MODULE II

HABITAT TECHNOLOGY

climatology

Climatology: - The branch of atmospheric science concerned with both the description of climate and the analysis of the causes of climatic changes and their practical consequences. - Scientifically defined as weather conditions averaged over a period of time. -Climatologists study both the nature of climates (local, regional or global) and the natural or human-induced factors that cause climate to change. - Climatology considers the past and help to predict future climate changes

CLIMATE & WEATHER

 Weather – Weather describes whatever is happening outdoors in a given place at a given time - It can change a lot within a very short time. For example, it may rain for an hour and then become sunny and clear. - It includes daily changes in precipitation, pressure, temperature, wind etc., in a given location - More specifically, weather is the mix of events that happen each day in our atmosphere. - The weather isn't the same all around the world. Weather is different in different parts of the world and changes over minutes, hours, days, and weeks

Climate – Whereas weather refers to short-term changes in the atmosphere, climate describes what the weather is like over a long period of time in a specific area. - It is the average weather pattern in a place over a long period of time (many years) - This includes average weather conditions, regular weather sequences (like Summer, Winter, Rainy) and special weather events (like cyclones and floods). - Different regions can have different climates

FACTORS SHAPING CLIMATE

- ► Solar Radiation (Quality & Quantity)
- Earth's Thermal Balance
- Insolation
- Temperature
- Humidity & Precipitation
- Wind
- Vegetation
- Urban heat island

Koeppen climate classification

- ► Koeppen's Classification of climate is the most commonly used classification of climate.
- ► This climate classification scheme was developed by Wladimir Peter Koeppen in 1884.
- ► He recognized a close relationship between the distribution of vegetation and climate.
- ► The categories are based on the data of annual and monthly averages of temperature and precipitation.
- ► He selected specific values of temperature and precipitation and related them to the distribution of vegetation and used these values for classifying the climates.

- ► The Koeppen climate classification system recognizes five major climatic types and each type is designated by a capital letter- A, B, C, D, E, and H.
- ► The seasons of dryness are indicated by the small letters: f, m, w, and s.
 - ▶ f -no dry season
 - m Monsoon climate
 - w- Winter dry season
 - s Summer dry season
- ► The small letters a, b, c, and d refer to the degree of severity of temperature.

List of climatic groups and their characteristics according to Koeppen

Group	Characteristics
A- Tropical	The average temperature of the coldest month is 18° C or higher
B- Dry Climates	Potential evaporation exceeds precipitation
C- Warm Temperate	The average temperature of the coldest month of the (Mid-latitude) climates years is higher than minus 3°C but below 18°C
D- Cold Snow forest	The average temperature of the coldest month is minus 3° C or below
E- Cold Climates	Cold Climates Average temperature for all months is below 10° C
H- Highlands	Cold due to elevation

MICRO & MACRO CLIMATE

- ► The climate of the earth consists of a series of interlinked physical systems powered by the sun.
- Macro-climate the climate of a larger area such as a region or a country
- Micro-climate the variations in localized climate around a building
- ► The macro and micro climate has a very important effect on both the energy performance and environmental performance of buildings, both in the heating season and in summer.

Factors affecting site climate/micro climate

Air Temperature

Humidity

Air movement

Vegetation

Urban heat island

Air Temperature

- ► The air temperature near the ground is dependent on heat gained/lost by the earth surface.
- ► Heat exchange varies with day/night, season, time of the year, latitude and cloud cover.
- During the day, with the heating of the earth surface, the air nearest to the ground (within 2 meters) gains most temperature. At night, the direction of heat flow is reversed

Humidity

- ► Relative humidity is inversely proportional to temperature.
- During the day, when the lowest layer of air is heated by the ground surface, relative humidity decreases rapidly.
- ► This leads to higher rate of evaporation (If there is water body, vegetation, etc.) leading to increase in absolute humidity.
- At night, when dew point temperature is reached, fog formation takes place and if there is no further rapid cooling or air movement, a deep layer of fog develops

