

# WIND ROSES OF AHMEDABAD, GUJARAT, INDIA

**Dr. Akshey Bhargava**

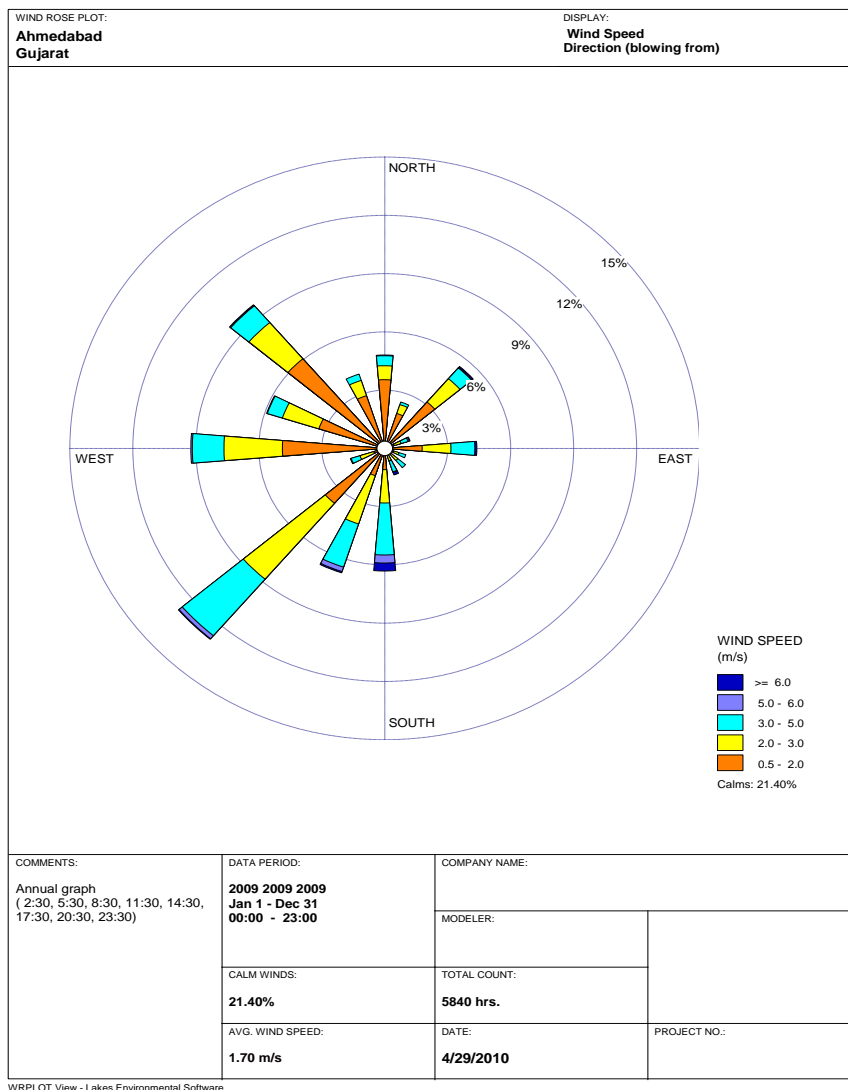
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**Abstract:** Wind rose is a graphical presentation of percentage frequency distribution of different wind speeds and directions at a given place or location, it helps in locating industry or industrial area, Identification of measure impact area for development of master plan, optimizing the concept of industrial zoning, urban planning in respect of alignment of roads, location of parks and urban infrastructure. It also helps in optimizing the vertical to horizontal expansion of the city and concreting to non - concreting surface area, determining the atmosphere stability , disaster management, and also helps in overall planning and development of social forestry and greenbelt development having regard to aero- dynamics. An attempt has been made in the present paper to prepare wind roses of Ahmedabad considering annual average, seasonal in the form of summer, winter, and monsoon, post monsoon, along with monthly, day & night.

