Sustainable Planning and Architecture

Lecture 6

Eco-Building Construction Materials

SOURCE OF MATERIAL

- Renewable sources: forests
- Reuse from waste: old plumbing, doors etc…

These are all come under Eco-building construction materials.

As we seen in this picture there is raw materials which is been processed my manufacturing and packaging companies and it is been transported and which we are using day-to-day life like furniture, and for construction etc. and it been operator and use and then one it cannot be used are it has reached is life time it can be renewed or recycled disposed and it can be brought again as a raw material. And it can be recycled adding few elements which can fixed to the original form.

Some of the these materials are, for example

WOOL BRICK

- Obtain by adding wool and a natural polymer found in seaweed to the clay of the brick,
- 37% more strength than brunt bricks
- Resistant for cold and wet climate

This how the brick look it's been found in sea vies by adding some polymer and adding to it. This makes it as good as the construction material and its butter than burnt bricks by 37%.

SUSTAINABLE CONCRETE

- Crushed glass
- Wood chips or slag – a byproduct of steel manufacturing
- Reduce the emission of co_2

When a crushed glass and wood chips or slag mixed together and wood chip or slag is been byproduct. While producing steel those are like waste products which is been produced so adding these two products together it can produce sustainable concrete which is very similar to our convectional concrete and it also has reduced carbon dioxide emission because source of manufacturing these product uses less of energy.

SOLAR TILES

- Exit to simply protect the building
- The spend a large portion of the day absorbing energy from the sun

So this tile is very similar tile to roof tiles which is been used on sloped roofs. This roof can store solar energy which the form of renewable energy and it convert into the conventional energy sources.

PAPER INSULATION

- Made from recycled newspapers and cardboard
- Then filled with chemical foam
- Insect resistant & fire retardant

Using recycled newspaper grinding it and adding some of the chemicals to make it fire resistant and insect resistance can make an excellent insulation material; usually insulation is highly used in n0n-tropical region like colder climate or very hotter climate.

TRIPLE-GLAZED WINDOWS

As you seen in this picture a triple glazed window is a three glass layers within a gap usually air or organ.

- Super-efficient windows
- Stops heat to enter the building & from direct sunlight
  Since there are three layers which is been provided the heat usually pass and emit back and then radiates. Since there is three layers the heat absorbed by the glass very less and there is air layer in between each glass further

reduced the heat which is been passed through the glass and there are sun light.

This the section of triple glazed window which it shows how much heat from the room is reflected back in a coated glass even if it's a outside 0 degree Celsius and the inside can be protected to 20 degree Celsius because of the air cavity which is been present in between the two glass layers which reduce the heat loss basically.

ECO FRIENDLY

- Using bamboo replacing the steel bars
  These the one of the material which is been used by lot of architect rather than they using steel bars they are going more for bamboo which is also very flexible and which is good in tensile strength.

When you look at this picture it's a tall and its very tall restaurant which is been used this type of structure just using bamboo due its tension force.

<u>MERITS & DEMERITS OF GREEN BUILDING</u>

MERITS OF GREEN BUILDING

- Efficient technologies
- Easier maintenance
- Return on investment
  Since you're using these types of materials after few years energy base are reduce which is like return money you get what you are investing within few years.
- Improved indoor air quality
  In colder climate it reduces the heat loss and colder air penetrating within the built environment which reduces the usage of room heaters etc… which improves indoor air quality.
- Energy efficiency
- Water efficiency
- Waste reduction

The protection of these materials since the raw materials are basically from recycled materials and byproduct of other construction products the used energy and water is very less, Since we recycled the product over and over again the waste produce by this product is also very less.

- Temperature moderation
- Water conservation
- Economical construction for poor
- Healthier lifestyles and recreation
- Improved health

DEMERITS OF GREEN BUILDING

1. **Initial cost is high**
   Since it's a new technology, not lot of people using it construction is not done on a very huge industrial scale because of which initial cost might be little higher but it given back by its returns by saving energy bills.
2. **Availability of materials**
   Not all the materials which it goes as byproducts for creating. This type of construction material may not be available readily
3. **Need more time to construct**
   Since the technique used for the construct our craft man ship is very limited for these types of constructions it may take prolong time and it take more labor for construction. And more skilled workers are required to do this.
4. **Need skilled worker**

ENVIRONMENTAL LIFE CYCLE ASSESSMENT

Now move onto environmental life cycle assessment.

