CHAPTER 5:
STUDY OF LEED FOR
INDIA RATING SYSTEM
AS A FRAMEWORK FOR
SUSTAINABLE HOUSING
DESIGN & ENERGY
EFFICIENCY
5.0  INTRODUCTION

Specifically for housing projects, the sustainability paradigm is crucial. For instance, approximately 30% of the energy of India is consumed by buildings; much of the energy is consumed by houses. On the other hand, houses cause much of the CO2 emissions in the atmosphere. In the light of this information, sustainability starts to be an absolute necessity. Sustainable design therefore is an excellent opportunity for India which brings numerous benefits not only to the environment and community, but also to the country itself. Sustainable design principles can be assessed by various tools available in India. Study of these tools in detail shall give an insight for drawing various design approaches for affordable & sustainable eco home design for Rajasthan.

5.1  LEED INDIA

The Leadership in Energy and Environmental Design (LEED-INDIA) Green Building Rating System is a nationally and internationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED-INDIA provides building owners, architects, consultants, developers, facility managers and project managers the tools they need to design, construct and operate green buildings. It promotes a whole-building approach to sustainability by recognizing performance in the following five key areas:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection and
- Indoor environmental quality
This chapter discusses the components of a green building by taking an in-depth look at those elements that make a building green. In order to create commonality in this thesis, the categories developed by LEED for Homes will be used. This was done because LEED for Homes is comprehensive and covers the spectrum of green building aspects. This thesis is not favoring LEED for Homes over any other descriptive or rating system, but merely using the categories as a way to approach and discuss the elements that make up a green building.

The eight categories are: innovation and design, location and linkages, sustainable sites, water efficiency, energy & atmosphere, material & resources, indoor air quality and awareness & education. Each category will start with the basic LEED description including LEED for New Construction as well as the LEED for Homes.

5.2 INNOVATION & DESIGN PROCESS

The basic intent of LEED for Homes is special design methods, unique regional credits measures not currently addressed in the rating system, and exemplary performance levels. The LEED for Homes lists three ways to earn points for innovation and design. This can be accomplished by promoting an integrated, system-oriented approach to green project design and development. The development of the green project consists of following activities:

- Conceptual or schematic design;
- LEED planning;
- Preliminary design;
- Energy and envelope systems analysis or design;
- Design development;
- Final design, working drawings or specifications; and
- Construction.

Building orientation for solar design receives points for example if 90% of the glazing on the south-facing wall is completely shaded, the roof has a minimum of 450 square feet of south-facing area that is oriented appropriately for solar applications, the east-west axis is within 15-degrees of due east-west and the glazing
area on the north-south facing walls are at least 50% greater than the sum of the east-west walls. The credits are given for durable planning and management, all related to the planning process prior to the start of construction.

The LEED states that both site selection and planning have a major impact on the relative “greenness” of any facility. The selection includes issues such as transportation and travel distances for building occupants, impacts to wildlife and hydrology (storm water flows, wetlands, etc.). These decisions will impact the immediate natural community as well as the building energy consumption and occupant comfort. Good site planning minimizes site-clearing and preserves existing vegetation. Existing vegetation avoids supplemental irrigation and fertilizer. Mature strands of native vegetation provide energy saving shade and wind control that would otherwise require years to develop from new plantings. Placement of the building on the site promotes energy conservation by taking advantage of natural site features such as topography, sunlight, shade and breezes.

In the site design and planning phase efforts are made to minimize resource costs and site disruption. The USDOE recommends the following guidelines be followed:

- **Soils/Geology**: Minimize excavation and disturbance of groundwater. Avoid large impervious surface areas and building footprints that collect rain and create concentrated runoff onto the site. Heat Island Effect – Using trees for shade and less pavement reduces or avoids air-conditioning use. Reflective coatings on pavement and roofs will reduce contribution to the heat island effect.

- **Natural Site Features**: Preserve natural drainage systems, locate driveways, parking, entrances, on the buildings south side (this is especially important in snowy climates to prevent buildup of snow and ice), orient the building with the long side facing in line with the east-west axis (this allows for the highest winter solar gains and lower summer solar gains), minimize ground-level wind loads (control winds at ground level with the use of vegetation, walls, fencing and natural topography.
• **Vegetation**: Maximize native vegetation, avoid cutting mature vegetation. Minimize the visual impact by using natural vegetation and adjust the building plan to minimize the visual impacts of facilities.

• **Hydrology**: Minimize erosion by locating and design the building to minimize impact on erosion and natural hydrological systems. Safeguard hydrological systems from contamination during construction. Allow precipitation to naturally recharge groundwater.

