CLIMATE & BUILT ENVIRONMENT

Lecture 9

Climate

Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count in a given area over long period of time, says 30 years.

In a place whatever happens for 30 years is called as climate. Summer are usually supposed to be hotter, falls during April to August in a place like Chennai and then monsoon starts from later of August and prevails till September or October that is monsoon period this changes from region to region to simply put climate is what we expect and weather is what we get. Weather is what changes that happen on a day to day basis even during the summer month there might be few rainy days and those changes due to weather conditions. That is why we call it as a weather report that we hear it in the every day morning. A climatic condition is the seasonal variation that happens over all longer period.

The climate of a place is dependent on its longitude, latitude, location and if how much it is been elevated from sea level and the presence of water bodies that is presented around the location and prevailing wind direction and the speed of the wind current, so all this goes into making a climatic of a place.

Worldwide climate classifications:

We have different climatic conditions in the world. What we are going to concentrate now is

Classification of climate:

The tropical regions of earth are divided into three major climatic zones:-

- Warm and humid equatorial climate.
- Hot dry desert climate.
- Composite or monsoon climate.

Now, we are going to explain about warm and humid equatorial climate.

Warm and Humid Climate:

The space in which the temperature is higher as well as the presence of relative humidity or the moisture content in the given air is also higher so this type of climatic condition is classified as warm and humid climatic conditions.

As the equator passes through above the equator of 15(degrees) towards the north and below 15(degrees) from the equator to the south the belt that forms in between 15(degree) above the equator and below the equator is where usually warm and humid climatic conditions happens.

There is very less seasonal variation throughout the year.

Example – Colombo, Singapore, Hawaii, Malaysia etc. Are typical examples of warm and humid climatic conditions.

Typically how it looks, it has good amount of vegetation and warmer air temperatures and also good amount of water bodies present and the cloud cover is high.

These are all the typical examples of warm and humid climatic conditions.

Reasons for warm and humid climate:

As we saw how land and wind breeze has been created in our previous presentation this is due to the presence of huge amount of water bodies close to land which is creating are increasing the humidity content in the air. Because of this the temperature is also high and the humidity is also high due to the presence of water bodies and due to the location closer to the sun. Which increases the air temperature and also the humidity because of the combination of these two is warm and humid climatic condition is basically created.

It is the same the air that is present above the land is going to get heated up faster compared to the air that is present above the water bodies, because of which the air is going to start gets moving because of two pressure zone that is been created.

Due to the movement of air from the high pressure zone that is above the land and the low pressure zone that is above the sea or water bodies. This starts to increase air temperature and as well as the moisture content the air which is resulting in the warm and humid climate.

Climate and Architecture:

When you see this type of climatic conditions, we do not have much of diurnal variation the difference between morning temperature and the night temperature is not more than 10(degree Celsius) and also seasonal variation is very less. Only thing that changes is hotter days and your monsoon days and the prevailing wind directions. So you need to come out with the design which can be adapted according to the human needs so when the prevailing wind direction is on say you need to keep open on the northern east side which can be used for 6months of the year and you need to keep opening on the eastern west side also when the wind directions changes the people can start to move their living spaces from this corner to the other end so which will be beneficial and people will start to reduce the usage of any other conventional energy sources or depending on the air conditioning systems.

This is the climatic conditions of India and we have hot and dry warm and humid composite temperate and cold climates. So this was warm and humid climate happens. Basically for temperature during day its between 27(degree Celsius) 32(degree Celsius) and night time it’s between 21(degree Celsius) and 27(degree Celsius) as we noticed here is the difference between the day temperature and night temperature is roughly closed 10(degree Celsius) and humidity, relative humidity remains high, 75percent for most of the time, but vary from 55percent to almost 100percent. Due to presence of high amount of water bodies around our land. As we all know that we are completely by sea or water bodies because of which the humidity that is present in this area is also high it can go up to 100 percentages from 55 percentages. Typically Goa, Mumbai, Vishakhapatnam, Thiruvananthapuram, Chennai, Kolkata, Puri and Tripura are some of the typical examples. In India, which is experiencing warm and humid climatic conditions.

Hot and Humid Climate:

The difference between warm and humid climate and hot and humid climate is just that the temperature in the locations where it can raise above 36(degree Celsius) can be classified into

hot and humid climatic conditions. Whereas the regions in which it is going to have the same climatic conditions just that the temperature is going to be within 36 (degree Celsius) is going to be classified as warm and humid climatic conditions. But the architectural implications are modifications that has to be done in your fazards are build form for both the climates are going to be the same that is for warm and humid climate as well as hot and humid climate.

Cross – ventilation is hence very essential here. Adequate shading measures are also necessary to protect the building from direct solar radiation.

General Recommendations for Building

First Site. Landform – For flat sites, design considerations for the landform is immaterial. In case of slopes and depressions, the building should be located on the windward side or crest to take advantage of cool breezes.

