

Sustainable Landscape Architecture for Solar Buildings

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ABSTRACT: Modern architecture presents a major developmental approach in implementing the solar building technologies. These technologies shall be environmentally sound, resource efficient and govern all *ecological principles*. Accordingly, the design of solar buildings calls for an augmentation in landscaping architecture to regulate major environmental parameters within and outside the buildings. Proper placements of medicinal plants, shrubs and vines around the buildings conserve energy in addition to good appearance. Sustainable landscape architecture is a special category tool for design, confined to outer space of the building. In fact, a typical landscape design is presented in this paper addressing the control modes of air circulation around and within the building, to maintain normal heating and cooling during day and night, achieving higher *energy-efficiency* in its conservation, balancing and maintaining healthy environments. These can be achieved only by inducting pollution free and economic energy systems by means of maximum utilization of the solar radiations and rain water harvesting, in multiple ways, in particular considering the recent advanced technology scenarios like in-house power generation and storing methodologies as a redundant source for residential applications. This emphasizes more on building-up moderate landscaping devices / designs, for installation on the roof as well as in surroundings of the building.

Key words: *ecological principles* , *energy - efficiency*

1. INTRODUCTION

Knowledge from Ancient Egyptians reveals the application of solar radiations in the passive form quite long ago. In the 3rd Century BC, Greeks used mirrors to concentrate the energy from the sun to prevent the invasion from Romans. In the northern part of Italy, 100 AD, a house was built with mica windows in one room particularly to store the heat to minimize to the burning of wood for cooking. Subsequently Americans initiated in building houses, on and by the side of cliffs as well as mountain ranges to allow the storage of heat during the day and to release of heat at night. These concepts confirm

certain the existence of inherent technological features, in utilizing building environmental requirements coupled with solar radiations. The present paper describes the nature and qualities of solar buildings with essential mandatory guidelines for consideration. Also narrated the art of architecture in preserving the global burning problem on conservation of energy with respect to sustainable landscaping architecture. The designs are developed for a roof garden of a building and sustainable landscapes for a single floor apartment are projected, proposed to implement at Hyderabad, Andhra Pradesh, India.

2. SOLAR BUILDINGS

Solar buildings are the only energy saving buildings designed to reduce green houses gases at local regional levels adopting more energy efficient production, processing and distribution technologies. The improvement of building techniques is the only alternative approach in increasing energy efficiencies there by achieving low gas emissions. These buildings are classified into Residential, Industrial, Commercial, Laboratories, Hospitals, Auditoriums and Entertainment Parks. Special attention has been addressed on the buildings design to make use of existing resources from Nature [1].

2.1 Design rules for solar buildings

The following guidelines help the designers to a large extent:

- A better understanding of the geographical site location and climate changes is needed to recognise the dependence of natural conditioning.

- Provide full insulation to all parts of the building to reduce energy requirements of the house.

- Limit the K-value for walls and roof within the 0.5.

- Position the openings and solar collectors on the southern side avoid shadings facing.

- Optimize the window and door areas in achieving to balance the internal energy levels to moderate.

- Implement the rain water harvesting and storing system for day to day necessities of residents.

- Adopt in-house modern technologies concepts to generate power from solar radiations (aim for uninterrupted independent power).

- Protect building environment by sustainable landscaping and roof gardening

Implementation of these rules, results 50% of reduction of energy usage for a given living space compared to present typical levels.

An innovative concept is studied and designed to have self sufficiency in the solar

building to have an uninterrupted power utilizing solar radiations and rain water harvesting as well as groundwater / other resources of water.

Requirements

Essential building design requirements are highlighted for understanding:

- Orient the building with the north-south major axis to receive more solar radiations compared to other axis of orientations.

- Design the layout and volume of building so that maximum space content is obtained for the minimum area of walls.

- Evaluate and determine the heat losses through outer surfaces, ventilation and storage where ever applicable.

- Determine the most economical ratio between comfort, storage and external energy behaviour.

- Estimate the best utilization of natural light with respect to heat loss and heat gain as well as glare problems.

