# Green Buildings

## Module - I.

Greenbuildings :- Green building. the reference is specifically made to the structure and the processes involved that are, being environment friendly and resource efficient throughout the the building's life cycle beginning from site to its design, construction, operation, maintenance, renovation and demolition everything

Introduction :- Advantages & Dis Advantages

① Advantages

a) Environmental Benifits

① Redue Wastage of water
② Conserve natural resources
③ Improve air Quality

b) Economical Benifits

① Redue operating cost
② Improve occupant productivity
③ create market for green product service.

c) Social Benifits

① Improve Quality of life.
② Minimise strain on local infrasture.
③ Improve occupant health & comfort.

Dis Advantage :-

① Initial cost is high
② Time consumption is more
③ The availibility of skilled labour

## Source of Green material

Green materials :- The material which have atleast one eco-friendly nature.

1) Strawbale :- The waste product from the Agricult Although straw bale construction is rare, it's gaining in popularity. Builder build these structures in a manner similar to a log home. The building offer excellent insulation and sound deadening properties. They are surprisingly resistant to fire due to inability of air flow

2) Cellulose :- Made form Recycled paper, cellulose. is the second most common insulation material and is considered a very green choice when used properly. Also it is relatively inexpensive with costs similar to fibreglas.

3) Slate/stone Roofing :- These natural materials are excellent green choices but are very expensive due to both material and labor consideration but can be cheap at the places where they are easily available. They have a very long life

④ low/no VOC paints/coating:- Paints, and stains are a source of indoor air quality issue due to the an g harmful VOC's needed to keep them in a liqui liquid from VOC's spur the quick evaporation g liquids in pain to leave behind a solid film g color. Many manufacturers are now offering low/no VOC alternatives to address this enviroment concern.

⑤ Natural fiber flooring:- Whatever type of flooring is desired there are green alternatives. Rugs & carpets are available in natural material such as wool & cotton while wood and other solid alternatives such as bamboo and cork offer high durability and sustainable harvesting metho

Green Material...

They are materials that are local and renewable. Local material often are unique to the place and connect. Reclaimed material are materials that can be reused in their existing from for new purposes. Recyclable materia are materials that can move from being waste material to being reused through reprocessing. Green materials today are defined as materia that are non-toxic, improve occupancy health, lower cost and conserve energy.

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Green Buildings :- It is also known as green construction or sustainable o

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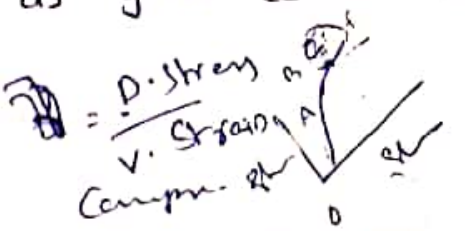


① The green is always greener on the other side of the fence
— That teaches us it's not good : to be jealous, (to want what other people have)

② Don't cross the bridge until you come to it

omsairam

① Green Buildings
② Proverd
③ Content —
① Introduction to G.B
② Def
③ objectives
④ Why for you
⑤ Advantages
⑥ Dis Advantages
⑦ Buildings Top 5 Green Building in world
⑧ Top 5 G.Bui Hyderabad

① Introduction
Sustainable Development
① No poverty ③ Good Health
② No Hunger ④ Quality Education
⑤ Gender equality ⑥ Clean water and sanitation
⑦ Renewable energy ⑧ Good jobs & economic Growth
⑨ Innovation & Infrastructure ⑩ Reduce Inequality
⑪ Responsible consumption ⑫ Climate action
⑬ Life below water ⑭ Life & land
⑮ Partnership for Goals ⑯ Peace & Justice
⑰ Global Goals — Relative Environment

→ The earth is one system
Security Quality of life and Global sustainability are all linked

