OEN751 - GREEN BUILDING DESIGN

UNIT-I

Environmental Implications Of Building

Introduction:

A "green" building is a building that in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life.

There are a number of features which can make a building 'green'. These include:

⇛ Efficient use of energy, water and other resources.

⇛ Use of renewable energy such as solar energy.

⇛ Pollution and waste reduction measures and the enabling of re-use and recycling.

⇛ Good indoor environmental air quality.

→ Use of materials that are non-toxic, ethical and sustainable.

→ Consideration of the environment in design construction and operation.

→ Consideration of the quality of life of occupants in design, construction and operations.

→ A design ~~under~~ that enables adaptation to a changing environment.

→ Any building can be a green building, wheather it's a home, an office, a school, a hospital, a community center or any other type of structure provided it includes features listed above.

→ However it is worth nothing that not all green buildings are - and need to be - the same. Different countries and regions have a variety of characteristics such as distinctive climatic conditions, unique cultures and traditions, diverse building-types and ages or wide-ranging environmental, economic and social

Priorities – all of which shape their approach to green building.

Steps Involved in Creating Green Building:

There are a number of ways to make a building Green. These include:

Taking an intelligent approach to energy

⇒ Minimising energy use in all stages of a building's life cycle, making new and renovated buildings more comfortable and less expensive to run, and helping building users learn to be efficient too.

⇒ Integrating renewable and low-carbon technologies to supply buildings energy needs, once their design has maximised inbuilt and natural efficiencies.

Safeguarding water resources

⇒ Exploring ways to improve drinking and waste water efficiency and management, harvesting water for safe for indoor use in innovative ways, and generally minimising water use in buildings.

considering the impact of builings and their surroundings on stormwater and drainage infrastructure, ensuring there are not put under undue stress or prevented from doing their job.

Minimising waste and maximising reuse:

→ Using fewer, more durable materials and generating less waste as well as accounting for a building's end of life stage by designing for demolition waste recovery and reuse.

→ Engaging building users in reuse and recycling.

Promoting health and wellbeing:

→ Bringing fresh air inside, delivering good indoor air quality through ventilation and avoiding materials and chemicals that create harmful or toxic emissions.

Incorporating natural light and views to ensure building users comfort and enjoyment of their surroundings and reducing lighting energy needs in the process.

⇛ Designing for ears as well as eyes. Acoustics and proper sound insulation play important roles in helping concentrations, recuperation and peaceful enjoyment of a building in educational, health and residential buildings.

⇛ Ensuring people are comfortable in their everyday environments, creating the right indoor temperature through passive design or building management and monitoring systems.

Keeping our environment green:

⇛ Recognising that our urban environment should preserve nature and ensuring diverse wildlife and land quality are protected or enhanced, by for example, remediating and building on polluted land or creating new green spaces.

⇛ Looking for ways we can make our urban areas more productive, bringing agriculture into our cities.

Creating resilient and flexible structures

⇛ Adapting to our changing climate, ensuring resilience to events such as flooding, earthquakes or fires so that our buildings stand the test of time and keep people and their belongings safe.

⇛ Designing flexible and dynamic spaces anticipating changes in their use over time and avoiding the need to demolish, rebuild or significantly renovate buildings to prevent them becoming obsolete.

Connecting communities and people:

⇛ Creating diverse environments that connect and enhance communities, asking what a building will add to its content in terms of positive economic and social effects and engaging local communities in planning.

⇛ Ensuring transport and distance to amenities are considered in design reducing the impact of personal transport on the environment and encouraging environmentaly friendly options such as walking or cycling

⇒ Exploring the potential of both "smart" and information communications technologies to communicate better with the world around us, for example through smart electricity grids that understand how to transport energy where and when it is needed.

considering all stages of building's life cycle

⇒ Seeking to lower environmental impacts and maximise social and economic value over a building's whole life-cycle (from design, constructio operation and maintenance, through to renovation and eventual demolition

⇒ Ensuring that embodied resources such as the energy or water used to produce and transport the materials in the building are minimised so that buildings are truly low impact.

Benefits of Green Building:

They provide some of the most effective means to achieving a range of global goals such as addressing climate change, creating sustainable and thriving communities and driving economic growth.

Highlighting these benefits and facilitating a growing evidence base for proving them is at the heart of what we do as an organisation. The benefits of green buildings can be grouped within three categories:

- Environmental
- Economic and social.

Hence, we provide a range of facts and statistics from various third-party sources that present these benefits.

Environmental

- One of the most important types of benefit green buildings offer is to our climate and the natural environment.

→ Green buildings can not only reduce or eliminate negative impacts on the environment by using less water, energy or natural resources, but they can – in many cases – have a positive impact on the environment by generating their own energy or increasing biodiversity.

Economic :

→ Green buildings offer a number of economic or financial benefits which are relevant to a range of different people or groups of people. These include cost savings on utility bills for tenants or households lower construction costs and higher property value for building developers increased occupancy rates or operating costs for building owners. and job creation.

Social :

→ Green buildings benefits go beyond economics and environment, and have been shown to bring positive social impacts too. Many of these benefits are around the health and wellbeing of

People who work in green offices or live in green homes.

Ecological Footprint :

⇒ It is the impact of human activities measured in terms of the area of biologically productive land and water required to produce the goods consumed and to assimilate the wastes generated. More simply it is the amount of the environment necessary to produce the goods and services necessary to support a particular lifestyle.

Energy Use :

⇒ Energy is the foundation for green building. Energy codes define the minimum acceptable standards for a climatic zone. This information has a direct impact on us as builders.

⇒ Building comprises certain % of direct energy use in India. Remaining % goes into heating, ventilation, and air conditioning, heats. hot water, lighting.

⇒ In terms of Carbon dioxide production in total buildings are responsible for 48%. of all greenhouse gases

⇒ Energy efficiency requires a systems-based approach to designing and building at home.

Energy efficiency of benefits in building are summarised as following.

(i) Energy efficiency in building is compelling, cost effective and can help consumers to save money in the long term.

(ii) Energy efficiency in buildings help to meet energy targets and resource energy shortage.

Carbon Cycle:

⇒ The movement of carbon from one area to another is the basis for the Carbon cycle. Carbon is important for all life on Earth. All living things are made up of carbon. Carbon is produced by both natural and human-made sources.

Sources of Carbon:

- Carbon is found in the atmosphere mostly as carbon dioxide. Animal and plant respiration place carbon into the atmosphere.
- It is found in the lithosphere in the form of carbonate rocks. Carbonate rocks came from ancient marine plankton that sunk to the bottom of the ocean hundreds of millions of years ago that were then exposed to heat and pressure. Carbon is also found in fossil fuels, such as petroleum, coal & natural gas.
- Carbon is found in the biosphere stored in plants and trees. Plants use carbon dioxide from the atmosphere to make the building blocks of flood during photosynthesis.
- It is found in the hydrosphere dissolved in ocean water and lakes. Carbon is