### 5.3 LOCATION AND LINKAGES

The basic intent of LEED for Homes is the placement of homes in socially and environmentally responsible ways in relation to the larger community. There are six areas where points can be earned in this LEED category for Homes:

• Neighborhood development by complying with LEED for Neighborhood Development program,

• Avoid development on environmentally sensitive sites, for example no building at or below a 100-year flood plain, 100 feet of any waterway, on any site that has listed federal or state threatened or endangered species, land that contains “prime soils,” “unique soils,” or “soils of state significance.”

• Encourage building homes near or within existing communities for example build on a previously developed lot.

• Build homes in developments that are served by or are near existing infrastructure. Home must be within at least ½ mile of existing services.

• Build homes that allow for walking, biking, or public transportation, thereby minimizing use of automobiles and their associated environmental impacts.

• Select a site that is within ½ mile of a publically accessible or community-based space at least ¾ acre in size.

### 5.4 SUSTAINABLE SITES

The basic intent of LEED for Homes is to use the entire property so as to minimize the project’s impact on the site. There are six point earning segments within LEED for Homes:
Minimize long-term environmental damage to the building lot during the construction process. Accomplish this by pre-planning for the construction to: minimize areas disturbed on the site, erosion protection, and preserve existing plantings.

Design landscaping features to avoid invasive species and minimize the demand for water and the need for synthetic chemicals, and use drought resistant plants.

Design landscaping to reduce the local heat island effect. Accomplish this by placing plantings to provide shading and install light-colored materials over at least 50% of the sidewalks, patios, and driveways within 50 feet of the house.

Design site features to minimize erosion and runoff from the site. For example, design the lot such that 70% of the build environment (not including the roof area), is permeable to capture water runoff.

Design the home features to minimize the need for poisons for insects, rodents and other pests. For example: keep all wood (i.e. siding, trim, structure) 12 inches above the soil, seal external cracks, joints, etc., no wood-to-concrete connections, install landscaping so that mature plants are at least 24 inches from the home, and implement termite control measures that meet specific LEED criteria.

Make use of compact development patterns to conserve land and promote community livability, transportation efficiency, and walk ability. Another way to phrase this requirement is to build in areas where homes are already located to minimize impact on unused land.

The basic intent of LEED for New Construction is to reduce pollution from construction activity, avoid development of inappropriate sites and reduce the environmental impacts of the location of the building on the site. LEED for New Construction is similar to LEED for Homes, with a few differences. For example, limit site disturbance to within 40 feet of the building perimeter. Specific to New Construction are:
• Provide a high ratio of open space to the development footprint to promote biodiversity.
• Limit disruption and pollution of natural water flows by managing storm water runoff.

The USDOE under its recommendation for Site Planning and Land Development states that consideration to the entire community and existing infrastructure in addition to the individual building can amplify the benefits of green home building. For example, by the improvement of a subdivision’s storm water management plan and preserving the available natural surroundings through careful design and construction, can impact the entire community and reduce infrastructure costs.

5.5 WATER EFFICIENCY

The basic intent of LEED for Homes is to provide water-efficient practices, both indoor and outdoor. There are three elements within this category where points can be earned:

• Use of municipal recycled water, or offset central water supply through the capture and controlled reuse of rainwater and/or grey water.
• Reduce demand for outdoor water through water-efficient irrigation.
• Minimize indoor demand for water through water-efficient fixtures and fittings.

The basic intent of LEED for New Construction is to limit or eliminate the use of potable water and use other natural surface or subsurface water resources available on or near the site. There are also three elements in the LEED for New Construction for water use efficiency:

• Limit or eliminate the use of potable water, or other natural surface or subsurface water source available on or near the project site, for landscape irrigation. Use only captured rainwater, recycled wastewater or recycled grey water.
• Reduce the generation of wastewater and potable water demand, while increasing the local aquifer recharge by using water-conserving fixtures, or treat 50% of the wastewater on-site to tertiary standards.
Maximize water efficiency within the building to reduce the burden on municipal water supply and wastewater systems.

The USDOE, in an on-line article, Commercial Building: Site Design and Planning, says, “Water efficiency is the planned management of potable water to prevent waste, overuse, and exploitation of the resource. Effective water-efficiency planning seeks to, do more with less, without sacrificing environmental performance.” The USDOE recommends reducing water use for landscaping, and other outdoor demands by using recycled water, or water with grey water.

In water conservation measures it suggests reducing the impact on natural water resources, storm water and wastewater treatment. Water availability and usage varies from region to region, the concern with adequate supply is becoming widespread geographically. Landscaping can reduce outdoor water use and provide energy use reductions for the home. Use of native species that are drought resistant and provide cooling shade can make a significant difference in water demand for a home.