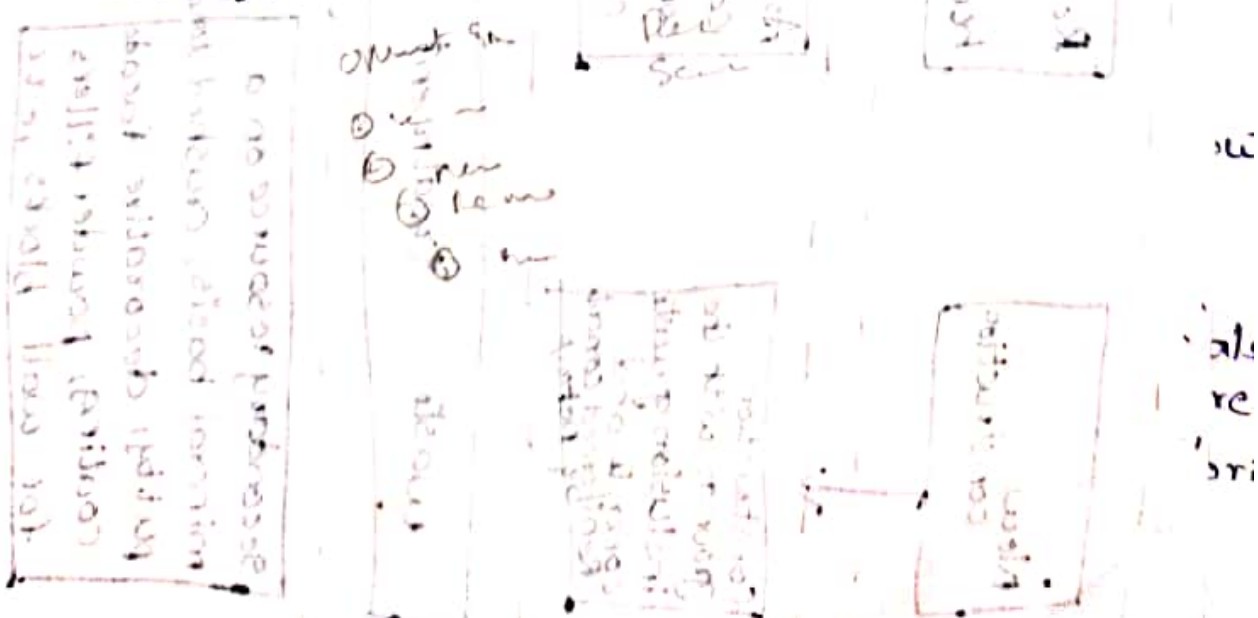
G.A.L S.B.L

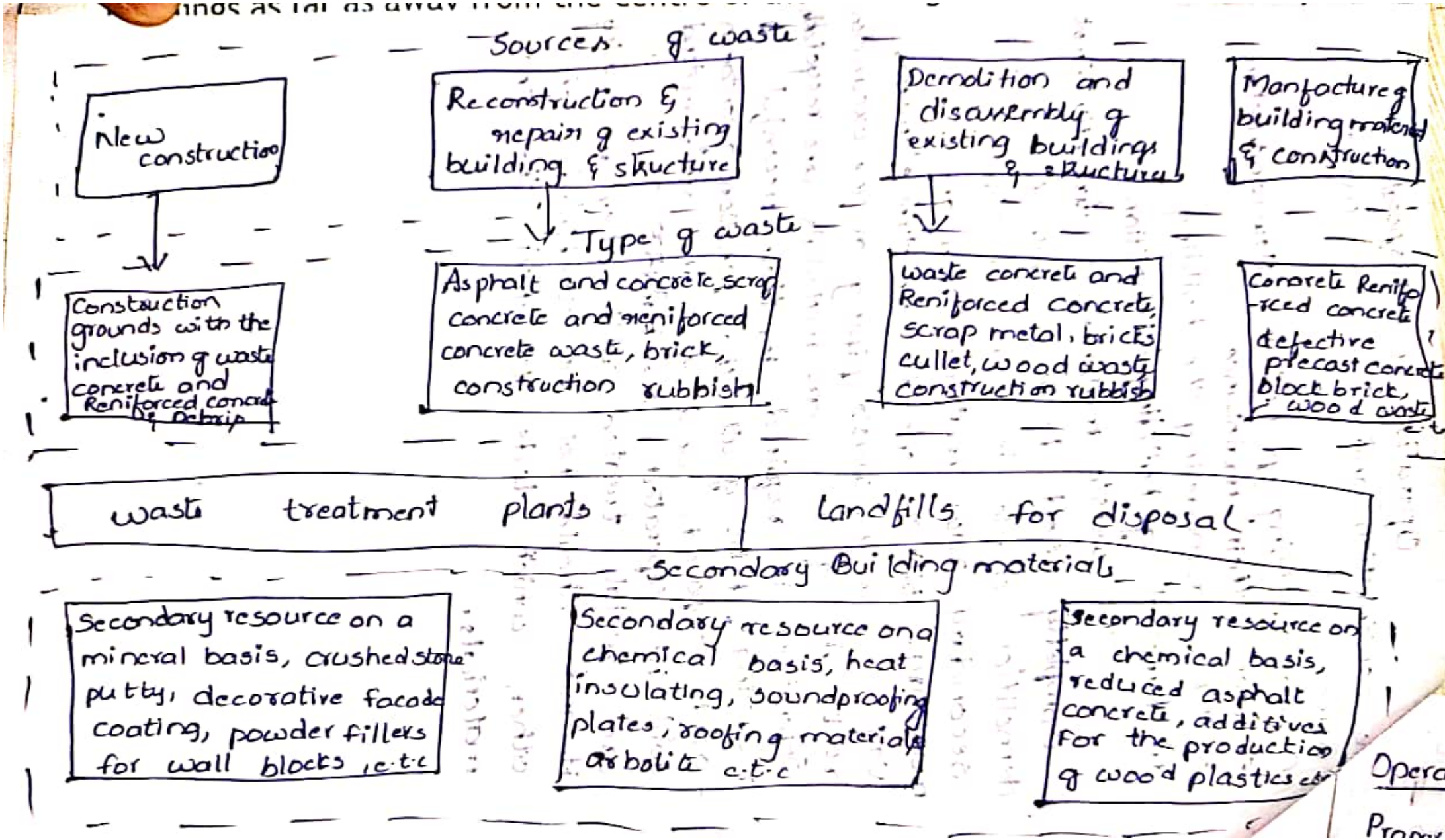
## Operation and Disposal

The construction and demolition waste arises :-

① when setting up building / New construction
② when their maintance
③ when remodeling the building
④ Removal of building / demolition.

The waste material is currently almost completly used because construction and demolition waste is significant source of secondary raw materials. They are bricks, masonry, tiling, wooden structure elements, various wiring, waste piping or the excavation, rock. All of these are materials are recyclable Seperation is required for their succensful recycling. Frist of all the speration of contamin -ated compounds and then the other materid will be seperated. The hazardous compounds are special treated while they are reusing it and should not be combined with other, which leds to toxic the other materials.





## Operation And waste Disposal

Proper Disposal of waste should be done for some major reasons like

① Control pollution :- Water, Air & soil pollution

② Conserve Natural Resource :- Waste disposal is vital for the conservation of all our environmental resource i.e forest, mineral water etc.

③ Control spread of Diseases :- To control the rapid spread of infectious ailments

④ Recycle for further Use :- Recycle hazardous waste for more production

→ Green Globes :- Is an online Green Building rating and certification tool that is used. Primarily in Cannada and USA.

### characterics of Green Globes

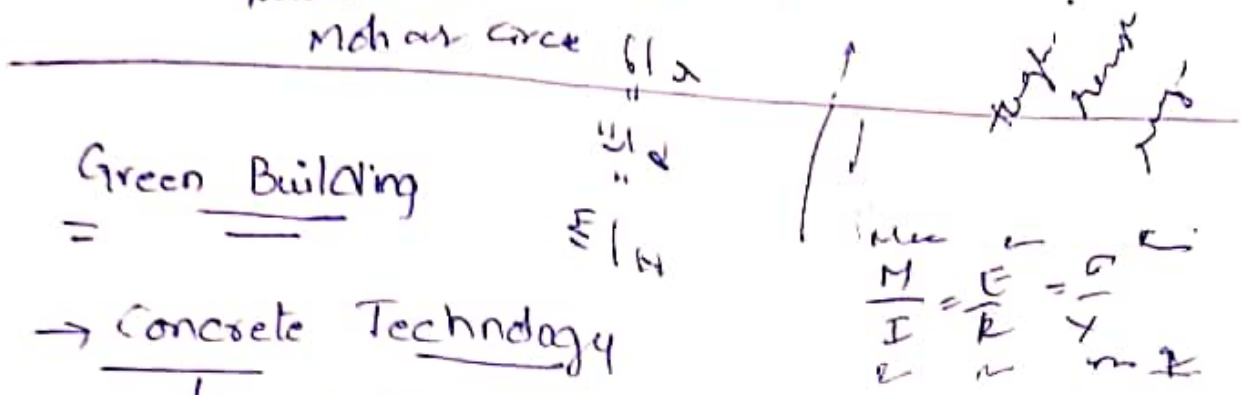
Green Globes is structure as a self-assessment to be done in house using a project manager and design team. The system is questionnaire based with pop-up tips, which show the Applicable technical tablets that are needed to reply to the question. As online manual is also available. Users can see how points are being awarded and how they are scoring

The Green Globes platform includes optional interactive guidance to help implement the integrated design process from goal setting to construction documents.

