work tasks. However, for work areas where employees use VDU it is necessary to comply with ISO 9241-307, which defines the maximum luminance values of the used lighting fixtures at an angle of 65° up to a maximum of 90°.

Lighting requirements	High luminance screen L > 200 cd/m²	Medium luminance screen L ≤ 200 cd/m²
Case A *For spaces with common CRI and visual acuity demands.*	≤ 3000 cd/m²	≤ 1500 cd/m²
Case B *For spaces with above-standard CRI and visual acuity demands.*	≤ 1500 cd/m²	≤ 1000 cd/m²

Maximum luminance values of used lighting fixtures at an angle of 65°

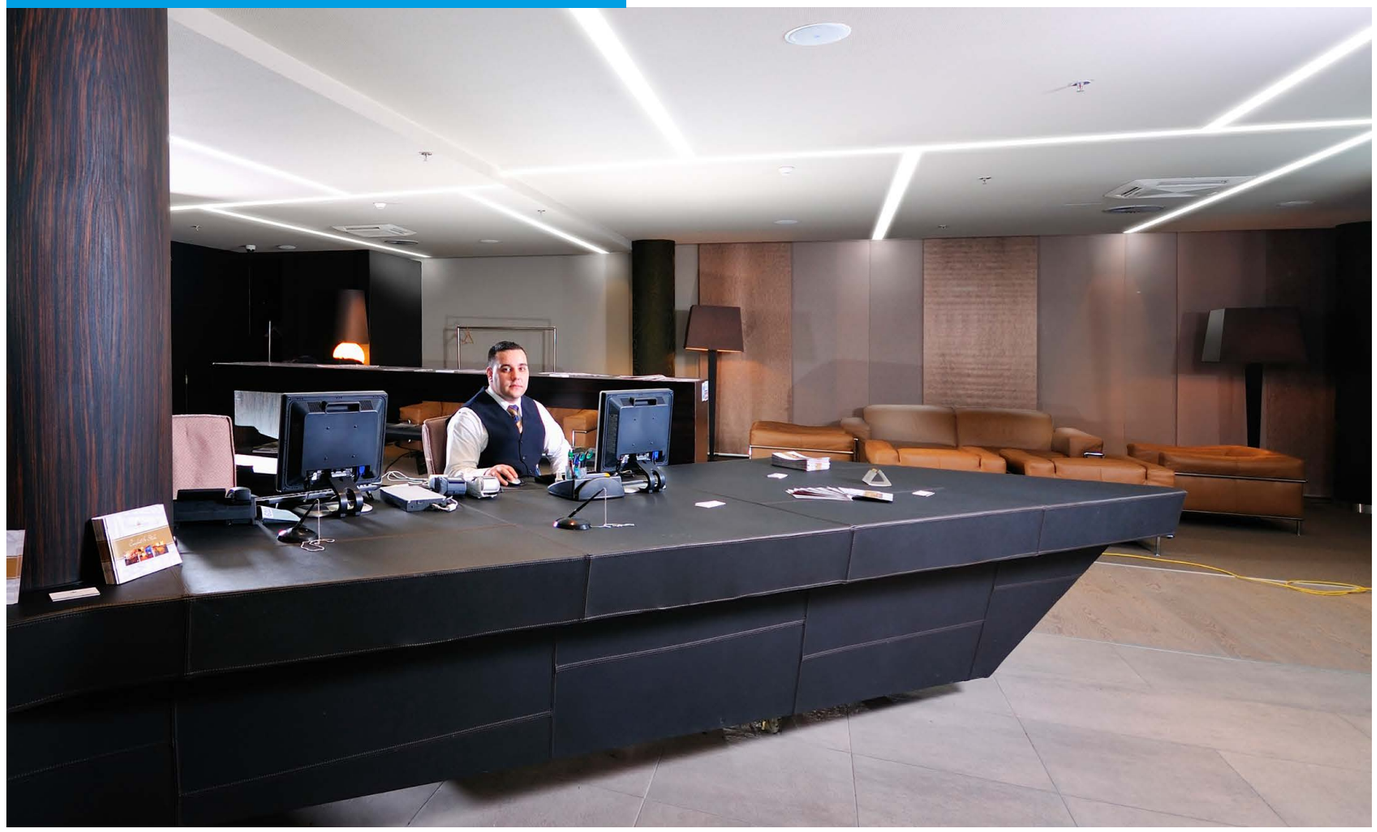
Glare is caused by the presence of areas within our field of vision that have significantly higher luminance than the background luminance or luminance of the task being undertaken. This causes excessive contrast that ultimately results in reduced visual acuity, sometimes to an extreme extent.

Correct setup of the working area will reduce the risk of glare. In offices, conferences rooms and kitchens with access to daylight we recommend positioning working areas at a right angle to windows so that employees and are not exposed to direct sunlight. We also recommend the addition of shading equipment such as blinds or curtains. The choice of luminaire and its positioning are also vital tools for reducing glare. Luminaire optics with a matt surface help, and should be located so as to not directly shine onto desks or other working surfaces.

LQS VALUE

Glare prevention

Glare prevention	LQS Value
URG ≤ 16	5
URG ≤ 19	4
URG ≤ 22	3
URG ≤ 25	2
URG ≤ 28	1
URG > 28	0



Unified glare rating

The quantification of glare is calculated according to the Unified Glare Rating (UGR) system developed by the Commission Internationale de l'Eclairage, with lower values representing lower levels of glare. In basic terms, it divides the glare of visible light sources by the general level of background luminance.

The highest LQS rating, 5 points, is given to lighting solutions with UGR ≤ 16.

$$UGR = 8\log\left[\frac{0.25}{L_b}\sum\frac{L^2\Omega}{p^2}\right]$$

Where:
- *L luminance a of light source in the direction of the eye of the observer in cd/m²*
- *Ω cut off angle of the luminaire relative to the eye of the observer in steradians*
- *p Guth position index representing the location of the observer relative to the light source*
- *L_b background illuminance in cd/m²*

Direct glare

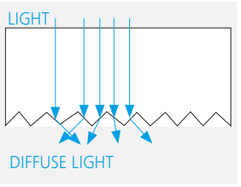
Direct glare is a result of excessive brightness created by improperly placed or unshaded luminaires. As this leads to both psychological and visual discomfort, the glare needs to be reduced to a minimum.

Indirect glare

Apart from leading to the same psychological and physiological stress as direct glare, indirect glare also reduces our capacity to perceive visual contrasts. This type of glare occurs when light reflects off shiny surfaces, such as glossy paper or screens.

Microprizm

Microprizm is the most effective optical material for minimising glare as the light 'breaks' on the external edge of the material, on the so-called optical prisms. This ensures that the light is uniformly distributed and soft, which is visually comfortable and pleasing and has a suitably low UGR rating.



The type and position of luminaires directly influences the minimisation of glare.

ILLUMINATION LEVEL

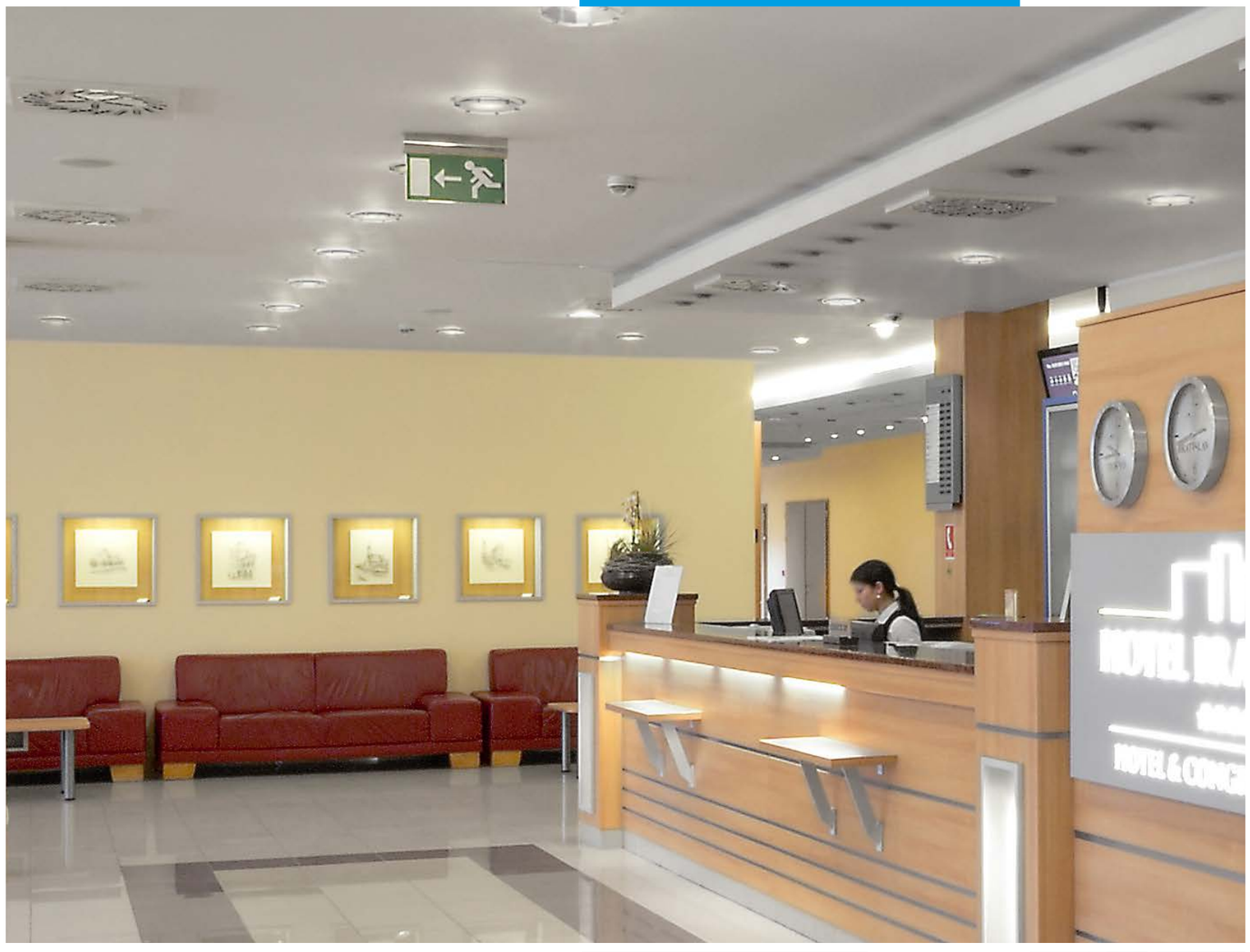
Light has a profound effect on human wellbeing. Its impact is not limited to visual perception alone, but also to psychological comfort, work performance and the abilities to concentrate and regenerate. In hotels and restaurants, appropriate lighting facilitates the performance of demanding visual tasks as well as having a positive effect on customer experience.

Task area

Standards only outline recommendations for working areas such as offices, receptions and kitchens. EN 12461-1 defines a minimum illuminance of 300 lx for task areas such as reception desks. However, based on vast experience, we recommend a higher level of 500 lx to better aid both performance and concentration.

Furthermore, appropriate lighting is not only determined by the amount of light, but also from where it is directed. The optimal solution is to position lighting fixtures is such a way that the light is directed from above and slightly to the left of the task area, meaning that employees do not cast shadows over their work and maintain clear visibility. This solution is suitable for right-handed people; nonetheless, there are technologies now available that allow for the adjustment of the light direction according to the individual user of the space. Workplace lighting is not only about the task area itself, but about having suitable brightness levels within the visual field in order that contrast between the visual focus and the environment is not excessive and optimal acuity is maintained.

The LQS standard awards 5 points to those spaces that comply with normative requirements, and 0 points to those that fail to reach the required illuminance level of the task area.



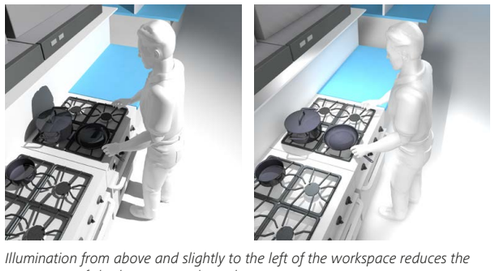
Illuminance of the task area E_{task} lux	Illuminance of immediate surrounding areas lux
≥ 750	500
500	300
300	200
200	150
150	E_{task}
100	E_{task}
≤ 50	E_{task}

Relationship of the illuminance of surrounding areas to the illuminance of a task area.

Surrounding area

Proper illumination of the surrounding (0.5 m from the place of visual task performance) and the background (3 m from the surrounding area) is as crucial as the illumination of the workplane itself. The appropriate illumination of these areas can eliminate problems with object recognition and minimise the risk of visual impairment, stress and mental strain. To ensure harmonious distribution of brightness within the field of view, the illuminance of the surrounding and background needs to be adjusted to the illuminance of the task area.

The LQS standard awards 5 points to those spaces that comply with normative requirements, and 0 points to those that fail to reach the required illuminance level of the surrounding area.



Illumination from above and slightly to the left of the workspace reduces the occurrence of shadows across the task area

LQS VALUE

Illumination level (task area)

Illumination level (task area)	LQS Value
Yes	5
No	0

LQS VALUE

Illumination level (surrounding area)

Illumination level (surrounding area)	LQS Value
Yes	5
No	0

A wide distribution of both direct and indirect illumination provides the most uniform and comfortable light for task areas.

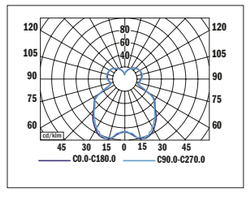
Spaces with the highest normative requirements on illuminance uniformity can get excellent results when using luminaires with a wide light distribution.

LIGHTING UNIFORMITY

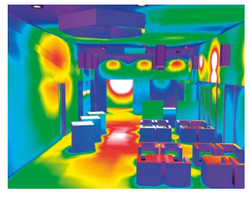
When a space is uniformly illuminated, we perceive the light as consistent. This aids visual acuity and comfort. Conversely, when a space is non-uniformly illuminated there are large contrasts between the amount of light in various parts of the space, a phenomenon which is both visually and psychologically fatiguing.

Lighting uniformity is the ratio of minimum to average illumination within a space. The closer the two values, the more uniform the lighting. An ideal state can be achieved by installing a quantified number of luminaires in correctly calculated positions so as to create an even level of illumination across all surfaces. Lighting fixtures that provide both direct and indirect illumination with a wide LIDC have proved to be the most effective. European standard EN 12461-1 requires a uniformity of 0.7 for areas where visually demanding tasks are performed.

From the LQS point of view, an optimal lighting solution complying with the standard scores 5 points, and the one that fails to do so scores 0 points.



LIDC of PRO P SUSPENDED FACET 2 x 26W + 1 x 57 W



The DIALux software enables the simulation of lighting uniformity during the design of the lighting system.

The LIDC gives the designer a hint about the resulting effect of the lighting.

The customer will receive a visualisation of the room that includes definition of all room surface materials and colours.

LQS VALUE

Lighting uniformity

Lighting uniformity	LQS Value
Yes	5
No	0

Well-balanced distribution of brightness aids visual acuity and allows the eye to quickly focus and perceive contrasts and detail.

Because the type of surface materials and textures used affects the overall harmonious distribution of brightness, it is recommended to use lighter colours that make the space look brighter and create a sense of higher illuminance. Dark walls, ceilings and furniture, on the other hand, have a lower level of brightness and therefore make the space look darker, or even cramped.

HARMONIOUS DISTRIBUTION OF BRIGHTNESS

Significant differences in brightness within a space cause not only visual and psychological fatigue, but can have long-term and even permanently damaging effects on eyesight. The eye must react and adapt to changes in brightness, a process that takes time, and which, if not taken into account, can result in greatly reduced visual acuity. Uniform illumination allows the eye to easily perceive contrasts and details and supports concentration and comfort. One way to ensure more uniform illumination is to minimise the level altogether, minimising the difference between light and dark areas, this is however not recommended as it is important to provide enough light.

The material, colour and finish of interior surfaces also directly impacts the uniformity of illumination within a space. Lighter colours on walls and ceilings make a space appear bigger and reflect light well, whereas darker surfaces absorb light and make a space feel smaller and gloomy.

Suspended luminaires with a 50/50 mix of direct and indirect light distribution are ideal for the creation of even illumination, with 50 % of the light output directed at the task area and 50 % to the ceiling from where it is softly diffused into the room. This softens and minimises harsh differences in brightness levels and aids in the modelling of objects and faces. Such illumination is perfectly suited to reception desks and offices where face-to-face contact is important. European standard EN 12461-1 recommends that ceilings be illuminated with ≥ 30 lx, with a reflectivity of 0.7 - 0.9 and uniformity of ≥ 0.10, and that walls be illuminated with ≥ 50 lx, with a reflectivity of 0.5 - 0.8 and uniformity of ≥ 0.10. For general spaces such as lobbies, corridors and stairways the illumination of walls should be ≥ 75 lx with a uniformity of ≥ 0.10, and the illumination of ceilings ≥ 50 lx with a uniformity of ≥ 0.10.

Two exceptional luminaires from the OMS portfolio are MIRZAM and TERZO, both specifically designed to illuminate ceilings and walls as well as task areas. This negates the cave effect in spaces, providing psychological and visually comfortable and pleasant light. This is facilitated using a projected diffuser that directs the light in both a direct and indirect way.

Based on the illuminance level and uniformity, LQS rates the lighting solution on the scale from 0 to 5 points.

LQS VALUE

Harmonious distribution of brightnees (contrast)	LQS Value
	Harmonious distribution of brightness
Em(wall) ≥ 150 lux with U_o ≥ 0.3 Em(ceiling) ≥ 75 lux with U_o ≥ 0.3	5
Em(wall) ≥ 75 lux with U_o ≥ 0.3 Em(ceiling) ≥ 50 lux with U_o ≥ 0.3	4
Em(wall) ≥ 75 lux with U_o ≥ 0.1 Em(ceiling) ≥ 50 lux with U_o ≥ 0.1	3
Em(wall) ≥ 50 lux with U_o ≥ 0.1 Em(ceiling) ≥ 30 lux with U_o ≥ 0.1	2
Em(wall) ≥ 30 lux with U_o ≥ 0.1 Em(ceiling) ≥ 10 lux with U_o ≥ 0.1	1
Em(wall) < 30 lux or U_o < 0.1 Em(ceiling) < 10 lux or U_o < 0.1	0

MIRZAM, TERZO
Optimal illuminance that meets the normative requirements on harmonious distribution of brightness can also be achieved by using recessed luminaires that produce both direct and indirect light distribution and are equipped with specially shaped protruded diffusers directing sufficient amounts of light onto the ceiling.

LIGHTING REQUIREMENTS FOR RESTAURANT AND HOTEL AREAS, TASKS AND ACTIVITIES EN 12464-1

Restaurants and hotels

Type of area, task or activity	Em (lux)	UGR_L	U_o	CRI	Specific requirements
Reception/cashier desk, porters desk	300	22	0.6	80	
Kitchen	500	22	0.6	80	There should be a transition zone between kitchen and restaurant.
Restaurant, dining room, function room	-	-	-	80	The lighting should be designed to create the appropriate atmos-
phere.					
Self-service restaurant	200	22	0.4	80	
Buffet	300	22	0.6	80	
Canteens, pantries	200	22	0.4	80	
Preparation and baking	300	22	0.6	80	
Finishing, glazing, decorating	500	22	0.7	80	
Conference and meeting rooms	500	19	0.6	80	Lighting should be controllable.
Corridors	100	25	0.4	80	During the night, lower levels are acceptable.
Stairs, escalators, travolators	100	25	0.4	40	Requires enhanced contrast on the steps.
Elevators	100	25	0.4	40	Light level in front of the elevator should be at least Em = 200 lx.
Public car parks (indoor)					
In/out ramps (during the day)	300	25	0.4	40	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
In/out ramps (at night)	75	25	0.4	40	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
Traffic lanes	75	25	0.4	40	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
Parking areas	75	-	0.4	40	1. Illuminances at floor level. 2. Safety colours shall be recognisable. 3. A high vertical illuminance increases recognition of people's faces and therefore the feeling of safety.
Ticket office	300	19	0.6	80	1. Reflections in the windows shall be avoided. 2. Glare from outside shall be prevented.

Em = average illuminance in lux (maintained value)

U_0 = lighting uniformity

UGR_L = unified glare rating limit (upper limit of glare)

CRI = Colour Rendering Index of light sources

LIGHTING REQUIREMENTS FOR RESTAURANT AND HOTEL AREAS, TASKS AND ACTIVITIES EN 12464-1

EMOTION

Hotels and restaurants are spaces where customers want to feel comfortable, where they wish to relax, recuperate and enjoy themselves. They are also work-spaces where employees are required to fulfil many different tasks. Light is a key tool by which to influence mood and behaviour, making a customer's stay and an employee's workday pleasurable and valuable.

Light is one of the most powerful tools for influencing and creating emotional responses and connections. Many call it the fourth element of architecture.

To be able to fully benefit from the ability of light to influence mood, perception, atmosphere and experience, we must look at it in several key ways: the biological effect of light, the role of daylight and the parameters of brightness and illumination.

THE BIOLOGICAL FACTOR OF LIGHT

Decades of scientific research have greatly changed our view of the role of artificial lighting. Our increased awareness and understanding of the effect light has on the circadian rhythm and overall psychological wellbeing of humans has highlighted the importance of creating lighting that is not merely subject to the rules of ergonomics but also biologically effective and psychologically beneficial.

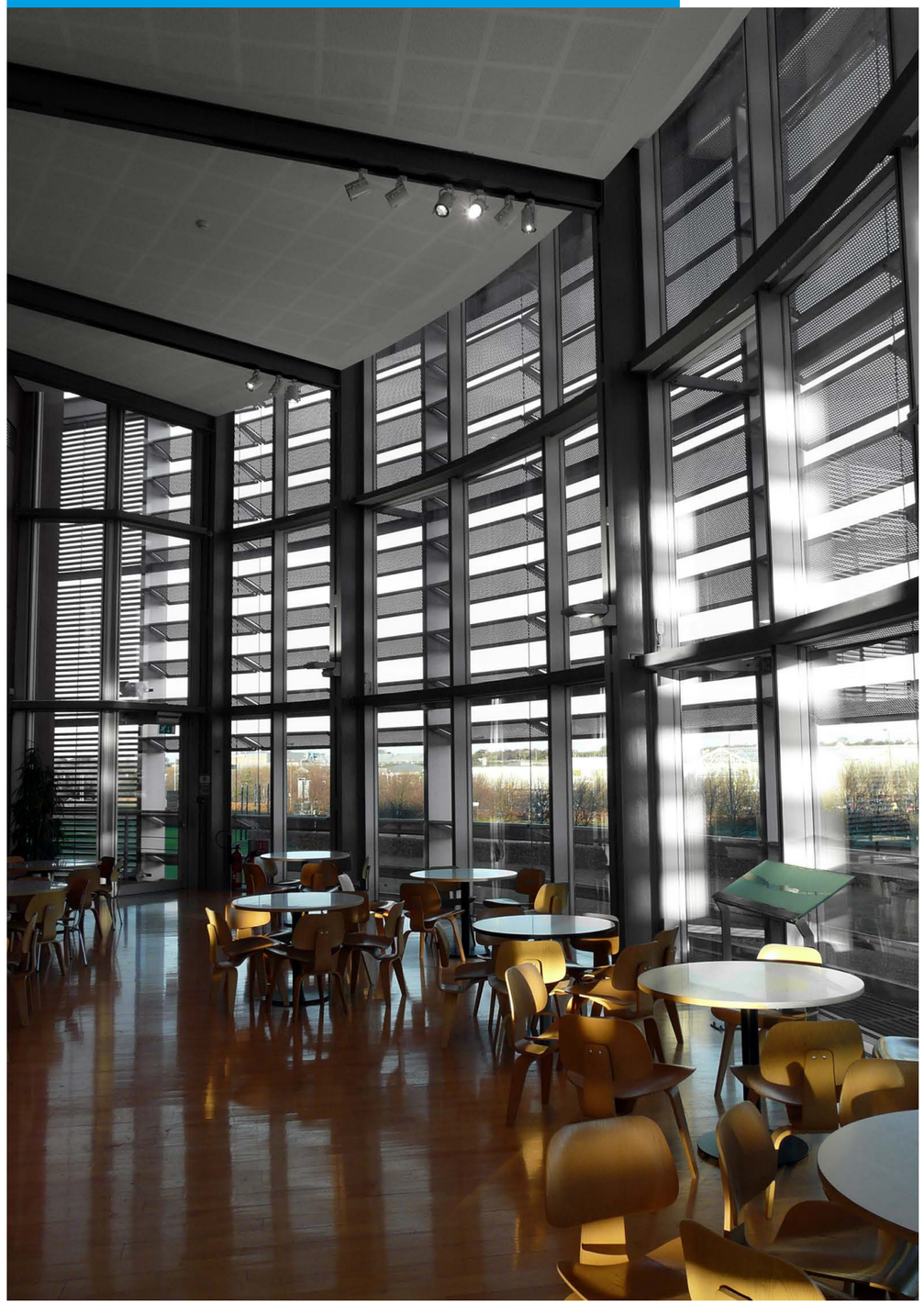
It goes without saying that daylight is the most favourable and beneficial light for our bodies and psyche, and should be used to illuminate interior spaces to the greatest extent possible in combination with suitable measures to minimise possible glare. However, in many interior spaces daylight availability is very limited or even non-existent. However, many advancements in both understanding and technology have been made in recent years, leading to artificial light being able to simulate many of the natural properties of daylight. This is something any space can benefit from, be it with or without access to natural light.

LQS VALUE

Biological factor of illumination

Biological factor of illumination	LQS Value
availability of daylight	0/1 (No/Yes)
blue light content	0/1 (No/Yes)
daylight simulation	0/1 (No/Yes)
dynamic lighting	0/1 (No/Yes)
tunable white	0/1 (No/Yes)

The role of artificial light is to supplement the daylight in spaces where there is a lack of it, or to replace it in spaces where there is none of it.



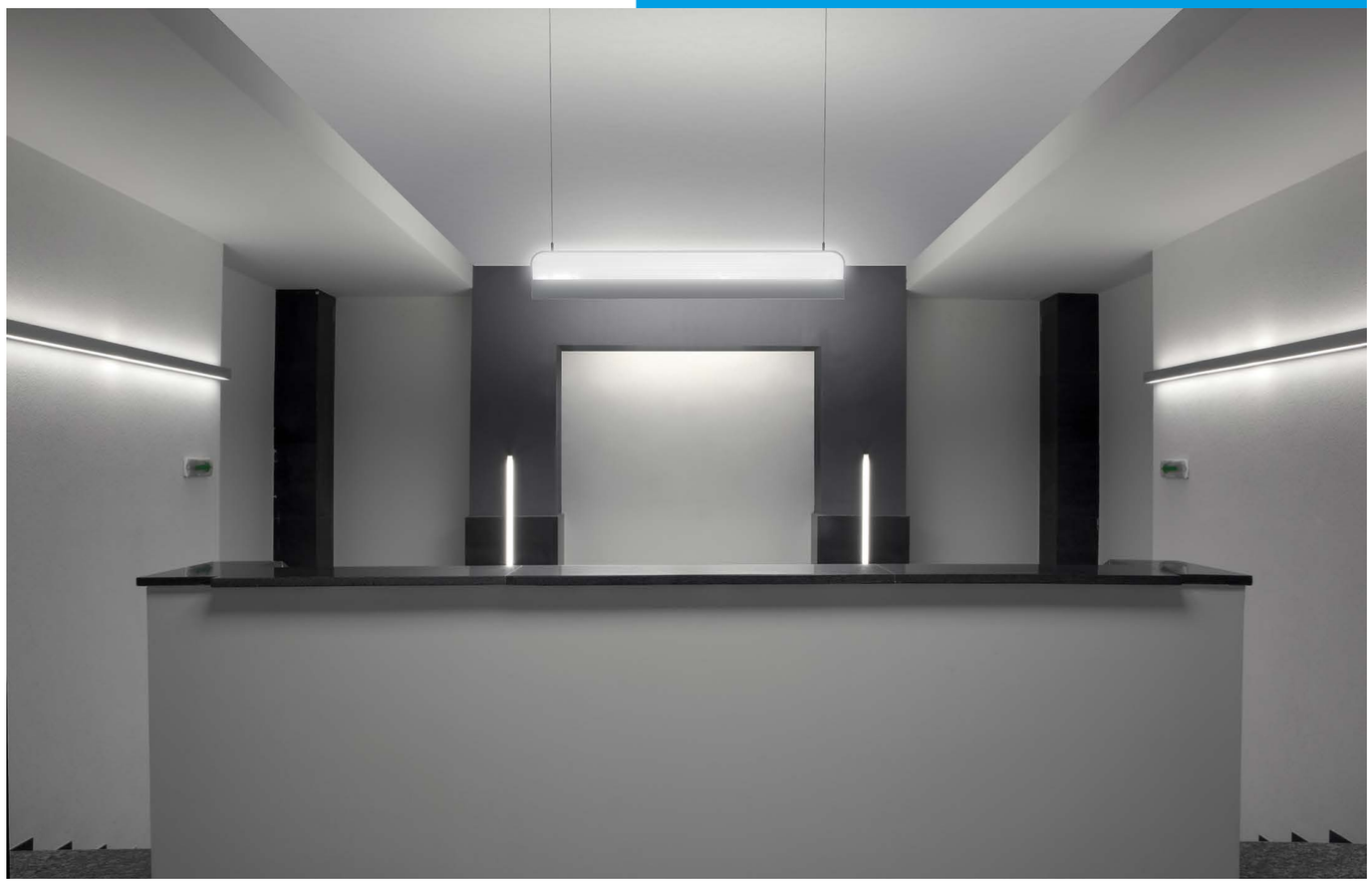
BLUE LIGHT CONTENT

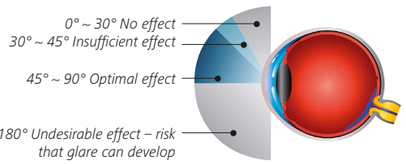
In the early 2000s scientists made a remarkable discovery that changed the face of lighting, adding a new and fundamental dimension to our understanding of light and its capabilities. This discovery was the detection of a third photoreceptor in the human eye, one that directly influences the body's production of the hormones melatonin, cortisol and serotonin. All of which, especially melatonin, have a governing effect on our circadian rhythm, acting as the cue to our bodies that it is day or night. The photoreceptor was found to be particularly sensitive to the blue part of the light spectrum with a wavelength of around 464 nm.

Instigating a flurry of new research and development within the lighting industry, luminaires and light sources are now available that can provide the right light at the right angle to positively affect human behaviour.

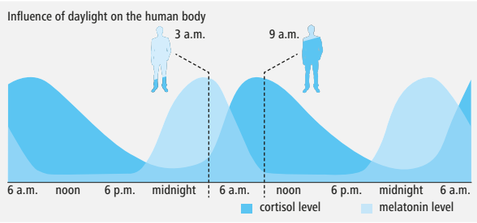
Hospitality environments can benefit from the use of blue light in several ways. Thanks to its influence on the circadian rhythm, blue light can be used in combination with warmer light to stimulate suitable sleep-wake cycles in both visitors and employees, thereby improving the sleep and relaxation of customers and the alertness and productivity of workers. Also, blue light can be used to motivate and energise at times where people may otherwise struggle, maybe during a long conference or seminar.

A insufficient amount of blue light signals the human body that it is time to relax and stimulates melatonin production.

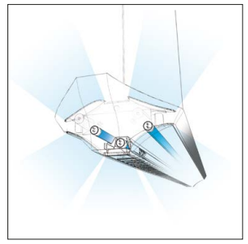




The third photoreceptor is particularly receptive to light with a wavelength of 464 nm, the blue part of the spectrum. This function acts to stimulate and regulate the production of certain hormones and the circadian rhythm.



During the morning hours, the human body produces the hormone cortisol to stimulate metabolism. its concentration in the blood peaks around 9 a.m. and gradually decreases through the day. Melatonin, also known as the sleep hormone, is produced by the body during the night, with its concentration in the blood peaking at around 3 a.m.



RAY
The basic attributes of the unique luminaire Modul RAY are an innovative and compact design as well as the mechanical structure. The luminaire can be dimmed, if necessary, and can be equipped with various types of sensors and tools for intelligent management.

SPIKER
SPIKER is a biologically effective luminaire. The direct light emitted from LED light sources passes through a microprismatic refractor that softly diffuses the illumination. The side optics are designs to direct the blue part of the light spectrum at an optimal angle to influence the third photoreceptor. The biological effectiveness is especially pronounced when the light emitted is of CCT 6500–8000 K.

3000 K

6500 K

SPIKER
It is a LED luminaire with two modules. The bottom module directs the luminous flux directly downwards and ensures optimal illuminance of the workplace. The backlit side diffuser is a source with specially adapted spectrum to support the bluelight content. Its vertical displacement ensures optimal luminance levels in the field of vision and at the same time a higher level of the vertical illuminance. The luminous flux flowing out of the luminaire in a specific direction helps, together with vertical surfaces of the room, direct a certain part of the luminous flux to the human eye in the required angle. It is able to directly affect the receptor in the eye sensitive to light (the so called third photoreceptor) that controls the internal biorhythm of people and in this way it is able to optimise their performance efficiency during working hours. The luminaire design itself, suitably selected light sources and appropriate directing the luminous flux create a concept of the so called biologically effective lighting.

Melatonin
Melatonin makes us feel drowsy, slows down bodily functions and lowers activity levels to facilitate a good night's sleep. It also ensures that a large number of metabolic processes are wound down. Body temperature falls; the organism, as it were, is put on the back burner. In this phase, the body secretes growth hormones that repair cells at night.