3. ARCHITECTURE

Architecture depends on five fundamental principles namely Order, Eurhythm, Symmetry, Property and Economy. These are connected with three specified areas like art of building, making of models and the construction of machinery. At present the role of architectural designs are addressed to Landscaping controlled by environments for achieving sustainability.

3.1 Sustainable architecture

Architecture is a unique challenge to achieve sustainability. Sustainability is “a form of development that meets the needs of the present, without compromising the ability of the future generations to meet their own needs”. During the design, it features the integration with electrical, mechanical and structural engineering. Also designers are more concerned on traditional aesthetics of massing, proportion, scale, texture, shade and light in addition to long term cost.

3.2 Sustainable designs

The salient features of the sustainable designs are as follows:

- *Thorough planning and optimization design parameters
- * Integrated with critical components
- * Control and reduction of energy consumption levels.
- * Economically sound
- * Philosophical approach of building.

To satisfy the above salient features, the architectural sustainability must involve a combination of aesthetic, environmental, social, political and moral values. A talented architect visualizes the criteria in balancing the environmental considerations and economic constraints in a well defined manner.

3.2 Sustainable design principles

A better understanding of the following parameters enhances the design qualities of buildings.

Place: Sustainable design begins an intimate understanding of place. This helps to determine the design practices such as solar orientation of a building on the site, preservation of natural environment and access to public transportation.

Nature: Effective building site design connected with nature brings environment back to life.

Natural process: In nature, a life depends on the other for survival. This dependence regenerates rather than deplete, for longevity of life.

Environmental impact: Sustainable design possesses environmental impact of the design by evaluating the site, the embodied energy and toxicity of the materials.

People: Sustainable design must take into consideration, the wide range of cultures, races, religions and habits of people who inhabit the built environment.

4. ENVIRONMENTAL ARCHITECTURE

The environmental architecture reveals how to design and use the Earth's green space. These designs associated with any type of buildings retain sustainability in establishing

long life. Thus the concept of sustainability confirms environmental protection with the two basic principles of less energy and less land. The environmental architecture deals with the surroundings and directs to use renewable materials for houses for sustainability. The environmental designers design the plant layers on rooftops to reduce the thermal effect. The parameters herein are the coverage ratio (CR) and the total leaf thickness (TLT) of plants. The plants are to be employed for an indoor experiment with controlled environmental conditions [2].

4.1 Environmental landscaping

Environmental Landscape conserves energy, saves water, reduces pollution and saves money. The conservation of energy in landscaping controls and conserves heat during summer and winter respectively. Plantation helps to regulate the temperature absorbing carbon dioxide to prevent global warming. Landscaping has a great effect on conservation of water. Conservation of water through landscaping is known as Xeriscaping, achieved by choosing plants that are drought resistant, belongs to native area [3].

5. LANDSCAPE ARCHITECTURE

The landscape architecture is a clear intellectual conceptual design bonded with nature. It is associated with the modern design art, to built the out door space for environment sustainability in reducing and eliminating green gas emissions. A landscape developed with sustainable practices will improve the environment by conserving resources and reducing chemical applications. A sustainable landscape will also control labor inputs making it less expensive to implement and maintain.

5.1 Sustainable landscaping

The sustainable landscaping means the consistency of an attractive and beautiful environment that is in balance with the local climate. Its design includes functional, cost

efficient, visually pleasing, environmentally friendly and easily maintainable locations. The sustainable landscape design also needs direct solutions for certain selection processes and operational devices. They are utilization of space and its existing conditions needs for plants and landscaping, renovations and criticalities in maintenance. Many flours or bedding plants and vegetable plants have higher nitrogen and phosphorus requirements herbaceous perennials, shrubs and trees. Some native plants can actually declare from two many applications of fertilizer.

5.2 Sustainable landscape design

Landscape design starts with an understanding of certain features like house area, local covenants and budget. The design process needs base plan, site inventory, construction, maintenance and implementation process. This process adopts a real planning on the following:

- i) Installation of bedding plants
- ii) Erecting of sprinkler heads drip irrigating
- iii) Removal of debris, odd sod and irrigation weeds.
- iv) Installation of drainage systems
- v) Installation of wood edging and create shrub borders.

