# Sustainable Planning and Architecture

## Lecture 10

### Urban Heat Island

Look at this picture you will abserve this is temperature and this is how scale of the town is. First is start with rural and then suburban residential and then slowly move on to the commercial and then downtown which is completely highers buildings in industrial sector and then again it's urbeb residential and parks and suburban residentian again rural areas.

When you look at the temperature you will note is there is saden increase as this changes. When there is rural community the temperature is very low because there is no type of emission that's been happening here. And then as you move on as the growth increases the temperature increases. This type of an aspect called urbun heat iland. So, there is an actual temperature of a place is diferent and when there is lot of industrial growth and different economical growth which is happening an specific sector the temperature of that specific locallity its completely different from the sub urban areas, surrounding areas. So, this type of an island which is been created by increasing temperature is what we call it as urban heat island.

Urbanization negatively impacts the environment mainly by the production of pollution, the modification of the physical and chemical pro[erties of the atmosphere, and the covering of the soil surface. Considereing to be a cumulative effect of all these impacts is the Urban Heat Island.

So, as we said before due to industrial growth and urbanization and lot of impact which is been happening on the environment. What is been shown in the previous picture like just for a small community there is lot of temperature difference and heat is been accumuated

because we been emitting lot of different fossil fuels in the form of CO2 which is been trapped within the ozone layer and it increase the temperature of that locality creating a different micro climate compare to the rest of the city. This effect is called urban heat island effect.

When you look at this picture this area is completely different it marked in red. Because the teperature of this area is different and when the formal and surround will be much cooler compared to the area Which is complete developed. This effect is called urban heat island.

Little vegitation or evaporation causes cities to remain warmer than the surrounding country site.

Urban heat island defined as the rise in temperature of any man-made area, resulting in a well-defined, distinct “warm island” among the “cool aed” represent by the lower temperature odfthe area’s nearby naturel landscape.

It is the warm island which is been created because of any human activity or human development that is been made on a specific locality and compare to the rest of the greenary or vegitation of landscaped areas which is surrounding it. The temperature difference in the same area of same climatic zone but there is two temperature is difference because of this type of development that we are doing which is causing this type of effect.

This picture as you seen when there is a tree the temperature goes down because the tree will be emitting lot of moiture content towards the admosphere and heat from the road surface is been emitted out and than vehicles the temperature increases because of the heat from vehicles is also emitted and than here the tempereture we little less compared this zone.

Then sunlight falling is been absorbed all the surfaces and as you see this building will be consuming lot of air conditioning and different human activities which will be also emitting certain type of temperature and leading to temperature increase and heat from the building surface by which we tree the hazard their must be lot of sunlight which is been absorbed and then emitted back. Which will also cause in temperature and when there is a rever the temperature automatically goes down. So, this is the small sectional example in which you can see temperature due to different landscape with a whole city.

**CAUSE OF UHI**

It is well-know that the progressive replacement of natural surfaces by builtsurfaces, through urbanization, constitutes the main caus os UHI formation. Natural surfaces are often composed of vegetation and moisture-trapping soils.

The cause is because of that development we are making. So, without knowing this we are creating increase in temperature we are making this whole urban development on a much bigger scale and then we are again looking at a unit scale for a specific building and we are trying to reduce the temperature. When we are planning at this urban scale the temperature can be maintain very similar to the surrounding natural scapes. Because the natural vegetation which is present in the formal an arround the city will be much lesser temperature because its been absorbing moisture content and the soil is also trapping some type of specific amount of moisture with in it. But when we come to urban cities the presents of vegetation is completely destroy ans also the soil is completely repalced by payment which is absorbing solar radiation and emittng it to the environment.

So, as you see its marked in this picture and different scale of development across this city there is different temperature which is

been increasing which is been radiated because of urban areas to the admosphere. When there is green land it is actually 30 degrees and when it is  urban space it is almost 32 and even up 35. There is lot different between adopting to 35 degree celcious of temperature and for a user to adopt to 30 degree celcious. There is of five degree celcious of heat which is been created just because of this urban heat island effect which we are doing while developing while making the design aspect of the city.