Cortisol
Cortisol is a stress hormone, produced from around 3 a.m. onwards in the adrenal cortex. It stimulates metabolism again and programmes the body for day-time operation. The first light of the day then stimulates the third receptor in the eye and suppresses the production of melatonin in the pineal gland. At the same time, the pituitary gland makes sure the body secretes more serotonin.

Serotonin
Serotonin acts as a mood-enhancing, motivating messenger. While the level of cortisol in the blood falls during the day in a counter-cycle to melatonin, serotonin helps us achieve a number of performance peaks. When daylight fades, the internal clock switches to night.

However, if our body does not get enough light during the day, it produces only a low level of melatonin. As a result, we sleep badly, we wake feeling unrested, we are tired during the day and lack energy and motivation. Insufficient exposure to stimulating light during autumn and winter can turn the process into a downward spiral. At that time of year, some people develop seasonal affective disorder (SAD). Their internal clock misses its cues because the hormonal balance in the brain is upset.

Nature gave us biologically effective daylight; modern technology gave us biologically effective artificial light.

DAYLIGHT

While in the past brightness was the key factor in the design of a lighting system, modern lighting must fulfil more complex and universal needs. Lighting designers base their work on the knowledge that daylight is by far most beneficial for humans due to its spectral composition, polarisation and rate of exposure, all of which effect bodily cycles, metabolism and immunity. Light has a huge impact on our overall wellbeing and health.

This knowledge has acted as the driving force behind the lighting industry's effort to bring many of the benefits of daylight to our artificially illuminated interior spaces. Where possible, available daylight should be harnessed and supplemented by artificial light with blue light content and the correct distribution. However, daylight can also be very powerful, causing visually disturbing and sometimes permanently damaging glare, so suitable action must be taken to provide methods to minimise glare, such as using blinds and curtains on windows and doors.

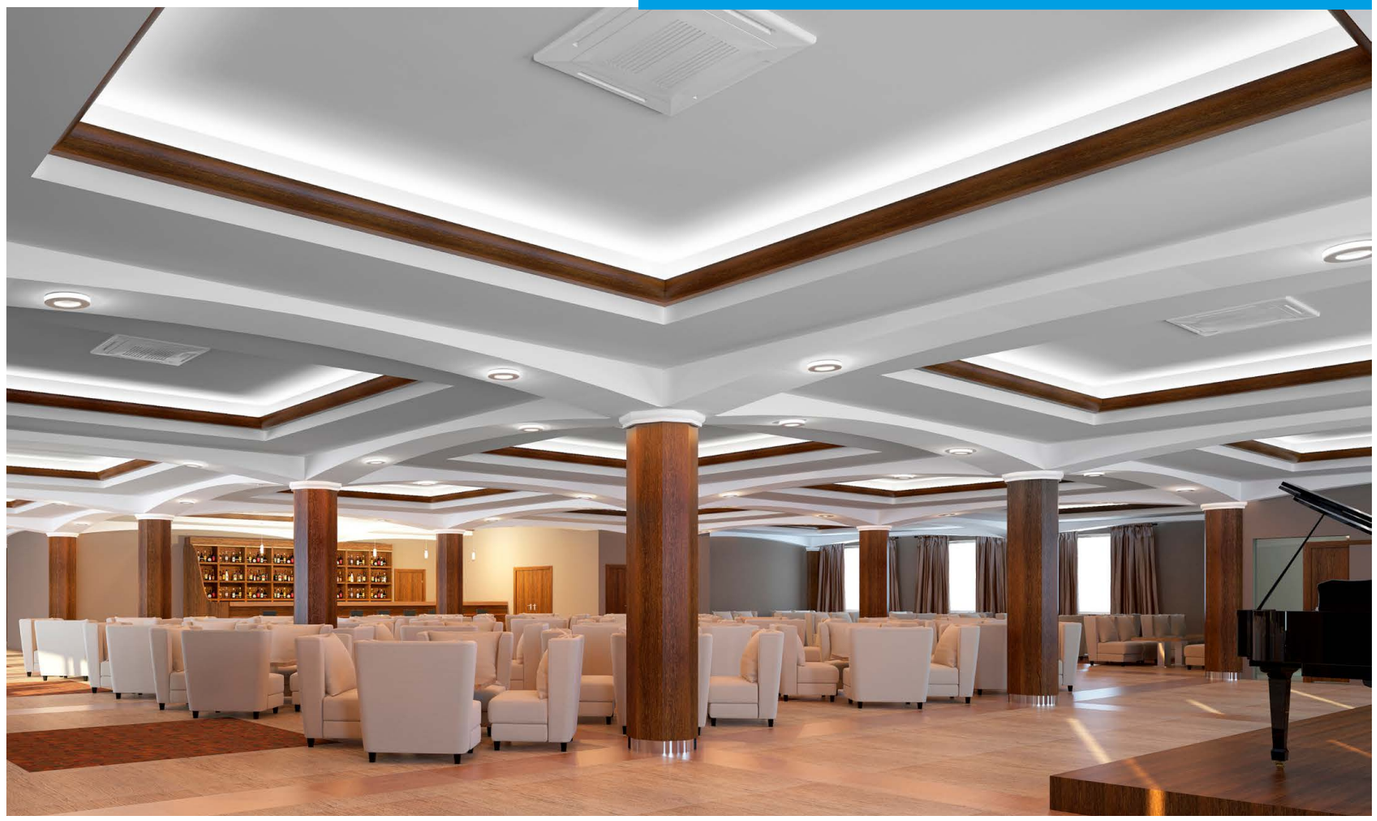
European standards outline the amount of daylight required within a space, such as restaurants and receptions, after which point supplementary artificial light is required. Generally, the human eye responds most positively to uniform illumination of large spaces, with minimal contrasts between light and shaded areas. The most effective way to ensure uniform illumination is to use luminaires that direct part of their light output towards the ceiling and walls from where it is softly diffused into the space. Such lighting most closely resembles the distribution properties of natural daylight and ensures visual comfort.

Dynamic lighting
Daylight simulation
TunableWhite

Dynamic lighting is the term used to describe lighting where the properties change over time according to lighting scenes. This can include changes in brightness, colour temperature and colour. Daylight simulation is one particular kind of dynamic lighting where the brightness and colour temperature of the light changes in such a way as to mimic the natural changes of daylight. TunableWhite is a modern and versatile development in lighting, enabling the adjustment of CCTs between warm and cool white, which when used in connection with dimming enables daylight simulation. TunableWhite is possible thanks to the use of two different light sources within one luminaire, one with a cool CCT of 6500 K and one with a warm CCT of 3000 K. The LED driver adjusts the output of each light source so as so create the desired overall light colour temperature.

Dynamic lighting and daylight simulation are very useful for the creation of various atmospheres within a space and can be especially useful in areas such as restaurants, bars, wellness and spa facilities where the creation of different moods can positively influence customers' ability to relax, recuperate and enjoy their visit. In areas such as lobbies, daylight simulation can adapt to the natural properties of the light outside at any given time, providing a stimulating experience for visitors as they enter. A perfect example of this is the use of warm and bright 'sunny' light inside when outside it is grey and raining. This encouraging impression lifts the mood and prompts positive reactions and impressions, creating a getaway from the gloomy and busy world outside. It is also applicable to use different CCTs in order to achieve a particular result, for example using activating and energising cool light in the morning to motivate people, or a warmer light at lunch to relax and calm people.

Daylight sensors are a crucial tool in the simulation of daylight, adjusting the brightness of luminaires according to predefined levels.



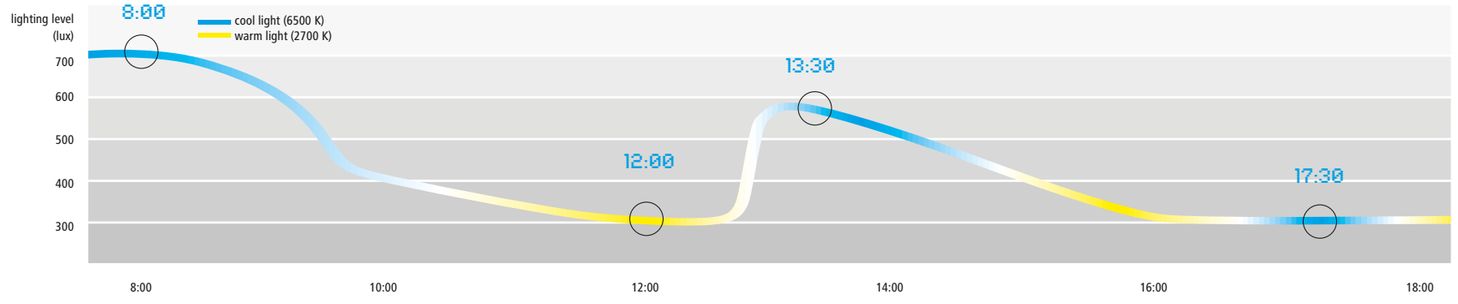
The goal of daylight simulation is to achieve a light intensity and colour that mimics the properties of daylight as truthfully as possible.

Good morning
Cool, fresh light raises the energy level of people and provides a good start to the day.

Lunch time
Warm light with a reduced intensity facilitates relaxation.

Post-lunch dip
After lunch,we usually feel sleepy. The light level rises again and changes to cool white to counter the 'post-lunch dip'.

Happy hour
Just before the end of the a change to cooler white light provides an alertness boost ahead of the journey home. For people staying late, warm white light creates a pleasent 'homely' atmosphere.



Daylight falls on us evenly from above, a kind of illumination now possible to copy in our interior spaces.

ILLUMINATION OF ROOM SURFACES

It is important to approach the subject of illumination holistically, thinking not only of the illumination of horizontal surfaces, but also the suitable illumination of ceilings and walls. By maintaining an optimal ratio of illumination between all surfaces, it is possible to create a visually and psychologically pleasant atmosphere in a room.

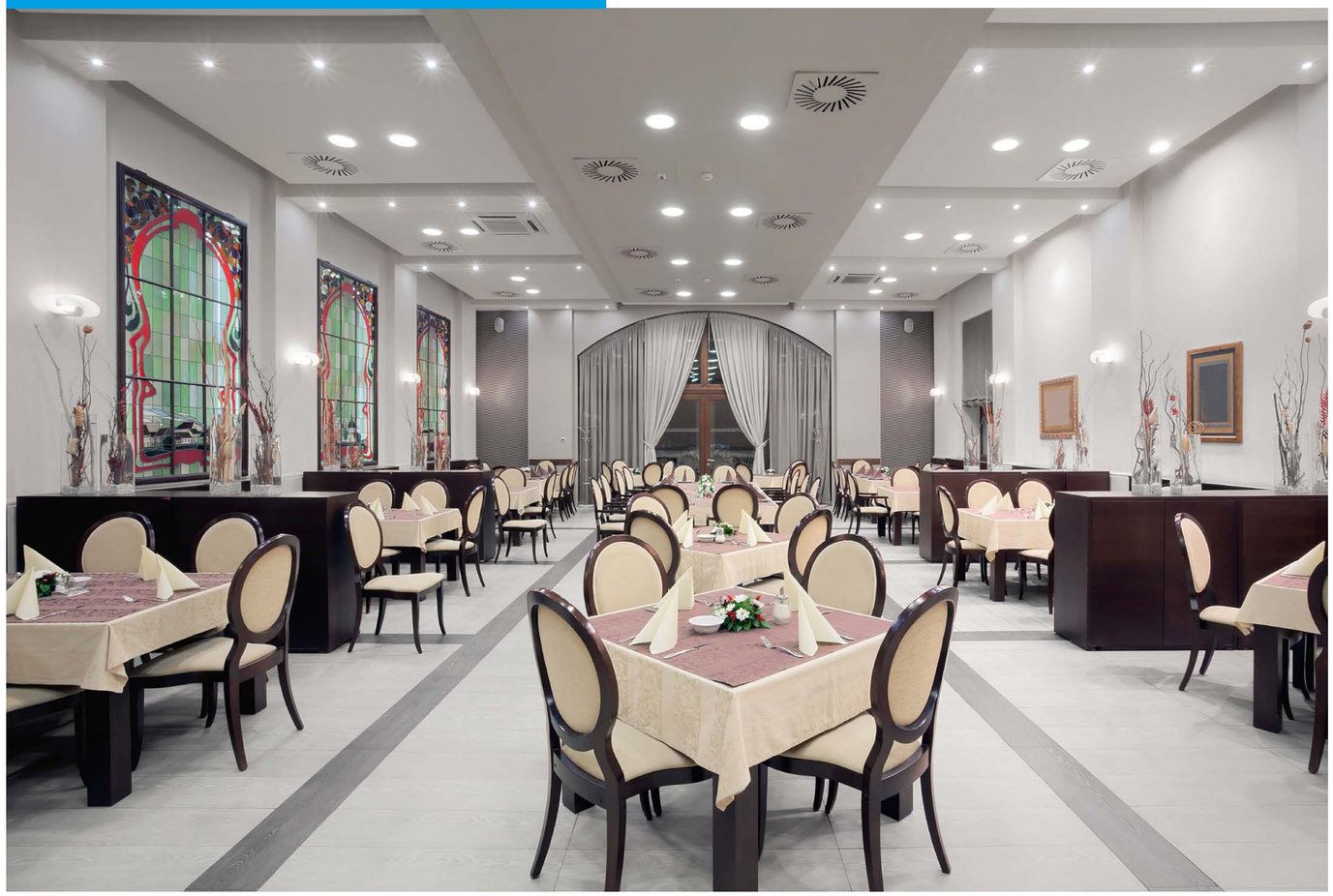
A high level of horizontal illumination with little vertical illumination creates a phenomenon called the cave effect, where horizontal surfaces are adequately illuminated but walls and ceilings are dark. In some cases the contrast between light and dark surfaces is quite high, which is both visually unpleasant but also disturbing and results in reduced visual acuity. When defining the ratio of horizontal to vertical illumination, LQS emphasises the reflectance of all surfaces within a space and the overall value, a standard exceeding those outlined in the commonly used British LG7 guidelines.

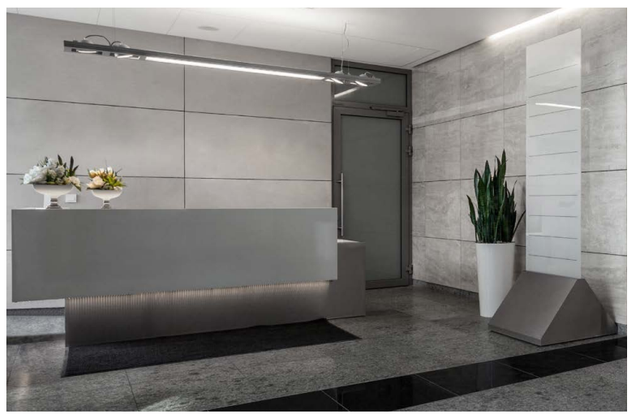
Vertical illumination

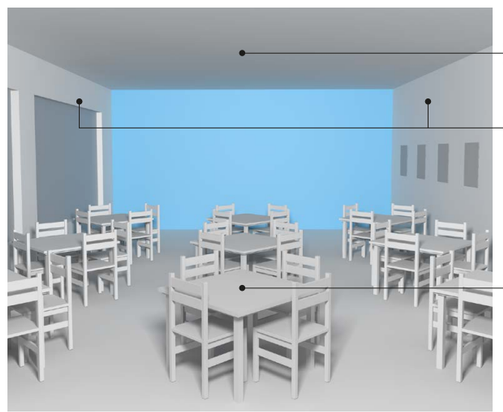
We are more or less sensitive to light depending on the angle at which it enters the eye. This fact defines our understanding of how vertical illumination relates to horizontal illumination and informs the way in which we use luminaires to create optimal optical conditions, including the vital visual component of contrast.

Vertical illumination mimics the characteristics of daylight where the light comes from above and falls on all surfaces, not only horizontal ones. This is an important factor in interior illumination where we want to copy such characteristics for their visual and psychological benefits. Based on the established sensitivity of the human eye to light from various angles it is possible to support visual functions such as orientation and the recognition of shapes and faces as well as creating a communicative atmosphere in spaces where face-to-face contact is required.

The best way to ensure sufficient levels of vertical illumination is to use suspended luminaires that emit light both directly and indirectly. If the use of suspended luminaires is not appropriate, an alternative is to use asymmetric luminaires mounted on the ceiling at a distance from the wall corresponding to one third of the wall height. Both lighting options ensure excellent illumination of walls from floor to ceiling.







By ensuring an optimal ratio between the illumination of all room surfaces, it is possible to positively influence the occurrence of visual and psychological fatigue.

Ceiling illumination

Ceilings represent a large proportion of the overall surface of a space, and tend to be neglected. However, their appropriate illumination can change the face of any interior environment, ensuring a pleasant atmosphere and, if suitable, highlighting interesting architectural details.

To illuminate ceilings it is necessary to count on the use of luminaires that provide a degree of indirect illumination. An illuminated ceiling helps to provide similar lighting conditions to daylight where light predominantly falls homogeneously from above. Specially design ceiling recessed luminaires can be used that have protruding diffusers that ensure light is distributed across the ceiling surface as well as downwards. When the architecture of the space allows, suspended luminaires that provide both direct and indirect illumination are the ideal solution.

LQS VALUE

Vertical illumination

Vertical illumination	LQS Value
$Ev_{avg} \geq 0.5\ Eh_{avg}$ (Wall LG7) $Ev_{avg} > 150$ lux	5
$Ev_{avg} \geq 0.5\ Eh_{avg}$ (Wall LG7)	4
$Ev_{avg} \geq 0.4\ Eh_{avg}$	3
$Ev_{avg} \geq 0.3\ Eh_{avg}$	2
$Ev_{avg} \geq 0.1\ Eh_{avg}$	1
$Ev_{avg} < 0.1\ Eh_{avg}$	0

LQS VALUE

Ceiling illumination

Ceiling illumination	LQS Value
$Eh_{avg} \geq 0.3\ Eh_{avg}$ (Ceiling LG7) $Eh_{avg} > 75$lx	5
$Eh_{avg} \geq 0.3\ Eh_{avg}$ (Ceiling LG7)	4
$Eh_{avg} \geq 0.2\ Eh_{avg}$	3
$Eh_{avg} \geq 0.15\ Eh_{avg}$	2
$Eh_{avg} \geq 0.1\ Eh_{avg}$	1
$Eh_{avg} < 0.1\ Eh_{avg}$	0

Accent lighting enhances special details, while ambient lighting determines the overall atmosphere of the space.

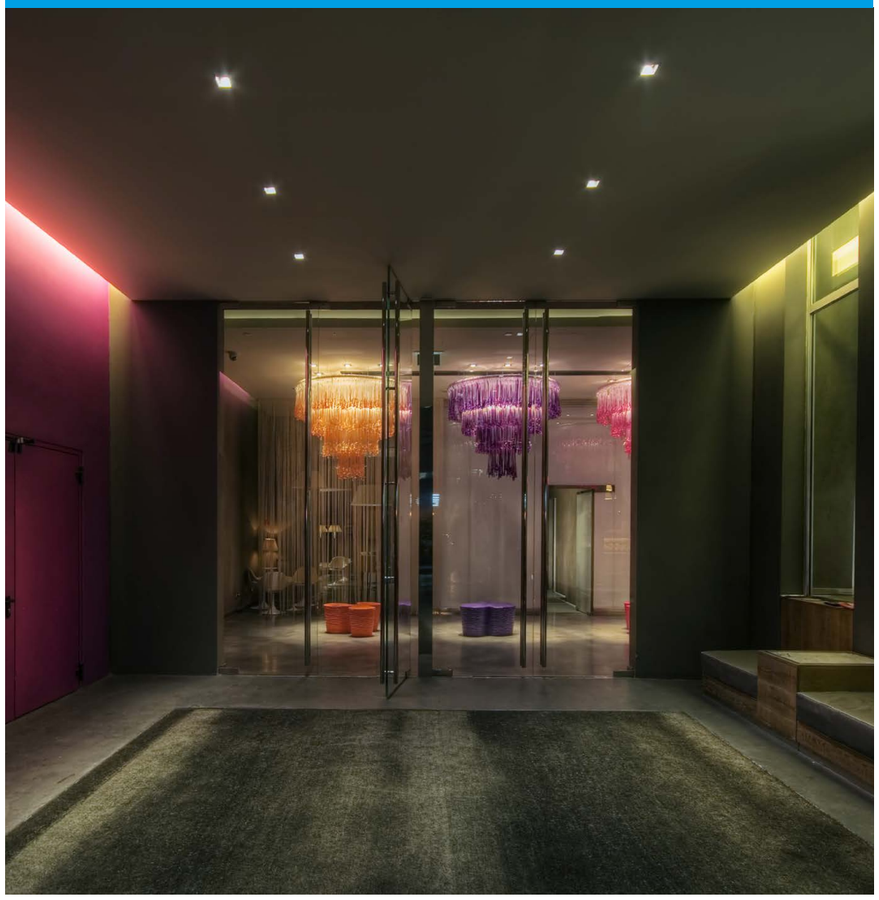
EMOTIONAL LIGHTING

Hospitality environments need fulfil only a few normative requirements, enabling lighting designers to make full use of their creativity in determining the ways in which light is used to emotionally affect customers and employees.

RGB colour mixing

Few areas of application offer the creative potential that hospitality spaces do. Here, the use of colour can greatly impact on the emotional responses and associations made by customers, directly influencing their perception of the environment, services and impression of the premises, and ultimately their levels of satisfaction. In wellness areas and hotel rooms, coloured lighting can be used to create a relaxed atmosphere, and in bars and restaurants to entertain and stimulate.

When using coloured lighting, it is important to fully know the details of the space to be illuminated as it is vital to select the right colours and effects to achieve the desired result.



Ambient lighting

Ambient lighting uses luminaires hidden within recessed areas or coves in ceilings, walls and even floors. This kind of lighting provides a glowing light that is pleasant and highly flexible. It is possible to use both white and coloured light, which can change dynamically throughout the day or according to desire or event. Such lighting can be used in various ways, for example, to highlight the structural elements of a space such as interesting ceilings, or to draw attention to receptions, bars and other key areas. Another way is to use ambient lighting along walls to aid navigation along corridors whilst maintaining the feelings of intimacy and ease that are generally missing in such spaces. RGB combined with ambient lighting is a great way to multiply the positive effects of these emotive lighting methods.

Accent lighting

Accent lighting attracts attention by causing a concentrated beam of light to fall on a particular location, to which the human eye is especially responsive. In this way, it is possible to highlight an interesting object such as a sculpture, or to illuminate a logo or other corporate item. In order to achieve an attracting and memorable effect, it is necessary to ensure a minimum ratio of contrast between the accent and background illumination of 3:1.

LQS VALUE

RGB colour mixing

RGB colour mixing	LQS Value
Yes	5
No	0

LQS VALUE

Accent lighting

Accent lighting	LQS Value
Yes	5
No	0

LQS VALUE

Ambient lighting

Ambient lighting	LQS Value
Yes	5
No	0

ECOLOGY

ECO
FRIENDLY

Respect for the fragile equilibrium of the environment has been core to innovation and growth in many industries over the past few decades. The lighting industry is no exception, having great ecological potential and consistently pushing to the forefront the values of environmental responsibility and understanding.

Environmental respect and the need for ecologically sustainable solutions are gradually finding their place in hotels and catering establishments.

Gone are the days when the provision of light is enough. Now light source and lighting technologies are required to be energy efficient, recyclable and have a long lifetime, additional to being effective and having a low environmental impact during production, use and disposal.

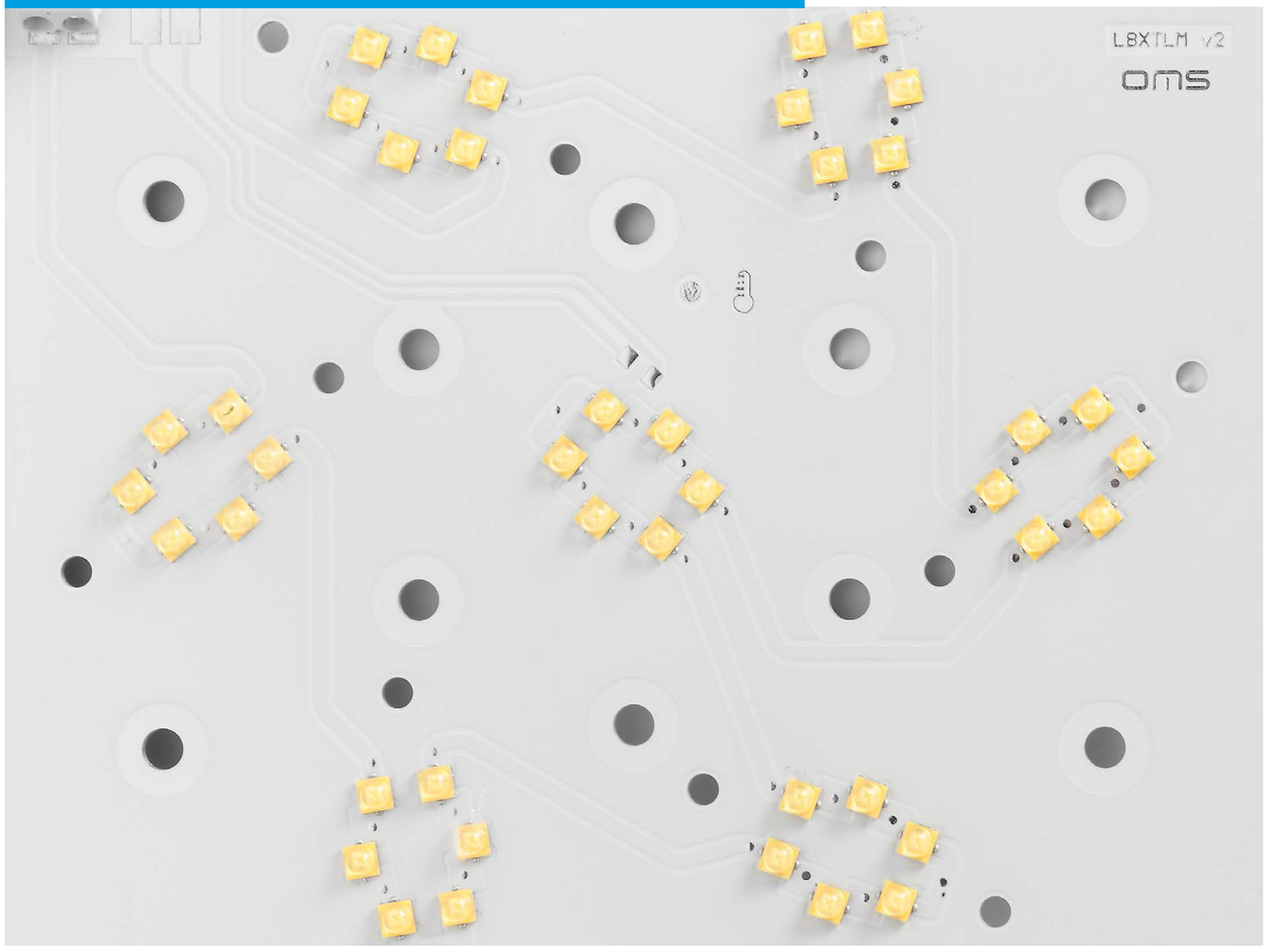
All of these factors combined make for an ecologically sound solution, as well as a cost effective one, both advantages being strong driving forces behind technological development and customer uptake. The need to attend to ecological issues is now a central factor in all areas of hospitality lighting.

More than 90 % of all light source development is occurring within the field of LED.

USING THE LATEST LIGHT SOURCE TECHNOLOGY

The time when people applauded Swan and Edison are long gone. Although history will forever remember them as the fathers of artificial light, science is rapidly and consistently driving advancement in this area.

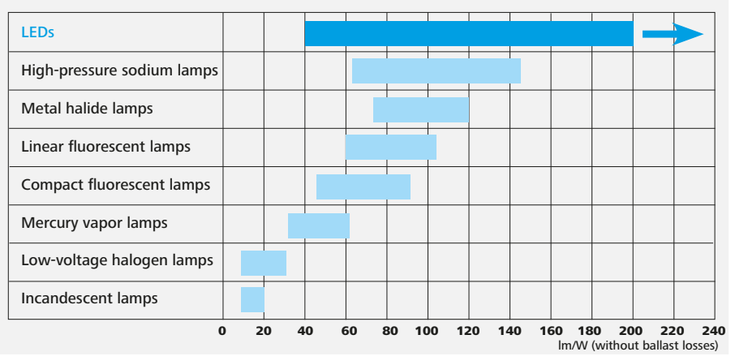
Energy sources are limited and prices are constantly rising. Awareness of this makes it more and more important to attain greater light source efficiency and lower energy consumption. A few years ago, metal-halide lamps were the light source of choice but are now rapidly losing ground against LED technology. Compared to conventional light source technologies LED has many advantages including being more effective, consuming less energy, emitting negligible amounts of heat and containing very low levels of hazardous materials. In terms of light source development, more than 90 % of innovation is taking place in the field of LED, with innovation in conventional technologies occurring at a much-reduced rate. However, we must remember that the driving force behind both LED and conventional light source development is their efficiency, with conventional lamps being replaced by eco and long-life versions, and even standard metal-halide lamps by second generation ceramic filament ones.



The key indicator of the efficiency of a light source is its efficacy, how much light is emitted in lumens in relation to the power consumed in watts, resulting in an easily quantifiable lm/W value. This is a core parameter for any lighting designer when designing a lighting system. In this respect, LED proves its worth by offering efficacies far higher than those of conventional light sources.

Currently, despite being far more efficient and providing very high quality light, LED technology has not yet replaced conventional technology, mainly due to the higher initial price. However, to gain a clear view of the situation we must look at the wider context as lower power consumption, reduced maintenance and long lifetimes make this new technology very appealing by providing excellent return of investment. Nevertheless, it is not merely a case of using LED light sources, but also of using lighting fixtures specifically designed for use with this very different technology. There is now an influx of retrofit LED light sources available, which although suitable for domestic application are not a reasonable option for larger scale use as their efficiency is greatly marred by the fact the lighting fixtures used are not suited. Lighting fixtures designed for LED are able to capture and direct the light very effectively, exploiting the power saving potential of the technology to its fullest extent, wholly justifying the investment.

EFFICACY OF LIGHT SOURCES



LQS VALUE

Latest lamp technology	LQS Value
Latest lamp technology	
η > 100 lm/W	5
η > 90 lm/W	4
η > 80 lm/W	3
η > 70 lm/W	2
η > 60 lm/W	1
η ≤ 60 lm/W	0

The materials used in the construction of the lighting fixture and its optical system have the greatest effect on its system efficacy.

SYSTEM EFFICACY

Light source efficacy is only one part of the equation. The use of inappropriate and ineffective lighting fixtures negates the positive effects of the light source, therefore it is vital to ensure that effective lighting fixtures are also part of the plan.

$$\text{LOR} = \frac{\text{Lumen output of luminaire}}{\text{Lumen output of lamps}} \times 100\ \%$$

$$\text{System efficacy of luminaire} = \frac{\text{Lumen output of luminaire}}{\text{Installed power of luminaire}} \left[\frac{\text{lm}}{\text{W}}\right]$$

System efficacy refers to the effectiveness of the lighting fixture itself, how well it can direct the light whilst reducing losses on the surfaces of the optical system to a minimum. This is measured in much the same way as light source efficacy, with the light output of the luminaire in lumens divided by its overall power consumption resulting in a lm/W value. Another important value with regard to lighting fixtures is the Light Output Ratio (LOR) that expresses the ratio of the light source output to the lighting fixture output. This ratio can be applied to both the illumination directed upward and downward, expressing how much of the light output is directed above or below the lighting fixture. This is important for those spaces that place high demands on ceiling illumination.

How to make an effective luminaire

The materials used in the construction of a lighting fixture have the greatest influence on its effectiveness. Optical materials are used to diffuse light, modify its distribution and change its spectral composition. They are divided into two types, those that reflect and those that transmit. Aluminium, with various surfaces finishes, is the most common material used for reflectors, while glass and plastics are used for transmitting parts. Every material has different reflectance and absorption properties, but generally the more effective the materials used the lower the amount of light lost on the surfaces and the higher the efficacy of the luminaire.

However, the effectiveness of a lighting fixture is also dependent on the shape and design of the optical system. Well designed optics ensure that the greatest amount of light is directed as desired with minimal losses. Modern computer applications, such as LightTools®, are able to calculate the optimal mathematical and geometric properties for the individual parts of a given optical system.

The highest LQS score is given to luminaires with an efficacy higher then 80 lm/W.

LQS VALUE

System efficacy of luminaire

System efficacy of luminaire	LQS Value
η > 80 lm/W	5
η > 70 lm/W	4
η > 65 lm/W	3
η > 55 lm/W	2
η > 40 lm/W	1
η ≤ 40 lm/W	0

THE THERMAL OUTPUT OF LIGHT SOURCES

The part of the light spectrum visible to human eyes ranges between infrared (IR) and ultraviolet (UV). Even though we cannot see IR radiation we can still sense it, as heat.

All light sources emit a certain amount of IR radiation, energy that is lost as heat rather than being useful as light, therefore, the lower the amount of IR radiation a light source emits the more effective it is. From this point of view, the incandescent bulb is the least effective as 95 % of the energy they consume is emitted as heat, and only 5 % as light.

This factor is of vital importance. A light source that emits a high proportion of heat will consume a lot of energy to provide very little light, meaning more light sources will need to be used and a great deal of heat will be radiated into the space. A comfortable temperature is important in any kind of hospitality premises as a comfortable visitor will stay longer and is more likely to return. Air conditioning is a vital component of almost any space, one that consumes a lot of energy, with a direct correlation existing between increased lighting energy consumption and air conditioning energy consumption. As a result, the use of light sources that emit low levels of heat not only provides energy savings within the lighting system, but also reduces the cooling load placed on the air conditioning system, which in turn results in energy savings. When we look at IR radiation in this way, it is clear to see that what may at first seem like a trivial factor is in truth of great importance. LED is the technology of choice here as they emit negligible amounts of IR radiation, making them not only highly effective as light sources, but also greatly reducing the work required of air conditioning systems.

