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# GREEN BUILDING CONVENTION (2010) PUNE

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# SESSION III:

## KEYNOTE ADDRESS BY

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# GREEN ARCHITECTURE

# RATING CRITERIA AND CODES

# PREAMBLE:

Apart from the market popular LEED rating, promulgated by UGBC and IGBC, there are THREE national ratings advocated by different government agencies.

# 1.ECO-HOUSING CRITERIA VERSION II:

Formulated jointly by International Institute of Energy Conservation (IIEC), United States Agency for International Development (USAID),

The Energy Research Institute (TERI), New Delhi, and Science and Technology Park (STP), University of Pune, this rating is applicable to all residential buildings, building complexes and single family residences in all climate zones, and is voluntary.

It is adopted by Pune Municipal Corporation and a little revised version which is adopted by Mumbai Municipal Corporation, with tax incentives for the attained star rating. The criteria focus on Sustainable Design Principles and Practices.

## 2. **GRIHA – Green Rating for Integrated Habitat Assessment:**

Formulated jointly by The Energy Research Institute (TERI), New Delhi, & Ministry of New and Renewable Energy (MNRE), Government of India, caters for all types of buildings but mainly for Institutional & Commercial buildings. It is voluntary.

These criteria focus on Sustainability as well as on Energy Conserving Building Codes (ECBC), National Building Code (NBC), relevant Development Plan rules and Bye laws. Compliance of all these criteria is expected. The incentives are offered by MNRE, depending on the star rating achieved.

## 3. Energy Conservation Building Code 2007 (revised in 2008): ECO-III Project:

Formulated by Bureau of Energy Efficiency (BEE) of Ministry of Power, Govt. of India, is applicable to all buildings having a connected load of 500 kW or greater ……

…….. or contract demand of 600 kVA or greater and to buildings having 1000 sq. m. of air conditioned area or greater. The code focuses strictly on Energy Conservation and is voluntary for now.

ECBC 2007 is likely to be mandatory very soon, in near future, and with the possibility of applicability to buildings having a connected load of 100 kW only.

Once notified by the Central and State governments in the official gazette, the ECBC will become mandatory, meaning compulsory by law.

In my opinion, it would be prudent to focus on ECBC 2007 which would be mandatory, may be this year. The provisions of the code apply to:

- Building Envelops,
- Mechanical Systems & Equipments,
- Service Hot Water Heating
- Interior and Exterior Lighting, and
- Electrical Power and Motors

This code claims to be a “dynamic document, under continuous maintenance”.

Addenda, errata & interpretations can be issued, as and when necessary, by the concerned authorities such as Ministry of Power, Bureau of Energy Efficiency, & State Governments etc.

The state nodal agency MEDA (Maharashtra Energy Development Agency) will be the Implementing Authority.

I will restrict my observations, with respect to Building Envelop Design only.

## The section pertaining to Compliance Approaches (3.2):

In addition to the flexibility measures such as different options to comply with code requirements namely R – values and U – values etc …….

……. and the trade off options among roof, walls & fenestration and the Whole Building Performance Method, the following may be considered as credits for trade offs:

- Use of fly ash concrete bricks
- Use of other sustainable materials and technology
- Use of sustainable practices such as Rain water harvesting, gray water treatment, black water treatment on site, solid waste management,…….

…….bio-degradable waste treatment & biogas generation, provision of vegetation and creation of water bodies to modify micro-climate, design of solar passive buildings providing comfort without A/ C etc.

It is possible to quantify the conserved energy by sustainable principles, using scientific methods.

3. Identification of approved energy simulation soft wares, necessary for ECBC compliance via the Whole Building Performance Method

4. Allowing manual calculations based on ASHRAE & IESNA to substitute computer simulation programmes

5. A dictionary of building material and equipment manufacturers, suppliers, supply outlets, service & maintenance companies & price lists of all products etc should be made available by the implementing agency

6. Training programmes for Architects, Engineers, & consultants for Integrated Design Approach and for Building officials from local departments for compliance & enforcement process are a must for mainstreaming the code requirements

7. Section 3.4:
Compliance Documents: A list of ascertained & accepted R – values (or k - values) as well as U – values of all building envelope materials, including fenestration U – factors,……

…….SHGC, VLT etc, should be made available by the implementing authority. Envelope sealing requirement should be applicable to A/C buildings only

8. Sizing for vertical & horizontal external shading devices should be allowed to be calculated as per solar altitude & azimuth angles …….

…….which depend on the latitude of the place & they should be allowed to be considered on the climatic & seasonal bias

9. Make a hard / soft copy available for the entire document ISO–15099 (Section 4.2.1.1)

10. Publish list of accredited independent laboratories for testing, certification & labeling, for SHGC data

11. The code has been revised in 2008; a soft / hard copy should be made available.

# ENVELOPE DESIGN – CHAPTER 4:

## 4.3 Prescriptive Requirements:

## 4.3.1 Roofs:

Roof assembly U values should be climate specific. They may not be same for extreme climates such as Composite, Hot and Dry and Cold and oppressive climate like Warm and Humid, as well as Moderate climate.