Therefore, they uitilize a relatively large proportion of theabsorbed radiation in the evapo-transpiration process and release water vapour that contributes to cool the air in their vicinity. So, if there is a tree usually traps water moliquls within even within leaf which is why when we stand under a tree we feel much cooler compare to standing under the shade of the building . so, there is a small water content which is been always release to the environment which increases which is transaction process which increases the coolness arround the place. Because of our urbanization this process is been last because of which the temperature eventualy increases.

In contrast, built srfaces are composed of a high percentage of non-reflecive and water –resistent construction materials. So, as we know for different type of building environment that we are creating we are mostly using non reflective surfaces because of which the instand solar radiation which is falling on the building or any type of surface is been absorbed and trapped in and then been emitted out. Which is also causing this type of in urban heat and effect. if we are using more reflective surfaces the instand solar radiation will be mostly reflected back to the environment ratherthan it bee absorbed, trapped in and increasing this temperature.

So, as you see in this image because of the Greenland the grass due to transpiration which is by evaporation transpiration= which is happening due to transpiration + evaporation. This temperature of

the green land is much lesser compare to place which is shown in the next picture. Where there is no vegetation is present.

**EFFECTS OF UHI**

So let's consider a city, the hottest place in great Vancouver area is located in Canada. Surface temperature on this site reached $41.31^{0}$C on July 17, 2004 (10:43 am). Because of covering the payments and because of road construction we are reducing the percentage of green soft abs which present in the city. Which is leaving to the increase in surface temperature when radiation heats in surface temperature increases? Immediately after some time the surface gets heated up when the temperature from the surface is emitted back to the environment. It will increases the temperature which in term causes use a discomfort and we are more preferring to the air conditioning spaces and we cannot even say outside. Even through the add temperature is less the surface temperature is very high.

The same place as above seen by a thermal satellite band. The magenta colour means the warmest place. So, as you see this is a river which is running. There is a lot of development which is happening around the river. Which is leading to urban island effect which shown by this magenta colour which means that area is completely been paved. It has very high temperature compare to with surrounding areas. This is due to urbanisation.

**IMPACTS**

- Hot days & heat wave- health issues.

  So, as we must be also aware of every year almost more than 20 to 30 people are dying due to heat strokes and heat waves. In India, Hyderabad due to lot of radiation and because of this heat island effect which has been affecting them and they completely become dehydrated and the eventually it costs health issues such as heat stroke and fainting and even an death.

- Increases the overall energy consumption of cooling.

  So, imagine when your building is located in such a place. Where the temperature is already very high and there is another building which is been located on a form land which is been surrounded by vegetation and which is not been affected as much the urbanization urbanised area. There will be lot of temperature difference between these two areas on the environment itself. So, for example the temperature of the first scenario is $35^0$C and the temperature of the second scenario is just $30^0$C. The cooling loads set the thermostat set are let say for $28^0$C. Just to achieve this $7^0$C there will be lot of cooling load which been acting on building which intern increase the energy built. And where is when you consider the same thermostat with just $2^0$C difference has been achieved this building which is located in the green land. Because of which it puts less pressure on the compression motor of the air conditioner which reduces the energy eventually.
- Increased green house effect.

  So, as you letting out lot of carbon dioxide it's been trapped within the ozone layer and it cannot be emitted back again. Because of which there will been lot of emissions and it also affects the health of each and individual.
- High night time temperatures – affective human health & lifestyle.

  Even through the add temperature as we know during the night is very less due to the solar radiation because the earth surface urbanised area been absorbed by lot of day radiation during the presents of sun. Which again emitted back during the night? Because of which there is not lot of temperature different even during the day or during night even through the add temperature is very less. We still need the air condition even during the night.

- Heatstroke, heat exhaustion, heat syncope, and heat cramps, are some of the main stress events, while a wide number of diseases may become worse, particularly in the elderly and children.

So, its same as we discuss the different types of health issues which is been elaborated due to the same effect of UHI.

Whatever the solar radiation falling on the earth surface needs to be emitted outside. As you see here when it is water or green land the emission is much higher. But when it is surrounded by urbanised area the absorption and then we are adding of more towards this emission in forms of carbon dioxide.

**WHAT CAN BE DONE?**

What can be done to reduce the effect of urban heat island?

