International Journal on Emerging Technologies **3**(2): 134-136 (2012)

ISSN No. (Print) : 0975-8364
ISSN No. (Online) : 2249-3255

An Overview of Codal Provisions of Energy Conservation Building Code of India

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(Received 15 October, 2012 Accepted 01 December, 2012)

ABSTRACT: Building consumes considerable amount of energy and leaves 'carbon foot prints', than any other sector, including transportation. Over exploitation of natural resources and converting them as non reusable materials have caused environmental pollution which has led to climatic changes and global warming. Hence, recent efforts worldwide are to achieve improved energy performance of buildings and thereby to achieve net-zero energy. In India, Bureau of Energy Efficiency (BEE) has published the Energy Conservation Building Code (ECBC), which among others addresses the requirements of energy efficiency in buildings. In this paper, an overview of ECBC for building's envelope, ventilation and lighting have been highlighted. It is suggested that the proactive route to design and construct 'green building' be adopted so that the precious natural resources and the environment saved for the benefit of future generations.

Keywords: Energy efficiency, exterior façade natural ventilation, HAVC, lighting, ECBC code.

I. INTRODUCTION

Indian construction industry is the largest producer / consumer of modern construction materials like bricks, aggregates, cement, steel, plastic products when compared to any other industry. In India, the construction industry consumes 33% of electricity in which residential sector consumes 25%, whereas, the commercial sector consumes 8%. Further, it is also responsible for emission of 30% of GHGs (green house gases). The above situation is due to sustained shift opted by the industry from the use of zero energy materials like stones, soil, thatch, unprocessed timber etc to the use of above modern materials, thereby exploitating the energy and natural resources of the country. In well developed countries like US and in the EU it has been mandated that sustainability in buildings be considered in the planning, design and construction phases for quite some time now. On the other hand, in India even awareness is lacking on the energy efficiency parameters and design of buildings except in the past few years. Realizing the importance of energy conservation and to create awareness among the various stake holders, India has come up with comprehensive guidelines in energy-conservation in building in the form of Energy Conservation Building Code (ECBC 2007) [1, 2]. The above code defines the minimum norms and standards for energy-efficient design of buildings and construction and applicable for the five climatic zones recognized in India and specified in the National Building Code (NBC-2005) [3].

Energy-efficiency in buildings can be achieved only if all the issues are addressed from the planning, design to the execution of buildings. In order to achieve energy-efficiency in buildings, it is necessary to understand the ECBC stipulations and apply it to buildings from the stage of planning to completion and occupation. Hence, in this paper, an overview of ECBC codal provisions as applicable to building envelope, ventilation and lighting have been presented, for the benefit and awareness of all stakeholders in the construction industry.

II. ENERGY CONSERVATION BUILDING CODE (ECBC) FOR BUILDINGS

A. Extent of Applicability

ECBC, hereinafter referred to as 'the code' is applicable to buildings or building complexes that have a 'connected load' of 500 KW or greater or a 'contract demand' of 600 KVA or greater. Generally, buildings or building complexes having conditioned area of 1000 sq.m or more will fall under this category. As of now it is 'optional' but, may become 'mandatory', as and when it is notified by the central and state governments. The code is applicable to the five recognized climatic zones namely: hot and dry; warm and humid; temperate; cold; composite. The provisions of the code is applicable to:(a) building envelopes; (b) heating, ventilation and air conditioning systems; (c) interior and exterior lighting systems; (d) service hot water and (f) electrical power systems and motors.

However, the provisions of this code do not apply to: (a) buildings that do not use either electricity or fossil fuel and (b) equipment and portions of building systems that are used primarily for manufacturing processes. Further, wherever conflict exists between the code with that of safety, health and environment (SHE) codes, 'SHE' codes take precedence over ECBC.

B. Building Envelope

'Building envelope' refers to the exterior façade, and it comprises of: walls, windows, roofs, skylights, doors and other openings. ECBC has prescribed the comfort requirements and physical manifestations in buildings for each climate zone, separately. ECBC has a set of 'prescriptive requirements' for the envelope based on compliance to: (i) exterior roofs and ceilings; (ii) cool roofs; (iii) opaque walls; (iv) vertical fenestration and skylights. In roofs, the U-factor (thermal conductance) for all assemblies or minimum R-values (i.e, thermal resistance) for all the five climate zones (of India) are prescribed for 24 hours use building and daytime use buildings. Exterior roofs can meet the prescriptive requirements by: (i) using insulation with the required R-value (ii) using a roof assembly that meets the maximum U-factor criterion for thermal performance as prescribed in ECBC. The U-factor takes into account all elements or layers in the construction assembly, including the sheathing, interior finishes and air gaps, as well as exterior and interior air films. Various techniques to insulate different types of roofing systems can be adopted. However it is recommended that they are installed according to manufacturer's recommendations and in a manner that will achieve the rated insulation R-value.

C. Heating, Ventilation and Air-conditioning (HVAC)

Heating, Ventilation and Air-conditioning (HVAC) refers to the equipment distribution systems that provide, either collectively or individually, the heating, ventilation, or air-conditioning requirement of a building or to a portion of a building.

***(i)* Natural Ventilation:** Natural ventilation of buildings shall comply with the design guidelines provided for natural ventilation in NBC (2005, Part 8, 5.4.3 and 5.7.1). Energy conversation in wind-induced natural ventilation can be achieved by following the design guidelines prescribed by ECBC such as: a) provision of adequate number of circulating fans during the summer months in the hot dry and warm humid regions for necessary air movement; b) the capacity of the ceiling fan should be about 55D m^3/min, where D is the longer dimension of room; c) the height of the fan blades above the floor should be (3H+W)/4, where H is the height of the room, and W is the height of the work plane; d) the minimum distance between fan blades and the ceiling should be about 0.3 m; e) Electronic regulator, optimum size of ceiling fan based on the actual usable area of room can be chosen to save energy. NBC (2005) has prescribed the optimum sizes for rooms of different dimensions and number of fans required for comfortbility and thereby save energy.

