

# Role of ECBC User Guide in Implementation of ECBC

National ECBC Workshop  
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# ECBC User Guide



Administrative Guidance

Technical Guidance

Compliance/ Checklist

Case Studies/Examples

References

Energy Conservation Building Code (ECBC)

User Guide



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**ECBC  
User Guide**

**Objective**

**Administration**

**Min Performance  
Stand.**

**NBC**

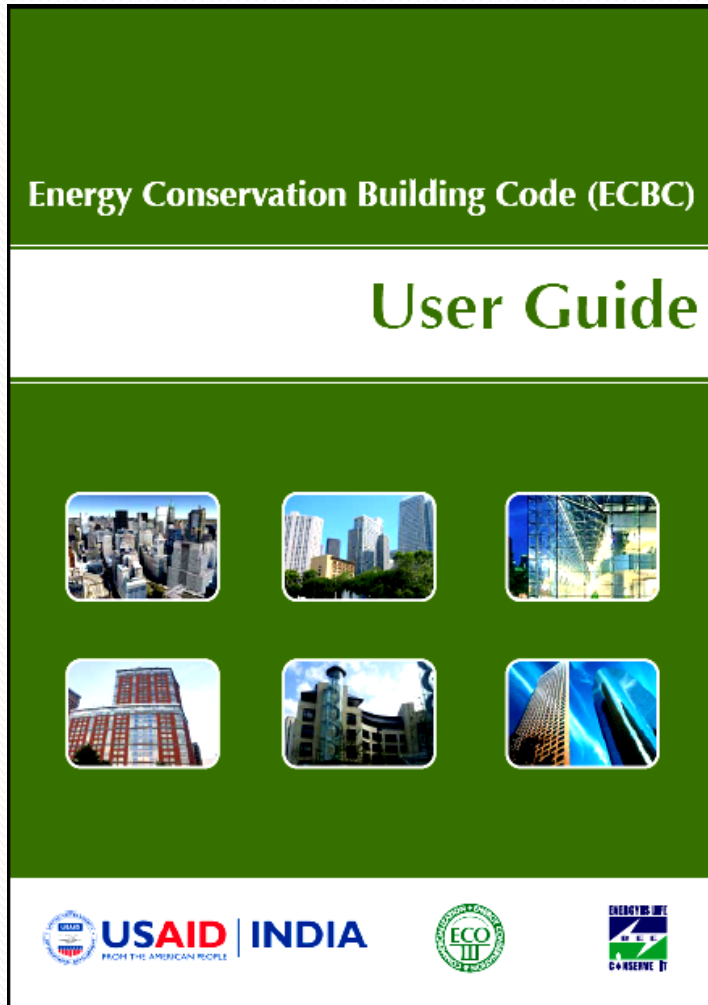
**Energy  
Simulation**

**Checklist**

**Future  
Actions**

# ECBC User Guide *(cont.)*

- Contains information related to
  - Purpose
  - Scope
  - Administration and enforcement
  - Building envelope
  - Heating, ventilation, & air conditioning
  - Service water heating & pumping
  - Lighting
  - Electrical power
  - Appendixes
    - A: ECBC definitions, abbreviations, and acronyms
    - B: whole building performance method
    - C: climate zone map of India
    - D: Supplemental material
    - E: Comparison of international building energy standards
    - F: References
    - G: ECBC compliance forms



# ECBC User Guide *(cont.)*

- How to use this guide
  - Text in Navy Blue is excerpted from ECBC
  - Frequently Asked Questions (FAQ) and examples are placed inside a box
  - Normal body text shows the text of User Guide

The Code is applicable to buildings or building complexes that have a connected load of 500 kW or greater or a contract demand of ..

### Box 1-A: : Role of

The ECBC building envelope defines five climate zones and their weather profiles (Appendix A). Buildings and their physical components that are applicable to these physical manifestations

It also explains the concept of visual light transmittance and Effective Aperture of Glazing. The prescriptive requirements place minimum

