

# CLIMATE & WEATHER

IMP

Weather is defined as the short term physical state of the atmosphere at a particular region relating to temperature, humidity, wind, rainfall, solar radiation, etc.

Climate is the long term physical state of the atmosphere at a particular region. climate can also be defined as an average pattern of weather condition.

## Principal Climatic Elements / Factors :-

The principal climatic factor shaping the climatic are :-

1. Solar radiation.
2. long wave radiation to the sky.
3. Air temperature.
4. Humidity.
5. Wind.
6. Precipitate.

## 1. Solar radiation:-

Solar radiation is the most important factor which influences the climate. The sun emits energy in the form of electromagnetic waves that travel with the speed of light. Solar radiation consists of rays of different wavelength varying from 290 - 2300 nm. and this is termed as solar spectrum.

The UV rays and IR rays form the two ends of the solar spectrum with the visible portion in b/w them.

The UV rays and IR rays are short waves having wave length ranging from 290 - 380 nm. The visible light has a wavelength ranging from 380 - 700 nm. The light is a combination of 7 colour mainly:-

1. Violet
2. Indigo
3. Blue
4. Green
5. Yellow
6. Orange
7. Red

The violet colours are shorter waves and red colours are longer waves.

The wave length of IR rays varying from  $700 - 2800 \text{ nm}$ .

The intensity of solar radiation ~~beats~~ reaching the upper limit of the atmosphere is taken as Solar radiation. Its value is taken as  $1396 \text{ W/m}^2$ . It may  $\downarrow / \uparrow$  depending on the distance b/w earth and sun.

The duration of the sunshine is ~~recd~~ measured using a sunshine recorder. The intensity of solar radiation measured by solarimeter.

The readings are taken for all the days in a month from this average values found.

## 2. Long Wave radiation to the sky;

The earth surface radiates heat to the atmosphere and the outerspace by long wave radiation. The radiation or heat loss depends upon the temperature difference b/w the earth surface and the atmosphere.

When the temp. difference is high long wave radiation is also high.

Water vapour,  $\text{CO}_2$ , and dust particles in the atmosphere absorb long wave radiation so in their presence radiative heat loss decreases hence air temp.  $\uparrow$ . The radiative heat loss is max when the atmosphere is clear and dry.

### 3. Humidity :-

Humidity refers to the water vapour content in the atmosphere. Water vapour enters the air by evaporation mainly from the oceans, water bodies and also from vegetation. The vapour is carried and distributed over the earth's surfaces by winds. If the capacity of air to hold water  $\uparrow$  as the temperature. The vapour distribution over the earth is not uniform. It is highest in the equatorial region and lowest in poles.

The humidity of air can be described as the Absolute Humidity (AH) i.e. the rate

OF moisture actually present unit mass / unit volume of air ( $\text{g/kg}$  /  $\text{g/m}^3$ ).

The Saturation point Humidity (SH) is the amount of moisture the air can hold and it depends on temp.

The Relative Humidity (RH) is the ratio of actual amount of moisture present to the amount of moisture the air can hold at a given temp.

$$RH = \frac{AH}{SH} \times 100.$$

RH is always expressed in %.

\* When the air is saturated RH is 100%.

Humidity is measured by an instrument called Hygrometer. Monthly mean max and monthly mean min. RH values for all the 12 months will give a clear picture of humidity condition.

#### 4. Air temperature

Earth surface gets heated by solar radiation. This heat is transferred to the air layers in contact with by conduction and upper layers by convection. Presents

of wind accelerates this, of a process of heat transfer and large masses of air are heated in this way.

Solar radiation is the important factor in determining the air temperature. Air temperature varies with the latitude. The max heating zone on earth because comes b/w tropics of cancer and tropics of Capricorn. Temperature of the air is measure in degree celsius with the help of a thermometer. If thermometer is used the present temp. as well as the max and min. temp. reached for the last 24 hours can be found. from these max and minimum values for all the <sup>w</sup> days of a month, monthly mean max. temp, monthly mean ~~mean~~ min. temp, and monthly mean temp. can be calculated. These values for all the 12 months will give an accurate picture of the temp. condition at a place.

