UNIT 1 ENVIRONMENTAL DESIGN

Structure

1.0 INTRODUCTION

Environmental design is not a new word; it has been part of our ancient architecture. If we deeply observe, engineering challenges were answered with delicate design intelligence in our ancient structures. Environmental design means an integrated approach to technologically feasible and economically viable way of design. An environmental design is a way to create human spaces, which are beneficial for both community and natural environment and achieve a sustainable and eco-friendly result.

A key aspect of eco-friendly and economic sustainability is an environmental design consists of a systematic consideration of environmental performance and potential environmental impacts at the earliest stages of product design and development. Environmental design considers various effects on the environment at all the stages of a project or product lifetime, including raw materials acquisition, manufacturing, packaging, distribution, installation, operation, and ultimate fate at the end of the useful product lifetime. Environmental design concentrates on the entire cycle of manufacturing products and providing services. Hence, environmental design is much more

effective and economic than more primitive pollution measures. Environmental designis composed of two broad fields; the first field of environmental design is '**design for sustainability'**, which focuses on conservation of resources through minimizing the uses of energy, mineral, material and water, and also aims to preserve natural capital. The second area is '**design for health and safety'** of occupants. Here the main focus is to reduce risks from toxic and harmful substances, pollutants, and waste as well as concerns related to public health and safety.

In environmental designing, both commercial and residential structures are built using environmentally friendly material. Environmental design involves professionals (environmental designers) in the fields of urban planning, landscape architecture, who assist and guide in the development of right infrastructure. These professionals focus on the use of environmentally sensitive techniques and materials. Their main focus is to study the relationship between man-made structures and the surrounding environment to develop optimum infrastructure, including commercial and residential buildings by taking into account functional, economic and ecological needs.

1.1 OBJECTIVES

After finishing this unit, the student will be able to:

- define environmental design;
- explain the basic principles and benefits of environmental design;
- discuss the objectives and potential of environmental design (ED); and
- explain the concept of green building, green infrastructure and green landscaping in deep.

1.2 DEFINITION AND SCOPE

Environmental design is a process which concentrates on creating structurally sound buildings for commercial and residential purposes that are not only functional but environmentally responsible as well. Main fields in environmental design are urban planning, architecture, geography, landscape architecture and interior design.

Earlier, environmental design comprised of an interdisciplinary area focused on historical conservation and lighting design. Presently, the term has expanded and extended to apply to larger scope involving ecological and sustainability issues. Environmental design does not mean a single or particular approach. It involves interdisciplinary areas such as architecture, urban planning and landscape design, and emphasis on the relationship of built infrastructure, urban landscapes and natural surroundings. Environmental designers construct buildings, landscapes and open civic spaces to be functional, be aesthetically pleasurable to users and to promote community developmentwithout harming natural environment.

The scope of each project that emphasizes environmental design includes thefollowing parameters:

- Collection, processing and management of solid wastes,

- Environmental impact assessment (EIA)and its alleviation,
- Water supply,
- Air pollution,biodiversity and soil conservation, and
- Treatment of wastewater

1.3 PRINCIPLES AND BENEFITS

Dear learners, let us now read about principles and benefits in the following sentences:

1.3.1 Principles of Environmental Design

Principle-1 Energy conservation

The prime aim of environmental design is reduction in operational energy consumption from the built infrastructure and focuses on the reduction in carbon emission and cost savings.This can be achieved by following the energy hierarchy, which is one of the most effective ways to reduce the energy related environmental impacts of buildings. The designer should follow and include the energy hierarchy in the building design (Fig. 1). Energy conservation should be kept in mind while designing new building and renovating old buildings.

Step 1- Reduction in energy demand

Here the main aim of the designers is to reduce the demand of energy in the new buildings. In any building, energy is needed for lighting, heating, cooling and cooking. Energy requirement can be reduced by selecting energy efficient devices, insulation of building, the use of insulated pipes and ducts, natural ventilation, use of daylight and passive design.

a. Step 2- Energy efficiency

During the designing of energy efficient building various energy efficiency services, appliances/equipment and controls should be used in the building. This can be achieved by adopting following approaches such as the use of high efficiency lighting system (LED lamps) and goods.

