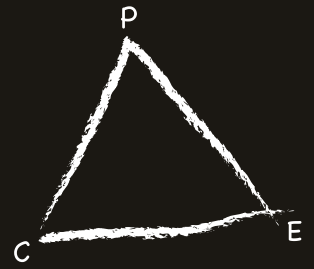


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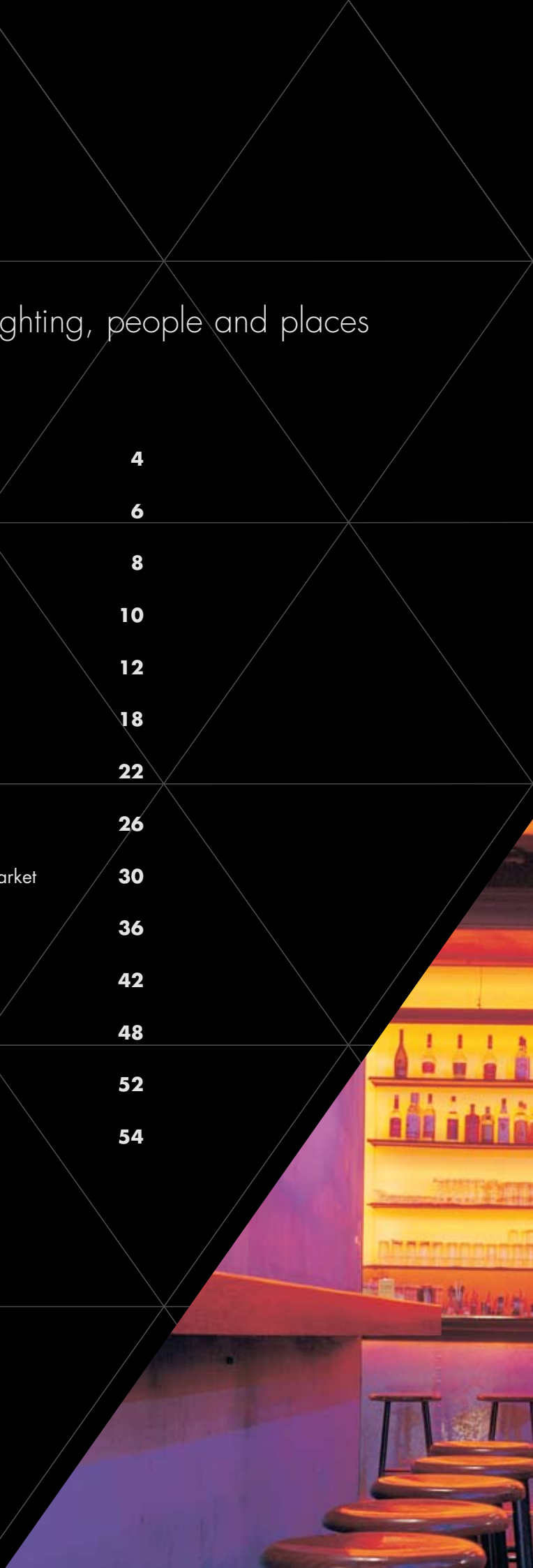
Performance, Efficiency and Comfort



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The framework for lighting, people and places

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PEC

Delivering better lighting, better efficiency, and a better environment, sustainably.

PEC – Performance, Efficiency, Comfort – is the dynamic, results-orientated programme that underpins the Thorn approach to lighting design and implementation. PEC reconciles the need for low direct and environmental costs with the need to deliver workplace and public lighting that promotes efficiency, safety, a healthy environment and productivity. With statutory and environmental pressures increasing, PEC offers Thorn customers the ability to provide optimum lighting solutions for people and places while conserving energy, cash and raw materials.

Getting the priorities right

PEC enables Thorn to use standard lighting components to create tailor-made and environmentally sensitive lighting that addresses the unique needs of every site, user and application. The programme is based on the principle that Performance, Efficiency and Comfort determine the effectiveness of lighting, its impact on the people using it, and its impact on the natural environment. Because no two projects and locations are the same, each requires a different balance between the three components.

A flexible tool

PEC enables customers to break free from the constraints of traditional lighting design. In the office, for example, it enables employers to create an employee-centric environment that can be implemented cost-effectively to deliver the benefits of higher morale and productivity, reduced absenteeism and improved staff retention. PEC works equally flexibly in any lighting application, from a small office or schoolroom to a major office development, road or football pitch. Each time, the balance between the three components of PEC will be different, while the underlying concept ensures a consistent, high-quality and cost-effective outcome.

Performance and efficiency criteria can be quantified and the solutions engineered to conform to requirements or recommended targets. Comfort criteria are subjective and influenced by psychology of lighting and the solutions are prepared to design rules and creative experience.

At the heart of PEC is the company's Design Philosophy. Design includes the need for the luminaires, whether switched on or not, to have a perfect appearance and architectural integration. The philosophy also embraces scheme presentation and the quality of information provided.

PEC can equally be applied to products, for the luminaire plays an important role in providing the right light on the right place at the right time.

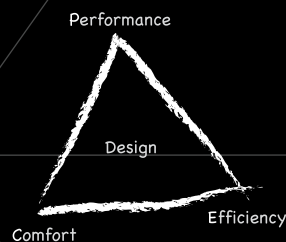
Real benefits

The best way to appreciate and evaluate PEC is to see it in action. This brochure illustrates the benefits of the programme and the viable, reliable, economic and sustainable results it delivers.

PEC application areas

PEC is an integral element of the Thorn approach to:

- Office lighting
- Education lighting
- Industry lighting
- Healthcare lighting
- Supermarket and Hypermarket lighting
- Road and Tunnel lighting
- Urban lighting
- Sports lighting





Performance

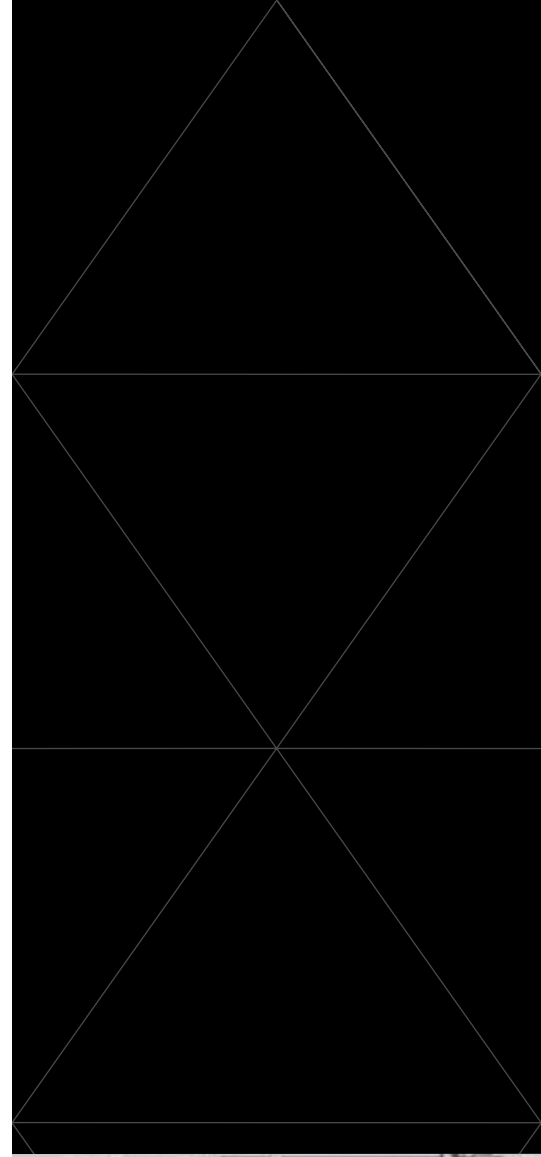
Delivering the required visual effectiveness.

The 'Performance' component of PEC addresses the ability of designers and users to define the desired visual effectiveness of a project and to measure the performance of the completed installation.

As part of the PEC programme Performance may be the lead priority or one of the supporting variables, depending on the profile of each project. It helps planners to determine optimum levels of visual conditions for effective performance. Once these parameters are established, the best choice of luminaire, technology and location can be established.

In a typical project Performance delivers productivity improvements in areas such as:

- task visibility – reveals task details in the required directions
- contrast – well discriminating, enhances detection, reveals shadows and texture
- modelling – enhances human features and reveals patterns in objects
- colour – shows more information and coloured details
- glare free – limits unwanted brightness or bright images in the field of view







Efficiency

Delivering optimum lighting performance with the best use of energy and minimal stray emissions.

The 'Efficiency' component of PEC addresses the efficient use of energy in all its forms as well as broader concerns such as sustainability and the quality of the built and natural environments.

It applies throughout the supply chain, from the manufacture of Thorn luminaires and controls to their deployment on site. For example, an application that reduces direct energy consumption may nevertheless fail to satisfy the demands of this PEC component if stray light is emitted into surrounding neighbourhoods. Ease of installation, control and maintenance is also fundamental to this aspect of the programme.

The general relationship between energy effectiveness and cost effectiveness requires lighting installations to use energy efficiently. Therefore both existing installations and proposed designs need to be appraised in a manner which determines energy effectiveness. Many countries now have their own energy-efficiency standards, regulations and ordinances. Indeed all EU member states have incorporated the Energy

Performance of Buildings (EPB) directive. A common lighting performance indicator is given in the proposed new European Standard prEN 15193 entitled "Energy performance of buildings – energy requirements for lighting", being the consumption in kilowatt hours per square metre per annum (Lighting Energy Numeric Indicator or LENI). This measure will be recorded within the building's energy certificate.

In a typical project Efficiency takes into account issues such as:

- Effective – sustainable and economic factors, including whole life costs
- Efficient – the optimum use of energy thereby reducing CO² emissions and the elimination of obtrusive light and waste
- Managed – provides controllable, with the ability to vary light levels; lighting linked to daylight and occupancy
- Practical – is easy to install, service and maintain



Comfort

Providing satisfaction and stimulation in every lighting application, exterior and interior.

The 'Comfort' component of PEC addresses the physiological and psychological needs of people in places. It is a more subconscious factor relating to the ability to give people satisfaction and stimulation in all areas such as the workplace, town centre or leisure facility.

An application where Comfort is given its full weight is likely to see benefits beyond physical lighting. Visitors and occupants can experience heightened levels of concentration and creativity as well as general satisfaction and a feeling of safety. Health issues arising from seasonal changes in natural light may also benefit while, in outdoor applications, the emotional impact of dramatic lighting can be highly stimulating and rewarding.

In a typical project, attention to Comfort is likely to see benefits such as:

- Atmosphere – setting the right tone of the lit area or space
- Stimulation – inspiring creativity and activity
- Satisfaction – improving productivity and fulfilling user expectations
- Safe – providing an assured environment which meets regulations, even in an emergency
- Health – awake, aroused, circadian cycle driven light
- Ambience – welcoming light that is easily adapted to the brightness pattern
- Ergonomic – stress free and accommodating (including transition zones for exteriors)
- Interest – variable with variety of visual patterns
- Flow of light – creating 'feel of light' movement
- Colourful – a natural appearance and balanced colours
- Relaxing – effective glare free light with glitter and sparkle
- Integrated – improved aesthetics meeting architectural expectations by night and day





Office

Improving the working conditions of the office environment for employers, employees and the local community.

The application of PEC to office lighting enables design solutions to be developed that improve efficiency and comfort at work. With PEC, lighting schemes can be created that give staff the ability to process paper-based and computer-based tasks more comfortably, promote effective personal communications, and provide a safer working environment.

Good lighting design with PEC goes beyond adherence to the lighting requirements of National and European health and safety legislation. Comfortable, safe working conditions have been shown to minimise health risks, repetitive strain injury, stress and eye fatigue. They can also reduce the incidence of clerical and administrative errors.

PEC enables designers to focus on all the relevant personal and environmental factors that affect employees, thereby promoting reduced absenteeism, lower levels of staff turnover, increased productivity and lower costs.