Air movement

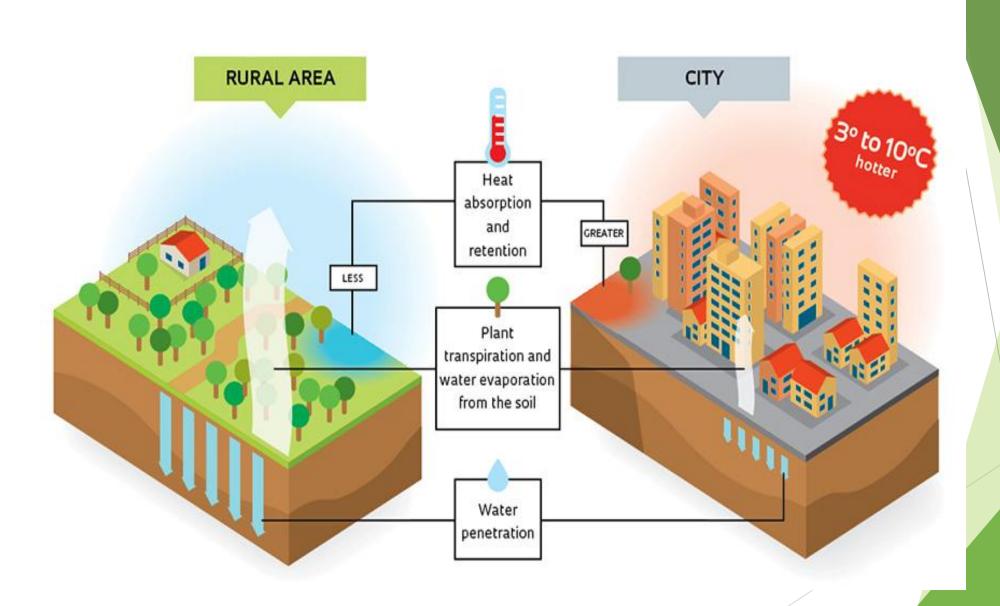
- Air flowing across any surface is subjected to frictional forces. Wind speed near the ground is less than the speed higher up and their difference depends on the smoothness of the surface.
- ➤ On hilly sites, the greatest speeds are experienced at the crest of the hills. The valleys may experience wind speed if their direction coincides wit the direction of the wind flow.
- ► Large bodies of water modifies local temperatures

Vegetation

- ▶ It influence the local or site climate.
- Forming an intermediate layer between the earth surface and the atmosphere, they have a moderating effect on air temperature, humidity, radiation and air movement.
- ▶ Trees provide shade and affect the micro climate of the place.
- Trees and shrubs give off moisture (evapotranspiration) that increase humidity
- Ground Cover Trees, shrubs and grasses provide shade that prevents moisture from evaporating.
- Permeable surfaces reduce temperatures through evaporative cooling.

Urban heat island

- An urban heat island is an urban area that is significantly warmer than its surrounding rural areas due to human activities.
- The temperature difference is usually larger at night than during the day, and is most apparent when winds are weak.



- The heat is trapped on lower levels, the temperature is warmer.
- ► Urban heat islands can have worse air and water quality than their rural neighbors.
- ► UHIs often have lower air quality because there are more pollutants (waste products from vehicles, industry, and people) being pumped into the air.

Elements of climate

- ► Temperature
- ► Humidity
- Precipitation
- ► Radiation
- Wind

- Temperature The atmosphere is heated in two ways; by direct absorption of solar radiation and by the absorption of heat from the earth surface.
 When the lower layers of the air are heated its
 - When the lower layers of the air are heated its density decreases and this layer of the air risesup.
 - The resulting vertical convection current carry heat to the upper layers of the atmosphere. The ocean currents and the direction of prevailing winds in an area is an important factor in air temperature variation

► Humidity & Precipitation – Atmospheric humidity is the amount of water vapour or moisture in the air. - Abosolute humidity is defined as the amount of water vapour to be found in air for any given time and is expressed in g/m3 of air. - A major factor influencing abosolute humidity is temperature. - Precipitation occurs due to the condensation of the water vapour in the atmosphere and it includes rainfall, snowfall, drizzle etc.

▶ Wind – Wind is the movement of air masses in horizontal direction – The wind speed is expressed in m/sec – A difference in temperature causes a difference in pressure. – Equillibrium of pressure is the basic principle of wind movement. Air moves from high pressure areas to low pressure areas inorder to establish a state of relative equillibrium which resuls in wind Solar Radiation - Quality - Radiation means to send out rays - Solar radiation is radiant energy emitted by the sun from a nuclear fusion reaction that creates electromagnetic energy. - It provides light and heat for the Earth and energy for photosynthesis. - This radiant energy is necessary for the metabolism of the environment and its inhabitants - Solar radiation spectrum extends from 290nm to 2300nm. - The three relevant bands along the solar radiation spectrum are ultraviolet rays, visible light and infrared rays

Solar Radiation - Quality - The three relevant bands along the solar radiation spectrum are ultraviolet rays, visible light and infrared rays. • Ultraviolet radiation: 290nm to 380nm • Visible light: 380nm to 700nm • Infrared radiation: 700nm to 2300nm - Most of the solar radiation that reaches Earth is made up of visible and infrared light. Only a small amount of ultraviolet radiation reaches the surface. - Not all radiation emitted from the sun reaches Earth's surface. Much of it is absorbed, reflected or scattered in the atmosphere. - The amount and intensity of solar radiation that a location or body of water receives depends on a variety of factors such as latitude, season, time of day, cloud cover and altitude.