## 5. Precipitation

it is the any form of water that falls to the earth surface. It is the collective term used for rain, snow, dew and gauges etc

When air containing given amount of water vapour is cooled its moisture holding capacity ↓ and air becomes saturated. The temp. at which air becomes saturated is known as the dew point.

When the air is further cooled below the dew point the vapour gets precipitated.

When air in contact with the cold earth surface is cooled below the dew point dews are formed. When the air not in direct contact with the cold earth surface is cooled below the dew point fog is formed.

Precipitation is measured by rain gauge in mm/unit time (mm/hour or mm/day or mm/month). The total precipitation for each month is measured and these values show the pattern of dry and wet seasons. The maxm rainfall for any 24 hour period is useful for the prediction of flooding. The maxm intensity of rainfall/hour (mm/hour) is useful for designing surface drainage like roofs, gutters and paved areas.

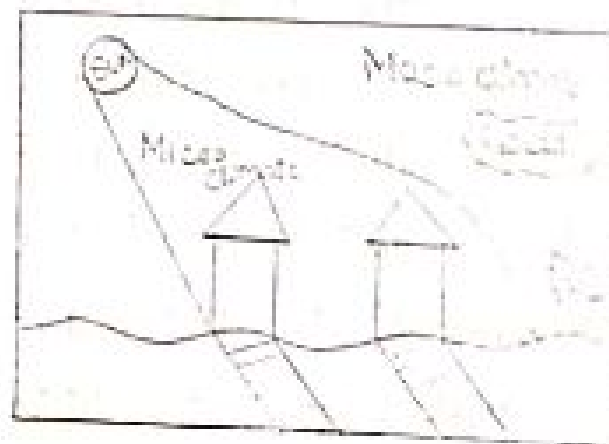
## Wind

Moving air is called wind. Its direction and velocity are very important in controlling cooling, dust carrying, raining and ventilation. Based on the velocity of wind it may be named as breeze, wind, hurricane etc.

## Macro climate & Micro Climate

Macro climate <sup>is</sup> the climate of a larger area such as the a region or a country.

Micro climate is the climatic variation in a localised area around a building.