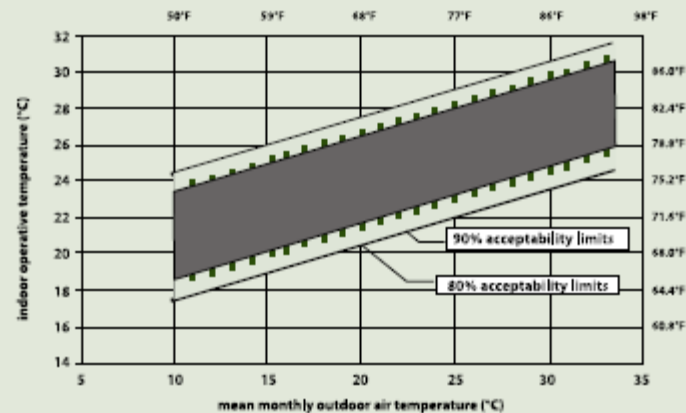
ECBC User Guide	Objective	Administration	Min Performance Stand.	NBC	Energy Simulation	Checklist	Future Actions
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## Box 5-E: Optional Method for Determining Acceptable Thermal Conditions in Naturally Conditioned Spaces Based on Field Experiments Conducted in Tropical Countries

The adaptive model of thermal comfort is derived from a global database of 21,000 measurements taken primarily in office buildings in the tropical climate. The allowable operative temperature limits may not be extrapolated to outdoor temperature above and below the end points of the curves in this figure. If the mean monthly outdoor temperature is less than 10°C or greater than 33.5°C, this option may not be used. Occupant-controlled naturally conditioned spaces are those spaces where the thermal conditions of the space are regulated primarily by the occupants through opening and closing of windows. Field experiments have shown that occupants' thermal responses in such spaces depend in part on the outdoor climate and may differ from thermal responses in buildings with centralized HVAC systems primarily because of the different thermal experiences, changes in clothing, availability of control, and shifts in occupant expectations. This optional method is intended for such spaces.

In order for this optional method to apply, the space must be equipped with operable windows that open to the outdoor and that can be readily opened and adjusted by the occupants of the space. Mechanical ventilation with unconditioned air may be utilized, but opening and closing of windows must be the primary means of regulating the thermal conditions in the space. The space may be provided with a heating system, but this optional method does not apply when a heating system is in operation. It applies only to spaces where the occupants are engaged in near sedentary physical activities, with metabolic rates ranging from 1.0 met to 1.3 met. This optional method applies only to spaces where the occupants may freely adapt their clothing to the indoor and/or outdoor thermal conditions.

Limits on Temperature Drifts and Ramps					
Time Period	0.25h	0.5h	1h	2h	4h
Maximum Operative Temperature Change Allowed	1.1° C (2.0°F)	1.7° C (3.0°F)	2.2° C (4.0°F)	2.8° C (5.0°F)	3.3° C (6.0°F)



Acceptable operative temperature ranges for naturally conditioned spaces.

Allowable indoor operative temperature for spaces that meet these criteria may be determined from figure. This figure includes two sets of operative temperature limits- one for 80% acceptability and one for 90% acceptability. The 90% acceptability limits may be used when a higher standard of thermal comfort is desired.

Source: ASHRAE 55, 2004.

# ECBC User Guide (cont.)

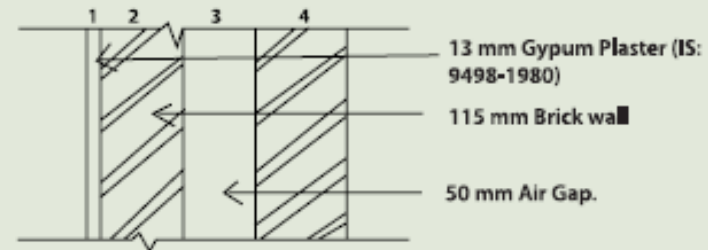
- Box
  - Optional Method for Determining Acceptable Thermal Conditions in Naturally Conditioned Spaces Based on Field Experiments Conducted in Tropical Countries

# ECBC User Guide (cont.)

- Example
  - R -Value Calculations for Cavity Wall with Plaster

## Example 4.2: R-Value Calculations for Cavity Wall with Plaster

Cavity Wall with Plaster ect.



