

# STRATEGIES FOR AFFORDABLE, SUSTAINABLE & ENVIRONMENTAL FRIENDLY BUILDINGS IN RAJASTHAN, INDIA

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**Abstract**— India is having high growth of population, with this the need of housing activity is fast growing. Though traditional construction procedures are being followed it is creating lot of environmental degradation. Of late there has been much awareness in building construction about using green technology.

IGBC (Indian Green Building Council) has been promoting the construction of green buildings. Affordable & Sustainable construction is now the need of the hour. Various codes like ECBC, GRIHA by TERI (The Energy Research Institute), LEEDS(INDIA) (Leadership in Energy Efficiency Design) by IGBC etc. have been formulated for getting certification for green building in the entire nation.

There are huge variations in climate, construction methods & materials across the whole country and the strategies & approaches for making the eco-homes affordable & sustainable differ from place to place.

In this context the paper accesses few simple approaches & strategies suitable for hot & dry climate zone of Rajasthan, India which can be easily adopted for making affordable, sustainable Eco-homes.

## I. INTRODUCTION

The development is taking fast in the construction of various building with the population boom in the country. This is creating lots of challenges in meeting demands for natural resources such as water, land, materials, power etc. Over exploitation of these resources is creating environmental degradation like climate change, pollution, global warming etc..

India's 2011 census reveals that one in every third Indian lives in urban environment. Number of million plus cities have shot up to 53 from 35 in 2001. The census houses have increased from 25 crore to 33 crore.

The challenge is now to meet the necessary & basic needs for all, while maintaining required levels of comfort. This can only be achieved by using natural resources which are adequate for the current generation but also enough for future generation as well i.e. having minimum impact on environment. This requires simple yet effective & locally relevant changes in the way we develop & construct in our

urban & rural habitats, enabling us to reduce our resource consumption.

There are few codes like ECBC (Energy Conservation Building Codes), NBC (National Building Codes) & Ministry of Environment & Forests regulations on energy conservation and protection of the environment which are being followed currently nation wide.

India traditionally had a rich culture of human evolution & settlements with diverse culture in various parts of country with different climatic conditions having variety of building styles in practice. Cold Himalayan belt of North & North-East, Hot Arid region in West & Central India, Warm & Humid in Coastal Regions. The character of buildings thus can be attributed to the social customs & climatic adaptations. India being a country with diverse climate & ecological zones. The state of Rajasthan has Hot & Dry climatic conditions with variations in the prevailing construction methods & available materials across the state, respecting the local materials & climate in construction.

There is a need to formulate various measures & methods for the construction of Eco-buildings which are affordable & Sustainable in Hot & Dry climatic region.

## II. GREEN BUILDINGS

Contemporary buildings being made are both energy intensive in construction & usage. Global warming is leading to rise in temperatures & extreme weather conditions. Land for buildings is scarce & Greenfield areas are being depleted to make buildings. In case of the environment around buildings, the air is polluted, fresh water is scarce and many water sources are polluted. Deteriorating health of building occupants due to sick building syndrome arising from non-natural & potentially toxic materials. Increasing energy use for other utilities like transportation due to sprawling cities & towns. Large scale depletion of non-renewable energy resources. With these drawbacks in a conventional building a Green building should have following broad properties:

1. Use less water
2. Is energy efficient
3. Conserves natural resources
4. Generates less waste
5. Provides healthier spaces for occupants.

## III. STRATEGY PLANNING FOR AFFORDABLE & SUSTAINABLE MEASURES

### 3.1 Site Context & Environment

How we build is influenced by, and in turn also influences our surrounding natural environment and its components i.e.

**Manuscript received Dec 03, 2014**

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atmosphere, biosphere, lithosphere and hydrosphere. This forms our “site context”. Responding to this context in building design is essential for a holistic green design approach

**3.1.1 Regenerative Design**

Regenerative design is of higher value than just efficient green design. This can be termed a “better-than-before” scenario. For. e.g. A barren site with water flowing away from can be improved by Recharging water and planting to improve local ecology forms a regenerative approach.

**3.1.2 Influence of Atmosphere**

The Sun and the climate influences Building Orientation, Layout & renewable energy choices.

