

Course Name: Architectural Approaches to Decarbonization of Buildings

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Week: 06

Lecture 01

Settlement planning principles for carbon neutrality

Hello students. So last class we had seen about how to have green practices at a planning level, at a building level as well as at a small campus or settlement level. To ensure that we give appropriate openings, we place the buildings in such a way that we do not cause too many wind shadow regions. We facilitate cross ventilation and how do we position high rise buildings? Do you want movement at the air movement at the ground level or you want to avoid air movement at the ground level? We had seen all of this and we had also seen at a planning level what are the basic things we have to consider. We will continue with it at a planning level. Now integrating urban greenery.

Urban greenery means it should include parks, green spaces, tot lots, playgrounds into spatial planning enhances not only the aesthetics of the place but it provides a natural cooling effect and contributes to better outdoor thermal comfort. We need that kind of lung spaces in our settlements. Additionally, encouraging green roofs and walls in building design improves insulation it mitigates the impact of urban heat island effect again a new terminology you are learning now because roofs can radiate a lot of heat whereas having cool roofs will absorb because there is vegetation on a cool roof. It will absorb the radiation and not radiate the heat back and hence it reduces the impact of urban heat island effect and it offers benefits such as thermal regulation, improved air quality and sustainable storm water management.

The combination of all these strategies supports sustainable urban development. It creates aesthetically pleasing, environmentally friendly and comfortable urban environments. Collaboration amongst urban planners, architects, authorities and communities is crucial for the successful implementation of these initiatives and you have to have adequate open spaces. So, your outdoors are green because of which short wave and long wave radiation get blocked by the plant canopy. And less heat is absorbed by building and ground surfaces because this greenery on the wall is insulating the house. This greenery is preventing the solar radiation from hitting the wall. And you will have lower surface temperature if you have sufficient ground covers and you will have lower

air temperature if you have sufficient shrubs. The evapotranspiration increases latent heat flux and decreases sensible heat flux. It lowers surface temperature for canopy and turf and it lowers air temperature.

This roof garden aids in many ways. See, you should understand that there is direct shortwave radiation and there is reflected shortwave radiation. You have direct longwave radiation and reflected longwave radiation. The building can get insulated from all of these if it has a lot of vegetation. Less heat is absorbed by canopy, lower canopy temperature and less long wave transmission.

Having cool roofs, if you have multiple cool roofs, radiation is absorbed by the plants and it does not percolate inside the house. If you do not have, say for example, if you do not have a green roof, then what happens is the radiation is reflected. Multiple reflections happen, adjacent buildings it gets reflected. And then it gets reflected on the ground and so on and so forth. When all the buildings do that, the roads and the grounds become very warm and hot.

In a particular area, if all the roads reflect this, especially this happens in the evenings because during the day these roads also absorb a lot of temperature. To reduce this impact, we must have cool roofs. So, cool roofs are another strategy that we can adopt not only for insulation of the building, but also to protect the entire settlement. Promoting mixed use zoning is a strategy to reduce commuting distances, as against having exclusive land use policy. What do you mean by exclusive land use policy? When you have a master plan, if you have a policy which says that this is completely residential, this area, this is say residences, this is entertainment. This is office or work and this is school you have amenities And these are sports facilities. If you have exclusive land use, then it is found that there is a lot of transportation and movement from one zone to another even for basic things. Say to get a small product or a small say even vegetables on a day-to-day basis, people have to commute long distances. If you want to reduce this commutation, why must we reduce this commutation? Because having too much commutation entails vehicular movement and vehicles you know emit a lot of GHG.

And it is also found that exclusive land use demarcation doesn't really work, especially in the Indian situation because we are not grown up with that. We always have a small shop, a shanty shop at the end of our street. The puncture shop is there. There is the ironwala (Presser) somewhere very close to our house and that is how it works. But if you start having a planned settlement with exclusive land use, then it entails a lot of movement.

And also its posters are very because of the transportation you do not have pedestrian

friendly communities and so on and so forth. If you want to avoid that, you must reduce commuting distances, make your settlement more walkable and you should plan to foster vibrant, sustainable communities. This involves planning for a blend of residential, commercial, recreational, educational, health facility in close proximity. Inclusive planning as part of this approach aims to minimize the need for transportation and create a diverse urban environment. The synergy between mixed-use zoning and inclusive planning contributes to more sustainable, walkable and socially dynamic communities.

This strategy aligns with principles of smart growth and encourages collaboration among urban planners, developers, and the community to enhance the overall livability of urban areas now transportation planning it's a strategy that involves prioritizing the development of efficient public transportation systems and planning for pedestrianizing and cycling infrastructure Emphasizing public transit aims to reduce reliance on private vehicles, addressing issues such as traffic congestion and environmental impact. Simultaneously, the focus on pedestrian and cycling infrastructure promotes sustainable and healthy modes of transport, contributing to improved public health, reduced air pollution, enhanced community interaction, enhancing community livability. The integration of both strategies supports a comprehensive approach to creating efficient, sustainable and people centric urban transportation system. Of these, when there is a need for a very fast or long distance public transportation, the way out is Mass transit systems. Mass transit systems entail things like what we call as the metro rail, trams, and public buses.