$R_1$ : Resistance for Layer 1 (13 mm Gypsum Plaster) =  $0.013/k = 0.056 \text{ Km}^2/\text{W}$

$R_2$ : Resistance of Layer 2 (115 mm brick wall): =  $0.115/1.24 = 0.1426 \text{ Km}^2/\text{W}$

$R_3$ : Resistance of Layer 3 (50 mm air gap):  $0.18 \text{ Km}^2/\text{W}$  (from Table xx)

$R_4$ : Resistance of Layer 4 (115 mm brick wall):  $0.1426 \text{ Km}^2/\text{W}$  (as above)

$R_T$ : Minimum R-Value for the composite wall =  $R_1 + R_2 + R_3 + R_4 = 0.056 + 0.1426 + 0.18 + 0.1426 = 0.5212 \text{ Km}^2/\text{W}$

$R_f$ :  $R_a + R_r + R_{in} = 0.1 + 0.5212 + 0.04 = 0.6612$

Maximum U-Value for the composite wall:  $U_{min} = 1/R_f = 1 / 0.6612 = 1.5124017 \text{ W/m}^2\text{K}$

# ECBC User Guide *(cont.)*

- FAQs
  - Glazing Selection for ECBC Compliance

## Box 4-N: Glazing Selection for ECBC Compliance

**What is the most important feature that a building professional should look for regarding windows, doors, and skylights?**

The SHGC and U-factor ratings are the most important items to verify during inspections. Building professionals should verify that the ratings of the installed windows, doors, and skylights meet or exceed the ratings specified on the plans. It is also important to verify that the same window area has been installed as the area shown on the plans and that the glass orientation on the plans and building are consistent.

**What is Solar Heat Gain Coefficient?**

The Solar Heat Gain Coefficient (SHGC) is a measure of the percentage of heat from the sun that gets through a window or other fenestration product. The SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits to the interior of the building. SHGC can also refer to shading so the lower the SHGC the more effective the product is at shading the heat gain from entering the interior.

**What is low-e glass?**

Low-e stands for low-emissivity and refers to a special coating that reduces the heat transfer of a window assembly. Low-e coated products that reduce solar heat gain can be produced by adding a metallic coating either while the glass is in a molten state or by applying to the glass after it has cooled to a solid state. Low-e glass is readily available from all the glass and window manufacturers. The coatings typically add about 10% to the cost of a window but costs vary by product type, by manufacturer, by retailer and by location.

**What is spectrally selective glass?**

The sun emits visible solar radiation in the form of light and infra-red radiation that cannot be seen, but causes heat. Spectrally selective glass transmits a high proportion of the visible solar radiation, but screens out radiant heat from the sun – significantly reducing the need to cool a building's interior. Spectrally selective glass is used to describe low-e coated glass that lowers the SHGC.

**How can I be sure I have spectrally selective glass?**

The SHGC rating for the product is the key to determining whether you have glass with a spectrally selective coating. In general, windows with a spectrally selective low-e coating will have SHGC ratings of 0.40 or lower.



# Why is User Guide Important?

- ECBC Compliance & Implementation
  - Prescriptive option
  - Trade-off option
  - Whole Building Performance option
- Fills essential gaps in ECBC (revised version – 2008)
  - Creation of Standard and Proposed Design
  - Tables for all Standards References

ECBC User Guide	Objective	Administration	Min Performance Stand.	NBC	Energy Simulation	Checklist	Future Actions
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# Why is User Guide Important?