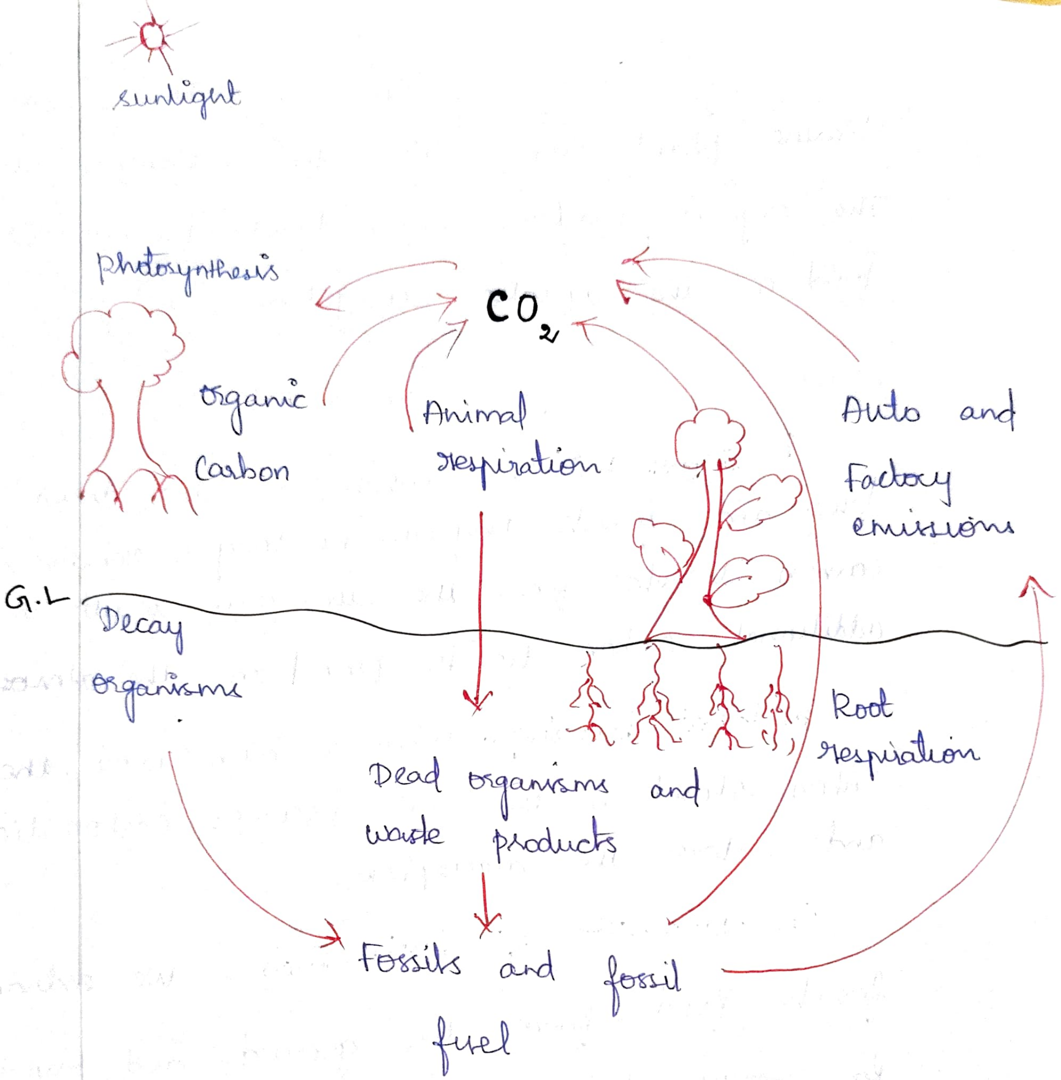
used by many organisms to produce shells. Marine plants use carbon for photosynthesis. The organic matter that is produced becomes food in the aquatic ecosystem.

Carbon omission from Human Activities

i) **Deforestation** – when we cut down trees and forests, they can no longer remove carbon dioxide from the air. This result is additional carbon dioxide placed in the atmosphere.

ii) **Wood burning** – when we burn wood, the carbon stored in the trees becomes carbon dioxide and enters the atmosphere.

iii) **combustion of fossil fuels** – we extract fossils fuels from the ground and burn them ... plants. The burning of fossil



Carbon Emission :

A building's carbon footprint is defined as the amount of CO_2 it produces during its operations and activities. It is found that residential and commercial buildings are responsible for almost 40% of U.S. carbon dioxide emmissions. From houses and hotels to schools and skyscrapers, buildings in the United States use about 40% of the country's energy for lighting, heating, cooling and appliance operation. It is estimated that the manufacture, transport and assembly of building materials such as wood, concrete, and steel account for another eight percent of energy use. About 30% of the electricity buildings use is generated from coal-burning power plants, which release greenhouse gases, causing climate change. A building's $LCCO_2$ emissions into three stages:

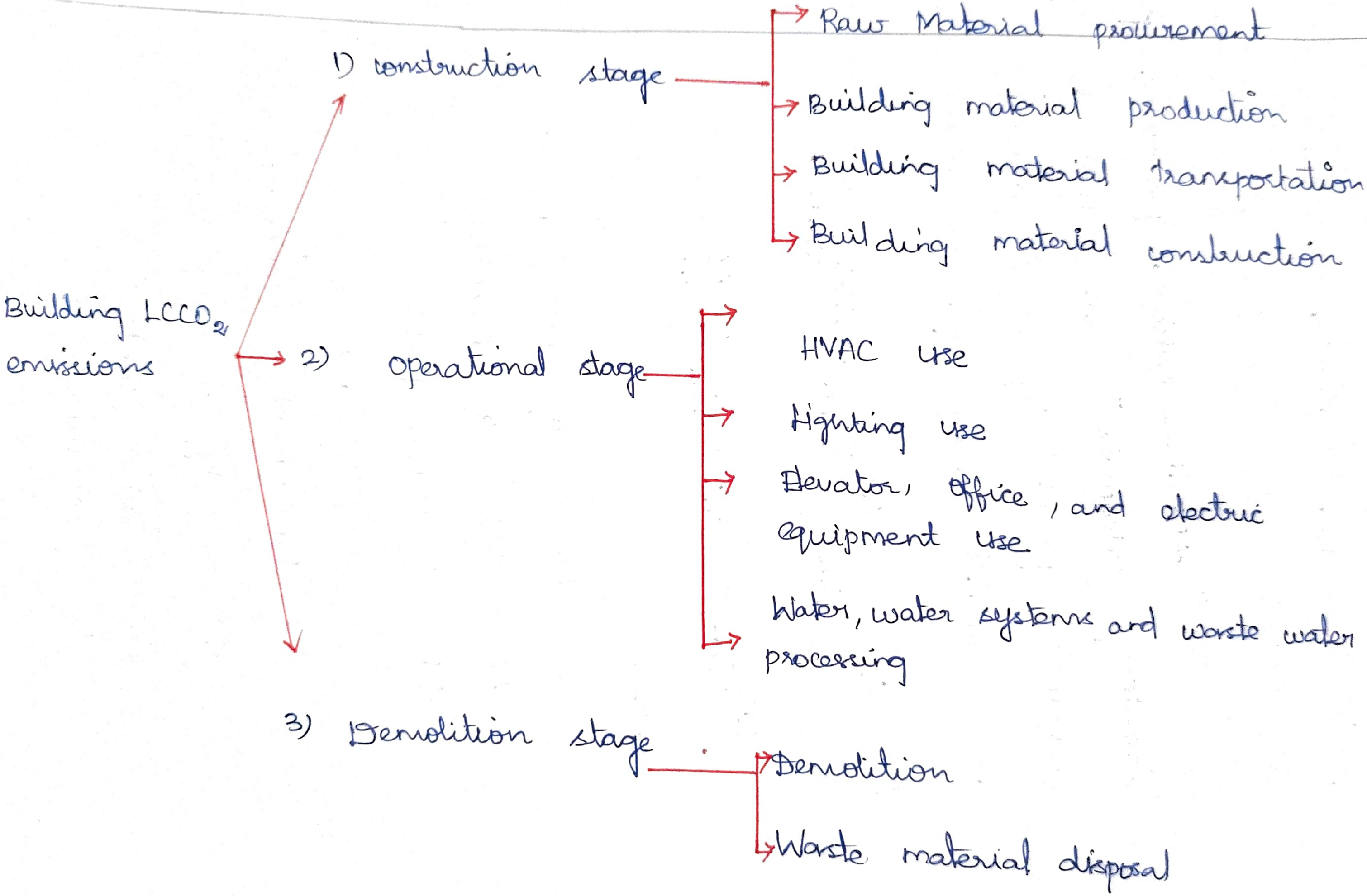
1) The construction stage - including processes such as procurement of raw materials building material production, transportation and construction.

2) The operation stage,

3) The demolition stage - Including

Processes such as building demolition and waste material recycling and processing.

The maintenance stage was excluded due to its lower weight in importance, The carbon emissions of the operational stage primarily include those generated by heating, ventilation, and air conditioning, lighting, office equipment elevators and water pumps. The sequestration from the surrounding greenery might also be considered. The below figure shows a flowchart of these phases.


Building $LCCO_2$ emissions
1) construction stage
Raw Material procurement
Building material production
Building material transportation
Building material construction
2) operational stage
HVAC use
Lighting use
Elevator, office, and electric equipment use
Water, water systems and waste water processing
3) Demolition stage
Demolition
Waste material disposal

Basic Measurement Method for Carbon Emissions:

The "2006 IPCC national greenhouse gas inventory categories" states that the GHG emissions generated by energy activities can be calulated using formula below:

$$C = \sum_{i,j,k} AD_{i,j,k} \cdot EF_{i,j,k},$$

$$EF_{i,j,k} = c_k \cdot \eta_{i,j,k} \cdot \frac{44}{12},$$

where,

- C = Amount of carbon emissions,
- AD = Level of Activity
- EF = Emission factor
- i = Industry and region
- j = Equipment & technology used
- k = The type of fuel used
- c_k = Carbon content
- $\eta_{i,,}$ = Oxidation rate

i) AD is based on the amount of fuel burned and is usually taken from national energy statistics.

ii) EF is the average emission factor.

iii) For CO_2 the emission factor is determined mainly by the fuel's carbon content.

iv) The burning conditions are relatively unimportant. Therefore, the amount of carbon, emissions can be accurately estimated based on the total amount of fuel burned and the average carbon content in the fuel.