- Community can take a number of steps to reduce the heat island effect, using four main strategies:
    1. Increasing tree and vegetative cover
    2. Creating green roofs (also called “rooftop garden” or “eco-roofs”)
    3. Using cool or green pavements
    4. Installing cool or reflective roofs.

So, when you are making different types of construction or different growth in our urbanised area. We are destroying certain amount of green land and to make a new development in the locality. We must ensure the whatever we will been using is been replaced in forms of say roof top gardens are even on a hazarders green wall which will be same percentage as whatever we have been destroying on the on ground make this type of huge structure. So, by this way even we can create urbanised areas and also create with vegetation which reduces the micro climate effect and not increasing the temperature

of the surrounding island and creating this island is urban heat island effect.

**CASE STUDY**

**BO01, VASTRA HAMMEN MALMO, SWEDEN**

“It’s an internationally leading example of environmental adaptation of a densely built urban area”.

So, it’s an example of sustainability.

**What’s a sustainable community?**

**Sustainable communities:**

“Places where people want to live and will continue to want to live”.

As we saw in the previous presentation it’s not just about protecting the environment or creating money are just about people it’s about all the three keeping all this three in the balance and this is an example which is been created in sweeten. Which is reducing this type of urban heat island and also considering different aspects and different pillars of sustainable development? So, let see how it was,

The Egan reviews, skills for sustainable communities defines seven components that together constitute the goal of a sustainable community are,

1. **Social and cultural**
2. **Governance**
3. **Environmental**
4. **Housing and the built environment**
5. **Transport and connectivity**
6. **Economy**
7. **Service**

First **social and cultural** aspect is the social dimension of sustainable development. The second point the **governance** is to create such policies for the bodies to maintain it’s been keeping tap of all the

three difference dimension of sustainable development. it can be only on a government or edgier policy  in make which will keep which will ensure all this issues will be addressed. And **environmental** protecting the ecosystem the biodiversity of the place and that surrounding locality. **Housing and the built environment**. So, there is no point in creating good urban space than in the built environmental is completely using more heating or cooling. It will again add up to the energy built and even the emission increase. So even we have to consider from each and individual built environment. **Transport and connectivity**. So, your community has been planned in such a way every one can connect to their day to day activities likes going to your school, or going to office is in a commutable distance and it's well connected by public transportation. It reduces the usage of cost and which eventually reduces green house effect. **Economic and services** is the economical dimension of sustainable growth. Which keeps in mile there is enough money which is been to the community and maintain to all the everything is balanced.

The Bo01 housing Estate in the Vastra Hamnen (Western harbour) district of Malmo is the first phases of a long-term development plan for the area. So, this was developed as show of the Harbour. Which is been developed as a first and one of the kind in sweat and it is also set of as an example for different community development on the same basis in and aspect across Europe.

This is the picture of the sustainable community.

Built for the European housing Expo in 2001 as the 'city of tomorrow', the site comprises around 800 apartments and a small number of shops and cafes over 30 hectares. So, initially this was design for a housing expo 2001 as an example for cities for tomorrow. And it is been built with 800 apartments and over different cafeteria as restaurant over 300 hectares of land.

Bo01 aims to be “an internationally leading example of environment adaptation of a densely built urban area” and a demonstration project for our countries. As I said before it been built with an intention to create an example not just across Europe but across the globe to create an encourage people to create such environment and sustainable community for the future

As well as increased biodiversity and recycling of water, resources and waste, the site’s energy requirements are met by 100% local renewable energy sources.

So, even the environmental aspect of sustainable development is been kept in act by keeping 100% of renewable energy resources and everything protect the biodiversity and ecosystem is also been ensured in this community design even from the aspect from the basic design, schematic design itself.

Now, moving on to the master plan.

So, this is the overall master plan. This is the harbour. So, as you see the huge sunk of green and how much over built environment is been created. There is lot of green packets which is present around each development. Here and this is a area where 100% locally renewable energy is been created and this is completely for creating different water system. Here you can see water system, fair and organic and locals, sun, wind and water, circulation. So, all the aspects of environmental sustainability in met in the sector which is been marked in the red square.