Submittal Requirement consist of documents consists of documents that are normally produced as part of any well executed green construction project that uses the integrated design process. They consists of construction drawing, specification, energy modeling, life cycle Analysis, records of meeting, and any 'green' plan that the team has developed for example, storm-water managm landscaping and comissioning.

Before entering the construction mate' markets secondary raw materials must pass the certification and certification procedures, confirming their technological process properties and

Significance
Pure bending
High precision jig
Toughness, weight by hardness
Section modulus
Neutral axis
Mohr circle



Green Building

→ Concrete Technology

↳ Latin → to grow together

Cement → Binder

Aggregates < F.A 4.75 Sieve
C.A

water

Admixtures < M.A (Replacement of cement)
ChA (Replacing water)

Cement :- (Lime + clay) calcination

Types

OPC
PPC

Grades
33
43
53

Mix Proportion - IS

M5

M80

M10 - 1:3:6
M15 - 1:2:4
M20 - 1:1:5:3
M25 - 1:1:2 - Standard

## Assessment tools / Tools for Assessment:-

Green building primarily having energy efficient usage, water conserving, the use of recyclable material, non-toxic and other features that contribute to the environmental, social and economics

There are five main sustainable rating tools they are BREEAM, LEED, CASBEE, GreenMark and Green Building Index.

1) BREEAM:- One of the earliest and most profound assessment tool in UK Building Research Establishment Environment Assessment Method (BREEAM) developed in the year 1990. The main function of this assessment tool are primary on building specification evaluation including the design, construction and use (2013). The vast experience of BREAAM in building assessment has lead its methodology to be the foundation of the new building assessment tool in Canada, Hongkong etc - latest version - BREEAM, UK newconstruction 2011

2) LEED:- Leadership in Energy and Environmental Design (LEED), second oldest tool was available in the year 1998. which was developed by United states Green Building Council (USGBC). Up to date there are 135 countries implementing LEED certification tools. Similar to BREEAM, LEED has also been the earliest model that is being adopted and modified accordingly to one's countries environment and nature. LEED new version for construction v2009

2020

3) CASBEE:- Japan as one of the most developed country in Asia has come up with their rating tool know as Comprehensive Assessment System for Building environment Efficiency in the year 2001. One of the first tool emerged in Asian region and the reliability of tool have gained reputable status as BREEAM and LEED has been the oldest ~~model that~~ is being adopted and modified. The rating tool is mainly focused in green building certification in Japan and Asia (2013) CASBEE for new building (2010)

4) Green Mark :- Green Mark was initialed in the year 2005 by Building and Construction Authority of Singapore. It was first tool developed in South East Asian Region. The emergency of this tool has encouraged other South East Asian region to develop their own rating tool – BCA Green Mark for New non-residential building (Version NRB/4.1) 4.1

5) Green Building Index :- GBI in Malaysia is one of the new rating tool available in the market. The rating tool was developed by Malaysian Institute of Architects(PAM) and the Association of Consulting Engineers Malaysia(ACEM) The GBI rating are mainly two type, which are building and township. The main objectives of GBI is as a way to enhance and promoting the sustainable built environment as well as igniting the awareness for every parties involved with building about the issues in environments and sustainability for the future generation,

- Non-Residental New Construction (NRNC) version 1.05

**Green Roof:-** Green roof is one of the new building method in construction. The roof implements plants and vegetation on top of the structure. Growing medium and soil are also embedded according to the type of green roof

They are two types of green roofs

① Extensive ② Intensive/semi intensive

Extensive green roof shallow soil depth and consist of sedum based covering and small plants are grown The system require less maintenance.

Another type of green roof is semi intensive. This roof having 25% covering of the total roof with green area.

## Case Study

| BREEAM | LEED | CASBEE | Green mark | GBI. |
|---|---|---|---|---|
| 1) Management (12%) | 1) Sustainable site (26) | Built Environment Quality 0.3 | Part 1:- Energy (16) Efficiency | 1) Energy efficiency (35) |
| 2) Health & well being (15%) | 2) water efficiency (10) | 1) Indoor Environment | Part 2:- Water (17) efficiency | 2) Indoor Environmental Quality (21) |
| 3) Energy (19%) | 3) Energy & (35) Atomsphere | 2) Quality of Service 0.3 | Part 3:- Environmental protection (42) | 3) Susitainable site & management (16) |
| 4) Transport (8%) | 4) Material & (14) Resource | 3) Outdoor Environment on site 0.4 | Part 4:- (8) Indoor Environmental Quality | 4) Material & Resources (11) |
| 5) Water (6%) | 5) Indoor Environmental Quality credit (15) | Built Environment load | Part 5:- (7) other Green features | 5) Water efficiency (10) |
| 6) Material (12.5%) | 6) Innovation in Design (6) | 1) Energy 0.4 | 190 | 6) Innovation (7) |
| 7) Waste (7.5%) | 7) Regional Priority (4) | 2) Resource & material 0.3 | | 100 |
| 8) Land Use & Ecology (10%) | 110 | 3) Off-site 0.3 Environment | | |
| 9) Pollution 10%. | | | | |
| 100%. | | | | |

| Points | Rating |
|---|---|
| 90 & ↑ | G.M Platinum |
| 85 to 90 | G.M Gold |
| 75 to 85 | G.M silver |
| 50 to 75 | G.M certified |

| Points | GBI Rating. |
|---|---|
| 86↑ | Platinum |
| 76 to 85 | Gold |
| 66 to 75 | Silver |
| 50 to 65 | Certified |

12%.
15
19
18
16
12.5
7.5
10
10

& GM - Green Mark.