The highest LQS score is given to those lighting systems whose average amount of IR radiation emitted does not exceed 15 %. This is mostly the case with LED light sources.

LQS VALUE

Thermal output of lamp

Thermal output of lamp	LQS Value
< 15 % proportion of IR radiation	5
< 26 % proportion of IR radiation	4
< 28 % proportion of IR radiation	3
< 31 % proportion of IR radiation	2
< 60 % proportion of IR radiation	1
≥ 60 % proportion of IR radiation	0

ECO FRIENDLY

HAZARDOUS MATERIAL CONTENT

When people think of the dangers associated with broken lamps it is usually of being cut. In fact, the risks connected with most types of light source are far greater and have a serious impact on our health as well as on the environment.

The main reason why we say this is that most types of light source contain mercury, a highly toxic heavy metal and vital component especially of fluorescent and metal-halide lamps. Despite a great deal of research being done into finding a suitable substitute for mercury in light sources, none has yet been found. Alternative light sources that are not dangerous to people and the environment are so costly that they are not financially viable for mass use.

The risks associated with these light sources are not present during general use. It is only when a lamp is broken during handling, or disposed of inappropriately, that it poses a threat by releasing vapours into the air or soil. If damaged during handling, depending on the

number of lamps affected, the size of the room and its ventilation, short-term health effects such as nausea and mental distress can be felt. If disposed of inappropriately the contamination can spread into the soil and possibly water as heavy metals do not decompose and become a permanent element of the environment.

Lighting designers must therefore consider the ecological impact of the light sources they use. Newer 'eco' fluorescent lamps do contain less mercury, but in this respect LED comes to the fore as the safest and most responsible option as they contain no mercury.

The LQS standard evaluates light sources from the point of view of mercury content and awards the highest 5 point score to those with zero content.

SERVICE LIFETIME AND MAINTENANCE COSTS

It is no issue to change a lamp at home, it is not even such a problem in an office, but in hospitality applications light source maintenance can be highly inconvenient and costly. As a result, from the very beginning of the design process, lighting designers should consider the lifetime of the chosen light sources and their maintenance needs.

The main reason why people switched from using incandescent bulbs to fluorescent lamps is their lifetime, with some fluorescent tubes capable of lifetimes twenty four times longer than the average incandescent bulb. However, for the same reason incandescent lost favour, so now is fluorescent. LED light sources have a lifetime double that of fluorescent, greatly reducing the need for maintenance. This is beneficial as lamp replacement is costly in terms of the material, personnel, time and equipment needed, additional to costs associated with access to more difficult to reach places.

LEDs standardly have a lifetime of 50,000 hours, meaning that if a lighting fixture is used 18 hours per day, 7 days per week, the light source will function for more than 7 years. Another advantage is that LEDs do not just stop working but reach the end of their life when their output falls below 70 % (or in some cases 50 %) of that when new. So even if the light source is old, it will still illuminate, providing time to plan and carry out maintenance in the most cost effective way. Also, LED light sources have a very low failure rate compared to conventional lamps, with only two LED dies per 1 million failing, meaning you can rely on the ones you have to function throughout their entire lifetime. By using LED in combination with a Lighting Management System, it is possible to reap vast benefits in terms of energy savings, controllability and ease of use, all of which make this light source technology perfect for hotel and restaurant applications.

When taking into consideration all relevant criteria, the LQS standard gives the highest lifetime and maintenance cost score to light sources with a minimum lifetime of 50,000 hours.

LQS VALUE

Dangerous material content

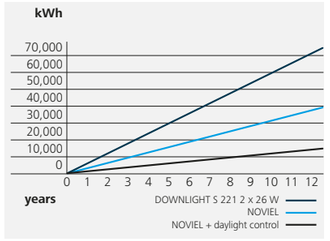
Dangerous material content	LQS Value
mercury content 0 mg	5
mercury content < 0.5 mg	4
mercury content < 1.5 mg	3
mercury content < 2.4 mg	2
mercury content < 5 mg	1
mercury content ≥ 5 mg	0

LEDs are an ecologically sound option as they are safe to use and dispose of.

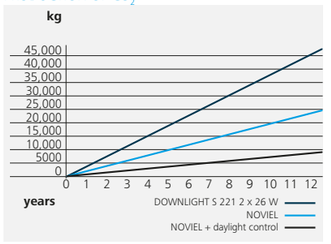
A good lighting system requires little maintenance and will last for years.

type of luminaire		DOWNLIGHT S 221 2 x 26 W	NOVIEL	NOVIEL + daylight control	
type of light source		FSQ	LED CRI90	LED CRI90	
power consumption		26	25	25	W
number of light sources in luminaire		2	1	1	pcs
control gear		CCG	ECG	ECG	
type of lighting control		none	none	daylight sensor	
lifetime of light source		13,000	50,000	50,000	hours
power consumption of luminaire		52	25	12	W
luminous flux		3600	2300	2300	lm
LOR		52	100	100	%
luminaire light output		1872	2300	2300	lm
number of luminaires		20	20	20	pcs
average time when luminaire switched on between 6.00 – 18.00		10	10	10	hours
average time when luminaire switched on between 18.00 – 6.00		4	4	4	hours
number of days in week when luminaire switched on		7	7	7	days
price for electrical energy		0.15	0.15	0.15	€/kWh
purchase price of luminaire		27	78	88	€
purchase price of light source		3	0	0	€
purchase price of service hour		20	20	20	€
time needed for the exchange of one light source		0.25	0.25	0.25	hours
COOLING ENERGY					
cooling system usage factor		50	50	50	%
cooling efficiency		2.5	2.5	2.5	Wh/Wc
purchace price for initial installation		660.00	1560.00	1760.00	€
number of maintenance required per 12 years		4	1	1	
maintenance fee		220.00	0.00	0.00	€
power consumption of luminaire		52.00	25.00	16.00	W
power consumption of cooling system		8.40	6.80	3.26	W
total power consumption of room		1208.00	636.00	385.20	W
consumption of electrical energy per	day	16.91	8.90	3.30	kWh
	month	514.41	270.83	100.26	kWh
	year	6172.88	3249.96	1203.10	kWh
CO_2 emissions per year		3950.64	2079.97	769.98	kg
price for electrical energy per	day	2.54	1.34	0.49	€
	month	77.16	40.62	15.04	€
	year	925.93	487.49	180.46	€
difference between input costs			900.00	1100.00	€
saving difference per years for power consumption			-438.44	-745.47	€
CO_2 savings per year			-1870.67	-3180.66	kg
payback excluding maintenance			2.1	1.5	Years
payback including maintenance			2.1	1.5	Years

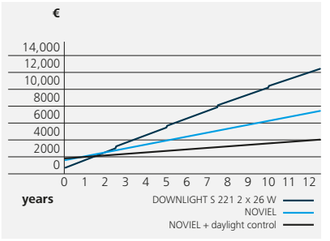
POWER CONSUMPTION OF LIGHTING INSTALLATION



PRODUCTION OF CO_2



OPERATING COSTS AND PAYBACK TIME



LQS VALUE

Product lifetime & maintenance costs

Product lifetime & maintenance costs	LQS Value
≥ 50,000	5
> 24,000	4
> 19,000	3
> 12,000	2
> 10,000	1
≤ 10,000	0

EFFICIENCY

Light is a fundamental tool in the creation of a unique atmosphere in each hotel, restaurant, bar and cafe. It affects mood, creates visual and psychological comfort, relaxes and stimulates appetite, as well as enabling employees to work effectively and productively. In an ideal case, the lighting should be a perfect balance of biologically effective daylight and artificial light, with optimal functionality achieved by using a Lighting Management System.

We live in a world defined by technology, resource consumption and ever-increasing energy prices. The decision to incorporate a Lighting Management Systems (LMS) into a lighting system is most often motivated by the potential to reduce energy consumption and associated costs. However, the possibilities opened up for lighting effects, simple control and emotional stimulation in hospitality environments is vast, bringing many benefits additional to reductions in energy use.

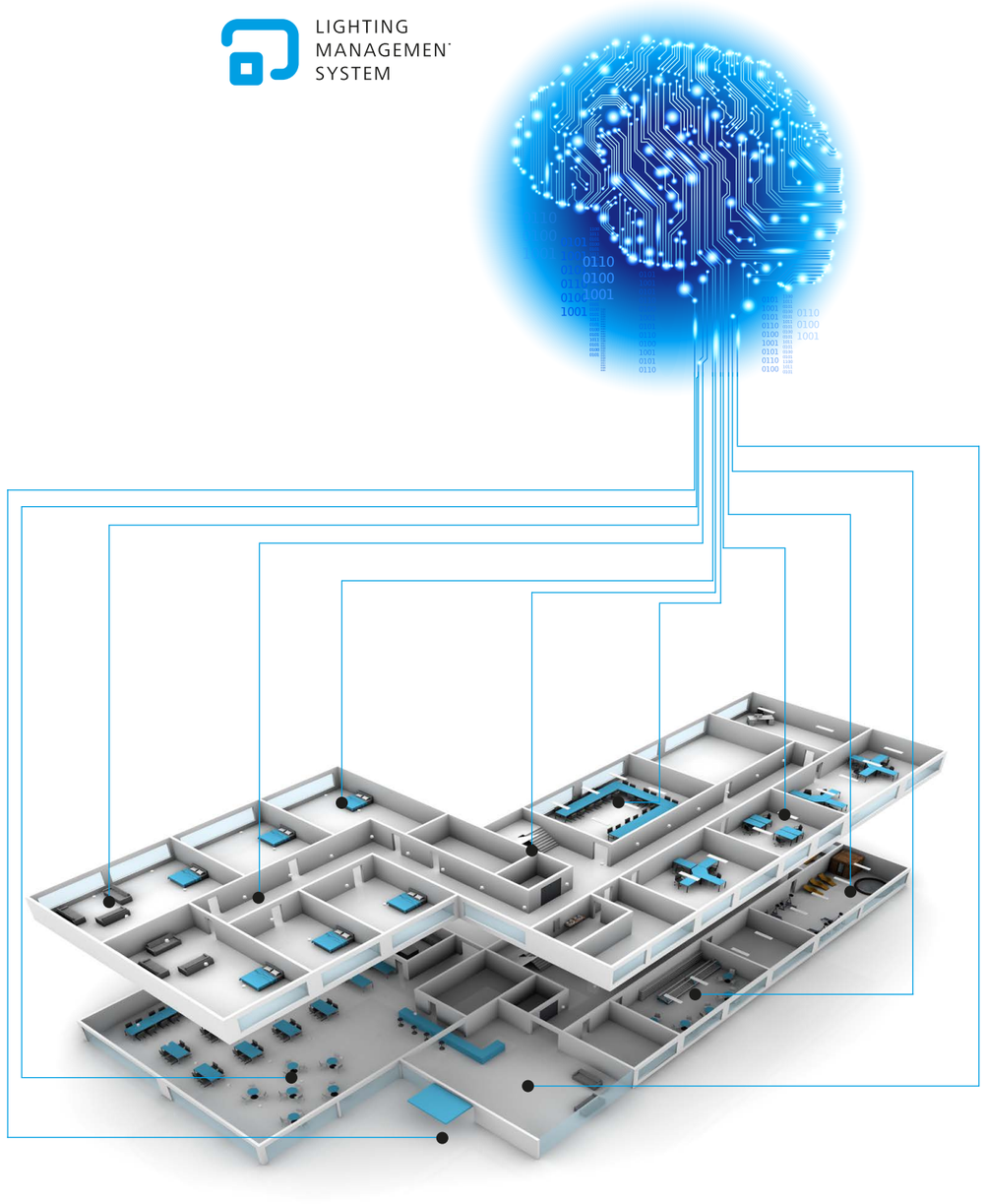
Energy saving is, however, only one aspect of an efficient and effectively designed and controlled lighting system. By implementing suitable control tools retailers can rest assured that they have reduced their CO_2 emissions and impact on the environment, whilst also benefitting from the comfort of simple, autonomous and flexible control of their extensive lighting systems. Two things determine the comfort offered by a lighting system: the functional parameters defined for the given space, and the control tools used to regulate the system. As a rule, the more sophisticated the control tools used, the more comfortable and user-friendly the system is, with high-tech methods such as smart device, computer and remote control reducing and even removing the need for user intervention. Extensive control systems are ideal for spaces that have large and complex lighting systems that cannot be simply and effectively controlled by employees, such as hotels and larger restaurants.

OMS have produced a comprehensive and simple to understand overview of control methods, tools and ideas, 'Lighting Management Systems', where you can find all you need to understand the full potential provided by using lighting management.

Finding the right balance

As we know, emotional engagement is key to the success of such sense-driven establishment as restaurants. Finding the perfect balance between emotional impact and energy saving is a complex task, with each premises having different needs. Experienced lighting designers know how to define the many details, and determine which tools and methods are most suitable for each application.

Lighting consists of four parts: general lighting, accent lighting, RGB colour mixing and ambient lighting. All have their own inimitable role to play, some more than others depending on the particular application. The autonomous control of these, and the resulting energy savings, user comfort and visual impact can be achieved using several methods.



Modern technology enables the simple control of lighting systems from tablets and even smartphones.

LIGHTING SCENES

One of the most useful methods of complex control is to use pre-defined 'lighting scenes'. Each scene has its own unique combination of lighting parameters such as brightness, colour temperature, RGB colour and ambient lighting, which can be activated across one luminaire group, several groups at once, or a whole system. Scenes can be selected manually via computer, smart device, touch panel or switch, or implemented automatically based on time and date settings.

Lighting scene control allows for easy and fast changing of lighting parameters, from the simple adjustment of brightness levels to the complex setting of individual groups of luminaires and colours. Lighting scenes can also be used for dynamic lighting, allowing for the autonomous changing between various parameters over a period of time. This means that the lighting can be adapted precisely to the needs of any given time. Perfectly suited to use in areas where lighting intensity can be reduced when people are not present, such as corridors, it is also ideal for use in conference and seminar rooms where many varied activities and events take place, all of which have their own lighting needs.

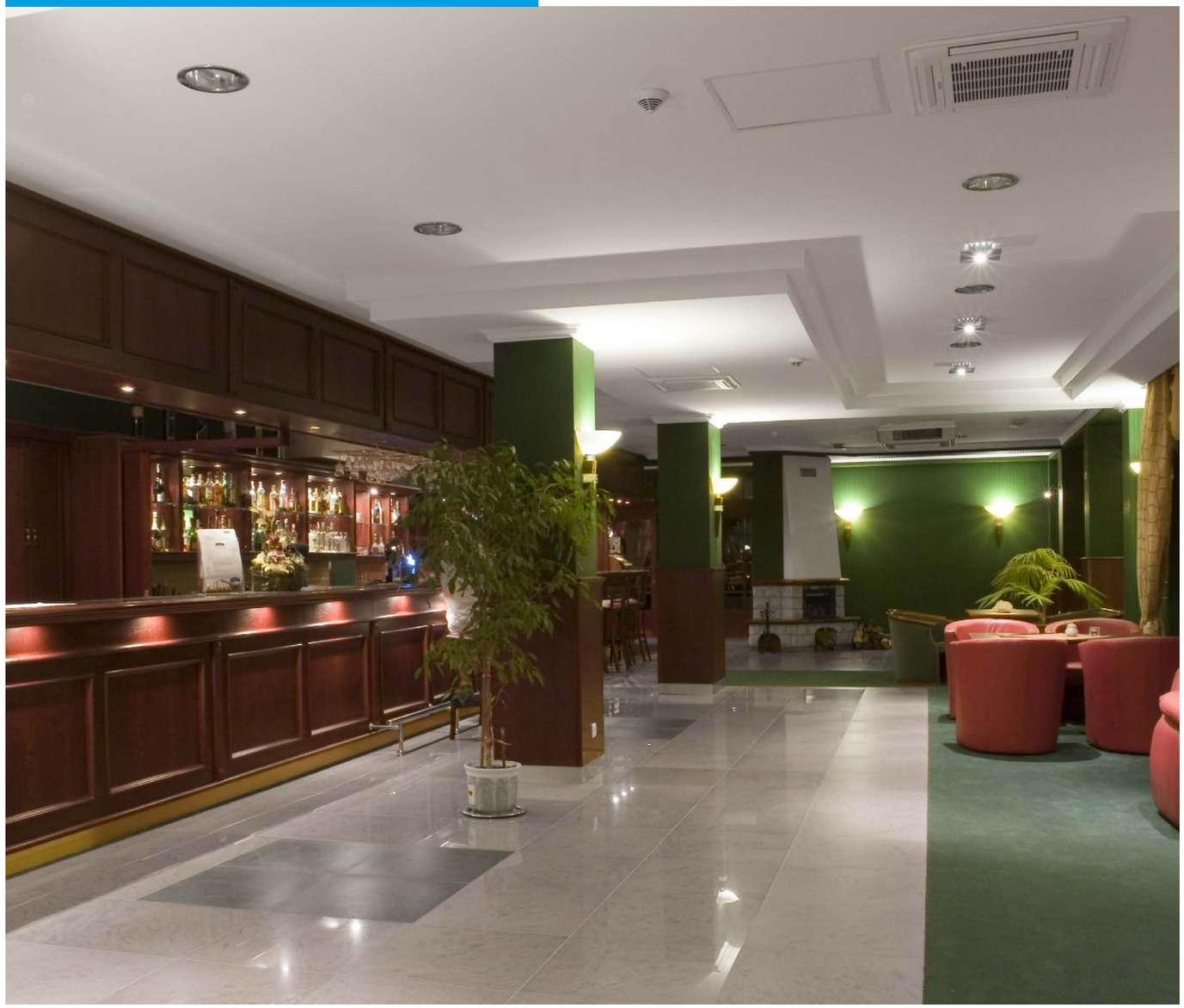
Control devices such as wall switches, touch panels and computer-based applications mean that employees can very easily change settings at the touch of a button. In complex spaces we recommend the use of High Frequency remote control as the electromagnetic waves used can penetrate solid obstacles allowing employees to control lighting elements far from them through walls and even floors. This method of control also allows for the incorporation and management of peripheral devices such as blind and air conditioning units.

There are various protocols used to control lighting scenes. The protocol and control devices chosen depend entirely on the type of lighting, the needs of the space and its users. Lighting designers fully understand the advantages of each protocol and can advise you as to which will suit your needs best. The two most commonly used protocols are DALI and DMX.

DALI

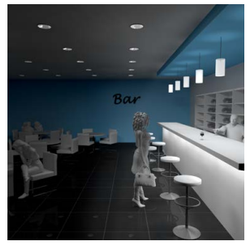
DALI (Digital Addressable Lighting Interface) enables the control of complex lighting systems using two-way communication between the controlling and controlled devices, in most cases a touch panel or computer and DALI compatible luminaires. Various control devices can be used, from simple wall push buttons, through customised touch panels, to complex computer based applications. Additionally, various peripheral devices can be controlled, including blinds and air conditioning units.

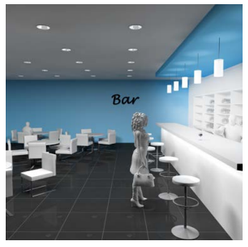
Each DALI bus enables the control of 64 devices, dividable into 16 groups. It is possible to combine several DALI buses to create a large system. Each device can be controlled independently as each has its own address. Furthermore, the fact that DALI uses two-way communication means that each component of the lighting system can be monitored, with statuses, faults and failures immediately reported to the user.



DMX

DMX (Digital Multiplex Transmission Standard for Dimmers and Controllers) allows for multi-channel digital control along one control phase. Communication to all controlled devices happens simultaneously meaning that the requested changes in lighting parameters are almost immediate. This makes DMX perfect for RGB and dynamic lighting.
All controlling and controlled devices are individually addressable allowing for the independent control of each simultaneously, although several components can be addressed in the same way allowing them to act as one group. DMX communication is only one way, so although fast, information can only be sent or received at any one time making this protocol less suitable for lighting systems that require monitoring.





Customers with the first choice tended to select seats so that they faced illuminated walls. Studies show that people do not like to sit in brightness but like to see it, which leads to the conclusion that people prefer spaces with wall luminance.

LQS VALUE

Calling of lighting scenes

Calling of lighting scenes	LQS Value
Yes	1
No	0

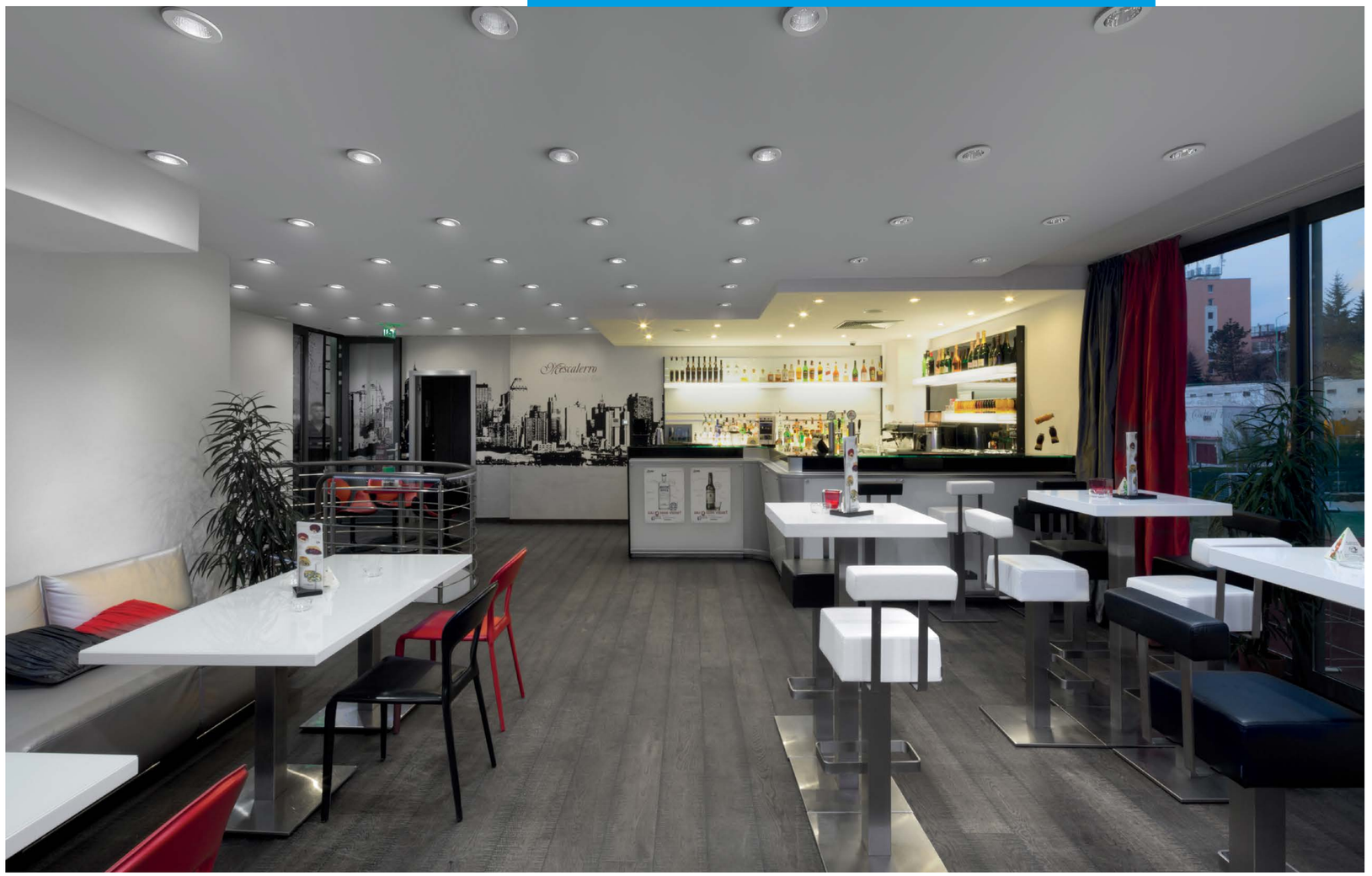
Control based on daylight availability is fully autonomous and therefore provides great savings potential.

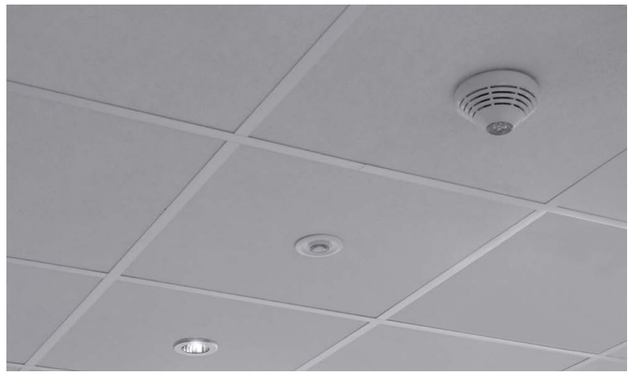
DAYLIGHT AND CONSTANT ILLUMINANCE SENSORS

The basic functionality of these two sensors is to ensure a determined level of illumination, although both operate on very different principles. Daylight sensors adjust the level of illumination according to the amount of daylight available within a space, whereas constant illuminance sensors ensure that a set level of illumination is delivered throughout the entire lifetime of a lighting system.

These sensors can be used independently or as part of a complex control system. The advantage is that they make sure light is only provided where and in the quantity needed, never more, never less. This opens up a huge potential for energy savings, especially in areas with access to a large amount of daylight, working on the principle that artificial light can function in a supplementary role to natural light. By measuring the scanned area these sensors adjust the amount of artificial light provided according to the amount of daylight. What this means in practice is that if the required level of illumination is provided in full or in part by daylight, the luminaires will be switched off or dimmed. Only when there is little or no daylight available will the luminaires produce their full light output. In larger spaces where daylight may only be available in certain areas, luminaires can be dimmed according to an average assessed brightness value or in cascading groups. The cascading group functions in the way that the group closest to the window may be switched off, whilst the group furthest away from the window may work at full power, with groups between working at various brightness levels.

It is important to bear in mind that this is best used in a continuous way as the amount of daylight available changes throughout the day, even within a single hour depending on weather conditions. Also, the amount of light cannot be assumed as the location of windows have a large effect on the effectiveness, with south facing windows allowing the greatest amount of daylight into a space. In this kind of system it is important that the scanning areas of each sensor do not overlap as this could result in destabilisation of the regulation.





The light conditions change during the day in dependence of the time of the day, weather and the season of the year. The task of the artificial lighting is to balance the differences and to complete or to replace in full extent the natural light when its availability is limited.

50 % of power consumption

75 % of power consumption

85 % of power consumption

100 % of power consumption

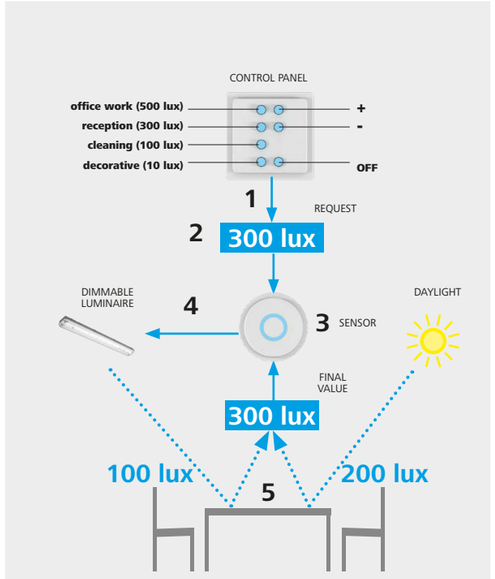
LQS VALUE

Daylight sensor

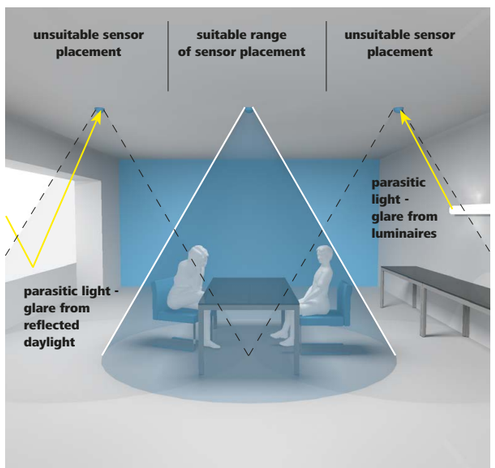
Daylight sensor	LQS Value
Yes	2
No	0

This lighting system consists of two groups of luminaires, where one is placed near the windows and the other further from them. During the day, when there is daylight available, the light sensor regulates the luminous intensity of the luminaires near the windows to 40 % and the luminous intensity of the luminaires in the space with less daylight to 70 %. The result of this offset regulation is a uniform illuminance across the space. In the event of there being little or no daylight available, both luminaire groups emit light of the same luminous intensity. However, when using daylight sensors, we need not forget that daylight access is not only influenced by the time of the day, but also by other factors, such as the window orientation or cloudiness.

With brightness sensors incorporated into the lighting system, the illumination automatically adjusts to the current lighting needs or requirements, and creates an even illuminance level across the task area. It is possible to regulate either one or both luminaire groups and it is of high importance to ensure that one luminaire group does not interfere with the other and does not illuminate its detection area. Likewise, the detection areas cannot overlap as it leads to the subsequent destabilisation of the regulated lighting system. In this regard, it is essential to place the light intensity sensors at an appropriate distance from both the windows and light sources that could affect the sensors and their operation. The sensors detect the brightness levels of the area below them,



1. *Through the control panel user set level at which shall be maintained illuminance.*
2. *Setpoint is delegated to control system (sensor).*
3. *The daylight sensor scans luminance and compares the current value with the required.*
4. *When detecting difference, system makes a change (luminaires are dimmed up or dimmed down).*
5. *The resulting illuminance on the working plane is composed of sunlight and adjusted artificial lighting.*



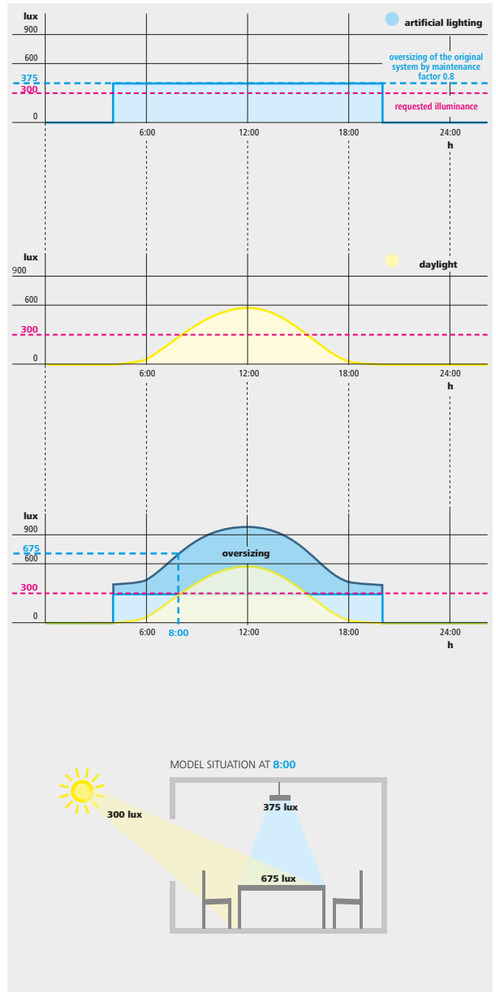
Proper placement of daylight sensors excludes adverse effects.

so their placement should enable smooth detection of the space illuminated by the fixtures they regulate.

The brightness level detected by sensors depends on the reflectiveness and colour of the detection area. If they change, for example, because is put in the detection area, the detection circumstances will change too. In this case, the brightness intensity increases and results in dimming. To solve this issue, we can set a delay time and make the change of the luminous intensity more gradual and less visible. The rapid change of lighting conditions can also be prevented by choosing a detection area with minimal environment changes. To ensure proper regulation of the luminous intensity, the initial setting of the illuminance level, used as the target illuminance level, needs to done when there is no or minimum daylight access.

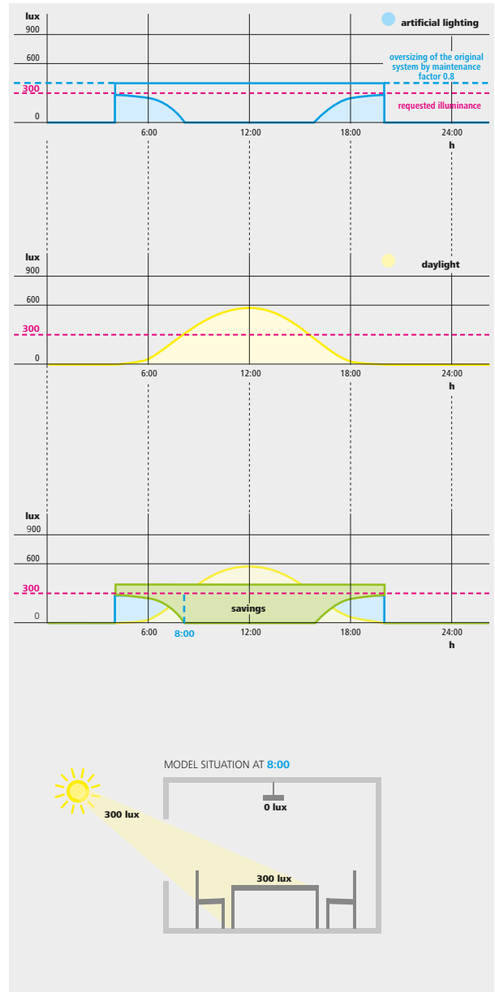
Light sensors come in various construction types and can be either ceiling mounted, ceiling recessed, luminaire mounted or attached to the light source.