5.6 ENERGY AND ATMOSPHERE

The basic intent of LEED for Homes is to provide energy efficiency, particularly in the building envelope and heating and cooling design. There are eleven items for possible credit under the LEED for Homes:

- Meet or exceed the performance for an ENERGY STAR label.
- Design and install insulation to minimize heat transfer and thermal bridging.
- Maximize the energy performance of windows. Windows and doors must meet or exceed the requirements of ENERGY STAR performance.
- Energy consumption due to thermal bridges and/or leaks in the heating and cooling distribution system must be minimized.
- Reduce energy consumption associated with the heating and cooling system by following the ASHRAE handbook.
- Reduce requirements for domestic hot water systems, by improving the efficiency of both hot water system design and the layout of the fixtures in the home.
• Reduce energy consumption of interior and exterior lighting. Lighting must have the ENERGY STAR label, motion sensor controls on exterior lighting, and use ENERGY STAR rated lamps in at least 80% of the home.

• Appliances must meet ENERGY STAR requirements.

• Reduce the consumption of non-renewable energy sources by installing and operating renewable electric generation systems.

• Select and test air-conditioning refrigerant to ensure performance and minimize contributions to ozone depletion and global warming.

The basic intent of LEED for New Construction is verifying that the energy related systems are installed and performing according to the project design as well as establishment of maximum energy efficiency, reduce ozone depletion, increase use of renewable energy, provide for ongoing accountability of energy consumption over time and encourage development of renewable energy technologies on a near zero pollution basis. More specifically, there are few more areas where credit can be earned under the LEED for New Construction:

• Verification that the building’s energy systems are installed calibrated and performs according to the project requirements, basis of design, and construction documents.

• Establish the minimum level of energy efficiency for the building and systems by designing the project to comply with mandatory and prescriptive provisions of ASHRAE/IESNA.

• Reduce ozone depletion by zero use of CFC-based refrigerants in the air conditioning systems & minimizing direct impact on global warming.

• Achieve increased levels of energy performance above the baseline.

• Encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use.

• Provide ongoing accountability of the building energy consumption over time through the development and implementation of a Measurement & Verification Plan.
The USDOE has a significant focus on energy use. Specifically breaking energy use in commercial buildings into; water heating, appliances and equipment, heating, ventilating, and air conditioning and lighting and day lighting. A brief synopsis of each is supplied here:

- **Water Heating**: A significant amount of energy can be tied up in water heating. It lists and describes in detail a number of technologies available to reduce energy demands for heating water:
  - Conventional water heating efficiency
  - Drain water heat recovery
  - Heat pump water heating
  - Demand (tank less or instantaneous) water systems
  - Solar water heating

- **Appliances and Equipment**: Office equipment, food service equipment, and laundry equipment consume energy and present opportunities for energy reduction in commercial buildings. The main focus by the USDOE is the use of ENERGY STAR listed equipment, but also on shutting down equipment when not in use.

- **Heating, Ventilating, and Air Conditioning**: HVAC systems accounts for 40 to 60 percent of the energy used in the United States for commercial and residential buildings. ASHRAE is the recommended source for HVAC information and technologies. The USDOE recommends looking at alternate sources of energy such as wind power, solar-assisted systems, and cogeneration.

- **Lighting and Day lighting**: Lighting is essential to any building and provides aesthetics of indoor spaces, and illumination for tasks and activities. An efficient lighting strategy, including natural day lighting, can provide proper levels of illumination and reduce energy costs. Lighting technologies include:
  - Lamps – lighting sources, like fluorescent and incandescent light bulbs, and solid-state lighting.
  - Ballasts – used with electric-discharge lamps such as fluorescent lamps, ballasts transform and control electrical power to the light.
Luminaries (Fixtures) – complete lighting units that contain the bulbs and, if necessary, the ballasts.

- Lighting Controls – devices such as timers and sensors that can save energy by turning lights off when not in use.
- Day lighting – the use of natural light in a building.

Minimizing the environmental impacts of energy used in the construction, operation of the home and in the making of the construction materials. This is the most quantifiable aspect of green building. This helps the builder create a better building envelope and incorporate more energy efficient mechanical systems, appliances, and lighting into the home, yielding long-term utility bill savings and increased comfort for the homeowner.

Energy used to heat and cool a home over its lifetime is significant. However, energy used during the construction phase is also significant, especially when we consider the number of homes built every year (estimated at 1.85 million per year in 2006). NAHB estimates that between 1990 and 2001 the average home consumed about 12,800KWh per year for space and water heating, cooling, and lights and appliances. Total energy expenditures during a year cost the homeowner about $1,600. Energy efficiency improvements in a green home can reduce that cost by at least 20%. In regards to the guidelines, the most significant improvements are from a “whole systems” approach to the building of a green home.