PEC profile – Performance

- *Task visibility.* For an office situation illuminance should be established to ensure adequate revealing capability, typically reading a document on a desktop.
- *Contrast.* Contrast is desirable for well discriminating lighting that enhances detection
- *Glare free.* Lighting designs should eliminate unwanted stray light in order to ensure no reduction in the effectiveness of the illuminance. A high CRF (Contrast Rendering Factor) figure is desirable.
- *Colour.* Good colour rendering lamps enhance both performance and visual clarity (The Ra should not be less than 80).
- *Modelling.* Improving eye to eye and face to face communication.

Efficiency

- *Effective.* With the lighting systems' capital cost needing to be balanced against the operating costs, it is important to adopt a life cycle costing approach.
- *Energy utilisation.* The essential need here is for efficient and effective luminance that provides the right light when required.

- *Managed.* Modern control systems offer daylight linking, absence detection and light blend control.
- *Practical.* The lighting system must be easy to install and maintain, with attention to the replacement of failed lamps, rectifying equipment faults and cleaning surfaces.

Comfort

- *Atmosphere.* The lighting must help to create the right appearance, atmosphere and sense of comfort. An attractively lit office gives people a greater sense of welfare and they are likely to perform better through greater satisfaction and stimulation. Research has shown that people prefer a space to appear 'Visually Light' and 'Visually Interesting'.
- *Health.* Algorithmic variations in illuminance and colour temperature of the light employed impacts on the perception of a space and wellness.

- *Ambience.* In addition to providing sufficient light for tasks to be carried out, the occupants must also feel that there is enough light. In basic terms, the higher the average level of surround illuminance, the brighter the room will appear.
- *Relaxing.* The avoidance of glare is important to achieve a lively interior, good visual comfort and fatigue free working.
- *Ergonomic arrangements.* The lighting system must be designed to suit the needs of the users and the tasks performed.
- *Flicker.* A high percentage of office workers may experience some degree of discomfort resulting from flicker. This can be avoided by operating the lamps at high frequency. It has the added advantage of improving energy efficiency.
- *Integrated.* The lighting solution provides the aesthetics and architectural appearance expected. Emergency lighting will be required in most parts of an office and can be integrated with the general lighting.



Transforming the office environment

If you want to know what the building of tomorrow will look like, then The Royal Bank of Scotland's (RBS) Gogarburn campus, outside Edinburgh is a good place to start. This distinctive two-storey building, with six 'business houses' arranged around a central 280m internal street, houses world-class office accommodation for 3,250 of the bank's staff and was required as the bank has been growing so strongly. Outstanding lighting feature of the scheme is the use of chilled beam luminaires.

Performance

With chilled technology putting space pressure on the size of the luminaires, specially designed fluorescent units employing 1 x 35W T16 lamps and low brightness louvres were neatly mounted continuously along both sides of the chilled beams. The lighting, which is in constant use within the open plan offices, is pleasantly subdued with no glare and is engineered to provide a uniform light spread across the bespoke barrel ceiling, which provides the scheme with its most striking interior motif. The design objectives were fully met in terms of good vertical and horizontal illuminance with very good colour discrimination (class 1B). The harmonious, glare-free lighting system, imperative for VDU operation, has a good CRF for visibility of detail within tasks. The flow of light created through the windows enhances the modelling of the space while the indirect/direct artificial light within supports good facial modelling.

Efficiency

Efficient lighting was a requirement of RBS in its aim to provide a first class working environment and the building has been awarded a coveted UK 'BREEAM' (Building Research Establishment Environmental Assessment Method) excellent rating for energy efficiency. A lighting control system leads to further economies. Flying leads and plugs were used for easy installation on site.

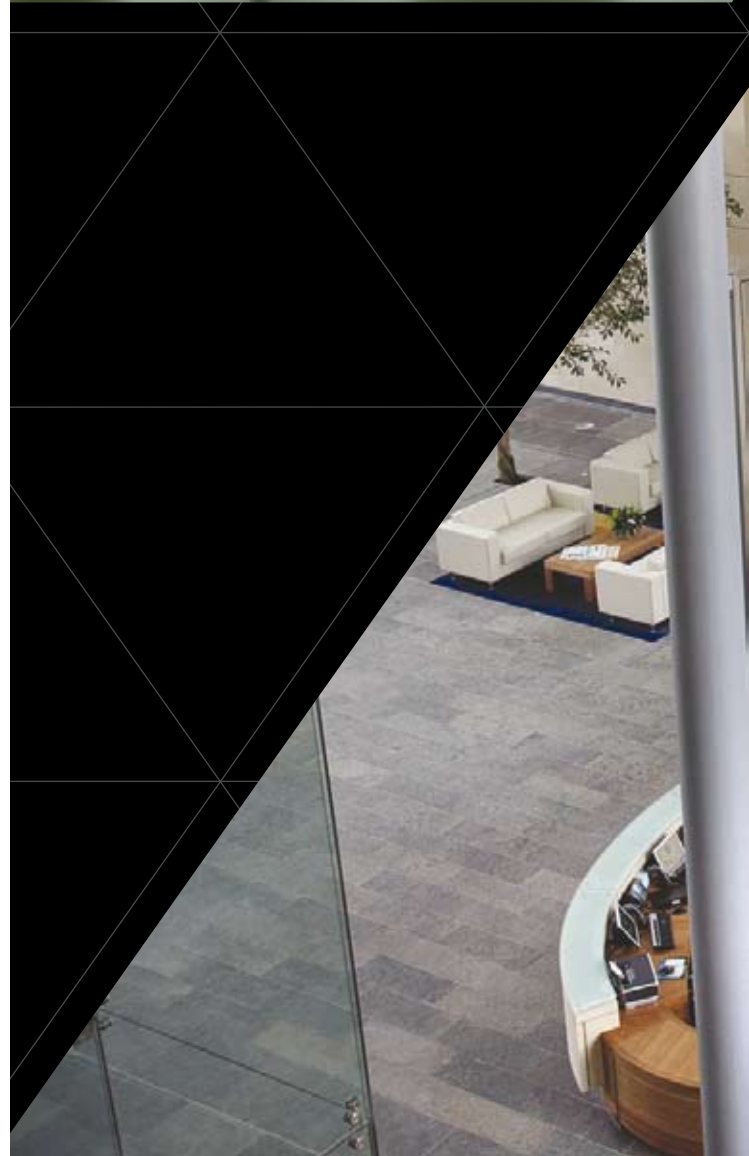
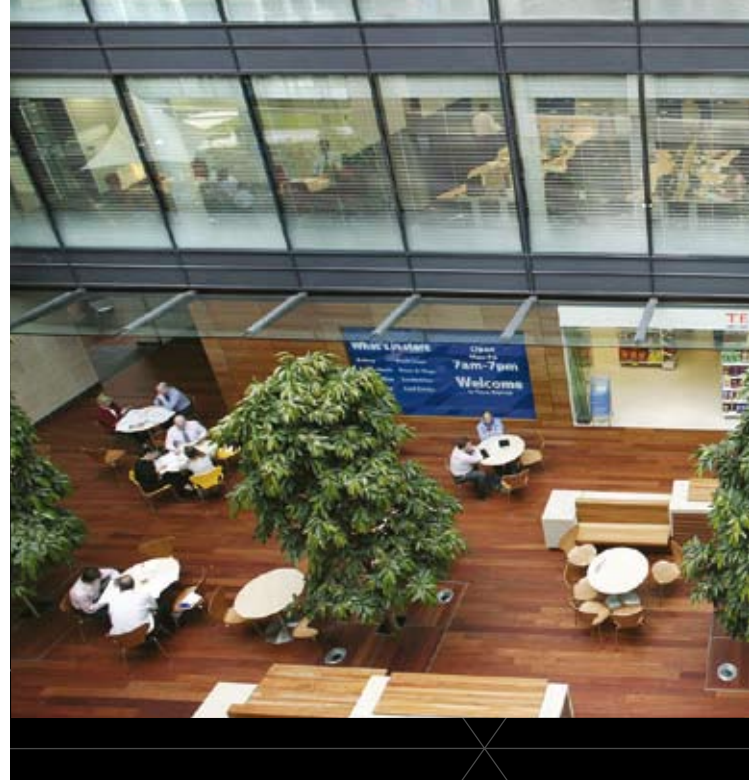
Comfort

The chilled beam lighting balances up, side and down lighting to illuminate the task, walls and ceiling, thus creating visual interest in the wider space. The result is a more uplifting and stimulating atmosphere which can increase comfort and satisfaction and even reduce absenteeism. The use of T16 lamps yields a number of benefits, mainly the complete absence of flicker, and hence discomfort, headaches and eye strain.

Design

The luminaires integrate with the ceiling beam giving a tidy appearance to the offices.

Scheme Associates: Scotland's biggest office development was designed by Michael Laird Associates and engineering design was undertaken by WSP working in partnership with project and construction manager MACE Ltd. Trox were responsible for the chilled beams.





Communication and colour for banking headquarters

The recently opened Westpac Place in Sydney is one of the most modern corporate headquarters in Australia – not least in its main lighting. More than 8,500 recessed fluorescent luminaires illuminate the 53 floors of themed office areas, providing a refreshing environment for the Westpac Banking Corporation's 5,000 employees. The building has been designed to bring about a change in office culture by creating a more interactive working environment. Fixed office concepts have been replaced by adopting a dynamic 'city within a city' approach. Strong markers, such as light, colour, textiles, furniture and graphical numbering denote work and circulation areas, promote social interaction and encourage informal meetings.

Performance

High quality control of the light distribution was required to ensure good viewing conditions. The CAD designed modular luminaires provide a high light output with low glare at 2.7m spacings. Using T16 lamps to achieve excellent colour rendering with an LOR of 77 per cent, the scheme achieves excellent visual performance. Its high-contrast rendering (CRF) also minimises unwanted reflections – perfect for use with PCs.

Efficiency

In order to meet high environmental standards the compact luminaires had to be cost effective. The computer designed optical system, optimised for the T16 lamp, takes efficiency to a new level. Furthermore, all luminaires incorporate high frequency dimmable ballasts, and are controlled by lighting controls.

Comfort

Good visual effectiveness helps people to concentrate better and work more effectively. The high Ra lamps combine low lumen depreciation with flicker free high frequency control gear to give good light quality and good colour appearance enhancing face-to-face communication. The distributed light output enhances the colour patterns.

Design

The luminaires are made as small as possible, limiting intrusion into the office while creating a comfortable working environment.

Scheme Associates: The building architect was Johnson, Pilton, Walker, and for tenancy fitout, the interior design architects were Geyer Design and Hassall. Electrical consultants and lighting designers were Webb Australia and installation was undertaken by Slowe Australia. Photographer: Tyrone Branigan.



MenloSoft SR

With a single luminaire type, MenloSoft SR solves the problem of lighting display screen areas while meeting recommendations for ceiling and wall illuminance ratio. The semi-recessed modular fluorescent has a suspended optic, designed to deliver an efficient light output with excellent glare control. The slim butterfly-shaped optic has either a central aluminium louvre or diffuser and can house lamps of different colour temperatures.

Performance

A LOR of over 60 per cent. Direct/indirect light output gives good task illuminance

14W or 24W T16 lamps ensures very good colour rendition

The batwing distribution ensures good illumination of task and people, enhancing faces and even video conferencing, plus improving CRF

Efficiency

Innovative optics, optimised for T16 lamps reduces energy use

MiniSensa versions give integrated light/presence control

45 luminaire lumens/circuit watt saves on energy use

Comfort

The upward light component provides surround illuminance

A dual lamp colour temperature option enables light to be adjusted to the changes of the day. It has the potential to impact on human circadian (24-hour) rhythms which can be maintained enabling occupants to stay more alert during the day

High frequency gear gives flicker free light

A choice of louvre/diffuser ensures glare free light

Semi-recessed, with air-handling capabilities makes for good architectural integration



Healthcare

Improving the caring environment for patients, medical staff and the community.

The application of PEC to hospital and healthcare lighting helps managers to create lit environments within which their staff can deliver high quality, safe patient treatment in a caring, friendly and efficient way.

