

Overview and Update on Street Lighting Luminaire Standards and Code of Practices

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ENERGY SAVING OPTIONS – STREET LIGHTING

- **Use of energy efficient lighting**
- **Design based approach**
- **Regulating power parameters to suit the actual requirements**
- **Providing guidelines on usage of quality Material Controlling the burning hours of the lamps**

INDIAN STANDARD

- **IS 10322(Part 5/Section 3)**
 - **Safety Requirements**
 - **Performance Requirements (Photometry)**
- **IS 13383 (Part 2) Methods of Photometry of Luminaires**
- **Standard Harmonized with IEC 60598-2-3**
- **Method of Test for Photometry as per CIE Publication**

CODE OF PRACTICE

- **IS 1944(Part 1) : General Principles**
- **IS 1944(Part 2) :Lighting for Traffic Routes (Group A1, A2, B1 and B2)**
- **IS 1944 (Part 5): Lighting for Grade Separated Junctions, Bridges and Elevated Roads (Group D)**
- **IS 1944 (Part 6): Lighting for Town and City Centres and Areas of Civic Importance (Group E)**
- **IS 1944 (Part 7)Lighting for Roads with Special Requirements (Group F)**
- **National Lighting Code**
- **Codes are based on CIE Publications**

ROAD AND STREET LIGHTING LUMINIARE STANDARD

- Construction
 - IP Classification
 - Static Load Test
 - Wind Force test
 - General construction
- Creepage Distances and Clearances
- Provision for Earthing
- Terminals
- External and internal wiring

ROAD AND STREET LIGHTING LUMINIARE STANDARD

- Protection against electric shock
- Endurance tests and thermal tests
- Resistance to dust and moisture
- Insulation resistance and electric strength
- Resistance to heat, fire and tracking

SALIENT ASPECT OF LIGHTING CODES

- **Classification of Installation**
 - **Basis of lighting requirements**
 - **Classification of Lighting**
- **Public Lighting**
 - **Aims of Public Lighting**
 - **Principles of Vision in Public Lighting**
 - ✓ **Requirement of Driver**
 - ✓ **Visual field of Driver**
 - ✓ **Visibility**
 - ✓ **Glare and Visual Comfort**

SALIENT ASPECT OF LIGHTING CODES

- **Criteria of Quality**
 - Level of luminance,
 - Uniformity of luminance,
 - Limitation of glare, and
 - Visual Guidance
- **Electric Light Sources**
 - Luminous flux,
 - Economy (determined by lumens/watt and life),
Dimensions of the light sources, and
 - Colour characteristics

SALIENT ASPECT OF LIGHTING CODES

- **Types of Light Sources**

- **Incandescent Lamps**

- **Mixed Incandescent and High Pressure Mercury Vapour Lamps**

- **High Pressure Mercury Vapour Lamps With Clear or Fluorescent Bulbs**

- **Tubular Fluorescent Lamps**

- **Sodium Vapour Lamps**

- **Mercury-halide Lamps, and**

- **High Pressure Sodium Vapour Lamps**

- **LED**

- **Induction Lamps**

SALIENT ASPECT OF LIGHTING CODES

- **Selection of Luminaire**
 - **Nature and power of the source or sources**
 - **Nature of the optical arrangements and the light distribution which they provide**
 - **Light output ratio**
 - **Whether the luminaire is open or closed type**
 - **Resistance to heat, soiling and corrosion**

SALIENT ASPECT OF LIGHTING CODES

- **Selection of Luminaire**
 - **Resistance to atmospheric condition (IP)**
 - **Ease of installation and maintenance**
 - **Presence or absence of auxiliaries**
 - **Fixing arrangements, the weight and area exposed to wind pressure**
 - **Cut-off luminaires**
 - **Semi-cut-off luminaires**
 - **Non-cut-off luminaires**

SALIENT ASPECT OF LIGHTING CODES

- Aesthetics
 - Design and Siting
 - Columns and Surroundings
 - Size and type of Luminaires
 - Forms of Bracket
 - Assembly of Column, Bracket and Luminaire
 - Arrays of Luminaires
 - Material, Finish and Colour of Column and Bracket

SALIENT ASPECT OF LIGHTING CODES

- Clearance between Column and Carriageway
- Maintenance
 - Breakdown
 - Preventive

LIGHTING REQUIREMENTS FOR TRAFFIC ROUTES

- Classification Of Lighting Installation
 - Group A1,A2,B1,B2
- Type of Roads
- Choice on the Type of Luminaire
 - Cut-off
 - Semi-cut-off
 - Non- cut-off