## Building System

Envelope

HVAC

Lighting

Electric Eqpt &  
Systems

Service Hot  
Water and  
Pumping

## Compliance Options

**Prescriptive  
Option**

**Trade Off  
Option**

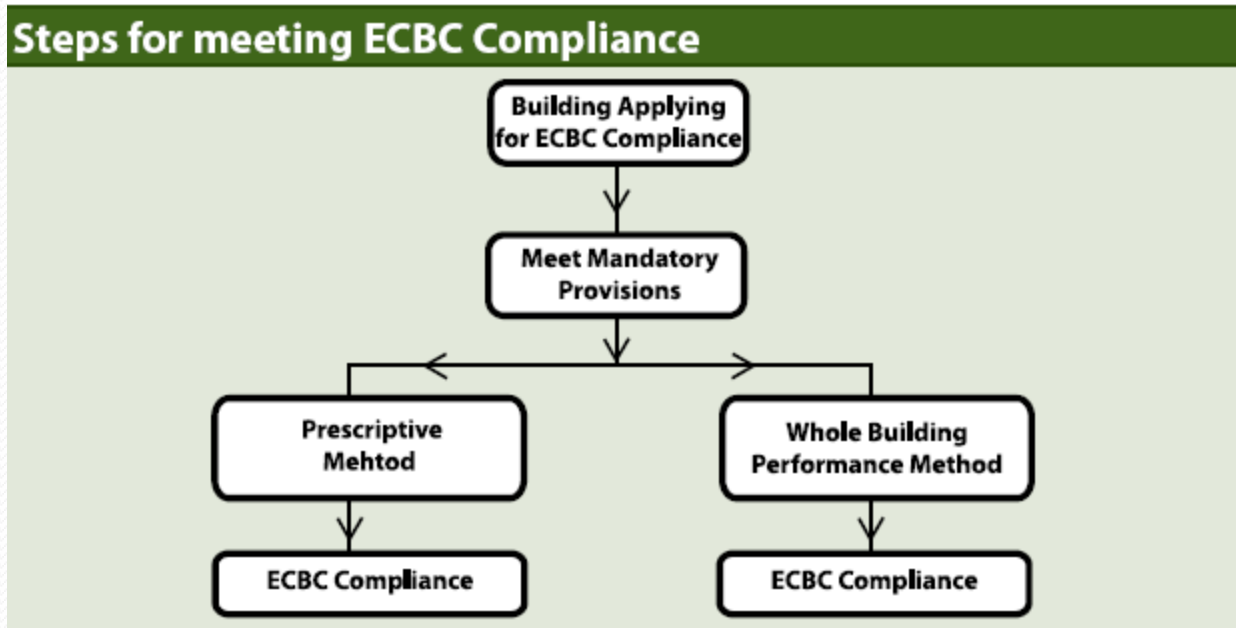
**Whole Building  
Performance**

Mandatory  
Provisions  
(required for most  
compliance options)

Energy Code  
Compliance

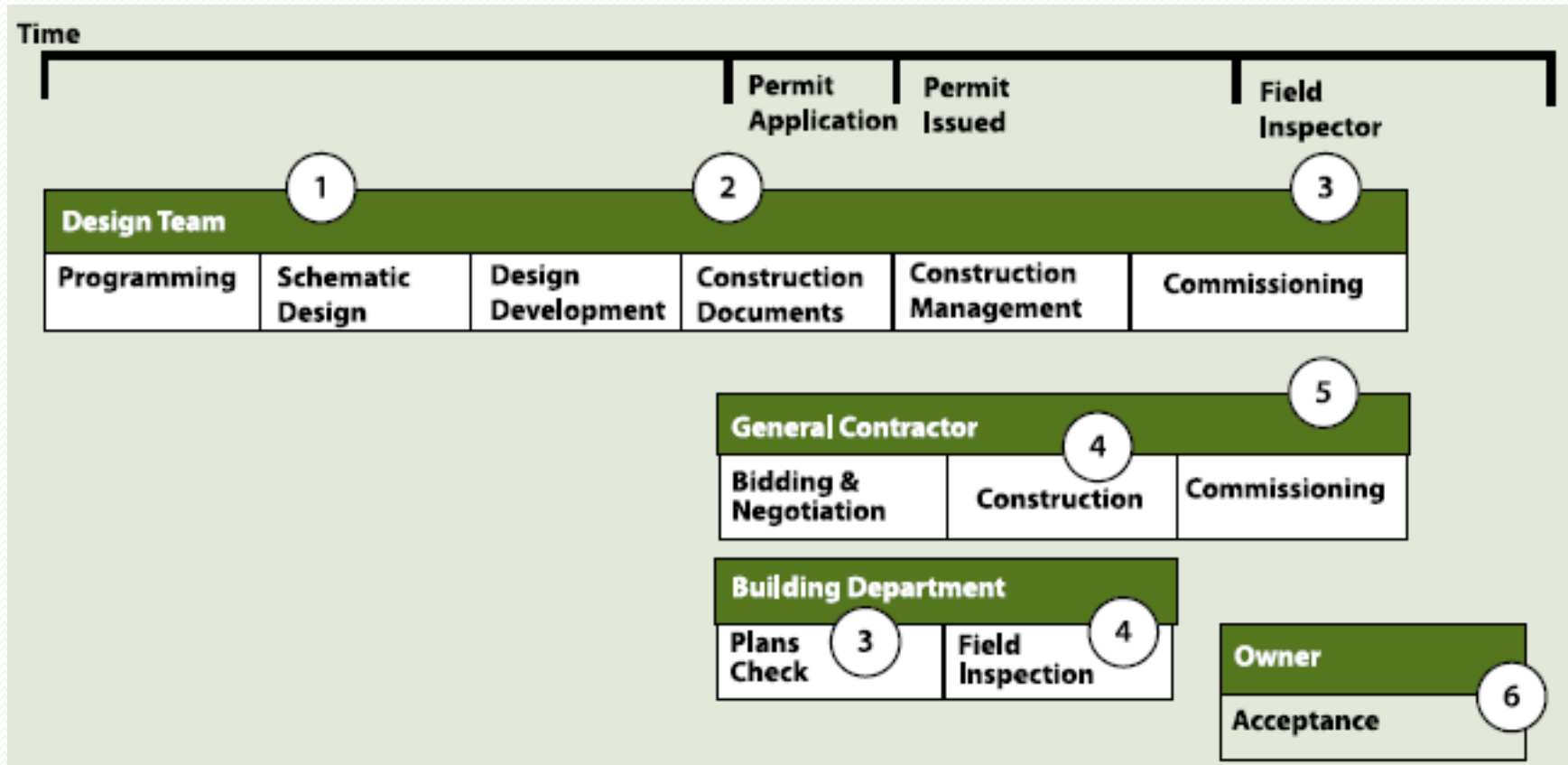
# Chapter 3: Administration & Enforcement