Addition of structures on the top 8 to 12 inches of the soil is a big slow process. Some organic material such as grass clipping decomposes quickly and does to some extent a little change in soil structure.

5.2.1 Selection of plants.

Selection of right plants for the identified location is essential to thrive. Plants those are not adapted to the local environments require more inputs. Plants placed to the environmental conditions like lighting, moisture and temperature that doesn't meet the qualifications becomes stressed. Stressed plants are more prone to pest problems. Plants suit for environments whether native or exotic, have a better chance of serving our conditions. Use deciduous plants to create shade in the summer to help cool the home. Allow light penetration in the winter

as a solar heating device. Avoid evergreen trees close to the house basement because they creed shade and block solar radiations in winter.

5.3 Landscape for energy conservation

South facing plants of a house receive the most intense sun light. Shading the south side of the house, will contribute the cooling atmosphere during summer. Two or three large deciduous trees can provide sufficient summer shading for single floor or family houses. These trees should be planted away from the foundation to avoid the problems with the roots. Evergreen plants provide the most resistance and to be planted at reasonable distance. The approach of illuminating the gardens and landscapes is to be reviewed carefully. Prevention of light trespass reduces light pollution and reduces excessive glare to promote energy conservation. Usage of solar garden lights replacing electric lights increases the conservation of energy environmentally.

5.4 Roof garden design

Due to intense solar radiations, in the tropic and subtropics regions, the amplification of thermal load in the buildings, the costs for maintains cooling increases. Planting small trees, maintaining roof gardens and parks reduces thermal loading. A typical concept is shown below.

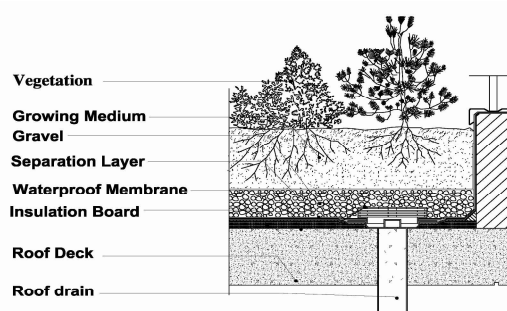


Fig. 1: Typical detail of roof garden.

The roof area utilization in buildings is planned for achieving sustainability. 60% of the roof of the building is covered by the roof garden, as a good insulator to cut down the load on the air conditioning system. The balance portion of the roof is covered by solar photo voltaic with 24 kW capacity to

generate power of 100 to 200 units per day into the grid meeting 20% of total energy cost of the building. Details of paving on the roof garden are shown in Fig.2.

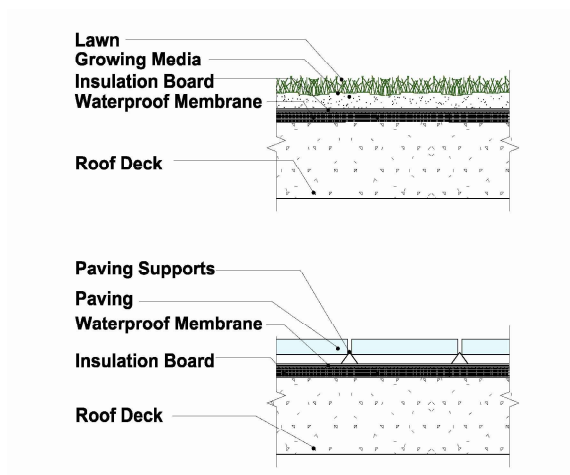


Fig. 2: Details of the paving on the roof garden.

5.2 Medicinal plants and herbs

Eastern Himalayas and the Western Ghats of India are among the 18 crucial regions of bio-diversity in the world. Three types of medicinal plants and herbs are freely available and possible to grow similar to Indian environmental conditions. These plants are to be planted, preferably on eastern direction of the building as the ultra-violet radiations from the sun deliver and circulates a good quality of air, surrounding and inside the buildings through ventilators.