b. Step 3- Use of renewable and low/zero carbon emission technologies

The energy requirement in buildings should be fulfilled from on-site renewable sources. Low or zero carbon emission technologies should be incorporated to provide as much energy as is technically and economically feasible sources. This includes considering rooftop solar water heaters, solar PV panels, wind energy, biomass energy etc.

c. Step 4 – Purchase green energy

The building will fulfill its remaining energy needs by purchasing Green Energy Tariff (electricity generated from renewable energy sources off-site). These steps would be beneficial for the growth and development of new large-scale renewable energy generation and infrastructure. A green energy tariff works by the supplier promising to match all or some of the electricity with renewable energy, which it then feeds back into the National Grid. As more people sign up to a green energy tariff, the bigger the percentage of green energy in the national supply.

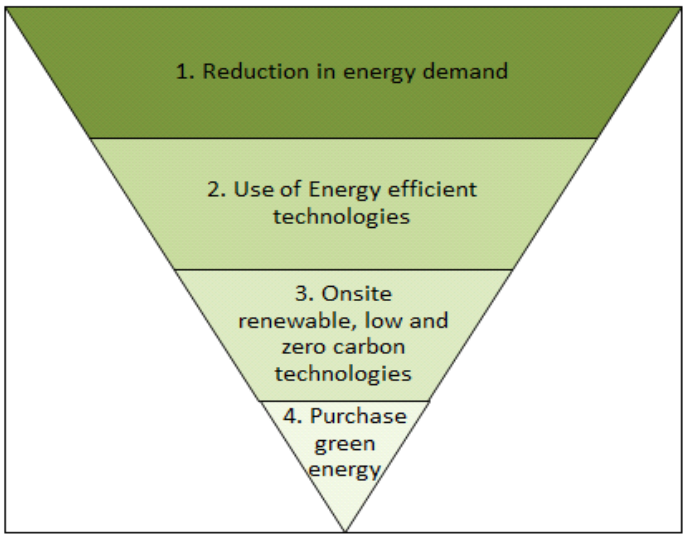

Fig. 1.1: Energy hierarchy of environmental design.

Principle 2- Building Materials

In the construction of a building with environment design, various materials are required in different quantity. Usually, products made from natural, renewable materials and products with recycled content are used. Use of eco-friendly building materials in construction reduce environmental impacts and life cycle impacts and are economic on a long term basis. Earlier stages of the material life cycle, such as extraction, processing, manufacturing and transportation to site should also be considered, because these stages may cause significant impacts on the environment. Other environmental impacts of materials such as over-utilization of resources, forest cutting, rise in climate change, environment pollution etc., should also be kept in mind. So it is necessary to take steps to reduce the life cycle impacts of building materials in any construction.

Principle 3-Water Consumption and Drainage

Reduction in water intake should be practiced through various water conservation measures in buildings. Water conservation should be cost effective and use of alternate water sources also be practiced in the building. Utilization of sustainable drainage measures must be used to reduce surface water run-off and flood risk. This can be achieved by various methods, i.e. by installing water efficient technologies to promote the use of rainwater and recycled water. Sustainable urban drainage systems such as green roofs, rainwater harvesting and permeable paving should be adopted in building to reduce water runoff.

Principle 4-Biodiversity

The designer should focus on enhancing biodiversity and encouraging its profits for occupants and local communities. They are responsible for the protection of biodiversity and to recognize chances for enhancement. This can be attained by confirming that all natural habitats are protected during construction of structures. During the construction work opportunities should be recognized on the project site to recover biodiversity. This can be attained by including green roofs, green walls, boxes for birds, planting trees or the inclusion of water bodies. Further, other opportunities can be recognized to include emergent spaces as part of new projects.

Principle 5-Minimize Travel Impacts

The designers should keep an eye on the impact associated with the travel arrangements for workforces, occupants and locals. Planning should be done to reduce the impacts of travel by encouraging the use of efficient modes of transport that decrease environmental impact, reduce congestion and air pollution.

Principle 6-Waste Management

The designer should focus on employing the waste hierarchy (refuse, reduce, reuse, recycle and dispose). Various methods should be used in design to reduce the quantity of waste generated during different stages of construction.

Principle 7- Pollution Control

Provisions for the prevention of pollution should be proposed and applied to the project. This can be achieved by reducing local discharges to air, land and water. It can be done by modifying building materials, proper drainage system, use of non-toxic materials, and use of green energy at site for different activities and by reducing transportation. This is particularly important during construction and refurbishment activities on a project. All designers must obey with the overall practice for health, safety and the environment.

