Sustainable Planning and Architecture

Lecture 5

BIOMIMICRY

Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies.

Basically biomimicry is an inspiration from nature whatever we inspire, for example the structure of plant likes how a single vein and branches into different smaller veins and the leaf structure. The similar structure can be adopted in the building design or developing a structure too. So that type of developing and something inspired from natural element is called biomimicry.

What **Steve Jobs** say about biomimicry is "I think the biggest innovation of the 21st century will be at the intersection of biology and technology. A new era is beginning."

Basically in nether lands last year the traffic hours per year were 70,000,000 so over all in one year almost traffic was stopped. Vehicles are still almost 70,000,000 hours which is like waste of time so what biomimicry aims is zero hours stopped in traffic. And 20 percent of the world's annual energy use to keep these structures within one degree Celsius. Similarly, as you see the building on the right side end different buildings which is using 20% of world's annual energy to maintain within certain temperature but where it's when you see on the picture left side below it shows the fossil fuels required to keep these structures within one degree Celsius is 0%. So these is the natural structure built by the insect to have their livelihood but it maintain with 1 degree Celsius and there is no energy required to built this structure, inspiring from these type of structure trying to adopt within our buildings is called biomimicry.

"When nature has worked to be done, she creates a genius to do it."-**Ralph Waldo Emerson**

Since we are moving to biomimicry architecture we having new techniques and new research teams have been developed. To develop these types of strategies it reduces the energy demands.

The Biomimicry Institute empowers people to create nature-inspired solutions for a healthy planet. So these like a team which it works for the biomimicry types of structures. One of the main strategy that been inspired from biomimicry passive cooling

PASSIVE COOLING

- The operation of buildings represents 40% of all energy used by humanity, so learning how to design them to be more sustainable is vitally important. Architect Mick Pearce collaborated with engineers at Arup Associates to design East gate, which uses 90% less energy for ventilation than conventional buildings its size, and has already saved the building owners over $3.5 million dollars in air conditioning costs.

  In overall energy demand that been used in the world all most 40% of that is been contributed for the building sector so they are starting to develop different scenario this can be further reduced one of such example is been developed design by Arup Associate and Architect Mick Pearce.
- We generally think of termites as destroying buildings, not helping design them. **But the East gate Building, an office complex in Harare, Zimbabwe, has an air conditioning system modeled on the self-cooling mounds of termites** that maintain the temperature inside their nest to within one degree, day and night (while the temperatures outside swing from 42 ‘C to 3’C).

  As we saw the structure initially which is been built by insect even though the outside temperature is fluctuating from 42 degree Celsius hash day time and 3 degree Celsius during the cooler nights. There is no change in temperature within the structure so it been inspired from the type of structure to build this East gate building located in Zimbabwe.
- The high-rise East gate Centre building in Harare, Zimbabwe was designed to mimic the way that those tower-building termites in Africa construct their mounds to maintain a constant temperature. These was developed from this structure which is been built by the insects which located in Africa, so they study that structure and they try to mimic the same structure in the buildings. The insects do this by constantly opening and closing vents throughout the mound to manage convection currents of air – cooler air is drawn in from open lower sections while hot air escapes through chimneys. The innovation building

uses similar design and air circulation planning while consuming less than 10% of the energy used in similar sized conventional buildings!

When you seeing this mounds there are smaller opening that is been located in the lower part of the section and due to convection current of cooler air when the cooler air is coming in it get used and it become hot. We know the hot are usually travels up and it tresses above when the hot air raises above and there is opening located in that place for the hot air to escape. There is constant air-movement from the lower part of the structure to the higher part so this was same was inspired and constructed so this building which is constructed in the Zimbabwe which follow the same technique.

And it uses less than 10% of what energy will be demanded and maintains these temperatures without any fluctuation compare to convection building of the same size.