UNMANAGED SYSTEM



Incorrect solution *– oversized illuminance level*

SYSTEM MANAGED BASED ON ILLUMINANCE LEVEL



Correct solution *– required illuminance level*

Limitless control of the largest and most complex lighting and peripheral systems via one simple to use interface.

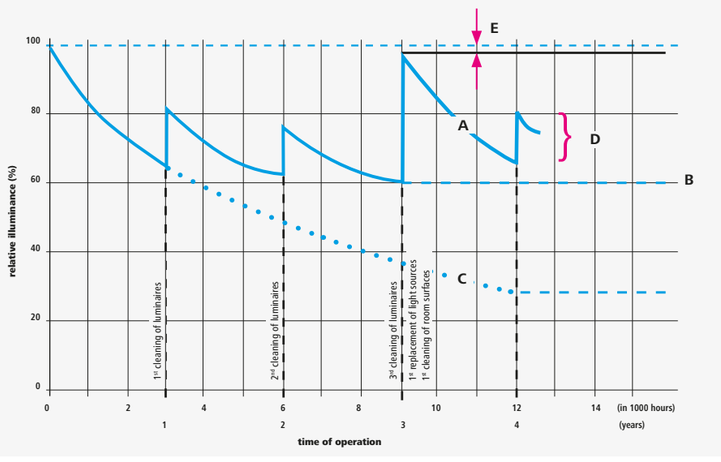
COMPLEX MANAGEMENT

Complex management of a lighting system can include various functions including lighting scenes, as well as RGB colour mixing and the regulation of extensive installations and peripheral systems, with the possibility for incorporation into a Building Management System such as KNX.

This kind of lighting system management is highly flexible and powerful, suitable for use in smaller hotels and restaurants as well as large hotels that include restaurant, sports, wellness and spa facilities. Control can be implemented from one or several central locations such as at reception, as well as from various other locations throughout the establishment. It is possible to programme both smaller detailed functions as well as those with a much larger scope, for example a night regime for a hotel. Complex management systems can also be managed from a remote location, meaning that the owner of an establishment can check, update, set and monitor the system from anywhere in world via the internet.

These kinds of system continually monitor and provide feedback from all components, informing immediately of a failure, malfunction or some other issue to the central location, showing the precise position of the fault so that action can be taken straight away. As the system is so fully regulated it allows for the greatest possible energy savings.

Communication is done using DALI in most cases, in connection with other protocols like DMX, KNX and using TCP/IP over an Ethernet connection. The combination of devices and protocols depends entirely on the needs and specifications of the spaces within the establishment.



Illumination changes during the life of the lighting system
A – maintained lighting system curve
B – maintained value – maintenance factor
C – unmaintained lighting system curve
D – benefits of cleaning luminaires at regular intervals
E – irreversible loss caused by ageing of luminaire materials

LQS VALUE

Constant illuminance sensor

Constance illuminance sensor	LQS Value
Yes	1
No	0

Truly bring a space to life using the combined psychological power of light and colour.

RGB COLOUR MIXING

RGB lighting can be used widely in hotel and restaurant premises. Both light and colour, as independent elements, can have a profound effect on the emotional engagement, mood and behaviour of people as well as on the aesthetics and atmosphere of a space. Combine the two elements and the possibilities are more than multiplied.

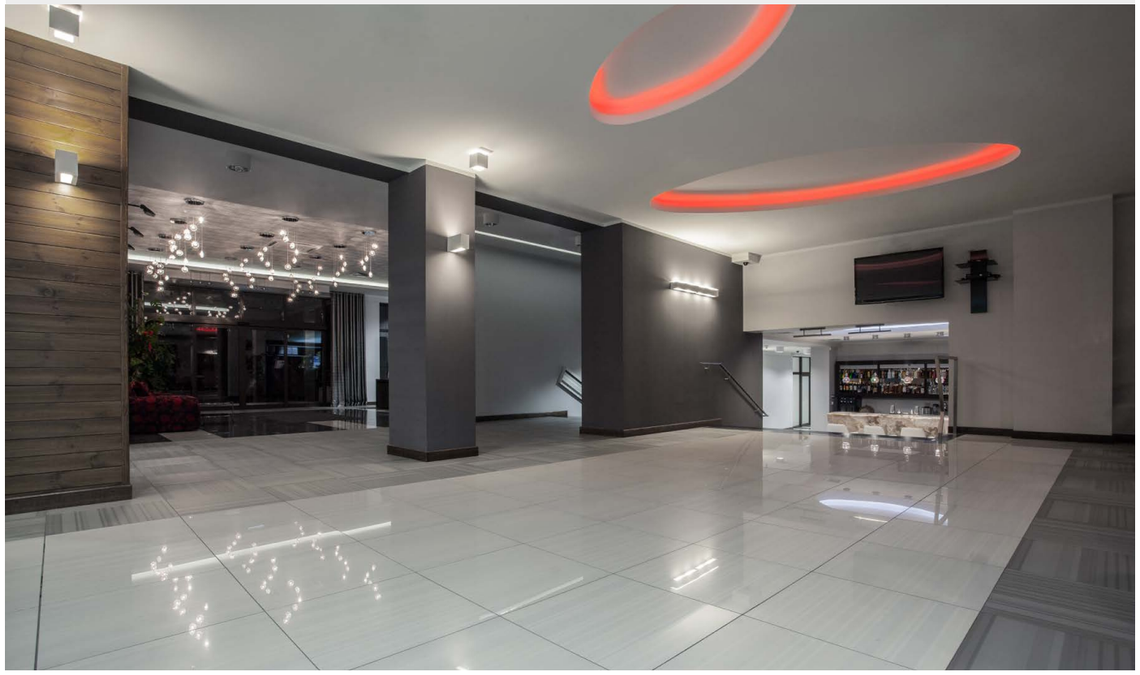
Using RGB colour mixing you can create a unique and dynamic atmosphere in a bar, induce a feeling of intimacy and relaxation in spa or safety and privacy in a hotel room. The possibility to select any colour from within the RGB colour space means that the supply of lighting combinations is endless and can be tailored to any space, time, activity or mood. This type of control is not limited to only the colour parameters of the lighting, but also the brightness. Lighting scenes and dynamic lighting are perfect methods by which to gain the most benefits from this vibrant tool whilst ensuring simple and comfortable use. To gain the most rewarding result we recommend that various types of luminaire and light distribution be used.

Controlled using various components such as remote controls, touch panels and smart devices based on timers, calendars and sensors, there is no barrier to experimenting and making full use of the possibilities. It is also an option to incorporate RGB colour mixing into a larger system including white and TunableWhite lighting and peripheral devices. Due to the speed of communication, DMX is the most suitable protocol for controlling RGB lighting.

APPLICABILITY OF LMS TOOLS

Applicability of LMS tools	Lighting scenes	Lighting intensity	Complex management	RGB colour mixing	Presence detection
Foyer	•	•	–	•	–
Reception	•	•	•	•	–
Corridors	•	–	–	•	•*
Staircases and elevators	–	–	–	•	•*
Rooms	•	–	–	–	–
Bathrooms	•	–	–	–	–
Gym and wellness	•	•	•	•	–
Sport facilities	•	•	•	–	–
Function rooms	•	•	•	•	–
Conference and seminar rooms	•	•	–	–	–
Offices	–	•	–	–	•*
Restaurants	•	•	•	•	–
Self-service restaurants	–	•	•	–	–
Buffets	–	•	–	–	–
Bistros and bars	•	•	•	•	–
Kitchens	–	•	•	–	–
Technical rooms	–	–	–	–	•
Indoor parking	–	–	–	–	•*

* when there are no people in the space, the intensity is reduced to a safety level and not to zero.



PRESENCE DETECTORS

The most commonly used control tool, presence detectors can provide great user comfort and savings potential of up to 50 % in certain types of space. It is possible to use them independently or as part of a complex control system, all depending on the needs of the particular area. Functioning based on movement within the scanned area, the lighting is turned on, off or dimmed to pre-set levels.

There are two main types of presence detector, each with its own set of advantages.

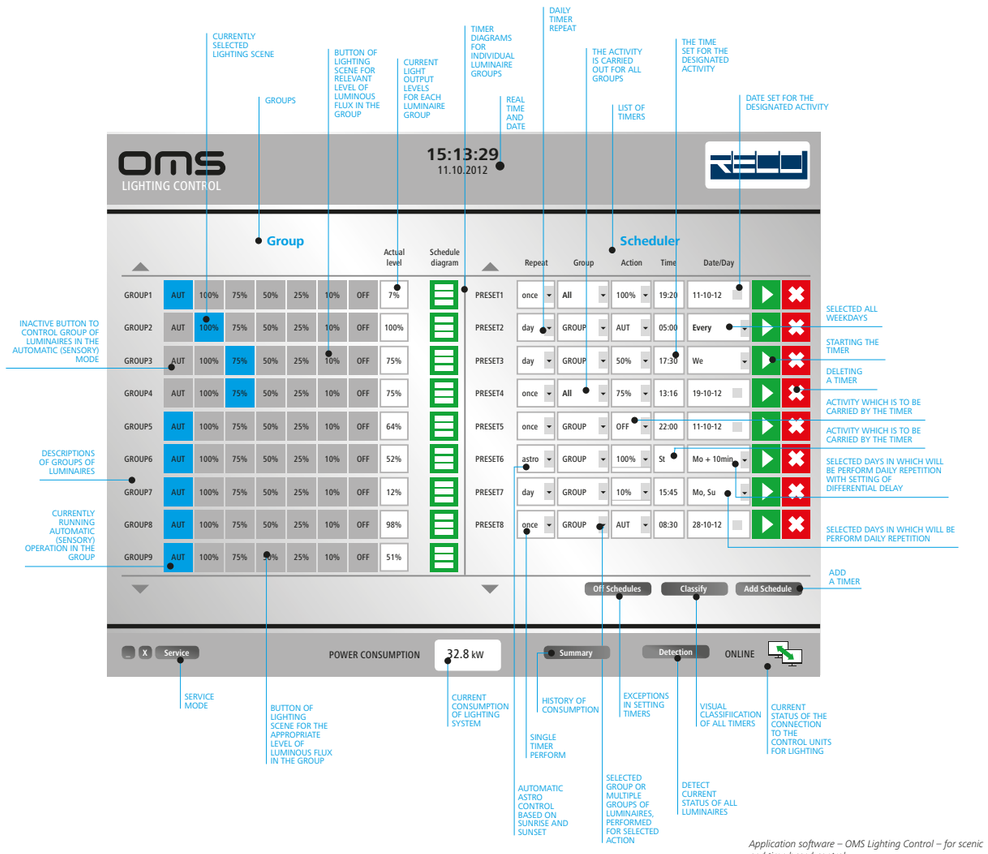
Passive Infrared (PIR)

These sensors respond to the heat of passing people, which causes the sensor to communicate with the lighting to turn it on or increase the brightness. The scanning element of the sensor emits no radiation, which is why it is called a passive sensor. Suitable for use in both interior and exterior spaces, these sensors can be set with various levels of sensitivity according to their positioning, with mounting heights of up to 12 m.

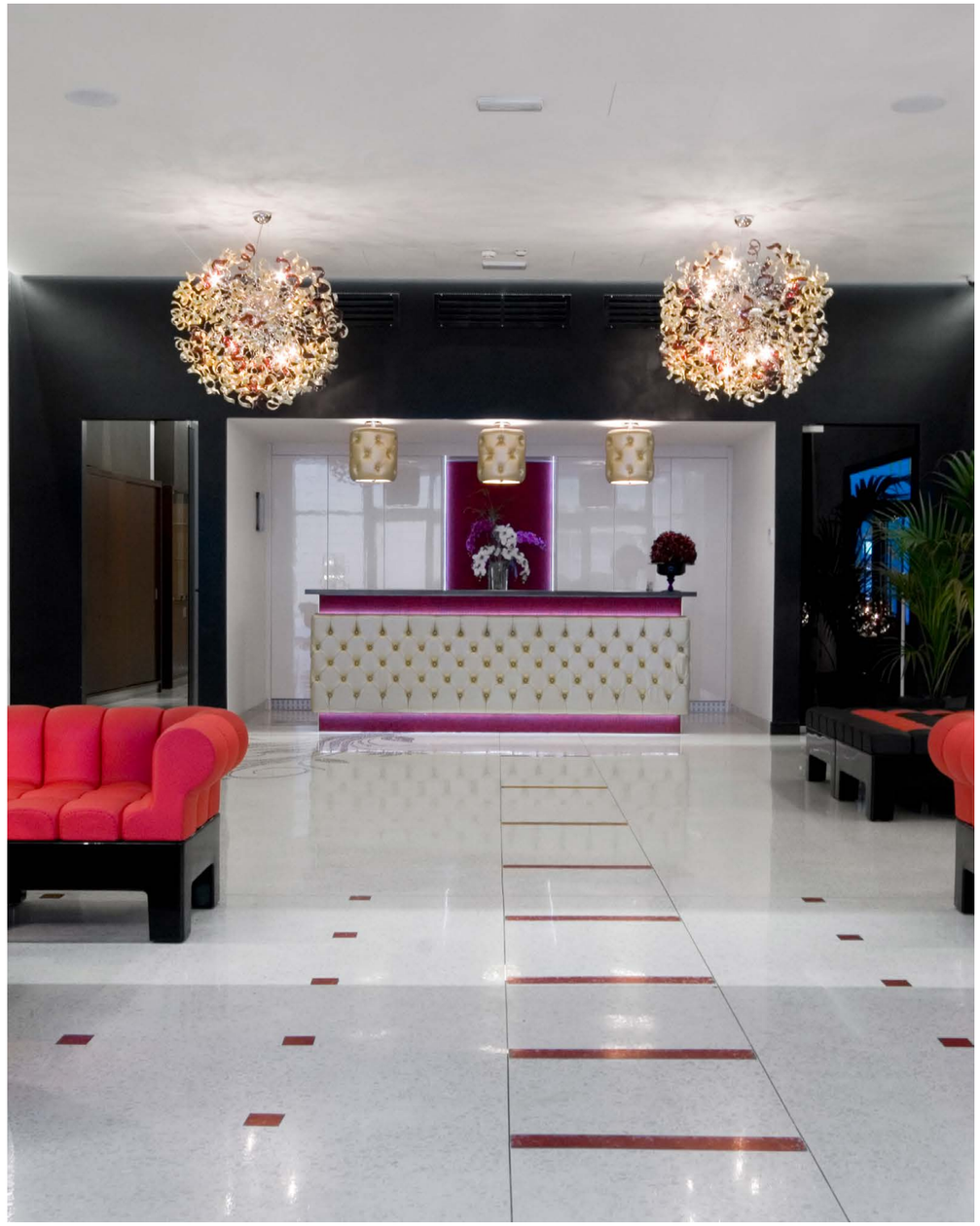
In order that the sensors are not compromised, is it important that they be installed at an adequate distance from heat sources, including the lighting fixtures they control, as well as air conditioning or heating systems. It is also important that the ambient temperature of the space is not too high so that there is an adequate difference between it and the temperature of passing people. Sensitivity is greatest if a person passes in front of the sensor, with reduced sensitivity if the person is walking directly towards it. Sensitivity is also impaired if people are wearing many clothes, reducing the amount of body heat emitted, and by large obstacles which again block or limit the sensing of heat.

High Frequency (HF)

This type of sensor emits and receives a signal, based upon which it switches or dims the controlled lighting. Suitable also for use in interior and exterior spaces with large obstacles as the signal can pass through them, HF sensors are ideal



Application software – OMS Lighting Control – for scenic and time based control.



for use in hotels, restaurants, wellness and sports facilities and any other space with a complex interior. Not affected by ambient temperatures, and sensitive to even the smallest movements, these sensors are very effective. They do have the disadvantage of sometimes detecting irrelevant movement, so must be positioned and set very carefully by an experienced technician.

Both types of presence detection function most effectively when the scanning areas of individual sensors slightly overlap, ensuring there are no 'blind spots'.

Switching and dimming

The simplest method of presence detector control results in the switching of lighting within the space. However, 0 % and 100 % are not always the best options, and immediate switching is not recommended in many areas of application as it is visually disturbing and may impairing safety.

In many areas it is necessary to maintain a safety level of illumination even when people are not present. Sensors can be set in such a way as to dim the lighting to, for example 10 %, rather than switching it off completely. It is also appropriate in some cases to delay the switching off or dimming of the lighting so that people are not disturbed by darkness seemingly following them. This is also a safety feature as people can rapidly return to an area after leaving, in which case the lighting will still be at full illuminance.

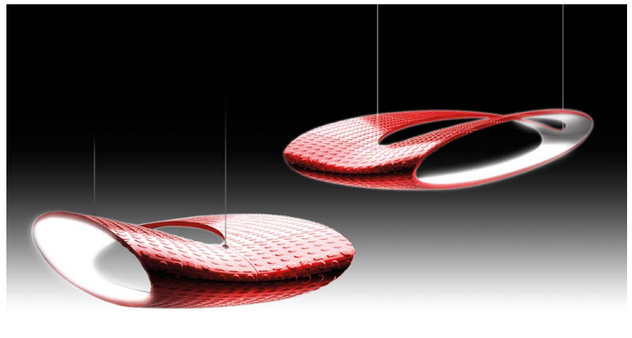
ESPRIT

Esprit is about making the ordinary into something extraordinary, about a sense of grace, humour and the ability to surprise, enriching our lives by bringing an element of the unfamiliar to our everyday environments. This is something our designers know very well. They consciously push the boundaries of design when creating new luminaires, scorning stereotypes in favour of pure imagination. The result is a range of luminaires perfect for use in a wide range of spaces.

When a space needs to evoke an emotional reaction, the used luminaires take on a new and unique architectural role, sometimes by their extravagance and other times by their restraint. Functionality ceases to be the sole criteria as it is joined in equal part by originality and innovation.

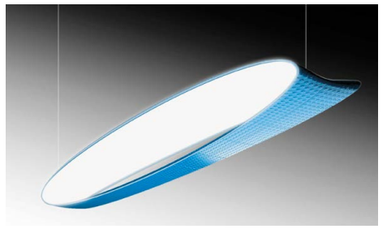
OMS has responded to the diversity of customer and solution requirements by establishing an in-house design team within our Research and Development department, where experienced and talented product designers work in collaboration with technical specialist to put new luminaires and technologies into the hands of customers. The result is a collection of unique and highly effective luminaires with a futuristic soul, fixtures with the ability to infuse a space with a breath of fresh air. Our use of various high quality materials, combined with wide-ranging technical experience, allows us to develop truly special products, all of which can be tailored specifically to any customer request.

There are no quantifiable criteria within the LQS for evaluating esprit as it is a highly subjective topic, however, there are several important elements we urge customers to consider in order that they make the most informed, and ultimately satisfying choice about which luminaires to use. Firstly, consider the overall impression the luminaire and its intricacies make, what is the immediate and longer-term emotional response; like a fine perfume, there are the details that attract immediately, and the subtleties that linger. Secondly, how does the luminaire fit into the space, both in terms of presence and how ties in with or complements the interior design; it can be a refined addition to the space, or a statement piece. Thirdly, the surface finish, which is a fundamental part of our reaction to its presence; does it evoke the desired feelings and communicate the right qualities. Fourthly, consider the materials used and its functionality, as these aspects determine not only the practicality of the item, but also its value to the customer; everyone wants something that perfectly fits their needs without compromise on quality.



SLEDGE

by Anton Zetocha

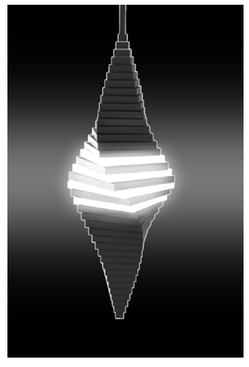


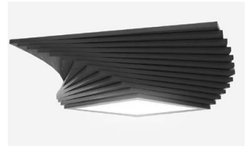
The idea behind the suspended luminaire SLEDGE responds to market requirements for a quality LED fixture that can direct one portion of the illumination towards the ceiling, and another portion, stronger in the blue part of the spectrum, towards the human eye in order to positively influence the human body. The luminaire is characterised by its airy design in contrast to the uniquely technical surface inspired by the indented anti-skid floor used in public transport vehicles. In this way, the concept combines modern technology and materials with an unconventional design.

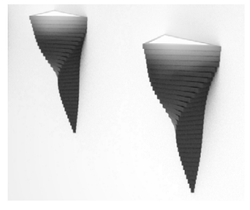
THE ‘HIDDEN’ TABLE LAMP

by Branislav Lukačovič

Inspired by the art of Alexander Calder, the designer wanted to capture the movement of both lampshade and light source, a technically difficult idea that found form by imitating the structure of certain insects. When ‘open’ the top four segments of the luminaire illuminate and when ‘closed’ a secondary circuit activates and the bottom four segments illuminate.







SCULPTURE

by Patricia Verdeguer Coll

These decorative luminaires are based on the idea of generative modelling, where one shape is manipulated by resizing and twisting around an axis. This allows the designer to create a wide variety of organic shapes that can be used for various applications. The twisting effect evokes a sense of dynamism while the sculptural aspect makes the luminaire a work of art and not only a functional object.

EXCEPTIONALITY

Here at OMS, we do not wish to hide our ambition to be a trendsetter in the lighting industry. With a unique combination of exceptional products and vast knowledge and experience at our fingertips, we are able to provide unrivalled and tailor-made solutions for every project. The satisfied customers we have across 122 countries worldwide are evidence of this.

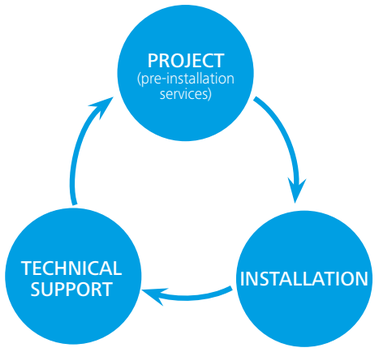
Merely introducing a high quality product to the market is no longer enough. Customer needs and desires are increasingly demanding, and comprehensive solutions are preferred over products that are just 'good'. Customers now search for ways to save energy and money, ways to achieve sufficient return on investment whilst at the same time being advantageous due to the use of the latest technologies.

We have at our disposal an outstanding technical background and many years of experience in both the development and production of luminaires, which we use to define how the lighting industry develops. This complex combination of knowledge and understanding gives us the advantage of great flexibility and enables us to offer customers exactly what they need with full support throughout its realisation. This process covers several stages, from the design of the lighting project, through its installation, to its servicing.

In a period characterised by awareness of environmental and ecological issues, rapidly depleting energy resources and ever-increasing energy prices, the efficiency and effectiveness of a solution becomes core to its suitability and success. Therefore, every new lighting project begins with an energy audit, which provides the necessary values and materials for building energy certification. The aim of the audit is to fully assess and evaluate the state and efficiency of the current lighting system, identify energy saving potential and suggest specific measures that would enable the full utilisation of that potential. Based upon the audit, OMS specialists will prepare various lighting design recommendations, quantify the savings of each option, and propose exactly how to realise it.

Our specialists can create a tailored lighting project according to the individual needs of each customer along with extensive post-project support.

LIGHTING SOLUTION



PROJECT

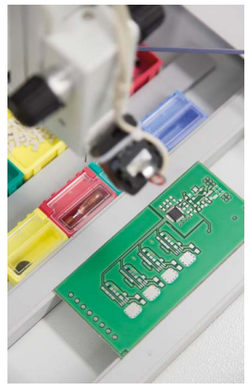
- SPECIFICATION
- VISUALISATION
- CALCULATION
- WIRING DESIGN
- LMS PROJECT
- LQS PROJECT
- ENERGY SAVING
- BLUEPRINT

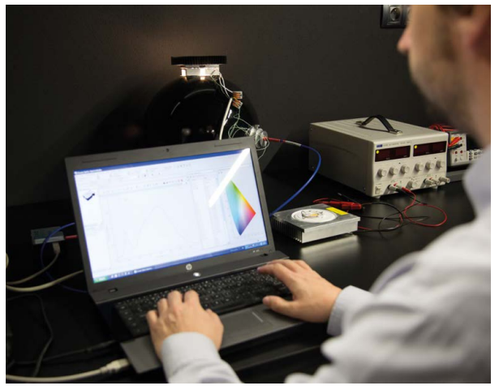
TECHNICAL SUPPORT

- ELECTRICAL INSTALLATION
- LUMINAIRE INSTALLATION
- LMS INSTALLATION AND PROGRAMMING
- TECHNICAL SUPERVISION
- AIMING LUMINAIRES
- REMOVAL OF LUMINAIRES
- RECYCLING OF LIGHTING EQUIPMENT
- MAINTENANCE SCHEDULE

LIGHTING SOLUTION

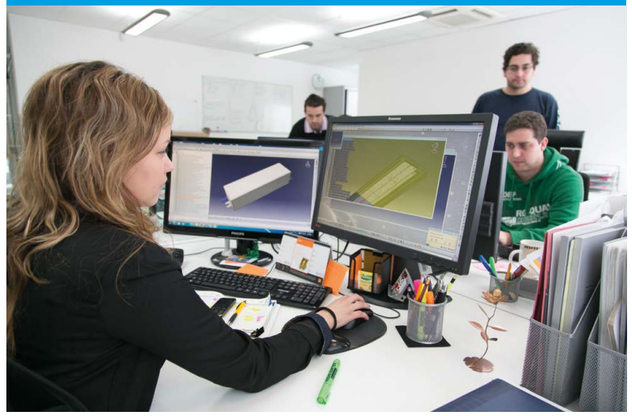
Where others see obstacles we see solutions, thanks to our ability customise any product to meet the specific needs of any customer and any space.

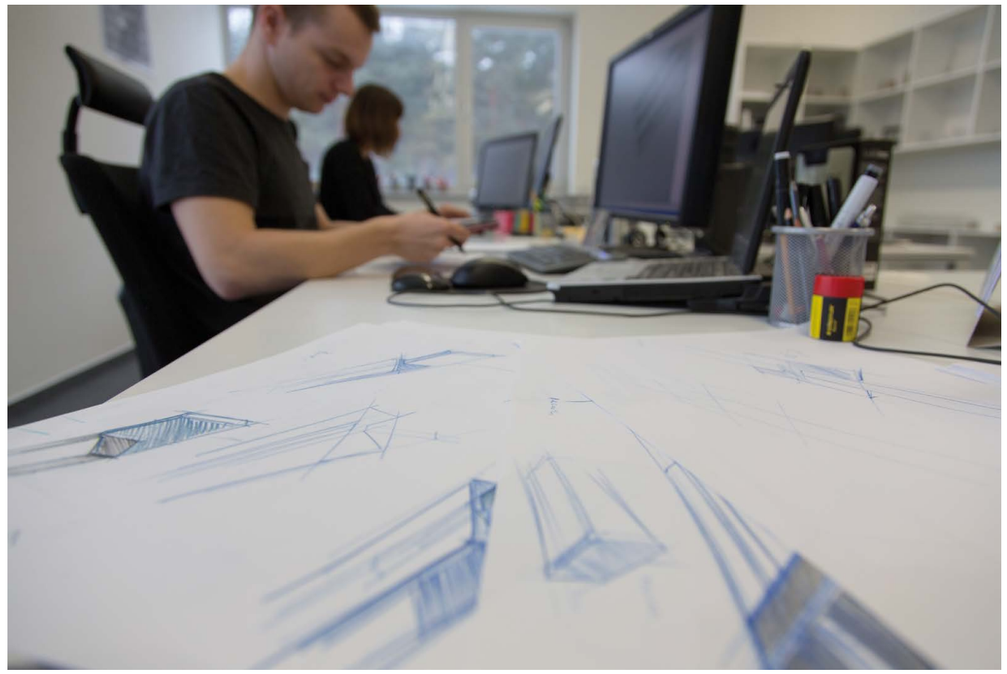


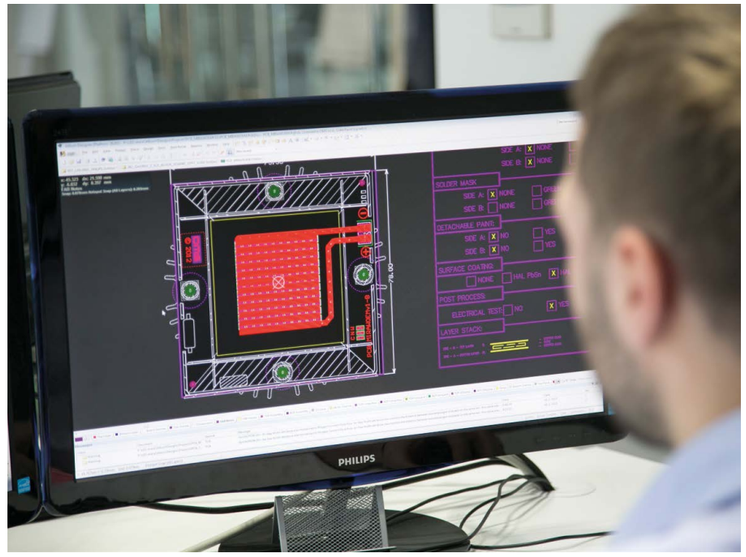


Our Lighting Solutions department has the technical means and experience to perform the full range of lighting measurements. This covers the initial assessment of the current system, including its light output and luminance levels and their evaluation according to legal requirements and standards. Then the energy consumption measurement will inform us of losses and ineffective elements, enabling us to create a tailored lighting project based on the energy savings requirements of each customer, which acts as the base for energy certification. Next, in collaboration with the customer, we will develop a model of the lighting system and provide customers with the necessary support to choose the most appropriate luminaires for their needs. Here we can provide additional help as customers can choose from the wide range of high quality luminaires offered in our portfolio, all of which can be customised to specific demands on request. After, we use specialised software to calculate the optical parameters for the new system based upon which we will design the electrical project, which includes the electrical plan, wiring, and programming of the system and LMS.

Our extensive experience, solid technical background and emphasis on the research into and development of new technologies means we can give customers full support when choosing the most suitable LMS. Besides standard tools such a daylight, presence and constant illumination sensors, we also offer our own carefully developed control tools, DeeBridge, DayWatch and Central Power Source within the framework of the LMS. As a truly modern company, we have always been able to respond to lighting management trends, allowing for the control of lighting from smart devices for which our designers can create customised applications for each customer.







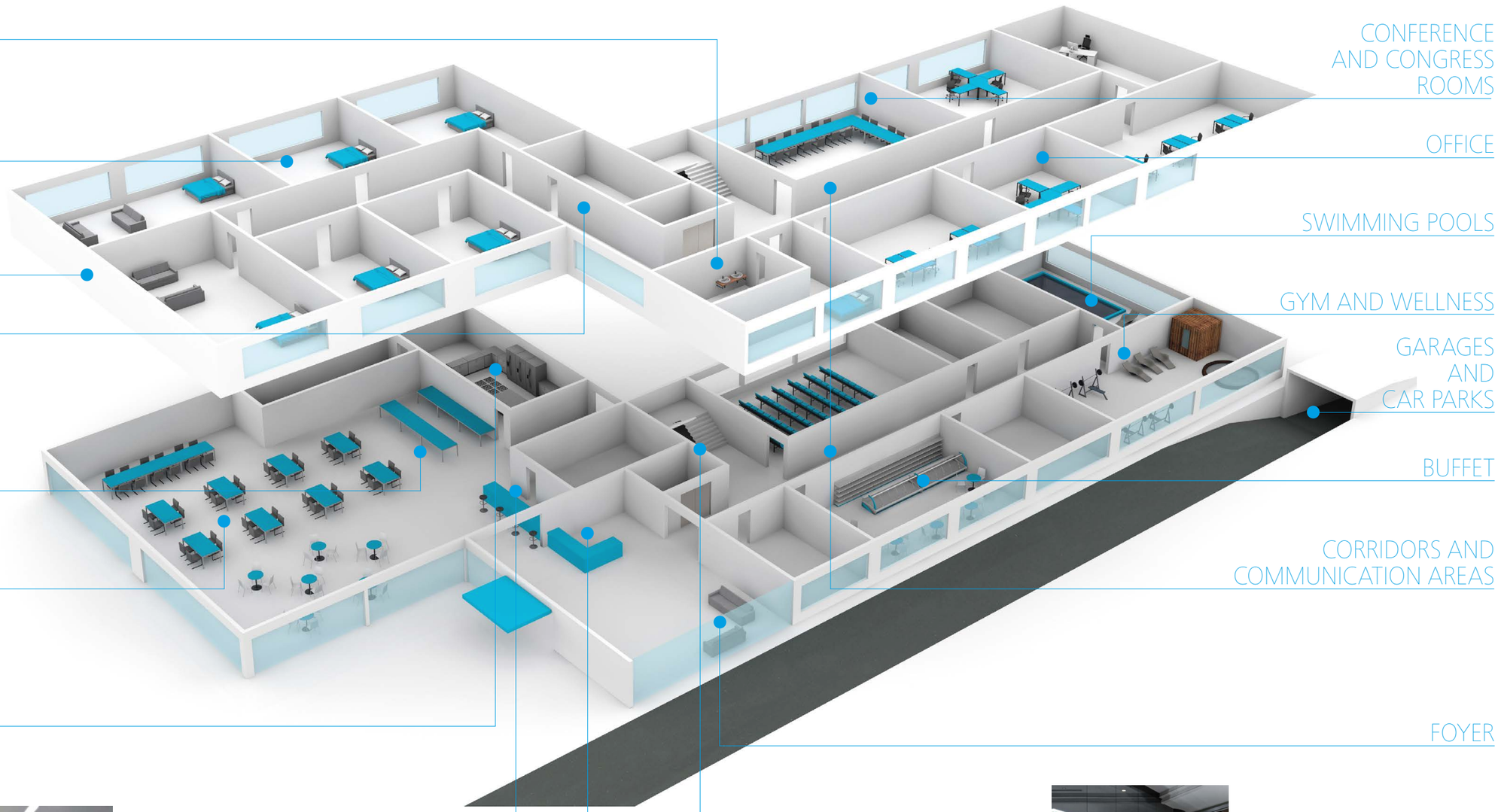
LIGHTING IN HOTEL AND GASTRO

BATHROOM

ROOMS AND SUITES

FACADE

EMERGENCY LIGHTING



CONFERENCE AND CONGRESS ROOMS

OFFICE

SWIMMING POOLS

GYM AND WELLNESS

GARAGES AND CAR PARKS

BUFFET

CORRIDORS AND COMMUNICATION AREAS

FOYER

SELF-SERVICE RESTAURANT

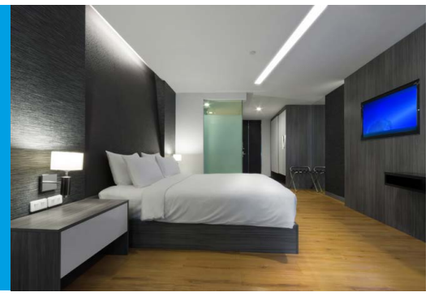
RESTAURANT

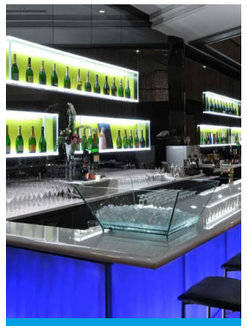
KITCHEN

BISTRO AND BAR

RECEPTION

STAIRWAYS AND ELEVATOR





Lighting acts as one of the initial communicators of brand, image and service quality to customers before they ever make face-to-face contact with hotel personnel.