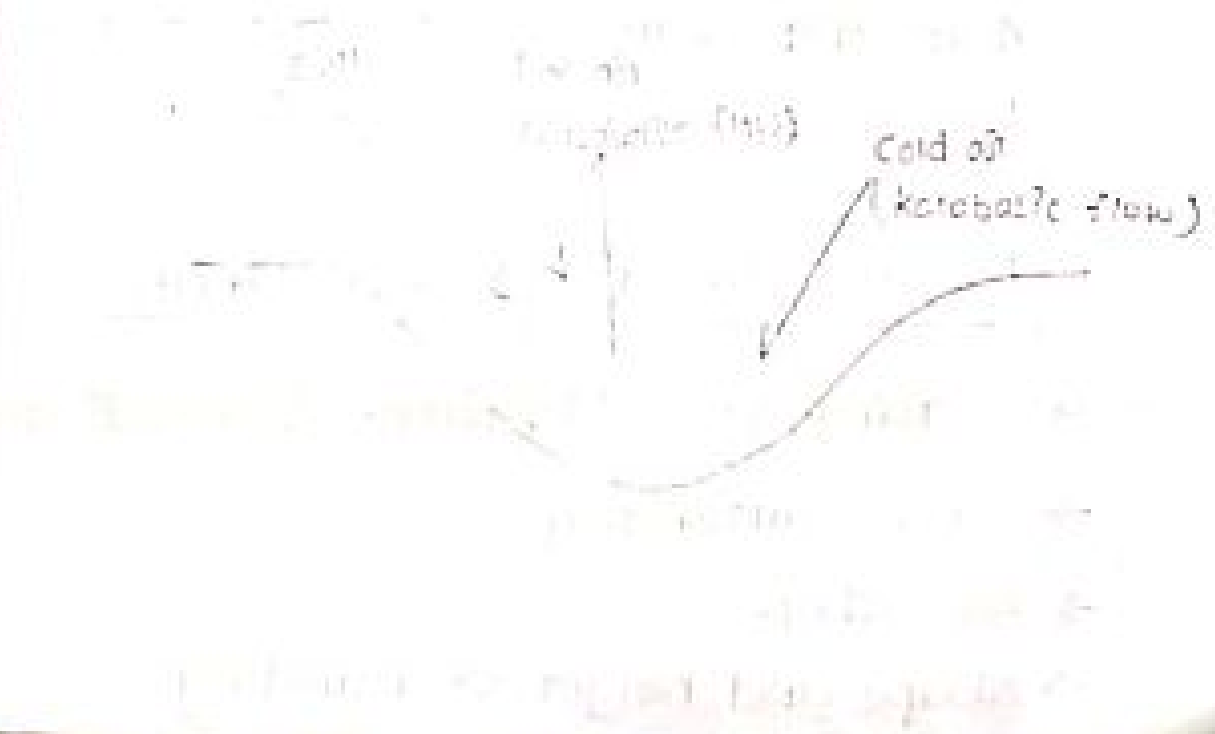


In the  
Following datas give an idea of meso  
macro climatic conditions:-

- Seasonal temperature difference
- Erital to Typical wind speeds and direction.
- Annual solar radiation
- Rainfall intensity.

### Effects of local terrain

Surround<sup>ing</sup> slopes have important effects on  
air movement. Especially at the bottom of a  
valley. At bottom hot air rises upwards  
due to buoyancy effects (anabatic flow).  
To be replaced by cooler air moving  
down the slope (katabatic flow) so that  
the valley flows are significantly colder  
than the other locations.



## Micro Climate - effect of building

The buildings themselves create micro-climates by shading the ground, changing the wind flow patterns. Solar Energy absorbed and re-emitted from building surfaces creates a warming effect on the surrounding air. Also large quantities of building break up the wind flow, reducing wind speeds and causing the warm air retained in that area. This also causes increased pollution as well as temp

The presence of high rise buildings can change the local climate, as wind speed at ground level can be ↑sed while the presence of high rise building blocks the access to the sunlight for a long period ↑ing the warming effect in surrounding buildings.

## Factors affecting micro-climate

- Spacing and Orientation of buildings
- Sites surrounding
- Site shape
- shape and height of building

- topographic features.
- Surrounding buildings.

## Winds

Types:-

1. Local winds      Eg. sea breeze, land breeze
2. Planetary winds
3. Trade winds
4. Polar winds
5. Seasonal shifts Eg. Monsoons

Air movement on the surface of earth due to difference in pressure is called winds. Here the air movement is from high P → lower P.

## Local Winds

Always  
All winds from breezes to hurricane are caused by differences in the atm. temp. by the rotation of the earth and by the unequal heating of the ~~oceans~~ oceans.

The sun heats land and sea differently. Over oceans and lakes most of the heat energy is absorbed by the water.

Or used in evaporation. So the air is not heated very much. But in the case of lands absorb only 60% as much heat as water does and evaporation is less. So air over lands having more heat than air over water.

Heated air at spaces expands and become lighter. Air over the sea doesn't heat as quickly and so it remains denser than the land air. So the air movement occurs from the sea portion to land portion. This movement is called sea breeze.

During the night the opposite occurs. The Planetary winds land cools more quickly than the sea and so does the air above it. At some time in the night the breeze is reversed and blows out to sea as land breeze.

Similar day and night changes cause mountain and valley breeze. By day the greatest heating occurs along mountain sides. Cooler air from the lower levels of valleys then blows towards the mountain region at night this action is reverse.

## Planetary Winds

Generally air movements can occur on a world wide scale due to world wide temp. Variations. These vast movements are called planetary winds. The main cause of the temp. variation is the different effect of the sun's heat in the tropics and polar regions.

Throughout the year the most heated part of the earth is tropical zone. This keeps the tropical air warm and light. So the cooler, heavier air from polar regions move towards tropical zone.

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## Trade Winds

The flows of air on either side of the equator are known as trade winds. The trade winds do not blow directly towards the equator. They are deflected by the earth rotation.

