Summary
of
Guidelines for Energy Efficiency Measures in Commercial and Residential Buildings

5th June, 2009

Submitted to

Ministry of New & Renewable Energy

Block No.14, C.G.O. Complex,
Lodhi Road
New Delhi-110003

By:
Environmental Design Solutions

Environmental
Design Solutions

A SET OF CLIMATE ZONE-WISE ENERGY EFFICIENCY GUIDELINES FOR COMERCIAL & RESIDENTIAL BUILDINGS

Summary

In India, there are several norms, regulations, codes and standards to establish energy efficient buildings that have been evolved by various ministries and government bodies. The MNRE invited consultants to bid for an assignment which shall harmonize various energy efficiency and renewable energy related codes/standards/ norms and guidelines for buildings and larger habitats.

The aim of this study is to propose a set of climatic zone-wise passive architectural guidelines including other energy efficiency and renewable measures for buildings both in residential & commercial sectors to be followed by CPWD and Municipal Corporations all over the country. The guidelines are in harmonization with ECBC 2007, NBC 2005, EIA notification 2006, other relevant IS codes.

The guidelines have taken into account the provisions of the National Building Code 2005; the Energy Conservation Building Code 2007 announced by BEE and other IS codes. The guidelines by its qualitative and quantitative assessment criteria would be able to ensure an optimized green building design focusing on passive and other energy efficient techniques. It would be applied to new building stock of varied functions – commercial, institutional, and residential.

Methodology

NOTE - National codes/standards referred for this project are duly referenced. In case of absence of a local code/standard a relevant international Code/standard is referred. However in absence of both relevant suggestions are proposed by EDS.

- By-laws of different regions/states like Delhi, NCR region, Jaipur etc are being reviewed to understand their respective structure and indentify possibilities of incorporating changes within these.
- To have better understanding of bye-laws and identify areas of synergies among the codes/ norms of the respective departments detailed discussion with BEE, BIS (Respective NBC 2005 Committee Members), MoEF, MOUD, GRIHA secretariat are being held.
- Relevant national codes/standards like ECBC 2007, NBC 2005, GRIHA and LEED etc are then referred to develop enforceable strategies and options to be incorporated as minimum standards in By-Laws. A list of all relevant common and congruous requirements of the codes and norms formulate one document that covers all aspects related to passive design, energy efficiency and renewable energy of above mentioned documents in logical sequence(under relevant sections within bye-laws) that will be followed by architects /building designers.
- Wherever relevant, a set of practically adoptable recommendations (with detailed specification) that can be used by an architect to design and implement suitable energy efficiency measures (emphasizing solar passive architectural techniques) in all climate zones are being recommended.
- The guidelines are formulated in a way such that the municipalities and development authorities should be able to incorporate these guidelines to modify building by laws as required.

- Future methodology – to have further necessary discussions with the officials of MNRE and GRIHA Secretariat during the time of preparing the documents and will incorporate suggestions made by them in the documents. Draft guidelines prepared may also be discussed by MNRE with MoUD and some Municipal Corporations and the suggestions made will be incorporated in the final document.

Recommendations

Based on the above methodology relevant recommendations are being made emphasizing on solar passive architectural techniques, energy efficiency along with thermal comfort for commercial and residential buildings under the following sections:

1. Envelope
2. Heating, Ventilation and Air-conditioning
3. Hot water and Pumping
4. Lighting
5. Passive Design

A document is being formulated to explain all the recommendations under the following categories:

- **Intent** of all the recommendations,
- **Performance requirements** which includes detail specifications of types of materials (including their physical properties like u-factor, r-value etc), efficient equipments (cooling, heating and lighting), design parameters such as orientation, shading devices, façade glazing ratios, thermal mass etc. These requirements are to be made mandatory under the respective sections as specified in Incorporated As and Under Section.
- **Prescriptive requirements** further elaborate quantitatively/qualitatively on the recommendations made under the performance requirements section by specifying the current maximum/minimum requirements taken from above mentioned codes and standards. In some cases where there are no existing requirements, relevant suggestions have been made by EDS itself.
- **Reference standard** all the National codes/standards referred for this project are duly referenced under this section. In case of absence of a local code/standard a relevant international Code/standard are referred. However in absence of both relevant suggestions is proposed by EDS.
- **Incorporated as and under (Only for Delhi Building Bye-Laws)** specifies the relevant section under which all the respective recommendations are suggested to be made mandatory. However, further suggestions are required from BEE, BIS, MoEF, MOUD, GRIHA secretariat for further clarity on incorporating such under respective categories.
- **Current requirements** specify the existing requirements if any under the bye-laws corresponding to the respective recommendation.

