
BURO HAPPOLD

NOMA Angel Square Public Realm

Stage 2 – Lighting Strategy for planning
RP 001

Rev.01

Project No: 0052681

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Executive Summary

Introduction

This exterior lighting strategy document has been prepared by Buro Happold on behalf of MEPC in support of the planning application for the upgrade of Angel Square public realm.

The lighting design considerations that will follow in the next sections of this report take into consideration aspects of the overall ambition to create a public space for the city users, the landscape architectural design, the material palette and the integration of equipment into the landscape.

Buro Happold Lighting role

Buro Happold Lighting team have been appointed to provide external lighting design services to all landscape areas of the Angel Square within the red line boundary. Our involvement stretches from RIBA Stage 2 Concept Design to RIBA Stage 4 Detailed Design and commissioning.

Reason for issue

This report has been issued to support the lighting design concept in conjunction with the landscape architects vision for the square and to inform the initial lighting design ideas for acceptance to proceed to stage 3.

Report audience

This document has been produced for a wide audience including the Client, Landscape Architect and planners

The purpose of this report is to communicate the initial lighting design concept proposal for the '**Angel Square**' and their background to the client and design team. It will give the opportunity for coordination and approval in order to finalise lighting proposals in stage 3, Scheme Design.

Benefit of following Buro Happold lighting recommendations

Following the Buro Happold lighting design scheme will support the client and project aspirations to transform the public realm design into a unique people focused environment after dark. The Buro Happold design embodies the characteristics of placemaking, layered lighting and enlivening of the three dimensional landscape.

Summary of lighting strategies covered in this report

This report covers the following chapters:

- **The Lighting Design parameters & Assumptions**, the key lighting requirements to meet the design criteria for each area of the site.
- **The Lighting vision**, the story behind our lighting proposals and the application of our lighting vision in each space
- **Basis of Design**, Regulatory and lighting level requirements

The **next steps** will be to develop the concept into a refined stage 3 lighting design upon the planning approval in coordination with the landscape architects.

THE LIGHTING DESIGN PARAMETERS & ASSUMPTIONS

Environmental Lighting Zones

The environmental zone rating can be used to help ensure that the lighting goals of an environment are appropriately defined and met, considering the context and relevant surroundings.

Environmental Zone	Surrounding	Light Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark	National parks, Areas of Outstanding Natural Beauty, etc.
E2	Rural	Low district brightness	Village or relatively dark outer suburban location
E3	Suburban	Medium district brightness	Small town centres or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Environmental Zone	Sky Glow ULR (Max %)	Light Intrusion (into windows) Ev (Lux)		Luminaire Intensity I (cd)		Building Luminance (pre-curfew)
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average L (cd/m2)
E0	0	0	0	0	0	0
E1	0	2	0	2500	0	0
E2	2.5	5	1	7500	500	5
E3	5	10	2	10,000	1000	10
E4	15	25	5	25,000	2500	25

Recommended Environmental Lighting Zones in Powderhall bowling green site project

Design Considerations and Lighting objective



Economic Sustainability

Appropriate lighting will help support the development and growth of the night-time economy. The areas open to visitors will be designed to optimise value with regards of both the capital and maintenance cost ensuring a sustainable lighting approach.

Luminaires and their control equipment's whole life-cycle will be considered in relation to the project life, the energy cost, hours of use, labour rates and driver replacement periods.



Environmental Sustainability

Keeping in line with the recommended luminance levels in the exterior context endorses the efforts in mitigating obtrusive light and its consequent adverse effects in the nocturnal environment and on human health and wellbeing.

Poor optics and excessive amount of artificial light is often observed when walking through an urban area, reflecting a dated mentality of 'more light equals more safety'. This has resulted in loss of the night ambience and dark sky, causing health problems to the occupants and shifting the ecosystem of the area.



Social Sustainability

Lighting will be designed to help always maintain a safe environment. Lighting will provide an overall sense of security and will support active and passive surveillance systems. Lighting will also provide adequate means for facial recognition and modelling of people. Excessive contrast and glare should be avoided to ensure ease adaptation of the eye and reduce the risk of accidents.