Hospitals and healthcare buildings are complex because of the diverse activities that take place within and around them, yet the PEC programme enables lighting schemes to be provided for them all. The lighting provided can satisfy the requirements of both the patient and the nursing staff throughout the day and night delivering improved health outcomes. The PEC programme ensures that lighting can address all the issues related to performance, efficiency, health and comfort.

PEC profile – Performance

- *Task visibility.* Good task illuminance enables medical workers to perform their tasks and activities without visual discomfort, using either task, localised or general lighting. Although many tasks take place on the horizontal plane, many have a vertical component as well, such as wall-mounted equipment and life support machines. Many patients find it difficult to cope with extreme variations of light. Therefore uniformity of illuminance is important, as is sensible diversity between adjoining areas if the task requirements differ. The building or environment should be designed in such a way that all people, including those with special lighting needs or visual impairment, can move around as independently and freely as they would like.
- *Contrast and Modelling.* Care should be taken to ensure that contrast and modelling caters for close human contact. Likewise shadows caused by natural or electric lighting must not give rise to concerns, such as optical illusions.
- *Colour rendering.* Lighting should enable clinical quality colour judgements to be made. Lamps should have a minimum of Ra 80, consistent throughout the whole area, department or hospital complex.
- *Glare free.* Glare can be a problem, especially to patients with impaired vision. The adoption of good lighting practise that gives due consideration to disability glare is always warranted.

Efficiency

- *Effective.* Energy costs need to be taken into account at an early stage so that they can be kept at an acceptable level. The initial choice of lighting should be made with low long-term operating costs in mind.
- *Efficient and Managed.* Since hospitals function for 24 hours a day, 7 days a week, it is recommended that high efficacy lighting techniques are employed together with lighting controls. To maximise lighting energy efficiency the designer should optimise the use of available natural daylight.
- *Practical.* In hospitals luminaires have to meet high standards of hygiene and safety. In particular they should have the minimum area on which dust may settle and be easy to clean. Noise is an important consideration and fluorescent lamp luminaires should employ high frequency electronic control gear. Also regular maintenance is required - people can be seriously compromised by being in a premises where lights do not work!

Comfort

- *Satisfaction and stimulation.* Good lighting has a vital part to play in creating an atmosphere that is sympathetic and stimulating towards recovery.
- *Ambience.* The atmosphere created by the lighting varies according to the parties concerned. For those patients in the operating theatre a clinical atmosphere is vital. For members of the public in residential homes the aim is to provide a homely, caring appearance. The co-ordination of interior decor and lighting can create areas suitable for recovery and relaxation. Where appropriate the lighting should be controlled by dimming or switching so that the illuminance can be adjusted to meet individual needs.
- *Safe.* Emergency lighting will be required in most parts of a hospital or healthcare building. Standby lighting will be required in some areas to enable essential activities to be carried out during an emergency.
- *Colourful.* Colour temperature should be 4000K unless it is specified for specific applications.
- *Integrated.* Lighting equipment should be selected to harmonise with the overall architectural concept.



Healthy lighting

Designed by the architects PLOT, the new psychiatric hospital in Elsinore (Helsingør), Denmark breaks with tradition, both in its architecture and lighting

In terms of function, the star shaped building is divided in two main areas: a ground floor for living and an upper level, which connects with the existing hospital, for treatment. All the various parts of the building merge together in the centre of the structure. The use of long corridors and open communal rooms meets the need for supervision without the patients being made to feel watched and shut in, whilst the lighting supports the needs of all occupants.

Performance

The luminaires achieve even lighting with good colour rendering, creating a bright, safe environment for the patients and staff. The patients' apartments have special functionality and safety requirements. For instance built-in LED wall lights at skirting board level function as night-lights.

Efficiency

To maximise lighting energy efficiency the architect has optimised the use of available daylight. The living area is landscaped into the hospital grounds ensuring that there are green views from all the 48 single rooms. All linear fluorescent luminaires employed in the corridors, offices, treatment rooms and central area use advanced optics with T16 lamps to achieve low energy. The LED lights consume even less power and have a long operational life – ideal for the long burning hours. A lighting control system operates.

Comfort

For architectural integration the architect chose oblong fittings for the whole upper floor, which is characterised by numerous corridors in various directions. These provide direction and follow the building's movements. They are also adapted for exterior use - standing upright, they function as a unique cross between park lighting and low bollards and make a strong link between the internal and external environments. On the lower floor, classic glass fittings are used to focus on the directionless and openness of the large rooms. The discreet LED's help the patients feel secure. Overall, the lighting echoes the efforts of the architecture to create a modern, functional hospital that radiates anything but a sterile hospital atmosphere



Invincible II

The most appealing feature of the Invincible II range of modular sealed luminaires is its low frame profile and lack of external fasteners, which makes it delightfully easy to clean. It has an IP65 protection classification (IP54 from above) and a "self regulating breather" which prevents any air and moisture ingress in and around the seals.

Performance

A choice of louvre or prismatic diffuser ensures accurate lighting control

IP65 (below) / IP54 (above) protection

A choice of fluorescent lamp type provides very good colour rendition

Glare-free output eliminates distracting reflections on equipment, such as monitors

Efficiency

The range caters for T16 (14-54W) or TC-L (40-55W) lamps and is available with integrated emergency or digital dimmable gear. The combination of sophisticated optics and high efficacy light sources saves on energy use.

Maintenance is quick and easy thanks to the front frame's internal locking mechanism that is simply opened by a suction cup

Easy to wipe clean smooth, aluminium frame

Comfort

Promotes a clean environment

The optic design gives glare free light while the use of high frequency gear produces flicker free light

A sleek recessed profile makes the luminaire inconspicuous within the ceiling



Education

Improving the learning experience for children, parents, teachers and the public interest.

The application of PEC to lighting in the educational world enables authorities to create lit environments within which students and staff can carry out their activities easily and comfortably, in attractive and stimulating surroundings.

PEC enables architects and school managers to create an optimum lighting installation using an integrated design approach. This holistic approach considers all lighting requirements and objectives across the school, as well as the different solutions that may be available.

As part of this process, PEC provides a structure which enables planners to consider all requirements and constraints. The end result is the best possible solution that addresses daily operational needs as well as budgetary constraints. The PEC programme is flexible and modular, enabling the process to be varied according to the management style of the sponsoring authority and the culture of the school.

PEC profile Performance

- *Task visibility.* Task illuminance enables users to perform tasks and activities, including detailed work, without visual discomfort, using task lighting, localised lighting or general lighting.
- *Contrast.* The laws of luminance contrast (between a

task detail and its background) are important in lighting engineering for an object or task to be resolved and distinguished.

- *Modelling.* Moderately strong modelling is desirable for formal communication; weaker modelling for informal or close contact.
- *Colour rendering.* Lighting should enable accurate colour judgements to be made, especially in art, science and craft subjects. Lamps should have a minimum Ra of 80.
- *Glare free.* The experience of over-bright light sources, often linked with excessive contrast, can lead to disability glare occurring. Screen based tasks are a good example, where without attention an increase in ambient light levels can cause disability glare and thus reduce visual performance.

Efficiency

- *Effective.* Energy costs need to be taken into account at the design stage so that they can be kept at an acceptable level. The initial choice of lighting should be made with low long-term operating costs in mind. This is particularly important to a school or college as the people paying for the installation often differs from those paying for the operational costs.
- *Efficient.* Educational buildings need to be designed so that energy is used efficiently

and effectively. This reduces primary energy use as well as CO₂ emissions from power stations.

- *Managed.* With suitable controls lighting can be used only when it is required, giving significant savings in energy consumption. The intelligent positioning of switches may encourage more frequent switch-off of equipment. Extensive use of natural lighting can provide considerable energy savings, and Thorn's lighting controls can integrate blind control.
- *Practical.* Physically luminaires need to be robust, not easily damaged and easy to maintain.

Comfort

- *Satisfaction and stimulation.* An attractively lit interior will give people a greater sense of well-being and they are likely to perform better through greater satisfaction and stimulation. For instance by treating an art or music room as more than just another classroom the lighting can contribute to providing an inspiring atmosphere.
- *Ambience.* The illumination of all structural surfaces is important and it is not always sufficient just to provide adequate illuminance on the working plane. The appearance of vertical surfaces contribute to an overall ambience for students and staff. This is particularly

relevant to entrance halls, reception and circulation areas. Dimming may be a useful facility to set different moods for the day and evening.

- *Safe.* Emergency lighting will be required in most parts of an educational building.
- *Interest.* To create visual interest it is necessary for the light pattern to have some illuminance variation which creates attractive areas of light and shade.
- *Colourful.* Different lamps create different interiors. Systems that deliver tones close to daylight give better colour accuracy but may seem 'cool', while other choices can create a more 'homely' effect.
- *Integrated.* Lighting equipment should be selected to harmonise with the architectural concept.



An educated choice

Egå Gymnasium secondary school in Denmark, has been designed to bring about a change in learning culture by placing greater emphasis on individual study and project work. An outstanding feature of the building is its large circular atrium – Denmark's largest skylight – known as the Forum or common room. A basic idea behind the building design is that each room should have several functions, each supported by appropriate lighting.

This demanding set of requirements was addressed using a variety of solutions. In the Forum, for example, general lighting is provided by large suspended pendants, augmented by dimmable recessed wall lights (Mica S) and linear T5 luminaires to create social and teaching zones within it.

Performance

The versatile and flexible lighting design combines task illuminance with good uniformity. It ensures the right amount of light for each student and task, across the full range of school activities.

Efficiency

Great use is made of glass, natural daylight and simple but effective controls over lighting. Classroom illumination can easily be adapted to any activity, avoiding over-lighting and saving energy. Overall consumption is reported at 6W per square metre.

Comfort

Lighting can influence concentration, mood and interaction. When a class works in groups, teachers can select a neutral working light; when a film is to be

shown, teachers can dim it.

The solution caters not only for standard teaching aids such as black/white boards, but also for student laptops and smart boards.

Design

Throughout the school, luminaires are adapted to the design of each space, while the lighting pattern accentuates the architecture, often combining circular and square shapes. Thus, the sports hall, with its rough and rustic ambience, incorporates unpainted luminaires, while lighting in the rectangular classrooms is via square recessed modules with round diffusers.



Optus IV

Whether surface or suspended, the Optus IV linear fluorescent brings a visually striking, ultra-modern design feature to educational and commercial premises. Its slender body, with concave profile, can complement modern surroundings to a far greater degree than standard fluorescents. Lighting performance, too, is impressive and includes an asymmetric whiteboard option for classrooms.

Performance

An LOR of 0.71 per cent. The up and down light output gives good task illuminance

T16 lamps ensure very good colour rendition

The batwing distribution models faces and improves CRF

A choice of specular or semi-specular louvre ensures glare free light

Efficiency

The optical system with twin 28W, 35W or 49W T16 lamps gives high light output for minimal energy consumption

Integrated digital dimmable (DSI) versions available

MiniSensa versions give light/presence control

Comfort

The upward light component provides surround illuminance

High frequency gear gives flicker free light

The suspended pendant design is an ideal ergonomic arrangement as the balanced indirect/direct light maximises productivity by reducing student and staff fatigue and discomfort



Industry

Improving productivity and safety in production, treatment, manufacture, distribution and transport.

The application of PEC to industrial lighting helps managers to ensure quick and accurate work, to promote the safety of employees, and to create a good visual environment. By helping designers to develop environments which maintain high levels of operation with fewer errors and incidents, PEC can help businesses to stay more competitive and profitable.

Industrial tasks are many and varied, and PEC enables lighting schemes to be developed for them all. Although many operations take place on a production floor, some may have a vertical component as well as a horizontal one, and some applications may involve the use of dangerous substances.

That is why illuminance on the task is the main criterion used for industrial and technology lighting, whether it applies to part of a workshop or a complete factory floor or transport terminal. Although achieving this can be complicated by the presence of large pieces of machinery, overhead lines conveyers, cranes and pipework, PEC enables designers to evolve flexible and cost-effective layouts that address all issues related to performance, productivity, health and safety.