BUILDING TYPE - Non Residential

CATEGORY	Intent	PERFORMANCE REQUIREMENTS	PRESCIPTIVE REQUIREMENTS	REFRENCE STANDARD	INCORPORATED AS and UNDER (Delhi Building Bye-Laws)	CURRENT REQUIREMENTS (As per Bye-Laws)
ENVELOPE	Reduce infiltration	1. Air leakage for glazed swinging entrance doors and revolving doors shall not exceed 5.0 l/s-m2. Air leakage for other fenestration and doors shall not exceed 2.0 l/s-m2.	None	ECBC 2007, Section 4 - 4.2.1.3	Mandatory - Building Bye-Laws, Section 16.4.1 - Doorways.	None
	Heat transfer reduction through opaque envelope	2. The opaque construction shall comply with the maximum assembly U-factor or the minimum insulation R-value from ECBC Table - 4.2.	Currently these minimum values are as follows: Composite: U-factor 0.440, R-value 2.10 (40mm) Hot and Dry: U-factor 0.440, R-value 2.10 (40mm) Warm and Humid: U-factor 0.440, R-value 2.10 (40mm) Moderate: U-factor 0.440, R-value 2.10 (40mm) Cold: U-factor 0.352, R-value 2.35 (45mm)	ECBC 2007, Section 4 - 4.3.2	Mandatory - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Heat transfer reduction through roof	3. The roof construction shall comply with the maximum assembly U-factor or the minimum insulation R-value from ECBC Table - 4.1.	Currently these minimum values for day-time use buildings are as follows: Composite: U-factor 0.409, R-value 2.10 (40mm) Hot and Dry: U-factor 0.409, R-value 2.10 (40mm) Warm and Humid: U-factor 0.409, R-value 2.10 (40mm) Moderate: U-factor 0.409, R-value 2.10 (40mm) Cold: U-factor 0.409, R-value 2.10 (40mm)	ECBC 2007, Section 4 - 4.3.1	Mandatory - Building Bye-Laws, Section 14.11 - Roof.	None

	Heat transfer reduction through glazed envelope	4. The vertical fenestration shall comply with the maximum area weighted U-factor and maximum area weighted SHGC requirements from table 4.3 from ECBC.	Currently these maximum values are as follows: U-factor / Maximum SHGC (WWR<=40%) / Maximum SHGC (40%<WWR<=60%) Composite 3.30 0.25 0.20 Hot and Dry 3.30 0.25 0.20 Warm & Humid 3.30 0.25 0.20 Moderate 3.30 0.40 0.20 Cold 3.30 0.51 0.20 Vertical fenestration area is limited to a maximum of 60% of the gross wall area for the prescriptive requirement.	ECBC 2007, Section 4 - 4.3.3	Mandatory - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Adequate Day-lighting Indoor	5. The glazing products used in offices, banks, libraries, classrooms with predominant daytime usage, must have the minimum visual transmittance (VT), defined as function of WWR, where Effective Aperture > 0.1, equal to or greater than the Minimum VT requirements of Table 4.5from ECBC.	Currently these minimum values are as follows: Window Wall Ratio / Minimum VLT 0 - 0.3 0.27 0.31 - 0.4 0.20 0.41 - 0.5 0.16 0.51 - 0.6 0.13	ECBC 2007, Section 4 - 4.3.3.1	Mandatory/Provisional - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Heat transfer reduction through sky-lights	6. The Sky-lights shall comply with the maximum assembly U-factor and maximum SHGC requirements of Table 4.6 from ECBC.	Currently these maximum values are as follows: U-factor / SHGC(0-2% SRR) / SHGC(2.1-5% SRR) Composite 11.24 0.40 0.25 Hot and Dry 11.24 0.40 0.25 Warm & Humid 11.24 0.40 0.25 Moderate 11.24 0.61 0.40 Cold 11.24 0.61 0.40 Sky light area is limited to a maximum of 5% of the gross roof area for the prescriptive requirements.	ECBC 2007, Section 4 - 4.3.4	Mandatory - Building Bye-Laws, Section 14.11 - Roof.	None
HEATING, VENTILATION and AIR-CONDITIONING	Promote natural ventilation	1. Natural ventilation shall comply with the design guidelines provided for natural ventilation in the National Building Code of India 2005 Part 8, 5.4.3 and 5.7.1.1	Refer Standards	NBC 2005, Part 8, 5.4.3 and 5.7.1.1	Mandatory - Building Bye-Laws, Section 14.14.1 - Lighting and Ventilation of Rooms.	None
		2. Install renewable energy systems for at least 2.5% of annual consumption of the building.		ECBC 2007, Section 5.2.3.2	Mandatory/Provisional - Building Bye-Laws, Section 21 - Building Services.	None