BREEAM

| Rating | % score |
|---|---|
| Outstanding | ≥85% |
| Excellent | ≥70% |
| Very good | ≥55% |
| Good | ≥45% |
| Pass | ≥30% |
| Unclassified | <30 |

BREEAM Enviromental section weightage

| Environmental section | Weighting |
|---|---|
| Management | 12% |
| Health & well being | 15% |
| Energy | 19% |
| Transport | 8% |
| Water | 6% |
| Material | 12.5% |
| Waste | 7.5% |
| Land use & ecology | 10% |

→ LEED Rating

| Rating | Point |
|---|---|
| Certified | 40-49 points |
| Silver | 50-59 points |
| Gold | 60-79 points |
| platinum | 80 point & Above |

| Criteria | Points |
|---|---|
| Sustainable site | 26 |
| Water efficency | 10 |
| Energy & Atoms phere | 35 |
| Material/Resource | 14 |
| Indoor environmental Quality | 15 |
| Innovation in Design | 6 |
| Regional priority | 4 |
| | /110 |

→ CASBEE Rating

| Rank | Assessment | BEE value |
|---|---|---|
| S | Excellent | BEE = 3.0 / Q = 50↑ |
| A | Very Good | BEE = 1.5-3 Q = less than |
| B+ | Good | BEE = 1.0-1.5 |
| B | Fair Poor | BEE = 0.5-1.0 |
| C | Poor | BEE = less than 0.5 |

BEE = Q: Building Environmental Quality & Performance / L: Building environmental loading = 25 x (5-1) / 25 x (5-3 LR)

# Unit-2

## Benefits of Green Building:-

### Environmental Benefits:-

1) Reduced operational energy
2) Reduced water requirement
3) lesser volume of waste water generation
4) Resulting in lesser water pollution
5) Less material usage.
6) Longer building life
7) Lower maintence cost.

### Social Benefits:-

1) Enhance occupant comfort and health
2) Minimize strain on local infrastructure, improve quality of life.

### Economic Benefits:-

1) Reduces operation cost
2) Lower utility cost significantly
3) Optimize life cycle economic performance

### Business Benefits

1) Lower operation cost.
2) Higher return on investment
3) Greater tenant attraction
4) Enhanced marketability
5) Productivity benifits
6) Reduced liability risc
7) A healthier place to live and work

Sustainable building refer to both the structure and process that is more environmentally responsible during the entire life cycle of a building. These life cycle stage are

1. Site selection
2. Design
3. Construction
4. Operation and maintence
5. Renovation
6. demoilition.

Design

## Site Selection of Green Building :-

(A) Site Characteristics

(1) Size :- The ideal site will allow for future expansion

(2) Building Area :- The floor space of the building with an approximate 12,000 sq.ft

(3) Slope :- Most desirable would be flat site or a slight gradual ~~shape~~ slope downwards to south. The site should have maxmize solar acess.

(4) Surface drainage :- Site with good surface drainage away from the building location would be most desirable

(B) Environmental condition :-

(a) Natural Ecopystem :- The site should allow for construction of the building with as little site disturbance as possible. Construction should not require significant deforestation.

(b) Prime farmland :- Avoid sites that have previously been used as prime farmland.

(c) Damage Site :- Site which have previously suffered environmental degradation can be consider for this building. Degradation can include waste land, illegal dumps

(C) Resource :-

(a) Mass transit :- The side should be with in one quarter mile of two or more bus lines. Near by side walks are desirable and should be extenable to this site

(b) Public water system :- It should be able to accessible to public water supply

(c) Sanitary Sewer :- The site must be accessible to public sewer district for sanitary sewage disposal. Most desirable would be a site which would also & allow for future construction & an onsite treatment area for grey water

# Design

Design:-

Green buildings are designed to maintain Indoor comfort condition with respect to the local climate. The practics or technologies empolyed in green building are constanly evolving and differ from region to region. The fundamental principles includes efficiency of structural design, materials, energy and water

While designing a Green building folbwing parameters are taken into consideration, utilization of natural light (solar) and ventilation to maximum limit & using locally available, low embodied energy and recycled materials for construction

The Energy efficiency of the built form is affected by decision to be taken at all the design stages. The design of built form with solar passive techniques including shape and size of built form, orentation, site planning and design of building componets such as roofs, walls, doors, windows e.t.c

Materials should be extracted and manufactured locally to building site. It will minimize the energy embedded in their transportation. Prefabrication building element or modular unit, which can be joined together to create larger or smaller homes gives sustainable construction technique.

Green Roof act as insulation reduce heat flux through the roof. Using a fluorescent lamp system reduce upto 40% electric energy consumption if 100% installation is done

Raincwater harvesting presents an opportunity for providing the rain water for sustainability by utlizing them for watering plants, cleaning utensils and minor uses

following Methodology should be consider

1) Deciding shape, dimensions and orientation of building on the basis of passive solar design approach
2) selection of appropriate green material for reduction in embodied energy of building
3) selection of energy efficient lighting and cooling methods
4) Estimation of rain water harvesting system
5) Estimation of comparison of cost for conventional and green alternatives in building design
6) Using of pozzolanic materials in cement which makes the cement to release low amount of $CO_2$ into atmosphere

Expt. No..... Sheet No..... Date .....

# Construction

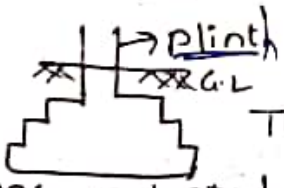
**Foundation:-**


G.L- Ground level

The type of foundation depends on soil type, The safety of the structure mostly depends on the soil characteristics. It is recommended to adopt a foundation depth of 0.6m for normal soils like gravelsoil, red soils etc. In the case of black cotton soil and other soft soils it is recommend to use under ream pile foundation which save 25% over all cost than conventional building.

While excavating the trenches (deepditch) for the foundations, it is recommended to shovel (fill back) the soil in trenches. some of the expense of excavation can be reduced to some extent To avoid cracks in foundation coat it with mortar (1:6)

**Plinth:-**




The plinth of height 0.2m above ground level was adopted construction with 1:6 cement motor The plint slab of (100-150)mm is accommadated To reduce soil erosion of soil, a impervious concrete slabs or stone slabs are provided

**Rat-Trap Bond Walling:-** This technique had been developed by "Baker". The rat-trap bond is laid by placing the bricks on their have a cavity (Gap) of 80-100mm, with alternate course of stretchers stretchers and headers. The main advantage of this bond is the economy in use.