***(ii)* Minimum Equipment Efficiencies:** HAVC equipment should meet the minimum efficiencies and it includes chillers, unitary air conditioner, spilt air conditioner, packed air conditioner, and boilers. ECBC has prescribed the types of HAVC equipments and overview of central chilled water system with direct expansion or "DX" systems. The energy efficiency of HAVC equipment can be obtained in terms of coefficient of performance (COP), energy efficiency ratio (EER) and integrated part-load value. ECBC stipulates the minimum efficiency of chillers for saving energy. Power consumption ratings for unitary air-conditioners, split air-conditioners and packed air conditioners have also been prescribed in 'the code'. The overall systems design, auxiliary components such as fan & blowers, proper ductwork, refrigerant charge air flow rates and proper sizing can increase the energy performance.

***(iii)* Controls:** Controls refer to the most critical elements for improving efficiency of any HVAC system. ECBC has prescribed the use of time clocks, temperature controls / thermostats and two-speed or variable speed fan drives for achieving or improving energy efficiency.

***(iv)* Piping and Ductwork:** Piping of heating and cooling systems should be properly insulated to minimize heat losses and thereby save energy. Similarly, ductwork should be properly air sealed and also protected from moisture absorption. ECBC has specified the required R-values (thermal resistance) for heating and cooling systems based on the temperature of the system. The insulation exposed to weather shall be protected by aluminum sheet metal, painted canvas or plastic cover. Cellular foam insulation apart from the above protection can be painted with water retardant paint as an alternate form of protection. The ECBC specifies the sealing of duct based on duct location, static pressure classification and type of the duct (exhaust or return), based on ASHRAE (2007) [4].

***(v)* System balancing:** System balancing is a process of maintaining the performance of HVAC system for providing comfortablity to the occupants which yield energy efficiency, extend the life of the equipment and to reduce the operating cost. The code specifies that construction documents which provide vital information be provided to the building owners for the operation and maintenance of HVAC systems equipment.

***(vi)* Condensers, Economizers:** A condenser is a heat exchanger that liquefies refrigerant vapor through heat removal and it comprises of a compressor, a fan motor, and coils, along with controls. The code specifies the location of condensers and use of soft water for attaining maximum efficiency and thereby save energy.

Economizer allows outside air inside when the temperature at outside is cooler than inside and it comprises of dampers, sensors, actuators and logic devices. A properly operating economizer can cut the energy costs by 10% based on local climate and internal cooling loads. The code specifies the type of equipment and capabilities to reduce energy.

III. LIGHTING

Lighting accounts for 15% of total energy consumption in India and it is an area that offers many efficiency opportunities, both in existing or now building facility. Efficient lighting equipment and controls can ensure lighting energy efficiency while maintaining or even improving lighting conditions. Modern fluorescent light such as electronically ballasted T-8 systems can provide the same of light as older fluorescent light while consuming as little as two-third of the energy. The code covers the lighting requirements to: (a) interior spaces of buildings; (b) exterior & building features including facades, illuminated roofs, architectural features, entrances, exists, loading docks and illuminated canopies; (c) exterior building grounds lighting that is provided through the building's electrical service. The methods employed for computing the maximum permissible lighting power as the code guidelines are:

A. Building Area Method

The building area method is the simplest method. The code provides light power densities for various types of building area. The following steps are adopted to compute the maximum permissible lighting power (MPLP): (a) identification of light power density of the building area type; (b) calculation of gross floor area of the building based on building plan; (c) the maximum permissible lighting power is the product of lighting power density and gross floor area of the building.

B. Space Function Method

Space function method is applied to compute the maximum permissible light power to only a portion of entire building which is not listed as building type or the building which has more than one occupancy type. The code provides lighting power densities for various functions. The following steps are adopted to compute the maximum permissible lighting power (MPLP): (a) identification of light power density of space; (b) calculation of space area type by measuring to the centre of the partition walls and inducing spaces allotted to balconies or other projections; (c) The maximum permissible lighting power for individual space is the product of the light power density and space area.

IV. CONCLUDING REMARKS

The tools to assess the energy efficiency of the building as per ECBC have been highlighted. The guidelines used in the design of exterior façade to control thermal effect of the sun' s rays and thereby increasing the conformability of the occupants by reducing the cost towards electricity is narrated. The concept of natural ventilation and use of energy efficient lighting system to save energy as per ECBC and thereby save our environment has been highlighted. India is a energy deficit country. If the concept of 'green building' based on the ECBC guidelines are implemented it is possible to overcome to some extent the energy crisis what India has to face in the decades ahead.

REFERENCES

[1]. "Energy Conservation Building Code (ECBC)" May 2007, Ministry of Power, Govt. of India, 63pp.

[2]. 'Energy Conservation Building Code (ECBC) user guide", July 2009, Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India, 78pp. (under USAID ECO III Project)

[3]. 'National Building Code, India, Second Revision, 2005, Bureau of Indian Standards (BTS), New Delhi, India.

[4]. ASHRAE (2009), "User manual: ANSI/ASHRAE/IESNA standard 90.1-2004", American Society of heating, Refrigeration, 'Air-conditioned Engineers, (www.ashrae.org), Atlanta, GA, USA.