- Decision on “Authority Having Jurisdiction”
- The Building Design & Construction Process



# Chapter 3: Administration & Enforcement

(cont.)



Source: ASHRAE



# Minimum Energy Performance Standard (MEPS)

- ECBC code refers to MEPS
- ECBC User Guide now has all the tables for minimum performance specifications
- BIS should review its MEPS recommendations
  - MEPS should be consistent with BEE's Star Labeling Program
  - MEPS << Energy Efficiency level of single star of BEE in some cases



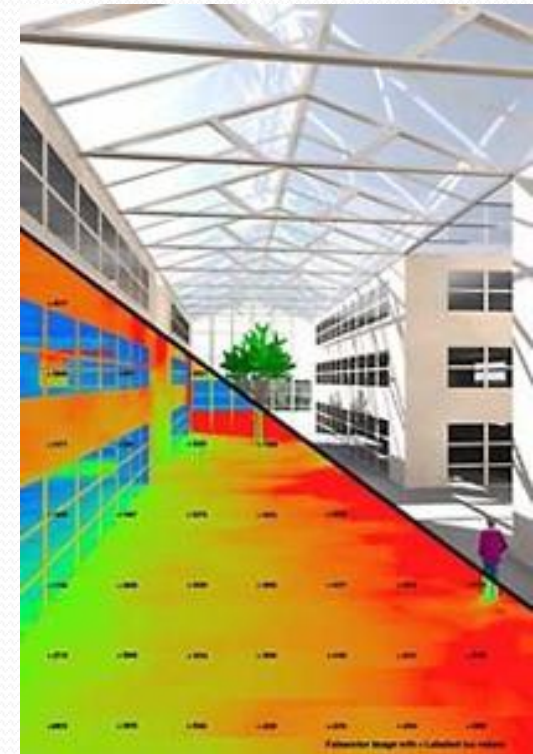
# Reference to National Building Code (NBC)

- ECBC User Guide specifically refers NBC for Natural Ventilation Process in HVAC Section (ECBC § 5.2.1)
- Reference standards must provide recommendations
  - Unambiguous procedure/specs
  - Reference to general standards undesirable
- Give credit where it is due and use them to our advantage
  - ASHRAE 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings
  - ASHRAE/ANSI 55: Thermal environmental conditions for human occupancy
  - ASHRAE 62: Ventilation for acceptable indoor air quality

ECBC User Guide	Objective	Administration	Min Performance Stand.	NBC	Energy Simulation	Checklist	Future Actions
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# Energy Simulation Procedure

- Reduces Heating/Cooling Load
  - Optimized HVAC Design
  - Right Sizing of Chillers, Fans and Ducts
- Helps in Optimizing Daylight
  - Optimized Lighting System Design
- First Cost AND Recurring Savings
- Helps in Utilizing Latest Technological Advances
  - Thermal and Optical properties of Glazing
- Simulation Models Greatly Aid in designing High Performance Envelopes





# Energy Simulation Procedure

- The User Guide Complements ECBC
  - On whole building performance method
    - Assumptions are now included
    - Case study (ECBC demonstration project) is now included in ECBC User Guide Chapter 10.
  - Acknowledgement to ASHRAE
    - Most authoritative reference on this topic
    - Indian users are already well familiar with the ASHRAE std.
  - System wise
    - Heating equipment