Why Sustainable Construction?

Social progress, which recognizes the needs of everyone

- Effective protection of the environment
- Prudent use of natural resources, and
- Maintenance of high and stable levels of economic growth and employment

Using this type of construction protects the environment from lot of carbon emission which eventually as the greenhouse gas which results in global warming all these reduce by building sector by using this type of construction technique. It uses the natural resources so we are less dependent on non-renewable energy source which is also a good thing and maintenance of high and stable levels of economic growth and employment. So there is new opportunity for more employment and more economical growth when we are inventing s new type of construction techniques.

DEFINING SUSTAINABILITY

Sustainability can be defined using the following comparison:

Traditional criteria

- Performance
- Quality
- Cost

Sustainability criteria

- Resource depletion
- Environmental degradation
- Healthy environment

Sustainability which is divided into two things which is traditional and sustainability criteria which accounts into performance, quality and cost which all these come under traditional criteria, the sustainability criteria is resource depletion, environmental degradation and producing more in healthy environment by producing these type of renewable and sustainable type of material.

LIFE CYCLE ASSESSMENT

When a material is produced then it's taken to factory to make it usable it's then again move to coating and manufacturing & packaging then step 4 his making it usable by giving final coats and then finally it done all the process which can be readily use and then it's transported to the site and it is made used by the end users

like else and then after the life time is over it again send to the factory can be recycled again.

LCA (Life Cycle Assessment) as defined by ISO 14040 “is a technique for assessing the environmental aspects and potential impacts associated with a product by;

When we are using the product is potential environment aspects and impacts which is been created by the product, manufacturing, transportation everything. Some of these techniques not show awareness to the people so this likes an assessment which is done to know about each and every material. Impacts it bringing to the environment

- Compiling an inventory of relevant inputs & outputs of a product system;
- Evaluating the potential environment impacts associated with those inputs & outputs;

  As we said before for creating each material and the raw material use and everything that creating an impact on the environment is been assessed and then it’s been taken in account for the life cycle assessment.
- Interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study.

  So the objective is know about the impacts and then faces which is been going on so that we don’t create more or larger bad impact on the environment.

ENVIRONMENTAL CONSIDERATIONS

1 Energy use, global warming and clinical change;
2 Resources, waste and recycling;
3 Pollution and hazardous substance;
4 Internal environment; and
5 Planning, land use and conservation.

So these are the some of the environmental consideration that has been done for the every product and also for the byproduct from manufacturing to transportation and usage to recycling how much we are impacting on the environment is the sum of strategies.

More selective of building materials

The following considerations need to be taken into account;

Environmental performance of the processes used by manufacturers and suppliers generally;

- Use of recycled materials;
  So when we buy a product we must know from where it came and it can be recycled again, since we already been using the plastic so much and plastic can only be recycled and cannot be degraded at all which is major pollution which is been happening currently so in order to stop coming us again in the future. Before hand what type of material and byproduct is going in making a construction material
- Re-usability of materials and items; and
- Recyclability of materials and items,

Waste minimization through re-use and recycling,

This as to be like a cycle which as to go again, product which is been disposed which cannot be used and it should be more added other byproducts and it can make into the new product which can be make it again. More like re-cycle thing which is analyst.

SUSTAINABLE DESIGN

- Energy conservation features
- Solar energy utilization
- Water conservation features
- Incorporation of recycled materials
- Low emitting material
- Reduced building construction waste
- Less environmentally destructive site development

These are sum of strategies is to taken in a account on larger scale how much of the renewable energy sources they are been using not just byproduct but also what type of machine is creating, if it affecting the users, even who are involved

in the producers and manufacturer, people who are all directly involved with the products from making to transportation.

WHAT CAN THE CONSTRUCTION INDUSTRY DO?