**KEY FEATURES**

The site is built on reclaimed, previously developed industrial land thereby helping to protect Sweden’s arable and agricultural land.

This land was initially used by industrial land it is not been used after that and they are chosen an site to give the relief to the whole locality and which will been example so lot land which is been used

by industries and been categorized as non agricultural land. So, this will set an example the future will follow the same and such environments.

So, as you see this is the picture overall community.

The Bo01 master plan helps minimise heat loss from the buildings by placing taller apartment blocks on the outskirts, facing the sea to protect the smaller-scale inner buildings from the cooling effects of the wind.

So, as you see as we know Sweden is most is on a higher latitude location of the globe. There is their will be experiencing more of cold or climates on the prolonged winder season. It's been designed in keeping in mind this type of environmental aspect as well. As you see in this picture low lying areas are kept in the centre and the toll building are move to the outside. So, there is two benefiting aspect for the both scale of buildings are while keeping toll building out cuts it does in hinder solar radiation falling on the taller hazards and it also gives encourages passive solar heating and while keeping the smaller blocks inside within a certain dimension is to make sure there is no colder regions the urban areas become very cold because of the wind pattern and due to pressure difference and stack off it. There is lot of wind stream which is been created. So, that is been avoided because of placing taller building of the outs side and smaller building is the inside of the city.

A 'green space factor' had to be applied to every apartment block and required developers to provide on-plot vegetation such as planet walls or roofs, and surface water courses. Whatever they of lost creating in ground floor for each and every individual block is been replaced vegetation on roof top or green wall or water sources.

When you see this picture which has how the water is been interconnected even within inside the city and amount of greenery surrounding it.

As an energy saving measure across the scheme, a target ‘energy use’ figure for homes was set at less than 105kWh/$m^2$ per year (including household electricity). Before this each and individual block design started. So, the energy builds which will come for each house has been sated limn. The insulation and different property which goes in the design is been kept in mind the amount of internal gains passive solar heating should be used to more and this will meet up to 105kWh/$m^2$ per year.

Rainwater is treated locally at Bo01 through surface run-off systems, without any connection to the community infrastructure i.e. green roofs, channels and dams. So, this was the rainwater is treated.

All waste (e.g. newspaper, packaging, batteries) is sorted and recycled where possible, with waste separation units installed in homes. From even an and individual home it’s has to be aggregated by the user While dumping their waste from different battery use, paper waste, recyclable way. For

Example paper waste can be recyclable and the battery waste which has to be undergrounds some certain chemical process which can be only then it can be reused again. It is been ensured even each home this type of aggregation of waste materials has been made.

**HOUSING AND THE BUILT ENVIRONMENT**

21 different architects were engaged in the design of the neighbourhood, with the aim of creating a high quality environment with an abundance of architecture expressions.

So, this how the city is been builds and while designing it was design by 21 different architects to meet all this aspects of the sustainability development, social economical and environmental aspects.

Bo01 ‘waterfront’ character and distinctiveness is created with the integration of canals, recreation harbours, docks and waterfront promenades. For the sustainable community they do not just restrict

themselves with just with three pillars of sustainable development but they also want to make sure a people are happy and there they want to live in this type of community for which created lot of different architectural styles and different recreation an outdoor space. This will be appreciated by the user.

Urban parks, meeting places and social areas are provided across the site to encourage interaction amongst local residents.

The outdoor spaces associated with each apartment block at Bo01 are kept well managed and maintained, through long-term maintenance programmes established by the developers at the outset of the scheme.

So, as you seen this picture three difference apartments which will be interconnected to this small urban park which is accessible on an everyday basis.

**TRANSPORT AND CONNECTIVITY**

Distance / home working and electronic trade are encouraged in Bo01 through the neighbourhood communications networking including broadband information.

While the car is recognised as an important from of transport and is accommodated in underground car parks, pedestrians and cyclists have priority access across the neighbourhood. A regular local bus service also connects the area to the city centre.

This is the aspect in which the first we saw the seven key features which makes the sustainable community. This is how the transport and service been met in the Bo01 priority is been given pedestrian and cyclist mainly and car parking is also given in the ground floor, but mostly priority is given for public transportation.