Total Carbon Emissions computation for the Life cycle of a building:

The total amount of carbon emissions produced over the life cycle of a building was taken as the sum of the carbon emissions generated during the construction operational and demolition stages. The formula is,

$$C = C_b + C_u + C_d - C_t$$

where,

C is total amount of carbon emissions over the life cycle of the building,

C_b is the total amount of carbon emissions during the construction stage,

C_u is the total amount of carbon emissions during the operational stage,

C_d is the total amount of carbon emissions during the demolition stage,

C_t is the total carbon sequestration by vegdation around the building.

Total Carbon Emissions during the construction stage, C_b

The total amount of carbon emissions during the construction stage included processes such as material production, transportation, and construction the formula is

$$C_b = C_{be} + C_{bt} + C_{bp}$$

where,

C_{be} is the total carbon emissions generated by the building material production.

C_{bt} is the total carbon emissions generated by the building material transportation

C_{bp} is the total carbon emissions of building materials used during building construction.

Total Carbon Emissions during the building Demolition stage d,

The computation of the carbon emissions generated during the demolition stage includes the carbon emissions generated during the demolition process and the construction waste material treatment process:

$$C_d = C_{d1} + C_{d2}$$

where,

C_{d1} is the carbon emissions generated during the demolition process.

C_{d2} is the carbon emissions produced during the waste material treatment process.

Total Carbon Sequestration by vegetation around the building C_t.

The Carbon sequestration by vegetation around the building is calculated using formulas.

Total Carbon Emissions during the building operational stage, C_u.

The buildings get hot in the summer and cold in the winter. The energy source during the building operational stage is electricity and water use. Therefore carbon emissions generated by air conditioning, lighting, elevators, equipments are considered here.

Reduction in carbon emission by green Buildings:

Reduced Losses during Fabrication

⇒ For many green buildings the raw materials and components themselves are purchased from green suppliers. These suppliers adhere to strict standards and controls to ensure that their production methods conserve natural resources and reduce overall carbon dioxide emissions.

⇒ Some of the ways that they do this include more efficient processes designed to reduce energy consumption during fabrication; transporting goods on more efficient means of transportation.

and leveraging new and growing technologies like solar power to reduce dependence on fossil-fuel-based power plants.

⇛ Furthermore, green buildings are erected in a way that minimizes inefficiencies and leverages modern materials science in a way to reduce overall emissions even during construction.

⇛ Contemporary green building materials can dramatically reduce the overall carbon dioxide emissions, both in their construction and in their installation.

Water Efficiency in Green Buildings:

⇛ The excessive use of water drawn from both surface and underground sources has led to a deficit in this precious resources. Various water-efficiency measures in commercial buildings and homes can greatly reduce water waste, yielding lower sewage volumes, reduced energy use and financial benefits.

→ A Green building design largely emphasises on making effectual use of natural resources like water, energy etc. while reducing several bad effects on the environment and the occupant's health during its use. The five main gears of green buildings are,

1) Site and Design Efficiency
2) Reduced Energy Usage
3) Reduced Water Consumption
4) Environmentally safe construction materials
5) Better air quality

Considering water efficiency in Green Buildings today several technologies are being used rainwater harvesting, recycling and reuse of grey water, low-flow fixtures, sensors etc.,

Water Efficient Technologies:

1) Rain water harvesting:

→ In simple terms, it is the active collection and distribution of rainwater which rather than going to the sewage is put into use in daily life. Typically, rainwater is collected from the rooftops, deposited in a reservoir with filtration. Once the water is purified, it is can be used for cultivation, gardening and other domestic uses.

→ One of the biggest uses of rainwater harvesting is in drier states where there is a lower rate of rainfall. They can store this water and can later purify it to make usable water or can use it for washing or watering plants.

2) Landscaping Techniques:

The use of native, adapted or drought

tolerant plants is the first step to reducing the amount of water used in landscaping. Native and adapted plants are suited for the climate of the project location and do not usually require additional irrigation.

Irrigation Techniques:

There are a few options for reducing irrigation water use. One is to install a moisture sensor system, so the sprinklers only run when it's not enough moisture is the ground.

Water Reuse and Treatment:

There are two types of reuse systems, gray water and black water. Gray water is the water that comes out of bathroom sinks, showers, dishwashers and washing machines. It is considered to be less contaminated than black water. With minimal filtration gray water can also be used for drinking and cleaning.

Waste Disposal:

Upto 40% of the waste going to landfills is related to the construction and demolition of buildings. Even more waste is produced during the occupancy of buildings and the production of goods that we consume every day. Poor waste practices and treatment of the environment in the past have not only lead to a degradation of our water, air and land resources but also represent a big financial burden to current and future generations.

By reducing, recycling and reusing waste we can:

→ Reduce the amount of waste going to landfill.

→ Reduce emissions, pollution and contamination.

⇒ Protect scarce resources

⇒ Reduce overall construction costs.

Environmental Implications of Building Materials:

Natural resources are limited on earth but looking at the uncontrolled able consumption of construction materials has comptaibly increased along with production in the past century. Although there are few drops in the graph during 1940's and 1990's but no sustainability was employed for the economy of construction materials. With this trend of consumption of uncontrolled able construction materials will result in environmental degradation on a global scale.

Each material is assessed at five stages of its life:

⇒ Mining / Extraction

⇒ Manufacture

⇒ Construction

⇒ Use

⇒ Demolition

An Australian system, BMAS (Building Material Assesment System) based on life-cycle analysis, has been developed to compare the relative ecological impacts of various types of wall, floors and roof assemblies. High numbers indicate greater environmental impact; lower numbers indicate lesser impact.

Walls

Timber Frame, Plasterboard	= 7.2
Steel Frame, plaster board	= 7.4
AAC Blocks - rendered	= 20.6
clay bricks - rendered	= 49.1

Floors:

Timber, Brick piers, Footings	- 41.9
Concrete Raft slab	- 74.4

Roofs:

Timber, Bricks Frame, corrugated steel	- 5.2

Embodied Energy in building materials:

⇛ Embodied energy is the energy consumed by all of the processes associated with the Production of a building, from the mining and processesing of natural resources to manufacturing, Transport and product delivery.

⇛ Embodied energy does not include the operation and disposal of the building material which would be considered in a life cycle approach.

Reducing embodied energy

⇛ Building should be designed and materials selected to balance embodied energy with factors such as climate, availability of materials and transport cost.

⇛ Lightweight building materials often have lower embodied energy than heavyweight materials, but in some situations, lightweight construction may result in higher energy use. when selecting building materials, the embodied energy should be considered with respect to,

⇛ The durability of building materials

⇛ How easily materials can be seperated

⇛ Use of locally sourced materials

⇛ Use of recycled materials

⇛ Specifying standard sizes of materials

⇛ Avoiding waste

⇛ Selecting materials that are manufactured using renewable energy sources.

Embodied energy in transportation:

⇛ Life cycle assessment accounts for the effects of transportation mode and not just distance.

⇛ A product traveling a long distance using a highly efficient transportation method can actually have a smaller transportation footprint than a closer product travelling inefficiently.

⇛ It is natural to expect that locally sourced products would be more environmentally responsible than those shipped a great distance.

⇛ But this is usually based on the assumption that transportation energy contributes a lot to the overall energy equation. and life cycle assesment can prove that this is usually not the case.

⇛ while buying local may help the local economy, it is not necessarily the best environment choice. In many cases, transportation energy is a very small component of overall energy consumption

Maintenance Energy For Buildings:

Every building's energy consumption can benefit from rigorous operations and maintenance practices. Properly planned and executed O&M is one of the most cost effective strategies for ensuring equipment longevity, reliability, safety and energy efficiency in commercial buildings.

Green Building Maintenance and Repairs:

Listed below are several suggestions for building maintenance and repairs.

In today's society where many items are considered disposable, including things as significant as the building's roof and facade any change in the maintenance practice that adds to the longevity of the building's components can be viewed as a "green" practice.

