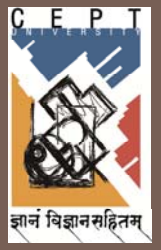
Energy Conservation Building Code (ECBC)

Lighting



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Implementation of Energy Conservation Building Code
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Lighting: Outline

- **Introduction**
- **Whole Building Design Approach**
- **ECBC Requirements**
  - **Mandatory**
  - **Prescriptive**
- **ECBC Compliance Forms**

Introduction

- Lighting is a major energy consumer in commercial buildings
- Lighting accounts for 15% of total energy consumption in India
  - Commercial Buildings 20-40%
- In most commercial buildings, lighting is one of the largest sources of internal heat gain
  - Heat generated from electric lighting contributes significantly to the energy needed for cooling of buildings
  - Each kilowatt-hour (kWh) reduction in lighting energy approximately saves 0.4 kWh in cooling energy
- Lighting is one of the fastest developing energy-efficient technologies

Whole Building Design Approach

1. **Improve the space**
2. **Optimize light quality**
3. **Capture Daylight**
   - Daylighting Design Approaches
   - Energy savings and demand reduction
   - Glazing selection
   - Redirecting daylight
   - Controls for daylight dimming
4. **Consider lighting quantity**
5. **Energy-efficient electric lighting**
6. **Use of lighting controls**

SOURCE: E Source Technology Atlas Series, Volume I Lighting (2005)

ECBC Requirements: Overview

ECBC Lighting Requirements apply to:

- **Interior spaces** of buildings
- **Exterior building features,** including façades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies
- **Exterior building grounds** lighting that is provided through the building's electrical service
- The **mandatory requirements** for lighting mostly relate to **interior and exterior lighting controls.**
- The **prescriptive requirements** limit the **installed electric wattage** for interior building lighting.
  - Demonstrated through the Building Area Method or the Space Function Method

ECBC Requirements: Mandatory

Automatic Lighting Control

- Interior lighting systems in buildings larger than 500 m^2 (5,000 ft^2) shall be equipped with an automatic control device.
  - All office areas less than 30 m^2 (300 ft^2) shall be equipped with occupancy sensors.
  - For other spaces, this automatic control device shall function on either:
    - A scheduled basis at specific programmed times. An independent program schedule shall be provided for areas of no more than 2,500 m^2 (25,000 ft^2) and not more than one floor;

      or
    - Occupancy sensors that shall turn the lighting off within 30 minutes of an occupant leaving the space. Light fixtures controlled by occupancy sensors shall have a wall-mounted, manual switch capable of turning off lights when the space is occupied.

ECBC Requirements: Mandatory

Space Control

- Each space shall have at least one control device to independently control the general lighting
- Each control device shall be activated either manually by an occupant or automatically by sensing an occupant.
- Each control device shall:
  - Control a maximum of 250 m^2 for a space less than or equal to 1,000 m^2, and a maximum of 1,000 m^2 for a space greater than 1,000 m^2
  - Be capable of overriding the shutoff control required in Automatic Lighting Shutoff for no more than 2 hours
  - Be readily accessible and located so the occupant can see the control

ECBC Requirements: Mandatory

Daylighting Control

If Daylighting strategy is used in the design, ECBC requires controls that can reduce the light output of luminaires in the daylit space.

- Luminaire in daylighted areas greater than 25m^2 shall be equipped with either a manual or automatic control device that:
  - Is capable of reducing the light output of the luminaires in the daylighted areas by at least 50%
  - Controls only the luminaires located entirely within the daylighted area

- There are also control requirements for exterior lighting (with photosensor or time switches) and specialty lighting applications (i.e. displays, hotel rooms, task lighting).