PEC profile Performance

- *Task visibility.* The main criterion for industrial lighting. It is common for tasks to occur on different planes, not just the horizontal and the space will benefit from greater lighting uniformity on the task. Care is required to deal with possible shadows from obstructions.
- *Contrast.* It is important to manage the difference between the amount of light falling on the shadow and brightly lit areas of the subject.
- *Modelling.* The direction of lighting is important for the lighting of areas such as container parks or industrial storage sites. The revealing power of the light is essential to ensure visibility of texture and finishes of the materials being handled.
- *Colour.* When people are required to make accurate colour judgements, appropriate light sources can be installed as required, for the complete installation or for areas such as inspection booths. For accurate colour judgements lamps of colour rendering index 90 should be used.
- *Glare free.* Attempts should be made to eliminate disability glare and not to exceed the limiting glare index for lighting installations.

Efficiency

- *Effective.* Through life costing is a key ingredient. The latest technology coupled with efficient design, will do much to strike the balance between capital and running costs over time.
- *Efficient.* Typically long burning hours places the emphasis on energy efficient equipment and controls.
- *Managed.* A lighting control system must be designed and managed to permit good control of energy use and provide flexibility of use.
- *Practical.* Ease of access for routine maintenance should always be considered when designing an installation. Lamp replacement intervals, lamp and luminaire cleaning intervals and room surface cleaning intervals should also be considered. Excessive heat, cold, vibration or a corrosive atmosphere can cause damage to the lighting system. In such conditions, lighting equipment has to be selected with great care. For all industries, a hazard exists if people have to evacuate the building in darkness. Emergency lighting should be provided to allow people to safely and quickly leave the building.

Comfort

- *Atmosphere.* The way in which an industrial space is illuminated can affect its character and the appearance of objects within it.
- *Satisfaction.* Good industrial lighting enables quick and accurate work thus fulfilling user expectations.
- *Safe.* Quite clearly in hostile and hazardous areas, the feeling of safety must never be ignored or mitigated.
- *Health.* Stroboscopic effects can cause considerable discomfort and possibly danger. They can be eliminated by specifying high frequency lighting.



Speeding the containers

Few container ports are as big as Port 2000 at Le Havre, France. In Europe's largest construction project for 30 years, this facility aims to double its container trade with Asia and North America. As part of the project, Thorn was asked to develop a lighting scheme that provided high levels of safety and security while minimising stray light.

The solution was based on 200 Champion floodlights fitted with 1kW high-pressure sodium lamps. This installation has banished the night, giving clear, even illumination over the 4.2km long quayside and 500m wide container yard.

Performance

Operators of the giant quayside gantry cranes report no disturbing glare and the required lighting levels are met with reasonable colour rendering and avoid shadows and obstructions from the containers.

Efficiency

The optical design of the floodlights, optimised for high pressure sodium lamps reduces energy costs and minimises the number of floodlights required. The site, at the mouth of the Seine, is of particular environmental significance and obtrusive light has been kept to a minimum thanks to the use of low-glare asymmetrical optics.

Comfort

The Port 2000 installation creates an excellent ambience - a workplace that feels 'friendly' as well as optimising safety, security and productivity. The lighting blends with its surrounds with virtually no obtrusive light. It has been well received by managers and employees.

Design

The floods are installed on high masts to avoid multiple columns, reduce clutter and enhance the useful space.



Concavia

Designed for high bay applications the Concavia range is suitable for everything from retail and commercial premises to specialist heavy industrial buildings. It combines the unique aesthetics required for stores and malls with the robust construction necessary for production areas and warehouses. The range consists of three different sized families of luminaires – 'S' small, 'L' large and 'XL' extra large. A number of features offer choice and flexibility, including a wide variety of lamp types and wattages, various housings, reflectors, suspension kits and attachments.

Performance

An LOR up to 95 per cent with a choice of distribution that gives good task illuminance.

A choice of compact fluorescents and metal halide lamps ensures excellent colour rendition

The batwing distribution ensures good glare control, uniformity of horizontal and vertical illuminance and wide spacing of luminaires. Versatility is enhanced by direct/indirect reflector options.

The IP65 protection is ideal for tough industrial surroundings

Efficiency

A wide array of possible light sources, from 42W compact fluorescents to 1kW high pressure sodium, guarantees less energy

High lumen per circuit watt packages use less energy

The induction lamp option with a long service lifetime (60,000 hours) is ideal for applications where maintenance is very difficult or costly.

The high IP rating versions extend the long maintenance cycles

Consistent tool-free installation and assembly

Comfort

Upward light component on certain reflectors provides surround illuminance

Choice of striking reflectors maintains a good architectural integration

Elegant style and co-ordinated sizes blend well with traditional and modern classic buildings



Supermarket and Hypermarket

Improving the amenity benefit of the retail environment for customers, owners and the community.

The application of PEC to retail lighting helps designers and operators to attract the customer, initiate the purchase and complete the sale. PEC enables managers to create the right appearance for the store and its products while enhancing the merchandising process to ensure a comfortable atmosphere for customers.

Retail lighting can have a strong influence on the selling of goods and services. Guided by the principles of PEC, it is possible for designers to create lighting that gives a distinctive visual presentation of product quality, customer service and a store's customer target group. A careful balance between ambient and accent techniques can then attract customers into the store and even encourage them to spend.

Appropriate lighting can draw the casual pedestrian's attention to a store. Once inside, lighting can be used to create 'islands' of visual interest that draw shoppers into the environment.

Because buying decisions start when the customer is visibly intrigued by the product, lighting must ensure that reading a label or browsing through a magazine is made effortless and natural. PEC ensures that lighting can support all stages of the buying process, enabling retailers to provide focal points of interest within the store and to present all items in an attractive way that stimulates sales.

PEC profile – Performance

- *Task visibility.* Directional lighting reveals form and texture and tends to increase the contrast of displayed objects by forming shadows. It can direct attention to certain key areas and displays.
- *Modelling.* Good lighting not only makes the merchandise look interesting, revealing its form or texture, but helps shoppers to identify other people and makes sales assistants appear more welcoming.
- *Contrast.* To be visible to the purchaser every item of merchandise must differ sufficiently in brightness from its background.
- *Colour.* When you consider how important colour is in merchandising using lighting which destroys the effect is a poor economy. Attention to colour rendering brings out the best in the merchandise.
- *Glare free.* Excessively bright areas in view in a store can, separately or together, impair visual performance.

Efficiency

- *Effective.* At a time of rising energy costs, systems must be chosen to reduce the total cost of ownership through life.
- *Efficient.* Low energy lighting can reduce electricity bills by being more efficient, especially with the long trading hours involved. Lighting should be sensitive to today's green issues.

- *Managed.* Suitable lighting controls giving significant savings in energy consumption should be installed. Also control provides flexibility of use for the occupants and for the store owner.
- *Practical.* Systems must be quick to install and chosen to deliver optimum performance over extended maintenance and cleaning cycles.

Comfort

- *Ambience.* The lighting must make the store look interesting and inviting. Good lighting can subconsciously direct people within the store, improving the utilisation of space and the time that people spend there.
- *Atmosphere.* The lighting must seem warm and friendly, not cold and harsh. It sets the image of the establishment and creates the right atmosphere for the selling process.
- *Interest.* With good lighting the shopping experience should be pleasant and interesting, encouraging future visits, rather than unpleasant or bland.
- *Stimulation, satisfaction and health.* Good lighting stimulates interest and alertness, thus increasing sales impact considerably and even stimulating 'impulse' buying.
- *Ergonomic.* The lighting should be accommodating and stress free.
- *Relaxing.* It must be easy for the visitor to feel relaxed and adapt easily to the lighting level. A lively interior encourages longer shopping.

- *Flow of light.* The directional qualities of the luminaires employed plays an important role, from the punch of light from a spotlight to the drift of light from a fluorescent.
- *Colourful.* The choice of lighting appearance can be varied, from warm to cool, within a store. The actual choice is dependant upon the type of merchandise being displayed, from where it will be seen, and the times of day when trade must occur.
- *Design.* Lighting can help create or reinforce corporate image whilst delivering a non-domineering appearance that reflects the architectural intention



Supermarket gets full marks for variety

In the modern retail market, customers demand increasing variety and stimulation. The Morgan Family's new IGA supermarket in the suburb of Delahey, Melbourne, Australia provides an excellent example of the way in which lighting can create a dynamic atmosphere. The solution complements different zones and types of merchandise within the store, helping to make shopping a pleasure rather than a chore.

Performance

The lighting matches the locations and types of merchandise, making shopping a pleasure rather than a chore. Retail areas now rarely use horizontal counters – merchandise is displayed in vertical fashion and the illuminance on vertical surfaces is increasingly important. Subtle fluorescent lighting in grocery aisles with low brightness louvres and symmetrical reflectors gives high horizontal and vertical illuminance levels, avoiding the glare normally associated with traditional supermarket luminaires. Colour quality is high.

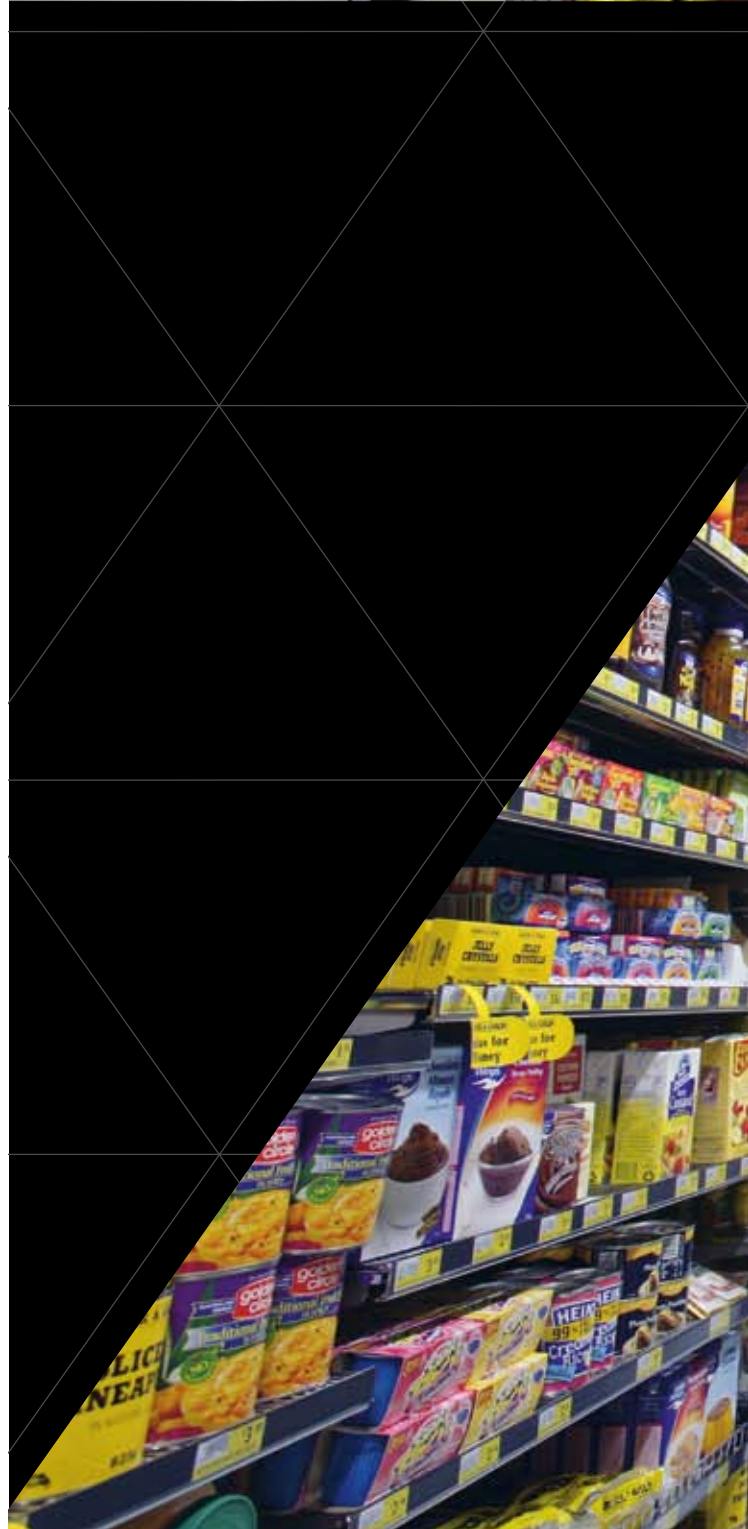
Efficiency

Single lamp fluorescents achieve 1.64kW per aisle against the 2kW target – an 18 per cent saving. The scheme meets the energy requirements under the new Building Code of Australia regulation.