As we just heard the humidity level that is present air is very high because if there is lack of wind movement across the room or across your skin conditions you're going to sweat more. To avoid this kind of situation and to improve you're psychological cooling effect you need locate your buildings in such a way you're paying advantage of the prevailing wind direction as the wind starts to move across your body you will automatically starts reducing sweating rates, which is going to reduce your cooling effect almost 2/4 to 5(degree Celsius) even though the air temperature is the same.

In the sample image the prevailing wind direction and they kept openings everywhere in the buildings. The wind that is coming in and hitting the building is going to be carried through the building and move all the spaces and it is going out. The hot air will raise above and has been taken cared by the two vents that is been provided and also the floor has been elevated from the existing ground level a small air gap has been provided the hot air that going to be accumulated in the centre is also going to be escaped due to the pores nature of the structure. So you need to have your structure in such a way. The cross ventilation can happen throughout your building not just one room are one corner of the building.

Water bodies: As we saw the presence water body can actually increase the presence of relative humidity but reduce the air temperature in climatic conditions such as warm and humid climates the presence of water body might further elevate your relative humidity and it might cause discomfort. Since reduction in humidity levels become crucial you can avoid usage of water bodies directly closed to your sight because it will further increase your relative humidity and discomfort for the occupants.

Street width and orientation: For designing a location in which the air temperature is less only the relative humidity is high we need to orient your buildings parallel 30(degrees) towards your prevailing winds because of which the humidity levels will be controlled because of the air movements through the gaps that is present between your building blocks. But if you're designing for places in which the temperature is going to be very much higher and the relative humidity is also higher you need to first block your sun by keeping narrower street width and narrower opening.

Say for example we must have noticed street planning of Mumbai which is very close to each other even though it is a warm and humid climatic condition the solar radiation level is very high to block the instant solar radiation levels the street width is been made very small so that

the streets can be much more cooler compared to keeping it further away. So this encourages psychological cooling effects.

As we see your prevailing wind direction can kept parallel to 30 (degrees) just need to reduce your humidity levels.

Open spaces and built form: Providing tilt floors only beneficial because of the pores nature the air that is going to be prevailing winds that is going to hit the building is going to get circulated throughout the open space and its gone to move on to the other side of the building because of the pressure difference that has been created . So this can be beneficial when you need to cool your ground floors.

As we see here your open spaces and built form has to be in such a way the humidity level as well as instant solar radiation has been reduced

Orientation an platform: Keeping a built form on a much narrower sight is much more beneficial for this type of climate because when the wind is made to blow.

Imagine if you're having a huge blow of construction and your wind is blown inside the wind can hit smaller part of the building. It cannot go throughout your building if you're having smaller building width, the wind can go inside to all the spaces and it can cool your interior spaces. Whereas if your keeping doubly loaded corridors, say if you're having room on one side and then again a corridor and then again a room and then again a corridor the possibility or the chance of wind to come throughout the building is very less. Compared to singly loaded corridor, where the air starts to enter through the corridor due to its protection from the direct sunlight due to the projected eves the temperature is going to be the further less and then the cooler has going to get starts to circulate into your interior spaces which is much more beneficial compared to the previous option. As we see here if it is doubly loaded corridor and your sun is going to move from left to right if you're keeping in this orientation of your shorter section facing towards north, then your longer section being east and west going to get exposed are its going to get observed more of instant solar radiation where as if your orienting a building in such a way longer section facing towards north and south it reduces the higher solar radiation which is on the east and the west. So orienting the building is much more beneficial compared to this type of design and also keeping singly loaded corridor or keeping your building with in restricted dimension is more beneficial.

The spaces like kitchen and bathrooms is going to produce lot of heat energy. If you're keeping all this very close to living spaces say bedroom or living room the heat that is in higher temperature which is been produced in your kitchen is going to move towards your living room and its going to start air temperature of your living room as well. Zoning this little far away from each other is going to reduce this transmission of heat from the kitchen or hotter zone towards a cooler zone which is a living area. You need to ideally separate these two spaces.

As we see here this is the typical example, your living spaces is located here which is been surrounded by vegetation and your kitchen and bath is separated further by this small corridor which is present here and this is your kitchen and bath area which is also further the temperature has been reduced by the presence of vegetation.

You can provide a good amount of balconies or outdoor spaces since the movement of air becomes very much essential more than reducing your temperature you need to keep your occupants much closer to the outdoors spaces, say if your providing in this picture huge amount

of roof space has been projected and your platform has been projected outside so all your day time activity can happen here, due to the presence of the eve spaces the instance solar radiation is going to get cut down due to the projections and your outdoor spaces going to be much cooler and a wind also move across your body which is going to make you feel much more comfortable. The same way this has to be adopted for your interior spaces also to make the wind to move from one prevailing wind direction point to the entire house and take out the hotter outside.