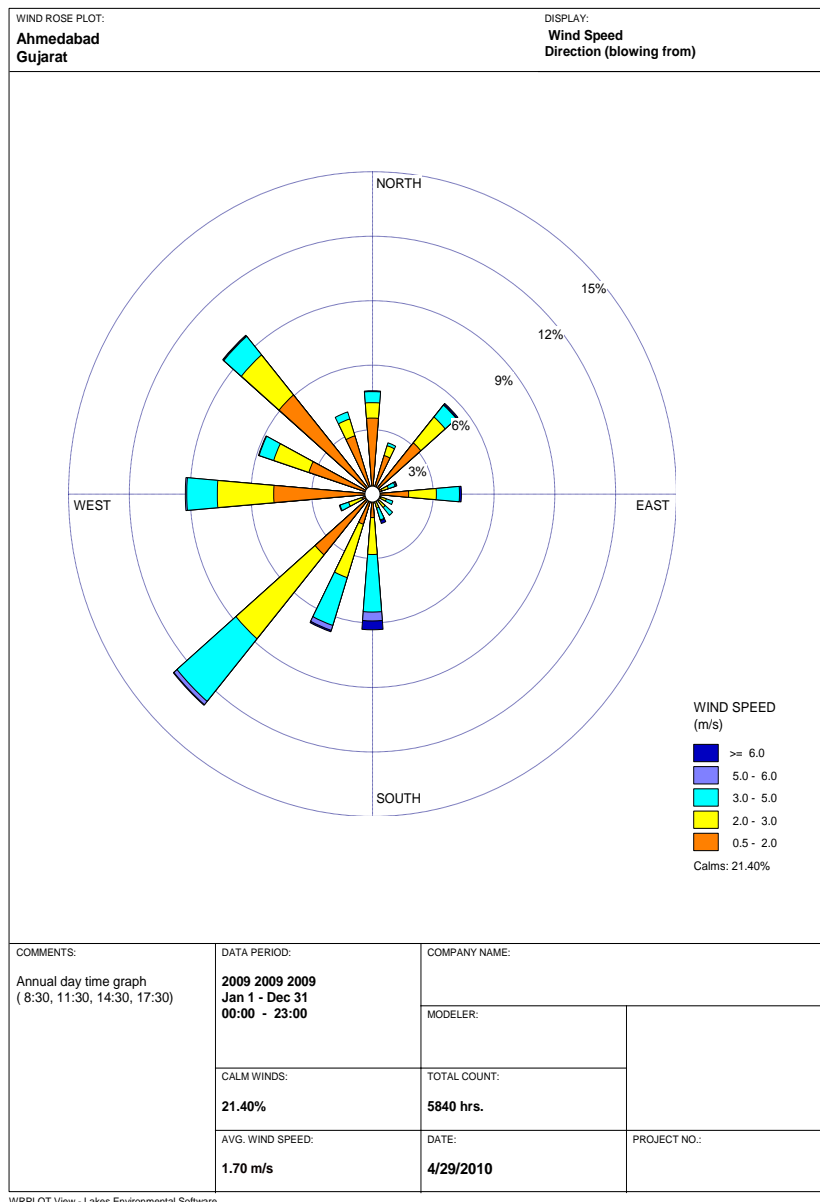
**Wind Roses:**

Meteorological data in the form of hourly wind speed and direction has been collected from the Indian Meteorological Department , Ahmedabad and percentage frequency distribution of different speeds and directions were tabulated along with calm conditions and there after Wind Roses have been prepared and analyzed for the benefit of Researchers, Governmental Agencies and Town Planners. These Wind Roses are depicted as under along with their detailed analysis:



**Figure 1 Annual wind rose**

Figure 1 depicts annual average wind rose which tends to indicate predominant wind direction as SW with predominant south-westerly wind sector, followed by NW, NE & SE wind sectors. The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 21.40%