Comfort

Overall the lighting concept humanises the shopping experience and achieves greater delineation between sales areas. The sales areas feel open and spacious for customers selecting their goods and the check-out areas make them feel relaxed and welcome when paying and talking with IGA staff. It also shows the supermarket to its best advantage as a clean, well-lit store.

Scheme associates: The lighting designer was Peter Shaw of IGA Distribution's Retail Development Department and the installing electrical contractor was KLN Electrical.





Selling in a better light

The renovation of Dixon's tax-free electronics store at Birmingham airport in the UK – with its strong focus on digital technology – sets new standards of excellence in retail lighting.

Powerful Concavia S pendants deliver low-level ambient lighting, enabling alternative light sources to provide supplementary lighting to greatest effect. Primata trunking is used to light the aisles both horizontally and vertically, drawing attention to displays of merchandise.

Performance

The scheme creates glare-free white light with good colour rendering, enabling shoppers to feel comfortable and secure when natural light is insufficient. Lighting has made the store inviting from the outside, attracting visitors. Once inside, their attention is drawn to the merchandise and directed towards items the retailer wishes to promote, stimulating 'impulse' buying.

Efficiency

The use of fluorescents and 150W metal halide pendants, which achieve over 60 luminaire-lumens/circuit Watt, greatly reduce electricity bills.

Comfort

Dixon's uses the physical appearance of the luminaires as well as the quality of light to take the shopper on a journey through the store, improving the utilisation of space and extending time people remain involved. The overall effect is stimulating and attractive, with careful use of different luminaires to maintain a safe, 'human scale' environment. The sequencing of the linear trunking fittings 'pulls' visitors along the brightly-lit aisles. As well as improving turnover, the lighting improves working conditions to ensure that staff experience less visual fatigue at the end of the day.



Primata II

The Primata II pre-wired trunking system features a simple, tool-free, 'snap-on and turn' mounting system that provides instant electrical connection. Another 'plus' is the wide array of luminaires, optics and accessories – including asymmetric distributions for shelf illumination. The ability to include track and spotlights offers additional scope for display lighting. Angle connectors and modules integrating presence detectors widen applications even further. The continuous row lighting system is available in modular lengths for surface mounting or suspension by wires or chains.

Performance

An LOR up to 95 per cent gives a wide choice of distributions for optimum task illumination

Fluorescent light source ensures very good colour rendition (Ra over 80)

Asymmetric distribution for precise direction of light for shelf lighting or wall-washing and conventional distributions for area lighting

Flexibility is enhanced with the ability to integrate spotlights and the system can easily be adapted to changing space layouts

Efficiency

Computer designed optics, optimised for T16 and T26 lamps saves on energy use

Electronic, dimmable control gear gives good light control and less energy

Integrated presence detector provides simple energy control

A choice of wiring configurations is provided with up to 9 poles for mains power supply, dimming and emergency operation. This offers reduced maintenance and increased user friendliness

Comfort

The wide choice of optics provides the right combination of glare control, direct lighting and indirect distribution to create a comfortable and productive environment

High frequency gear gives flicker free light

A choice of louvre ensures glare free light for customer comfort



Roads and Tunnel

Improving the safety and usability of roads for motorists, pedestrians and residents.

The application of PEC to road lighting helps designers and authorities to ensure that all features of the road and traffic that are important to all users, including pedestrians, are illuminated.

Road lighting is now an integral part of road safety planning through its ability to contribute to a reduction in the number of night-time accidents. According to cost-benefit analyses carried out in the UK at urban sites, the savings resulting from accident reductions offset the costs of improving and maintaining lighting.

The use of PEC in creating a road lighting design enables safety to be enhanced while also contributing to the prevention and detection of crime. Some statistics suggest that enhanced lighting can reduce the incidence of crime by as much as 41 percent. As a valuable by-product of such investment, residents report that they feel more secure in areas that are well lit. Consideration of the effective lighting of the whole visual scene at night is highly desirable for many reasons. In civic centres, main streets and boulevards and other places that are the hub of a city or town, coherent road lighting is highly desirable.

For drivers, PEC helps authorities to ensure that motorists can easily absorb sufficient visual information to proceed safely at a reasonable speed, see the route ahead, respond to signs and manoeuvre in good time.

PEC also caters for tunnel lighting. Here the major concern arises not by night, but by day, as drivers approach the tunnel mouth from bright daylight. There has to be sufficient lighting in

the entrance (called the threshold zone) to ensure that drivers have adequate visibility into the tunnel before they enter it. Upon entry driver's eyes will adapt, and so beyond the threshold zone, the lighting level is reduced in stages (transition zones) to a minimum 'daytime' level in the tunnel interior. On emerging from a tunnel into daylight, however, the eye adapts far more quickly to the higher luminance level.

PEC profile Performance

- *Task Visibility.* In most lighting the aim is to light objects of interest rather than their background, in road lighting it is the other way round. For road lighting the road surface and the immediate surrounds are lit, against which objects will generally appear in silhouette. To be visually satisfactory the value and uniformity of road luminance should be in accordance with given recommendations. These recommended average luminances ensure that the road is sufficiently bright to reveal objects adequately.

For residential and subsidiary roads the purpose of the lighting is to enable pedestrians to orientate themselves and detect vehicles and other hazards and to deter crime against people and property. The lighting on the roads is to provide guidance for drivers but may be insufficient for revealing objects on the road without the use of headlights. The lighting design method is based upon providing a recommended illuminance rather than luminance.

- *Contrast.* For a driver to detect the presence of an object it has

to present sufficient contrast against its background. This is true by both day and night, but at night the driver's ability to perceive contrast is considerably poorer at lower lighting levels. The requirement here is to make the general scene as bright as possible and to maximise the contrast between objects and their background.

- *Modelling.* Road lighting must have the ability to reveal solid form.
- *Colour.* Lamps require satisfactory colour rendering properties. Lighting users are now exploiting the benefits of metal halide.
- *Glare Free.* The presence of glare will cause disability and discomfort and it is important that this is restricted in the lighting of the roads. Attention, therefore, must be paid to the intensity of the light directed towards the driver's eyes by the lanterns and the angles at which they are seen.

Efficiency

- *Effective.* The economics of road lighting is complex. There are many parameters involved including capital costs, installation costs, maintenance costs and energy costs.
- *Efficient.* Poorly designed and installed road lighting may lead to needless pollution of the environment, contribute to global warming and other ecological problems.

In these cases the light distribution should be controlled to minimise light spill on adjoining areas.

- *Managed.* Modern lighting controls offer a full spectrum of control and monitoring features

which enable authorities to go beyond simple compliance with applicable standards by adapting light specifically to respond to different traffic situations.

- *Practical.* Maintenance programmes should include lamp replacement, luminaire cleaning and fault clearance. A maintenance factor for the lantern can be estimated by using its IP rating and assuming or knowing the pollution category and cleaning interval. Reliability is paramount as the consequences of traffic congestions are costly.

Comfort

- *Atmosphere and ambience.* Much can be done to ensure that the lighting directly helps to create a pleasant and attractive after dark atmosphere, especially for areas of civic importance and amenity.
- *Satisfaction.* Lighting designs can be created that improve the experience of a locality for both drivers and pedestrians.
- *Safe.* Good lighting improves traffic safety for motorists and surroundings are often required to be lit to ensure that pedestrians, on the pavement are seen against the road and any buildings.
- *Colourful.* The type of light source selected used will affect the appearance of the road lighting.



Light in the fast lane

The 1767m long Pont d'Aquitaine suspension bridge in Bordeaux carries the A630 motorway over the Garonne, linking France to southwest Europe. It has been relit with 180 custom lanterns specially equipped with twin optics. Decorative illumination is achieved from blue LEDs fitted to the structural columns.

Performance

The high performance lantern satisfies the required European lighting standard (EN13201) and delivers the desired levels of uniformity. The double Optibloc® system is engineered to improve visibility and reduce glare. Additionally, both lamps can be powered simultaneously in poor weather conditions, such as mist and fog.

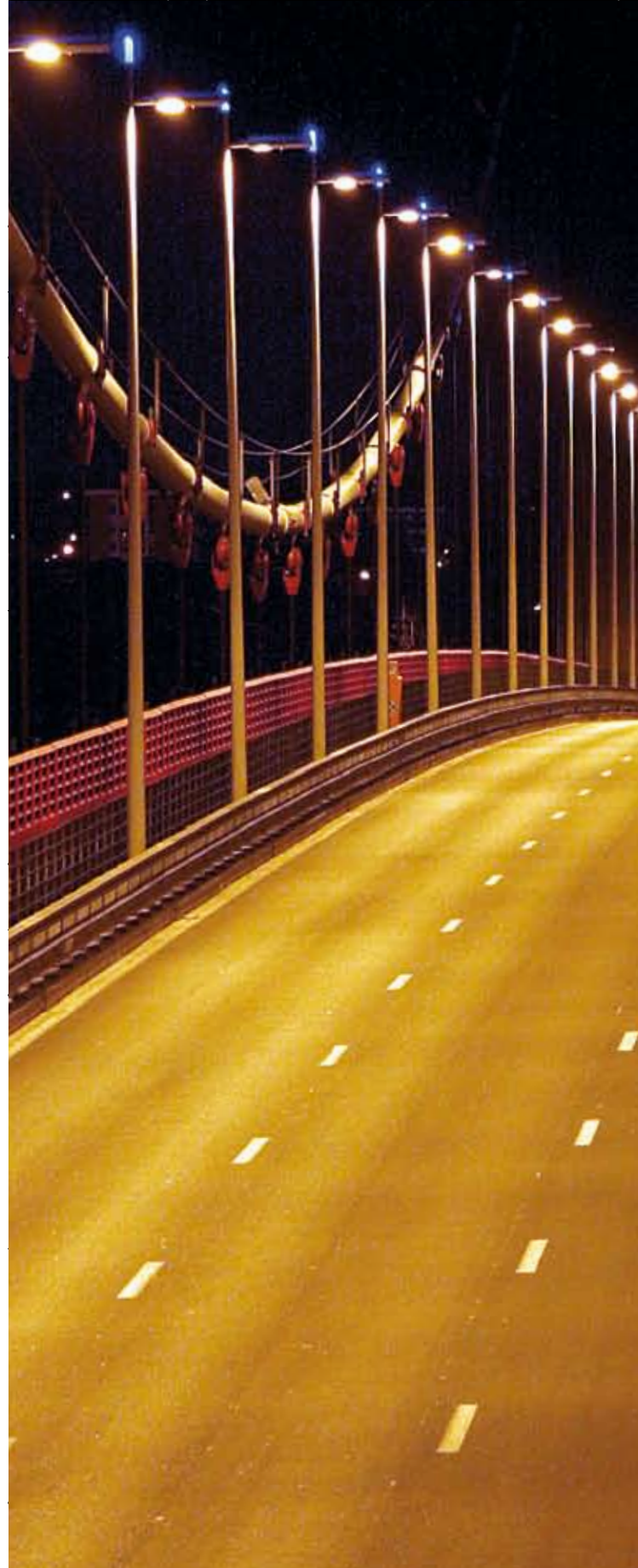
Efficiency

Low energy usage is assured through a combination of 150W and 100W high pressure sodium lamps with electronic ballasts. The lamps combine energy efficiency with high output levels and long service life to give a low overall cost of ownership. The twin optic with lighting control allows the operator

to reduce maintenance visits by 50 per cent. The flat glass optic, with strict cut-off, ensures no upward light and the use of aluminium permits efficient re-cycling after many years of operation.

Comfort

Excellent driving conditions and a welcoming, calming atmosphere of safety are provided by the even, glare-free illumination. The blue LEDs provide motorists with a visual reference point, making route confirmation easier, easing stress.