	Use energy efficient equipment	3. Cooling equipment shall meet or exceed the minimum efficiency requirements presented in Tables 5.1 of ECBC. Heating and cooling equipment not listed there shall comply with ASHRAE 90.1-2004 § 6.4.1.	Refer Standards	ECBC 2007, Section 5.2.2, ASHRAE 90.1-2004 § 6.4.1	Mandatory - Building Bye-Laws, Section 21 - Building Services.	None
	Prevent conductive heat loss and gain	4. Piping for heating systems with a design operating temperature of 60°C (140°F) or greater shall have at least R-0.70 (R-4) insulation. Piping for heating systems with a design operating temperature less than 60°C (140°F) but greater than 40°C (104°F), piping for cooling systems with a design operating temperature less than 15°C (59°F), and refrigerant suction piping on split systems shall have at least R-0.35 (R-2) insulation. Insulation exposed to weather shall be protected by aluminum sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above, or be painted with water retardant paint. Ductwork shall be insulated in accordance with Table 5.2.4.2 from ECBC	Refer Standards	ECBC 2007, Section 4 5.2.4.1	Mandatory - Building Bye-Laws, Section 21 - Building Services.	None
LIGHTING	Use energy efficient equipment	1. Lighting systems and equipment shall comply with the mandatory provisions of § 7.2 and the prescriptive criteria of § 7.3 and § 7.4 from ECBC		ECBC 2007, Section 7.2, 7.3 & 7.4	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Provide lighting system control to optimise lighting load.	2. Interior lighting systems in buildings larger than 500 m2 (5,000 ft²) shall be equipped with an automatic control device. Within these buildings, all office areas less than 30 m2 (300 ft2) enclosed by walls or ceiling-height partitions, all meeting and conference rooms, all school classrooms, and all storage spaces shall be equipped with occupancy sensors.		ECBC 2007, Section 7.2.1.1	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Intelligent zoning of lighting system control to optimise lighting load	3. Interior lighting control devices shall: (a) Control a maximum of 250 m2 (2,500 ft2) for a space less than or equal to 1,000 m2 (10,000 ft2), and a maximum of 1,000 m2 (10,000 ft2) for a space greater than 1,000 m2 (10,000 ft2). (b) Be capable of overriding the shutoff control required in 7.2.1.1 of ECBC for no more than 2 hours, and (c) Be readily accessible and located so the occupant can see the control.		ECBC 2007, Section 7.2.1.2	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None

	Minimise internal lighting load	4. Luminaires in daylighted areas greater than 25 m2 (250 ft2) shall be equipped with either a manual or automatic control device that: (a) Is capable of reducing the light output of the luminaires in the daylighted areas by at least 50%, and (b) Controls only the luminaires located entirely within the daylighted area.		ECBC 2007, Section 7.2.1.3	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Use energy efficient equipment for external lighting	5. Lighting for exterior building grounds luminaires which operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or exempt under § 7.1.		ECBC 2007, Section 6.2	Mandatory - Building Bye-Laws, Section 12 - Open Spaces, Area and Height Limitation.	None
	Minimise internal lighting load	6. The installed interior lighting power for a building or a separately metered or permitted portion of a building shall be calculated in accordance with § 7.3.3 and shall not exceed the interior lighting power allowance determined in accordance with either § 7.3.1 or § 7.3.2 of ECBC.		ECBC 2007, Section 7.3.1, 7.3.2 & 7.3.3	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Optimise lighting load	7. Lighting for all exterior applications not exempted in § 7.3.4 of ECBC shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required. Internally-illuminated exit signs shall not exceed 5 W per face.		ECBC 2007, Section 7.2.1.4	Mandatory - Building Bye-Laws, Section 12 - Open Spaces, Area and Height Limitation.	None
HOT WATER and PUMPING	Use energy efficient equipment	1. All service water heating equipment and systems shall comply with the mandatory provisions of § 6.2 of ECBC.		ECBC 2007, Section 6.2	Mandatory - Building Bye-Laws, Section 22 - Plumbing Services.	None
	Prevent conductive heat loss	2. Piping insulation shall comply with § 5.2.4.1 of ECBC. The entire hot water system including the storage tanks, pipelines shall be insulated conforming to the relevant IS standards on materials and applications.		ECBC 2007, Section 5.2.4.1	Mandatory - Building Bye-Laws, Section 22 - Plumbing Services.	None
	Prevent heat loss	3, Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a non-recirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank.		ECBC 2007, Section 5.2.3.2	Mandatory/Provisional - Building Bye-Laws, Section 22 - Plumbing Services.	None