FOYERS AND RECEPTIONS

In few places is the rule of 'first impression' more relevant than when thinking about the entrance to a hotel. The ability of an entrance area to effect the overall perception a visitor has of the standard, quality of service and brand of a hotel makes its effective illumination crucial.

From an architectural point of view, entrances tend to be spacious and consist of several zones including the initial foyer, the reception and possible seating areas as well as to peripheral bar, restaurant and elevator facilities. Each zone places individual demands on the lighting, highlighting the importance of a professionally planned lighting system than seamlessly merges and meets all needs into a harmonised whole. Lighting in these spaces serves to guide perception, aid orientation and promote feelings of relaxation and satisfaction.

If the architecture of the space allows, it is suitable to use a combination of design-focused ceiling and wall mounted luminaires that help to define the area and aid navigation. Lighting should be used to highlight each zone within the entrance area, possibly by using wall mounted luminaires to the sides of doorways or recessed downlights to flood important features with higher levels of illumination.

Another vital factor to take into consideration is the energy consumption of the chosen lighting as hotel entrances must be illuminated 24 hours per day. In this respect the use of energy efficient LED luminaires is the most suitable solution, especially if dimming capability is also incorporated. During times when there is little traffic within the space it is appropriate to reduce the lighting level, bringing further energy savings.

Receptions

The most important zone in a hotel entrance is of course the reception. Every visitor must go here and it is the first point of contact with hotel personnel. Higher levels of illumination immediately draw visitor attention guiding them to the appropriate place. It is appropriate to use statement suspended luminaires at reception that match the overall aesthetic of the space. Luminaires that emit a combination of direct and indirect illumination will ensure sufficient illumination of the reception desk as a workplace by providing visually comfortable light for the performance of tasks. Such luminaires also provide excellent levels of vertical and cylindrical illumination, which aids in the easy recognition of faces and the minimisation of shadows and leaves a lasting positive impression of the personal contact and service quality

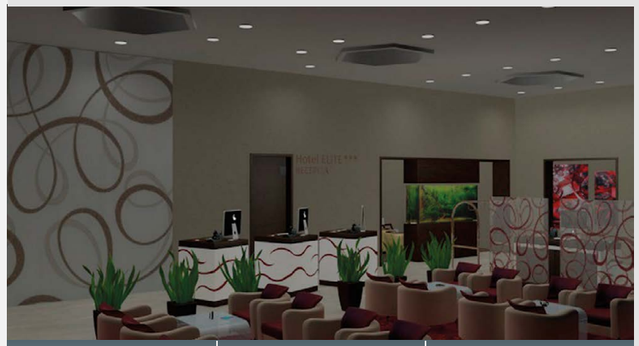
The European standard EN 12464-1 defines a minimal illumination of 300 lx and a lighting uniformity of 0.6 at the reception desk. Light sources must ensure a glare factor of no more than UGR 22 and provide colour rendition of at least CRI ≥ 80.

Cove mounted ambient lighting can be used to define zones and aid orientation, as well as offering the possibility of using RGB colour mixing to create various atmospheres according to desire and need.

Excellent rendition of facial features makes visitors and employees alike feel more comfortable during face-to-face contact, therefore, sufficient cylindrical illumination is important. Low-glare suspended luminaires are ideal for the provision of suitable lighting.

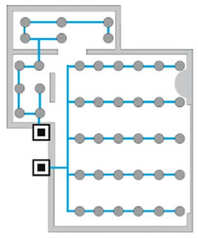
LQS COMPOSER RECEPTION

Downlight Phact Clearance



BENEFITS | SCHEME | COMPONENTS

Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.



Mains (230V) Switch

DOWNLIGHT 202/212/222 POLISH
REF FSQ G24d
2x26W, CCG,
RAL 9003

Switch

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [x] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [ ] Daylight simulation
- [ ] Dynamic lighting
- [ ] Tunable white

- [ ] Accent lighting
- [ ] RGB colour mixing
- [ ] Ambient lighting

ECOLOGY
Latest lamp technology: Classic
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product life-time and maintenance costs

EFFICIENCY
- [ ] Presence detector
- [ ] Constant illuminance sensor
- [ ] Daylight sensor
- [ ] Calling of lighting scenes

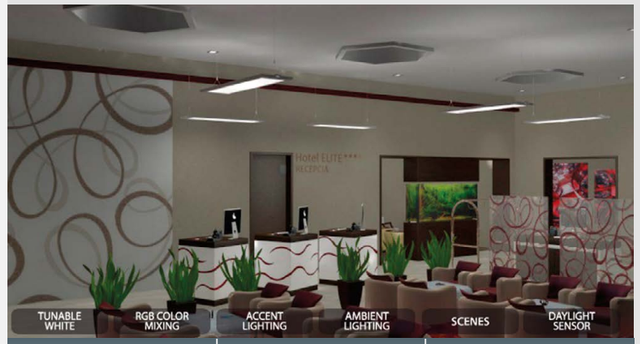
R3 Auto ON/Dimmed
normal movement of
R8 Photo cell dimmin

Working days:
Mon Tue Wed Thu Fri Sa Sun
Working hours / day: 12 Working hours / night: 6

Power consumption	29623	[kWh/year]
Power consumption with LMS	29623	[kWh/year]
CO_2 savings	0	[kg/year]
LENI	197.48	[kWh/year.m²]

Receptions play a key role in setting a pleasant mood for the visitors of each hotel. Here, the lighting design helps to shape the aesthetic style of the venue as well as having a functional role. The original solution uses compact fluorescent downlight fixtures that do not allow for the change of lighting intensity, light colour temperature or any other lighting parameter. Such fixtures not only waste energy, but they also waste an opportunity to create something special for a place like reception. The overall LQS rating is very low at only 1.69. The energy consumption of the system is unnecessarily high at 197 kWh/year.m², based on 18 hours of operation, 7 days per week.

Downlight Phact Clearance



BENEFITS | SCHEME | COMPONENTS

RGB colour mixing
possibility to set up not only exact colour but also brightness and saturation of the colour.

Accent lighting
enhance visual properties of an illuminated object.

Ambient lighting
show details of ceiling and enhance atmosphere of room.

Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.

Bluelight content (Tc>6500K)
lighting installation contains of light sources with increased portion of blue in the spectrum, which has an influence to circadian receptors of humans.

Daylight simulation
lighting installation with impact on well being of humans. Installation contains of light management system that is slowly changing colour temperature duirng a day, thus simulating natural conditions in interior.

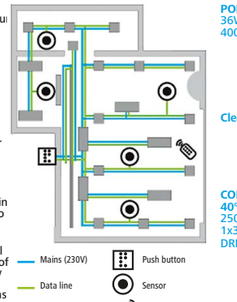
Dynamic lighting
lighting installation with impact on well being of humans. Installation contains of light management
system that is slowly altering light level during a day, thus simulating natural conditions in interior.

Tunable white
lighting installation with impact on well being of humans. Luminaires in installation are equipped with two white colour temperatures, warm and cold. It is possible to change the proportion between them and mix the requsted colour temperature.

Constant illuminance sensor
reduce the use of artificial light in the early life lighting system.

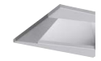
Daylight sensor
Sensor reduce the use of artificial light in interiors when natural daylight is available.

Calling of lighting scenes
Lighting system allows to program several lighting scenes, which can be launched anytime by using of different user interfaces.



Mains (230V) Data line
Push button Sensor Remote controler

POLUKS LED
36W 2600lm
4000K 80Ra



Clearance

COMET MOTION 40° LED
2500lm/830
1x31W, LED
DRIVER

LED STRIP RGB

Push button

Remote controll

Power supply
for the DALI line

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [ ] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [x] Daylight simulation
- [x] Dynamic lighting
- [x] Tunable white

- [x] Accent lighting
- [x] RGB colour mixing
- [x] Ambient lighting

LG7

ECOLOGY
Latest lamp technology: LED
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product lifetime and maintenance costs

EFFICIENCY
- [ ] Presence detector
- [x] Constatnt illuminance sensor
- [x] Daylight sensor
- [x] Calling of lighting scenes

R3 Auto ON/Dimmed
normal movement of
R8 Photo cell dimmin

Working days:
Mon Tue Wed Thu Fri Sa Sun
Working hours / day: 12 Working hours / night: 6

Power consumption	9469	[kWh/year]
Power consumption with LMS	5547	[kWh/year]
CO_2 savings	2392	[kg/year]
LENI	36.98	[kWh/year.m²]

The new solution uses the latest LED light source technology inside a variety of luminaires. Therefore, the lighting design is completely different to the original in terms of luminaire type, their positioning and capability. The design makes use of TunableWhite general lighting to simulate the natural conditions of daylight, ambient and RGB colour mixing to the set the right mood for visitors and daylight sensors to provide energy savings. This makes it possible to make the reception the unique area it deserves to be. The energy consumption of the system is less than one fifth of the original solution at 37 kWh/year.m², and the overall LQS rating is almost the maximum possible rating at 4.67.

CORRIDORS AND COMMUNICATION AREAS

Corridors are the communication system of a building, connecting all individual points into a whole. Suitable lighting of corridors is essential to aid correct and stress-free navigation of even the largest hotel and ensure safety and comfort. It is also important at all times to maintain a representative character to the lighting and consider this when choosing luminaires.

The illumination of corridors may at first seem like a simple task, however, to truly utilise the available options to ensure the highest levels of psychological and visual comfort and safe and easy navigation, the job must be entrusted to the hands of an experienced lighting designer. There are a few basic parameters to consider including illumination level and light distribution. Corridors are often narrow and have little or no access to daylight, and can seem claustrophobic and psychologically unsettling. To help combat this, and create the impression of spaciousness and comfort, it is important to ensure sufficient illumination of ceilings and walls and not only of floors. Ceiling mounted luminaires with wide light distribution and wall washers are ideal for this as they provide predominantly vertical illumination, visibly widening the space and minimising dark corners and shadows.

A common mistake, especially in long corridors, is to use uniform illumination. This negates any visual cues as to the visitors' progression through the space, which is disturbing and makes navigation difficult. It is better to use various levels of illumination to give visitors a way by which to assess their position, for example by using higher brightness at corridor junctions, or by illuminating doors. This structured lighting will visibly shorten the corridor and help visitors feel comfortable and calm.

As mentioned, corridors often lack daylight and require 24 hour illumination. In this respect the use of efficient and long lifetime LED light sources is ideal, minimising operational and maintenance costs. It is also useful to implement dimming, for example during the night hours when there are fewer people around, or using presence detectors so that only used areas are fully illuminated whilst unused areas are only illuminated to a safety level.

Make corridors more attractive and stimulating or reinforce brand image by using coloured ambient lighting. Installed in coves along the upper edge of walls, the colour will appear to come from within the walls and ceilings, visually opening the space and providing a welcoming splash of entertainment and distraction.

Higher levels of vertical illumination ensure stress-free and psychologically open corridors.

Lighting designers often make the mistake of uniformly illuminating long corridors, which creates a psychologically unpleasant atmosphere with no visual cues about location.

It is better to use various levels of illumination to provide visual cues as to where visitors are and to supress the feeling that they are walking along a never-ending corridor.

By placing decorative objects along corridors, visitors can navigate easier and are visually stimulated. Use accent lighting luminaires to highlight such objects as well as to illuminate door numbers. Alternatively, door numbers could be backlit to ensure that a visitor can always find his or her room.

Most corridors have little or no access to daylight and require 24 hour illumination. LED light sources are an efficient and effective solution.

During times when the frequency of movement within a corridor is expected to be higher, it is possible to use presence detectors to dim the lighting to a reduced level for brief periods when nobody is around. These intervals are short but can still provide considerable energy savings over time.

During the night hours when very few people pass through corridors it is appropriate to dim the illumination to 50 %. In this way, chosen accent illuminated items and areas will stand out to aid navigation and to draw attention to the hotel identity. The use of presence detectors ensures that as soon as a person is present the illumination will increase to 100 %, and once they have passed will once again return to the reduced level.

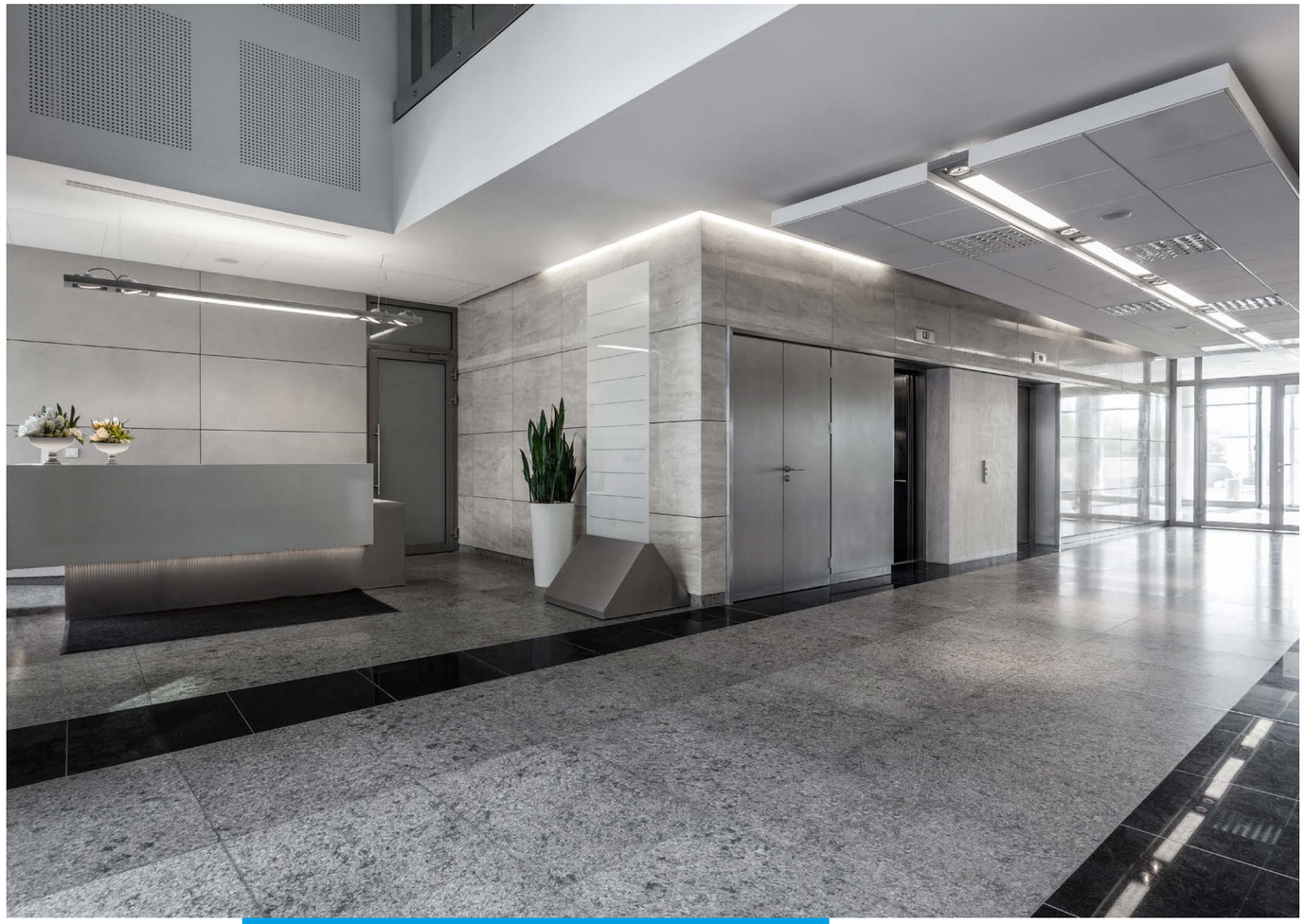
Stairways

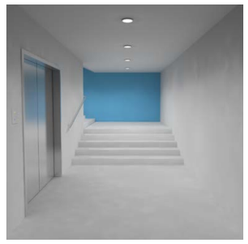
Corridors are not the only method of navigating a building. Visitors and staff must also use stairways. Due to the nature of stairways, safety must be of core importance, although it is appropriate to also reinforce hotel identity in these areas.

In terms of safety, a key factor to consider is the minimisation of glare. If a person is glared when walking up or down stairs they are more likely to make a wrong move and trip or fall. Luminaires with a wide light distribution and shielded light sources are suitable, alternatively it is visually attractive and highly effective to use floor recessed luminaires that highlight individual steps. It is essential that no shadows be caused on steps by the steps themselves, by other objects and even by people in the direction of their movement.

The used materials and colours need to be taken into account when the lighting is designed for stairways. Dark surfaces necessitate the provision of higher levels of illumination. If a designer wishes or it is necessary to use dark surfaces we recommend that they be reflective so as to limit the need for more light.

Given that corridors and stairways fulfill the role of escape routes, it is necessary, when planning, to count on the installation of emergency and safety luminaires in accordance with current standards (see the chapter 'Emergency and safety lighting').





Corridors and stairways are also emergency routes in the case of an unexpected event. It is therefore a legal requirement to provide suitable emergency lighting in these areas.

Higher levels of illumination around elevator doors helps visitors to locate them. Luminaires placed either side of or over the doors will distinguish them from other doors. Wall mounted luminaires are also useful for drawing attention to stairways.

It is vital to remove the occurrence of shadows on stairways so that people can clearly see the edges of steps, minimising the risk of accident and injury.

Elevators

Elevators are a sensitive area, with many people feeling claustrophobic and uncomfortable inside them. Correct lighting can minimise negative feelings and help people to stay calm. In elevators that are fully opaque we recommend the use of light coloured interior surfaces so as to visually enlarge the space, with the use of mirrors on ceilings and walls helping greatly. In elevators with glass walls, which can be problematic for those with a fear of heights, it is important to consider the reflectance of transparent surfaces and to provide high enough levels of illumination that they feel safe inside rather than their eye always being drawn outside.

In all cases, it is suitable to use luminaires with soft and diffused light that provides good cylindrical illumination to aid facial recognition and minimise shadows. This will help people to feel more connected with fellow passengers and less anxious.

Well-designed illumination will enable a single room to be separated into a bedroom, living room and study.

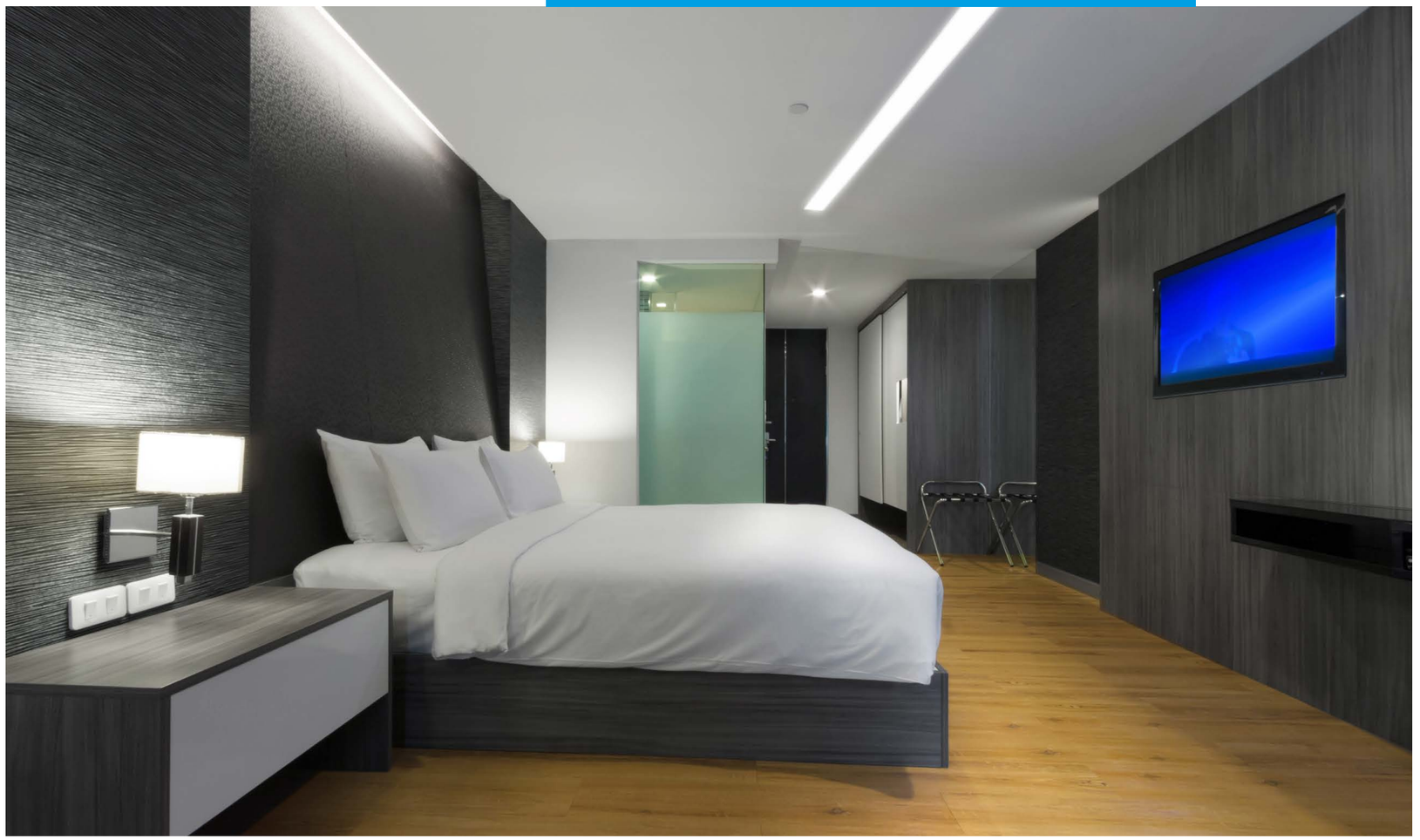
ROOMS AND SUITES

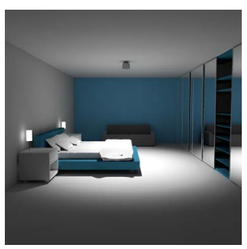
Hotel rooms are where visitors spend predominantly their evening and night hours making artificial lighting a fundamental part of the space. The creation of a comfortable, relaxing and intimate atmosphere is important so that visitors feel that their room is a home from home.

Hotel rooms and suites in particular are very much defined by the layout of various zones and corresponding furniture. Each zone is designed to fulfil a particular task to which the lighting must be suited and adaptable. In such spaces, lighting designers are not restricted by normative standards and can use their imagination and personal style in the creation of interesting, appropriate and multi-functional illumination.

When choosing luminaires it is important that they fit the overall character of the space and furnishings. For general lighting it is suitable to use ceiling surfaced luminaires with convex diffusers to evenly distribute soft light across the ceiling, walls and horizontal surfaces, ensuring that the space feels open and airy and that there are no harsh shadows. For atmospheric lighting, walls are a great place for mounting accent or ambient lighting luminaires, whilst freestanding luminaires are ideal for use in reading zones and next to beds. In all cases, it is important to position the fixtures in such a way to prevent the risk of glare.

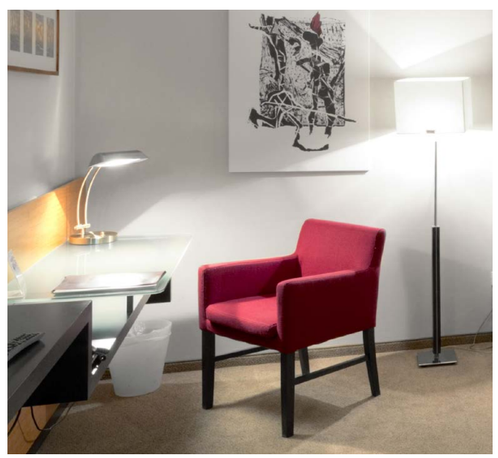
It is highly beneficial to incorporate a Lighting Management System into the installation to allow visitors to easily control various lighting parameters according to lighting scenes from several locations within the room, for example from bed, providing added convenience and comfort.



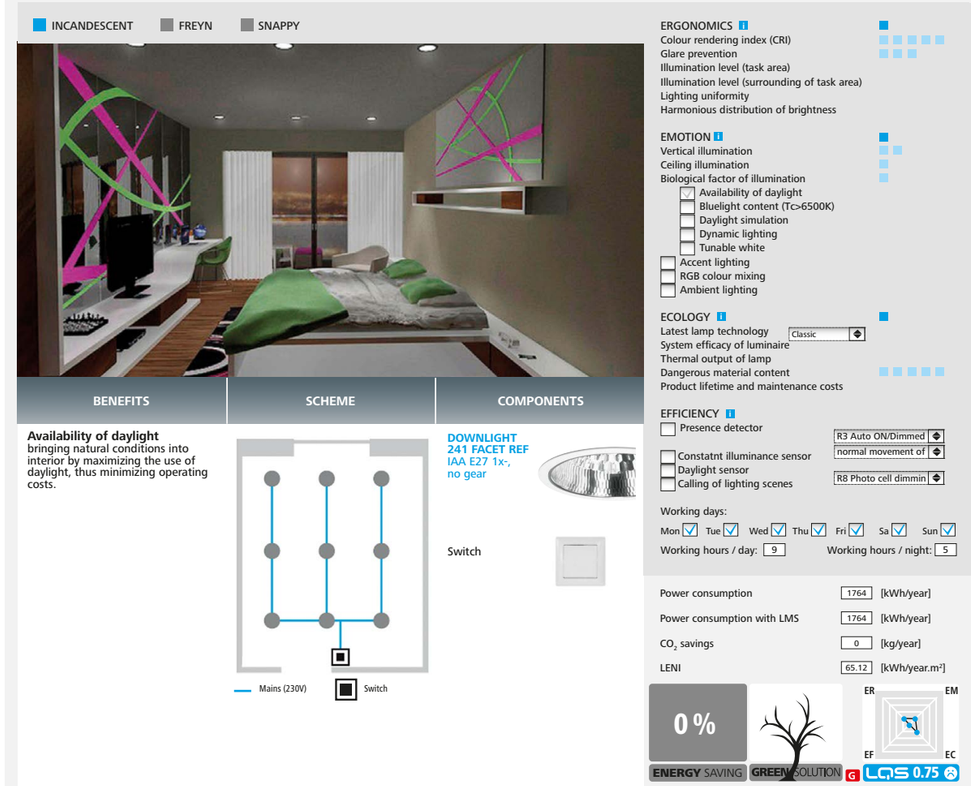


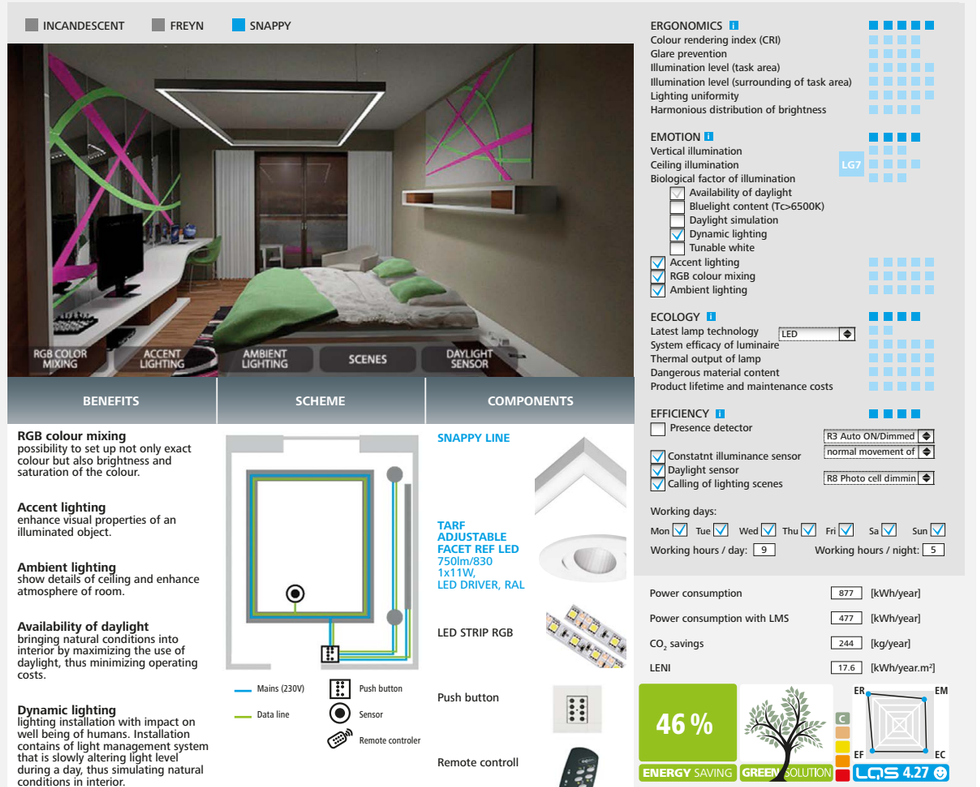
It is important that lighting designers not limit their focus to general lighting only. Added touches of light from statement freestanding luminaires for reading and relaxation, or recessed luminaires positioned under shelves and in wardrobes, can make the difference between a room being functional and truly comfortable. The use of lighting scenes will allow users of the space to choose the lighting they prefer at any time, further contributing to feelings of comfort.

Lighting designers must have a thorough knowledge of the space to be illuminated including the colours, finishes and reflectance of all room surfaces. Dark and matt surfaces make it necessary to use higher levels of illumination.



A light source that emits cool white light strong in the blue part of the spectrum is ideal for use over desks as the light will activate guests and increase their activity.





Visitors spend most of their time in the hotel room, especially during the evening and night hours. Therefore, the lighting of these spaces is very important. Surprisingly, many hotels still use standard incandescent lamps, which adversely affect power consumption and must be regularly changed, greatly increasing operational costs. In this solution, the lighting system comprises six downlights equipped with incandescent bulbs, which is reflected in the annual power consumption of 65.12 kWh/year.m². Incandescent blubs also have the disadvantage of emitting higher levels of IR and UV radiation, which negatively influences to the lifetime of materials used in the room. The resultant LQS rating of 0.75 is due to the use of out-dated technologies. Such a rating indicates that this solution is very bad.

