

Street Lighting

Steve Coyne

Light Naturally



Primary Purpose of Street Lighting

To make people, vehicles and objects on the road and adjacent paths visible without causing discomfort to the driver, cyclist or pedestrian







Primary Purpose of Street Lighting cont...

- This is achieved by producing a difference in luminance or perceived colour with the immediate background
- Either positive or negative contrast





Secondary Purposes of Street Lighting

To beautify the city







Need for Wise Energy Use

Limit sky glow/pollution



Directing light to where it is required





Need for Wise Energy Use

- Energy efficient lighting practices
 - Efficient light sources
 - Do not over light
 - Light only when required









Good Street Lighting

- Light level set by needs
 - Traffic volume
 - Pedestrian activity
 - Crime likelihood
 - Visual amenity/prestige
- Good Illuminance uniformity
- Glare control
- Good visual appearance of the environment
- Ability to see colours well



Good Street Lighting





Good Illuminance Uniformity

Requires the right amount of light directed to all parts of the road

The $I(C, \gamma)$ greater the distance and C_n plane larger the angle then more light is required in that direction to create uniformity Eighth lites.asia meeting – Manila, Philippines, 2-3 October 2013

7₁₈₀ plane

Good Illuminance Uniformity

Photos and demos







Good Illuminance Uniformity - Distribution





Good Illuminance Uniformity – Pole Spacing





TENSI

TOE IN (10°'

Glare Control

No light leaving fixture above the horizontal plane

Limit light leaving fixture 20 degrees below horizontal







Good Visual Appearance of Environment

Known as colour temperature of the light source

CCT (K) *	Colour designation	Appearance	
2700-3300	Warm White	Similar to incandescent	
3300-5300	Cool White	Neutral light	
5300-6500	Cool Daylight	Cold, harsh, unrelaxed light	









Ability to see Colours Well

- Known as colour rendering, Ra
- Values range from 0 100 (higher the better)



Ra:10080(low values reduce colour contrast)



60

Mesopic Vision & S/P Ratios



Product Performance

Key Attributes

Light Weight

Limits pole loading

Safety of installation crew





Small Sail Area

Limits wind loading





Ambient Temperature Range

- No loss in performance at all possible ambient temperatures
 - Fluorescent lamps can underperform in cold temperature environments
 - LED lamps can underperform in hot temperature environments



Good Thermal Performance (LED)

- LEDs are sensitive to temperature
- Require good thermal design to facilitate optimal performance









Ease of Cleaning



Olites.asia

Maintenance

Maintenance philosophy

- In-field in-air replacement
 - Preferably tool-less, quick release connectors for all replaceable components
- On-ground at vehicle
 - Preferably tool-less, quick release connectors for detachable heat sink
- Return to workshop
 - Quick release connectors for LED/heat sink compartment or entire luminaire



Common Components

- Limits stock required to be held
 - Same PSU chambers
 - Same heat sink
 - Same LED modules



PSU Chamber

- Bottom access to PSU chamber
 - Not exposed to weather when open
 - Crew not near overhead wires
- All covers fixed to chamber (or have safety wire attachment)







Fixture Alignment and Pole Mounting

- Integrated bubble level along road axis for horizontal alignment
- Options for different upcast angles (e.g. 0° to 15°)
- Ease of mounting to outreach
- Connecting power cable (tool-less connectors)



Ingress Protection

IP65 (LED and PSU chambers)

 Have seen bugs entering through spigot





High Efficiency and High Efficacy

- High efficiency fixture/lamp combination is the key energy performance
 - Quality optical design (limiting losses and directing light to where it is required)
 - High efficacy lamps/LEDs



Electrical Interference on Network

- Need to limit Total Harmonic Distortion (THD)
- Caused by inferior electronics in PSU
- Creates interference with Power Line Carrier control signals





Electrical Quality

- Need high Power Factor
- Otherwise impacts on the current carrying capacity of the network



Failure Modes

 Failure of all components to be safe (no fire or electrically live components)

 Failure of any integrated light sensors should be in the ON state. This allows for safe night lighting and easy identification during daytime



Control Options - Sensor based

Light level

- Turns ON just before dusk
- Turns OFF just after dawn
- Activity (pedestrian or car)
 - Turn ON with oncoming traffic
 - Dim after traffic has passed



Control Options - Programmable

Set Times

- Set times for classing as lower category road.
- e.g. less traffic after midnight so switch from 15 lux to 10 lux
- Traffic volume

Seasonal time adjustment

 If light sensor problematic due to site difficulties (many glazed high rise buildings) a time clock with seasonal adjustment for sunset and sunrise.



Control Options - Programmable

- Networked (one way communication)
 - Allows switching of light levels for different situations (events, accidents etc.)
- Feedback/reporting (two way communication)
 - Features of one way communication system
 - Fixture performance information
 - Failure
 - Not turning OFF



Future Proofing

Upgradeability of key components

- Control gear
- LED panels
- Network and sensors



Harmonisation - IEA 4E SSL Performance Tiers



Solid State Lighting Annex: Performance Tiers for LED Street Light Luminaires - DRAFT

ANNEX PROPOSED TIER LEVELS

Efficient Electrical End-Use Equipment (4E) International Energy Agency

AUGUST 2012



Parameter	Tier 1	Tier 2	Tier 3 (for future use)
Energy-Efficiency			
Minimum downward Iuminaire efficacy (Im/W) ^{1,2}	= (0.0010 x Φ) + 51 where Φ is downward lumen output	= (0.0012 x Φ) + 64 where Φ is downward lumen output	
Life			
Lumen maintenance (minimum time to L70)	At 35,000h: lumen maintenance > 70% of initial flux	At 50,000h: lumen maintenance > 70% of initial flux	
Minimum rated Iuminaire lifetime (B50)	At 35,000h: 50% of population will be operative	At 50,000h: 50% of population will be operative	
Colour			
Colour Rendering Index (CRI)	N/A	≥ 60	
Colour maintenance (Δu',v' at 6,000h)	N/A	< 0.007	

Plus other common performance parameters



Conclusion

- No technology completely removes the need for maintenance/cleaning of the fixture
- Typical fixture life expectancy is beyond 20 years
- Many factors to consider in selecting best street lighting not just energy performance