And we must prioritize the development of efficient public transportation system and reduce the reliance on private vehicles. Then this is at a larger city level or this is at a larger what shall I say at a between two settlements. Within a settlement, within a neighborhood more emphasis must be. So, this is would say between neighborhoods between neighborhoods within the neighborhood we need to create more pedestrian friendly planning. We also need to create cycling and if at all we have to have vehicular vehicular transport it must be based on green energy.

And what is green energy vehicular transport? With electric vehicles. So, we must encourage electric vehicles. So, these are very important strategies to create a low carbon settlement. We are not touching on low carbon settlements in much greater detail now. We are looking only at basics.

As the class moves, we could probably do it. So, integrating public transport between neighbourhoods and focusing on pedestrian and cycling infrastructure and battery operated vehicles or electric vehicles within the settlement will ensure that we have a Now another important dimension we need to look at is water management. Now how do

you implement sustainable water management strategies? We can implement sustainable water management strategies by first is rain water harvesting. We need to harvest the rain water which can happen in two ways. One is we can collect the rain water and use the rain water.

So, we can do rain water harvesting and that can happen through collection of rainwater or directing the rainwater to pits and therefore it recharges the aquifer. Then we can also have other strategies can include having permeable places. Your surfaces can be permeable instead of having surfaces through which water cannot seep inside. You can have surfaces which are made up of permeable materials and then you must reduce Very very important.

Reduce water consumption. How do you do that? How do you reduce water consumption? First is- be aware. So bring in a lifestyle change which we had discussed earlier also. Next is use fixtures which are which consume less water. Now, imagine a commercial building or a office building or an institution building. If we are able to have fixtures, say water fixtures, or if we are able to have urinals which require very very little water. And if we have flush tanks which require very little water for flushing the cistern, a lot of water can be saved in this manner.

And then we need to manage the storm water runoff. Besides, we must also focus on water flow. Treatment. So, treatment of water is very important and how do you strategize recycling of this water and reuse of treated water? So water, waste water can be classified as grey, grey water, brown water and black water. Grey water is all the water that comes from the kitchen sink and the wash basins.

The brown water is all the water that comes from surface runoff. And the black water comes from the WC or the closets from the toilets. All these three water must be separately they must be stored and they must be treated and it should be reused. Because water as a precious commodity should not be wasted and if you look at large housing complexes you can imagine the humongous amount of water and waste that we can get which we could always recycle and again put it back into the system circularly.

This diagram depicts so. It shows that there is a rooftop terrace which is going to aid in the urban heat island dissipation. There is segregation of water from the WC or from the closet. The water goes, gets stored and probably gets treated. It's grey water which comes from the wash basin and the bathroom which again is collected and treated and this water goes for the trees or watering the plants and trees and here you can see permeable surfaces, permeable surfaces and here you have a rain water collection pit from which gets treated and the water is stored. So, you have rain water harvesting and recycling and

you have rain gardens, you have grey water collection and sedimentation system and phytoremediation systems which is also called as root zone treatment.

So, this is the green-blue infrastructure. We should also have a plan for preservation of natural habitats and biodiversity inside within the urban areas. So, climate responsive design considers a design to address regional climate conditions incorporating strategies for extreme temperature, humidity and precipitation. Now thermal comfort in a climate responsive design aims to enhance thermal comfort by incorporating features such as shading, insulation and natural ventilation by adapting to extreme temperatures. Energy efficiency- We try to achieve it by designing buildings and infrastructure in alignment with the regional climate which reduces the reliance on mechanical heating or cooling systems thus promoting energy efficiency.

Resilience by considering the local climate designs become more resilient to extreme weather events contributing to long-term sustainability. Microclimate planning must not be neglected and we analyze and plan for microclimate within the urban environment understanding how the built environment influences local weather conditions. Urban heat island mitigation can be called as understanding and planning for microclimates which allows for strategies to mitigate the urban heat island effect where urban areas experience much higher temperature than the rural surroundings. Wind flow management can be addressed by analyzing microclimate which help in managing wind flow, optimizing natural ventilation and reducing wind induced discomfort in specific areas. Optimized planning is the key which has knowledge of microclimate aids in strategically placing vegetation to maximize their cooling effects and contributes to urban greenery.

And so it becomes important for us as architects and planners to not look at buildings in an isolated manner alone, but also look at buildings as part of the system and holistically look at what can be done for a particular building when there is an adjacent building. To say that there is an opening, provide an opening for wind to come is a very isolated way of understanding the situation. But to understand that there is an adjacent building which will influence air movement and which is the reality. And that is why I have included this unit in between so that at every stage you understand that even though we talk of impact of one factor or element on the building actually the impact is compounded by adjacent buildings too. With this understanding, I will close today's lecture and we will continue again for a new topic.