- Re-use existing building assets
  Sum of this already becoming every popular, The shuttering which is been now a days can be recycled and can re-use in different places since it coming infinite shapes and sizes on a module systems which can be used again and again.
- Aim for loan construction
- Minimize energy in construction
  When we use more of sustainable construction products so it uses less energy since the energy used in creating the raw materials is already very less
- Minimize energy in use
  These like a triple-glazed window functions like how the heat loss is reduced, so it eventually come update for the energy use within the building so it minimize the energy use of building.
- Do not pollute
- Conserve water sources

WHAT CAN YOU DO TO IMPROVE?

Operation Carbon Dioxide (Energy Consumption)

Whether specifying for new build or refurbishment, in design (for operational cost) and in construction, carbon dioxide emissions from energy consumption impact on the environment and on costs. Ways to reduce carbon dioxide emission.

When a product is manufactured we also taken into account how much the carbon dioxide product is been built with and how much carbon dioxide it was emitted from it was manufacture. Because if your producing some lower sustainable product and it producing more of carbon dioxide and there is no point in creating a such type of a material because it eventually producing the gas which is affecting the environment.

- Energy efficient equipment (for heating and cooling, lighting – indoor and street, equipment etc) and sensible assessment of internal heat gains.
- Simple and effective controls
- Maximizing good day-lighting
- Controlling solar gain
- Natural ventilation and the use of passive engineering techniques, such as thermal mass
- Improved insulation and air tightness

So these are the sum of techniques like using day lighting and natural ventilation, these are some of elements which is available in the nature readily to us. We have to start using more of those types of elements to reduce the energy demand itself initially while designing it as to incorporate by the architects.

- Source of renewable energy (wind, solar, wave, bio-sustainable fuels)

Whatever we were using it as been more from renewable energy sources like solar, wind, bio-sustainable fuels.

- Appropriate use of combined heat and power

Embodied Carbon Dioxide (Embodied Energy)

Embodied carbon dioxide is how much carbon dioxide is been given while latest manufacture, when product is manufacture.

All aspects of component selection are important; design, quality, production, transport, product life, and environmental impacts from "cradle to grave".

From a material, from being a material of byproduct and from the place where it can be actually used that will lot of different stage which it goes to make this type of byproducts so all these have to be analyses how much of carbon dioxide which is been embodied within the product and to create the product to that final stage.

Ways of reducing this includes:

I. Lean construction/prefabrication/right first time
II. Avoidance of waste in design and manufacturing

III. Use of local materials and suppliers and avoidance of CO_2 intensive components
IV. Avoidance of CO_2 intensive components

So we have to reduce the products which use lot of carbon dioxide and go which making of this products we have stop reducing the embodied carbon dioxide as well. Same wise it continuous for water

Water

You should consider

1. Use of water saving devices
   Like we said before we have start using star rated products which reduces the usage of water
2. Sub-metering (to allow identification and monitoring of high demand facilities)
3. Leak detection (to facilitate prompt maintenance)
   It as to be good building maintenance service department has to develop keep in track of everything work in fine in the place to reduce the waste of the resources.
4. Opportunities for grey water recycling and use
   Grey water is basically the water comes from washbasin and from kitchen sinks which is re-used by minimal cleaning and it can use for gardening flushing of toilet etc.
5. Rainwater collection and use; and
6. Use of sustainable drainage systems.

Waste

Significant reductions in waste can be achieved through good design, improved logistics, better onsite construction practice and re-use/recycling wherever possible.

A hierarchy of waste management should be adopted:

1. Reduce-design out waste
2. Re-use-look for opportunities to re-use material on site

3. Landfill- also reduces transport movements.
   So we have to reduce the wastage when we design, when the product is design is comes under definite shape and size so we have consider that while designing itself in that case it can be reduced the wastage of product. The product which is used for onsite has to be made reusable which is like shuttering of woods like concreting we discussed before
4. Recycle-look for opportunities for others to use your waste
5. Recover (energy)
6. dispose
   after we use the products which is been consider not usable for us can be used for some other construction time so the opportunity for recycling or re-usable as to be invented and we have to start using those type of accepts to for the products also proper disposal so it doesn't affect the environment or make any other hazards products.

Biodiversity

Construction does not have to reduce the ecological value of a site in many cases it can be used to enhance it. Habitat can ever be created within buildings.