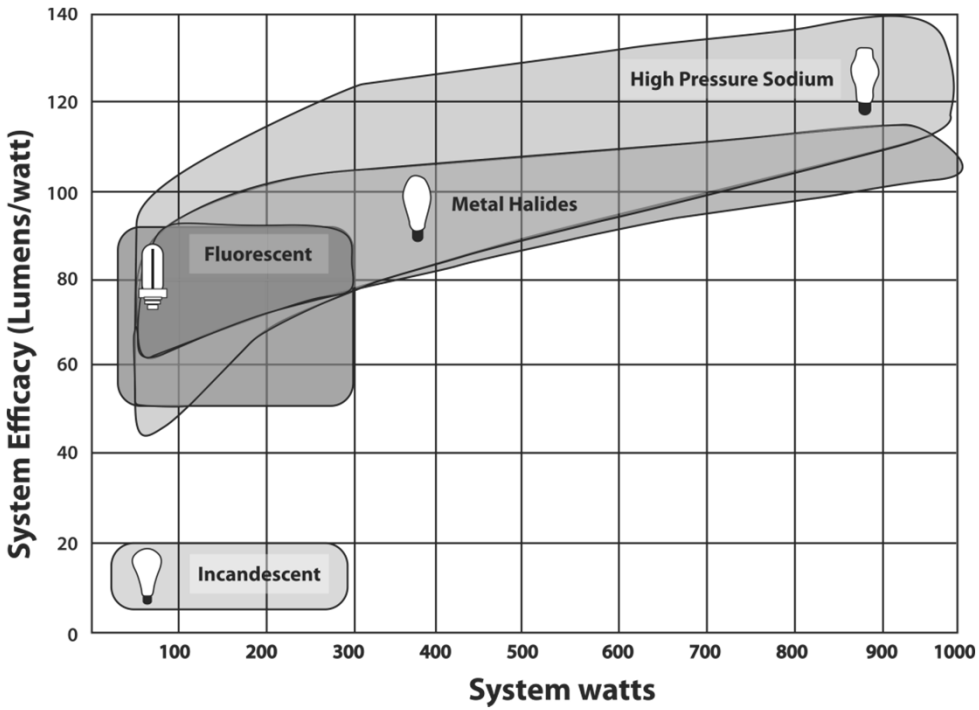
ECBC Requirements: Mandatory

Exit Signs

- Internally-illuminated exit signs shall not exceed 5W per face.

Exterior Building Grounds Lighting

- Lighting for exterior building grounds luminaires which operate at greater than 100W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor



Exterior Grounds Lighting and specific Technologies

NOTE: *Luminaires meeting these requirements include fluorescent, mercury vapor and high pressure sodium*

SOURCE: (Image) Adapted from ASHRAE/IESNA Standard 90.1-1999

ECBC Requirements: Prescriptive

Interior Lighting Power

- Prescriptive lighting requirements limit the installed electric wattage for interior building lighting
- Trade-offs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are NOT permitted
- Installed lighting power is calculated and compared using the maximum permissible interior lighting power densities
  - Specified for various building types (Building Area Method)

    OR
  - Building space functions (Space Function Method)

ECBC Requirements: Prescriptive

Building Area Method

1. Determine the allowed lighting power density (LPD) from Table 7.1 of ECBC for each appropriate building area type
2. Calculate the gross lighted floor area type
3. Multiply the allowed watts/sq.mt. Listed for each selected building type by the corresponding lighted floor areas to determine the allowed LPD
4. The sum of all the interior lighting power for various areas of the building cannot exceed the total watts to be in compliance

Table 7.1: Interior Lighting Power-Building Area Method

Building Area Type	LPD (W/m^2)	Building Area Type	LPD (W/m^2)
Automotive Facility	9.7	Multifamily Residential	7.5
Convention Center	12.9	Museum	11.8
Dining: Bar Lounge/Leisure	14.0	Office	10.8
Dining: Cafeteria/Fast Food	15.1	Parking Garage	3.2
Dining: Family	17.2	Performing Arts Theater	17.2
Dormitory/Hostel	10.8	Police/Fire Station	10.8
Gymnasium	11.8	Post Office/Town Hall	11.8

ECBC Requirements: Prescriptive

Space Function Method

1. Determine the appropriate building type and their allowed lighting power densities, which varies according to the function of the space
2. For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area.
3. The lighting power allowance for a space is the product of the gross lighted floor area of the space times the allowed lighting power density for that space.
4. The interior lighting power allowance for the building is the sum of the lighting power allowances for all spaces.

Table 7.2: Interior Lighting Power – Space Function Method

Space Function	LPD (W/m²)	Space Function	LPD (W/m²)
Office-enclosed	11.8	• For Reading Area	12.9
Office-open plan	11.8	Hospital	
Conference/Meeting/Multipurpose	14.0	• For Emergency	29.1
Classroom/Lecture/Training	15.1	• For Recovery	8.6
Lobby*	14.0	• For Nurse Station	10.8
• For Hotel	11.8	• For Exam Treatment	16.1
• For Performing Arts Theater	35.5	• For Pharmacy	12.9

ECBC Requirements: Prescriptive

Exterior Lighting Power

- The connected exterior lighting power must not exceed the allowed limits by ECBC.
- Trade-offs between applications are not permitted.