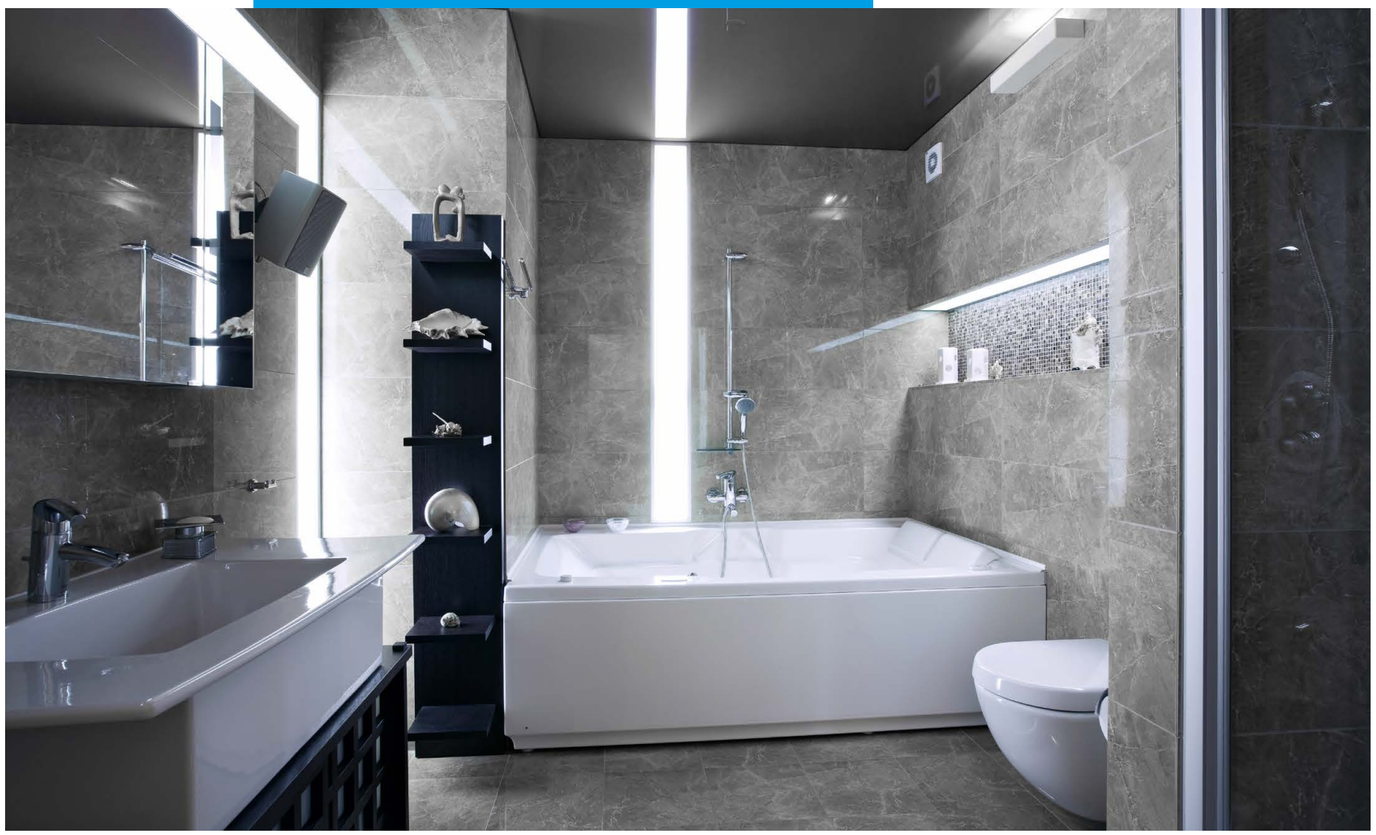
The new solution uses the latest LED light source technology, and achieves an excellent overall LQS rating of 4.27. The use of modern LED technologies minimises the amount of IR and UV radiation. However, the main advantage of the solution is the controllability of the light, which makes use of dynamic and RGB functionality, and a daylight sensor to reduce the lighting levels during the day and save energy. The energy consumption of the new solution is almost four times lower than the original design, at only 17.6 kWh/year.m².

The use of wall and cove mounted luminaires will make a small bathroom appear visibly larger.

Light and highly reflective materials, as are often found in bathrooms, make the space look larger. On the other hand, darker and less reflective materials absorb light and make the space seem optically smaller and therefore necessitate the use of higher levels of illumination.

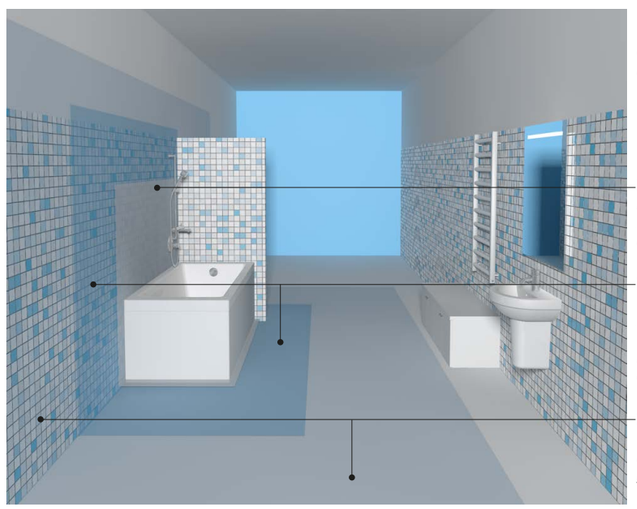
BATHROOMS

We all start and finish our day in the bathroom. Regardless of whether we are at home of in a hotel, appropriate lighting will have a highly positive effect on the atmosphere of the room, making it cosy and comfortable, especially when warm light colour temperatures are used.



The European standard EN 12464-1 determines that a minimal illumination level of 200 lx and lighting uniformity of 0.4 be used in bathrooms and toilets. However, based on our own experience we recommend the use of at least 300 lx to ensure visual comfort. Also required is a maximum glare rating of UGR 25, which can be provided by luminaires with opal glass diffusers that softly and evenly distribute the light throughout the room.

As with any space, lighting designers must pay attention to the colours and surface finishes and base their concept on the size of the room. A small bathroom can be adequately illuminated using a single ceiling mounted luminaire. In order to improve vertical illumination it is advisable to install wall or cove mounted luminaires, which will also visibly increase the size of the space. Another way to enlarge the space is to add mirrors. In larger bathrooms, such as those found in luxury hotels, it is necessary to use variable lighting that fits the use of particular zones. Independently controllable luminaires will increase user comfort and convenience. Additionally, bathroom lighting in any size room will benefit from dimming functionality, which will prevent guests being glared by relatively bright light during the night.



The selection of luminaires for the bathroom fall under strict safety criteria. They must be resistant to humidity and direct contact with water. The degree of this protection, along with voltage requirements, depend on the exact location of each given luminaire within the space.

Zone 0
Luminaires located in a bathtub, in direct proximity or in a shower space. Such luminaires must use a very low voltage of no more than 12 V and have a minimum protection rating of IP X7.

Zone 1
This zone is defined by the vertical proximity of luminaires to bathtubs and showers. If a shower has no solid walls, the safety zone is considered to 1.2 m in all directions. The upper limit of this zone is 2.25 m from floor level. Here, luminaires must also use no more than 12 V, transformers are forbidden and have a minimum protection rating of IP X5.

Zone 2
This zone consists of an additional 60 cm around zone 1. Luminaires located here must have a minimum protection rating of IP 44. If a whirlpool or jacuzzi is used in the bathroom the protection must be a minimum of IP X5.

Mirrors
A special area of attention is illumination in the proximity of mirrors. It is always beneficial to provide this lighting independently of the general lighting in order that it be controlled according to need. The correct choice of luminaires and their position will prevent harsh shadows and glare. Built-in linear fluorescent luminaires will evenly illuminate the face, alternatively it is possible to position similar luminaires down either side of the mirror, and for large mirrors above also.

Luminaires placed within the field of vision must not exceed a luminance of 3000 cd/m² in order to prevent glaring. A minimum illumination level of 500 lx in the area in front of the mirror will also help to reduce glare. Additionally, we recommend that the used light sources provide colour rendering of at least CRI = 90 and a neutral light colour temperature of 4000 K so as to ensure the skin looks natural.

Swimming pool lighting offers a special challenge to lighting designers, where safety, functionality and aesthetics are all equally important.

SPA AND WELLNESS FACILITIES

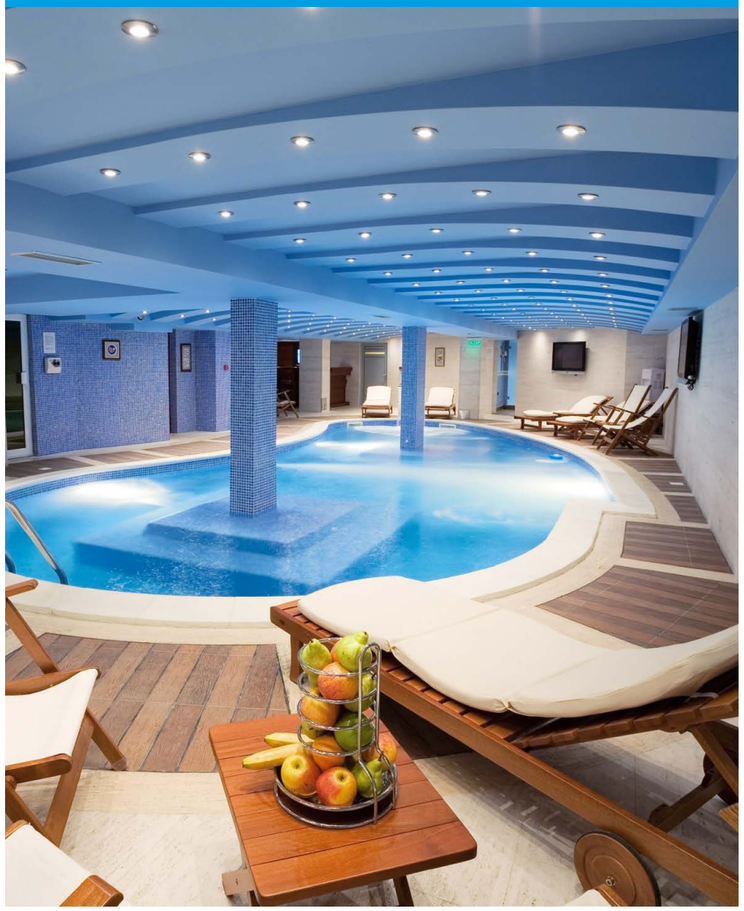
Modern hotels are not merely places to sleep, but offer a wide range of services. Restaurants, bars, conference and sports facilities and swimming pools are standard features nowadays.

The development of wellness tourism has encouraged hotels to extend the range of services on offer to include relaxation amenities such as pools, saunas, jacuzzis and massage centres. Hotel spa and wellness facilities represent a creative challenge to lighting designers additional to the fact that they must also adhere to many strict normative requirements.

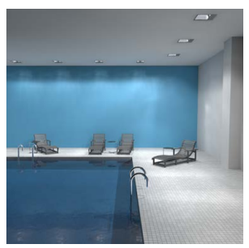
Swimming pools

Outdoor and indoor pools are common facilities in hotels, which have greatly different lighting needs to sports pools, these facilities are areas determined for rest and relaxation. Lighting designers must bare this in mind when designing the lighting to ensure that it is stimulating, entertaining, and not only functional.

Standards dictate that a body of water and its immediate surroundings be illuminated with a minimum of 50 lx and a lighting uniformity of 0.7.



Ceiling mounted luminaires with a wide light distribution are a suitable solution. Ideally positioned around the circumference of the pool to prevent glaring reflections from the water's surface and light shining directly into the eyes of those swimming backstroke. Such luminaires must have a minimum protection rating of IP 44.



Larger pools benefit from having luminaires with asymmetric light distribution positioned around the circumference of the pool, preventing glaring reflections whilst ensuring that sufficient illumination is directed towards the pool. Again, a minimum protection of IP 44 is required.

It is possible to reduce the risk of glare from reflections on the water's surface by installing luminaires inside the pool and under the water. This kind of lighting also makes the pool more aesthetically appealing, as the water appears to glow from within, as well as enabling swimmers to better guess the depth of the water. Underwater luminaires must have a minimum protection rating of IP 68.

Outdoor pools must be illuminated from within to help swimmers assess the depth of the water, ensuring safety even during dark evening hours.

Bollards are ideal for the illumination of outdoor pools, acting to provide both sufficient light levels as well as to guide guests towards the pool, doors and amenities. Such lighting will continue the horizontal illumination from the pool into the surrounding area. For outdoor application, luminaires must have a minimum protection rating of IP 54.

Outdoor swimming and thermal pools are places where guests can enjoy the water all day and all year round. Therefore, suitable lighting is vital to ensure visual acuity during darker hours. Safety and aesthetics play equally important roles, presenting lighting designers with a unique yet rewarding challenge. The water itself and its immediate surroundings must be suitably illuminated with a minimum of 50 lx and a lighting uniformity of 0.7, however that illumination can be provided in various ways allowing for highly creative and captivating lighting effects.

To increase the sense of relaxation, we recommend using light sources emitting warm white light.

Sauna and massage facilities

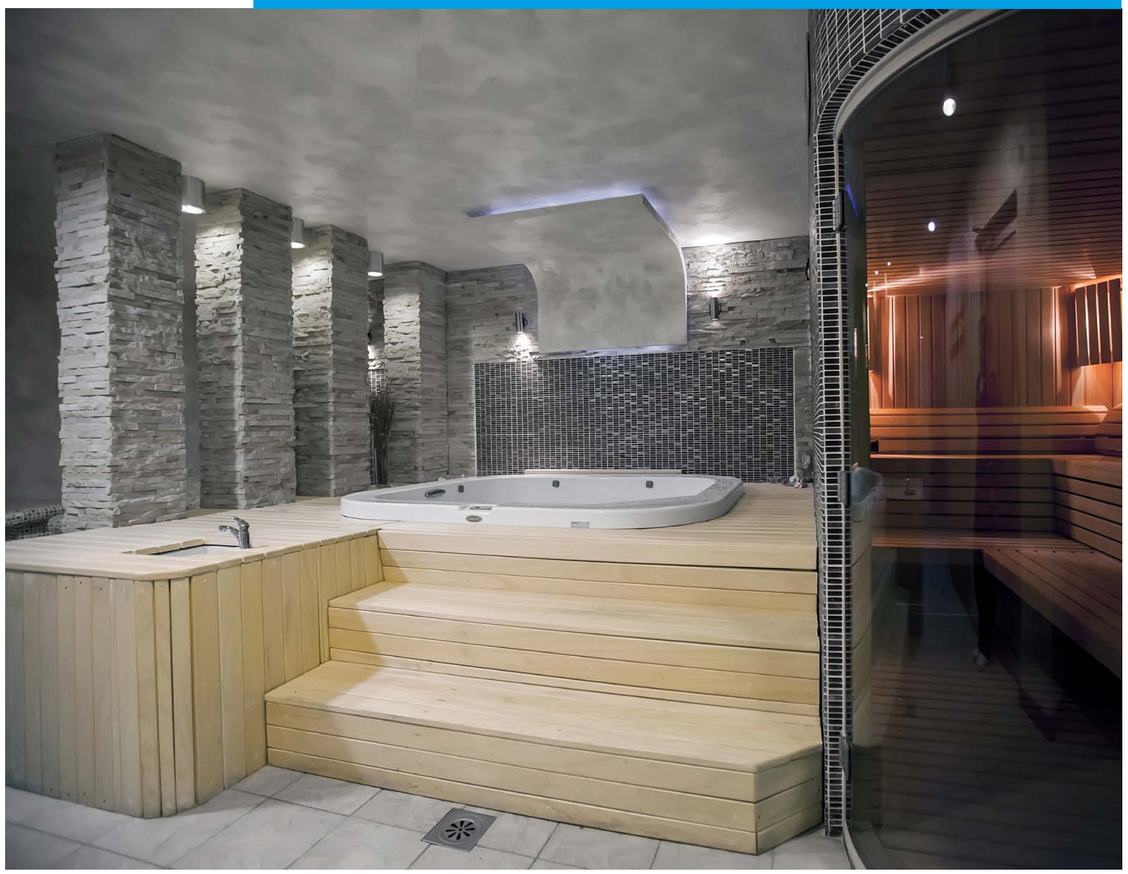
Apart from pools and hot tubs, spa and wellness hotels often offer their guests the services of in-house saunas and massage parlours. The lighting systems of such areas need not only comply with the normative requirements, but also add an aesthetic value to the overall design of the place.

The EN 12464-1 standard requires a minimum illuminance level of 300 lx for general sauna areas such as corridors between the sauna and the cold water pools or showers. However, the general rule here is that the higher the illuminance level is, the bigger the sense of cleanliness and safety it exudes.

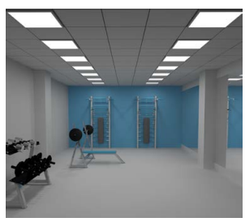
When planning the lighting system, it is advisable to pay extra attention to the vertical illuminance of the walls to ensure adequate psychological and visual comfort. This can be achieved by ceiling recessed fixtures with wide light distribution such as downlights.

To increase the sense of relaxation, we recommend using light sources emitting warm white light.

The lighting of massage parlours allows for more creative solutions, but the normative standard and increased hygienic demands require a minimum illuminance level of 300 lx. Since it is necessary to make clients feel relaxed during massages, we recommend a lighting solution combining ambient and accent lighting. The main illumination should be produced by luminaires emitting warm white light, and a more eye-pleasing effect can be achieved by using additional accent luminaires with RGB colour mixing functionality.



Saunas themselves do not need high illuminance levels. But it is important to use luminaires with a high protection rating – at least IP 44 for dry saunas, and IP 68 for steam saunas – that can resist high sauna temperatures.



When planning the lighting system for a fitness centre, it is highly important to minimise the risk of uncomfortable glare that comes with exercise devices where people lie on their backs and look up at the ceiling. To prevent the risk of glare in such cases, we recommend using either diffuser luminaires that emit soft, glare-free light or luminaires with asymmetrical luminous intensity distribution placed out of the visual field of the client. These luminaire types will also prevent undesired glare on the displays of other exercise devices.

Gyms

The EN 12464-1 standard requires a minimum illuminance level of 300 lx with a uniformity of 0.4 for task areas in fitness centres. In order to eliminate injuries in areas with many potential obstacles – exercise machines – we need to create lighting conditions that help emphasise the horizontal and vertical lines of these devices. Therefore, we need a good level of vertical illuminance, which can be reached by using luminaires with wide or asymmetrical light distribution.

The luminaire GACRUX has built-in TunableWhite technology and can provide suitable illumination for different types of fitness centre activities by colour-tuning the white light to specific needs. Light stronger in the yellow part of the spectrum increases the sense of relaxation during yoga, stretching, and other non-dynamic sports, while cooler white light used during condition training and cardio exercises can lower the blood melatonin levels and make people feel more active and perform better.

The right lighting solution enhances the perception of the information being presented and contributes to a positive communication atmosphere.

CONFERENCE AND CONGRESS ROOMS

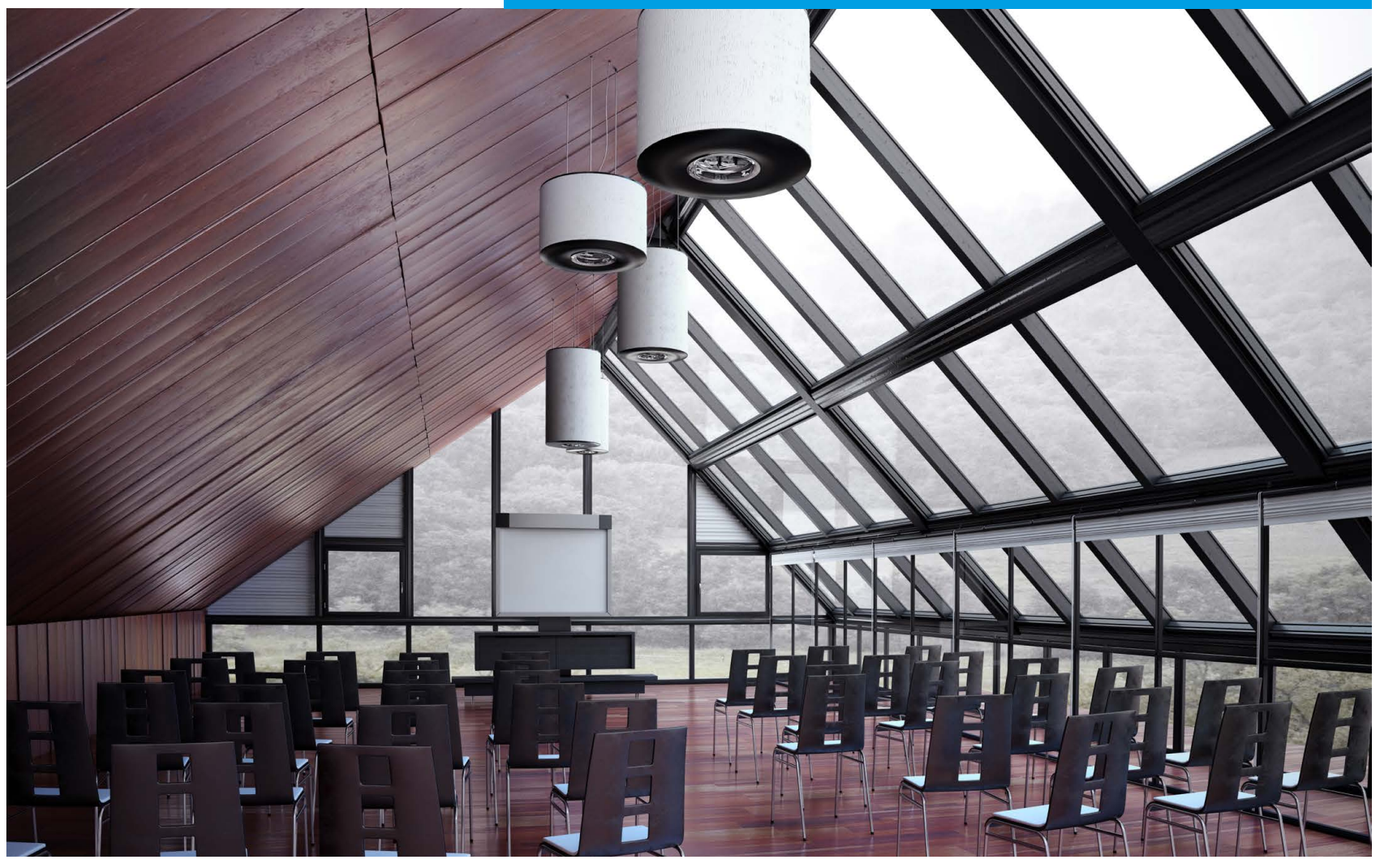
Information sharing is the cornerstone for the development of information society and is highly influential on the whole social system. The need to share information by other than electronic means raises the demand for meeting venues. Many modern hotels respond to it by creating conference and congress rooms equipped with the latest technologies.

The right lighting solution in these areas enhances the perception of the information being presented and contributes to a positive and communicative atmosphere. Therefore, we need to pay appropriate attention to the lighting system when designing conference and congress rooms. Interactive seminars, meetings, workshops, lectures or conferences using multimedia presentation devices require various types of illumination. The key to the right solution is in the right selection and placement of luminaires and integration of suitable lighting management tools.

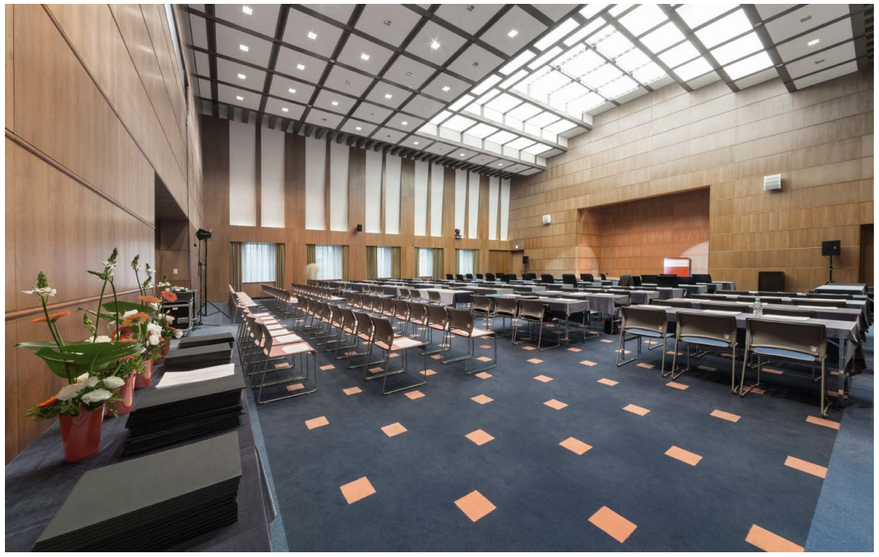
The normative illuminance level required for the illumination of such task areas (conference tables) is 500 lx. To meet this requirement, we can either use suspended luminaires with both direct and indirect light distribution or ceiling recessed fixtures with a wide light distribution. These solutions provide adequate illuminance of the work area, walls and ceiling, as well as harmonious distribution of brightness, and thus create optimal lighting conditions for concentrated work.

A presentation area and lectern require a lighting solution of its own. In both cases it is necessary to meet the minimum required illuminance level of 500 lx.

A lectern requires cylindrical illumination of at least 150 lx that enables the audience to see the face of the presenter clearly and without any dark shadows. Several spotlights with narrow light distribution that illuminate the speaker from various angles can do this well. However, when choosing this solution, you need to make sure that the spotlights meet the normative UGR requirements and do not dazzle the speaker. Alternatively, we can also use downlights with adjustable reflectors, in which case COMET MOTION from OMS is the perfect solution as it enables the directing of luminous flux as needed.



The illumination of presentation screens, such as boards, flipcharts or projecting screens, can be done by a linear luminaire with asymmetric distribution placed 0.5 - 0.8 m above and 0.85 - 1.3 m from the presentation screen. This solution provides the required uniformity and optimal vertical illuminance of the presentation screen.



Emotional lighting is a particularly popular solution for conference and congress halls. Accent lighting draws attention to special objects, such as paintings or hotel logos, placed in this area and ambient lighting with RGB colour mixing adds the final touch to the overall feel of the event.

Since conference and congress halls are used for various different activities and events, the luminaires used need to be separately controllable in terms of their light intensity and CCT. Such flexibility can be reached by implementing a lighting management tool with predefined lighting scenes.

To ensure the true colour representation of the meals served, we recommend using light sources with a minimum colour rendition of CRI ≥ 90.

RESTAURANTS

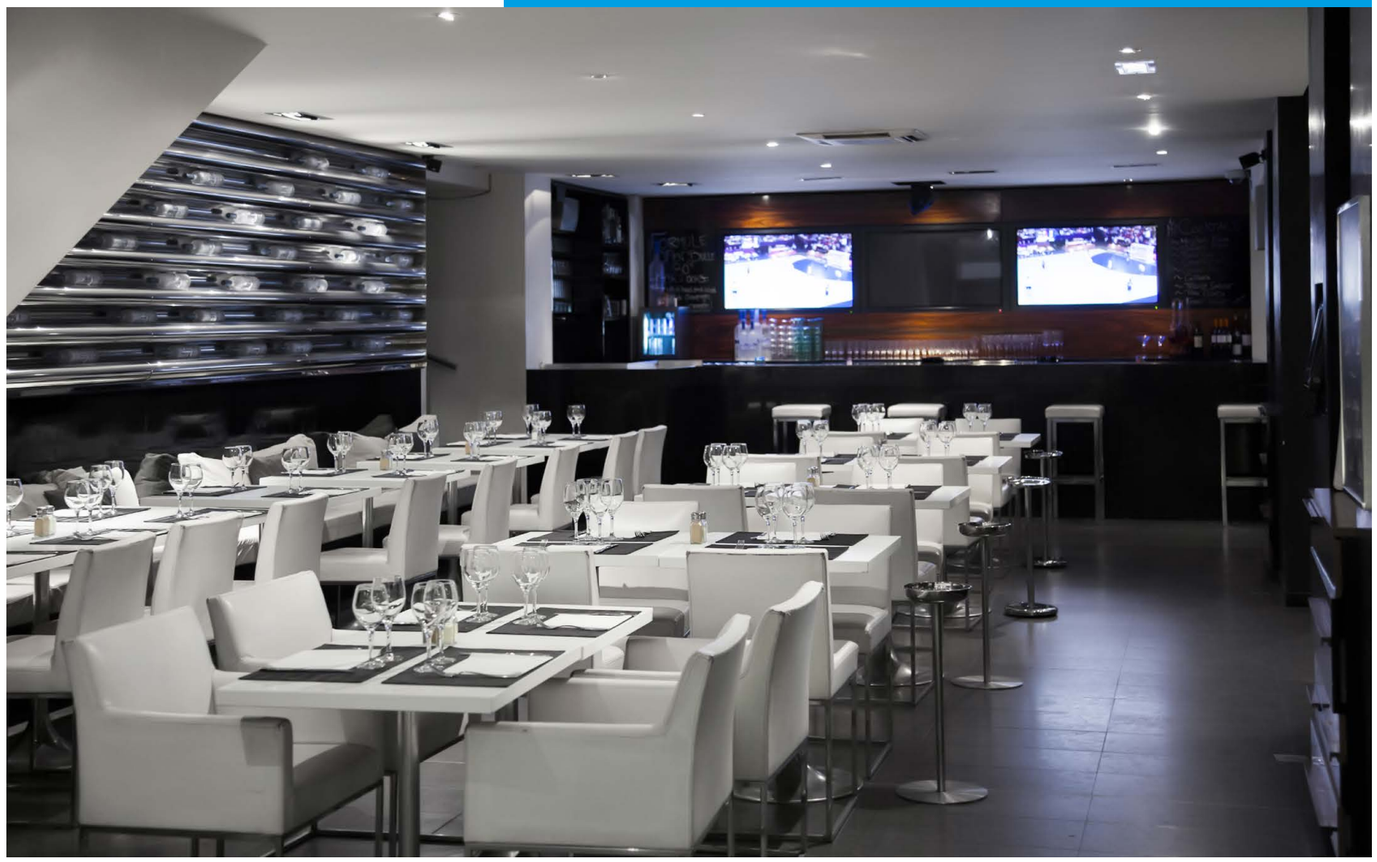
The lighting system of a restaurant needs to be adjusted to the overall design and concept of the place. A suitable light distribution and CCT can promote appetite and create a relaxing and intimate atmosphere.

There are almost no normative restrictions limiting the selection of restaurant luminaires, so lighting designers can unleash their creativity. The only normative requirement set for this type of area is the CRI of the used light sources. The EN 12464-1 standard requires it to be CRI ≥ 80, but to ensure the true colour representation of the meals served, we recommend using light sources with colour rendition of CRI ≥ 90.

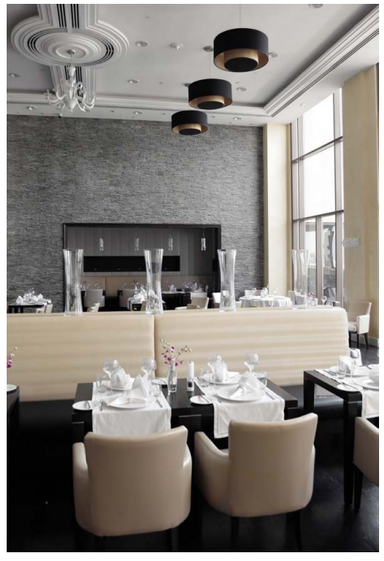
During the day, artificial light only plays a secondary role in restaurants with available daylight. The time when restaurants are mainly used is after the sunset and a wisely chosen lighting solution can contribute to the overall atmosphere and enhance the interior design.

Proper luminaire placement and light distribution can hide the service areas and draw attention to seating areas. To achieve this effect, we can supplement the main lighting system with narrow light distribution suspended luminaires or downlights placed above the tables.

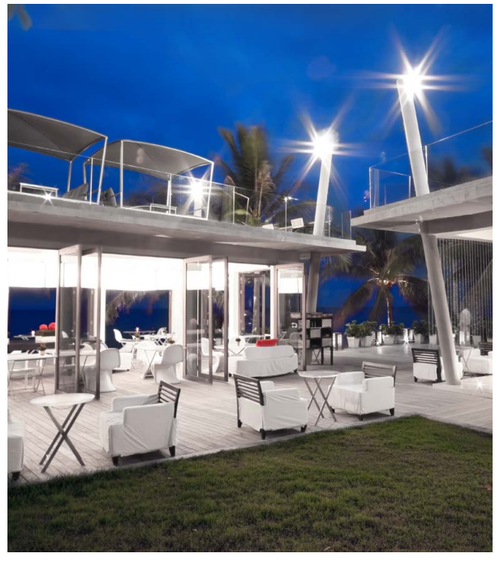
Research has shown that restaurant guests prefer lighting solutions where the illuminance level of the table surpasses the brightness of its surrounding. This enables guests to clearly see the meals and objects placed on the table while maintaining a sense of anonymity. However, the light intensity around the table must ensure that the guests are able to distinguish the faces, facial expressions and gestures of their communication partners. To keep the difference perceptible, we recommend observing the following sequence of illuminance values: 50 lx, 75 lx, 100 lx, 150 lx, 200 lx, 300 lx.



The distance between the suspended luminaire and the tabletop should be about 60 cm. This ensures that the luminaire is above the customers' eye level and does not block their view of fellow diners. The look of these areas will benefit from suspended luminaires with an opaque or coloured-glass finish.



Designer luminaires offer wide possibilities for restaurants, but they need to be adjusted to the overall concept of the interior. The proper placement of supplementary narrow light distribution luminaires can create visually interesting lighting effects and add to the attractiveness of the space.



Terraces

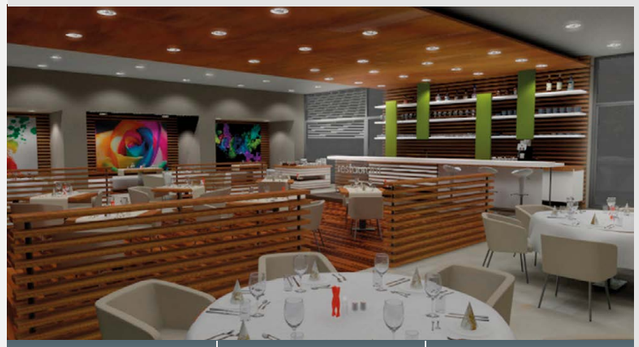
The role of a restaurant or bar terrace is not only to increase the seating capacity of the place. When set in a pleasant environment, it can also enhance the attractiveness of the space and make it look bigger. To make customers feel cosy even after the sun goes down, a carefully selected lighting solution for the terrace is a must.

The lighting design for the restaurant terrace should be based on the architectural layout of the place. Having a partially covered terrace enables the use of downlights for general illumination, as their design does not disrupt the uniformity of the ceiling and their wide light distribution can create a harmonious distribution of brightness. If terrace walls are available, it is advisable to use them for supplementary luminaires – wallwashers – that can increase the level of vertical illumination and nicely reflect the light from the walls back into the space.

Open terraces require the use of reflectors or pole-top luminaires. When determining the height of a pole or reflector-mounting bracket, it is necessary to bear in mind that guests and service staff should not be exposed to glare. Adjustable reflectors can also be used to illuminate the surrounding and highlight the greenery or interesting architectural details during the night. An even higher attractiveness of the space can be achieved by using free-standing LED RGB luminaires of an interesting design.