→ strength is equal to the standard of brick arrangement, but consumes 25% less bricks
→ This will save upto 26% over all cost of materials
→ The gaps (cavity) created b/w the brick layer helps in maintaining a good thermal comforts. This will more of benifical to South Asian Countries.
→ Plastering is not neccessary in this type.

## Doors & Windows

It is recommended to use wooden or bamboo doors and windows in place of concrete or steel section frames as it helps to get good thermal insulation, and have less effect of temperature variations. The doors and windows should be located mostly in northern and southern direction so that not to face sunlight directly and provide sufficient ventilation and air circulation for cooling effect.

## Tiles On the Outer Face of the WALL :-

Tiles provide protection to the walls from atmospheric heat ensuring the reduction of the temperature as well as increasing the cooling effect. Tiles also saves the painting cost on walls and also 'VOC' or materials emission into atomsphere through paints

## Roofing and Gardening

Normally 12.5cm thick RCC slabs are used for roofing of Residental buildings the roof may be flat or inclined. If the roof of building is partially or completly covered with vegetation and grocing medium, planted over a waterproofing membrane and. include some additional layers such as root barriers, drainage and irrigation system is called Green Roof

According to survey published 2007: 1/3rd of USA believe that global warming is the world's most critical environmental problem

As is evident from the discussion, the importance of environmental issues has gained momentum. As a consequence, research in the design and execution of construction project has been focused on "sustainable practies" can reverse the impact of global warming

The growing awarness of sustainable construction's potential to positively impact environmental issue is pushing "Green Building" to the forefront. As a Result, more local governments are Adopting "Green Building" standards and regulations permitting and financial incentives for sustainable development. These thing also on the rise of (U.S. Green Building council 2006)

## Def of Green Building

A variety of terms are used to mean "Green" in the construction industry, including green buildings, sustainable design, high performance building. This collection of industry term represents a movement taking place over the past 40years to change the way we understand building Architecture design, construction, use and decomission.

Green Building seeks to
(i) Min / eliminate impacts of environment, natural resource and non-renewable energy source to promote the sustainability of the built environment
(2) Enhance the health, wellbeing and productivity of occupants and whole communities.
(3) Cultivate economic development and financial returns for developers and whole communities
(4) Apply life cycle approaches to community planning & development

## Costs & Profitability

Costs:- Cost is the context of construction project, refers to the efficiency with which the project team crafts and deliverable.

Profitability:- It is of the facility speaks to how well the business case of the project was drafted and how well the cost or benefits of the deliverable was studied before comissioning the construction of the project deliverable

A survey of 4,00,000 architects engineers and contractors was conducted (2008) showed that the potential to reduce energy use was selected by 54% of respondents as the top reason for Green Building and 24% of respondents stated that green building's value to the environment was the driving force behind their involvement in the industry

→ Higher cost is only top hurdles to the green building.

Green Specification :-

some of Green specification are

→ use only type of the lighting fixtures used in LED fixture
→ The significant feature of LED's is that the light is directional as opposed to conventional bulbs which spread the light more spherical

(2) Plumbing :- In Green plumbing fixture discharge range from 5 lpm to 15 l.p.m
② w.c discharge range b/w 7 l.p.m to 12 l.p.m

(3) PVC flooring :- pvc vinly flooring is a type of synthetic flooring, It is easy to install

(3) Green Wood :- Engineered wood products are made from a combination of wood fibres, strips and veneer sheets Smaller dia trees of the same hard and soft wood osed to manufacture lumber also used.

(4) Green paints :- Paints with reduced levels of voc's are more eco-friendly than conventional paints, some house paints have an even lower environmental impact

(5) Bricks :- Flyash Bricks are considered as the Green material of construction, So in this case it is used in the Green construction

(6) Cement :- If PPC is used in construction, it will be green material

Communication will be improved if all trades work together, whereas subcontractors only concern themselves with their own scope and little no collaboration and coordination with other trades.

In order to bridge both technology and communication gap that occur with a green building project USGBC launched an accreditation program to train and certify professionals families with "Leadership in Energy & Environmental Design" "LEED". Its focuses on performance in 5 key areas including (1) sustainable site selection, (2) water saving (3) energy efficiency, (4) material selection and (5) Indoor Environmental Quality."

→ charatte - A public meeting / workshop devoted to a concerted effort to solve a problem / plan the design

Among all other things. Have a project manager who is well rounded in all construction efforts with the additional knowledge.

# Impact of Green Buildings

Green building are more costly compared to those conventional buildings especially its soft-cost expenses due to addition care in design, Analysis, technical, efficiency It it will save the operation cost of the building

## Site selection of Green Building

(1) Site characteristic:-

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Resource:-

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b) Public water system :- It should be able to accessible to public water supply

c) Sanitary Sewer :- The site must be accessible to public sewer district for sanitary sewage disposal. Most desirable would be a site which would also allow for future construction of an onsite treatment area for grey water.

Unit-3

Quality, health and Saf Environments

Landscape strategies

III

Building Energy system strategies

- Inlates cycle strategies
- Material selection.
- Indoor Environment Quality.

→ Landscape strategies

Landscape:- All the visible features of an area of land, its land forms and how they integrated with nature or man-made features

→ Building Energy system strategies :-

① Use energy-efficient heat/cooling system in conjunction with a thermally efficient building shell

② High R-value wall and ceiling insulation to be installed

③ Minimum glass to be employed on east and west exposures and light colors for roofing and wall finishes

④ Encourage the usage of renewable energy sources such as solar, wind or other alternative energy to reduce operational cost and minimize the use of fossil fuels

⑤ Minimize as much as possible electric loads created by lighting, appliances and other systems.

⑥ Employ passive design strategies in building shape and orientation, passive solar design and use the nautral lighting which impact building energy performance.

⑦ Employ modern energy management controls to more energy management in temperature better to use well know - strategies which helps not to mislead the techniques.

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(8) Design / Develope strategies to provide natural lighting and views. which improves productivity

(9) A green building is typically designed to take advantage of the sun's seasonal position to heat its interior in winter and frequently incorporates design features such as light shelves overhanging / landscaping to mitigate the suns heat in summer.