PHOTOMETRIC REQUIREMENTS

- Average Value of Road Illumination on Road Surface
- Uniformity Ratio
- Transverse Ratio of Illumination

SITING OF LUMINAIRE

- Type of Arrangement
 - Single sided
 - Staggered
 - Opposite
 - Axial
- Mounting Height
- Spacing and Space Height Ratio
- Outreach and Overhang of Luminaire

SITING OF LUMINAIRE AT SPECIAL FEATURES

- Curves
- Crossroads
- Pedestrian Crossing
- Intersection
- T-Junction
- Roundabouts
- Transition Zone
- Treatment of Gradient

NATIONAL LIGHTING CODE

- Primary Objective of the Code:
 - Energy saving through selection of efficient lamp technologies and design practices
 - Capital cost saving using proper spacing and placement
 - Maintenance cost saving using lamps with longer life and optimum spacing
 - Reduced glare and improved visibility by careful selection of luminaries and lamps

NATIONAL LIGHTING CODE

- Improved sense of security by selection of efficient system and incorporating proper design. This can make an area appear safer and more secure
- Improved sense of economic development of communities
- Improved safety of motorists, cyclists and pedestrians, improved traffic guidance and a pleasant environment

NATIONAL LIGHTING CODE

- Design Principles
 - Requirements of Road Users
 - Fundamental Quality Criteria
 - ✓ Luminance level
 - ✓ Illuminance level
 - ✓ Illuminance uniformity
 - ✓ Degree of glare limitation (Bad, Moderate and Good)

NATIONAL LIGHTING CODE

✓ Visual guidance

- Positioning of poles
- Using different lamp colours
- Use of high masts (>20m)

✓ Surround Ratio

NATIONAL LIGHTING CODE

- Effect of Road Surface
- Defining Road and Pole Installation
 - Carriageway
 - Type of Pole Configuration
- Type of Pole Arrangement
 - Single sided
 - Opposite sided
 - Staggered
 - Twin-Central and Opposite Arrangement

NATIONAL LIGHTING CODE

- Preferred Pole Location
 - Trace the traffics flow and direction
 - Try to follow the shape of the road along with the traffic flow
 - Reduce spacing near bends
 - For complex multi level junctions, high mast lighting preferred instead of array of poles

NATIONAL LIGHTING CODE

- Lighting Parameters
 - Luminance
 - Illuminance

CLASSIFICATION OF ROADS

Description of Roads	Lighting Classification
High speed roads with separate carriageway, free of crossings at grade and with complete access control, motorways, express roads.	
Traffic density and complexity of road layout.	
High	M1
Medium	M2
Low	M3

CLASSIFICATION OF ROADS

Description of Roads	Lighting Classification
High speed roads, dual carriageway roads, traffic control, such as the presence of signals, and separation of different types of road user into lanes.	
Poor	M1
Good	M2
Important urban traffic roads, radial roads, distinct distribution roads.	
Traffic control and separation of different types of road users.	
Poor	M2
Good	M3

Description of Roads	Lighting Classification
Connecting less important roads, local distributor roads, residential major access roads, roads which provides direct access to property and lead to connecting roads.	
Traffic control and separation of different types of road user.	
Poor	M4
Good	M5

LIGHTING RECOMMENDATIONS FOR DIFFERENT ROAD TYPES-CIE CLASSIFICATION

Lighting Class	All Roads			Roads with few Junctions	Roads with Footways
	L_{av}	U_o	U_L (min)	TI (%) (max)	Surround Ratio (SR)
M1	2.0	0.4	0.7	10	0.5
M2	1.5	0.4	0.7	10	0.5
M3	1.0	0.4	0.5	10	0.5
M4	0.75	0.4	-	15	-
M5	0.5	0.4	0.4	15	-

Lighting Recommendations for Different Road Types-IS Classification

Classification of lighting installation	Type of road	Average illuminance on road surface	Uniformity Ratio E_{min}/E_{av}	Transverse Uniformity (E_{min}/E_{max})
Group A1	Important traffic routes carrying fast traffic	30	0.4	0.33
Group A 2	Other main roads carrying mixed traffic like main city streets, arterial roads and throughway roads	15	0.4	0.33

Lighting Recommendations for Different Road Types-IS Classification

Classification of lighting installation	Type of road	Average illuminance on road surface	Uniformity Ratio E_{min}/E_{av}	Transverse Uniformity (E_{min}/E_{max})
Group B 1	Secondary roads with considerable traffic like principal local traffic routes and shopping	8	0.3	0.2
Group B 2	Secondary roads with light traffic	4	0.3	0.2