WALEPOWER WIND TIRBINE

- Inspired by the flippers humpback whales use to enable their surprising agility in the water, Whale Power has developed turbine blades with bumps called tubercles on the leading edge that promise greater efficiency in application from wind turbines to hydroelectric turbines, irrigation pumps to ventilation fans.
  How the Whale as different fans on their back to move faster so these same structure was mimic to make new turbine which uses the same structure and efficiently and very faster and which uses very less of energy.
- Compared to smooth surface fins, the bumpy humpback ones 32% less drag and an 8% increased lift in their movement through air or water. So it can survive both air and water and uses 32% lesser drag. Usually when it is moving forward there will be other force which is been acting which move the turbine little bit backside. It been reduced by 32% because of which 8% of the lift towards the push is been increase in air and water.
  Using such blades to catch the wind as communities and nations switch to renewable sources could provide a 20% increase in efficiency that will help to make wind power generation fully competitive with other alternatives.

Since wind power used only in the locations where there is high level of wind pressure seed. This is an alternative coming up which will increase the e20% of efficiency of using such type of Wind Turbine alternatively along with the renewable energy resources.

As you seen these fins which is been developed and inspired from the Whale.

This is how the entire turbine looks.

And these adopted in different path. See these like a highway which they were used in this structure and these also been used in the vertical planes like outside cities.

RENEWABLE & N0N- REBEWABLE ENERGY SOURCES

Now moving onto Renewable and Non-renewable energy sources. Now first have a look at renewable energy.

Renewable resources are natural resources that can be replenished in a short period of time.

- Solar
- Geothermal
- Wind
- Biomass

These are few of examples in the Renewable energy resources which is been abundant in the nature there is no definite time in which this as to be use are else these become exiting. So these are available abundant and these can be process to make different power energies which has been converted day-to-day life activities.
Solar: we been developing lot in solar energy which uses the sun radiation it stores the energy within the cell and use a battery to convert the direct current into AC and then it supplies to normal electrical appliance.

SOLAR

Energy from the sun.

Why is energy from the sun renewable?

Because sun does not have any expiry date within, this after certain day's sun is not there. Since the sun radiation is available so there is larger potential to use this solar radiation and to store in this cell and use it as power for fan, light and even water heaters etc.

GEOTHERMAL

Energy from Earth's heat

We have different planes which is there on the Earth below that we are studying deep layer of lava is present as certain amount of heat so this heated energy converted into convection energy sources for our day-to-day uses.

When you see this pictures how the Earth is been broken down and then the heat energy is taken out this also a developing strategies around the world.

WIND

Energy from the wind.

When you see this turbine, air from prevailing wind it usually facing the prevailing winds, so the prevailing wind as higher wind speed catches and these blades moving which eventually has a motor generates. Which it converts the energy in to electricity So that wind energy is also a renewable energy sources.

BIOMASS

Energy from burning organic or living matter.

We might also hear of biomass plants in huge campuses even in collages we must have learnt all these. To have this living organisms they decay and they produce the certain amount of energy which can be dumped into period of time and that can be converted into electricity again and even this biomass is converted into bio-gas

which use as a type of gasoline and even in households we might have seen the parents dumping waste vegetables that as a fertilizers so again it's the usage of biomass.

WATER or HYDROELECTRIC

Energy from the flow of wate .

When we store the water in the dams like this produces certain amount of energy which is usually convert into hydroelectric powers so there is lot of hydro-power electric stations places were have such dams which convert that energy into electricity.

WHAT IS RENEWABLE ENERGY?

Energy exits freely in nature. Some of them exist infinitely (never run out, called **RENEWABLE**), the rest have finite amounts (they took millions of years to form, and will run out one day, called **NON-RENEWABLE**)

With this in mind, it is a lot easier to lay any type of energy source in its right place. Let's look at these types of energy in the diagram below;

You will notice that water, wind, sun and biomass (vegetation) are all available naturally and were not formed. we know that coal and petroleum are been deposited under the ground over lot of years which made it these type of state and there is limited of finite amount of this energy sources because ones it get over it will take millions of year to form these type of energy for its use it again those energies are called as **Non-Renewable Energy.** The others do not exist by themselves, they were formed. Renewable energy sources are always available to be tapped, and will not run out. This is why some people call it **Green Energy.**

Approximately 20% of electricity produced globally in 2009 came from renewable sources. Out of this, hydro-power accounted for about 16%.