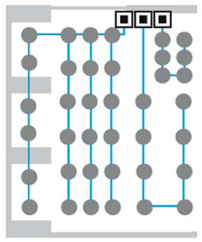
Partially covered terraces should be illuminated with at least IP 44-rated luminaires, while open terraces require luminaires of IP 54 protection class. Just like in the case of restaurants and kitchens, the guests should also perceive the true colours of the meals and drinks being served. To ensure this, we recommend using luminaires with good colour rendition of CRI ≥ 90.

CLASSIC CADAN



BENEFITS | SCHEME | COMPONENTS

Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.



DOWNLIGHT 205/215/225 BASIC POLISHED
REF FSQ G24q 2x26W, ECG
RAL 9003

Switch

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [x] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [ ] Daylight simulation
- [ ] Dynamic lighting
- [ ] Tunable white

- [ ] Accent lighting
- [ ] RGB colour mixing
- [ ] Ambient lighting

ECOLOGY
Latest lamp technology: Classic
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product lifetime and maintenance costs

EFFICIENCY
- [ ] Presence detector — R3 Auto ON/Dimmed
- [ ] Constatnt illuminance sensor — frequented movemen
- [ ] Daylight sensor
- [ ] Calling of lighting scenes — R8 Photo cell dimmin

Working days: Mon ☑ Tue ☑ Wed ☑ Thu ☑ Fri ☑ Sa ☑ Sun ☑
Working hours / day: 5 | Working hours / night: 4

Power consumption	11302	[kWh/year]
Power consumption with LMS	11302	[kWh/year]
CO_2 savings	0	[kg/year]
LENI	55.4	[kWh/year.m²]

The original solution uses compact fluorescent (CFL) lamps to provide dramatic accent lighting of products. CFL lamps are very dangerous when damaged due to their high mercury content, which can not only contaminate food but also negatively affect the health of guests. This solution does not make use of any lighting control. This combined with the use of old light source technology means that the system wastes a lot of energy. The efficiency of the lighting system is 55.4 kWh/year.m² and has an energy class B rating. The overall LQS rating is, therefore, a poor 1.64, representing the low quality of the lighting.

CLASSIC CADAN

BENEFITS | SCHEME | COMPONENTS

RGB colour mixing
possibility to set up not only exact colour but also brightness and saturation of the colour.

Accent lighting
enhance visual properties of an illuminated object.

Ambient lighting
show details of ceiling and enhance atmosphere of room.

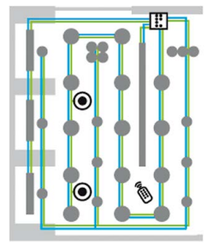
Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.

Dynamic lighting
lighting installation with impact on well being of humans. Installation contains of light management system that is slowly altering light level during a day, thus simulating natural conditions in interior.

Constant illuminance sensor
reduce the use of artificial light in the early life lighting system.

Daylight sensor
Sensor reduce the use of artificial light in interiors when natural daylight is available.

Calling of lighting scenes
Lighting system allows to program several lighting scenes, which can be launched anytime by using of different user interfaces.



VISION LED RECESSED POLISHED REF
LED 1100lm/840
1x13W, LED DRIVER

TUBUS CADAN 40°LED
1400lm/840
1x18W, LED DRIVER,
RAL 9005

RELAX ASYMMETRIC LED AL
LED 1900lm/840
1x27W, LED DRIVER,
RAL 9003

LED STRIP

Push button

Remote controll

Power supply for the DALI line

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION — LG7
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [ ] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [ ] Daylight simulation
- [x] Dynamic lighting
- [ ] Tunable white

- [x] Accent lighting
- [x] RGB colour mixing
- [x] Ambient lighting

ECOLOGY
Latest lamp technology: LED
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product lifetime and maintenance costs

EFFICIENCY
- [x] Presence detector — R3 Auto ON/Dimmed
- [x] Constatnt illuminance sensor — frequented movemen
- [x] Daylight sensor
- [x] Calling of lighting scenes — R8 Photo cell dimmin

Working days: Mon ☑ Tue ☑ Wed ☑ Thu ☑ Fri ☑ Sa ☑ Sun ☑
Working hours / day: 5 | Working hours / night: 4

Power consumption	5601	[kWh/year]
Power consumption with LMS	3316	[kWh/year]
CO_2 savings	1394	[kg/year]
LENI	16.25	[kWh/year.m²]

The new solution makes use of two luminaires using the latest LED light source technology, CADAN and VISION LED. The space is uniformly illuminated without the occurrence of disturbing shadows, and the luminaires used ensure low glare with a UGR rating of less than 19, although from the point of view of meeting normative requirements, such a space is not demanding. Ambient (cove) lighting is used in combination with RGB colour mixing technology to provide an atmospheric and flexible lighting solution, which can both stimulate or relax depending on need, and helps to promote feelings of wellbeing. In terms of safety, the use of LED light sources is advantageous as they do not contain any dangerous mercury. This solution also makes use of lighting control by means of lighting scenes, which can easily be selected, as needed, using a touch panel. The system efficiency is 16.25 kWh/year.m², meaning that it also gets an energy class B rating. However, the overall LQS is score is much higher than the original solution thanks to the increased effectiveness as well as superior control and aesthetic functions.

SELF-SERVICE RESTAURANTS

The increased number of business centres with hundreds of employees led to the boom of self-service restaurants in our cities. Their main goal is to satisfy the needs of mass consumers, but these facilities also have an ambition to create a pleasant dining atmosphere. Here, the right lighting solution plays a vital part.

The EN 12464-1 standard dictates a minimum illuminance level of 200 lx with a uniformity of 0.4 for these areas. The maximum glare rating allowed is UGR = 22 and the required colour rendition of the light source is CRI ≥ 80. However, to ensure true colour representation of the displayed food, we recommend using light sources with a minimum colour rendition of CRI ≥ 90.

Self-service restaurants are mainly used during workdays when we have limited time to relax during lunch. Therefore, we should not only pay attention to the normative requirements but also try to create lighting conditions that enhance the positive atmosphere of the environment. Many self-service restaurants have daylight access, but its combination with appropriate artificial lighting can create a sense of a perfectly lit open space.

Self-service restaurants are naturally divided into two parts – the dining area and self-service area. To emphasise the important, we recommend using lighting with higher illumination levels to highlight the entrance and self-service counter. Linear suspended luminaires with CRI ≥ 90 are an ideal solution for such applications since they literally show the displayed meals in the best light.

For the main illumination of the area, we recommend luminaires with both direct and indirect light distribution. They will not only ensure the normatively required illuminance level, but also sufficient illuminance of the walls and ceiling. From the point of view of hygiene, it is better to use recessed luminaires with specially shaped diffusers that are easy to clean from trapped residue. Alternatively, it is also possible to use ceiling recessed fixtures with direct distribution of the luminous flux and supplement them with wall-mounted luminaires, such as wallwashers, that increase the vertical illuminance of the space. Ceiling recessed fixtures with specially shaped diffusers that direct a part of the luminous flux onto the walls and the other part to the ceiling are an ideal solution ensuring the optimal level of vertical and horizontal illuminance.

From the point of view of hygiene, it is better to use recessed luminaires with specially shaped diffusers that are easy to clean from trapped residue.

An optimal lighting solution should include supplementary suspended luminaires or downlights with narrow light distribution placed in the dining area. We recommend the light sources emit a warm white light that increases the sense of wellbeing, gives the complexion a more natural shade, and which therefore adds a pleasant communication atmosphere to the dining experience.

To increase the saving potential of the space, we also recommend a lighting system with a daylight sensor and a lighting management tool with pre-set lighting scenes that adjusts the illuminance of the dining area to the current lighting conditions. With these tools, the lighting system will not be fully used during cleaning and after hour, but will dim the lighting to a safety illumination level.

Since the luminaires placed directly above the self-service counter are exposed to a higher steam concentration, it is better to use those of protection class IP 65.

The luminaires used in self-service restaurants should have a high CRI. OMS' solution for these areas is the POLUKS downlight. It comes in a design that suits all spaces and does not disrupt the concept of their interior. The asymmetric light distribution of this luminaire ensures an adequate illuminance of the task area that complies with all the normative requirements.

Our second choice would be the AVIOR TRACK luminaire with adjustable reflectors that come in handy when redesigning the seating area as they can easily adapt to the current lighting needs. To increase the illuminance of areas with restricted daylight, we recommend supplementing the main luminaires with CADAN suspended luminaires placed above the tables in the dining area. These will give the self-service restaurant a more intimate and pleasant atmosphere.

The lighting systems of refrigerator rooms usually use LED light sources since, unlike conventional light sources, their luminous flux does not decrease when the temperature falls below 0 °C. Given the humidity of the application area, it is necessary to use luminaires with protection class IP 54 or higher.

KITCHENS

A kitchen is usually separated from the remaining restaurant area to ensure that the technological facilities do not disrupt the restaurant´s design and the customers are at least partially shielded from the mixture of smells produced during meal preparation. In comparison with the restaurant area, the kitchen places higher demands on the quality of the luminaires used.

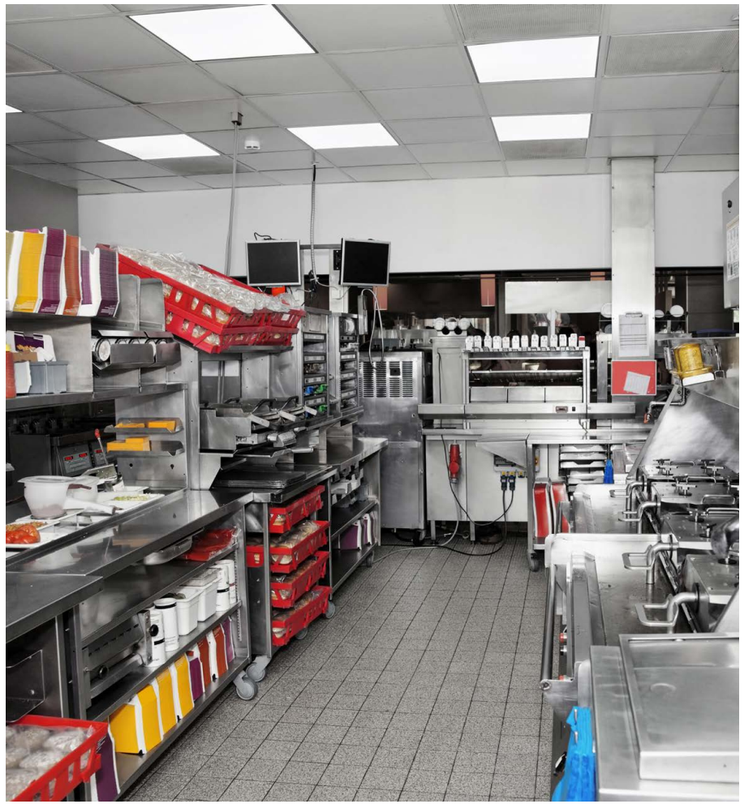
The EN 12464-1 standard requires a minimum illuminance level of 500 lx and a minimum colour rendition of CRI ≥ 90 to ensure true colour representation. In addition, the standard requires the kitchen luminaires to be high-temperature resilient, damp-proof and chemical-resistant. It is therefore recommended to use luminaires of protection class IP 54 or higher whose covers are either made of unbreakable glass or are protected with a construction preventing the glass fragments from entering food in the event of breakage.

Suspended luminaires with wide light distribution are a suitable solution for these task areas as they provide sufficient illuminance of walls, as well as the ceiling. Higher CCTs of 6500 K or more have an activating effect on the human body, increase the concentration ability of employees and as a result reduce the risk of occupational injury.

The work surface used for food processing and meal preparation should be illuminated with light of 3000 K, which enables the kitchen staff to see the meals in the same light as the restaurant guests.

From the point of view of safety, we recommend the use of LED light sources that, unlike conventional light sources, do not contain lead and eliminate the risk of food contamination in the event of light source breakage.

The difference between the illuminance of the kitchen area and the restaurant should be neutralised in the transition area between the two, so that the eyes of those moving between these places can easily adapt to the different brightness levels. The illumination of the area around the kitchen entrance/exit should be adjusted to the kitchen illuminance of 500 lx and should be at least 300 lx. The illuminance level of the passage area should then be further adjusted to the illuminance of the restaurant.



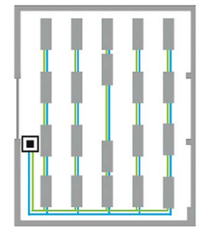
Apart from creating sufficient illuminance of the work surface it is also important to ensure adequate vertical illuminance of the shelves when planning the lighting system for kitchens.

Higher CCTs of 6500 K or more have an activating effect on the human body and increase the concentration ability of employees.

TORNADO TORNADO LED

BENEFITS | SCHEME | COMPONENTS

Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.



TORNADO STAINLESS STEEL - FD G13 2x36W

Switch

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [x] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [ ] Daylight simulation
- [ ] Dynamic lighting
- [ ] Tunable white

- [ ] Accent lighting
- [ ] RGB colour mixing
- [ ] Ambient lighting

ECOLOGY
Latest lamp technology: Classic T8
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product lifetime and maintenance costs

EFFICIENCY
- [ ] Presence detector
- [ ] Constatnt illuminance sensor
- [ ] Daylight sensor
- [ ] Calling of lighting scenes

R3 Auto ON/Dimmed
normal movement of
R8 Photo cell dimmin

Working days:
Mon ☑ Tue ☑ Wed ☑ Thu ☑ Fri ☑ Sa ☑ Sun ☑
Working hours / day: 4 Working hours / night: 3

Power consumption	3724	[kWh/year]
Power consumption with LMS	3724	[kWh/year]
CO_2 savings	0	[kg/year]
LENI	46.55	[kWh/year.m²]

Then original solution uses out-dated technology to illuminate the kitchen space. This results in a below average LQS rating of 2.43. The use of T8 fluorescent light sources in kitchens is especially dangerous because, in the event of damage, their high mercury content can contaminate food as well as being dangerous for kitchen staff. This solution does not utilise any kind of control system to dim the lighting during the day when there is daylight available, meaning that the ineffective T8 light sources are used for long hours and, therefore, waste a lot of energy. The energy consumption of the system is 46.55 kWh/year.m² and achieves an F energy class rating.

TORNADO TORNADO LED

BENEFITS | SCHEME | COMPONENTS

Availability of daylight
bringing natural conditions into interior by maximizing the use of daylight, thus minimizing operating costs.

Daylight simulation
lighting installation with impact on well being of humans. Installation contains of light management system that is slowly changing colour temperature duirng a day, thus simulating natural conditions in interior.

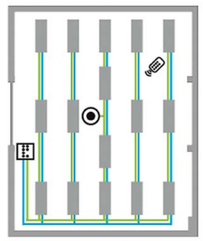
Dynamic lighting
lighting installation with impact on well being of humans. Installation contains of light management system that is slowly altering light level during a day, thus simulating natural conditions in interior.

Presence detector
Passive infrared sensor that reacts on movements. It is switching luminaires on to a pre-programmed level by occupancy of the room and switching luminaires off by absence of persons.

Constant illuminance sensor
reduce the use of artificial light in the early life lighting system.

Daylight sensor
Sensor reduce the use of artificial light in interiors when natural daylight is available.

Calling of lighting scenes
Lighting system allows to program several lighting scenes, which can be launched anytime by using of different user interfaces.



TORNADO PC LED WIDE 51W
5100lm 4000K 80Ra

Push button

Remote controll

Power supply for the DALI line

Combined motion and illuminance sensor

ERGONOMICS
Colour rendering index (CRI)
Glare prevention
Illumination level (task area)
Illumination level (surrounding of task area)
Lighting uniformity
Harmonious distribution of brightness

EMOTION
Vertical illumination
Ceiling illumination
Biological factor of illumination
- [ ] Availability of daylight
- [ ] Bluelight content (Tc>6500K)
- [x] Daylight simulation
- [x] Dynamic lighting
- [ ] Tunable white

- [ ] Accent lighting
- [ ] RGB colour mixing
- [ ] Ambient lighting

LG7

ECOLOGY
Latest lamp technology: LED
System efficacy of luminaire
Thermal output of lamp
Dangerous material content
Product lifetime and maintenance costs

EFFICIENCY
- [x] Presence detector
- [x] Constatnt illuminance sensor
- [x] Daylight sensor
- [x] Calling of lighting scenes

R3 Auto ON/Dimmed
normal movement of
R8 Photo cell dimmin

Working days:
Mon ☑ Tue ☑ Wed ☑ Thu ☑ Fri ☑ Sa ☑ Sun ☑
Working hours / day: 4 Working hours / night: 3

Power consumption	1999	[kWh/year]
Power consumption with LMS	641	[kWh/year]
CO_2 savings	628	[kg/year]
LENI	8.26	[kWh/year.m²]

The new solution is fully LED-based and comes with many advantages connecting to the use of the latest light source technology. As a result, the solution achieves a successful overall LQS rating of 4.71. The lighting design is the same as the original one, using ceiling surfaced luminaires with wide light distribution to ensure good lighting uniformity and illumination of room surfaces. By using LED light sources, the danger of mercury contamination is removed as LEDs contain negligible hazardous material content. The use of LED also provides excellent energy efficiency by combing the high efficacy of LED light sources with daylight and presence sensor control of the lighting according to the amount of natural light available and the occupation of the space. The energy consumption is less than one fifth of the original at on 8.26 kWh/year.m².

Neutral white light gives the customers an impression of a cleaner and more hygienic environment.

BUFFETS

The EN 12464-1 standard requires a minimum illuminance level of 300 lx with a uniformity of 0.6 for these areas. The maximum glare rating allowed is UGR = 22 and the colour rendering index of the light source should be of CRI ≥ 80. To ensure the true colour representation of the displayed products, we recommend using light sources with a minimum of CRI ≥ 90. In order to protect the customers and buffet staff from uncomfortable glare, it is also advisable to use the luminaires with UGR < 19.

Despite their small size, buffets are divided into different sections that all need to be taken into consideration when designing the lighting system. The main illumination throughout the buffet can be created by downlights with wide light distribution. If the products are placed in display racks behind the counter, it is necessary to create sufficient vertical illuminance along the entire length of the rack to ensure that all the products – from the top to the bottom shelf – are visible to the customers.

Refrigeration counters require a lighting solution of their own. The luminaires illuminating them must have CRI ≥ 90 to make the displayed food look fresh and appetizing. From a hygiene point of view, it is recommended to use LED light sources that only emit insignificant amounts of IR radiation and thus prevent rapid food decay. In addition, LED light sources are the only light sources whose luminous flux do not decrease when the temperature goes down, but increases with the lowering temperature of the area.

A properly selected CCT can add to the overall sense of cleanliness. Our practical experience has shown that neutral white light of 4000 - 5000 K gives the customers an impression of a cleaner and more hygienic environment.

If the buffet has access to daylight, we can also implement a daylight sensor to increase the saving potential of the lighting system.

The look of meat products, like salamis and pâtés, can benefit from light sources emitting light with a higher representation of the red light component.

BARS

Bars offer a wide range of possibilities for lighting designers. Because their lighting systems are an integral part of the architecture, they need to match the overall interior design of the place.

Knowing the premises, atmosphere of the place and the target customer group is essential for designing the lighting systems of bars. If a bar is a part of a larger catering establishment, such as a restaurant, and it is not structurally separated from the remainder of the premises, its lighting system needs to fit the look of the place.

There are almost no normative requirements that lighting designers need to adhere to. The attractiveness, intimacy and emotion-inducing character of the place play a key role.
The bar itself is the heart of the place, so it needs to capture the attention of incoming guests. The right lighting solution has the power to immediately direct customers´ attention to the bar and make it the most prominent spot.

The proper illumination of the bar requires an adequate level of vertical illuminance. Moreover, an adequate vertical illuminance of the area behind the bar enables the customer to easily recognise the products displayed in this area. If you want to further emphasize selected products or logos, place them within customers´ sight line and highlight them using backlighting.

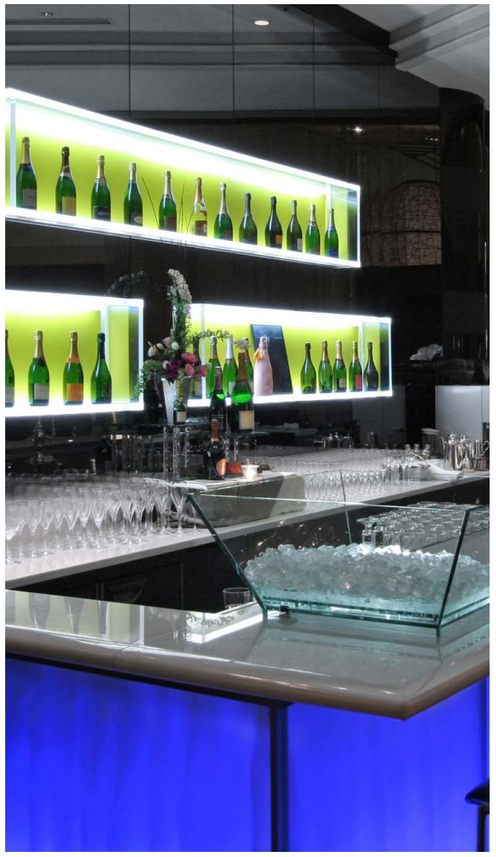
Accent lighting from ceiling mounted luminaires placed above the bar are a good choice for this area because the contrasting lighting conditions created by these luminaires will make the human sight perceive the bar as the most prominent object of the place.

For the bar tender and waiters the bar is simply a workplace. Since they must be able to identify all the ingredients and safely use all the utensils, the work area of the bar needs to be sufficiently lit and provide enough light for visual task performance. There are no normative requirements on the minimum illuminance level of the bar, but based on our practical experience, we recommend an illuminance level of at least 300 lx.

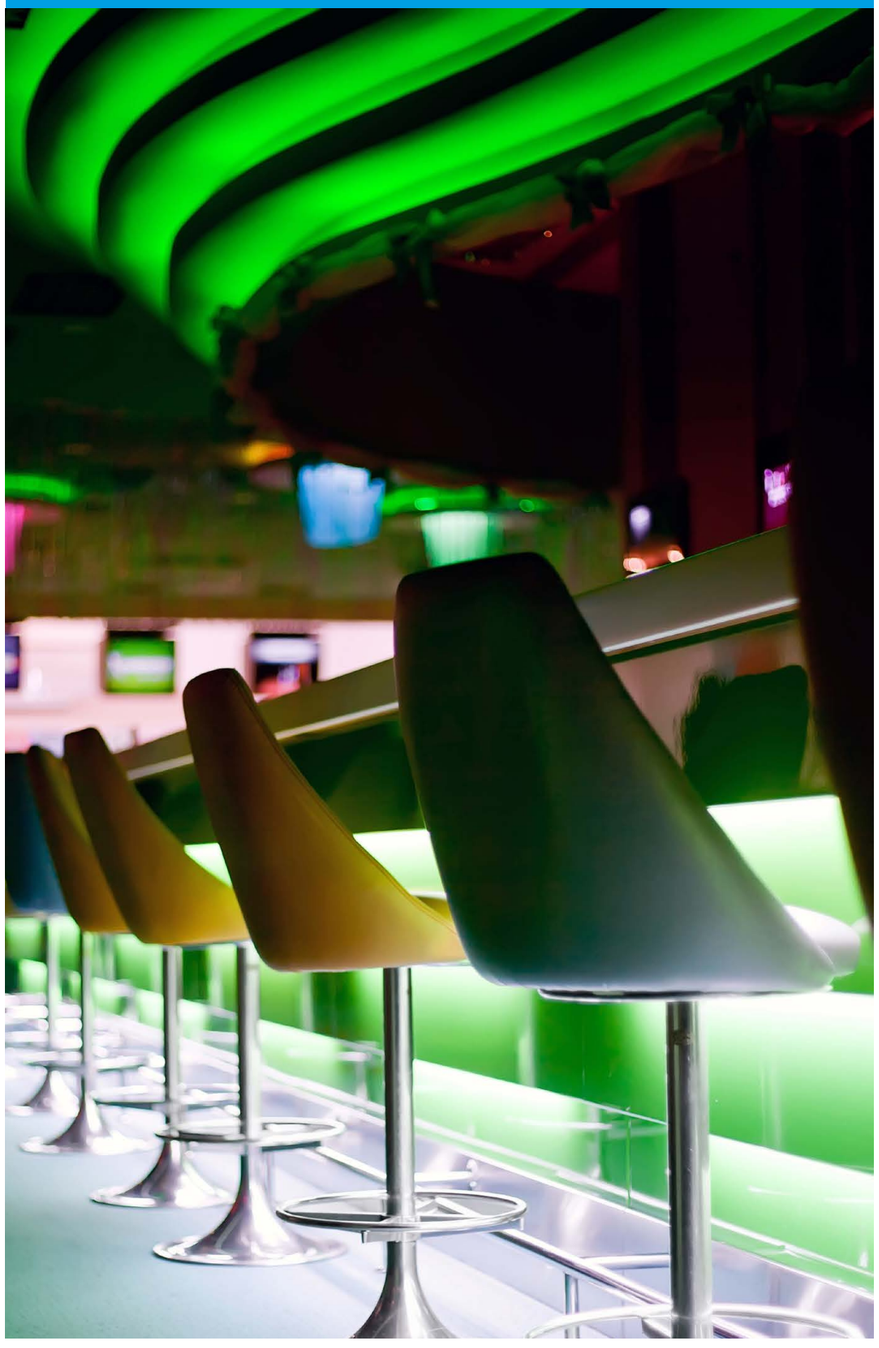
As these luminaires should enable the bar staff to properly recognize colours, the light sources used in the bar area should have CRI ≥ 90.

When planning the lighting system of the remaining area, the designer is free to choose from a wide range of luminaires with any type of light distribution. LED luminaires with RBG colour mixing functionality are a great solution for this type of area and their combination with a Lighting Management System gives the possibility of changing the overall colour and atmosphere of the place.

Low illuminance levels and well-chosen light colours create a sense of intimacy. However, we need not neglect the proper distribution and spacing of the luminaires as these help prevent the risk of uncomfortable glare.



The bar itself is the heart of the place, so it needs to capture the attention of incoming guests.



Sufficient vertical illuminance of the shelves behind the bar enables the bar staff to easily recognize the products and their labels. Spotlights integrated into the glass shelves increase the sense of cleanliness and highlight glossy surfaces.

The attractiveness of the bar can be enhanced by LED RGB luminaires. The proper selection and integration of the Lighting Management System can then enable staff to change the overall light colour of the area.

A good lighting solution can visually enlarge the space and make the employees feel more comfortable at the workplace.

Besides the functionality and original, representative design of the luminaires used, the illuminance of the office desk needs to comply with the strict normative standards ensuring suitable working conditions. Good results can be achieved using suspended luminaires that offer direct and indirect light distribution, modern design and compliance with the latest technological requirements. OMS' from ELITE product family has it all.

OFFICES

Unlike hotel rooms and suites, where the artificial light has rather an aesthetic and design function, the hotel office lighting has to meet certain normative criteria to create a suitable working environment.

The lighting systems of administrative hotel areas follow the requirements of the EN 12464-1 standard that sets the minimum illuminance level of offices to 500 lx. To further increase the lighting quality, we recommend following the guidelines on the proper illumination of walls and ceiling summarised by renowned British architects in their LG7 guide (Lighting Guide 7).

Although hotel offices are not usually accessible to hotel guests, the overall atmosphere and representative character of the hotel call for the use of designer luminaires. Suspension lights with both direct and indirect distribution of the luminous flux are a good choice for the main illumination of the space. The direct component of the luminous flux is directed down on the workspace and creates suitable working conditions. The indirect diffused component of the luminous flux directed to the ceiling helps to correctly model objects, and the quality of the light produced is very close to that of the daylight. The proper distribution and spacing of luminaires produces the minimum required illuminance of 500 lx and at the same time provides sufficient vertical illuminance of the walls and ceiling.

A good lighting solution can visually enlarge the space and make the employees feel more comfortable at the workplace. According to LG7, the optimal vertical illuminance value should be at least 50 % of the horizontal illuminance value, while the ceiling illuminance value should reach at least 30 % of the horizontal illuminance value.

It is not advisable to use luminaires providing only direct distribution of the luminous flux because they do not create sufficient vertical and horizontal illuminance and result in a 'cave effect', which makes employees feel cramped and claustrophobic.

Another good luminaire choice would be recessed luminaires with specially adjusted diffusers enabling both direct and indirect light distribution that ensures sufficient illuminance of the walls and ceiling.

HEAD OFFICES

The lighting solution for the head office follows the same requirements as the lighting solution of standard office spaces. However, the representative character of the head office and its division into work, conference, representative and relaxation zones requires the implementation of different luminaire types.

The required illuminance level of the conference head office section can be achieved using downlights with a wide light distribution. A very important aspect of this lighting solution is the CCT and the possibility to change and adjust it to the type of the meeting held.

Cool light helps people concentrate during important work meetings while warm light creates a pleasant communication atmosphere for business or less formal meetings with colleagues and business partners. Moreover, the warm light adds to our sense of wellbeing and gives our complexion a more natural look. The functionality of luminaires in this area can be further expanded by the Lighting Management System with pre-set lighting scenes that enable the adjustment of the illumination to the needs of projector presentations.

Representative and relaxation areas of the head office can be used to display either objects promoting the hotel and corporate culture or objects of personal value reflecting the taste and personality of the office user. The prominence of these paintings, photos or trophies can be highlighted by accent luminaires and the sense of relaxation in this zone can be induced by the light sources emitting warm white light.

Since offices are usually areas with daylight access, they have high energy saving potential and the installation of daylight sensors can save up to 60 % of their energy consumption. Moreover, pre-set lighting scenes enable the user to easily adjust the office illumination to current activities by simply pressing the button of the desired lighting scene.

FACADES

The outdoor lighting of hotels and restaurants should not merely make the place visible, but should also greet the guests and let them know they are coming to a place where they are welcome and will be looked after.

Unlike in the case of other task areas, the outside facade lighting does not have to match the building´s architecture or the greenery around it. Rather the opposite, hotel and restaurant buildings crave the creative touch of lighting designers who can let the buildings completely change their look after the sunset. If the lights go on even before that time, the guests will get a unique opportunity to watch the powerful light show of the building transformation.

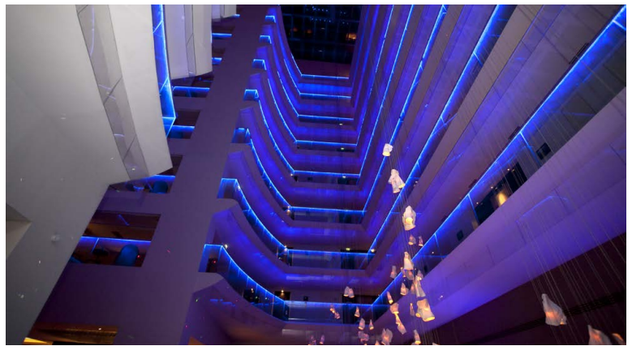
Pole luminaires with a wide light distribution placed in front of the building are an excellent solution for large-scale facade lighting. However, should the poles disturb the overall architectural impression, we suggest replacing them with recessed, asymmetrical light distribution luminaires placed within an appropriate distance from the facade. This second solution also comes with the added value of highlighting the vertical lines of the building. If you want to point to extraordinary architectural details, do it with accent lighting that is either fitted right on the facade or recessed and placed within an optimal distance from it.

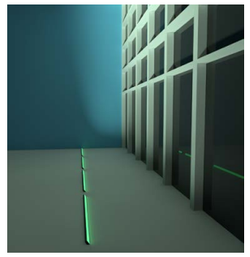
Apart from having an aesthetic value, the lighting system should also navigate the visitors and create appropriate lighting conditions for safe movement after dark. To make the orientation easier, it is advisable to place a series of luminaires along both sides of access roads or pavements to intuitively guide the guest to the building or the car park. The normative requirement for luminaires illuminating stairs or other such obstacles is 5 lx. Because the dark makes the human eye more sensitive to high illuminance levels, and the risk of glare arises, these luminaires need to be properly distributed and shielded with covers.

A well-chosen light colour can enhance the architectural style of a hotel or restaurant. The modern, clean-line architectural look benefits from neutral white light, while historical buildings look better when lit with warmer light. Dynamic lighting can further increase the overall attractiveness of the space by gradually turning lighting scenes or name signs on and off.

LED RGB luminaires take facade lighting to a whole new level by creating an impression of a colour changing facade. These luminaire types can create 16.7 million colour shades including white, and their long lifecycle, as well as stable luminous flux at low temperatures, make them an efficient and low-maintenance solution.

Greenery is an inevitable part of the hotel or restaurant exterior. Therefore, we need not neglect the choice of light sources used for its illumination. Metal-halide lamps are the standard, when it comes to green areas illumination, but we recommend using LED light sources that add a fresher look.





Depending on the building character, we can choose from two types of facade illumination. Modern, glass buildings can be illuminated by either bold-design interior lights or by narrow distribution downlights placed along the glassed areas. This will create an impression of a more open, sublime and elegant space. On the other hand, historical buildings or buildings with non-transparent surfaces need to be lit from the outside and the luminaires used in these cases need to be fitted on the facade, poles or be recessed within a suitable distance from the building.

If the lights go on even before the sunset, the guests will get a unique opportunity to watch the powerful light show of the building transformation.

Presence detectors will turn on the luminaires only where necessary.

GARAGES AND CAR PARKS

The proper illumination of car parks and underground garages does not only secure safe movement of cars and people, but also serves as a navigation point informing passers-by of a nearby hotel or catering establishment. This is why outdoor luminaires need to be placed along access roads to intuitively guide drivers to the entrance of the hotel, restaurant or underground garage.