Examples of appropriate actions for wildlife include;

Protecting parts of the site and its surroundings that are important for wildlife from damage during the construction process

We have seen in the last presentation like biodiversity lot of different element which goes into the ecosystem and which forms the biome. So we have to make sure it not disturbed as well for example using lot of wood for construction we had aware that we were not destroying the forest completely just for construction. That type of construction is also essential.

Planting tree species which occur, or could occur, naturally at the site.

Leaving some large grass areas uncut for the benefit of wildlife rather than keeping large lawns.

Minimizing the use of herbicides and use biodegradable products

Using environmentally friendly ways of controlling unwanted pests

These are the some of the things that varies from site to site or region to region. So this bio-diversity has to maintain and this analyses is made before starting of a design.

Transport (for the construction process)

Transport has significant impact on sustainability through the consumption of fuel. Reducing transport reduces environmental impacts and can save money. Careful planning can significantly reduce transport impacts.

So using of local available material reduce the cost which goes for the transportation of material from one place to another so it doesn't use any since to Italian marble in a place which is completely like in Asia are something which it gives lot of transportation to bring the material there to here and lot energy and amount can be saved from this transportation.

1. Minimizing the transport distances of materials
2. Transport of personnel (promote green travels plans to construction site for site employees, car sharing, minibuses etc.)
   So this more like sharing of public transportation or car pooling techniques.
3. Fuels type used for transport (use of cleaner fuels)
4. Local transport infrastructure (ease of access, public transport, car parking)
   Whenever developing like a huge satellite town ships something like that we have to consider its good connectivity towards the bus depot are something which reduces the usage of private vehicles.

WHOLE BUILDINGS"STRATEGY:

Existing R&D programs, building technologies, and components tied together by system integration and Computerized Designed Tools.

Some of the passive designed strategies which is been showed and other energy efficient materials and it advantages and hoe advanced technology can help in using this type of construction methods and this byproducts.

Now consider energy uses in offices

Energy uses in offices for a full LCA all these life-cycle stages should have been considered. So as you see extraction, manufacture, construction, disposal,

including re-use and recycling. So all these process have consider in your designing, say something like an office building and however data does not exist and resources did not permit the collection of information from the actual construction or erection phase not from the dismantling stage. Usually these type of building made is very protective about the information how much they were used energy sources since this not completely available for this type of building these were consider to be relatively small addition to the life cycle burden. Some of the small are finite calculation were been ignored but these are some of the major things which goes inside the energy usage for an office building.

CONSTRUCTION ALTERNATIVES

- 60 year building life
- Construction types
    - Steel frame, slimflor beams, precast concrete slabs
    - Steel flame, composite beams, composite slabs
    - In-situ reinforced concrete frame and slabs

    These are some of the construction types which is been used for the life cycle assessments.

    - Steel frame, cellular beams, composite slabs
    - Concrete frame, precast concrete hollow core units

BUILDING SERVICES OPTIONS

- Natural ventilation
- Different mechanical systems
- Full air conditioning
- Hundreds of calculation combinations!!

LIFE-CYCLE EMBODIED ENERGY

For these five forms of construction the embodied energy can be calculated the main structure which is foundation column beams those are the main structure is identified separately from the rest of the structure which is cladding internal wall building and furniture and other finishes which goes within the construction. Then the third component which is related tom the refurbishment the third component

which shows in a dark-blue relates to refurbishment and maintenance that takes place throughout the life time of the building. When you see the structure is very less and the rest of the finishes which is mention a secondary product occupying some of the life-cycle embodied energy but were as refurbishment takes as lot of energy. The building has to be reused are something else you have to keep that also in a mind while designing.

LIFE-CYCLE EMBODIED CO_2

The same details applied here but co_2 emission rather than the energy so this chart shows they show the amount of co_2 energy for the structure. When the structure was made and then rest also made and also refurbishment.

OPERATIONAL ENERGY

Over the past 60 years of life time of the building the amount of energy that run in the building like lights for heating and air conditioner for heating for maintenance of the building to keep within a thermal comfort those are the energy which is been shown in the chart is calculated for each construction type for different construction type the different heating and mechanical services that goes in the energy are shown in the chart.

Likewise this plot shows natural mechanical ventilated. The tree systems of mechanical ventilated for same type of construction. Which 4 storey office building, composite beams and composite slabs, 48m x 13.5m, over a period of 60 years