Beyond the region of the trade winds on each side of the equator are known as Horse Latitude. Because horses are died on ships becalmed. The air which was more Settles to  
the earth in this regions as the air travel towards the pole it become cooler and

this causes move downward. Some of the air which settles in the Hoisal Latitude goes back into trade winds. The rest flows towards the pole and circulate therefor a time before going back to the equator. The air movement at high level from the equator and later on the surface is called anti-trade winds.

### Polar Winds

Each polar region (north and south) tend to send cold winds towards the equator. Sometimes they are deflected to west (west ward wind) when they are moving towards east (east ward wind). When they are moving towards the equator sometimes two movements, sometimes these two movement interact from cyclic storms.

### Seasonal shift & Movements

Since the planetary winds are caused by heat from the sun, they shift northward and southward as the sun changes position with the seasons. When

heat from the sun is  $\uparrow$ ing it is absorbed by the earth. For a time before the temp rises when the heat from the sun is  $\downarrow$ ing the stored heat is given out and air temp is maintained. The monsoon winds usually bring heavy rainfall. But the winds <sup>are</sup> usually dry air.

### Climate Zones

Solar radiation reaches the ground on different part of the earth which different angles on the equator the sunlight reaches the ground almost  $\perp$ larly while at poles the angles of the sun is lower.

Throughout seasons the positions of the sun to the earth and the angle of incidents of the sunlight. The angle of the sun varies from  $\perp$  ( $90^\circ$ ). Within the tropics upto horizontal ( $0^\circ$ ) within the poles. Thus the sunlight warms up the earth around the equator much more strongly than at the poles. There are Four major climate zones.

- 1) Tropical Zone ( $0^\circ - 23.5^\circ$ )
- 2) Subtropics ( $23.5^\circ - 40^\circ$ )

3) Temperature Zone ( $40^{\circ}$  -  $60^{\circ}$ )

4) Cold Zone ( $60^{\circ}$  -  $90^{\circ}$ ).

### Tropical Zone

In this region the solar radiation reaches the ground nearly vertically at noon time during almost the entire year. Thereby it is very warm in this region. So the evaporation<sup>rate</sup> is more.

### Subtropics

In this region radiation is more in summer season, since the sun's angle at noon is almost vertical to the earth. This region receive less moisture or most of the deserts. In world as situated in this zone. In that seas winter season the radiation decreases and it can be temporarily cool and moist.

### Temperature zone

In this region the solar radiation arrives with a smaller angle and the average temp here are much cooler than the



Other regions.

### Cold zone

The polar regions are areas below  $60^\circ$  latitude and the poles receive less heat through solar radiation. Since the sun has a very flat angle throughout the ground because of the changes of the Earth's axis to the sun, the day length varies in this zone. In summer season polar days may occur. Vegetation is only possible during a few months per year. The conditions for life in this region were very hard.

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### Earth's thermal balance

Solar radiation provides almost all of the heat energy on the earth. Solar radiation is emitted as UV radiation, visible light and IR radiation. Atmospheric ozone absorbs most of the UV rays, while water vapour and  $\text{CO}_2$  absorb a larger % of IR rays. So thus out of the total amount of incoming solar radiation received at the atmosphere, about 25% is absorbed by this manner.

In the presence of clouds a major portion of solar radiation is reflected back to outer space by the clouds and the remaining part reaches the earth surface in a diffused form. When the atmosphere is clear and dry out of the solar radiation reaching the earth surface a small portion is reflected by the earth surface and the other portion is absorbed directly by the ground.

The total distribution of heat energy is as follows:

Solar radiation absorbed by the atmosphere  
 $= 25\%$

Solar radiation reflected from the cloud  
 $= 20\%$

" Earth surface  $= 5\%$

" diffused on earth surface  $= 23\%$

" absorbed directly on the earth surface  $= 27\%$

Total heat gained on the earth surface  $= 50\%$  ( $23\% + 27\%$ )

The absorbed heat is released by the earth surface by following procedure:

Earth emits long wave radiation to the atmosphere and outer space. The radiative heat loss is high when the atmosphere is clear and dry. This heat loss is about 20% of the total heat absorbed by the earth surface. Another 20% is lost by evaporation <sup>from</sup> water bodies and from vegetation. The air which is in contact with the hot earth surface gets heated. This air becomes lighter and rises and thereby losing its heat to the space i.e. remaining 10% lost by convection procedure. In this way earth achieves thermal balance.