Solar Radiation - Quantity - Solar radiation is measured in wavelengths or frequency. - As light travels in a wave, a wavelength is defined as the distance from peak to peak and is measured in nanometers (nm). - Frequency is defined as wavelength cycles per second and is expressed in hertz (Hz). Bands with shorter wavelengths produce higher frequencies. - The energy of the wavelength increases with the frequency and decreases with the size of the wavelength. In other words, shorter wavelengths are more energetic than longer ones.

▶ Solar Radiation - Quantity - The quantity of solar heat transmitted in one minute to one square cm of earth surface normal to the sun rays beyond the earth atmosphere is defined as solar constant which is approximately 2 cal per sq cm per minute. - Most of this radiation is perceived as heat and only a small part as visible light

Climatic zones in india

▶ The term climate is meant to describe the average weather of a location over decades. And climate zones are categories of climate that scientists have created. The origin of the categories date back to a German scientist named Wladimir Koppen who created and named his climate zones based on variables like temperature, latitude, annual precipitation, and the time of year when the precipitation fell. In the modern day, climate zones are usually separated into five types: tropical, dry, moderate, continental, and polar.

Climatic zones in india

- Climate zones are categories that scientists created based on regional long-term weather averages.
- ► The five major climate zones include tropical (humid and hot), dry (very little precipitation), moderate (warm and humid in the summer with mild winters), continental (warm summers along with very cold winters), and polar (the coldest of all).
- Where is a tropical climate?
- Tropical climate zones can be found near the equator all over the world. But one famous example is the Amazon rainforest in Brazil.

Tropical Climate: Definition & Examples

Tropical climates are usually divided into three subtypes:

- ► Wet tropical,
- ► Tropical wet dry,
- ► Tropical monsoon.

Wet tropical,

► The wet tropical climate is the tropical rainforest. Over 60 inches of rain per year and warm temperatures make this a breeding ground for biodiversity. This climate exists as a band around the Equator, with rainforests in Asia, Africa, the Caribbean, and South America.

Tropical wet dry

► Although we might associate tropical with wet, not all tropical biomes follow this weather pattern. The African Serengeti is a tropical wet dry climate. This climate has three distinct seasons: cool and dry, hot and dry, and hot and wet. Climate influences animal life tremendously. During the great migration in Africa, over a million wildebeests follow a migration loop through the Serengeti at the end of the rainy season each year in search of food.

Tropical monsoon

No climate can be more dichotomous than the tropical monsoon climates, particularly the striking Okavango Delta in Western Africa. This area is a hot, dry desert for part of the year; wildlife struggle to find food and water. But once a year the area experiences heavy rains and turns into a flooded grassland. Rivers form, and life flourishes in a way that looks unrecognizable from the earlier desert-like conditions.

SUN PATH DIAGRAM / SOLAR CHART

- Sun path diagrams can tell you a lot about how the sun will impact your site and building throughout the year.
- Stereographic sun path diagrams can be used to read the solar azimuth and altitude for a given location.

HUMAN COMFORT IN BUILDING

► Factors affecting comfort in buildings include; personal factors, health and wellbeing, thermal comfort, indoor air quality, visual comfort, noise nuisance and ergonomics

THERMAL COMFORT

- Human thermal comfort is defined as a condition of mind, which expresses satisfaction with the surrounding environment.
- ► High temperatures and humidity provide discomfort sensations and sometimes heat stress (i.e., reducing the body's ability to cool itself).

INDICES OF THERMAL COMFORT

- Research was carried out to find out if people felt comfortable in different conditions and this was used to develop equations that would predict comfort.
- ► The equations take into account; air temperature, mean radiant temperature, air movement, humidity, clothing and activity level.
- ► Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation

- ► Thermal comfort refers to the subjective feeling of temperature in an environment.
- Optimum levels of thermal comfort helps in maximizing productivity.
- Measurement of thermal comfort levels are complex and many indices have been proposed over the years.