UNIT – II Implications of Building Technologies

Embodied Energy of Buildings

Embodied Energy Assessment for Buildings

→ The exploitation of natural resources is significantly reducing the reserves of natural materials around the world. It can be observed that the materials employed in construction have a great responsibility in the environmental impacts. There are several methods of environmental assessment. They are classified into three groups.

i) Embodied Energy

ii) Life Cycle analysis (LCA)

iii) Identification using more simplified procedures such as LEED and BREAM.

→ All materials have some environmental impact and there are still no methods to accurately assess the total impact of a building. Even the analysis of individual materials is complex.

Alternative Building Materials in Green Buildings:

Materials

i) Fly Ash Brick (FAB)

⇒ FAB is a building material, specifically masonry units, containing class C fly ash and water.

⇒ compressive strength is 28 MPa at 28 days. at cured for 24 hours in a 66° C steam bath. then toughened with an air entrainment agent, the bricks last for more than 100 freeze - thaw cycles.

⇒ Owing to the high concentration of calcium oxide in class C fly ash, the brick is described as "Self-cementing".

⇒ The manufacturing method saves energy, reduces pollution and costs 20 % less than traditional clay brick manufacturing.

Jaali Walls:

⇒ Allow controlled passage of air and light into the interior space. Throw patterns of light and shadow on the floor enhancing aesthetics.

⇒ Ensure constant flow of breeze into the interior occupant comfort cools the interior.

⇒ An alternative to costly window construction. Diffuse the glare of direct sunlight.

Low-e glass

⇒ Low-e is standard clear glass which has a special coating on the surface of the glass.

⇒ It refers to low emissivity and this describes the capacity of a surface to radiate heat.

⇒ It is measured across a scale from 0 to 1.

Earth sheltering:

It is a an ancient architectural Practise of using earth against building walls / roofs for external thermal mass, to reduce heat loss, and to easily maintain a steady indoor air temperature.

Interior:

Bagasse Board:

By product of sugarcane industry - a good substitute for plywood or particle Board. It has wide usage for making partitions furniture etc. Eco-friendly method does not involve any harm to the timbers, unlike plywood.

VOCs

They are coating, especially paints and Protective coatings. Solvents are required to spread a protective or decorative film. Typical solvents are aliphatic hydrocarbons, ~~ety~~ ethyl accetate, glycole ethers and acetone

Motivated by cost, environmental concerns and regulations the paint and coating industries are increasingly shifting toward aqueous solvents.

Bamboo:

⇒ Underutilized for many years, bamboo has long been used as a traditional building material and is gaining more spotlight due to its potential for eco-friendly purposes in green construction.

⇒ It absorbs more carbon dioxide, and produce oxygen.

⇒ It is most cost effective construction materials.

⇒ It is highly sustainable and give aesthetic appeal in construction for building.

Recycling Industrial Waste into Building Material

⇒ Industrial waste is one of the most

important sources of environmental pollution in the world. Providing economic oppurtunities for recycling these wastes represent an essential solution to this problem to encourage waste produces to dispose it safely and to provide an added value for these wastes.

⇛ The use of different waste in the concrete mix or for obtaining new types of concrete had as result the development of a new type of construction materials: Green materials.

⇛ In this category is included inorganic polymer concrete which is obtained predominantly from industrial waste materials.

⇛ As important way to use the wastes is to introduce them as a powder or filler in the composition of construction materials (cement, concrete, asphalt etc) or to use as aggregates.

→ concrete is one type of building material that can incorporate many types of waste such as silica fume, fly ash, cinder, husk tires, glass etc.,

Silica Fume:

→ It is specially used as mineral admixture in concrete because of the fineness of the particles which can fill better the spaces between the components of concrete mix.

→ Compressive strength 150-180 MPa.

Slag:

→ It can be used in preparing composite cements or as aggregates in preparing concrete

→ Slag cements are used in concrete structures because it given some advantages such as less carbon dioxide emission during the production, lower hydration heat during hardening low permeability and good resistance to sulphate attack.

Ground granulated Blast Furnace slag:

⇒ It improves the flexural strength and compressive strength of concrete.

⇒ It is used in roads, highways, pavements, hydraulic construction.

⇒ It is used in producing cement concrete as mix compound of the concrete or as component of cement.

Sludge:

⇒ Sludge is used in the production of concrete as filling material

⇒ It improves the compressive strength, Freeze - thaw resistance and waterproofness.

⇒ It can be used as replacement of fine aggregates in asphalt paving.

Fly Ash:

⇒ It is used in cement and manufacturing of concrete, Production of bricks, tiles and pavements, lightweight aggregate.

⇛ Industry fly ash is also used for the production of low strength material also known as "Flowable Fill".

⇛ It is replacement of compacted soil.

Recycling constructional Waste into Building Materials:

⇛ Various building materials generated in the site during construction operation or during the demolition of building can be success-fully reused as a new material upon processing.

⇛ The construction waste is crushed, washed and used to make ready mix concrete, kerb stones, cement. bricks, pavement blocks, hollow bricks and manufactured sand.

1) Brick:

⇒ Brick wastes are generated as a result of demolition and may be contaminated with mortar and plaster.

⇒ Bricks are recycled by crushing and using as filling materials.

2) Concrete:

⇒ concrete wastes can be generated due to demolition of existing structures and testing of concrete samples etc.

⇒ Concrete wastes are used crushed concrete as aggregate.

⇒ It has been used as a replacement to natural aggregate.

3) Ferrous Metal:

⇒ It is highly profitable but also can be recycled nearly completely. It can be recycled multiple times.

Masonry :

→ It is produced as a result of demolition of masonry buildings.

→ It can be recycled by crushing.

→ It is used as thermal insulating concrete.

5) Non - Ferrous Metal :

→ Aluminium, copper, lead and zinc are examples of non ferrous materials wastes produced at construction sites.

→ It can be recycled.

6) Paper and Cardboard :

→ In this waste is estimated to comprise one - third construction and demolition wastes by volume.

→ These waste materials are recycled and reprocessed to produce new paper products.

7) Plastic :

→ These wastes are best possible for recycling if these materials are collected separately and cleaned.

→ It may be recycled

→ It used in products designed for utilization of recycled plastics. such as furniture, roof and floor.

8) Timber :

→ Timber waste from construction and demolition works is produced in large quantity all over the world.

→ In this waste utilized easily and directly.

Biomass as Construction Material :

Biomass

→ Biomass is organic material that comes from plants and animals and it is a renewable source of energy. Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called "photosynthesis". When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels.

Examples of biomass and their uses for energy.

i) Wood and wood processing wastes.
- burned to heat buildings, to produce process heat in industry and to generate electricity.

ii) Agricultural crops and waste materials
- burned as a fuel or converted to liquid biofuels.

iii) Food, yard, wood waste in garbage

- burned to generate electricity in power plants or converted to biogas in landfills.

iv) Animal manure and human sewage

- Converted to biogas, which can be burned as a fuel.

Natural Fibers as Construction material:

Natural fibers reinforced with polymer concrete base composites have gained more interest because of they are less expensive, light weight, easy processing, high specific modulus and also sustainable.

Examples of Natural Fibers:

i) Jute
ii) Sisal
iii) Pineapple
iv) Abaca and coir

Advantages:

⇒ Capability, improved capacity against delamination, spalling and Fatigue.

⇒ High volume fraction (< 2%)

Advantages of recycled and biomass fibers in reinforced concrete.

⇒ Natural and recycled fibers offer many benefits for reinforcement.

⇒ Low cost and abundant

⇒ Renewable

⇒ Non-hazardous - replacement of asbestos.

⇒ To maintain the environment clean.

⇒ Utilizing natural and recycled fibers will reduces the load on the land fields

⇒ It is the way to create wealth from waste.

⇒ Improved fatigue strength, water

resistance and durability of concrete material.

→ It improves mechanical properties of composite.

The use of biomass and recycled fibers from industrial or postconsumer waste could offer additional advantages of waste reduction and resources conservation.

→ Concrete with natural and recycled material combine very good mechanical properties with ecological characteristics have opened up the possibility of using them in sustainable civil and architectural applications.

→ It can contribute for creating sustainable buildings that save the energy, reduce environmental impact and provide a quality indoor environment for their occupants.

2 Marks

What is meant by frame construction?

Frame building, structure in which weight is carried by a skeleton or framework, as apposed to being supported by walls. The essential factor in a frame building is the frame's strength.

Define construction waste:

It includes waste that is generated during construction activities and materials that are surplus to requirements.

What is the need for recycling building waste?

Recycling of construction waste is one way to counter risk to construction wastes. So, the invention of proper technology to recycle these materials is of great importance.

4) Define sustainable building material.