It is important that the design of the lighting supports the needs of all of those visiting. Optimal lighting can help to guide people with diverse disabilities easily through the public spaces by creating a legible environment with the use of different lighting techniques



Identity

The experience at night will play an important role in forming the image of the square and the neighborhood. Lighting will relate and create a unique experience through the site and this could be achieved by careful consideration of intensity, luminosity, light colour temperature, mounting heights and desired lit effects.

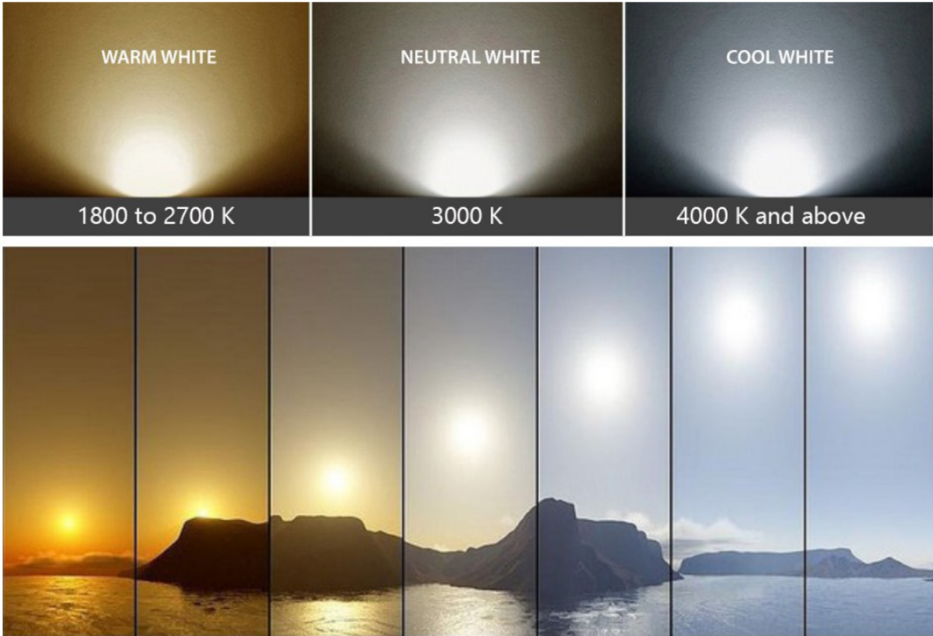
Lighting can help assist each zone having its own character by making distinctions between them. An overall and unified lighting character should be defined through the whole area, but the independent lighting design of each zone can help to create a unique character and experience.

Lighting Design Criteria

Light Colour temperature

The term CCT -Correlated Colour Temperature -is assigned to a light source to identify the chromaticity of the emitted light. The colour characteristics of the light source are measured in degrees Kelvin. The warmer the appearance of the light source, the lower the degrees of Kelvin. It is a quality to which people are subconsciously susceptible as our circadian rhythms are tuned to respond to natural light encompassing the full range of light colours throughout the day. Colour temperature is measured in the unit Kelvin and is the standard method for measuring the colour of light emitted from a lamp.

Colour	Kelvin degrees (K)	Perceived association and function
	3000K	Neutral Warm lighting General lighting for primary and active travel routes.
	2700K	Warm lighting General lighting to secondary routes and dwell areas
	2200K	Warmer lighting Defining fixed seating within landscape and feature areas