THERMAL COMFORT SCALE

- ► A single scale which combines the effects of various thermal comfort factors (such as air temperature, humidity, air movement and radiation) is called a THERMAL INDEX or COMFORT SCALE,
- ► The designer has to handle four such factors to understand the effect of climatic conditions on the body's heat dissipation process.
- ► The factors: Air, temperature, Humidity, Air movement, Radiation, Subjective factors.

- ► To create such a scale, experiments were done in specially built rooms where climatic conditions could be produced.
- ► The subjects were placed in the room and were asked to fill questionnaires after each variation in the conditions according to a set scale ranging from 'very hot' to 'very cold'.
- ► The answers were then evaluated statistically and plotted on agraph to find relationship among the factors.
- ► At least 30 or more scales were devised in this process.

NATURAL VENTILATION&ARTIFICIAL VENTILATION

Natural ventilation is an airflow through openings, such as windows or doors, induced by a pressure difference between inside and outside the building. Mechanical ventilation is an airflow controlled by specific devices.

FUNCTIONS OF VENTILATION

- Control impurities
- Air regulation
- Stop condensation
- Reduce temperatures
- Health benefits

Control impurities

You may think that the air quality where you live isn't great, especially if you live in a bustling city centre, but in many cases, the air inside can be more polluted than the air outside. A good ventilation system will help expel a build-up of pollutants, bacteria, moisture and unpleasant odours, such as body odour.

Air regulation

Unless you have a good ventilation system in place, you have no control of the air flow in your building. Too much fresh air can mean costly energy bills, which is why good ventilation helps control the air, while regulating to the required health and safety levels.

Stop condensation

Condensation can lead to mould and rotten surfaces - which, naturally, is something you would want to avoid. Damp conditions and condensation can also cause health issues, such as allergic reactions and respiratory problems for many people. However, ensuring your company or organisation has good ventilation systems in place will help reduce these risks.

Reduce temperatures

When there are lots of people in a confined space, whether is for work, conference or a public event, the environment can soon become hot and stuffy. A well-ventilated room will instantly be more comfortable - creating a more relaxed environment, while also making for a more productive workplace.

Health benefits

Another benefit of good ventilation systems is the positive impact it as on health and well-being. Indoor air pollution coupled with bad ventilation can lead to a number of health problems including headaches, allergies, asthma, rashes and sinusitis. However, this can be avoided with the installation of a good ventilation system

► WHY IS VENTILATION IMPORTANT?

Depending on your place of work, often we may need to spend a great deal of time indoors and in poorly ventilated spaces. If you're spending a large amount of your working time in these spaces, this can be detrimental to our health. That's why it is so important to have well-ventilated rooms both at home and in the workplace.

INDOOR AIR FLOW

According to ASHRAE standard 62.1 ("Ventilation and Acceptable Indoor Air Quality in Residential Buildings"), homes need to have at least 0.35% air changes of outdoor air for indoor air per hour to maintain the quality of the indoor air.

Factors affecting indoor air flow

- Pressure difference high-pressure area to a low-pressure area
- Indoor plan of building -without an effective barrier air flow through out the building
- Outside pressure- a higher out side pressure will always attempt to enter air to the home.
- Cross ventilation The correct alignment of window provide the cross ventilation
- Proportion of open spaces -eg: 5 CMF(cubic feet per min) for 100 SQFT,0.35 air changes per hr
- Sizes of ventilator
- Direction of wind

- ► What are openings in buildings?
- Building openings provide light, ventilation and climate control for rooms.
- ► At the same time, they are essential functional and design elements of facades, enabling communication between indoor and outdoor spaces as transparent or translucent structural components.
- ► **EG:** An open or closed window or passage between interior and exterior spaces, doors, ventilators

CROSS VENTILATION

- Where wind fresh air or a breeze enters upon an opening, such as a window, and flows directly through the space and exits through an opening on the opposite side of the building (where the air pressure is lower).
- This produces a cool stream of air and as well as a current across the room from the exposed area to the sheltered area. Other terms used for the effect include, cross-breeze, cross-draft, wind effect ventilation and cross-flow ventilation.

Windows or vents positioned on opposite sides of the room allow passive breezes a pathway through the structure, which circulate the air and provide passive cooling. Cross ventilation is a wind-driven effect and requires no energy, in addition to being the most effective method of wind ventilation. A commonly used technique to remove pollutants and heat in an indoor environment, cross ventilation can also decrease or even obviate the need for an air-conditioner and can improve indoor air quality.

CROSS VENTILATION