Sustainable building materials are those which are produced or sourced locally. These materials are containing recycled & industrial waste materials and byproducts. It have a lower impact on environment & are thermally efficient.

5) Difference between framed and load bearing structure.

The main difference between load bearing structure and framed structure is their members who are responsible for bearing and transferring the load to the subsoil. In load-bearing structure, load bearing members are walls, while in a framed structure, load-bearing members are beams and columns.

6) Difference between reuse and recycle.

⇒ Recycling means turning an item into raw materials which can be used again, usually for a completely new product. This is an energy consuming procedure.

⇒ Reusing refers to using an object as it is without treatment. This reduces pollution and waste, thus making it a more sustainable process.

7) List down the objectives of recycled construction waste.

- ⇒ Save energy
- ⇒ Conserve resources
- ⇒ Reduces pollution
- ⇒ Cuts waste disposal costs
- ⇒ Saves valuable raw materials
- ⇒ Reduces trash in landfills.

8) Write down the applications of FRC materials.

FRC is being used for the construction and repair of dams and other hydraulic structures to provide resistance to cavitations and severe erosion caused by the impact of large waterboro debris.

9) What are the uses of recycled concrete?

It can be used for constructing gutters, pavements etc. Large pieces of crushed aggregate can be used for building revetments which in turn is very useful in controlling soil erosion. Recycled concrete rubbles can be used as coarse aggregate in concrete.

10) What are the advantages of using recycled concrete?

Recycled aggregate concrete can be used for different purposes. It is suitable for use at various construction projects, landscaping and for home improvements.

Define Biomass.

Biomass refers to the mass of living organisms, including plants, animals and microorganisms or form a biochemical perspective, cellulose, lignin, sugars fats and proteins. Biomass is often reported as a mass per unit area ($g\ m^{-2}$ or $Mg\ ha^{-1}$) and usually as dry weight.

UNIT - III Comforts In Buildings

Thermal comfort:

⇒ According to the international standard EN ISO 7730, thermal comfort is "that condition of mind which expresses satisfication with the thermal environment".

⇒ In simple words it is the comfortable condition where a person is not feeling too hot or too cold.

Issues related to thermal comfort in buildings:

⇒ Constant thermal discomfort is likely to lead either to "Sick building syndrome" or "Building related Illness" (BRI). The term describe acute health and comfort effects of occupants related to the time spent in a building, without specific illness or cause. The ailment may be localized in a certain room or may be widespread all over the building.

Diagonsable illness

⇒ It can be attributed directly to airbone building contaminants.

Problems:

⇒ High temperature

⇒ High relative humidity jointly serve to reduce thermal comfort

Symptoms:

⇒ Discomfort

⇒ Eye, Nose, Throat irritation

⇒ Heddache

⇒ Dry or itchy skin

⇒ Dry cough

⇒ Dizziness

⇒ Nausea

⇒ Fatigue

BRI symptoms

- ⇒ Chest tightness
- ⇒ Caugh
- ⇒ Chills
- ⇒ Fever
- ⇒ Muscle aches

Inadequate ventilations may occurs:

- ⇒ Condensation
- ⇒ Mold
- ⇒ Emission of volatile organic compounds
- ⇒ Mites
- ⇒ Fabric deterioration
- ⇒ Draughts
- ⇒ Heat Loss

Factors Affecting Thermal Comfort in Buildings:

There are several factors which influence the thermal comfort in buildings. There are two factors afftected the thermal comfort in building there are,

i) Personal Factor

ii) Environmental Factor

Personal Factor

⇒ Clothing - It insulate a person from exchanging heat with surrounding air and surfaces.

⇒ Metabolic heat - The heat produced by physical activity.

Environmental Factor

1. Air Tightness and Ventilation

An airtight envelope together with natural or mechanical ventilation can control the indoor thermal environment by managing their air exchanges with the outside.

2. Thermal inertia

The materials used to construct the building have an impact on how quickly changes in weather conditions are felt.

3. Solar Gain:

Through its overall shape, Orientation number and size of windows and the ability of surfaces to reflect heat, the building envelope can control how much heat from the sun is gained to sunlight allowed to enter into the building.

4. Insulation:

Insulating the building enter and Using thermally efficient windows reduces heat loss in winter and conduction heat gains in summer.

Methods to improve Thermal comfort in Buildings

1: Use a HVAC system

Using HVAC system that actually measures and regulates the

the radiant component of operative temperatu[re] goes a long way to achieving thermal comfort.

2. Minimizing leakage:

Depending on the outdoor conditions your HVAC system may be heating up and humidifying cold, dry air or it would be cooling down and dehumidifying hot humid air.

3. Design and build for some occupant control:

Allowing access to the thermostat or operable windows and blinds might boost perceived thermal comfort. These will not only lower the energy load of the HVAC system but also allow occupants to more control the environment as they desire.

Design strategies to achieve thermal comfort in buildings

External heat gains are caused primarily by sunlight and high external temperatures and these factors are controlled thorought the consideration of passive design measures, and active design measures. It is worth nothing that there are very different "internal gains" heat profiles in hours across the day for residential and office settings.

- Natural design strategy
- Mechanical design strategy

Natural Design Strategy

In tropical climate, thermal comfort is obtained by reducing temperature to adequate levels by increasing natural ventilation within the building.

1) Orientation

Orientation is an important factor in providing a building with passive thermal comfort to take advantage of solar gains to reduce heat, loads or to protect against unwanted solar gains.

2) Solar Incidence:

Thermal mass refers to the ability of building materials to store and emit heat, so careful consideration should be given to integrating thermal mass and ventilation strategies.

3) The importance of fenestration design and glazing choices.

The fenestration design and glazing choices have a large impact on thermal comfort as radiation from the sun passes through glazing to heat the internal fabric of the building accumulating inside.

4. Shading and Daylight

The choice of the shading device is used is determined by the orientation and common "Shading" strategies include overhangs, external louvers, external shading and internal blinds

Blinds and shutters

They block solar radiation and thus reduce the amount of heat entering a room. Overheating during summer can be effectively reduced, and even eliminated by the use of proper solar shading.

Ventilative cooling:

It refers to the use of natural or mechanical ventilation strategies to cool indoor spaces. The use of outside air reduces the energy consumption of cooling systems while maintaining thermalmal comfort. The most common technique is to use increased ventilation airflow rates and night ventilation.

Materiachanical design strategy:

Mechanical design strategies include eating or cooling using HVAC systems. This also includes the drying or dampening of air by mechanical methods.

Heat Transfer characteristic of Building Materials:

Heat always moves from warmer areas to colder areas. In winter, we heat the interior of a home so the direction of heat flow is from inside to outside.

The greater the temperature difference the faster theat flows. If it is 70°F inside and 75°F outside there's not much energy moving through the enclosure and the differences is not very noticeable But, if it's 70°F inside and 0°F outside there is a lot of heat flow and the difference is immediately noticeable.

Heat moves through building assemblies Primarily in three ways.

i) By Conduction
ii) By convection
iii) By Radiation

Conduction

Conduction is the movement of heat energy directly through solid materials from molecule to molecule. The movement of the material plays no role in the transfer of heat. Building materials conduct energy at different rates.

The rate of conductive heat flow is measured as U-value and resistance to heat flow is measured by its reciprocal, R-value.

U-value = rate of heat transfer
R-value = Resistance to heat transfer

The lower a given material's U-value the less conductive it is. The higher the U-value of a material, the more conductive it is.

Convection:

When heat is transported by a fluid, like air or water this is called convection. The extend of convection heat transfer depends on a number of things like the position of the surface but mainly on the speed of the passing air. The speed in outdoors is determined by wind speed and direction.

When the air is driven by an outside wind force this is called " Force convection". When there is no wind, convection will occur by temperature or density differences. This is called " Free Convection".

Radiation:

Radiation is the movement of heat through space as electromagnetic waves. The sun's energy reaches earth by radiation.

Radiation is not affected by the air.

The sun and a campfire both emit radiant heat, even when the wind is blowing. Radiant heat moves at the speed of light without heating the space between radiant source be it in the sun, or a heated slab or a mass of asphalt roofing, underlayment and wood sheathing and the surface of another object.

When an object or an assembly is warmed by radiant energy, the energy is absorbed into the material. To be warmed by a radiant heat source, the surface needs to be in the line of sight of the heat source.

The angle of the surfaces to each other is related to the optical properties. If one surface is obliquely angled away from another surface, more energy will bounce off or reflect than if the two surfaces are closer to parallel to each other. Radiant energy moves in straight lines and when a surface is directly facing another, more of the warm surface's energy will see the facing surface.