1.3.2 Benefits of Environmental Design

Environment design is the need of the day considering the negative impact caused on the natural environment in the post industrialization period of human history. The benefits of environmental design are the following:

- Environmental design provides more business, by promising a healthy environment with sustainable design.
- Use of environmental design can create a unique and beautiful appearance too.
- The basic concepts of environmental design can enable reduction of environmental impact of a product during the process by optimizing the usage of raw materials and energy, management of wastes, and prevention of pollution in the future.
- It is an economically viable design, which meets the consumers need by reaching their expectations in terms of reasonable price, steady performance and quality of the product.

Check Your Progress 1

Note: a) Write your answer in about 50 words.
b) Check your progress with possible answers given at the end of the unit.

1) What do you understand by Environmental design?

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2) What is a Green Energy Tariff?

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3) What are the benefits of Environmental design?

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1.4 ENVIRONMENTAL DESIGN FOR BUILDINGS

Environmental design of buildings involves adopting techniques that ensure that the structure is designed, built, renovated, operated or reused in a sustainable and resource efficient manner. Environmental building design is also called green building design or eco construction or green construction. Initially the construction and design of green building may cost much more than a conventional building. Nevertheless, due to the least operating cost of environmentally designed building the overall cost comes down in the future. The green building practice applies a project life-cycle cost analysis for calculating the suitable upfront budget. This analytical method calculates costs over the useful life of the asset. It is necessary to take the help of professionals during the design and construction phase of building to reduce the expenditure.

1.5 CONCEPT OF GREEN BUILDINGS

Worldwide, the construction industry consumes a huge amount of renewable and nonrenewable resources (energy, water and raw materials) and generates a large amount of wastes (solid as well as liquid) and greenhouse gases. This has resulted in an increase in overall awareness about the importance of sustainability in the construction industry. Consequently, the demand for sustainable and green building concept is gaining importance in various countries past years. To date much of the emphasis in green building development has been on optimizing energy and resource efficiency. A green building, usually refers to a building that utilizes less water and energy, generates fewer wastes, effectively uses natural resources and provides healthier space for inhabitants than a conventional building (Fig. 2). They must also support the comfort and well-being of their occupants.

1.5.1 Objectives of Green Buildings

Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment in several ways. The main objectives of green buildings are as follows:

- To minimize the use of resources, maximize the reuse of materials, promotion of recycling and utilization of renewable resources in buildings,
- To reduce impact on the environment,

- To enhance the use of efficient building material and construction practices,
- Provide a comfortable, healthy and hygienic indoor environment for occupants, and
- To encourage the reduction of waste generation and efficient waste management practice, thereby decreasing pollution, and minimizing environmental degradation.

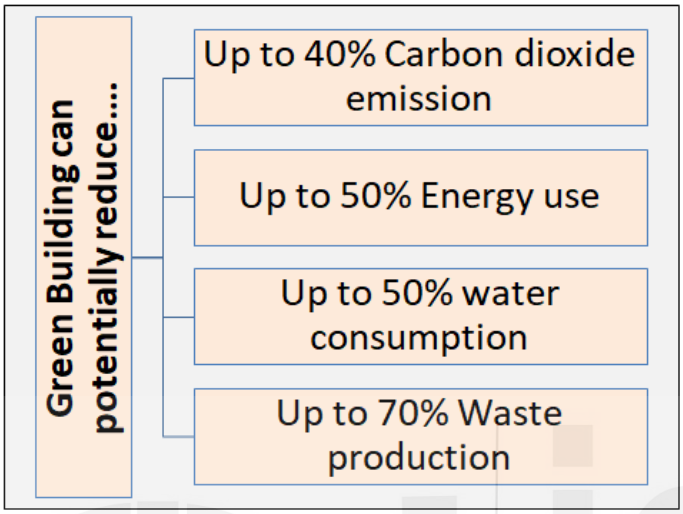

Fig. 1.2: Potential of green buildings in reduction of resource use and waste

1.5.2 Elements of Green Buildings

There are five most important elements of green building (Fig. 3). These elements should be considered while designing any new green building.