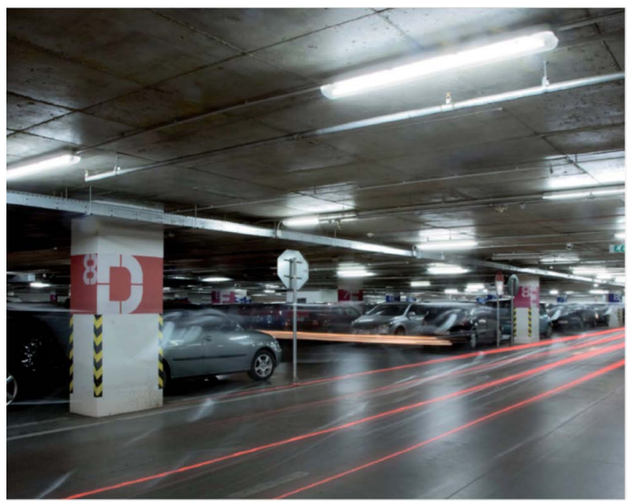
Outdoor car parks

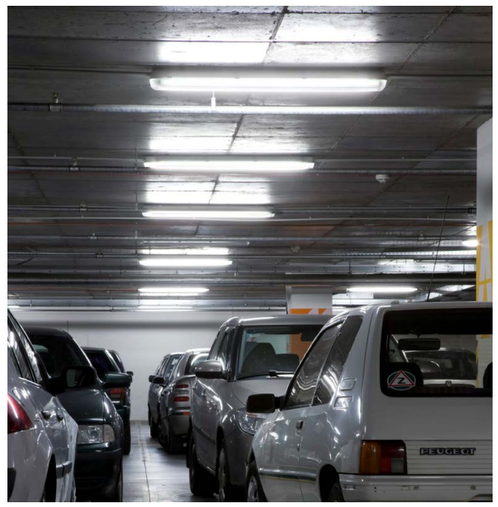
These areas should be illuminated with IP 54 or IP 65-rated pole luminaires that are resistant against damp, pollution and temperature fluctuations. If the driving lanes are not separated from the parking spaces and pedestrian areas, it is advisable to differentiate them with ground-recessed luminaires. A sufficient level of vertical and horizontal illuminance has a positive impact on the spatial orientation of both drivers and pedestrians. Based on the traffic density, the EN 13201-2 standard sets the minimum illuminance level at 5 - 15 lx. Ensuring the compliance of the lighting system with relevant normative requirements can prevent the risk of glare and possible collisions.

Underground car parks

Several criteria need to be taken into account when planning the lighting system of an underground car park. Extra attention needs to be paid to the entrance/exit because this is a place of significant light change, where the eye needs to adapt to changing lighting conditions. While the human eye can easily adapt to the dark-light transition, it needs several seconds to adapt to light-dark transition. To eliminate the risk of accidents during the eye-adaptation process, we need to reduce the brightness intensity of the entrance/exit to the minimum. An optimal solution for these areas uses the installation of several luminaires lessening the brightness level differences between the two areas. A good luminaire choice used for the main illumination of underground garages is vandal-proof luminaires placed on both sides of driving lanes. If you are looking for efficiency, low-maintenance, long lifecycle and low break-down rate, LED luminaires are the right solution offering it all.

Because the underground car park is a space with sporadic presence of people, the energy efficiency of the place can be enhanced by installing a constant illuminance sensor. Presence detectors will scan car movement and turn on luminaires only where necessary. In this respect, the lighting system will not only save on energy and maintenance, but will also guide the driver and help with orientation.





Sufficient illumination enables the distinguishing of faces and timely response to possible aggression.

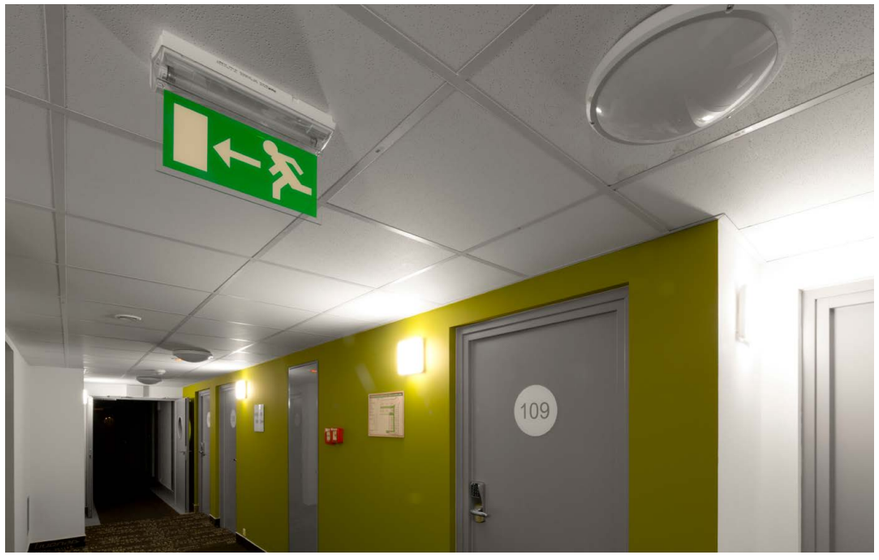
The EN 12464-1standard sets the minimum illuminance level of the entrance/exit to 300 lx and the illuminance uniformity to $U_o = 0.4$ during the daytime.
Nighttime operation requires the minimum illuminance level of 75 lx with $U_o = 0.4$.
The minimum normative illuminance level of underground driving lanes and parking areas is set to 75 lx.
The glare rating of the luminaires used should be no more than UGR = 25 and the light sources should enable the distinguishing of safety colours; which means the colour rendition of the luminaires must be of CRI ≥ 40.

EMERGENCY AND SAFETY LIGHTING

In the spaces with an increased concentration of persons, rooms without any access of the daylight and in the communication zones determined for escape paths the safety and emergency lighting helps to solve collision situations and reduces the risk of injury.

Regardless to the fact if it is a power cut, danger of fire or another crisis situation, the task of the safety and emergency lighting is to ensure the persons basic visibility and orientation during leaving the space or to make their access to the fire extinguishers easier. Correctly planned and carefully maintained emergency lighting can prevent an outbreak of panic, injuries and even save lives. When selecting the type of the emergency lighting the requirement on its long-term lifetime and the ability to fulfil its tasks at good visibility also during the power cut plays the most important role.

The battery pack LED luminaires represent the optimal solution – the producers guarantee here the minimal lifetime of 50,000 hours. In this way the maintenance costs are reduced and compared to other light sources the user can save up to 70 % of the power consumption. The effectiveness of the LED emergency lighting can be increased by installing the additional optics and reflectors which will reduce the number of the LED luminaires when the legal standard is fulfilled. The requirement on the safety and emergency lighting is adapted by the European standard EN 1838.



Correctly planned and carefully maintained emergency lighting can prevent an outbreak of panic, injuries and even save lives.

Definition of emergency lighting
The relevant standards define emergency lighting as lighting that is activated as a result of a malfunction in the general artificial lighting.

Objectives of emergency lighting
- Safe escape from the problem zone on failure of the general power supply (visibility required for evacuation)
- Adequate visibility and orientation along escape routes and in danger zones (illuminated or backlit safety signs along escape routes, direction signs to assist progression towards the emergency exit)
- Easy identification of fire-fighting and safety equipment

1. Safety lighting for escape routes
The safety lighting for escape routes is that part of safety lighting that enables escape facilities to be effectively identified and safely used.

Escape routes up to 2 m in width:	
Illuminance	at least 1 lux along the central axis, 0.5 lux over at least half the width
Uniformity	$E_{max} : E_{min} \leq 40 : 1$ lux
Colour rendering	CRI ≥ 40
Rated service time for escape routes	1 hour
Switch-on delay	50 % of the required illuminance level within 5 seconds, 100 % within 60 seconds

(wider than 2 m can be considered as a group of 2 m wide strip or can provide by lighting as in open area – anti-panic lighting)

2. Anti-panic lighting
Anti-panic lighting is that part of safety lighting that serves to avoid panic and provide illumination to allow people to reach a place where an escape route can be reliably identified.

Illuminance	E *(horizontal at floor level)* ≥ 0.5 lux
(Marginal areas with a width of 0.5 m are not taken into consideration)	
Uniformity	$E_{max} : E_{min} \leq 40 : 1$ lux
Colour rendering	CRI ≥ 40
Rated service time for escape routes	1 hour
Switch-on delay	50 % of the required illuminance level within 5 seconds, 100 % within 60 seconds

3. Hazardous workplaces
There are special requirements that relate to potentially hazardous work processes and situations. Proper shut-down procedures are needed for the safety of operators and all other occupants of the premises, for example in places where machines are running, in laboratories handling hazardous and in control rooms.

Illuminance	E_{min} = 10 % of the level needed for the task or at least > 15 lux
Uniformity	$E_{max} : E_{min} \leq 10 : 1$ lux
Colour rendering	CRI ≥ 40
Rated service time for escape routes	for as long as the hazard persists
Switch-on delay	0.5 seconds

SPECIAL REQUESTS FOR LUMINAIRES IN HOTEL & GASTRO

The luminaires applied in the hotel and gastro spaces are exposed to the influence of the surrounding environment. For the security and safety to be guaranteed at the workplaces in any respect, they have to be resistant against increased strain which is represented in this type of spaces by dust, humidity, water and flammable or explosive materials.

The value IP (International Protection Rating) defined by the international standard IEC and the European standard EN 60529 as well as the value Ex by which the European directive ATEX (Atmosphéres Explosibles) defines the necessary protection level of the luminaire at workplaces with the occurrence of flammable and explosives materials gives the information if the luminaires used fulfil the usage criteria in the concrete manufacturing spaces.

International protection IP

The code IP expresses the protection level of the interior or exterior luminaire against penetrating a foreign body or liquid. The code consists of two numbers IP XY – the first one assesses the protection level against a dangerous contact and penetrating of the foreign bodies (X) and the second one against penetrating water (Y). The luminaires with the minimal value IP 44 are recommended for the exterior usage, in the case of a direct contact with water IP 65. The dust-proof and water-proof luminaires which can be also used under water have the highest possible protection level expressed by the code IP 68.

Explosion-protected luminaires

The usage of flammable and explosive materials in the hotel kitchen requires luminaires resistant against fire or explosions.

Based on the unified classification the individual spaces are divided into zones according to the risk of an explosion occurrence. Each zone is assigned a value of the protection level which the luminaires used for the illumination have to achieve.

Degrees of protection

	1st code numeral (Protection against foreign bodies and contact)	2nd code numeral (Protection against water)
0	Non-protected	Non-protected
1	Protected against solid foreign bodies > 50 mm	Protected against dripping water
2	Protected against solid foreign bodies > 12 mm	Protected against dripping water when 15° titled
3	Protected against solid foreign bodies > 2.5 mm	Protected against spraywater
4	Protected against solid foreign bodies > 1 mm	Protected against splashwater
5	Protected against dust	Protected against jets of water
6	Dustproof	Protected against powerful jets of water
7	–	Protected against temporary immersion
8	–	Protected against prolonged submersion ...m

TEMPERATURE CLASSES

Ignition temperature or auto-ignition temperature (ATI) is the minimum temperature of a surface at which an explosive atmosphere ignites. Flammable vapors and gases can be classified into temperature classes according to their ignition temperature. The maximum temperature of a piece of equipment must always be lower than the ignition temperature of the gas – air mixture or vapor – air mixture in which it is placed. Equipment shall be marked to show the operating temperature or temperature class referenced to a +40 °C (+104 °F) ambient. **The temperature class (T code) is indicated on the manufacturers nameplate** and is based on the table below.

North American Temperature Code	IEC/CENELEC/NEC 505 Temperature Classes	Maximum Temperature °C	Maximum Temperature °F
T1	T1	450	842
T2	T2	300	572
T2A	–	280	536
T2B	–	260	500
T2C	–	230	446
T2D	–	215	419
T3	T3	200	392
T3A	–	180	356
T3B	–	160	329
T3C	–	150	320
T4	T4	130	275
T4A	–	120	248
T5	T5	100	212
T6	T6	85	185

SELECTING
THE RIGHT LIGHT SOURCE

The individual areas in the hotel and gastro spaces have different demand on the illumination. When designing a lighting system the task of the lighting designer is to choose the light sources with the most suitable parameters where besides the procurement price the categories of effectiveness, lifespan and safety are also included.

	Lamp type	power rating from - to (W)	luminous flux from - to (lm)	efficacy (lm/W)	light colour	colour rendering index (CRI) from-to	lifespan from - to	lampholder
	**Incandescent**	30 - 100	300 - 1000	10 - 12	ww	> 90	1000	E27, E14
	**Tungsten halogen**	5 - 116	60 - 2135	12 - 22	ww	> 90	2000	E27, E14, G9, GU10, GZ10
	**Tube-shaped fluorescent FD (T8) Ø 26 mm**	18 - 70	860 - 6200	61 - 93	ww/nw/dw	80 - 96	16,000 - 80,000	G13
	**Tube-shaped fluorescent FDH (T5) Ø 16 mm**	14 - 80	1100 - 7000	67 - 106	ww/nw/dw	80 - 93	24,000 - 45,000	G5
	**Compact fluorescent lamp**	5 - 80	250 - 6500	46 - 95	ww/nw/dw	80 - 90	5000 - 32,000	2G11, 2G7, 2G8–1
	**High pressure metalhalide lamp MT/ME (HIT/HIE)**	35 - 2000	3200 - 240,000	67 - 120	ww/nw/dw	65 - 96	6000 - 15,000	E 27, E 40, PG12-2
	**High pressure sodium lamp ST/STH (HST)**	35 - 1000	3500 - 150,000	74 - 150	ww	20 - 25	12,000 - 32,000	E 27, E 40, PG12-1
	Double ended metalhalide lamp MD/MN (HID)	70 - 2000	5500 - 230,000	73 - 117	ww/nw/dw	65 - 95	4500 - 15,000	RX7s, K12s
	**Double ended high pressure sodium lamp SD (HSD)**	70 - 150	6800 - 15,000	97 - 100	ww	20 - 25	12,000 - 32,000	RX7s
	**LED retrofit**	3 - 7	90 - 800	37 - 70	ww/nw/dw	80 - 90	5000 - 20,000	GU10, E27
	**LED module**	1 - 140	100 - 17,200	90 - 200	ww/nw/dw	70 - 98	50,000 - 100,000	-

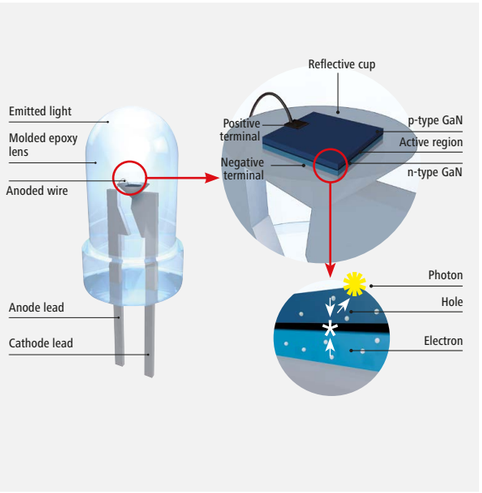
ww = warm white correlated colour temperature (CCT) below 3300 K
nw = neutral white correlated colour temperature (CCT) 3300 K to 5300 K
dw = daylight white correlated colour temperature (CCT) over 5300 K

LED FOR HOTEL AND GASTRO

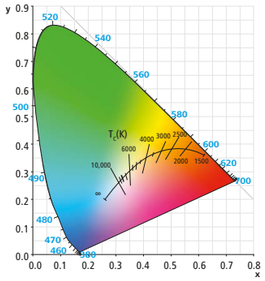
When in 1962 the American professor Nick Holonyak created the prototype of the first "light emitting diode" – LED, his invention remained almost unnoticed. The only one who anticipated its revolutionary future on the pages of the magazine Reader´s Digest was the inventor himself. It lasted almost forty years until the industry revealed all the exceptional properties of the LED and learned how to utilise them. In the lighting industry the LED sources currently represent an area that is developing in the most dynamic way.

In what respect are the LED light sources so exceptional and exceed the properties and parameters of the conventional sources? Why do the architects, developers and users of industrial buildings concentrate more and more frequently on the LED sources when designing the lighting systems? It would be possible to answer in a very simple way: The LED sources are highly effective, they have a long lifespan and an excellent colour rendering, they are cost-effective and environment-friendly. But let us have a look at the individual categories more thoroughly and we will explain why the LED sources represent also for your industrial spaces the best solution.

The LEDs are light sources based on the semi-conductor basis. A very small amount of energy is necessary for emitting the light. The diodes emitting light consist of two types of semi-conductors – the N-type with surplus of electrons and the P-type which has lack of electrons (the so called holes). After connecting the power the excessive electrodes and holes begin to migrate to the PN junction. When they meet the recombination develops and the diode starts emitting photons. By its size that is not larger than a dot made by a pencil the LED ranks among the smallest light sources. The package which is at the same time a lens serves as protection. It enables distributing the luminous flux directly under the angle 15° to 180°. While a common light bulb is able to change into visible light only 5 % and the fluorescent lamp 30 % of the electric power, the LED with its ability to change up to 40 % of the total energy reaches incomparably better parameters in this category. The efficiency of the light source or its efficacy says with what efficiency the electric energy is changed into the light, i.e. how much of luminous flux it produces from. the electric input power (W) delivered to the light source. The unit is lumen per watt (lm/W). While the first white LEDs in 1996 had an efficacy of 0.1 lm/W, today there are commercially available LED chips with an efficacy of 200 lm/W for cool white CCT LED and in the labs there has been achieved an efficacy of up to 303 lm/W.

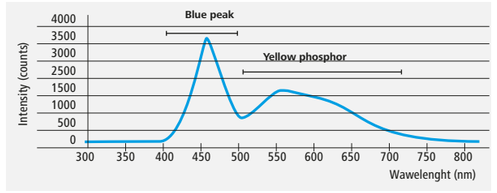


If the LED sources after binning are on the Planck curve, they emit "pure white", i.e. pure white light.



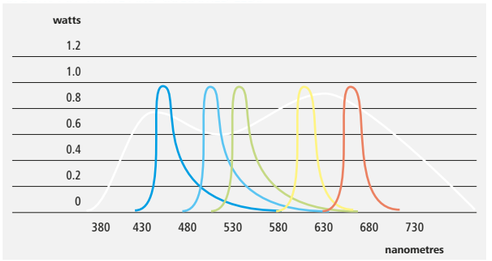
The LED luminaires used in the industrial and production spaces have to fulfil high ergonomic and economic requirements. In the industrial areas they are required to deliver high-quality, glareless lighting for the optimal visual comfort also for the Visual Display Units (VDU) and at the same time they have to fulfil the requirements of the European standards. The LED diodes are primarily the source of the white colour radiation. The white LED light can be acquired by various methods; however, the principle of luminescence is most frequently used for its production. In this method a thin phosphorus layer is applied to the blue LED which, after the switching on of the source, changes part of the blue light which passes it into the white one. This technology of the LED production enables achieving the emission of the white light with various correlated colour temperature from 2700 K to 10,000 K.

Another method making it possible to acquire the white LED light consists of mixing the coloured light of various wavelengths. Through additive mixing the red, green and blue colours (RGB) the white light can arise. The advantage of this method is that besides the white light by targeted mixing we can also acquire coloured light. The disadvantage when acquiring the white light by the RGB technology consists in its demandingness. It requires a lot of know-how because the management of the coloured LED with various values of luminance is demanding and the white light produced often achieves lower values of the colour rendering index CRI 70 - 98. If we consider changes of the correlated colour temperature of the white light when solving the illumination in the industrial spaces, it is suitable to combine the coloured chips with white LEDs. In this way optimal CRI values are obtained.



White light can be produced by combining blue and yellow light only. Sir Isaac Newton discovered this effect when performing colour-matching experiments in early 1700 s.

SPECTRA OF WHITE AND COLOURED LEDS



LEDs do not require colour filters. The colour tone of the light is determined by the semiconductor material used and the dominant wavelength.

COLOURS STRAIGHT FROM THE SEMICONDUCTOR

Colours straight from the semiconductor

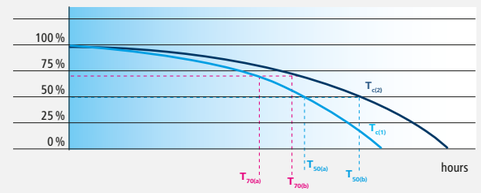
LEDs do not require colour filters: their light comes in different colours produced directly by different semiconductor materials. Secondary colours are also possible. The major semiconductors are:

Semiconductor material	Abbreviation	Colour(s)
Indium gallium nitride	(InGaN)	Blue, Violet
Gallium(III) nitride	(GaN)	Blue, Violet, Ultraviolet
Aluminium gallium indium phosphide	(AlGaInP)	Red, Orange, Yellow, Green
Gallium(III) phosphide	(GaP)	Red, Orange, Yellow, Green
Aluminium gallium phosphide	(AlGaP)	Green
Indium gallium nitride/ Gallium(III) nitride	(InGaN)/(GaN)	Green

The lifespan of the LED sources moves in the values of up to 100,000 hours which represents 22 years for 12-hour-operation daily, 365 days a year.

From the point of view of the lifespan the LED light sources achieve above-average parameters. Their lifespan moves in the values of up to 100,000 hours which represents 22 years for 12-hour-operation daily, 365 days a year. The drop of the light source performance to 70 %, in some cases to 5 % is introduced as the LED lifespan end. It means that the LED failure rate is substantially lower compared to the conventional sources. However, appropriate cooling of the light source is a necessary condition for maintaining the lifespan parameters.

DEFINITION OF LIFESPAN



LEDs do not fail but the intensity of the light they produce diminishes over time. The lifespan (L) of an LED thus needs to be defined for different applications. For emergency lighting, for example, rating up to L80 ore more are required, this means that the LED reaches the end of its service life when the luminous flux falls to 80 percent of the original flux measured. For general lighting, values of L50 or L70 are defined. The lifespan of an LED depends to a large extent on ambient and operating temperature. Where an LED is operated at a high temperature (Tc1) or with poor thermal management, its life is shortened.

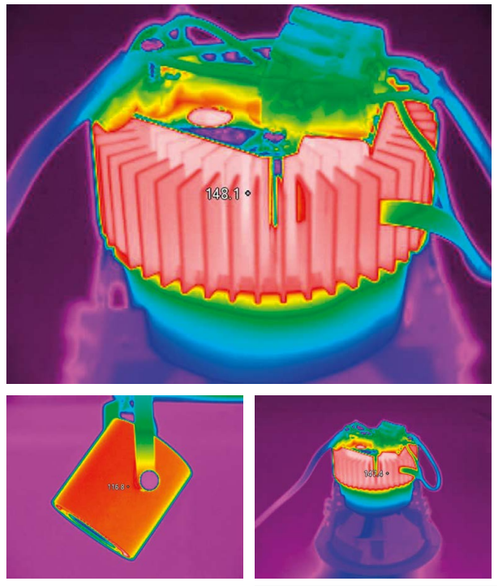
In spite of higher purchase costs the LED sources represent in a longer-term horizon the most effective and economical light solution. The experts estimate that if we replaced all existing light sources for the LED ones today, the energy savings worldwide could reach the amount of 30 %. If we realise that the artificial lighting consumes up to one fifth of the energy produced, this amount is not negligible at all. When we take into account a smaller area illuminated by obsolete conventional sources, we would be able to save up to 75 % of lighting system input power by the controlled LED illumination. All light sources also produce the IR radiation during the change of the electric power into the light which the human organism perceives as heat. However, the LED light sources produce it in a negligible amount compared to the conventional sources and thus they do not increase the inadequate costs for the air-conditioning power consumption. The lifespan and failure rate of the LED sources reduces the lighting system maintenance costs as it does not require any regular interventions of service staff and purchasing new light sources.

The LED source saving potential can be maximised by installing the intelligent lighting management which enables adjusting the radiation intensity of every luminaire in the lighting system automatically in dependence on the availability or intensity of the daylight.

The environment-friendly approach is a topic also for the producer of the light sources today. The reality is that the majority of the conventional light sources cannot be produced without using the toxic heavy metals – lead and mercury. The users of the premises equipped with this type of light sources have an additional burden when they replace them as they are compulsory to remove the used or damaged sources in compliance with the law about disposal of the toxic waste and on the other hand they are exposed to the risk of breathing the toxic vapours when the light source is damaged. In this respect the LED sources represent an incomparably lower risk. Though they contain a small amount of heavy metals, they are in solid state and so there is no danger of breathing in the toxic vapours when the LED source is damaged.

Thermal management

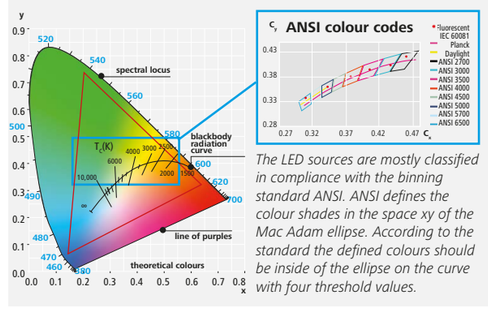
Similarly as in the case of other light sources, the temperature significantly affects the performance of the LED light source. Without any adequate thermal management overheating of the LED source can develop and it reduces its lifespan and the risk of its damage is also increased. Implementing a suitable cooling system we achieve maintaining the declared lifespan of the LED light source and its high efficacy. From this point of view the thermal management represents the most critical factor for the luminaires with the LED source.



Thermal output of DW Prettus and Avior

Binning

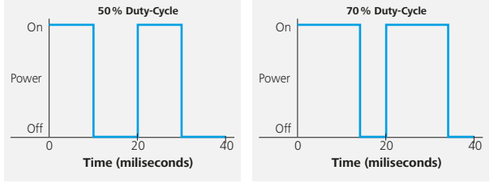
During the industrial production of LEDs deviations of the key parameters arise in the individual batches. In the framework of one batch the parameters are generally the same, but when we compare two various batches, the LEDs differentiate e.g. in colour or the luminous flux. To ensure the constant quality of light with the same level of luminance and colour of the light, it is inevitable to sort out every batch according to the value of individual parameters. This sorting is called binning. The main criteria taken into account when binning are as follows: the luminous flux measured in lumens (lm), the correlated colour temperature measured in Kelvins (K), the forward voltage measured in volts (V). The LED sources are nowadays classified according to the binning standard ANSI. This standard defines the colour shades of LED by the MacAdam ellipses which depicts the colour deviation on the axis X and Y. The MacAdam ellipses shows how the colour of the individual LED modules can differ. The binning standard ANSI recommends for the resulting colours to be inside of the ellipse on the curve with four threshold values. The binning groups of the LED sources which show minimal differences of the values measured will produce the light of the same colour.



The LED sources are mostly classified in compliance with the binning standard ANSI. ANSI defines the colour shades in the space xy of the Mac Adam ellipse. According to the standard the defined colours should be inside of the ellipse on the curve with four threshold values.

PWM control

The Pulse Width Modulation (PWM) represents the most effective method how to check the intensity of the LED light source. The PWM principle is based on periodical switching on and off of the constant current directed to the LED. The resulting intensity of the LED light source is characterised by the ratio between the state of switching on and off. The frequency of switching on and off is adjusted for the human eye to perceive the emitted light as a continuous luminous flux. Its intensity depends on the adjustment of the PWM cycle (0 % to 100 %). The advantage of the impulse width modulation is the maintaining of the constant correlated colour temperature in the whole range of dimming.



Compared with the conventional light sources the LED light sources reach the full luminance immediately. The immediate start of the LED source is a benefit from the point of view of safety and comfort. At the same time compared to the conventional sources, frequent switching on and off does not make any damage to the LED source and does not reduce its lifespan as well.

BASIC TERMS

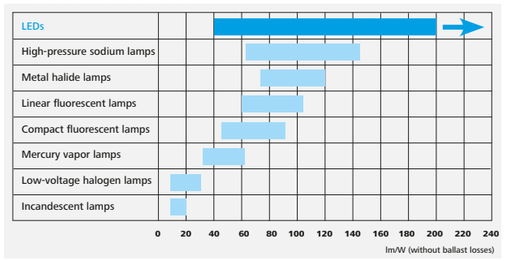
LUMINOUS FLUX (Φ)

The luminous flux is a physical quantity which states how much light in total a light source emits to all directions. It is the radiant power of the light source assessed from the point of view of the human eye sensitivity. The luminous flux expresses the ability of the radiant flux to cause a visual perception. The unit of the luminous flux is lumen (lm).

EFFICACY (η)

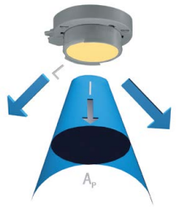
The luminous efficacy states with what efficiency the electric power is changed into the light, i.e. what proportion of the luminous flux is produced from the input power (W) delivered to the light source. The unit is lumen per watt (lm/W).

EFFICACY OF LIGHT SOURCES



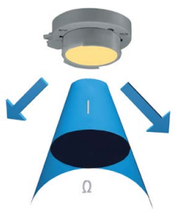
LUMINANCE (L)

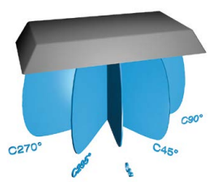
The luminance is the gloss of the shining or illuminated surface as the human eye perceives it. The unit is candela per square metre (cd/m²). This quantity gives the level of the luminous intensity over the specified surface area. The luminance of the illuminated surface depends in a great extent on its reflectance.



LUMINOUS INTENSITY (I)

The luminous intensity is a physical quantity which states what volume of the luminous flux the light source (or luminaire) emits to the elementary solid angle in the direction evaluated. The unit of the luminous intensity is candela (cd).

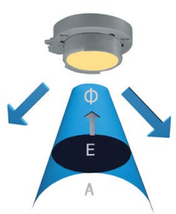




intensity distribution curve

ILLUMINANCE (E)

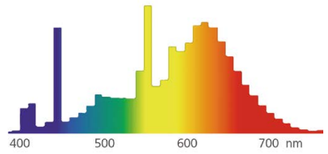
Illuminance is a vector quantity which states what amount of the luminous flux falls to the illuminated surface. The unit of the illuminance is lux (lx).



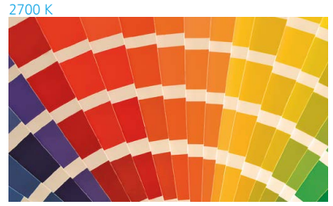
GLARE (UGR)

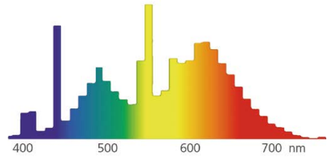
If too great luminance occurs in the field of vision of the eye, its differences or the spatial or time contrasts which exceed the vision adaptability, the glare arises. During the glare the activity of the visual system is deteriorated.

CORRELATED COLOUR TEMPERATURE (CCT)

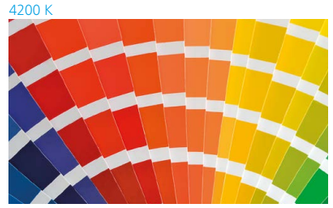


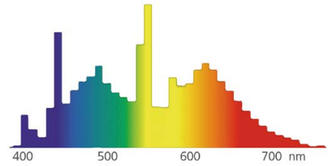
2700 K



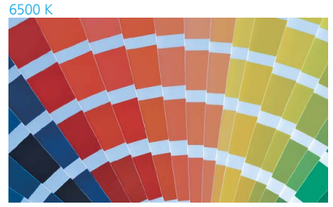


4200 K



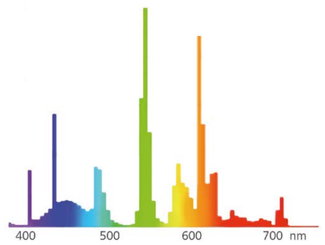


6500 K

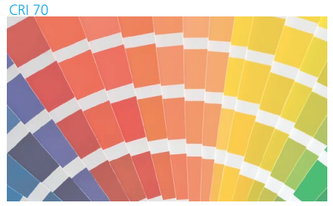


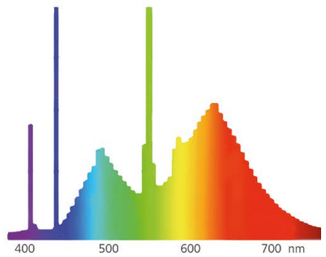
The correlated colour temperature of the light source determines the atmosphere in the room. It is defined by the correlated colour temperature of the light source expressed in kelvins (K). Low temperatures create a warm light, the high ones the cooler ones. The most used light colours are the warm white (below 3300 K), the neutral white (3300 to 5300 K) and the day white colour (over 5300 K). The warm white colour is predominantly used for emphasising the red and yellow colour. The blue and green colours become apparent at higher temperatures.

COLOUR RENDERING INDEX (CRI)



CRI 70

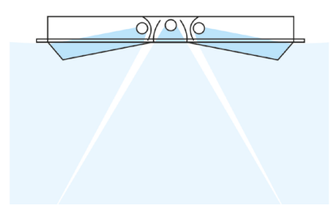




CRI 95

The properties of light source colour rendering are given in the levels of the general index of colour rendering – Ra. The CRI gives the rate of the congruence of the object surface's real colour illuminated by the considered light source under stated conditions of comparison. The smaller this difference is, the better the property of the colour rendering of the given source is. The light source with Ra = 100 renders all colours completely equally as a standard light source. The lower the index Ra is, the worse the colour rendering is.

LIGHT OUTPUT RATIO (LOR)



The Light Output Ratio is the ratio of the luminous flux coming out of the luminaire and the sum of the luminous fluxes from all light sources.