In 2009 survive was conducted which said that 20% of overall energy demand in the Global level is been taken from the renewable energy but still we were using remaining 80% from n0n-renewable energy resources which are finite. So we have

to change the scenario and make use of more of renewable energy sources which is available abundant and try to use of less of non-renewable energy sources because they are available only in a finite stage level.

In 2012 9% of the energy consumed in the USA came from renewable sources. This means the USA depends a lot on non-renewable sources. As we said in 2012 just in USA only the 9% of total energy demand was solved by renewable energy sources the remaining of which came from non-renewable sources. So 30% of the energy from renewable sources came from hydropower, while biomass, bio-fuels and wood, together accounted for about 49%. Within the renewable amount of energy 30% came from biomass, bio-fuel and hydropower put together.

This picture shows **Global new investment in Renewable Energy (in billion USD).** As you seen

Light-green is **Developed countries**

Dark-green is **Developing countries**

In 2004 as you see these developed countries investing the renewable energy sources is **31 billion USD** and developing countries are 8 as the year goes in 2011. Even developing country is starting to invest more on renewable energy sources and developed countries also like wise they keep to increasing the strategy of investing the renewable energy sources.

WHEN CAN ENERGY BE CALLED 'RENEWABLE'?

When its source cannot run out (like the sun) or can easily be replaced (like wood, as we can plant trees to use for energy)

As we said before the source cannot run out like wise plants and trees doesn't take millions of million years to grow them back. They also come under the renewable energy sources since its take few years to grow and become as a source of energy for us to use.

When their sources are carbon neutral, this means they do not produce Carbon compounds (such as other greenhouse gases).

These sources have the Carbon neutral so they don't produce any Carbon components. So it doesn't account to more of greenhouse gases which eventually needs in Global warming.

When they do not pollute the environment (air, land or water) and renewable energy includes Biomass, Wind, Hydro-power, Geothermal and Solar sources. Renewable energy can be converted to electricity, which is stored and transported to our homes for use.

As we saw before the some of the examples of renewable energy sources which can be converted into electricity to meet our day-to-day requirements.

ENERGY CONSERVATION

Just century ago, humans used very little energy because we had less of the things that use up energy. There were no computers, phones, TV, cars, lights, washing machines and all that. It's been increasing in the pass few decades we been using more of appliances which is use lot of electricity actually when we see hair-drier it takes 1000 watts of electricity which consumes lot of power when it used on the regular basis even like computers, phones and televisions which it becomes a part of a day-to-day life now we can't imagine a life without these type of appliances.

After the industrial revolution, people started using a lot more manufacture items such as electronics, automobiles and home appliances. We must have noticed in history of Architecture in Industrial revolution which says after post war. How the industrial revolution started in which they started mass producing everything by machines and deployed everything is made by handmade craft man ships. Which use lot of electronic because which this production of electronic automobiles as grown vastly in the past century.

These items use a lot of energy, but if we all cut our energy use by half, that would be huge savings. We should try to avoid using these types of electronic items individually more often so using it more like a community basis. For example using car for one person is wasting lot of energy and resources. If we make it for 3-

4 people then the energy usage eventually come down so reducing up to half amount is huge saving.

Saving energy can be achieved in a couple of ways:

1. Energy conservation,
2. Energy Efficiency, and
3. Recycling.

Energy Efficiency means using different star rated appliances which is been recently developed. We might have noticed while buying a Air-conditioner or refrigerator it must have mention 5star rating or 3star rating which means energy used by the appliances is less compare to the normal appliances without the star ratings when the star goes higher the usage of energy is less.