	Energy & water use reduction of swimming pools	4. Heated pools shall be provided with a vapor retardant pool cover on or at the water surface. Pools heated to more than 32°C (90°F) shall have a pool cover with a minimum insulation value of R-2.1		ECBC 2007, Section 6.2.6	Mandatory/Provisional - Building Bye-Laws, Section 22 - Plumbing Services.	None
PASSIVE DESIGN	Adequate Day-lighting	1. If the effective width of the habitable room is more than 2 to 2.5 times the distance from the floor to the top of the opening a light shelves at a minimum height of 7 feet from the floor level should be provided for deeper penetration of diffuse light..		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Adequate Day-lighting	2. For room depth greater than 8 mts openings on two opposite sides shall be provided to give greater uniformity of internal daylighting. Both the opposite walls in these cases shall be adjacent to an external space or an internal courtyard/atrium.		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Adequate Day-lighting	3. In case of multiple blocks within the same complex, the relative availability of daylight in multistoried blocks of different relative orientations should be checked from Table 7 of NBC 2005 section 4.2.9.		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Minimum Day-lighting	4. Minimum requirement of 10% openings shall be met for all habitable rooms having a maximum depth of 7 mts. Beyond that, the percentage will increase by 10% for every additional 7mts.		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Adequate fresh air supply	5. Fresh air requirements shall comply with the design guidelines provided for ventilation in the National Building Code of India 2005 Part 8, 5.2.2.1		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Adequate Day-lighting	6. Broader openings shall have their cills raised by 300 mm to 600 mm above the working plane.		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Natural ventilation	7. A minimum 4 percent window to floor area ratio should be provided as a provision for natural ventilation indoor.				

BUILDING TYPE - Residential

CATEGORY	Intent	PERFORMANCE REQUIREMENTS	PRESCIPTIVE REQUIREMENTS	REFRENCE STANDARD	INCORPORATED AS and UNDER (Only for Delhi Building Bye-Laws)	CURRENT REQUIREMENTS (As per Bye-Laws)
ENVELOPE	Reduce infiltration	1. Air leakage for glazed swinging entrance doors and revolving doors shall not exceed 5.0 l/sm2. Air leakage for other fenestration and doors shall not exceed 2.0 l/s-m2.	None	LEED , Section 4 - 4.2.1.3	Mandatory - Building Bye-Laws, Section 16.4.1 - Doorways.	None
	Heat transfer reduction through opaque envelope	2. The opaque construction shall comply with the maximum assembly U-factor or the minimum insulation R-value from ECBC Table - 4.2.	Wall Assembly 'U' Value Climate Zone / (W/m2K) — Maximum 'U'-Value of the overall assembly Composite — 1.1 Hot and Dry — 1.1 Warm and Humid — 1.25 Moderate — 1.25 Cold — 0.5	ECBC 2007, Section 4 - 4.3.2	Mandatory - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Heat transfer reduction through roof	3. The roof construction shall comply with the maximum assembly U-factor or the minimum insulation R-value from ECBC Table - 4.1.	Roof Assembly 'U' Value Climate Zone / (W/m2K) — Maximum 'U'-Value of the overall assembly Composite — 0.50 Hot and Dry — 0.50 Warm and Humid — 0.50 Moderate — 0.50 Cold — 0.50	ECBC 2007, Section 4 - 4.3.1	Mandatory - Building Bye-Laws, Section 14.11 - Roof.	None