- Smart Design (structure efficiency)

  Design has the biggest impact on cost and performance of a building. Its main intentions are to minimize the total environmental impact associated with all life- cycles of buildings.

- Energy Efficiency

  For energy efficiency, the main strategy is to reduce the operating energy use in the building. Use of renewable energy such as solar power, wind power, hydro power and biomass can significantly reduce the environmental impact of a building. Use of energy efficient tools and technology is also a solution.

- Eco Materials

  For a suitable green building the building construction materials should be natural, renewable, recycled or recyclable and eco-friendly. Examples are timber from forest, renewable plant materials like bamboo and straw and other products that are non-toxic, reusable, recycled, etc.

- Water Conservation

  Decreasing water consumption and shielding water quality are the key objectives of green building. The use of non-sewage and greywater for

on- site use such as site-irrigation and watering plants will minimize demands on the local aquifer.

- Waste and Toxic Reduction

  The quantity of waste can be reduced by recycling and reusing the resources.

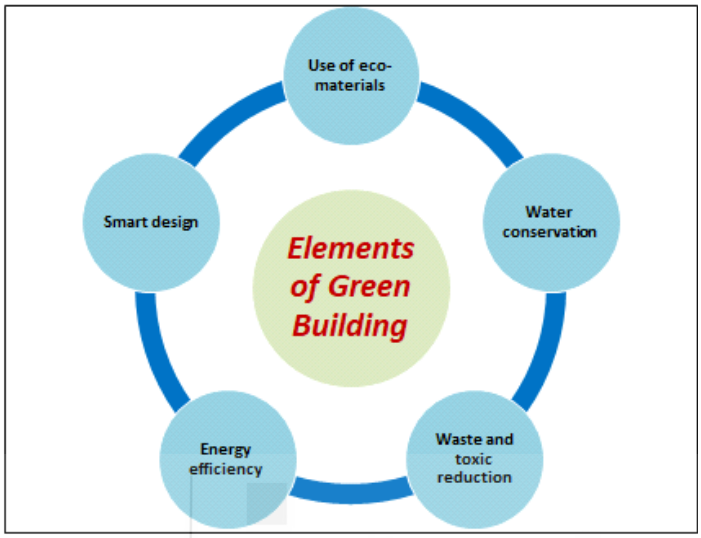

Fig. 1.3: Elements of green building

1.5.3 Examples of Green Buildings in India

Example 1: Suzlon One Earth, Pune

Suzlon One Earth's office building is designed in a unique manner by Pune based architect, Christopher Charles. The building is one of the biggest green building projects (about 10 acres in area) in India. This is the first building in the country, which has received LEED (Leadership in Energy and Environmental Design) certificate and has also received 'Platinum' rating in 2010. All the energy requirement of the building is fulfilled by on-site and off-site renewable sources. About 7% of total energy requirement of the building is generated by on-site 18 hybrid wind turbines and the remaining energy need is derived from off-site renewable energy sources.Further, the building is designed in a manner to utilize maximum sunlight and to reduce the use of energy consumption for lighting. Green practices such as rainwater harvesting systems, green areas, establishment of water permeable spaces, are used in the campus infrastructure to reduce storm water runoff and ground water recharge.

Example 2: Shapath V, Ahmedabad

Shapath V is 20000sq yards of land area developed by Savvy Infrastructures Ltd., Ahmedabad. It is the first LEED certifiedand 'gold' rated green building in Gujarat assessed by the Indian Green Building Council (IGBC). The developer has used energy conservation technologies such as high roof height, double glazed windows and central air conditioning with chilled water supply.For water conservation, the building adopted several steps such as rainwater harvesting system, water recycling, on-site

wastewater treatment plant etc. The building is also designed to reduce the carbon dioxide level produced in the building. The other major features of the building are multi-level parking, waste management, and use of eco-friendly, recyclable, recycled and renewable materials.

1.5.4 Rating System for Green Buildings

A building is really green or not, is defined on the basis of predefined rating systems set by various agencies. The rating system is mostly voluntary systems that have evolved over the past more than 20 years. These rating systems are developed on the basis of green materials and technologies used presently. Worldwide, large numbers of rating tools have evolved in a numerous nations that are likely to stimulate market and consumer interest in green buildings. A wide range of rating systems, have evolved in different parts of the world based on local climates and geographical conditions (Table 1). The key objective of these rating systems is to facilitate a general approach to make eco-friendly buildings, through architectural design, effective handling of waste, water and energy efficiency, and focus on occupant comfort and health.