Performance driven

The Allegheny Mountain Tunnel, which carries the busy Pennsylvania Turnpike across the eastern United States, has recently been relit. This toll road is divided into two bores which serve eastbound and westbound Interstate traffic.

Performance

A total of 1,426 twin lamp Gotthard luminaires (150/70W) are deployed along 1.85km of tunnel. Lighting at entry and exit points is provided by 400W high-pressure sodium lamps. The lighting enables traffic to flow through the tunnel with the same speed and degree of safety as on the approach road.

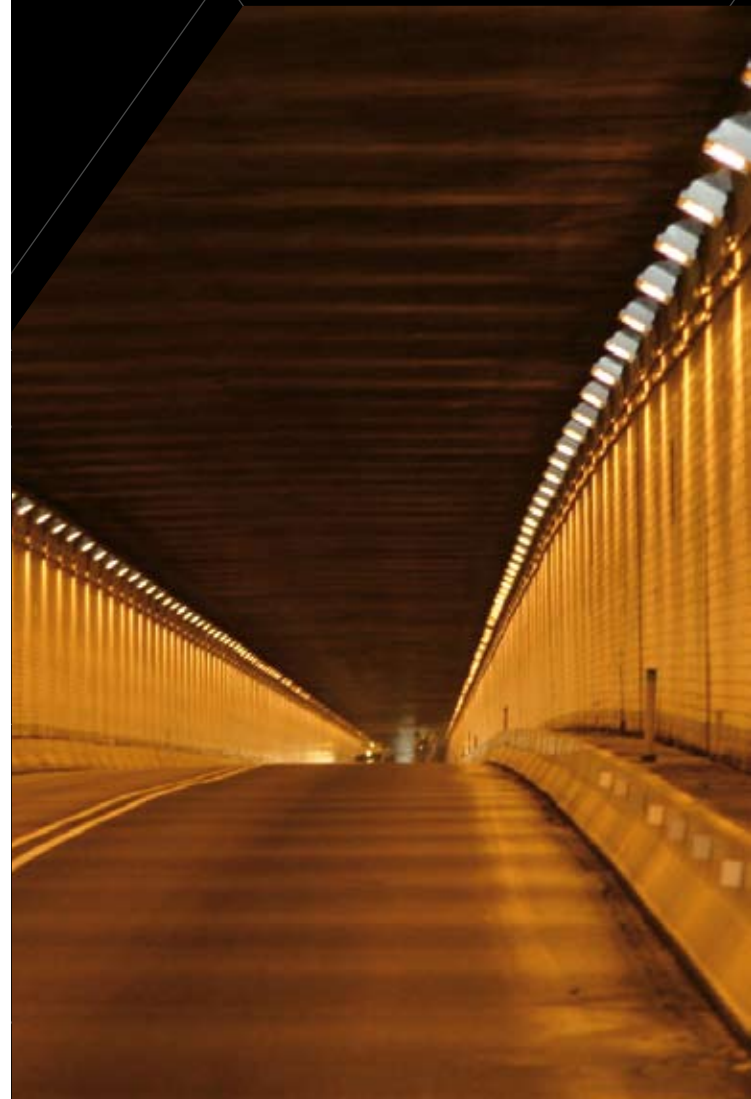
Efficiency

All luminaires employ low-energy high pressure sodium lamps, controlled by a Square D system, to minimise energy consumption. Closure for maintenance purposes will be considerably reduced due to the highly sealed, robust nature of the luminaires. Housings are specially anodised to give an extremely durable, corrosion resistant and long-lasting aluminium oxide finish. Contractors will welcome the quick release stainless steel front clips for easy access and the removable, custom made, gear

tray. An outstanding feature of the scheme was that no closure of the twin-bore tunnel in regular driving hours occurred during installation.

Comfort

The critical issue in lighting road tunnels is the need to provide adequate 'transitional' lighting at entry and exit points during the day. This enables drivers to adjust to the in-tunnel environment. At Allegheny, the necessary in-tunnel and transitional luminance was calculated by determining the brightness of the surroundings to the tunnel entrance. As a result, motorists enjoy good visibility and comfort during day and night.



*Scheme Associates.
Designed for the PA Turnpike Commission by engineers from Professional Systems
Engineering and installed by electrical contractors Lighthouse Electric. Supplied by
North Star Lighting, Thorn's US agent.*

Oracle

Few aluminium road lanterns combine contemporary styling with such an advanced performance as Oracle. It's all down to precision optics. There is a choice of light distributions. With a hinged canopy and an aerodynamic shape in two sizes, Oracle features a post-top or side entry body.



Performance

Lamp positions are tuned for optimum performance for specific road types and arrangements.

A choice of three road optics: Access, Wide or Comfort improves visibility. The latter optic designed for CEN/EN13201 maximises comfort by meeting all disability glare (TI) constraints.

The availability of metal halide and CosmoPolis lamps addresses colour rendering considerations and supports the trend towards white light.

Efficiency

Twenty five different fluorescent and HID lamp options, from 42 to 600W means less energy

Photocells - Nema socket or minicells, provide simple lighting control

Electronic control gear gives the benefits of less energy and longer life

Dimming features also minimise energy consumption and include the Telea lighting control system

Compact optics result in improved spacings, which means reduced lighting points compared with traditional products. Wide and Comfort versions have a double IP66-protected optical system (OPTIBLOC®) for reduced maintenance.

The aluminium body is ideal for recyclability and the lantern complies with RoHS requirements

The body caters for expansions and future innovations in light sources and associated controls.

The efficient optical systems deliver control of upward light and light spill beyond the highway boundary.

Self cleaning glass due to photocatalyst treatment.

Comfort

Good ambient illumination means no fatigue for motorists.

The optic design gives glare free light. Obtrusive light emission is minimised.

Telea lighting controls can provide remote management for maintenance and event dependent settings.

A sleek, smooth profile makes the lantern inconspicuous by day, minimising visual intrusion, whilst the column, bracket and lantern can be integrated within a towns or cities lighting design strategy.

Urban

Improving the perception of urban life for individuals, for culture and for business.

The application of PEC to lighting in the urban environment enables local authorities to create an attractive nightscape that makes places safer to live in and more attractive for visitors, business people, residents and shoppers.

The reasons for lighting the urban environment vary according to the interest group concerned. For members of the public, safety, security and easy navigation will come high on the list. For retailers, attracting shoppers and demarcating showrooms will be important. For civic authorities, other issues may include a strategy for economic and social development, promoting tourism or merely improving safety in parks and other open spaces.

PEC enables all issues to be given appropriate weight so that a balanced set of integrated solutions can be implemented. The programme enables authorities to highlight important historical and architectural buildings while deploying appropriate lighting to reduce crime, support CCTV and improve a sense of personal security. PEC also enables schemes to be devised that avoid waste or spill light, thus ensuring the best possible energy efficiency and a smaller environmental footprint. By applying PEC a comprehensive and controlled night time statement can be made to the benefit of all.

PEC profile Performance

- *Task Visibility.* Visual co-ordination is also important to improve the balance between individual lighting installations in terms of colour and brightness in relation to surroundings, background and subject importance.
- *Modelling.* In an urban scene it is the highlights and shadows that gives 'life' and achieve modelling, these are created by the direction (a function of the geometry of the installation) and the intensity of light. Modelling also depends upon the position of the viewer, so the direction of view needs to be assessed.
- *Colour.* The colour rendering chosen should be suited to the purpose. For instance colour finishes may need revealing or vandals and criminals recognised.
- *Glare free.* Excessive disability glare can arise in amenity lighting if careful consideration is not given to the luminaire's optical performance. Glare will be reduced if the luminaires are located further away from the normal eye-line. Glare will also be reduced if the surround brightness is increased.

Efficiency

- *Effective.* At a time of rising energy costs, systems must be chosen to reduce the total cost of ownership.
- *Efficient.* With long burning hours the efficient use of energy for urban lighting provision is of key importance. Well designed luminaires and lighting schemes can

substantially reduce the levels of wasted light without compromising the important role which lighting plays in improving the urban night time environment.

- *Managed.* Today's outdoor lighting control systems provides the ability for users to enjoy the benefits of flexibility, security, monitoring and simplicity.
- *Practical.* Systems must be chosen to deliver optimum performance over extended maintenance and cleaning cycles.

Comfort

- *Ambience.* The way we perceive our night-time surroundings is very much dependent upon how they are lit. Lighting can generate feelings of invitation and warmth, intimacy or spaciousness, or even excitement and drama. Each district has its own individual identity or character. Lighting can reveal and enhance this by emphasising a particular style of architecture or planning.
- *Atmosphere.* This adds pleasantness to an area. It serves the needs of the pedestrian but goes beyond purely functional lighting. It should reveal the footpath as well as providing sufficient light for other pedestrians to be seen clearly. This will ensure the area gives a feeling of security. The scale of the lighting should also be at a human level and not create a confining impression.
- *Stimulation and satisfaction.* The urban light spectacle is a way of extending our

enjoyment of sports and leisure facilities providing entertainment, amusement and recreation.

- *Safe.* Lighting makes for safe movement of traffic, shoppers and pedestrians. It vanquishes the twilight areas of our open spaces. It also creates a feeling of well being for residents in their own living area. Lighting is a powerful deterrent to night-time crime. It protects people and property and significantly reduces the fear of crime. Good lighting attracts visitors to an area increasing economic prosperity and reducing levels of crime.
- *Ergonomic.* Lighting of pedestrian areas and landmarks (such as churches and bridges) can help us find our way in an unfamiliar area at night by improving the overall visual scene and reducing visual confusion.
- *Colourful.* Distinct colours of light can be used to create aesthetically pleasing effects. Architectural features such as facades, bridges, statues and parks can benefit greatly from the use of colour.
- *Integrated.* Consideration should be given to visual co-ordination in terms of the equipment style/appearance, column types and mounting heights to the benefit of daytime and after dark appearance.



Streets ahead

The town of Benevento, in southern Italy, has at its centre the historical street, Corso Garibaldi, which has recently been revitalized for the benefit of locals and tourists alike. The solution is an excellent example of how urban lighting can be environmentally friendly and create a great atmosphere. A total of 138 Decostreet Size 1 lanterns with round body and bowls, each with a 70W metal halide lamp, have been installed on custom made, four metre high, columns. Each column is equipped with three lanterns, equally orientated at 120 degrees - two on the street side and one lighting the pavement.

Performance

The high performance optical system (Optibloc) is engineered for improved visibility and reduced glare. The solution provides an average horizontal illuminance of 50 lux. Decostreet spreads light downwards to a considerable distance, enabling lanterns to be spaced a long way apart without leaving areas of shadow. The optic is designed to reduce discomfort glare to a minimum. Colour rendering is excellent at Ra83.

Efficiency

The use of low wattage discharge lamps delivers energy efficient illuminance (75 lumens per Watt for the complete lantern). The original brief called for spheres to be used, which due to obtrusive light concerns were quickly changed. The new design minimises the spread of light above the horizontal resulting in very minimal upward light spillage and meeting the strict Italian regulations. The long

operation (lamp life is 12,000 hours) and IP66 optic will enable the local authority to save on maintenance costs.

Comfort

The installation achieves outstanding visual comfort. Comfortable warm light (2800K) is provided so that at night the lighting comes into its own, adding safety, security and a new aesthetic dimension to its context. By day, the lighting (and the columns which support them) brings its own style to the urban landscape. The colours of the column base (silver RAL 7001) and shaft (green RAL 6028) match that the lantern body and circular ring respectively. Such is the atmosphere created that the main street is now seen as a cultural meeting place well beyond daylight hours.



*Scheme Associates: lighting by Campania agency,
Column design by Pagliara Architetto of Napoli.*



Revelations at Reims

Notre-Dame Cathedral, Reims – arguable the finest example of Gothic church architecture - can now be revealed in a new light, thanks to new exterior spotlighting which adds a touch of magic to an already spectacular piece of architecture. The resulting balance of light and shadow creates a dramatic effect which can only be seen at night.