LIGHTING RECOMMENDATIONS FOR JUNCTIONS

Junction Type	E_{av} (Lux)	E_{min}/E_{av}
Key Junctions & Complex Flyover interchanges	50	0.4
Main City Junctions without any interchanges	20	0.4
Other smaller junctions	15	0.4
Pedestrian Crossings	50 *	-
Bus Bays	5	-

MAINTENANCE FACTOR

		MIN IP 5X			MIN IP 6X	
		Pollution Category			Pollution Category	
Cleaning Interval in months	High	Medium	Low	High	Medium	Low
12	0.89	0.90	0.92	0.91	0.92	0.93
18	0.87	0.88	0.91	0.90	0.91	0.92
24	0.84	0.86	0.90	0.88	0.89	0.91
36	0.76	0.82	0.88	0.83	0.87	0.90

LIGHTING SYSTEM SPECIFICATION

- Luminaire
 - Housing
 - Optical System
 - Lamp
- Controlgear
 - Ballast
 - Ignitor
 - Capacitor

SELECTION CRITERIA OF LUMINAIRE

- Mechanical
- Electrical
- Required lamp types
- Ambient operation temperature
- Required IP rating
- Air resistance, with/without bowl, with/without gear unit
- Component exchangeability, accessories
- Mounting functionality
- Material requirement

SELECTION CRITERIA OF LAMPS

- Colour temperature (T_c)
- Colour rendering (CRI)
- Lumen output
- Lamp efficacy
- Lumen depreciation
- Lamp life (hours)

CONTROL SYSTEM

- Control Switch
- Time Switch
- Photo Electric Switch
- Computerized Switch
- Step Dimming
 - Step Dimming ballast.
 - Preprogrammed Timer.
 - Power factor improvement capacitor.
 - Semi-parallel ignitor
- Tele Management

PHOTOMETRIC SPECIFICATION

- Key Elements
 - Type of distribution
 - Luminaire efficacy
 - Need for optic or lamp position adjustment
- Lighting Control Elements
 - Reflector
 - Refractor
 - Diffuser
 - Filter
 - Screening Device

LUMINAIRE PHOTOMETRIC PRINCIPLE

- Throw: The extent to which the light from the Luminaire is distributed along a road
- Spread: The amount of sideways spread of the light, across a road
- Control: The extent of the facility for controlling glare from the Luminaire

EVALUATION OF GOOD ROAD LIGHTING INSTALLATION

- Total cost of ownership
 - Preparation phase: Design, purchase and installation cost = Initial Investment
 - Running phase: Energy cost and maintenance cost
 - Total cost = Investment + Energy + Maintenance

ECONOMIC SOLUTION FOR COST REDUCTION

- Reducing investment Costs:
 - Increase luminaire spacing
 - Use single sided or central arrangement
 - Use of energy efficient luminaire
 - Use existing cable and photo cell
 - Post top luminaire mounting

ECONOMIC SOLUTION FOR COST REDUCTION

- Reducing Energy Costs:
 - Install the most efficient lighting system = lamp efficacy and luminaire application efficiency (for example using adjustable optics)
 - Choice of maintenance factor (lamp depreciation and IP factor)

ECONOMIC SOLUTION FOR COST REDUCTION

- Reducing Maintenance Cost
 - Minimize number of light points by increasing luminaire spacing
 - Lamps with long life and low early failure rate
 - Conscious decision for group or spot replacement
 - Reliable, longer life controlgear
 - Luminaire with high IP rating
 - Luminaire which is easy to maintain

APPROACHES TOWARDS MASTER PLAN

- For some roads technical specs are of first priority and for some other roads aesthetics is of first priority
 - Technical Specifications required for:
 - ✓ Ring Roads /Peripheral Expressways
 - ✓ City Roads, Main Vehicular Traffic
 - ✓ Residential Roads
 - Aesthetics is required for the following roads:
 - ✓ Heritage Roads / Celebration Routes
 - ✓ City Centre /Shopping Areas/Pedestrian Plaza

APPROACHES TOWARDS MASTER PLAN

- The aesthetics can be achieved by selecting one or more of the following procedures:
 - Different Lighting Levels
 - Different Shape of Luminaires
 - Different Pole design
 - Different Pole Arrangement

MEASUREMENT

- CIE Method
- Field Measurement

THANK YOU