Table 1.1: Widely used Green Building rating agencies and systems in world

S.no.	Rating agency/system	Country
1.	India Green Building Council	India
2.	Green Rating for Integrated Habitat Assessment (GRIHA)	
3.	Leadership in Energy & Environmental Design-India (LEED-India)	
4.	World Green Building Council (WGBC)	USA
5.	The Green Globe Rating System	
6.	Energy Star	
7.	Leadership in Energy & Environmental Design (LEED-USA)	
8.	Green Globes	USA and Canada
9.	Green Star	Australia
10.	Australia Greenhouse Building Rating (AGBR)	
11.	Building Research Environment Assessment Method Consultancy (BREEAM)	United Kingdom
12.	Ecology, Energy Saving, Waste Reduction and Health (EEWH) (Taiwan)	Taiwan
13.	Building Environment Assessment Method-Hong Kong (HK-BEAM)	Hong Kong
14.	Comprehensive Assessment System for Building Environment Efficiency (CASBEE)	Japan

15.	Thai's Rating of Energy and Environmental Sustainability (TREES)	Thailand
16.	Green Mark	Singapore
17.	Green Building Council (Korea)	South Korea
18.	European Environment Agency Rating	Europe
19.	Philippine Green Building Council	Philippine
20.	Leadership in Energy & Environmental Design-Canada (LEED-Canada)	Canada
21.	Leadership in Energy & Environmental Design-Brazil (LEED- Brazil)	Brazil
22.	German Sustainable Building Certiûcate (GSBC)	Germany

1.6 GREEN INFRASTRUCTURE

There are several definitions of green infrastructure are available in books, articles, research papers and websites. Different authors and practitioners focus on different scope/components as per their interest. The broad scope definition is presented by the Countryside Agency (2006) "Green infrastructure comprises the provision of planned networks of linked multifunctional green spaces that contribute to protecting natural habitats and biodiversity, enable response to climate change and other biosphere changes, enable more sustainable and healthy lifestyles, enhance urban live ability and wellbeing, improve the accessibility of key recreational and green assets, support the urban and rural economy and assist in the better long-term planning and management of green spaces and corridors". In simple words, green infrastructure is an effective, economic, smart and multi-purpose approach solution of present needs, which enhances the safety and quality of public life. The keyconstituents of this approach includemanagement of storm water, climate adaptation, reduced heat-stress, biodiversity conservation, enhancement in ecosystem health, sustainable energy production, clean water supply and improve soil quality. Besides these, it also involves other human centric functions such as increased quality of life through recreation and providing shade and shelter in and around rural and urban areas.Green infrastructure also helps to deliver an ecological framework for social, economic and environmental health of the surrounding. Green infrastructure mainly focused on nature-based solutions to improve infrastructure, by maintaining healthy ecosystems through the connectivity of fragmented natural areas and restore damaged habitats. It is a multi-approach concept, which may be used on different levels, from a small scale on individual house or building level and to a broader landscape level. Rainwater harvesting systems, green roofs, establishment of rain gardens, infiltration planters, permeable roadways/footpaths, trees and tree boxes are the some examples of local level green infrastructure practices. On a large scale, the preservation and restoration of natural landscapes (such as forests, floodplains and wetlands) are critical components of green infrastructure.

One of the major principles of green infrastructure is the formation of connective networks that allow migration and movement (ecological, economic or social) by connecting a number of supporting systems. Biodiversity is also a core

element; therefore the levels of biodiversity should be maintained and safeguarded in the development of green infrastructure. The main benefits of green infrastructure are given in table 2.

Table 1.2: Different benefits achieved by adopting Green Infrastructure

Benefits	Types
Environmental/ Ecological benefits	● Provision of clean water supply ● Reduction in air and water pollutants ● Rainwater retention and ground water recharge ● Control of soil erosion ● Improvement in soil/land quality ● Increased in pest control ● Enhancement in pollination ● Improved habitats for wild flora and fauna ● Habitat connectivity ● Landscape permeability ● Improve watershed health
Social benefits	● Provide a good and healthy environment to live and work ● Creation of green jobs ● Increase in recreation spaces which enhance tourism ● More attractive and greener cities
Economic	● Diversification of local economy ● Reduce hard infrastructure construction costs ● Reduce energy consumption and costs ● Maintain aging infrastructure ● Increase in property values ● Increase life cycle cost savings
Other benefits	● Climate resiliency ● Efficient land use ● Carbon storage and sequestration ● Alleviation in urban heat island effects ● Prevention of disasters such as forest fires, floods etc.