The west front of the coronation cathedral of France is an elegant design of great unity. The challenge of lighting such a building lies in its sheer volume – there are 2,203 statues alone. The lighting had to highlight the many components of the façade without over-lighting any of them. At the same time it needed to emphasise French Gothic focal points such as the triple doorway, arcade and rose window, line of kings and twin towers.

Performance

The project used 150 circular symmetrical Contrast floodlights, 60 of which were small 35W ‘pinspot’ units. These were augmented by 1,114 recessed end-glow fibre optic terminals, chosen to light details and statues. Metal halide was the selected light source giving high colour rendering. The light ranges from 5 lux for the buttressed doorways to 40 lux at the towers. Only major details were highlighted (to 200-300 lux). The form of the shadows is controlled by varying the closeness and beam angle of the lighting, the fibre optics being adjustable from 7-36 degrees.

Efficiency

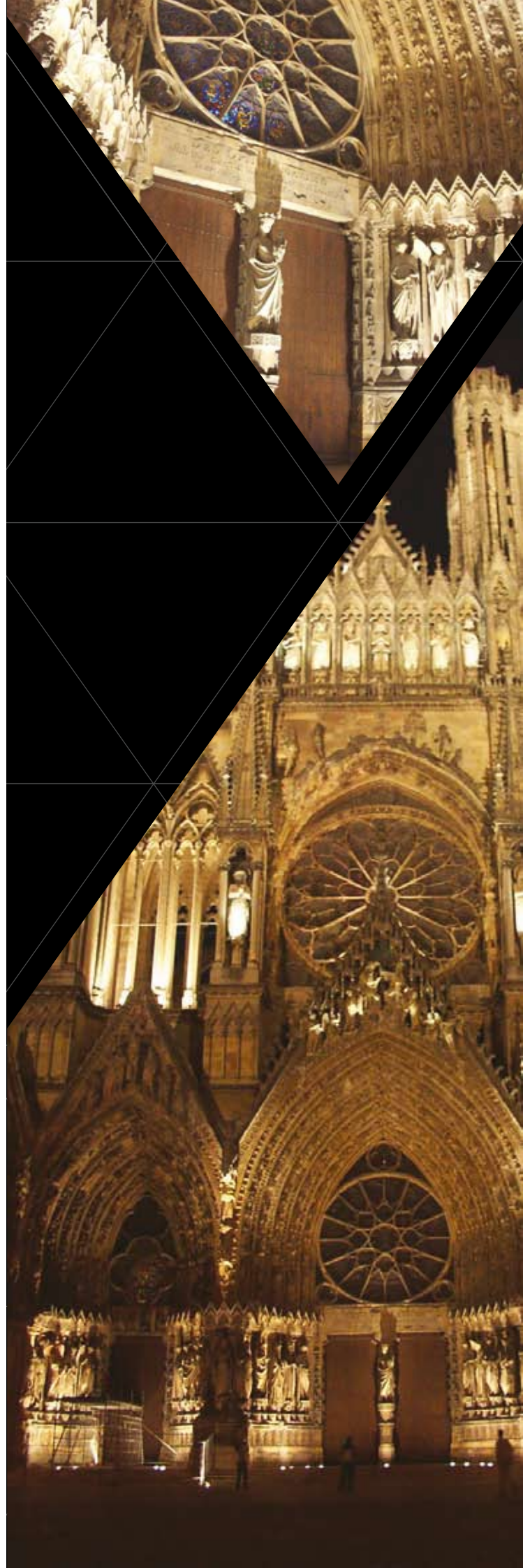
Maintenance efficiencies are achieved by minimising the number of lamp points. The majority of these are close-mounted and aimed upwards to reverse shadows while limiting obtrusive light. The use of highly efficient metal halide lamps satisfies power targets.

Comfort

Metal halide (warm 3000K for the floodlights and cool 4200K for the fibre optics) illuminates the façade in crisp white light, contrasting with the golden yellow of the surrounding street lighting.

The carefully-planned lighting strategy creates a dramatic lit effect. The light gradually intensifies upwards, drawing the eye easily and smoothly upwards. The result is a sensitive scheme which has unity, beauty and economy. The mixture of light and dark areas adds realism to the sumptuous carvings, as well as strengthening the three-dimensional impact of the cathedral in the cityscape.

Scheme Associates: Lighting design by Roger Narboni of Concepto Agency.



Avenue Virtual

The 'virtual' indirect lantern uses a unique concentric ring top reflector system combined with a precision light projector, housed in a body finished in silver grey. The closed projector achieves 97 per cent containment of output within the top reflector system, minimising light spill and providing minimal glare with an attractive lighting effect. The lantern embodies strong design values with full regard to aesthetic and performance needs. Dedicated columns have optional sleeving.

Performance

The amenity optic gives good seeing conditions and a light pattern that is attractive and welcoming. The flat top reflector with multiple rings eradicates glare whilst controlling the light distribution for excellent uniform illumination.

Metal halide lamps ensure good colour rendition

Efficiency

The indirect optic prevents the spread of light above the horizontal

The use of electronic ballasts assists energy saving

Comfort

The lantern adds visual appeal and pleasantness to an area, providing lighting at a human level.

The decorative lamp shield limits discomfort glare and the indirect optic reveals the ground level as well as providing sufficient spatial illuminance for pedestrians to be seen clearly

Architectural appearance is high by day as well as night and the lantern and column integrate well together.

Matching wall versions are available.



Sport

Improving the usability and visual appeal of multifunctional venues, indoors and outside.

The application of PEC to lighting for sport enables authorities and users to make the most of today's modern multi-purpose, community-orientated activity complexes.

Contemporary sporting centres may include facilities such as shops, restaurants, children's play areas and cafés, as well as fitness and health centres, playing fields and running tracks. There may be spaces for conferences and the car park may be used to hold markets.

This versatility poses a considerable lighting challenge to the designer. PEC enables a creative response to be developed.

For activity areas, indoors and outside, a key requirement is lighting that adopts the requirements defined in EN12193. It should deliver the required brightness and contrast over the playing surface whilst providing sufficient, glare-free light for players, spectators and visitors – without intruding into the neighbourhood, in the case of floodlighting. This is not simply a matter of 'seeing the ball': the right choice of lighting can also be a source of comfort in a health suite, or of clarity on the squash court. Lighting can be a guarantor of safety in a swimming pool, or of calm and organisation in the booking office. At the same time it can maximise safety and conserve energy.

With PEC incorporated into the design process, lighting for sport can help to create a more welcoming, safer and efficient environment.

PEC profile Performance

- *Task visibility and contrast.* High levels of uniform lighting are required for many sports. Lighting must deliver the required brightness and contrast over the playing surface whilst provide sufficient light for players, spectators and visitors alike.
- *Modelling.* Good sports lighting not only reveals form and texture, but helps players and spectators to identify people and this is achieved by vertical illumination.
- *Colour.* Colour rendering depends upon the event in question. The lighting, for example, may have to be sufficiently good to enable colour television pictures to be recorded or average for a local sports club's mid-week training.
- *Glare free.* Care must be taken to avoid excessive discomfort glare, especially floodlighting. For players glare will be reduced by increasing the floodlight mounting height, by aiming the peak intensity of the floodlights, and by ensuring that the luminance of the area and its surrounds is as high as possible. For spectators the key factor is to limit the intensities outside the actual beam of the floodlight.

Efficiency

- *Effective.* Cost-effective fittings with low running costs and flexible switching arrangements are a priority.
- *Efficient.* Neighbourhood issues such as light spill for local residents must be addressed. Most exterior sports lighting systems achieve high utilisation which ensures that for equal lighting performance over the playing area the energy load is considerably reduced when compared with systems providing less precise light control. In fact, excessive spill light, is invariably a sign of wasted energy, quite apart from the inconvenience it causes in the surrounding environment.
- *Managed.* Lighting controls, especially switching to achieve stepped illuminance levels is usually required for sports lighting, more so with multi-sports facilities.
- *Practical.* Systems must be chosen to deliver optimum performance over extended maintenance and cleaning cycles. Low maintenance requirements are essential. Wire guards and impact resistance are often required

Comfort

- *Stimulation and Satisfaction.* Better lighting encourages better performances and lets the crowd see more of what it wants to see.
- *Atmosphere.* Lighting can counter the 'industrial' feeling of large indoor spaces. It can create a pleasant and visually comforting atmosphere in many sports and leisure areas, such as fitness zones.
- *Safe.* The primary lighting objective for certain sports, such as swimming, is safety; the pool attendant must be able to see a swimmer in difficulty clearly
- *Integrated.* Exposed luminaires can be selected to complement the design of each facility.



Scoring for the environment

The floodlighting system installed at the multi-purpose Due Pini Stadium in Salo, northern Italy, is both functional and community-focused. It satisfies the requirements of the athletic and football governing bodies, and prevents the escape of stray light in order to respect the quality of life of nearby local residents. The 52 Champion 2kW metal halide floodlights, mounted on four 25m high masts, provide an excellent solution.

Performance

The scheme meets the recommended illuminance values published in UNI EN 12193 as well as the rules of the Italian National Olympic Committee (CONI) and Italian Football Association (FIGC). The playing surface appears uniformly bright when viewed from the relevant directions and disability glare is reduced to negligible levels.

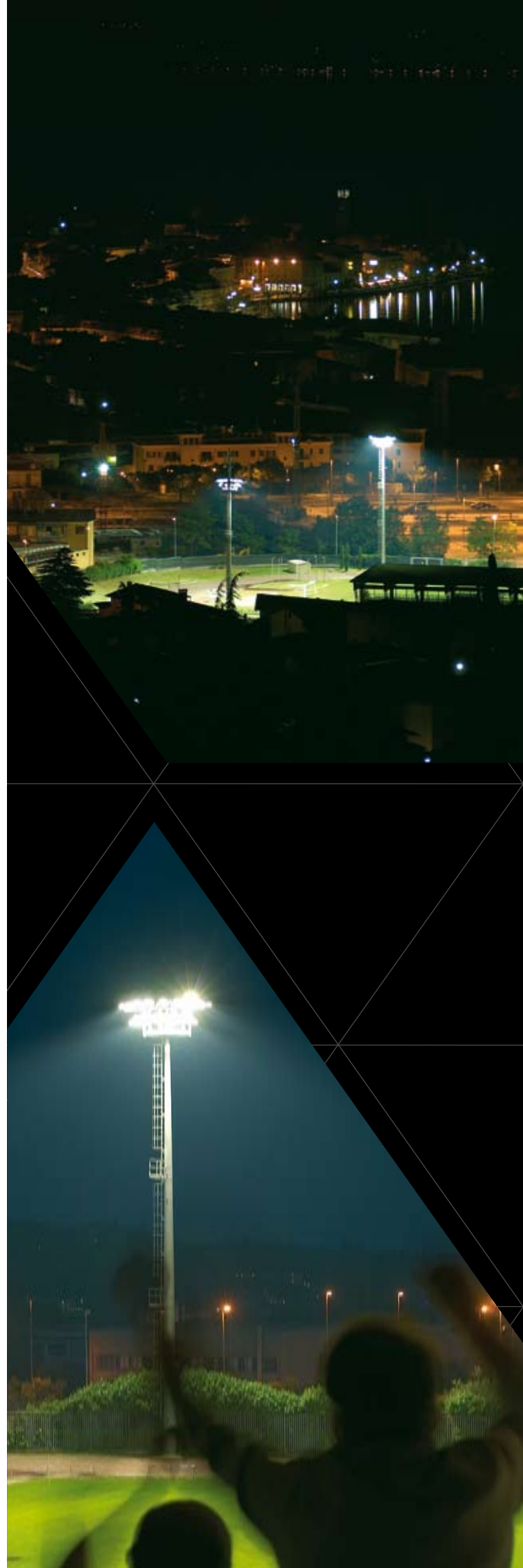
Efficiency

The use of precision optics ensures that all running track markings and the entire field area of play are precisely illuminated without emitting any stray light. The floodlights also score highly in terms of economic efficiency. Compared with conventional floodlights the scheme uses eight fewer projectors – a

13 per cent saving in power load. The design included three switching levels to meet the needs of different sporting events.