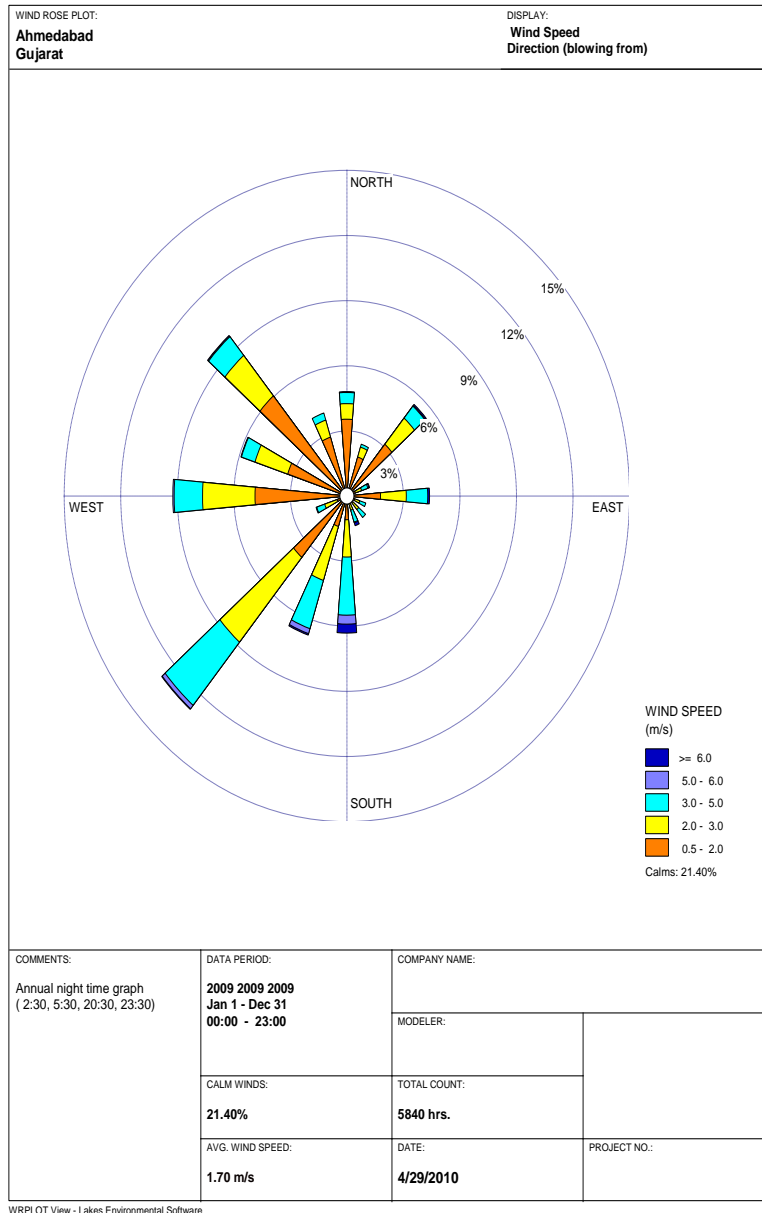


**Figure 2 Annual day time wind rose**

Figure 3 represents annual night time wind rose which tends to indicate predominant wind direction as SW along with predominant south-westerly wind sector followed by NW, NE & SE.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 21.40%