1.7 GREEN CONSTRUCTION MATERIALS

Construction of buildings and structures are responsible for impacts on the environment in different ways, such as consuming natural resources, energy, affecting biodiversity and environment pollution. The green building includes numerous approaches during design, construction and operation of a building project. If we are going to construct a green building,it can be achieved by using “green building materials”. The green construction materials are environmentally responsible materials as compared to usual construction materials and have a lesser environmental impact.

Preferably these green materials should not have any negative impact on the environment and should be infinitely reusable or recyclable. However, in real situations it is hard to find such material. But materials, which can eliminate or reduce the negative impact,can be considered as green building materials. Few examples of green construction materials are bamboo, recycled plastic, fly ash mixed cement and bricks, wood, wood bricks, recycled polyester, low VOC Paint and finishes, recycled glass, soybean fabric, organic cotton, recycled steel, stones, clay, etc. Green building materials should have at least one or more following environment and /or health traits.

- It should encourage indoor air quality of the building.
- It should be free from harmful substances such as toxic metals, Chlorofluorocarbons (CFCs), Hydrochloroflurocarbons (HCFCs), ozone depleting substances (ODSs), Volatile organic compounds (VOCs) and other pollutants.
- It should incorporate recycled content (post-consumer and/or post-industrial).
- It should be recyclable or have been recycled from existing or demolished buildings.
- Renewable resources should be used in formation of material.
- Material should be strong and need lesser care.
- It should be obtained from local resources and manufacturers.
- It should have low embodied energy.
- It should be biodegradable in nature.

Green construction can significantly reduce the environmental impacts of a new building by observing the complete life cycle of building materials. So it is necessary to consider the life cycle of building materials before construction. The life-cycle of a building material can be considered to have five stages:

- mining/extraction
- manufacture
- construction
- use
- demolition

In most of the cases, the major environmental impacts occur due to the first two stages (mining/extraction and manufacturing). The most factors to determine the impact on the environment includes loss of biodiversity, pollution of air, water and land. The consumption of energy for the production of construction material is also an important indicator of its impact on the environment. However, waste generation is a key concern of the last stage of the material cycle due to its proper disposal related issues.

Five main elements for assessing and choosing green construction materials are based on these factors:

1. Environmental factors
2. Local materials and transport requirement
3. Needs of occupants of houses
4. Need for suitable building design for marketing
5. Need for financial viability/affordability

1.8 GREEN LANDSCAPING

Landscaping is a method of physical modification of the landscape to serve the needs of the public. Conventionally, the main focus of landscaping was on making maximum human functionality and aesthetics of open areas by using plants, modifying the shapes of the land and building facilities such as pedestrian walkways, paths and picnic/resting areas. But recently a new method of landscaping has emerged commonly called Green landscaping. This new method design, creates, and maintains landscape in such a way, that it saves time, money, and energy. It is functional, aesthetically pleasing, low maintenance, cost effective, and environmentally sound landscape. So, green landscaping is a method to plan, create and maintain an aesthetically pleasing and environmentlly friendly landscape, without using harmful materials, unsustainable techniques and toxic chemicals. Green landscaping is efficiently a way of designing and conserving outdoor gardens and public spaces in such a way as to:

- Minimize destruction to the natural environment;
- Maximize the ecological function of the landscape (to supply ecosystem goods and services);
- Save time and money with lower maintenance requirements;
- Create a healthier and safer places for people to live, work and play.

1.8.1 Principles of Green Landscaping

Green landscaping can be achieved by using a variety of methods, these basic elements that are extremely useful. Each of these elements will help in maintaining green landscaping.