Building Envelope

Roof: In addition to providing shelter from rain and heat, the form of the roof should be planned to promote air flow. Vents at the roof top effectively induce ventilation and draw hot air out. We need to be very much aware of locations in which warm and humid climate usually happens the sun is usually very high which means roof is the portion which is going to get more of instant solar radiation. Your roof is one which is going to get exposed to sun rays always. So the designing of the roof becomes very much essential. Roof does not only provide protection from sun and heat but it also able to take out your hot air outside so that cool air will start to come inside and we will feel much more comfortable.

As we see here there are small opening suggestions that can be done depending on your structure to take out hot air out side.

If you're designing a space which is not going to have any air conditioning then providing insulation is not going to have any type of temperature difference are it is not going to help in elevating in your comfort condition. But your roof is going for asbestos sheet or a metal sheet which is going to absorb lot of instant solar radiation and its going to trap in. Then the heat that is trapped in your roof is going to get circulated inside, in those conditions you need to have small or very thin insulation to avoid the heat transfer that happens from the roof to your structures. And also you can look at having ventilation between your roofs spaces so the instant solar radiation get diverted outside or is should get reflected outside.

For example, if you look at the image actual building has been protected by an over case of vegetation so the instant solar radiation that is actually falling on the vegetation is not going to get affected inside. Actually it is going to cooler the space much more compared to the one without vegetation and the instant solar radiation that is falling on the first roof is going to get reflected and your roof that is the inner is going to get protected from with no solar radiation. So going for double roof is much more effective or beneficial in this climate. It can even reduce your room temperature up to 10 to 15 (degree Celsius).

Walls: As we saw in our earlier presentation if your prevailing wind direction is not beneficial in design you can create wing walls and baffle walls or even simple vegetation to divert your wind from outside to your interior spaces. So these are some of the examples again. How your architecture can be modified to take in the prevailing winds to the interior spaces.

Fenestration: Since air movement is very much essential your building should not be designed only for the air to come inside to one room it has to be made sure that air which comes inside from your wind direction or your wind ward side of your building is been circulated throughout your building and is been taken out towards a leeward side of the building. So keeping a smaller opening on your wind ward side or the prevailing wind direction and keeping the higher opening on the lee ward side or negative pressure zone can enhance the wind speed by the effect of plumb effect which is the venture effect in which we just saw how the wind is

been passed through and due to the presence of narrow opening the wind speed starts to get increase, the same way which can be applied for buildings in warm and humid climates

Different types of cross ventilation systems providing this type of systems aperture can be set in two different or opposite or adjacent wall it is much more beneficial for the air movement happen throughout the building or the room.

Ventilation: Window type for good air flow. How your hot air has to be escaped is also at most importance same as bringing in the cold air inside. This is keeping a smaller opening by louvres which is going to create a plumb effect here so the air is going to start move here and the air speed is going get increased here and due to the presence of huge opening the hot air is going to get escaped outside.

Extra ventilating devices used for proper air circulation

- Wind traps.
- Rotary vents.
- Ceiling fans.
  For this type of climatic conditions.

Building Planning: As we see in this plan, this is your verandah on both sides and the building plan is been restricted to only one room or one side. The wind it's going to come inside and it's going to escape outside. This is been surrounded by huge amount of vegetation and also the width of the overall plan is been reduced and it's been taken advantage of the prevailing wind direction. The larger side is facing towards the northern side.

Materials: Lighter construction is much more beneficial for this type of climate. Examples Timber house, Fibro house.

Colour and Texture:

- The walls should be painted with light whitewashed, while the surface of the roof can be broken glazed tile to reflect the sun back to the environment.
- This is the typical example of colour that can be used.
- Boundary fences should not block airflow.
- Make sure to block the summer breezes.
- Spacing of buildings should be carefully considered to avoid obstruction of wind.

Case study of Kerala:

Wind:

1. Winds have westerly component during the day and easterly components during the night throughout the year.
2. In general winds are quite strong during daytime when thermal circulation is best developed and weak during night.

- Humidity-
  Relative humidity ranges from 53%to 72% during the hot weather season.
  It is about 85% or above during the monsoon season.
- Even the rainfalls are high
- Average annual rainfall-

Receives an average rainfall of 3300mm.

This type of roof can be used to flow down your rain water.

The hot and cold breezes maintain the temperature because of the presence of good amount of vegetation and water body.

This type of projected eves can be used to benefit or block the solar radiation directly falling on the building, Use deciduous trees. Again how to have cross- ventilation some of the examples that is usually found in Kerala houses.

As we see here lots of roof that is happening and that's been projected over at each other to protect the lower roof and the upper roof receives all the solar radiation and it does not affect the inner temperature.