Phase change

When substances change phase for example changing from liquid to gas they absorb or release heat energy.

Example,

When water evaporates it absorbs heat, production a cooling effect and when it condenses it releases heat.

Phase materials can also be used in construction to reduce internal temperature changes by storing latent heat in the solid-liquid or liquid gas phase change of a material.

Incidence of solar heat on buildings

The principal function of a house is to provide shelter but in the long term the house is thermal comfort. Thermal comfort is a function of solar irradiance as the main generator of ambient thermal energy

The earth thermal comfort is a function of solar irridiance as maintained due to its axial rotation and its inclination at 66° to the plane of its solar orbit. The solar radiation has three components namely direct beam, diffuse and the reflected components.

$$I_t = I_d + I_f + I_r$$

It is relatively easy to measure the global solar radiation using a no of instruments like pyranometer and the campbell stokes sunshine Recorders.

solar gain is the that heat gain of a building as a result of solar irradiation onto the building and through is transparent surfaces.

In zero energy buildings the irradiation through windows can be controlled by active shading to reduce energy consumption.

During the day the angle of incidence of the sunlight varies. This changes the fraction transmitted light. At some angles for some wavelengths, all light is reflected while for other wavelengths and angles light is partially transmitted.

Implications of Geographical Locations:

Solar radiation often called the solar radiation resources is a general term for the electromagnetic radiation emitted by the sun. Solar radiation can be captured and turned into useful forms of energy, such as heat and electricity, using a variety of technologies. Everylocation on earth receives sunlight at least part of the year. The amount of solar radiation that reaches any one spot on the earth surfaces var

- Geographic Location
- Time of day
- Season
- Local landscape
- Local Weather

The earth is round the sun strikes the surface at different angles, ranging from 0° to 90°. when the sun's rays are vertical, the Earth's surface gets all the energy possible.

Diffuse And Direct solar Radiation

As sunlight passes through the atmosphere some of it is absorbed, scattered and reflected by:

- Air molecules
- Water vapor
- Clouds
- Dust
- Pollutants
- Forest fire
- Volcanoes

This is called diffuse solar radiation the solar radiation that reaches the Earth's

The sum of the diffuse and direct solar radiation is called global solar radiation.

Measurement

Scientist measure the amount of sunlight falling on specific locations at different times of the year. They then estimate the amount of sunlight falling on regions at the same latitude with similar climates.

Measurement of solar energy are typically expressed as total radiation on a hzt surfaces or as total radiation on a surface tracking the sun.

Distribution:

The solar resources across the US is xample for PV systems because they use both direct and scattered sunlight; Other technologies may be more limited.

However the amount of power generated by any solar technology at a particular site depends on how much of the sun's energy reaches it.

IV - UTILITY OF SOLAR ENERGY IN BUILDINGS

History of solar Energy:

The idea of passive solar building design first appeared in Greece around the 5th century. Up until that time, the Greeks main source of fuel had been charcoal but due to a major shortage of wood burn they were forced to find a new way of heating their dwellings.

Scorates wrote:

"In houses that look towards the south, the sun penetrates the portico in winter while in summer the path of the sun is right over our heads and above the roof so that there is shade".

Advantages of using solar power in Buildings

- Limitless Resources
- Low environmental support
- Energy Independence

- Multipurpose
- Ability for Additions
- Portable
- Post - Installation is zero

Methods to Empower solar powered Buildings

✓ Solar powered Buildings improve the Heating & cooling system's efficiency by 20% by proper installation of a new HVAC system..

Operating cost of a highly - efficient solar water heater can be reduced by 90% in solar powered Energy Efficient Buildings.

When you use Low - Emissivity window Glazing, it helps in reduces the space cooling needed by 40%.

A light - colour roof reduces a roof's temperature as it absorbs less than 50% of the solar energy.

Active Solar Energy :-

Active solar space Heating : In an active solar space heating system, a collector holding a heat transfer medium such as air or liquid capture's the sun thermal energy, which is then distributed through the building via electric fans or pumps.

Active Solar Building Techniques :

i) Solar Water Heaters

This produce thermal energy to heat water for households, commercial entities and swimming pools. These heaters are one of the most commonly implemented renewable energy technologies because of their cost effectiveness and relatively simple installation.

Solar water heaters typically need a backup conventional gas or electric water heater to account for cloudy days or unusually high water demand. solar water heaters consist of two parts

i) solar collector

ii) storage Tank

solar water heaters can reduce conventional energy consumption for heating water by 60% in commercial applications and upto 75% in homes.

Photovoltaic cells:

They are also known as solar cells are an active system in which small panels faced with semiconducting material turn sunlight into electricity.

Commercially available PV panels are up to 22.5% efficient at converting sunlight into electricity in optimal conditions but even in partly cloudy weather they can operate at 80% of their maximum outputs.

They generally have higher upfront costs than fossil fuel plants.

Concentrated solar powder

⇒ It is an active distinguished from other solar energy system by its ability to function as a utility-scale power plant.

⇒ CSP uses fields of mirrors to concentrated solar energy into channels holding heat responsive fluid.

⇒ The high temperature excite the fluid to a point where it powers a turbine or engine, which in turn runs an electric generator.

Passive Solar Design:

Passive solar design takes advantages of a building's site, climate and materials to minimize energy use.

A well designed passive solar home first reduces heating and cooling loads through energy-efficiency strategies and then meets those reduced loads in whole or part with solar energy.

Design basics of Passive Solar Building

1) Aperture / Collector

The large glass area through which sunlight enters the building. The collectors should face within 20 degrees of true south and should not be shaded by other buildings or trees from 9 to 3 daily during the heating season.

2) Absorber:

The hard, darkened surface of the storage element. The surface, which could be a masonry wall, floor, or water container, sits in the direct path of sunlight. Sunlight hitting the surface is absorbed as heat.

3) Thermal Mass:

Materials that retain or store the heat produced by sunlight. While the absorber is an exposed surface, the thermal mass is the material below and behind this surface.

4) Distribution

Method by which solar heat circulates from the collection and storage point to different areas of the house.

5) Control :

Roof overhangs can be used to shade the aperture area during summer months. Other elements that control under or overheating include electronic sensing devices, such as differential thermostat that signals a fan to turn on : operable vents and dampers that allow or restrict heat flow.

Methods to implement solar Gain

i) Direct Gain

ii) Indirect Gain (Trombe Wall)

iii) Isolated Gain (sunspaces)

Basic Elements of passive solar heating:

In simple terms, a passive solar home collects heat as the sun shines through south facing windows and release it in materials that store that heat known as thermal mass"

Properly oriented Windows:

Windows collect solar energy should face within 30° of true south and should not be shaded during the heating season by other buildings or trees from 9 to 3 pm each day.

Thermal Mass:

Thermal Mass in a passive solar home - commonly concrete, brick, stone and tile absorbs heat from sunlight during the heating season and absorbs heat from warm air in the house during the cooling season.

Control strategies:

Properly sized roof Overhangs can provide shade to vertical south windows during summer months.

Low emissivity

* operable insulating shutters & awnings

Refining the Design

* Insulation and air sealing
* Window location
* Glazing Type
* Window shading
* Thermal mass location & Type
* Auxiliary heating & cooling systems.

Passive cooling of solar

Passive cooling is the least expensive means of cooling a home in both financial and environmental terms. Passive cooling are required for,

* Hot humid climates
* Temperature & warm climates
* Cool and cold climates

Techniques to cool Building

i) The efficiency of the building

envelope can be maximised in a number of ways to minimise heat gain.

ii) Shading windows

iii) Walls and roofs from direct solar radiation

iv) Using lighter coloured roofs to reflect that heat

v) Using insulation

vi) To minimise conducted and radiated heat gains.

vii) Making selective or limited use of thermal mass to avoid storing daytime heat gains.

To maximise heat loss use the following natural sources of cooling.

- Air movement
- Cooling breezes
- Evaporation
- Earth coupling
- Reflection of radiation

Cooling Sources:

Sources of passive cooling are more varied and complex than passive heating, which comes from a single, predictable source, "solar radiation".

Cool breeze

Where the climate provides cooling breeze maximising their flow through a home when cooling is required is an essential component of passive design.

Earth coupling

Earth coupling of thermal mass protected from external temperature extremes. But winter sun enters the window, warming the slab on the ground. This is known as "passive solar control"

Design principles of passive cooling

Designing the floor plan and building form to respond to local climate and site.

Using and positioning thermal mass carefully to store coolness not unwanted heat.