5.7 MATERIALS AND RESOURCES

The basic intent of LEED for Homes is efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction. LEED for Homes has three areas in which points can be earned:

- Optimize the use of framing materials by limiting the overall waste factor to 10% or less. LEED defines waste factor as the percentage of framing material ordered in excess of the estimated material needed for construction. Credits are given for detailed advance planning for lumber requirements for the frame.
• Use products that are extracted, processed, and manufactured within the region. Provide all wood products that meet specified LEED environmentally preferred product requirements as defined in the LEED manual. In order to receive credits the materials must make up 90% of the component (i.e. environmentally preferable, low emissions, and local sourcing) by weight or volume. Use products that meet specifications as defined by LEED for low emissions, and/or are of local production and were extracted, processed, and manufactured within 500 miles of the home.

• Reduce waste generation to a level below the industry norm. Investigate, document and recycle all project waste stream materials. Industry norm is defined by LEED as the generation of 2.5 pounds of waste or less per square foot of conditioned floor area. The LEED for Homes manual contains a calculation formula for determining this.

The basic intent of LEED for New Construction is the storage and collection of recyclables by the occupant and diverts construction waste material from landfill disposal. Also facilitate the use of existing building materials, use of local and recycled materials, reduce the use of raw materials in the construction of the building. LEED for New Construction has one prerequisite and seven optional requirements for credit. LEED requires that easily accessible area be provided that serves the entire building, providing collection services for glass, plastic, office paper, newspaper, cardboard and organic wastes. The seven optional items consists of:

• Extend the life-cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

• Divert construction, demolition and land-clearing debris from disposal in landfills and incinerators. Redirect recyclable recovered resources back to the manufacturing process. Redirect reusable materials to appropriate sites. Accomplish this by recycling/or salvaging at least 50% on non-hazardous construction and demolition debris.
• Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5%, based on cost, of the total value of materials on the project.
• Use materials with recycled content.
• Use building products that have been extracted, harvested or recovered, as well as manufactured within 500 miles of the project site for a minimum of 10% of the total material value.
• Use renewable building materials and products for 2.5% of the total of all building materials and products used in the project based on cost.
• Use a minimum of 50% of wood-based materials and products, which are certified.

5.8 INDOOR ENVIRONMENTAL QUALITY
The basic intent of LEED for Homes is improvement of indoor air quality by reducing the creation of and exposure to pollutants. There are few areas where points can be earned in the LEED for Homes rating system:
• Install an ENERGY STAR approved bundle of air quality measures.
• Minimize leakage of combustible gases into the occupied space of the home.
• Control indoor moisture levels to provide comfort, reduce the risk of mold, and increase the durability of the home. Install dehumidification equipment to maintain humidity at or below 60%.
• Reduce occupant exposure to indoor pollutants by venting with outside air. Install whole building ventilation systems that meet the requirements.
• Reduce moisture and exposure to indoor pollutants in kitchens and bathrooms by meeting specific design requirements such as install exhaust systems with automatic sensors.
• Provide appropriate distribution of space heating and cooling in the home to improve thermal comfort and energy performance.
• Reduce particulate matter from the air supply system by installing air filters.
• Reduce occupants’ and construction workers’ exposure to indoor airborne contaminants though source control and removal.
The basic intent of LEED for New Construction is establishment of indoor air quality performance as it pertains to the comfort and well-being of the occupants from any hazardous particles or chemical pollutants or biological impacts. Provide lighting, heating and cooling comfort for the occupants. LEED for New Construction has two pre requisites, one that requires ventilation systems that meet ASHRAE standards. The other prerequisite requires the minimization of exposure to tobacco smoke. There are eight areas where points can be earned under the LEED for Construction guidelines:

- Install permanent monitoring systems to provide feedback on the performance of the ventilation system.
- Increase breathing zone ventilation rates to all occupied spaces by at least 30% above the minimum rates as required by ASHRAE.
- Develop and implement an Indoor Air Quality Program for the pre-construction and pre-occupancy phase.
- All adhesives and sealants used on the interior of the building shall comply with the requirements by the standards as referenced in the LEED for New Construction manual.
- Design to minimize and control pollutant entry into the building and later cross-contamination of regularly occupied areas.
- Provide a high-level lighting system control by individual occupants to promote the productivity, comfort and well-being of building occupants.
- Provide a comfortable thermal environment that supports the productivity and well-being of the building occupants.
- Provide the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

The guiding principle from the NAHB defines indoor environmental quality as the creation of healthy and safe indoor air as important in a green building. Indoor air quality is often cited as the second most important feature of a green home after energy use. More attention is on the type of building material used and the potential impact they have on the occupants of the home.
5.9 AWARENESS AND EDUCATION

The basic requirement of this category is to maintain the performance of the home by educating the occupants about the operations and maintenance of the home’s features and equipment. The NAHB stresses education as an important guiding principle. The NAHB says that improper maintenance can defeat the efforts to create a resource efficient home. An example of improper maintenance would be a home owner may fail to change air filters regularly or not open kitchen or bathroom exhaust air to remove excess moist air. These impacts the air quality of home and excess moisture can create mold that can impact the health of the occupants.