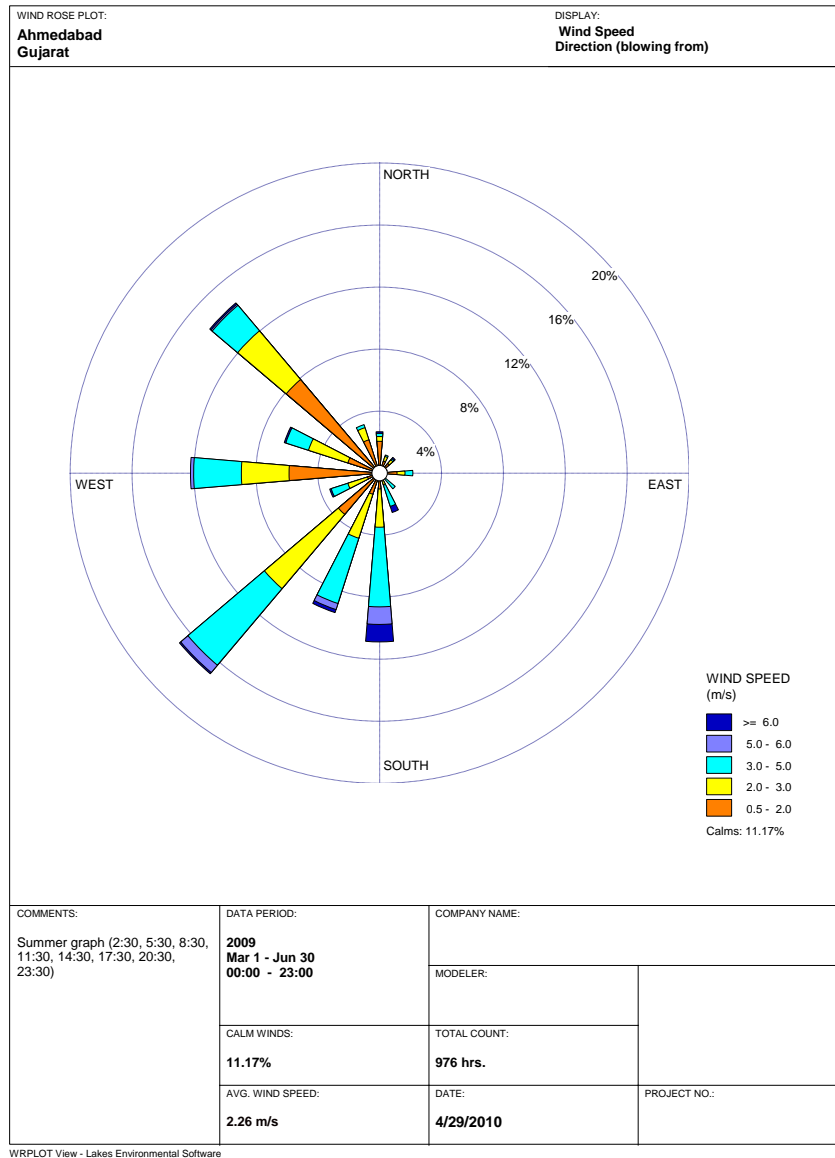
It would thus be evident that there is no marked difference between day and night time wind roses on an annual basis and reasonably match with the annual average wind rose.



**Figure-3 Annual Night time Wind rose**

Figure 4 depicts summer wind rose which tends to indicate predominant wind direction as SW along with predominant south-westerly wind sector followed by NW.

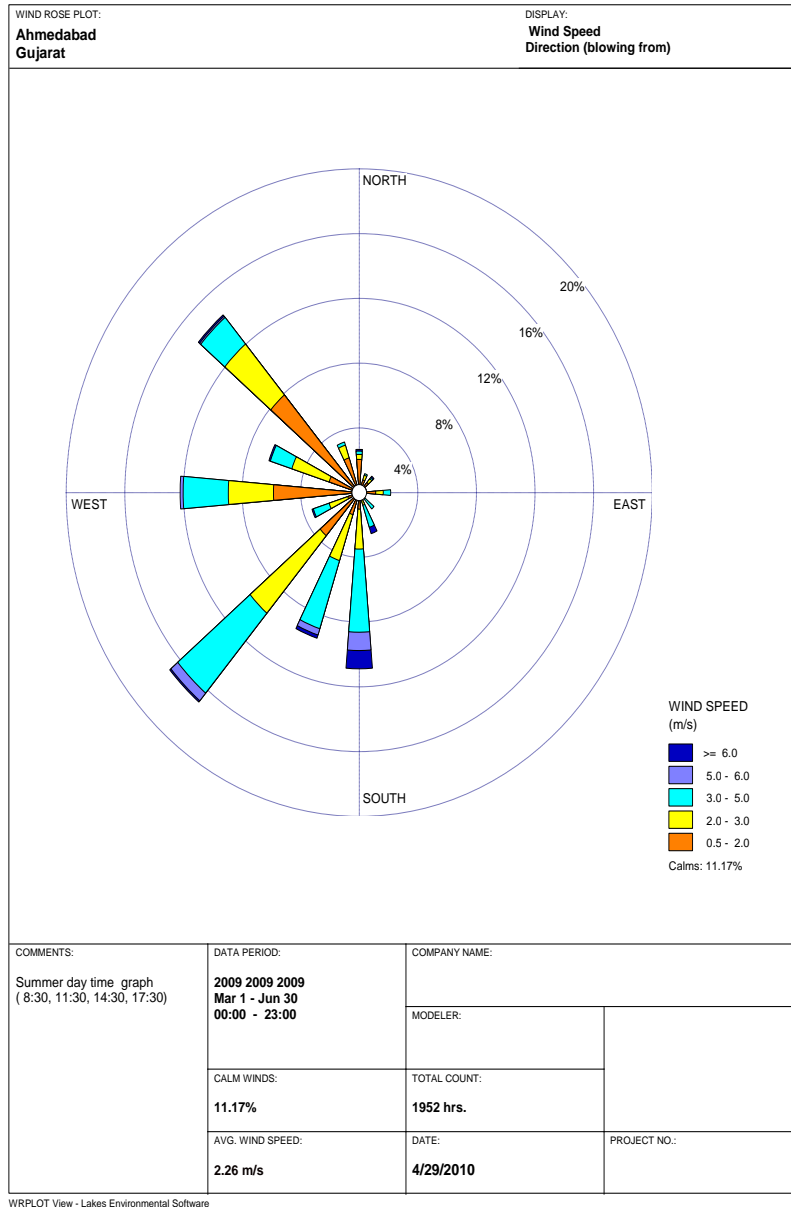
The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 11.17%



