2.2 WIND ROSE

A wind rose is a graphical tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location. Historically, wind roses were predecessors of the compass rose (found on maps), as there was no differentiation between a cardinal direction and the wind, which blew from such a direction.

- Using a polar coordinate system of gridding, the frequency of winds over a long time period is plotted by wind direction, with color bands showing wind ranges.
- The directions of rose with the longest spoke show the wind direction with the greatest frequency.

Uses of wind rose:

- Presented in a circular format, the modern wind rose shows the frequency of winds blowing from particular directions over a specified period.
- The length of each “spoke” around the circle is related to the frequency that the wind blows from a particular direction per unit time.
- Each concentric circle represents a different frequency, emanating from zero at the center to increasing frequencies at the outer circles.
- A wind rose plot may contain additional information, in that each spoke is broken down into color- coded bands that show wind speed ranges.
- Wind roses typically use 16 cardinal directions, such as north (N), NNE, NE, etc although they may be subdivided into as many as 32 directions.
- In terms of angular measurement in degrees, North corresponds to 0°/360°, east to 90°, South to 180° and West to 270°.
- Compiling a wind rose is one of the preliminary steps taken in constructing airport runways, as aircraft typically perform their best takeoffs and landings pointing into the wind.

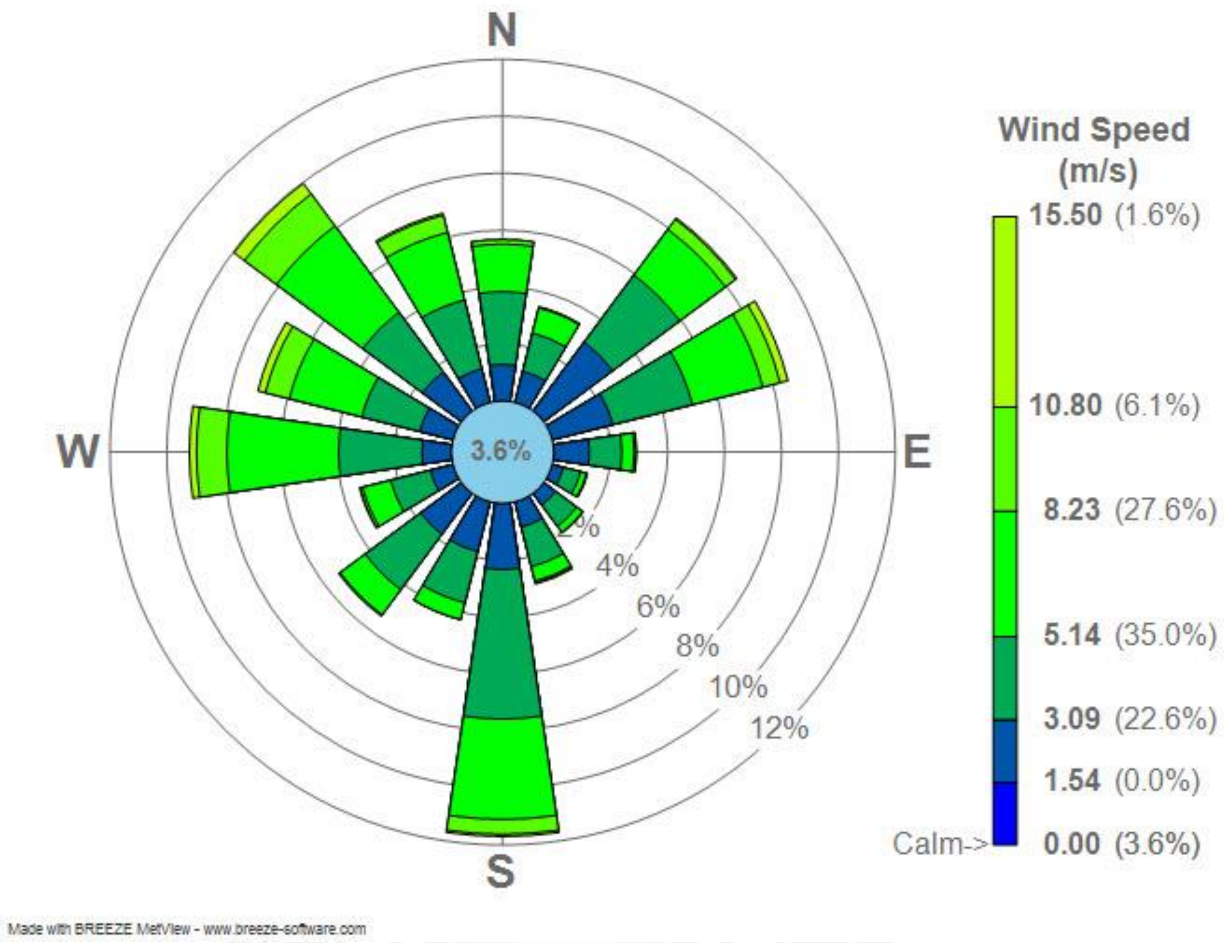

Figure2.2.1wind Rose Diagram

[Source:https://en.wikipedia.org/wiki/File:Wind_rose_plot.jpg]