Artificial and daylighting light colour variations

Lighting Design Criteria

Light Colour temperature

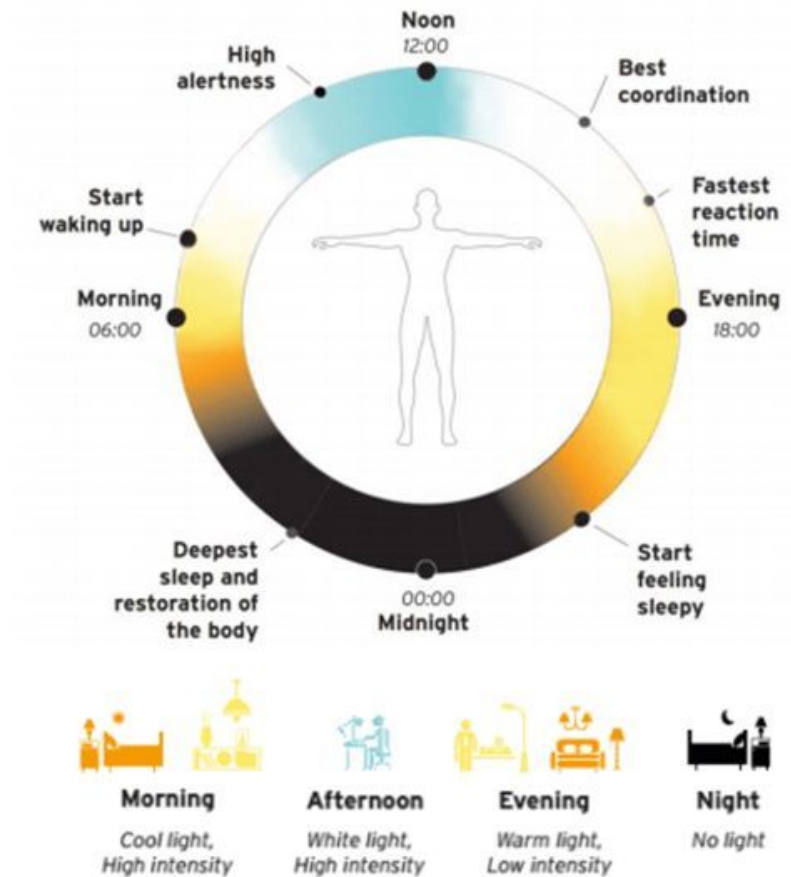
Human Rhythms

As each spectrum of CCT (correlated colour temperature) is proven to have **an impact on human psychology**, suitability is judged by the area usage, activities, footfall, time of the day etc. Warm light (max. 3000K) is proposed to be used across the active travel route with warmer temperatures introduced near sensitive habitats and areas to dwell for the following reasons:

- Warmer colour temperatures convey an informal relaxed message and are better suited for hospitality, residential, amenity and recreational areas. Warm light is mentally associated with safety, history, communion, and recreation, which are pivotal elements in the visitor experience.
- Any type of light could suppress the secretion of melatonin in human beings and different animals, however the exposure to blue light at night does so more powerfully as the human eye retina is more sensitive to shorter (blue light) wavelengths.
- According to different scientific studies and the International Dark Sky Association (IDA), blue light brightens the night sky more than any other colour of light, so it is important to minimize the amount emitted. Therefore, warmer colour temperatures aid towards minimising light pollution.



Effects of light to human psychology and health



Lighting Design Criteria

Lighting considerations

Flicker

A major issue affecting the LED lighting industry is visible flicker, which is defined as “variations of luminance in time”. Flicker may be inherent to the design of a luminaire but can also be introduced by external factors.

Especially in LED applications, the choice of the electrical components enabling the operating of an LED luminaire (drivers) can have a direct impact on the flicker performance of a luminaire, particularly visible when luminaires are at a dimming state.

Visible flicker can be responsible for a number of biological or even health effects on humans, including:

- Neurological problems, including epileptic seizure
- Headaches, fatigue, blurred vision, eyestrain and migraines
- Increased autistic behaviours

Flicker can also cause problems that are not health related such as:

- Reduced visual task performance
- Apparent slowing or stopping of motion (stroboscopic effect)
- Distraction
- Unstable light output in video applications

Therefore, it becomes evident that in spaces where the aging population will spend longer periods of time in these environments, it is of significant importance that any visible flicker is mitigated.