(10) Room Orientation should generally be designed to improve natural ventilation

(11) Install high efficiency lighting system with advanced lighting control system and motion sensors linked to dimmable lighting controls. It can reduce general overhead light levels

(12) Use BIM computer modeling when possible to optimize design of electrical and mechanical system and the building shell

(13) Employ retro-comissioning. Most existing buildings have never been comissioned during construction and as they age they Require Regular maintenance In this respect, retro-comissioning can be extremely useful by resolving problems that occur during the Design / construction phase.

(14) These Retro-comission can addressing problem that have developed throughout the buildings life and thus make a substantial difference in energy usage and savings

Water-cycle strategies:-

① Employ ultra-low flush toilets, low flow showerheads and other water-conserving fixtures to minimize waste water

② Use dual plumbing system that use recycled water for toilet flushing or a graywater system that recovers raincooter or other non potable water for site irrigation

③ Install recirculation system to be used for centralized hot water distribution and point of use water heating system for more distant location

④ Use a water budget approach that schedules irrigation system

⑤ Install self closing nozzles on taps and state of the art irrigation controllers

⑥ Employ micro-irrigation Techniques to supply water in non turf areas, building should be metered separately from landscape.

⑦ Employ Rain-Water Harvesting tanks and pits to reuse the waste water and collecting them for different uses

⑧ Encourage 'Green Roof' technology to grow plants on the roof and water can be conserved and saved.

## Material Selection strategies :-

① Choose sustainable construction materials and products whenever possible.

② Sustainability of material can be measured by several characteristics such as recycled content, reusability, minimum off-gassing of harmful chemicals, zero or low toxicity, durability, sustainably harvested materials, high recyclability and local production. Use of sustainable products promotes resource conservation and efficiency, minimize the adverse impact on the environment and helps to harmonize the building with its surroundings

③ Employ dimensional planning and other material efficiency strategies to reduce the amount of building material needed and cut construction costs

For Example :- The design of room to 4-foot multiples minimize waste by conforming to standard sized wall board and plywood sheets.

④ If possible, reuse and recycle construction - ~~content~~ and demolition materials. Using recycled content products cuts costs and assists in the development of markets for recycled materials that are being diverted to from land fills.

Ex :- The use of inert demdition material as a base course for a parking alot

⑥ Allocate Adequate space to facilitate recycling collection and to incorporate a solid waste management program that reduces waste generation.

⑦ Require waste management plans for managing materials through deconstruction, demolition and construction

# Indoor Environment Quality

Indoor Enviromental Quality (IEQ) refer to the Quality of a building's environment in relation to the health and well being of those who occupy space or in the Building.

Factors:-

IEQ depends on many factors including lighting, air quality and damp conditions.

IEQ are highly complex and building occupants may be exposed to a variety of contaminants either in the form of gases and particles. comes from office machines, cleaning products, construction activities and furnishing, perfumes, water-damaged building materials, microbial growth (fungal, mold and bacterial) insect and out door pollution.

other factors such as indoor environmental contaminats and controlling them can often help prevent or resolve building-related. worker symptoms.

Indoor Environment Quality can be achived by

1. Dampness and mold in Building
2. Building Ventilation
3. Health Hazard Evaluations
4. chemical and odors
5. Construction and Renovation

① Dampness and Mold in Building

Dampness results from water that come either from internal source (eg: leaking pipes) or external source (eg: raincoater). Dampness become a major problem to various material in buildings mostly ceiling tiles and rugs walls become wet for extended peroid of time.

Excessive moisture in the air means high relative humidity that is not properly controlled with A/c can also leed to excessive dampness

By using wet insulation with in a celing or wall; excessive moisture in the building due to slope of the cuwounding land can prevent this problem

Effects Research studies have show that exposures to building Dampness causes problem in respiratory system, asthma, hypersensitivity pneumonitis, rhinosinusitis bronchitis and respiratory infections.

② Building Ventilation

Building ventilation is the circulation of air throughout a building. ~~The ventilation or the heating, ventilating and air conditioning~~ We should provide air to building occupants at a comfoitable temp and humidity that is free of harmful concentration of air pollutants. This can achived by using 'HVAC' system which improve the operation and maintance for the below asceptr

① Carbon dioxide ② tabacco smoke ③ molds and bacteria
④ cleaning products ⑤ copy machines and printers
⑥ pesticides

## ③ Construction and Renovation

Construction and Renovation can adversely affect building occupants by the release of airborne particulates, biological contaminants and gases. Careful planning for 'IEQ' can prevents the exposure during these activites.

Particulates :- The materials such as dust and fibers are likely to be produced during construction and renovation activites. Source include dry wall, plaster, concrete, soil, wood, masonry, flooring, roofing and duct work.
→ Non toxic dusts are irritants and causes lung disease

Biological Materials

chronic dampness from water intrusion leads to increased bacteria, mold and other microbes in a building environment. Microbal contaminated materials require special precautions prior to demolition to perevent biological dusts. Another example of biological contamination is an accumulation of bird or rodent dropping. They will cause potentially allergenic / infectious dust to occupied building area.

By using appropirate techniques we can minimize these

Volatile Organic Compounds (VOC)

Sources :- ① coatings ② Adhesives ③ Paints, varnishes ④ wall coverings ⑤ cleaning agents ⑥ fuels and combustion products ~~⑦ storage agents~~ ⑦ Vinyl flooring ⑧ Fabric materials

Indoor Environmental
① Dampness / mold in Building
② Building ventilation
③ Health & Hazard evaluation
④ Chemical / odour
⑤ Construction / Renovation

## Unit-5

1) What is carbon credit, explain in brief?

Carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or mass of another green house gas with a $CO_2$ equivalent to one tonne of $CO_2$.

Carbon credits are typically measured in tonnes of $CO_2$ equivalents and are bought and sold through national online retailers and trading plat forms. Business that find it hard to comply with carbon emission, purchase carbon credits to offset their emissions by making finance readily available to renewable energy projects forest protection and reforestation projects around the world. These renewable energy and energy efficiency projects replace fossil fuel and industrial processes. This all help businesses in mitigating their emission and comply with the global standards

2) What is carbon accounting, explain some examples? How the carbon accounting done

Carbon accounting :- Carbon Accounting is used to measure and predict the amount of $CO_2$ and other green house gases emissions

Example :- 1) A land Based Accounting :- A land base approach to accounting would take as its starting point the change in carbon stock in applicable carbon pools on land containing activites. this involves frist defining the applicable activites and next step identifying the land units on which these activites occur. Next the change in carbon stocks on the land units during the relevant period is determined. In land-based approach, it could be

difficult to factor out the impact on stocks of indirect effects.