Climate influences building material choices & Fenestration design

Rainfall pattern & ground character influences rain water harvesting potential

Solar path, wind pattern & prevalent temperatures influences creation of architectural spaces like courtyards/ verandahs & helps plan passive cooling features.

**3.1.3 Influence of Biosphere**

Existing & proposed vegetation influences Building layout to promote shading & passive cooling

**3.1.4 Influence of Hydrosphere**

Ground water level influences building water supply & rain water harvesting methods

Ground water levels are influenced by paved areas  
Surface water influences Building water use pattern, waste water disposal method & methods for passive cooling/harnessing water energy.

**3.1.5 Influence of Lithosphere**

Ground water levels are influenced by paved areas

Geology influences foundation design

Land form influences building layout to minimize cut & fill on -site

Local material availability influences building material choice.

**IV. HOT-DRY CLIMATE ZONE DESCRIPTION & APPROACHES**

The Indian sub-continent has been broadly categorized into five regions with distinct climates. These climate zones, are Hot-Dry, Warm -Humid, Composite, Temperate & Cold. This warrants special provisions in each climate zone to aid in the functional design of buildings with respect to human thermal comfort and hence energy efficiency.

The table below shows the distinct climatic features of the hot - dry climate zone, which is the focus of this paper and these broad guidelines/strategy shall be applicable for designing affordable & sustainable Eco-homes

**Table 1.0**

<u>Climatic features</u>	<u>Situation in Hot -Dry</u>	<u>Generic corresponding</u>

	<u>Climate</u>	<u>strategy</u>
Typical landscape & vegetation	Sandy / rocky ground with little vegetation; Low water level	1. Preserve vegetation and conserve water
Solar radiation	Intense (800 - 950 W/m <sup>2</sup> )	1. Shade building especially openings as they admit maximum solar radiation 2. Solar energy generation
Mean Temperature in	40-45 degree C 1. Summer midday 20-30 degree C 2. Summer night 5-25 degree C 3. Winter midday 0-10 degree C 4. Winter night 15-20 degree C 5. Diurnal variations	1. Prevent solar access in summer but allow in winters 2. Insulate building to prevent conduction of heat indoors during the day time 3. Passive measures to reduce heat gain and promote heat loss through vegetation & water bodies.
Mean relative humidity	Very low (25 - 40 %)	1. Can use evaporative cooling where water is available
Annual rainfall	Low < 500mm / yr	1. Harvest rainwater for use in dry spells
Winds	Dust laden local winds often developing into sandstorms	1. Prevent wind infiltration; 2. Avoid wind-induced ventilation during overheated times
Sky conditions	Cloudless skies with high solar radiation causing glare	1. Prevent direct radiation ingress and glare into rooms

**V. STAGES OF PLANNING & DESIGN**

The Integrated Green Design (IGD) approach looks at a building in stages of its planning and design from the broader issues to the details. Each stage within the IGD approach fulfills one or more of the five ‘Green’ building imperatives as mentioned above in 2.0.

**5.1 Sustainable Site Planning:**

Utilizing existing infrastructure, laying out building blocks to benefit from existing land-form, sun-path and wind while minimizing damage to prevalent soil, flora, water and air quality.

### **5.2 Appropriate Landscaping:**

Planting in the right way to conserve water and improve micro-climate.

### **5.3 Building Energy Use:**

Efficient electricity usage and usage of clean energy.

### **5.4 Building Design Details:**

Detailing building fenestration design and construction details to promote shading, insulation and heat loss.

### **5.5 Building Water Use:**

Saving water through efficient fixtures and augmenting water through rain water harvesting & waste water treatment

### **5.6 Materials:**

Choosing materials which are local, durable, utilize waste, have low embodied energy content, use less water for processing and help insulate the building.

## **CONCLUSION**

The mentioned approaches in planning, designing & constructing houses if taken care at various stages shall go a long way in reducing environmental impact while meeting the needs of the people. Though the individual impact of each building may be small ,but the cumulative effects of integrating environment concerns right from site selection, its orientation, planning, resource & utilization, to operation & maintenance and reaching to buildings constructed by all -in rural & urban areas-will add up to a considerable reduction of the ecological footprint for state of Rajasthan where already the resources are limited and sustainability is desirable. Architects & Engineers can play a major role in providing Affordable ,Sustainable & Eco-friendly houses & buildings with simply following the approaches listed above

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