Choosing climate appropriate windows and glazing.

Positioning windows and openings to enhance air movement and across ventilation.

Using roof spaces and outdoor living areas as buffer zones to limit heat gain.

Windows and shading

Windows and shading are the most critical elements in passive cooling. They are the main source of heat gain, via direct radiation and conduction and cooling, via cross, stack and fan-drawn ventilation cool breeze access and night purging.

Insulation:

Insulation is critical to passive cooling - particularly to the roof and floor.

Windows are often left open to take advantages of natural cooling and walls are easily shaded; roofs, however are difficult to shade and floors are a source of constant heat gain through conduction and convection with only limited cooling contribution to offset it.

Roof Space

Well - ventilated roof spaces play a critical role in passive cooling by providing a buffer zone between internal and external spaces in the most difficult area to shade the roof.

Hybrid cooling systems

Hybrid cooling systems are whole house cooling solutions that employ a variety of cooling option in the most efficient and effective way. They take maximum advantages of passive cooling when available and make efficient use of mechanical cooling systems during extreme periods.

i) Fans

ii) Air conditioning

Climate specific design principles

Climate specific design responses and passive cooling methods are different for

- ⇒ Hot humid climates
- ⇒ Temperature and Warm climates
- ⇒ Cool and cold climates

Design responses to the hot humid climates:

High humidity levels in these climates limit the body's ability to lose heat by evaporating perspiration.

Design responses consider shading, air movement, insulation and construction methods.

Shading :

Permanently shade all walls and windows to exclude solar access and rain.

Consider shading the whole building with a fly roof.

Air Movement

Maximise exposure to cooling breeze onto the site and through the building.

Insulation :

Use insulation solutions that minimise heat gain during the day and maximise heat loss at night.

Construction :

Use low thermal mass construction generally.

Consider the benefits of high mass construction in innovative, well designed hybrid solutions.

Warm humid climates:

Design and orientate to maximise the contribution of cooling breezes.

Case study of passive solar building.

Designing sustainable buildings in a composite climate is a challenge. The techniques that are effective during summers do not work in winter, More than 10 years Ago, PEDA decided to construct an office building that utilises the movement of the sun for lighting, cooling and heating.

Examples:

A simulation based on the UK says the PEDA builing function successfully as a passive solar complex.

1. Walls:

They are made of two layers of bricks with 5 cm air gap in between.

2. Roof

As maximum heat gain is through the roof, a rockwool and polyurethane insulation at an air gap of 5 cm from the concrete slab has been placed.

3 Solar shells:

These concrete domed structures on the southwestern facade are one of the well recognised innovations of this project.

4. Shell roofing:

A portion of the roof of the atrium is covered by a lightweight shell roofing.

5. Photovoltaic Panels:

Shell roof and the 25kWp solar photovoltaic plant there is an integrated 25kWp solar photovoltaic plant in the building.

6. Water Foundation:

These are operational during

hot and dry months and help decrease the interior temperature through direct evaporative cooling.

7 Ventilation:

The wind tower is expected to function as a non mechanical air-conditioning system, but the mechanical component for the tower is yet to be installed.

Daylighting:

Sun lighting entering solar shells, shell roofing, glass-integrated photovoltaic panels and windows made of unplasticised PVC meets the building's lighting requirements, including that of the basements.

UNIT-V GREEN COMPOSITES FOR BUILDINGS

Composites:

→ Composite are biphase or multiphase materials which are made by combining two or more materials differing in composition or form.

→ Biopolymers or synthetic polymers reinforced with natural fibers frequently termed as "Bio composites" can be viable alternatives to glass fiber reinforced composites.

→ "Green composite" is a completely bio-based composite; both matrix and fibre are complettely biogredable and renewable.

Fiber + Matrix = Composite Material

Biofiber + Biopolymer

The two main components of the green composites includes:

1) Biodegradable Resin
2) Natural Fibers

Green composites

⇒ Green composites are completely biobased composites in which both matrix and fiber are completely biodegradable and renewable.

⇒ Natural, vegetable fibers can be applied to reinforce the natural polymers such as starch, lignin, hemicellulose and India rubber which results in 100% biodegradability material bonding.

Reinforcing Fiber:

In biocomposites the bio fiber serve as a reinforcement by enhancing the strength and stiffness of the resulting composite structures.

Reinforcing natural / Bio fibers

- Nonwood natural / Biofibers
  - Straw fibers
    - Example: Rice, wheat / corn straws
  - Bast
    - Examples: Kenaf, Flax, Jute, hemp
  - Leaf
    - Examples: Henequen, Sisal, Pineapple leaf fibre.
  - Seed / Fruit
    - Examples: cotton, coir
  - Grass Fibers
    - Examples: Bamboo Fiber, Switch grass, Elephant grass
- Wood Fibers
  - Examples: soft and hard woods
  - Examples: Recycled Wood fibers, Newspaper, Magazine fibers

Methods of Manufacturing composites:

1) Filament Winding
2) Lay up Methods
3) Resin transfer moulding
4) Injection moulding
5) Vacuum bonding
6) Autoclave bonding

1) Filament Winding

It is a process is which continuous fiber are pulled from a large spool and wound on to a rotating mandrel after sufficient layers have been built up the wound form is curved and the mandrel removed.

2) Layup Methods:

Layers of prepreg fabrics are built upon a mould in unidirectional or multi axial form. The process can be done either by hand or by automated lay-up method.

3) Resin Transfer Moulding:

In this method dry reinforcement fiber is held in a closed mould and then resin is pumped through the mould at high pressure.

4) Vacuum Bonding:

In vacuum bonding, the composite is first placed over a mould then a vacuum bag is placed over the top. The air is removed from vacuum, the whole part is placed to cure the resin and the material is produced in a relatively short time.

5) Autoclave Bonding:

An autoclave is a pressure vessel which controls exact pressure temperature and vacuum conditions. The technique is very similar to that of vacuum bonding except that the oven is replaced by an autoclave. The process takes much longer than others and is relatively expensive.

Methods of Manufacturing Green Composite Boards.

In general there are various methods existing by which the green composite particle board can be produced.

1) Three layer particle Board

This type of manufacturing is mainly known for producing three-layer particle board. More recently, graded density particle board has also evolved. It contains particles that gradually become smaller as they get closer to the surface. Such manufacturing can also be produced by this process.

Manufacturing process of three layer Particle Board

Particle board is manufactured by mixing wood particles or flakes together with a resin and forming the mix into a sheet. The raw material to be used for the particle is fed into a disc chipper between four and sixteen radially arranged blades. The particles are first dried after which any oversized or undersized particles are screened out. Resin in liquid form is then sprayed through nozzles onto particles.

Advantages of Green Composites over Traditional Composites

- Less Expensive
- Reduced weight
- Increased Flexibility
- Renewable resources
- Sound insulation
- Thermal recycling is possible where glass poses problems.
- Friendly processing and no skin irritations.

Disadvantages of Green Composites

- Lower strength properties
- Good moisture absorption causing swelling of fibres.

→ Lower durability

→ Poor fire resistance and irregular fiber lengths are the disadvantages.

Applications and End Uses of Green composites

Green composites are applied to various components with moderate and high strength such as cars, mobile phones etc.

Problems:

→ Moisture & humidity
→ Strength
→ Reliability
→ Enhancement in fire resistance.

Some other areas in which the Green composites are used:

→ False ceilings
→ Partition purposes
→ Doors
→ Furniture
→ Boxes for agriculture purposes.

Other Applications

- Rims
- Mobile panels
- Toys
- Aircraft
- Ships

Water Efficiency in Building

According to the EPA, "Water Efficiency is the smart use of our water resources through water saving technologies and simple steps we can all take around the house. Using water efficiently will help ensure reliable water supplies today and for future generations".

Green Building encourages innovative water saving strategies that help projects use water wisely. Project teams can follow an integrated process to begin assessing existing water resources, opportunities for reducing water demand and alternative water supplies. Effective strategies include:

1) Install efficient plumbing fixtures
2) Use non-potable water
3) Install submeters
4) Choose locally adapted plants
5) Select efficient irrigation technologies.

Management of sullage water and sewage

Water is used for various domestic purpose like washing, drinking, flushing, cooking, bathing watering lawns etc. This waste water is characteristically divided into three sub categories related to the organic strength or level of contaminants typically contained in the water.

i) Black water
ii) Dark - grey water
iii) High - grey water

Black water

It comes from toilets and

contains high concentrations of disease causing microorganisms and high levels of organic contaminants.