Non $CO_2$ green house gas emission estimates would also need to be accounted for. Modification could be made regrading. for ex:- Base line, leakage, timing issue and uncertainties. Aggregate accounted $CO_2$ emissions and removals are the sum of carbon stock changes over all appliable land units over the specific time period.

Example:- We can find the carbon accounting by using simple equation by have previous knowledge on the basics of climate change that proficient in basic mathematical operation or I preferably computer literate (excel) are done. They are familiar with activity / project process being accounted for carbon emission

Equation :) GHG = AXEF

where GHG: emission of $CO_2$ or CHyetic
A: Activity data ; EF = emission factor.

3) What is carbon foot print?,

Carbon foot print :- The total amount of green house gases produced to directly and indirectly support human activites usually expressed in equivalent tones of $CO_2$

Example: ① When you drive a car, the engine burns fuel which creates a certain amount $CO_2$, depending on its fuel consumption and driving distance.

② When you cool your houses with electricity, the generation of the electrical power may also have emitted a certain amount of $CO_2$ is release

③ When you buy food and goods, they produce of food and good also emitted some quantities of $CO_2$

∴ The carbon foot print. is calculated by the sum of all emissions of $CO_2$ which were induced by your activities in a given time frame.

(4) What is green house effect? Give the details of gases, source and impact gurm

Green house effect :- The green house effect is a natural process that occurs the earth surface. when the sun's energy reaches the earth's atmosphere some of it is reflected back to space and rest in absorbed and re-radiated by green house gases like $CO_2$, $CH_4$, $SO_2$, $NO_x$ etc.

Effects :- One of the chief concerns about an increase in the greenhouse effect is that the change become self-sustaining. As more green house gases enter the atmosphere, its ability to trap heat increases. As the warmth of the atmosphere, the amount of water vapour it can hold increase as well, further boosting the effect. In addition, increased global temperatures threaten to release large amount of carbon that is currently frozen into permafrost zones, also exacerbating the problem. Excessive heat retention could lead to massive changes in natural water distribution and available land mass on a global scale. The effect of mitigation factors, such as increased cloud cover reflecting sunlight back into space, is not well understood.

| Greenhouse Gas | Global Warming Potential |
|---|---|
| Carbondioxide | 1 |
| Methane | 23 |
| Nitrous oxide | 296 |
| Sulphur Hexafluoride ($SF_6$) | 22,200 |
| Perfluorocarbon (PFC's) | 4,800 - 9,200 |
| Hydrofluorocarbons (HFC's) | 12 - 12,000 |

Sources of Green House Gas

1) Powerplant :- In the power plant they burnt fossile fuels like coal, natural gas and oil produces green house gases

2) Residental Building :- The largest single source of global emission according to calculation ecofys is construction nearly and maintain in Building releases 11% of total GHG into atmosphere

3) Road transportation :- About 10.5% of $CO_2$ is released through vehicles. These emission is goes on increasing when compared to past despite improvements in vehicle fuel-efficiency and now account for about three quarters of transport emission.

a) Deforestation, forest Degradation & Land use change :- The damage done is two-fold first, the capacity of forest to absord $CO_2$ and act as the earth lungs is diminished; second large amount of climate warming $CO_2$, methane and nitrous oxide stored in trees and soils are released into amtosphere.

5) Cement, Ceramics & Glass production :- Cement production is very energy intensive, requiring first the quarrying of limestone & the processing of that limestone at very high temp $CO_2$ is emissions are also generated by carbonate oxidation in the cement clinker production process, the largest non-combustion source of $CO_2$ from industrial manufacturing. Other non-metallic materials like ceramics and glass also involve transforming minerals like limestone, silica, and clays using energy-intensive process.

given time fra

## 2.GRASSCRETE:

As its name might indicate, **grasscrete** is a method of laying concrete flooring, walkways, sidewalks, and driveways in such a manner that there are open patterns allowing grass or other flora to grow. While this provides the benefit of reducing concrete usage overall, there's also another important perk — improved stormwater absorption and drainage

## 3.Rammed earth:

What's more natural than the dirt under your feet? In fact, walls that have a similar feel to concrete can actually be created with nothing more than dirt tamped down very tightly in wooden forms. Rammed earth is a technology that has been used by human civilization for thousands of years, and can last a very long time. Modern rammed earth buildings can be made safer by use of rebar or bamboo, and mechanical tampers reduce the amount of labor required to create sturdy walls.

4. HempCrete:

is just what it sounds like – a concrete like material created from the woody inner fibers of the hemp plant. The hemp fibers are bound with lime to create concrete-like shapes that are strong and light. **HempCrete** blocks are super-lightweight, which can also dramatically reduce the energy used to transport the blocks, and hemp itself is a fast-growing, renewable resource

5.BAMBOO:

Bamboo might seem trendy, but it has actually been a locally-sourced **building material** in some regions of the world for millennia. What makes bamboo such a promising building material for modern buildings is its combination of **tensile strength**, light weight, and fast-growing renewable nature. Used for framing buildings and shelters, bamboo can replace expensive and heavy imported materials and provide an alternative to concrete and rebar construction, especially in difficult-to reach areas, post-disaster rebuilding, and low-income areas with access to natural locally-sourced bamboo.

## RECYCLED PLASTIC:

Instead of mining, extracting, and milling new components, researchers are creating concrete that includes ground up **recycled plastics** and trash, which not only reduces greenhouse gas emissions, but reduces weight and provides a new use for landfill-clogging plastic waste

## 7.WOOD:

Plain old wood still retains many advantages over more industrial **building materials** like concrete or steel. Not only do trees absorb CO2 as they grow, they require much less energy-intensive methods to process into construction products. Properly managed forests are also renewable and can ensure a biodiverse habitat.

## 8.MYCELIUM:

**Mycelium** is a crazy futuristic building material that's actually totally natural – it comprises the root structure of fungi and mushrooms. Mycelium can be encouraged to grow around a composite of other natural materials, like ground up straw, in molds or forms, then air-dried to create lightweight and strong bricks or other shapes

## 9.FERROCK:

Ferrock is a new material being researched that uses recycled materials including steel dust from the steel industry to create a concrete-like building material that is even stronger than **concrete**. What's more, this unique material actually absorbs and traps carbon dioxide as part of its drying and hardening process – making it not only less CO2 intensive than traditional concrete, but actually carbon neutral.