Comfort

The quality of light provided by the installation promotes quick reactions by players and competitors, encouraging improvements in skill and performance. The 10,000 spectators enjoy a clear view of all the action across the entire sporting area.



Champion

The optical design of the Champion is notably different from normal sports floodlights making it the ideal choice for those concerned with high performance and the avoidance of obtrusive light. Instead of having a 'flat glass' construction Champion's front glass closure is inclined inside the floodlight. The front of the body acts as a cowl for full cut-off and provides a 'virtual' light emitting surface, which is aimed parallel (flat) to the ground. Furthermore, each lamp option has a minimum of three lamp positions to provide different photometries from just one installed position.

As a result, Champion combines the performance features of classic floodlights (high light output) with those of 'flat glass' projectors (control of obtrusive light pollution). Illuminance and uniformity of floodlighting projects can be optimised without the need to tilt the floodlight, thus reducing obtrusive light.

Performance

An asymmetric Sports Optic for precise light control: good illuminance, uniformity and glare control.

A tight cut-off of light below the horizontal limits the spread of light beyond the playing area

A high peak beam angle with adjustability during set-up avoids the need for tilting the floodlight

The use of metal halide lamps means good colour rendition and blends well with natural daylight. Ideal for high illuminance level required with spectators.

Efficiency

No direct upward light above the horizontal results in minimal obtrusive light (just ground reflection)

The optical system is designed for two of the most powerful and efficient types of high intensity discharge lamps in use - metal halide (1 and 2kW) and high-pressure sodium (1kW)

Comfort

Precision optics provide perfect seeing conditions for players, officials and spectators and limited light spill for neighbouring householders.

The use of Champion can extend playing time and thus user satisfaction.

Above all it encourages better performances and enjoyment.



PEC Tools

Our lighting engineers throughout the world are equipped with lighting design instruments such as software. They are not a substitute for the skill of the lighting designer, but an aid, rather like a spanner in the hands of a mechanic.

These computers and associated software provide many facilities, but one part is that they allow a design to be visualised and enable scheme design parameters to be checked and optimised, thus allowing the highest levels of performance, efficiency and comfort to be designed in from the beginning. An example of this type of software is Thorn Roadsoft, which allows a road layout to be defined and visualised and design parameters to be optimised. It provides real-time results to the designer to help them understand the impact of design choices and therefore aid the production of high quality lighting schemes.

Our aim is to develop a range of simple lighting tools for the application of PEC, whilst continuing to put our faith in the skills of people.

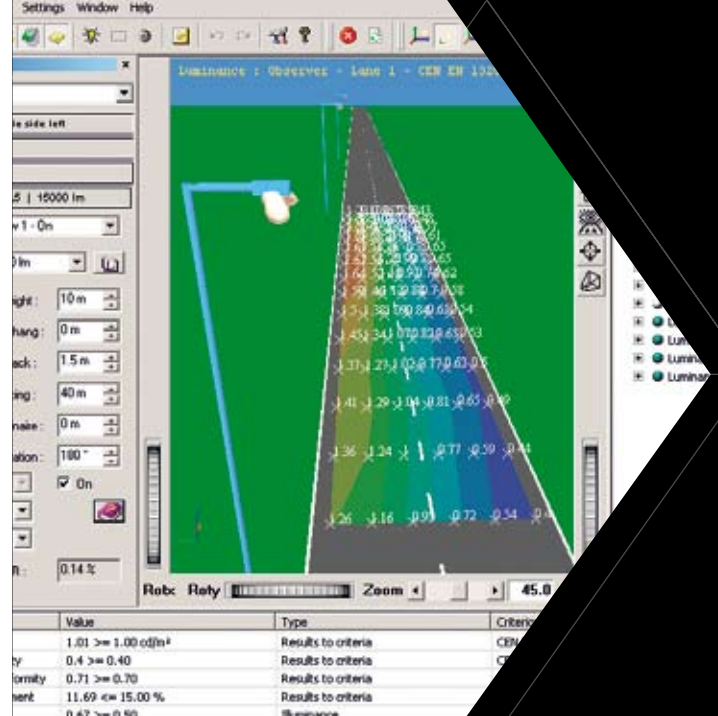
The Contrast Rendering Factor (CRF) Indicator

We can, for example, very quickly indicate how effectively the lighting system minimizes unwanted shiny reflections in the task. Lighting in the wrong place can reduce the contrast of what we are trying to see and a reduction in contrast is more serious than a reduction in illumination. The Contrast Rendering Factor (CRF) Indicator has been devised, which will result in good CRF and good visibility where it is needed. The

simple test can be used to detect where the CRF will be low so that measures can be taken accordingly. It takes about as long to do as the time taken here to read it.

The visibility of detail within a task depends upon its contrast and will be impaired if the lighting system degrades the contrast. This can happen if, for example, images of bright sources, such as luminaires or windows, are reflected within the surface of the task. The CRF is a measure of the degradation of contrast that is caused by veiling reflections (bright reflections in the task). It's important, partly because it is tangible (you can see the reflections), but mainly because it tends to have a greater impact on the effective contrast in practice.

The CRF varies considerably with the task, with the relative positions of task and luminaires, and with the direction of view. Although the illumination may appear satisfactory and the lamp shielded from direct view, minute reflections in the surface of ink and other materials, substantially reduce the effective contrast of the printed or written text. Even if the reduction in contrast were as little as 20 per cent; this would produce a serious loss of visibility. At office lighting levels it would be equivalent to reducing the illumination by a factor of more than ten! So quality is more important than quantity. CRF has also been found to correlate with the subjective assessment of the visual quality of a lighting installation.



PEC - your quick guide

CRITERIA AND TERMINOLOGY					
Performance		Efficiency		Comfort	
Task visibility		Effective		Atmosphere	Ergonomic
Contrast		Energy efficient		Ambience	Integrated
Modelling		Managed system		Stimulating	Colourful
Colour		Practical		Satisfaction	Interest
Glare free				Safe	Health

MEASURES AND UNITS					
Performance		Efficiency		Comfort	
Illuminance lux		Efficient lm/W	CO ₂ emission, kg/a	Creative	
Luminance cd/m ²		Economic £/m ²	Energy, kWh	Subjective	
Disability glare cd		Daylight link %	Recycled element, %	Aesthetic	
Colour rendition Ra		Presence link %	Ownership cost, £/y for life	Architectural	
Uniformity		Maintenance link %		Design	

DESCRIPTORS, ACTIONS AND IMPACTS					
Performance		Efficiency		Comfort	
Gives right environment	Enhance detection	Sustainable	Easy to service	Calm atmosphere	Full filling
Improves clarity	Reveal features/patterns	Reduce power demand	Fit for purpose	Lively atmosphere	Welcoming
Less fatigue	Reveal coloured details	Conserve energy	Economic	Balanced ambience	Pleasant
Quicker completion	Gives free view	Reduce global warming	Value for money	Reassuring	Accommodating
Fewer mistakes	Meets regulations	Saves resource	Limit obtrusive light	Variety	- glitter/sparkle
Easier discrimination	Reveals shadows	Less waste	Meets regulations	Variable	- stress free
Higher productivity	Reveals textures	Quick to install		Bio rhythmic	Inspire
Greater flexibility				Wellness	Arouse
				No flicker	Flow of light
					Relaxing

Note

Performance and Efficiency criteria can be quantified and the solutions engineered to conform to requirements or recommended targets.

Comfort criteria are subjective and influenced by psychology of lighting and the solutions are prepared to design rules and creative/artistic experience.

PEC also embraces design and the need for the scheme to have good architectural integration.

A Short Glossary of Lighting Terms

Carbon dioxide (CO₂)

An important greenhouse gas. Countries that ratified the Kyoto agreement have committed to reduce their emissions. Lighting designers have the power to hold down CO₂ emissions into the atmosphere (0.42 kg of carbon dioxide is produced for each 1 kWh/hour of electricity.)

Colour Appearance

The colour emitted by a near-white light source can be indicated by its correlated colour temperature (CCT). Each lamp type has a specific correlated colour temperature measured in degrees Kelvin e.g. 3000K and are described as warm, intermediate, cool and cold.

Colour Rendering

The ability of a light source to reveal the colours of an object. It is determined by the spectral power distribution or spectrum of the light source. Measured by the colour rendering index (Ra). The higher the number the better, up to a maximum of 100.

Contrast

Subjective experience of comparative brightness between points or areas of luminance, seen simultaneously or successively.

Contrast Rendering Factor (CRF)

A measure of the degradation of contrast that is caused by veiling reflections (bright reflections in the task). See also PEC Tools and the CRF Indicator.

Digital Addressable Lighting Interface (DALI)

A lighting control protocol set out in the technical standard IEC 929

Digital Serial Interface (DSI)

A lighting control protocol created by the Zumtobel Group, for applications where the addressing feature of DALI is not required.

Efficacy

Measured in lumens per Watt (lm/W) and a useful parameter for assessing how much light is available for the lamp for each Watt of power. Luminaire efficacy is often expressed by dividing the initial lamp lumens by the combined lamp and control gear power.

Glare

Glare is the result of excessive contrasts of luminance in the field of view. The effect may vary from mild discomfort to an actual impairment of the ability to see. When the ability to see is impaired this is called disability glare. Discomfort glare is associated more with interiors; it refers to the discomfort or distraction caused by bright windows or luminaires.

High frequency electronic control gear (HF)

Most artificial light sources other than incandescent lamps require special control gear to start the lamp and control the current after starting. HF electronic gear operates fluorescent tube(s) at high frequency (typically at 30-60 kHz) instead of the mains frequency of 50 Hz offering benefits of higher quality lighting, reduced running costs and ease of use, combined with safe reliable operation. Dimmable versions available. They may also be used with high intensity discharge lamps.

Illuminance

The amount of light falling on an area divided by that area - measured in lux. Generally, 500 lx is needed for office work, whereas a watchmaker requires 4,000 lux. In summer, the sun shines on the ground with 120,000 lux, and a full moon produces 3 lux.

Ingress protection (IP)

Denotes the protection against entry of dust/solid objects and moisture/water, provided by the luminaire enclosure.

Lighting Energy Numeric Indicator (LENI)

Defined in the European standard for assessing the Energy Performance of Buildings (EPBD), EN 15193 as the measure for annual lighting energy requirement for the building per square metre. The quick method of calculation being:

$$\text{LENI} = W/A \text{ \{kWh/(m}^2 \text{ x year)\}}$$

W is the total annual energy used for lighting {kWh/year}

A is the total useful floor area of the building {m²}

LED / light-emitting diode

An LED or light-emitting diode is a small semiconductor device which emits light, usually coloured, when an electric current passes through it. LEDs are energy saving and have a long service life.

Light Output Ratio (LOR)

The ratio of the total light output of the luminaire to the output of the lamp(s), under stated conditions.

Lumen (lm)

The unit of luminous flux or the rate of flow of light from a source or received by a surface. When a ray of light hits a solid surface, the process is known as illumination.

Luminaire

Modern term for "light fitting" or "fixture". A complete lighting unit that controls the distribution of light given by a lamp(s) and includes components for fixing and protecting the lamp(s) and for connecting them to the supply circuit. Luminaires for road lighting are often known as lanterns.

Luminaire-lumens per circuit watt

Is the luminaire efficiency factor given by LOR x (total bare lamp flux in the luminaire/circuit Watts)

Luminance

The measured brightness of a surface. The unit is cd/m².

Luminous intensity (candelas)

The amount of light that a small light source at the tip of a cone emits through a narrow cone in a given direction.

Lux

The unit of illuminance, equal to one lumen per square metre.

Modelling

The use of light to bring out the form of three-dimensional objects, structures or spaces.

Optic

The reflector and/or refractor system that directs the light emission from the lamp in the luminaire into required directions.

Spill Light

Stray light from a luminaire that incidentally illuminates nearby objects or surfaces within the public environment. Can be a cause of 'light trespass'.

Uniformity

The ratio of the minimum illuminance to the average illuminance over the specified surface area.

Visual performance is the ability to perceive detail and carry out the visual tasks.

Visual comfort is our feeling of ease or well being within the visual field.

Visual satisfaction is the qualitative impression of a lit space.

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