Lapse Rate:

As a parcel of air rises in the earth's atmosphere, it experiences lower and lower pressure from the surrounding air molecules, and thus it expands. This expansion lowers its temperature. Ideally, if it does not absorb heat from its surroundings and it does not contain any moisture, it cools at a rate of 1°C/100 m rise. This is known as dry adiabatic lapse rate. If the parcel moves down it warms up at the same rate.

- For a particular place at a particular time, the existing temperature can be determined by sending up a balloon equipped with a thermometer.
- The balloon moves through the air, and not with it.

- The temperature profile of the air, which the balloon measures, is called the ambient lapse rate, environmental lapse rate are the prevailing lapse rate.
- A super-adiabatic lapse rate also called a strong lapse rate occurs when the atmosphere temperature drops more than 1°C/100 m.
- A sub-adiabatic rate also called weak lapse rate, is characterized by drop of less than 1°C/100 m.
- A special case of weak lapse rate is the inversion, a condition which has warmer layer above colder air.
- During super-adiabatic lapse rate the atmospheric conditions are unstable. This is illustrated in the below figure2.2.2.
    - If a parcel of air at 500m elevation, at 20°C is pushed upward to 1000m, its temperature will come down to 15°C (According to adiabatic lapse rate)

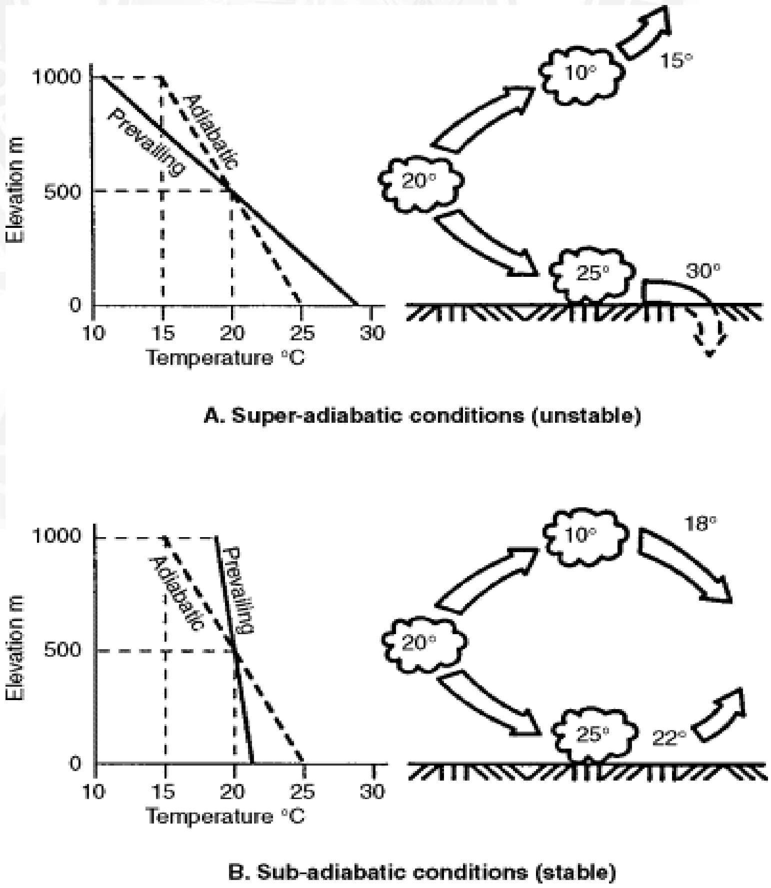

Figure2.2.2 Stability and vertical air movement

[Source:https://www.sciencedirect.com/browse/journals-and-books]

- The prevailing temperature is however 10°C at 1000m. The parcel of air will be surrounded by colder air and therefore will keep moving up.
- If the parcel is displaced downwards, it will become colder than its surroundings and therefore will move down.
- Super-adiabatic conditions are thus unstable, characterized by a great deal of vertical air movement and turbulence.
- The sub-adiabatic condition is by contrast a very stable system.
- Consider again a parcel of air at 500m elevation at 20°C. If the parcel is displaced to 1000m, it will cool by 5°C to 15°C. But the surrounding air would be warmer.
- It will therefore fall back to its point of origin.
- If a parcel of air at 500m is pushed down, it will become warmer than its surroundings and therefore will rise back to its original position. Thus, such systems are characterized by very limited vertical mixing.