5.3.1. Tulasi (Laminaceae)

The breeze from the plant has an impact of killing the germs in atmosphere. The juice from leaves has an application to cure catarrh, bronchitis, skin and other spreading



Fig.3: Tulaci

or coetaneous deceases. Hindu community in India worship this plant as *Goddess* in temples and dwelling houses (Fig.3).

5.3.2 Haridra (Zingiberaceae)

This is a perennial herb, native of Southern Asia and cultivated through out India. This can grow at all places ranging from sea level to an altitude of 1,220 meters and is very sensitive to climatic conditions. The drug has a cure in disorders of blood, liver, jaundice and non-tubercular respiratory diseases.

5.3.3 Sarpaganda (Apocynaceae):

These plants are available in Assam, lower hill planes of Ganges, eastern and Western Ghats and some central parts of India. The roots after dried yield tincture known as Indian Pharmacopoeia essential component used during injuries (Fig.4).



Fig. 4: Sarpaganda

6. LANDSCAPE DESIGN

A typical landscape design is shown.

Recent architectural sustainable design of a single storied building is presented. The first view is the ground plan (Fig.5) and the second view is the 1st floor of the building, roof garden (Fig.6). Both are self-explanatory from the figures.

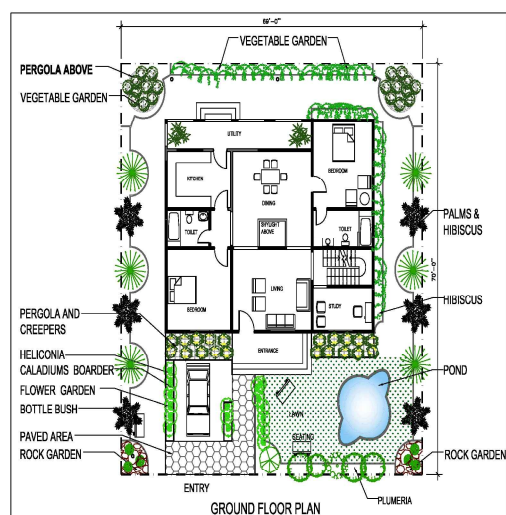


Fig. 5: Ground floor plan

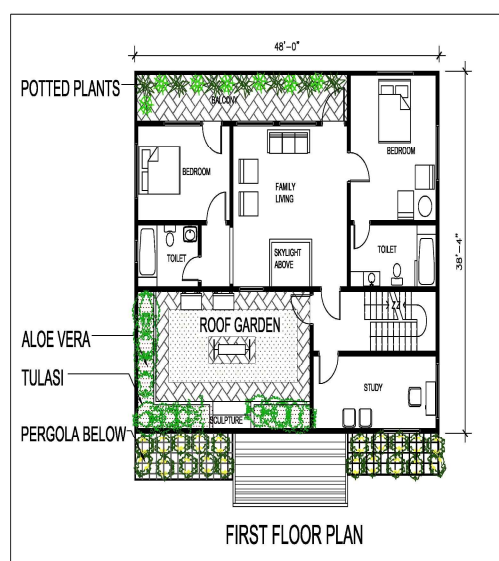


Fig. 6: First floor plan roof garden

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REFERENCES

- [1]Y.Feng, Thermal design standards for energy efficiency of residential buildings in hot summer / cold winter zones, Energy and Buildings 36(2004) 1309-1312
- [2]N.H.Wong, Y.Chen, C.L.Ong, A.Sia. Investigation of thermal benefits of rooftop garden in the tropical environment. Building and Environment 38(2003)261-270.
- [3]Cole.R, Emerging trends in building environmental assessment methods, Building Res Inf. 1988 .26(1): 3-16

7. CONCLUSION

The design of solar buildings calls for an attention to architects for induction of modern sustainable landscaping. This is preferably aimed to achieve a realistic approach in deriving conservation of energy and reduction of emissions in the buildings as well as surroundings. The design analysis of present single storied building revealed the fulfilment of described concepts.