	Heat transfer reduction through glazed envelope	4. The vertical fenestration shall comply with the maximum area weighted U-factor and maximum area weighted SHGC requirements from table 4.3 from ECBC.	Fenestration - SHGC Value Maximum SHGC Value Climate Zone WWR < 20% WWR 20 - 30% Composite 0.38 0.30 Hot and Dry 0.38 0.30 Warm and Humid 0.38 0.30 Moderate 0.50 0.40 Cold No limit No limit	ECBC 2007, Section 4 - 4.3.3	Mandatory - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Adequate Day-lighting Indoor	5. The glazing products used in offices, banks, libraries, classrooms with predominant daytime usage, must have the minimum visual transmittance (VT), defined as function of WWR, where Effective Aperture > 0.1, equal to or greater than the Minimum VT requirements of Table 4.5from ECBC.	Glazing - 'U' Value Climate Zone Maximum U-Value (W/m2K) Composite 3.3 Hot and Dry 3.3 Warm and Humid 5.0 Moderate 6.9 Cold 3.3	ECBC 2007, Section 4 - 4.3.3.1	Mandatory/Provisional - Building Bye-Laws, Section 14 - Requirements of Parts of Building.	None
	Heat transfer reduction through sky-lights	6. The Sky-lights shall comply with the maximum assembly U-factor and maximum SHGC requirements of Table 4.6 from ECBC.	Currently these maximum values are as follows: U-factor SHGC(0-2% SRR) SHGC(2.1-5% SRR) Composite 11.24 0.40 0.25 Hot and Dry 11.24 0.40 0.25 Warm & Humid 11.24 0.40 0.25 Moderate 11.24 0.61 0.40 Cold 11.24 0.61 0.40 Sky light area is limited to a maximum of 5% of the gross roof area for the prescriptive requirements.	ECBC 2007, Section 4 - 4.3.4	Mandatory - Building Bye-Laws, Section 14.11 - Roof.	None
HEATING, VENTILATION and AIR-CONDITIONING	Promote natural ventilation	1. Natural ventilation shall comply with the design guidelines provided for natural ventilation in the National Building Code of India 2005 Part 8, 5.4.3 and 5.7.1.1	None	NBC 2005, Part 8, 5.4.3 and 5.7.1.1	Mandatory - Building Bye-Laws, Section 14.14.1 - Lighting and Ventilation of Rooms.	None
	Use renewable energy	2. Install renewable energy systems for at least 2.5% of annual consumption of the building.		ECBC 2007, Section 5.2.3.2	Mandatory/Provisional - Building Bye-Laws, Section 21 - Building Services.	None
	Mechanical ventilation for kitchen and bathroom	3. Design exhaust systems in bathrooms and kitchen as per the requirements highlighted in the table below: Minimum Intermittent Exhaust Flow Requirements		ECBC 2007, Section 4 5.2.4.1	Mandatory - Building Bye-Laws, Section 21 - Building	None

		Location Minimum Airflow Minimum Airflow Kitchen For < 9.3 sq.m 100 cfm For > 9.3 sq.m (100sq.ft) floor (100 sq.ft) area proportionally increase air flow Bathroom For < 4.64 sq.m 50 cfm For > 4.64 sq.m (50sq.ft) floor (50 sq.ft) area proportionally increase air flow				Services.	
	Enhance natural ventilation	4. Design the building to ensure that each of the living spaces has an opening to the outdoor environment in at least two of the orientations. · The window should not have any obstruction within 2 m from outside surface. · The opening considered should meet the following baseline requirements: For Air Conditioned Spaces: Design a ventilation system for air conditioned spaces, to meet a requirement of 6.5 cfm per person for each air conditioned space. For Non-Air conditioned Spaces: Install openable windows or doors in living spaces, kitchens and bathrooms such that the openable area is designed to meet the criteria as outlined in the table below: Design Criteria for Openable Windows and Doors:	Space Type Living Spaces Kitchens Bathrooms	Openable area as a percentage of total carpet area 13.0% 10.5% 5.0%	ECBC 2007, Section 5.2.5.1.1 & 5.2.5.1.2	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
LIGHTING	Use energy efficient equipment for external lighting	1. Install energy efficient internal and external lighting luminaires (as applicable) which are at least three star rated under BEE labeling programme or luminaires which are more efficient.			ECBC 2007, Section 7.2, 7.3 & 7.4	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Intelligent zoning of lighting system control to optimise lighting load	2. Luminaires in daylighted areas greater than 25 m2 (250 ft2) shall be equipped with either a manual or automatic control device that: (a) Is capable of reducing the light output of the luminaires in the daylighted areas by at least 50%, and (b) Controls only the luminaires located entirely within the daylighted area.			ECBC 2007, Section 7.2.1.1	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None