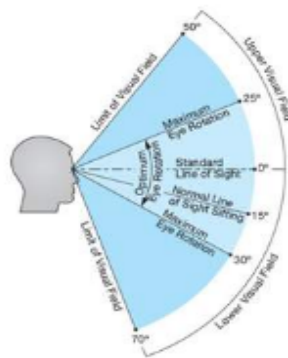
Vertical Illumination for vision and communication

Creating the right environment is considered essential in today's outdoor environments to foster interaction, health & wellbeing and creativity.

Lighting is one of the few environmental parameters that can have an instant effect on the perception of a space. By regulating elements such as the intensity, direction and the contrast ratios, our spatial perception can change drastically.

As brightness is mainly determined by what we see in our field of view over 80% of which is typically in the vertical plane, one of the major contributors to the perceived brightness of a space is the illumination of the walls and ceiling.

Over 55% of our communication is visual making the way we illuminate people and the our surroundings crucial.



Glare and perceived brightness

Glare is a highly subjective phenomenon caused by light from a bright source being scattered within the eye and creating a luminous veil on the retina. Glare is a phenomenon that can be experienced differently by people as the sensitivity of the eyes vary. The lighting design shall seek to support the needs of all of those visiting the public realm. Glare is present in the natural and built environments. During the day, direct view of the sun causes immediate glare, whereas exposing ourselves in the view of a high output light source from a close distance may invoke visual discomfort due to light scatter.

In the interest of limiting potential incidents of discomfort glare, the following design measures are to be considered:

- Avoiding excessive contrast ratios in neighbouring surfaces and controlling shadows
- Avoiding direct and reflected sources of glare
- Limiting upward lighting that could cause glare from elevated viewpoints or utilising glare control measures within products
- Limit the use of high gloss surfaces in large coverage to prevent visual confusion to control glare and indirect light source views from reflections.



Lighting Design Criteria

Light Colour temperature

Colour temperature defines the colour appearance of light. It is a quality to which people are subconsciously sensitive. The warmth of a fire or candle flame speaks at a very deep level with us of safety, history and communion with each other, cooler light as experienced on a clear night with a bright moon has a more open, dynamic and dramatic quality.

Architecturally, different surfaces benefit from being illuminated with colour temperatures that enhance their material qualities. A brick wall responds well to warm light. A clear modern façade with steel and glass might be well suited to a cooler colour temperature.

For NOMA's Angel square, the light colour temperature will enhance the circulation of the public space and define the different areas where visitors can relax, enjoy and celebrate after dark.

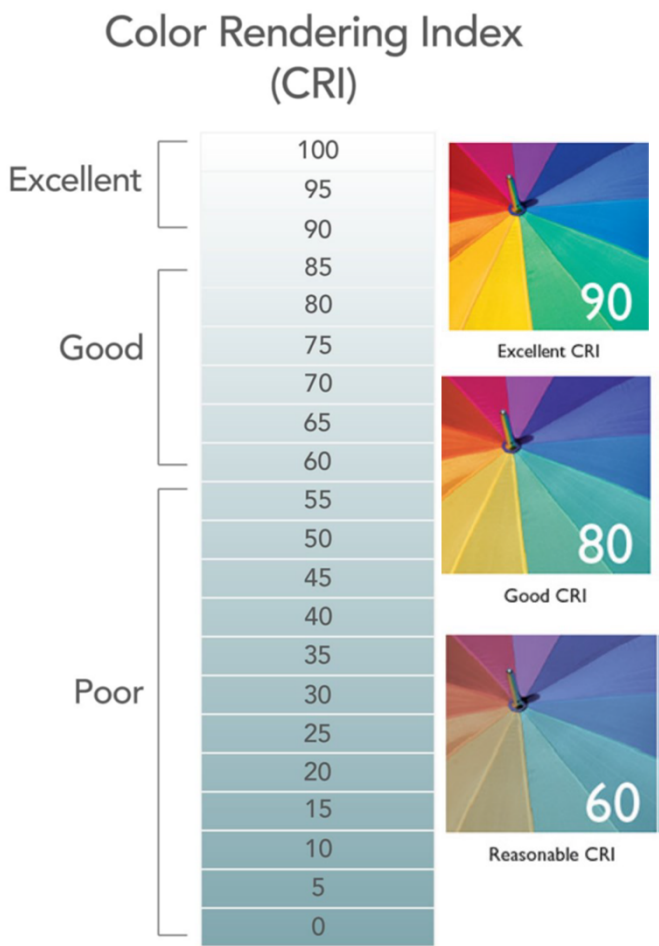
-  **Primary Route - 3000K (Warm to dim 3000K – 2200K – dusk to dawn)**
-  **Secondary Route – 2700K**
-  **Tertiary route – 2200K**