**Figure 4 summer wind rose**

Figure 5 depicts Summer day time wind rose which tends to indicate predominant wind direction as SW along with predominant south-westerly wind sector followed by NW.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 11.17%

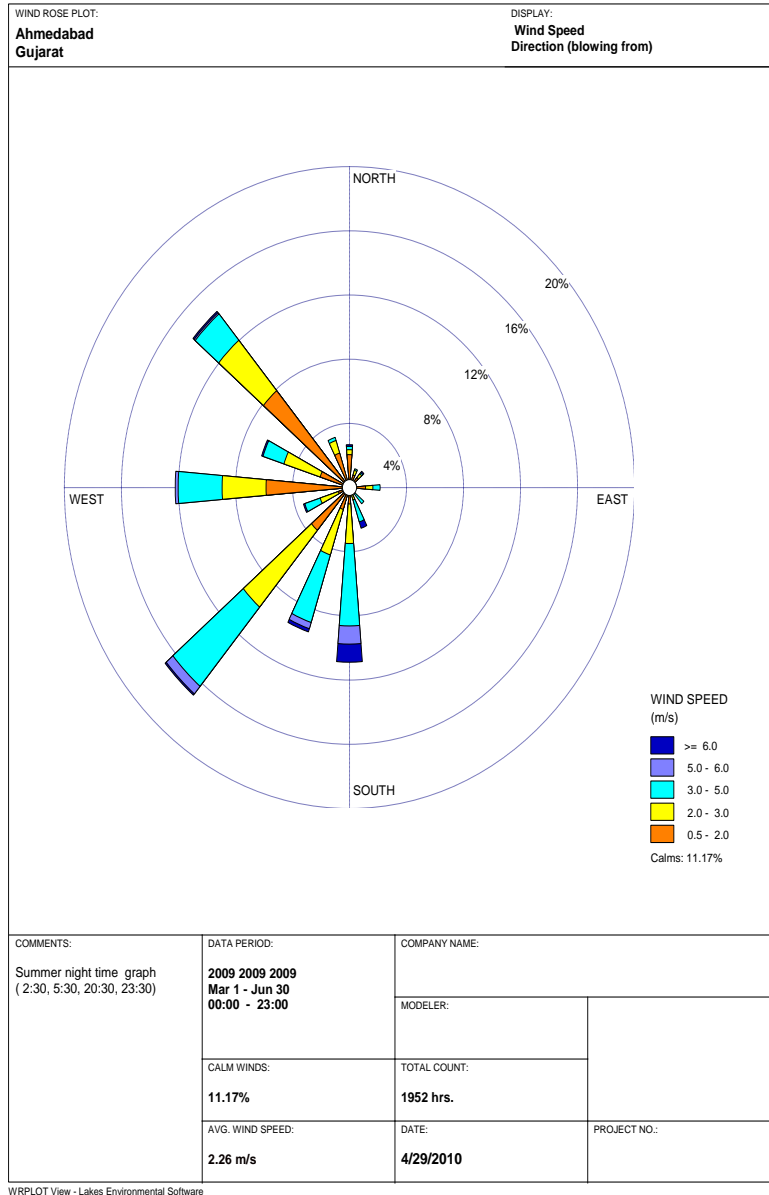


**Figure 5 summer day time wind rose**

Figure 6 depicts summer night time wind rose which tends to indicate predominant wind direction as SW along with predominant south-westerly wind sector followed by NW.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 11.17%