## 10.ASHCRETE:

AshCrete is a concrete alternative that uses **fly ash** instead of traditional cement. By using fly ash, a by-product of burning coal, 97 percent of traditional components in concrete can be replaced with recycled material.

## 11. TIMBERCRETE

**Timbercrete** is an interesting building material made of sawdust and concrete mixed together. Since it is lighter than concrete, it reduces transportation emissions, and the sawdust both reuses a waste product and replaces some of the energy-intensive components of traditional concrete. Timbercrete can be formed into traditional shapes such as blocks, bricks, and pavers.

# Materials (green):

Concrete is a material that quite literally holds our cities together. From homes and apartment buildings to bridges, viaducts, and sidewalks, this ubiquitous gray material's importance to modern urban life is undeniable. But you might have heard that it also has a dirty secret: the production of commercial concrete materials releases tons of the **greenhouse gas** carbon dioxide ($CO_2$) into the atmosphere each year, contributing to the calamity that is **climate change**. But it doesn't have to be that way. We have collated 11 green building materials that offer alternatives to concrete, and a lower environmental impact.

## 1.Straw bales:

Rather than relying on new research and technology, **straw bale building** hearkens back to the days when homes were built from natural, locally-occurring materials. Straw bales are used to create a home's walls inside of a frame, replacing other building materials such as concrete, wood, gypsum, plaster, fiberglass, or stone. When properly sealed, straw bales naturally provide very high levels of insulation for a hot or cold climate, and are not only affordable but sustainable as straw is a rapidly renewable resource.

Straw Bale:- Straw are agriculture by-product or waste it inexpensive and an easily renewable medium

→ Straw mainly field type yield from the creal crops such as barley, oat, rice rye and wheat

→ Bales may be square, rectanglar or round depending on the type of baler used

→ properly built, straw bale structure
(i) Fire-resistant (2) water proof and (3) actually pestfree with super-insulated walls.

Why straw is appealing as a building material for several reasons

(1) In Area of grain production, straw is in expensive

(2) The quality of lumber is dropping, prices are unpredictable and some suggest future supplies may be limited

(3) 21-26 inches (530mm) Rectangular bar will suit more

Properties of Straw Bale as Building

→ Acoustics - satisfactory sound insulation performance

→ Insulation - A carefully constructed straw-bale building has excellent thermal performance because of their combination of the bales high insulation value.

→ Thermal mass

② Bamboo :- Bamboo belongs to grass family It is also called as "Poor man's timber" "Green Gold"
Bamboo is widely recognized as high renewable, fast growing, economic row material. It is use in the construction and structural application

→ In India has the huge potential for bamboo with 14 hect g bamboo forest area.
In coming year India is expected to face timber shortage in order to meet the housing needs g the increasing population. Moreover the increased dependency on conventional material is held responsible for degradation g environment

→ Bamboo act as substitue for wood and steel as it considered as highly renewable and eco-friendly material

→ Bamboo products like bamboo boards, bamboo mats corsugated roofing sheet have physical and mechanical properties like hardness, stability and strength are gaining attention with large opportunities in emerging market

→ Bamboo has the capability g mitigation climatic change as it restores degraded land, act as carbon sequesters and protect soil from ersion

→ Bamboo can be used top grade housing in roofing, flooring, door and windows

and they are economical inexpensive material and can be used in construction with the replaced of bricks. The straw are tried with wires. and make them in bales. And this bales are used in construction. Mostly rectangle bale of size (21-26 inch) as used in the construction. The straw are renewable source

2.1.1.4. characteristics/properties of straubales.

① Act as sound proofing material and causes less Acoustic problem.

② straw bales maintains moderate temperature in the room by prevent the thermal entre into room at day and absord the thermal wave at night and coolb down the temp.

③ In earthquake pron- Area the straw bale can be used as it reduce the structural loss and polpulation damage.

④ Also prevent the water entring into the wall

Abtract:- Most of the materials we are using in the construction are non-renewable resource and. release Green house gases into the environment and cause pollution. A revolution had started to save the environment from such. material like cement, vac paint etc. choosing the eco-friendly material and also renewab resource in the construction will reduce. atleast 20% of total pdution.

Introduction :- In India 40% of pollution is caused by the construction, let us consider a convential material, cement. Cement used in the construction releases $CO_2$ into atomsphere when its get hydrated. As it cannot be replaced complete but can be partial replaced by some green material that will reduce % of pdlution in the environment. Present study is about the properties of Green material and there use in the construction

1.1 StrawBale:- The straws are the by product of the agriculture fields like, rice bale ete Paddy, ba wheat, creates

→ Thermal mass :- Thermal mass reduces temperature swings due to daytime warming and night time cooling by absorbing and then gradually releasing heat

→ Availability cost :- straw is an agricultural waste product , a by-product of grain harvesting. Cost depends upon time of purchase (harvest months)

→ Resistance to pest :- straw bales are thick and dense enough to keep out many kinds of pests. Plastered surface with no openings prevents the structure from infestation

→ Acoustics - straw bales have satisfactory sound insulation performace

→ structural properties :- load bearing straw bales walls are typically used only in single storey or occasionally double storey structure

→ Design and construction challenges-
straw bale buildings must be carefully designed to eliminate the possibility of moisture entering the wally, especially from above.
→ succesful design often incorporate roof overhangs that are wider than normal and roof shapes and detailing that minimize the risk of water

## Structural Capabilities of Bale walls

→ keep out the wind, inhibiting air/ moisture infiltration
→ Resist heat tranfer
→ keep the assembly from buckling, under a compressive load
→ keep the assembly from deflection in strong wind.
→ keep the structure apart from bursting in an earthquake, when pushed and pulled from all direction
→ support the roof load (compression)
→ Reduce damage / failure from high winds (ductility)
→ Reduce damge from eq earthquake

Plastering:- straw bale walls are most typically plastered on the outside with lime, clay or cement
→ Inside surface are typically lime, clay or gypsum
→ structural Analysis has shown that straw bale behave much like a sandwich panel, with rigid moulding skins initially bearing most of the load and adding considerable strength to walls.

Disadvantage:-
① Required skilled labour
② A sprak from electrical short or error causes flames and burns.