Dark - Grey Water:

It primarily originates from kitchen sinks, which can also contain disease causing microorganisms and have high levels of organic contaminants from food waste and grease / oils.

Light - Grey water:

It typically consist of drainage from bathroom sinks, tubs, showers and often laundry.

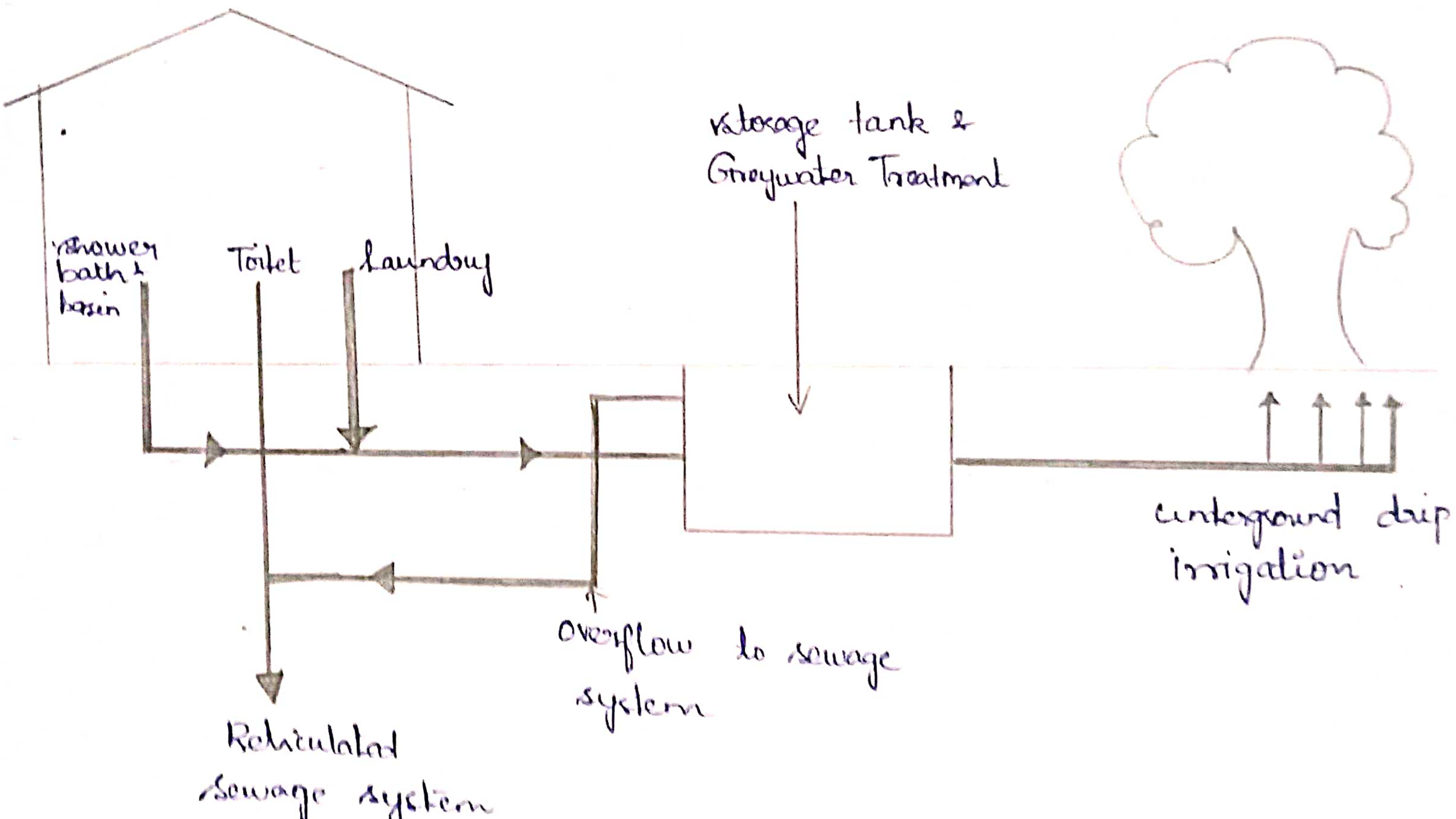
Grey Water Reuse:

There are various methods that can be used for grey water treatment right from simple low cost device that route grey water directly to applications such as toilets and garden irrigations to highly complex and costly advanced biological treatment process incorporating sedimentation tanks, bioreactors, Filters, pumps and disinfection systems.

Primary Grey Water System

⇒ These systems directly reuse virtually untreated domestic grey water from a single family dwelling for sub-surface lawn and/or garden watering with minimal treatment as shown in the fig. These systems do not allow storage or treatment apart from some surge storage and coarse screening/ filtration which removes hair, lint and coarse particles.

⇒ Grey water diversion systems which falls under this category can be either designed in to new houses or retrofitted to many existing homes.


shower bath & basin
Toilet
laundry
Storage tank & Greywater Treatment
underground drip irrigation
overflow to sewage system
Reticulated sewage system

Advantages of Grey Water Use

⇒ It can reduce the cost of potable water supply.

⇒ Grey water may contain nutrients.

Disadvantages:

⇒ It is very harmful

⇒ cost of treatment and diversion / transfer pipe & pumps.

Components of Grey water Reuse system

⇒ The system should be as simple and easy to use and maintain as possible.

⇒ Filters to remove hair, lint and coarse solid particles.

⇒ Sedimentation tanks to seperate and Greease.

⇒ Aerobic biological treatment to remove soluble organic contaminants.

⇒ Finally filtration to remove solid particles.

* Disinfection to remove pathogenic micro organisms

* Reuse water storage tank.

Green Buildings for Urban Environment

* Alternation the surface cover of an area causes the change in the flow of energy and matter through the urban ecosystems occurs creating multiple environmental problems.

* Urban areas detrimentally invade natural landscapes impacting the entire planet. more than 50% of the human population is nowadays residing in cities and it is predicted to rise up to 70% in 2050. The thermal stress is increased, thus both the indoor and outdoor thermal comfort levels are decreased and health problems are enhanced.

Green Walls

Green wall technologies may refer to all forms of vegeted wall surfaces. Two major categories can be identified.

(i) Green Facade
(ii) Living Walls.

Green Facade.

Green Facade are a type of green wall system in which climbing plants or cascading groundcovers are trained to cover specially designed supporting structures at the base of these structures in the ground or in intermediate planters.

Living Walls

Living wall systems are composed of prevegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or frame.

Green Living Roofs

The model of the green roof consist of three main components

i) structural support
ii) Soil layer
iii) Foliage layer

Structural support:

It includes all the layer between the inner plaster and the drainage layer or filter layer.

Soil layer:

Soil layer is complex consisting of the solid phase, the liquid phase and gaseous phase.

Foliage layer:

The Foliage layer is composed of the leafs and the air within the leafs.

Environmental benefits provided by the green living systems

Besides adding aesthetic values to the environment, the funtional benefits provided by the Green Living systems address a number of environmental, econmic and social issues arising from increased urbanization.

Energy savings obtained from green living systems

Possibility to cool the ambient air is important phenomena of the green roof.

This thermal benefits is result of the direct shading of roof surfaces and reducing solar heat gain through transpiration and photosynthesis by a foliage layer.

Stormwater Amelioration

Green roofs store rainwater in the plants and growing mediums and evaporate water into the atmosphere, the amount of water that is stored in a green roof and evaporated back is mostly dependent on the growing medium its depth and type of plants used.

Green roof stormwater retention has been shown to vary with climate, storm size, vegetation type and season.

Air pollution removal and air quality control:

The process of pollution removal is depended on distinguishing features of various plant species, their habit, habitat, leaf physical parameters and weather conditions present in the areas.

Carbon sequestration:

When green coverage is less than 10%, the concentration of CO_2 in the air would be 10% higher than the one with 10%, coverage rate reached 50%. The concentration of CO_2 in the air can maintain the rate of 320 ppm.

The Carbon fixation and oxygen release capabilities of the green roof depends on the plant selection. Trees, bushes and shrubs are better in controlling the CO_2 concentration improving the environment and maintaining oxygen balance than the grass.

Sterilization:

Garden plants are the major species in urban greening have the important role in reducing the amount of environmental harmful pathogenic microorganisms and improving the urban environment's ecological value and adding social benefits.

Plants can sterilize and inhibit the bacteria and other pathogenic microorganisms in their living environment to varying degrees. High green coverage rate helps to reduce bacterial content in the air. some tree species essential oils called phytoncides which when enhaled improves mental well being.