Lighting Design Criteria

Colour rendering

Colour rendering measures an objective indication of the ability of a light source to illuminate objects faithfully, so they appear natural. The general colour rendering index Ra has been introduced to specify the colour rendering properties of a light source. The maximum value of the metric (Ra) is 100 and it is assigned to daylight. Daylight is also used as a reference measure when evaluating artificial light sources. Higher figures represent good/ excellent colour rendering properties, whilst lower figures (<70) indicate poor colour rendition. It is important for visual performance and the feeling of comfort and well-being that colours of objects and of human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy. As this strategy focuses on a forward-thinking approach and long term lighting applications, satisfying basic lighting design criteria will ensure longevity and future proofing of the scheme. Considering the rapid development of the technology, values considered average today will be the absolute minimum in the coming years. Therefore, a minimum CRI 80 is deemed as a good provision for the future, albeit lower CRI values could still fall within the approved range.



Typically, conventional light sources or inferior LEDs have poor colour rendering

Mid-/ premium range of LED technology allows for good/ excellent colour rendition



Lighting Design Criteria

Light Intensity

A hierarchy of “brightness” is proposed according to the uses and way in which people will navigate through the spaces.

A good balance of light and shadow is important and neither of the two should be misplaced. In this way, space users will enjoy brighter spaces as well as more quiet ones. This balance will also enhance visual stimulation, offering users a space where they can enjoy, spend time outdoors and socialise, increasing the sense of local community and the feeling of being in a city living room outdoors.

-  **Primary Route - P3 7.5lux Av / 1.5lux min**
-  **Secondary Route – P4 5lux Av / 1lux min**
-  **Tertiary route – N/A**