# Energy Simulation Procedure

- ECBC is mostly silent on heating systems
  - Though India is a hot dominant region, code should provide comprehensive guidance to all types of climatic regions.
  - Boiler/furnace performance standard should be specified by BIS
  - BIS standards include test methods for many systems/equipment
    - Unavailability of efficiency specs in many cases makes BIS inappropriate reference
- Detailed guidance on WBP method included to help user community

# Energy Simulation Procedure

- ECBC User Guide Case Study
  - Explains whole building performance method



Fig. 6, Front Elevation

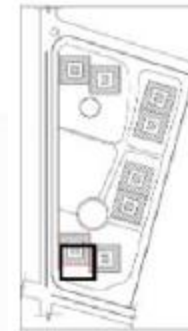


Fig. 1, Site Plan

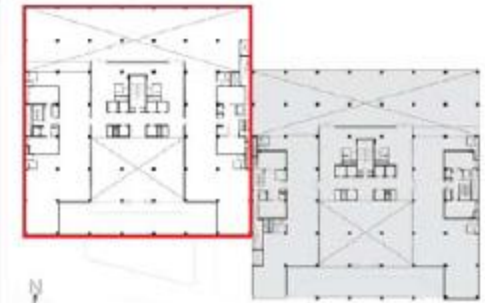
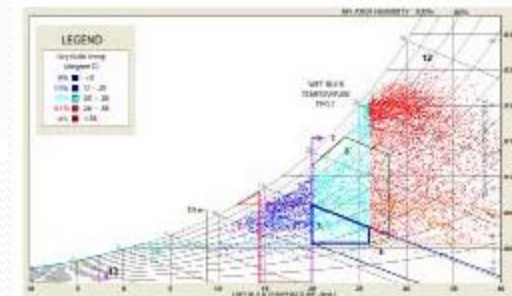


Fig. 2, Ground Floor Plan



# Role of Check Lists

- Compliance process
  - prerequisite information
- Capacity to be developed for
  - Checking of drawings
  - Data sufficiency

ECBC User Guide	Objective	Administration	Min Performance Stand.	NBC	Energy Simulation	Checklist	Future Actions
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# Role of Check List - Prescriptive

## Envelope Summary - Checklist

Envelope Summary		ENVELOPE Summary	
2005 India Energy Conserving Building Code Compliance Form		Draft 1, 27 March 2005	
Project Info	Project Address	Date	
		For Building Department Use	
	Applicant Name:		
	Applicant Address:		
	Applicant Phone:		
Project Description	<input type="checkbox"/> New Building <input type="checkbox"/> Addition <input type="checkbox"/> Alteration <input type="checkbox"/> Change of Use		
Compliance Option	<input type="checkbox"/> Prescriptive <input type="checkbox"/> Envelope Trade-Off (Appendix D) <input type="checkbox"/> Systems Analysis		
	<input type="radio"/> Hospital, hotel, call center (24 hour) <input type="radio"/> Other building types (daytime)		
Vertical Fenestration Area Calculation	Total Vertical Fenestration Area (rough opening)	divided by	Gross Exterior Wall Area times 100 equals % Vertical Fenestration
		<input type="text"/>	X 100 =
Note: Vertical fenestration area can not exceed 40% of the gross wall area for prescriptive option.			
Skylight Area Calculation	Total Skylight Area (rough opening)	divided by	Gross Exterior Wall Area times 100 equals % Skylight
		<input type="text"/>	X 100 =
Note: Skylight area can not exceed 5% of the gross roof area for prescriptive compliance.			
Hospital, hotel, call center (24 hour)		Other building type (daytime)	
<b>OPAQUE ASSEMBLY</b> Roof    m insulation R-value Wall    m insulation R-value		<b>OPAQUE ASSEMBLY</b> Roof    m insulation R-value Wall    m insulation R-value	
<b>FENESTRATION</b> Vertical Maximum U-factor Maximum SHGC (or SC) Overhang (yes or no) If yes, enter Projection Factor Side fins (yes or no) If yes, enter Projection Factor Skylight Maximum U-factor Maximum SHGC (or SC)		<b>FENESTRATION</b> Vertical Maximum U-factor Maximum SHGC (or SC) Overhang (yes or no) If yes, enter Projection Factor Side fins (yes or no) If yes, enter Projection Factor Skylight Maximum U-factor Maximum SHGC (or SC)	