	Minimise external lighting load	3. Lighting for exterior building grounds luminaires which operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or exempt under § 7.1.		ECBC 2007, Section 7.2.1.2	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Minimise internal lighting load	4. The installed interior lighting power for a building or a separately metered or permitted portion of a building shall be calculated in accordance with § 7.3.3 and shall not exceed the interior lighting power allowance determined in accordance with either § 7.3.1 or § 7.3.2 of ECBC.		ECBC 2007, Section 7.2.1.3	Mandatory - Building Bye-Laws, Section 12 - Open Spaces, Area and Height Limitation.	None
	Provide lighting system control to optimise exterior lighting load.	5. Lighting for all exterior applications not exempted in § 7.3.4 of ECBC shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required. Internally-illuminated exit signs shall not exceed 5 W per face.		ECBC 2007, Section 6.2	Mandatory - Building Bye-Laws, Section 14.14.2 - Lighting and Ventilation of Rooms.	None
	Optimise lighting load	6. S.No Space Lighting Power Density W/Sq.m W/Sq.ft 1. Living room 11.8 1.1 2. Bed room 11.8 1.1 3. Dining area 9.7 0.9 4. Kitchen 12.9 1.2 5. Dressing room 6.4 0.6 6. Rest room 9.7 0.9 7. Gymnasium 4.3 0.4 8. Exercise center 3.2 0.3 9. Home theatre 12.9 1.2 10. Lounge 15.0 1.4 11. Corridor 5.4 0.5 12. Stair case 5.4 0.6 13. Motels -Guest room 11.8 1.1 14. Motels– Dining area 12.9 1.2 15. Lobby / Reception 13.9 1.3 16. Hostels / Dormitories 11.8 1.1 17. External lighting 3.2 0.3		ECBC 2007, Section 7.3.1, 7.3.2 & 7.3.3	Mandatory - Building Bye-Laws, Section 12 - Open Spaces, Area and Height Limitation.	None
HOT WATER and METERING	Prevent conductive heat loss	1. All service water heating equipment and systems shall comply with the mandatory provisions of § 6.2 of ECBC.		ECBC 2007, Section 6.2	Mandatory - Building Bye-Laws, Section 22 - Plumbing Services.	None

	Prevent heat loss	Provide solar water heating system to satisfy hot water requirement for domestic purposes. The minimum hot water requirement for domestic purposes should be calculated for 25 liters per person per day		ECBC 2007, Section 5.2.4.1	Mandatory/Provisional - Building Bye-Laws, Section 22 - Plumbing Services.	None
	Energy & water use measurement and verification	Provide meters for any four of the following: · Energy meter for air-conditioning · Energy meter for internal lighting · Energy meter for external lighting · Energy meter for municipal water pumping · Energy meter for water pumping for landscaping		ECBC 2007, Section 6.2.6	Mandatory/Provisional - Building Bye-Laws, Section 22 - Plumbing Services.	None
PASSIVE DESIGN	Adequate Day-lighting	1. If the effective width of the habitable room is more than 2 to 2.5 times the distance from the floor to the top of the opening a light shelves at a minimum height of 7 feet from the floor level should be provided for deeper penetration of diffuse light..		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		
	Adequate Day-lighting	2. For room depth greater than 8 mts openings on two opposite sides shall be provided to give greater uniformity of internal daylighting. Both the opposite walls in these cases shall be adjacent to an external space or an internal courtyard/atrium.				
	Adequate Day-lighting	3. In case of multiple blocks within the same complex, the relative availability of daylight in multistoried blocks of different relative orientations should be checked from Table 7 of NBC 2005 section 4.2.9.				
	Minimum Day-lighting	4. Minimum requirement of 10% openings shall be met for all habitable rooms having a maximum depth of 7 mts. Beyond that, the percentage will increase by 10% for every additional 7mts.				
	Adequate fresh air supply	5. Fresh air requirements shall comply with the design guidelines provided for ventilation in the National Building Code of India 2005 Part 8, 5.2.2.1		NBC 2005, Part 8, 5.4.3 and 5.7.1.1		

References

1. ECBC 2007,
2. NBC 2005,
3. EIA notification 2006,
4. other relevant IS codes,
5. GRIHA,
6. LEED India NC Version 1.0
7. LEED India CS Version 1.0
8. IGBC Green Homes,
9. Municipal By-Laws (Delhi, NCR, Jaipur),
10. MNRE (Ministry of New & Renewable Energy) Publications,
11. MoEF (Ministry of Environment & Forest) manual etc.