Table 7.3: Exterior Building Lighting Power

Exterior Lighting Applications	Power Limits
Building entrance (with canopy)	13 W/m^2 (1.3 W/ft^2) of canopied area
Building entrance (without canopy)	90 W/lin m (30 W/lin f) of door width
Building exit	60 W/lin m (20 W/lin f) of door width
Building facades	2 W/m^2 (0.2 W/ft^2) of vertical facade area

ECBC Compliance Forms

15.5 Lighting Summary

Lighting Summary

2007 Energy Conservation Building Code Compliance Forms

Project Info	Project Address	Date
		For Building Department Use
	Applicant Name:	
	Applicant Address:	
	Applicant Phone:	

Project Description	☐ New Building ☐ Addition ☐ Alteration ☐ Change of Use	
Compliance Option	☐ Prescriptive ☐ Systems Analysis	
Alteration Exceptions (check box, if appropriate)	☐ Less than 50% of the fixtures are new and installed lighting wattage is not being increased	

Maximum Allowed Lighting Wattage (Interior, Section 7.3)

Location (floor/room no.)	Occupancy Description	Allowed Watts per m^2 **	Area in m^2	Allowed x Area
	** Document all exceptions		Total Allowed Watts	

Proposed Lighting Wattage (Interior)

Location (floor/room no.)	Fixture Description	Number of Fixtures	Watts/ Fixture	Watts Proposed
	Total Proposed Watts may not exceed Total Allowed Watts for Interior		Total Proposed Watts	

Maximum Allowed Lighting Wattage (Exterior, Section 7.4)

Location	Description	Allowed Watts per m^2 or per lm	Area in m^2 (or lm for perimeter)	Allowed Watts x m^2 (or x lm)
			Total Allowed Watts	

Proposed Lighting Wattage (Exterior)

Location	Fixture Description	Number of Fixtures	Watts/ Fixture	Watts Proposed
	Total Proposed Watts may not exceed Total Allowed Watts for Exterior		Total Proposed Watts	

15.6 Lighting Permit Checklist

Lighting Permit Checklist **LIGHTING Checklist**

2007 Energy Conservation Building Code Compliance Forms

Project Address					Date	
The following information is necessary to check a building permit application for compliance with the lighting requirements in the Energy Conservation Building Code 2007						
Applicability (yes, no, n.a.)		Code Section	Component	Information Required	Location on Plans	Building Department Notes
LIGHTING (Chapter 7)						
MANDATORY PROVISIONS (Section 7.2)						
		7.2.1	Lighting controls			
		7.2.1.1	Automatic shutoff	Indicate automatic shutoff locations or occupancy sensors		
		7.2.1.2	Space control	Provide schedule with type, indicate locations		
		7.2.1.3	Daylight zones	Provide schedule with type and features, indicate locations		
		7.2.1.4	Exterior lighting control	Indicate photosensor or astronomical time switch		
		7.2.1.5	Additional control	Provide schedule with type, indicate locations		
		7.2.2	Exit signs	Indicate 5 watts maximum		
		7.2.3	Exterior building grounds lighting	Indicate minimum efficacy of 60 lumens/Watt		
PRESCRIPTIVE INTERIOR LIGHTING POWER COMPLIANCE OPTION (Section 7.3)						
		7.3		Indicate whether project is complying with the Building Area Method (7.3.2) or the Space Function Method (7.3.3)		
		7.3.2	Building area method	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.		
		7.3.3	Space function method	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.		
		7.3.4.1	Luminaire wattage	Indicate on plans		
PRESCRIPTIVE EXTERIOR LIGHTING POWER COMPLIANCE OPTION (Section 7.3.5)						
		7.3.5	Exterior Lighting Power	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.		
ELECTRICAL POWER (Chapter 8)						
MANDATORY PROVISIONS (Section 8.2)						
		8.2.1	Transformers	Provide schedule with transformer losses		
		8.2.2	Motor efficiency	Provide equipment schedule with motor capacity, efficiency		
		8.2.3	Power factor correction	Provide schedule with power factor correction		
		8.2.4	Check metering	Provide check metering and monitoring		

Contact Information

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