1. Design with Nature for People

a. Maintain a balance between environmental, human and economic necessities.

b. Design to blend the landscape into the local natural surroundings.

c. Use design which requires minimum maintenance

d. Avoid altering existing natural habitats and ecosystems

2. Plant Selection

a. Plants are the key part to the "green" portion of green landscaping.

b. Use local plant species, because local or native plants are naturally adapted to the local climate.

c. To avoid monoculture, use a variety of plant species.

d. Avoid using exotic invasive species

3. Water Responsibly

a. Use of permeable pavers increases infiltration and reduce rainwater run-off.

b. Water grass occasionally in summers as it is naturally programmed to go into dormancy.

c. Use of xeriscaping (drought-tolerant landscaping) is also helpful in water conservation.

d. Use organic materials in garden beds and around trees to conserve soil moisture.

e. Include rainwater harvesting systems in the design and use that water for plant needs.

f. Also include grey water recycling systems where appropriate.

g. Change in watering methods or process to save water (timing of water, amount of water, water to a particular part of the plant, use of sprinklers, drip irrigation etc.)

h. Left some shallow depression, where runoff is directed.

4. Reduce Chemicals and Pollutants

a. Reducing the use of chemicals in green landscaping will be beneficial for the environment and wildlife.

b. Instead of chemicals, add manure or compost to improve the quality of soils.

c. Use organic waste of lawn for composting and to reduce disposal cost

d. Do not use polluted water to irrigate your landscape; it will add pollutants to your garden.

e. Trim your lawn less frequently to preserve soil moisture and maintain healthy root structure.

f. Promote the use of manual tools as compare to power driven equipment's.

5. Green Energy/products

a. Use renewable energy for street / landscape lighting (Solar PV cells, wind energy).

b. Use energy efficient or low energy consuming devices (LED for street lights).

c. Use eco-labeled or green certified products

d. Use recycled and recyclable materials

Check Your Progress 2

Note: a) Write your answer in about 50 words.

b) Check your progress with possible answers given at the end of the unit.

1) Write a note on two more green buildings and describe their features.

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2) What is "green infrastructure," how it is beneficial for the environment?

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3) Enlist various properties that are needed in a green construction material.

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1.9 LET US SUM UP

Now we are aware with the term 'Environment Design', its scope, principles and benefits. Environmental design is a plan to utilize land and natural resources in a sustainable way for the growth and development of rural, urban and suburban communities. The main principles of environmental design are energy, water and resource conservation, use of sustainable materials, waste management and pollution control. This unit also focuses on the concept of green buildings, objectives of green building and various elements that should be considered during designing of a green building. Examples of green buildings are also discussed with their green features to illustrate the concepts. A rating system for green buildings is also mentioned in brief with a detail of globally present rating systems. Green infrastructure is an economic, smart and multi-purpose healthy approach for managing urban and climatic challenges by building with nature. Its main constituents include storm water management, climate adaptation, biodiversity conservation, enhancement in ecosystem health, sustainable energy production, clean-water supply and improve soil

quality. The concept of green building can be achieved by using green building materials, these construction materials are environmentally responsible materials as compared to general construction materials. The chapter also provides guidelines and principles for the designing and maintaining green landscaping.

1.10 KEY WORDS

Biodiversity : The relative abundance and variety of plant and animal species within a given ecosystem, biome or for the entire Earth.

Environment : It can simply define as one's surroundings (biotic and abiotic environment) that include everything around the organism.

Ecology : Ecology is a branch of science which deals with the interrelationships between the biotic (living) and abiotic (nonliving) components of an ecosystem as well as the relationship of the individuals of biotic components.

Habitat : It is concerned with a physical space occupied by an organism.

Runoff : That part of rainfall or irrigation water that runs off the land into streams or other surface water.

Urban Heat Island Effect : Sometimes cities or towns are typically warmer compared to their adjacent rural areas due to human activities. This temperature difference is due to the uncommon state known as the urban heat island.

1.11 REFERENCES AND SUGGESTED FURTHER READINGS

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8. Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes. Kubba Sam, 2012

1.12 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress 1

Your Answer should include the following points:

1) To find answer read section 1.2 of this unit

Answers to Check Your Progress 2

Your Answers should include the following points:

1) CII-Sohrabji Godrej Green Business Centre and The ITC Maurya.

2) The definition is given in section 1.7 of this unit and some benefits are reduction in air and water pollutants, rainwater retention and ground water recharge, control of soil erosion and improve in soil quality, improved habitats for wildlife, habitat connectivity, landscape permeability, etc.

3) This answer will require your interest in section 1.8.