### Sustainable Development

It is defined as the development to meet the needs of the present generation without compromising the ability of future generation to meet their own needs. i.e. it is any development which does not cause damage to the environment or does not cause disturbance to the ecosystem and also does not harm

the interest of future generation.

Development is essential for the progress of the society. But every development is associated with some environmental problems. These environmental problems may be serious or may be sustainable. For example an industry manufacturing plastic covers is a non-sustainable development. B/c these plastic covers become a non-biodegradable waste. Whereas an industry manufacturing paper covers from old newspapers is a sustainable development. Since the waste can be easily disposed as the paper is biodegradable.

- \* Non sustainable developments must be discouraged as they affect the environment seriously.
- \* Sustainable development must balance the needs of society, the economy and the environment.

The important components of Sustainable development are

- \* Economic development:- creating job opportunities.

poverty eradication, industrial development etc.

- \* Social development :- Providing food, clothing, shelter, education and other essentials of people active participation of women.
- \* Environmental protection :- providing clean air, water and environment for the present and future generations and utilisation of resources, in sustainable manner.

Sustainable development in Construction

Industry :-

Questions

[2 Marks]

- Define climate and weather?
- Define micro climate & macro climate
- What is relative humidity?
- What is polar winds?

[6 MARKS]

- Write notes on

Stem • Solar radiation • Site climate  
IMP Quantity and Quality • Seasonal  
• Air temperature, humidity changes  
• Air movement • Sustainable development

• precipitation • climatic zones

• Humidity • Urban climate

IMP • Earth thermal balance

IMP • winds

→ List out the factors affecting climate

→ Explain sustainable development in construction industry.

→ Explain the efforts for protecting the atmosphere, air, water and earth.

### IMP Site climate

It is the climate of the area which is available for a given purpose and is to be used for that purpose, whatever may be the size of the project. Site climate may be slightly different from the regional climate. This is b/c the climatic elements namely solar radiation, air temperature, humidity, wind and precipitation are affected by some local factors,

1) Topography

2) Ground surface

3) 3-dimensional objects.

## Topography :-

It refers to the elevation, orientation, slope and exposure of the site and weather there are hills or valleys at the site or near the site as this may strongly affect the site climate.

## Ground Surface :-

Whether natural or manmade whether is a reflective surface its permeability and soil temp., presence of plants grass, water, paving etc

## 3D Objects :-

Such as building, walls, fences these may influence air movement and may cause shadows. closely built-up multi-storied building may cause influence precipitation wind velocity etc.

## Urban Climate

Urban area means large town or city. It consists of manmade environments of paved area buildings etc. These

manmade environment can create their own microclimate called urban climate. The factors causing deviations of the urban climate from the regional macro climate can be explained as follows:

### 1. Changed surface qualities.

Pavements and buildings absorb more solar radiation leading to an increase in air temperature. Evaporation decreases due to less vegetation and the quantity of water available for evaporation is less. So humidity decreases.

### 2. Buildings

Buildings create shadows and act as a barrier to winds. Buildings absorb solar radiation and store it, releasing it at night. Thus, it increases the night time temperature.

### 3. Energy Seepage

The heated buildings release heat through the walls and ventilation to the outdoor air. Heat is also released from



refrigeration plants air conditioning plants and electrical units. Industries and factories also produce more heat. All these factors  $\uparrow$  the air temp.

#### 4. Atmospheric Pollution

Smoke, ~~foams~~ fumes, and vapours from domestic and industrial units, from motor vehicles, from waste products cause air pollution in the urban area. This reduces direct solar radiation to the earth surface and  $\uparrow$ ses diffused radiation. Air pollution also acts as a barrier to the outgoing long wave radiation. Thus  $\uparrow$ ses the air temp.