Lighting Design Criteria

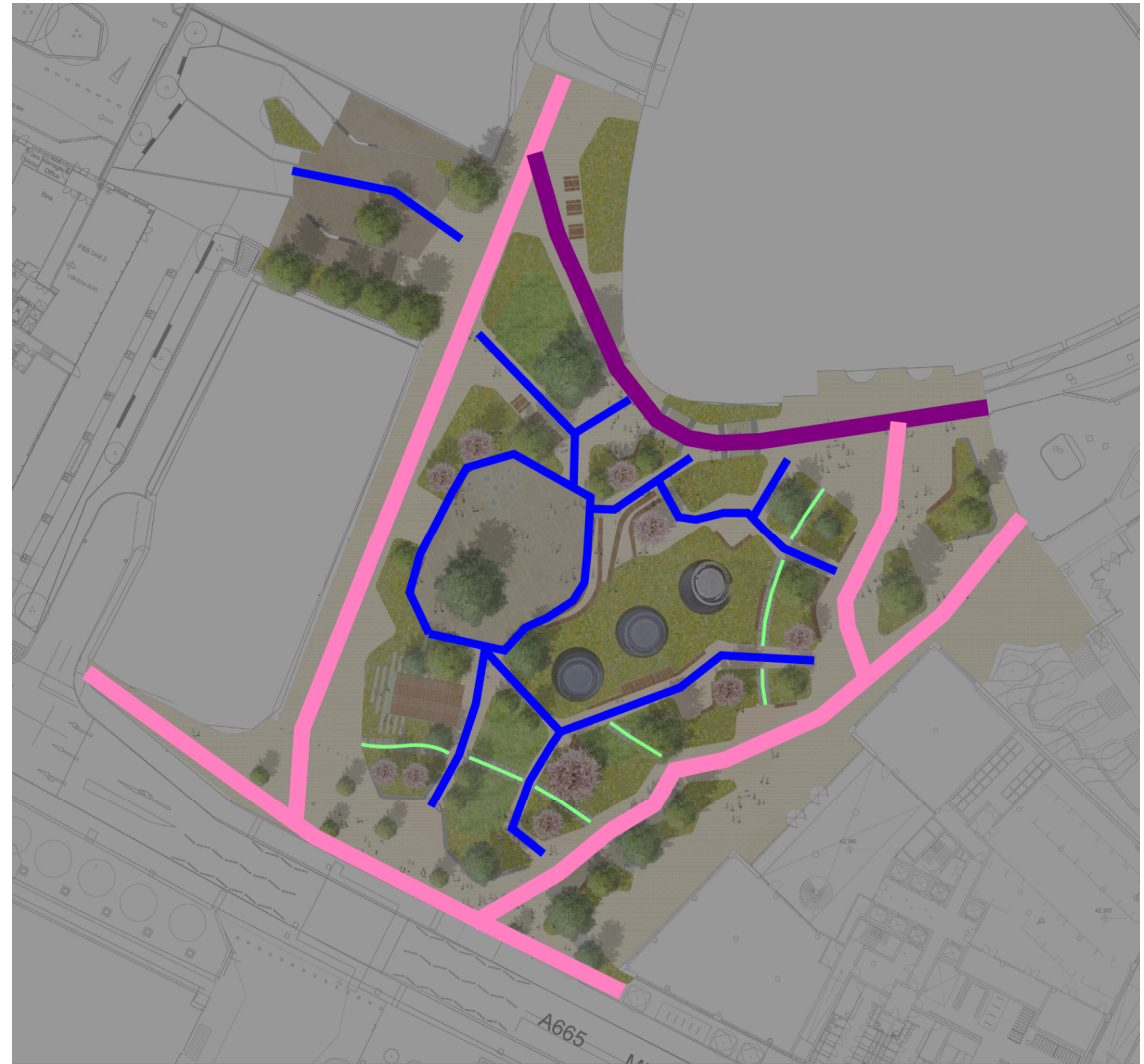
Light Source mounting height

The mounting height of the light sources must be sympathetic to the surroundings and proportionate to a more human scale and neighbouring context.

The mounting height of the light source is positively correlated to the frequency of the light source locations along a certain area in order to achieve the required illuminance levels and uniformity values, where applicable. That means that higher mounting heights will result in greater distance among the light points. However, due to the landscape green and maintaining these as darker areas to encourage biodiversity, a well-considered strategy is required with relation to light source mounting heights to achieve a balanced solution.

In principle, mounting lighting equipment along primary routes or combining various services on one column caters for reducing clutter on footway paths and improves the visual and spatial perception of the environment.

-  **Primary Route – 6m Max AGL**
-  **Secondary Route – 4m Max AGL**
-  **Primary Route adjacent Angle building – 6m Max AGL**
-  **Tertiary routes through landscape – 1.2m Max AGL**



Lighting Design Criteria

Luminaire aiming and shielding

In principle, luminaires across the project area should have:

- Accurate light optics aiming light towards the surface to be illuminated
- Integrated or additional external shielding
- Downward light emission respecting upward light emissions as per assigned environmental zones
- If adjustable, aiming angles not to exceed +30 degrees from the vertical axis
- Forward-throwing light distribution with a reduced kickback to minimise light spill
- Upward light to be limited and restraint for feature purposes only (Switched off post-curfew)