These first two are not the same, even though people often use them to mean the same thing.

Energy Conservation:

This is the practice that results in less energy being used, for example turning the taps, computers, lights, and TV off when not in use.

So, Energy Conservation and Energy Efficiency is not the same thing so Energy conservation is using less energy in the source itself using fewer appliances, using less time and switching it off and not in use that is called Energy conservation.

It also includes running in the park or outside instead of running on the treadmill in the gym. When you running on a treadmill to operate the treadmill it use certain amount of power which is also accounts to the city. When you do the same activity in the park the usage electricity of as treadmill can be saved.

Energy conservation is great because we can all do this everywhere and anytime. It is a great behavior we must acquire. It is like awareness that we have to build within ourselves to reduce energy usage.

1. Up to 25% of heat loss is through windows, plastic window covers can help reduce drafts. So in colder countries the air tightness is very important they have different standards for air tightness usually the ideal air tightness is 0.1.

which it gap between the window frame and the reaming wall is very less as the building is older actually it get bigger and the air come through the small gap is very high which make the heated place, the heat from the room heater get escaped through it and colder air comes in to maintain the same temperature the room heater will have to use more motor efficiency which increasing the electricity again.

2. 85 to 90% of energy used to wash clothes goes to heating water. When we use washing machine we usually turn on the water in the automatic machine as soon enter the power button. In which 85 to 90% of water is used for just for heating the water before washing it.

ENERGY EFFICIENCY

This is the use of manufacturing techniques and technology to produce things that use less energy for the same result. For example if a heater is designed to warm your home with less energy than regular heaters, that would be an energy efficient heater. As I said before it's like a rating system and it's a power usage is not a energy conservation it's a energy efficient. If your washing machine uses less energy to do the same job as other washer that is an energy efficient washer.

FACT: Homes built after 2000 are about 30% bigger, but there use less energy than older homes. As they are saying after the year 2000 the home built is usually 30% built in floor area compare to the homes which is older than that energy usage is reduced because there is lot of Energy efficient appliances which is been introduced in the market and which is starting to create more awareness within the people they are opting more energy efficient appliances which is using less energy at the sources itself.

RECYCLING

This involves the use of waste or old materials to make new ones. For example, we can collect all old newspapers from the town at the end of everyday and turn the papers into fresh paper for printing again. Some of the recycling techniques which is already used in newspaper companies mostly they use regale language

newspaper they used recycled papers for printing new ones. We can collect all plastic bottles and send them to be used for new plastics bottles, or used for children plastic toys. Like newspaper this can be adopted for plastics as well.

Recycling saves energy because less energy is used to recycle than to turn new raw materials into new products.

This means to save energy, we need to use all these great ways. If we all try do this, together we can save some money and use less natural resources too. Since already we are using more of non-renewable sources we have to start using these type appliances to reduce the energy.

NUCLEAR ENERGY

Nuclear fission uses uranium to create energy.

As we know uranium is also a finite energy sources which is non-renewable.

Nuclear energy is a non-renewable resource because once the uranium is used, it is gone!

COAL, PETROLEUM, AND GAS

Coal, petroleum, and natural gas are considered nonrenewable because they cannot be replenished in a short period of time. These are called fossil fuels.

HOW IS COAL MADE???

Before 300million years ago, when this natural element get decayed and buried into deep into the soil, In water is formed like 100million years ago which uses different bacteria and slowly started decomposing all these organic matter and they starting to form an thick rock and diet eventually they decay over a lot of years which is finally become cold. And then similar way oil and gas are made

HOW ARE OIL AND GAS MADE???

under the sea like 300-400 million years ago which is been decomposed by different sea animals and its formed thick belt and a sand & slit which formed and decompose over 300-400 million years which forma a deposit are a layer of gas

and soil slit which is driven deep into sea like this and it’s been taken and used for day-to-day activities.