# Role of Check List -Prescriptive

## Mechanical Permit Checklist

Mechanical Permit Checklist				MECHANICAL Checklist		
2005 India Energy Conservation Building Code Compliance Form				Draft 1, 27 March 2005		
Project Address				Date		
The following information is necessary to check a building permit application for compliance with the mechanical requirements in the 2005 India Energy Conservation Building Code.						
Applicability (yes, no, n.a.)	Code Section	Component	Information Required	Location on Plans	Building Department Notes	
<b>HEATING, VENTILATING, AND AIR CONDITIONING (Chapter 5)</b>						
<b>MANDATORY PROVISIONS (Section 5.2)</b>						
	5.2.1	Equipment efficiency	Provide equipment schedule with type, capacity, efficiency			
	5.2.2	Controls				
	5.2.2.1	Timers/clocks	Indicate thermostat with night setback, 3 different day types, and 2-hour manual override			
	5.2.2.2	Temp. & deadband	Indicate temperature control with 3 degree C deadband minimum			
	5.2.2.3	Cip tower, fluid cooler	Indicate two-speed motor, pony motor, or variable speed drive to control the fans			
	5.2.3	Piping & ductwork	Indicate sealing, caulking, gasketing, and weatherstripping			
	5.2.3.1	Piping insulation	Indicate R-value of insulation			
	5.2.3.2	Ductwork insulation	Indicate R-value of insulation			
	5.2.3.3	Ductwork sealing	Specify sealing types and locations			
	5.2.4	System balancing	Specify system balancing			
<b>PRESCRIPTIVE COMPLIANCE OPTION (Section 5.3)</b>						
	5.3		Indicate whether project is complying with ECBC Prescriptive Option OR with ASHRAE Standard 90.1-2004			
	5.3.1	Economizer				
	5.3.1.1	Air economizer	Indicate 100% capability on schedule			
	5.3.1.2	Integrated operation	Indicate capability for partial cooling			
	5.3.1.3	Field testing	Specify tests			
	5.3.2	Variable flow hydronic				
	5.3.2.1	Pump flow rates	Indicate variable flow capacity on schedules			
	5.3.2.2	Isolation valves	Indicate two-way automatic isolation valves			
	5.3.2.3	Variable speed drive	Indicate variable speed drive			
<b>SERVICE WATER HEATING AND PUMPING (Chapter 6)</b>						
<b>MANDATORY PROVISIONS (Section 6.2)</b>						
	6.2.1	Solar water heating	Provide calculations to justify capacity to meet 20% threshold			
	6.2.2	Equipment efficiency	Provide equipment schedule with type, capacity, efficiency			
	6.2.3	Piping insulation	Indicate R-value of insulation			
	6.2.4	Heat traps	Indicate heat trap on drawings or provide manufacturers specifications to show that equipment has internal heat trap			
	6.2.5	Pool covers	Provide vapor retardant cover for pools			
	6.2.6	Pools over 32 C	Provide R-2.1 insulation			

## Lighting Permit Checklist

Lighting Permit Checklist				LIGHTING Checklist		
2005 India Energy Conservation Building Code Compliance Form				Draft 1, 27 March 2005		
Project Address				Date		
The following information is necessary to check a building permit application for compliance with the lighting requirements in the 2005 India Energy Conservation Building Code.						
Applicability (yes, no, n.a.)	Code Section	Component	Information Required	Location on Plans	Building Department Notes	
<b>LIGHTING (Chapter 7)</b>						
<b>MANDATORY PROVISIONS (Section 7.2)</b>						
	7.2.1	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	Ext. lighting control	Indicate photosensor or astronomical time switch			
	7.2.1.5	Additional control	Provide schedule with type, indicate locations			
	7.2.2	Tandem wiring	Show wiring on schedule			
	7.2.3	Ext. signs	Indicate 5 watts maximum			
	7.2.4	Ext. signs grounds lbs	Indicate minimum efficacy of 60 lumens/Watt			
<b>PRESCRIPTIVE INTERIOR LIGHTING POWER COMPLIANCE OPTION (Section 7.3)</b>						
	7.3		Indicate whether project is complying with the Building Area Method (7.3.1) or the Space Function Method (7.3.2)			
	7.3.1	Building area method	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.			
	7.3.2	Space function method	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.			
	7.3.3	Luminaire wattage	Indicate on plans			
<b>PRESCRIPTIVE EXTERIOR LIGHTING POWER COMPLIANCE OPTION (Section 7.4)</b>						
	7.4	Building area method	Provide lighting schedule with wattage of lamp and ballast and number of fixtures. Document all exceptions.			
<b>ELECTRICAL POWER (Chapter 8)</b>						
<b>MANDATORY PROVISIONS (Section 8.2)</b>						
	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			