Glare Mitigation

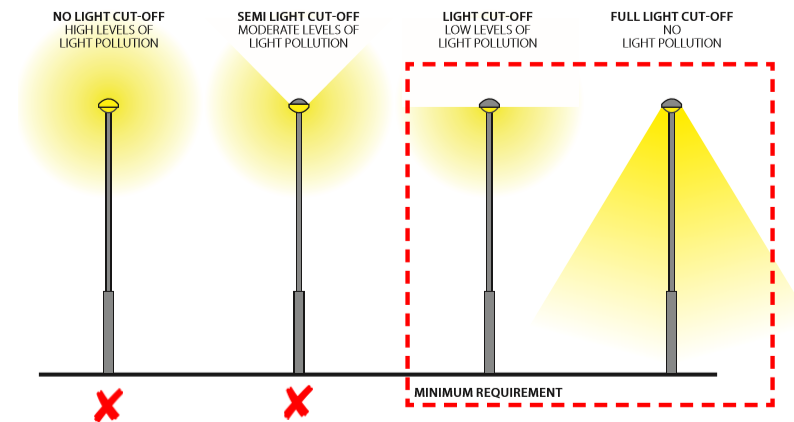
Exterior lighting should be designed in accordance with current good practice of Society of Light and Lighting (SLL) guidelines and in compliance with the Institution of Lighting Professionals (ILP) Guidance Notes for the Reduction of Obtrusive Light - GN01:2021.

To minimize the potential adverse effects of light pollution the following design principles should be applied

- Luminaires with accurate optics - directional and with tight light beam angles, whenever appropriate.
- Cowls or light shield accessories, where necessary, to avoid light spill.
- Lighting operated by time-based controls to limit post-curfew light spill.

In addition, the presence of luminaires with inadequate glare control or luminaires that are incorrectly focused can create unacceptable levels of glare. In order to avoid this, there are certain criteria that could help eliminate glare generated by electric light:

- If adjustable, light sources to be aimed at angles no greater than 30 degrees from the perpendicular
- Parabolic "dark-light" louvres, special lenses, honeycomb inserts, cowls or full/half moon snoot accessories on light fittings to shield luminaire and minimise visual discomfort.
- Highly specular surface finishes which may reflect bright light sources to be avoided



Lighting Design Criteria

Lighting controls

Smart lighting control systems linked to the exterior lighting equipment within the Proposed Development can help to reduce energy consumption and operate the lighting schemes in a more efficient way. These systems support interfacing devices for meteorological measurements, data collection and artificial intelligence development centres to create smart operation cycles. By installing a smart lighting control system, light scenes can be configured and informed by time, seasonality and other factors. This directly affects the running costs and prolonging maintenance intervals.

By employing an intelligent control system, the dimming levels and operation of the exterior lighting equipment can be pre-programmed to reflect different scenarios throughout the hours of darkness. The greatest benefit of such a system is that allows for both operational scenarios (i.e., events period and year-round) to be accommodated. As well as the following indirect benefits :

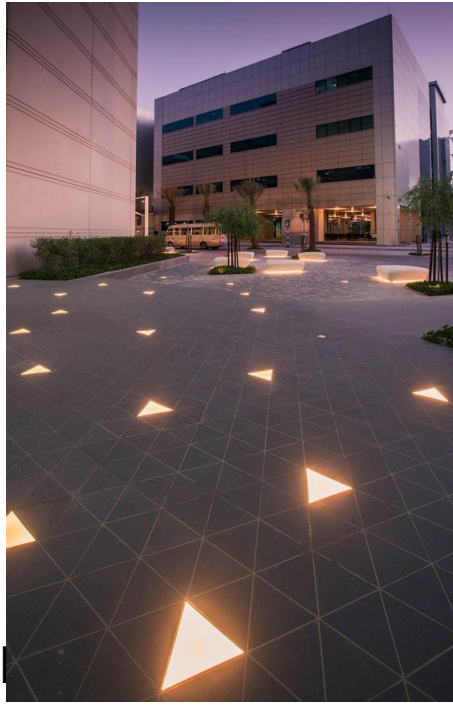
- Optimisation of energy resources
- Conservation and enhancement of local ecology and biodiversity by minimising duration of increased lighting requirements over early morning periods
- Promotion of natural conditions and adaptation to subdued environments in tune with human circadian rhythms