For any given U value the final quantity of heat transfer would depend on $\Delta T$ which is the temp difference between inside and outside.

Using sol-air temperature concept, where a certain amount of temperature value is added to the ambient air temperature to arrive at sol-air temperature, we have

**$Ts = To + (I \times a) / fo$**

Where,

Ts = sol-air temp in $^0C$

To = ambient air temp $^0C$

I = incident radiation in $W / m^2$

a= absorbance factor of surface material

fo = surface conductance

In this equation, if we consider value of (a) as 0.4 and (fo) = 20, then the variables are (I) and (To) which will depend on season and climate. Taking different values of (I) and (To) for different climates, we have three values for $\Delta T$, we have:

1. Ts = 30 + (500 x 0.4) / 20 = 30 + 10
   = $40^0$ C for Warm and Humid
2. Ts = 35 + (600 x 0.4) / 20 = 35 + 12
   = $47^0$ C for moderate and
3. Ts = 40 + (700 x 0.4) / 20 = 40 + 14
   = $54^0$ C for Composite & Hot & Dry
4. Ts = 10 + (400 x 0.4) / 20 = 10 + 16 = $26^0$
   C for cold climate

Now considering the desired temp as $22^0$ C for internal space, for all climates, we have the relevant values of $\Delta T$ as follows:

1. $40 - 22 = 18^0$ C
2. $47 - 22 = 25^0$ C
3. $54 - 22 = 32^0$ C
4. $26 - 22 = 04^0$ C

Using given U value of 0.261 for Composite, Hot and Dry, Warm and humid, and Cold climates, and 0.409 for moderate climate, the amount of heat transfer through 1 sq. m. of opaque wall, for these cases would be:

1. Q = 1 x 0.261 x 18 = 04.7 W for Warm and Humid
2. Q = 1 x 0.409 x 25 = 10.2 W for moderate
3. Q = 1 x 0.261 x 32 = 08.4 W for Composite and Hot & Dry and
4. Q = 1 x 0.261 x 04 = 01.0 W for Cold climate

The difference between first two heat gain values i.e. between Moderate and Warm & Humid climate is 117.02% & between second & third values is 21.43%.....

…….& between the third & last values is 88.09%. The difference between the least & the most values is a staggering 920%.

This can mean that, prescribing U values would be meaningless if the same value is given for the extreme climates as well as different values for 24 hour use and daytime use buildings.

Instead, the U value be kept floating, depending on the values of independent variables namely, (I) and (a), i.e. solar radiation and absorbance factor of the surface.

**4.3.1.1 Cool Roofs:**

The following observations are with regard to cool roofs:

1. Please supply hard / soft copies of ASTM E903 – 96 and ASTM E408 – 71 (RA – 1996).

2. The cool roof is defined by initial solar reflectance factor of no less than 0.70 & by an initial emittance no less than 0.75. Instead, it should be defined by solar reflectance factor (r) and the absorbance factor…….

(a) of the material, as all terrestrial materials', with the exception of bright metals, emittance is almost identical i.e. about 0.90 again depending on $\Delta T$ i.e. temperature of the material and the surrounding surfaces.

## 4.3.2 Opaque Walls:

The following observations are with regard to opaque walls:

1. A some what higher value (0.440) is
   given for extreme climates such as Composite, ……..

……..Hot and Dry and milder but oppressive climate of Warm and Humid than prescribed for Moderate climate (0.431) for no reason. Lower U values are desirable.

2. As detailed earlier, U values better be kept floating.

3. U values for roofs and walls should not make difference in 24 hour use buildings and daytime use buildings.....

……as both types of  buildings
Are exposed to same radiation
During daytime and the
“Temperature Inversion”
phenomenon during night
time for a given climate.

## 4.3.3 Vertical Fenestration:

The following are our observations:

1. For a given insolation rate, say 500 W / $m^2$ and prescribed SHGCs 0f 0.40 and 0.30, for moderate climate, we may calculate Direct heat gain for different WWRs, assuming wall area as 10 $m^2$ as follows,:

| S. no. | WWR in % | Area in m2 | Radiation in W/m2 | GAIN in W WITH SHGC of 0.40 | GAIN in W WITH SHGC of 0.30 |
|---|---|---|---|---|---|
| **1** | 5 | 0.5 | 500 | 100 | --- |
| **2** | 10 | 1.0 | 500 | 200 | --- |
| **3** | 13.33 | 1.33 | 500 | 266 | --- |
| **4** | 40 | 4.0 | 500 | 800 | |
| **5** | 40 - 60 | 6 | 500 | --- | 900 |

This shows that the solar gain depends largely on the area of vertical fenestration and the solar radiation and not only on SHGC.

It would be preferable to prescribe the area of glazing as a percentage of floor area in order to be able to make summation of all heat gains on floor area basis.

2. Heat gain may be reduced by having lesser percentage of glazed area in relation to wall area.

3. Heat gain may also be reduced by totally avoiding solar gain by applying proper shading devices using solar altitude and azimuth angle, in which case 100% glazing may be permitted.

# THANK YOU