# Role of Check List

– Performance Based

**Whole Building  
Performance Checklist**

**Performance Rating  
Method Compliance  
Table**

## 15.7 Whole Building Performance Checklist

Performance Rating Method Compliance Report		
Project Name		
Project Address		Date:
Designer of Record:		Telephone:
Contact person:		Telephone:
City:		
Weather Data:		
Climate Zone:		

Performance Rating Method Compliance Report		
Comparison of Proposed Design Versus Baseline Design Energy Model Inputs:		
Building Element	Proposed Design Input	Baseline Design Input
<i>Envelope</i>		
Above Grade Wall Construction(s)		
U factor 0.124		
U factor 0.124		
Below Grade Wall Construction		
Roof Construction		
U factor 0.063		
U factor 0.063		
Exterior Floor Construction		
Slab-on-Grade Construction		
Window-to-Gross Wall Ratio		
Fenestration Type(s)		
Fenestration Assembly U Factor		
Fenestration Assembly SHGC		
Fenestration Visual Light Transmittance		
Fixed Shading Devices		
Automated Movable Shading Devices		
<i>Electrical System &amp; Process Loads</i>		
Ambient lighting power density and Lighting Design Description.		
Process Lighting		
Lighting occupant Sensor Controls		
Day lighting Controls		

# Role of Check List – Performance Based

**Baseline Building Performance table**

Baseline Building Performance Table Baseline Energy Summary by End Use											
End use	Energy Type	0 rotation		90 rotation		180 rotation		270 rotation		Average	
		Energy (kWh)	Peak (kW)	Energy (kWh)	Peak (kW)	Energy (kWh)	Peak (kW)	Energy (kWh)	Peak (kW)	Energy (kWh)	Peak (kW)
Interior Lighting											
Exterior Lighting											
Space heating (Fuel 1)											
Space Cooling											
Pumps											
Heat Rejection											
Fans Interior											
Fans Parking garage											
Service Water Heating (Fuel 1)											
Receptacle Equipment											
Elevators and Escalators											
Other Process											
Total Building Consumption/Demand											
Total Process Energy											

**Performance Improvement Table**

	Proposed Building	Baseline Building	Percentage Improvement
Type	Energy Use (kWh)	Energy Use (kWh)	Energy (%)
<i>Nonrenewable (Regulated &amp; Unregulated)</i>			
Electricity			
Natural Gas			
Steam or Hot water			
Chilled Water			
Other			
Total Nonrenewable			
Regulated & Unregulated)			

# Future Actions

- Time line for updating the ECBC User Guide
  - BEE/ECO-III should take initiative
  - Governed by feedback from the practitioners
- ECBC Program Committee to take a call on making ECBC mandatory
  - Roles and Responsibilities
  - Submittal Requirements
  - Inspection Requirements
  - Transparent and Fast Approval Process

ECBC User Guide	Objective	Administration	Min Performance Stand.	NBC	Energy Simulation	Checklist	Future Actions
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# Future Actions

- Focus on right tools to make the process easy
- System should be automated
- Less use of administrative resources
- Remove guidance gaps in ECBC and its User Guide
- Provision of incorporation of new technology
- Promote sustainable material use
  - Local material use
  - Passive techniques

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# Acknowledgement

- USAID and BEE
- ASHRAE
- Indian Standards: BIS, NBC
- ECO-III team: Ravi Kapoor, Anurag Bajpai, Meetu Sharma, and Satish Kumar
- Rajan Rawal (CEPT), Vishal Garg & Surekha Tetali (IIIT), Jyotirmaya Mathur (MNIT)
- P C Thomas & G S Rao (Team Catalyst)
- Vasudha Lathey
- Others (included in ECBC development team)



# Thanks!

**For More Information, please contact**

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