THE LIGHTING VISION

Ways to layer lighting

Angel Square public realm



- Localised integrated lighting to benches to enhance dwell areas
- Illumination to tree foliage creating atmospheric and dappled lighting effect
- Uplighting to focal point within public space
- Integrated handrail lighting to define change in level
- Patterned lighting to create texture within public space
- Marker lights create landscape art piece installation

Public Realm lighting strategy

Primary and secondary Routes



Location plan – Primary (orange) and Secondary (green) routes



3000K

2200K

Dusk

Dawn



Public Realm lighting strategy

Events space and integrated furniture



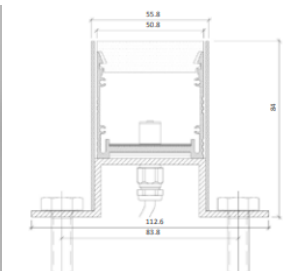
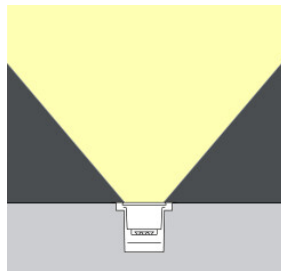
Location plan

Public Realm lighting strategy

NOMA tree



Location plan



BASIS OF DESIGN

Basis of Design

Regulatory requirements and best practice guidance

Category	Document	Area of application
Light Pollution	- ILP GN01: Guidance note for the reduction of obtrusive light, 2021 - CIE 150-2017, Guide on the limitation of the effects of obtrusive light from outdoor lighting installations - The Royal Commission of Environmental Pollution, Artificial Light in the Environment, 2009 - National Planning Policy Framework, 2019	All exterior areas including both horizontal and vertical surfaces
Public Realm and Landscape	- CIBSE/ SLL Code for Lighting (Society of Light and Lighting), 2012 - CIBSE SLL LG06: Lighting recommendations for the exterior environment - EN 12464-2:2014 Light and Lighting for outdoor workplaces	Lighting requirements and guidance for pedestrian routes and landscape elements
Ecological habitat	- ILP Guidance note 01/18 'Bats and artificial lighting in the UK' - Eurobats, Publication series no.8, Guidelines for consideration of bats in lighting projects, 2018	Areas of ecological sensitivity – soft landscape where biodiversity is enhanced
Planning	- Clean Neighbourhoods and Environment Act of 2005; - National Planning Policy Framework (NPPF –20th July 2021) by the Ministry of Housing, and National Planning Policies documents from each devolved administration; - Department for Environment, Food and Rural Affairs, Artificial Light in the Environment Policy Update, 2013	National and local planning policies applicable to all exterior areas
Construction	Construction (Design & Management) Regulations, 2015	Health and safety aspects, risk register

Basis of Design

The table below describes the lighting design criteria to meet the minimum levels of illumination for public realm spaces that provide a comfortable and safe environment for all.

	Area	Environmental Lighting Class	Area Lighting Class	Standard/Guidelines Reference	Lighting requirements	Light Colour Temperature	Max. Light Source Mounting Height	Operating strategy
Exterior Areas	Primary route – Pedestrians	E4	P3	BS 5489.1.2020, EN 13201 - 2	7.5 lux (1.5 lux min)	3000K	6m	Pre curfew: On Post curfew: Dimmed
	Secondary routes - pedestrians	E4	P4	BS 5489.1.2020, EN 13201 - 2	5 lux (1 lux min)	2700K	4m	Pre curfew: On Post curfew: Dimmed
	Tertiary routes	E4	N/A	Lighting not required, however a low ambient light to create atmosphere through these routes are optional				Pre – Curfew: On Post-Curfew: Off
	Event Space (Square)	E4	N/A	SLL code of Lighting 2012	5-10lux	2200K/ 2700K	Integrated to landscape furniture	Pre curfew: On Post curfew: Dimmed
	Public Realm Steps	E4	N/A	SLL code of Lighting 2012	20lux (Top and bottom step)	3000K	TBC	Pre curfew: On Post curfew: Dimmed

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We'd love to hear from you

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