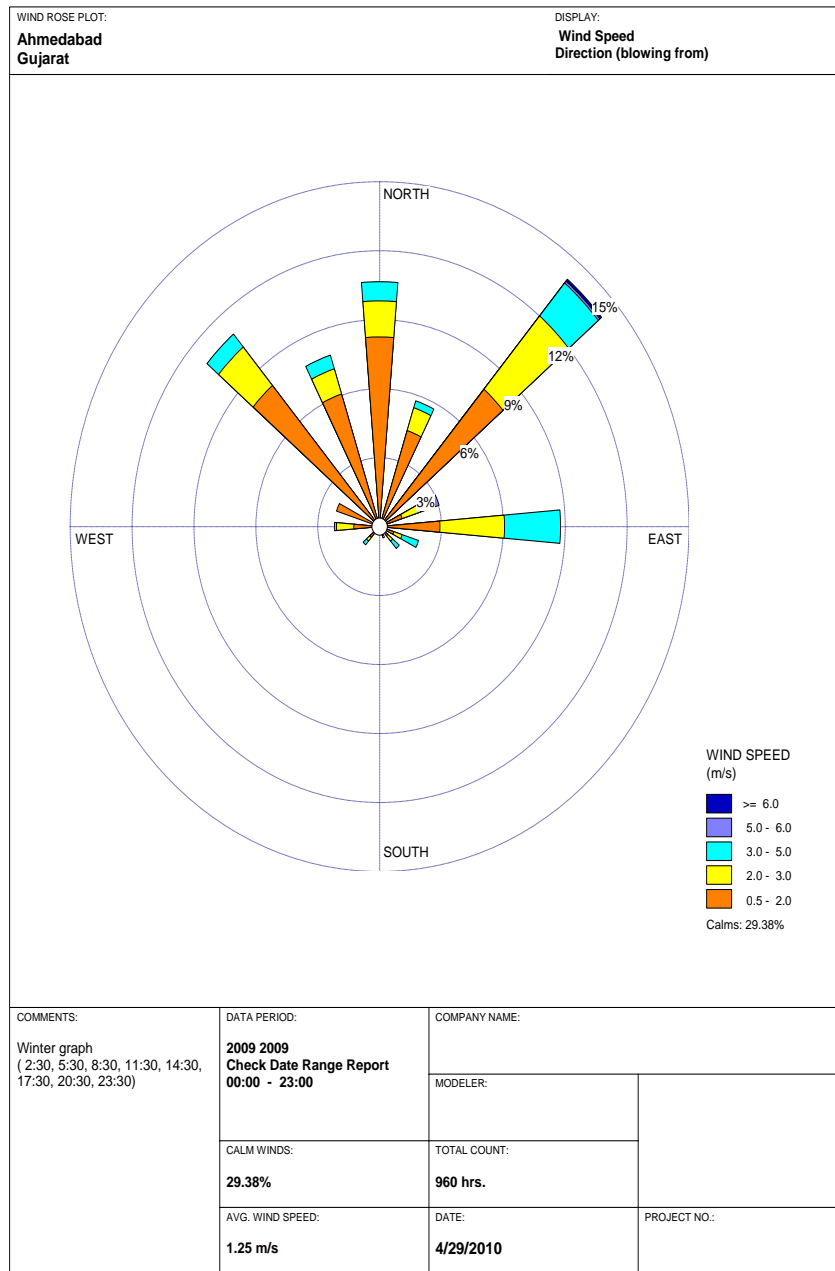
It would thus be evident that there is no marked difference between day and night time wind roses and reasonably match with the average summer wind rose.



**Figure 6 summer night time wind rose**

Figure 7 depicts Winter wind rose which tends to indicate predominant wind direction as NE along with predominant North-Easterly wind sector followed by NW.

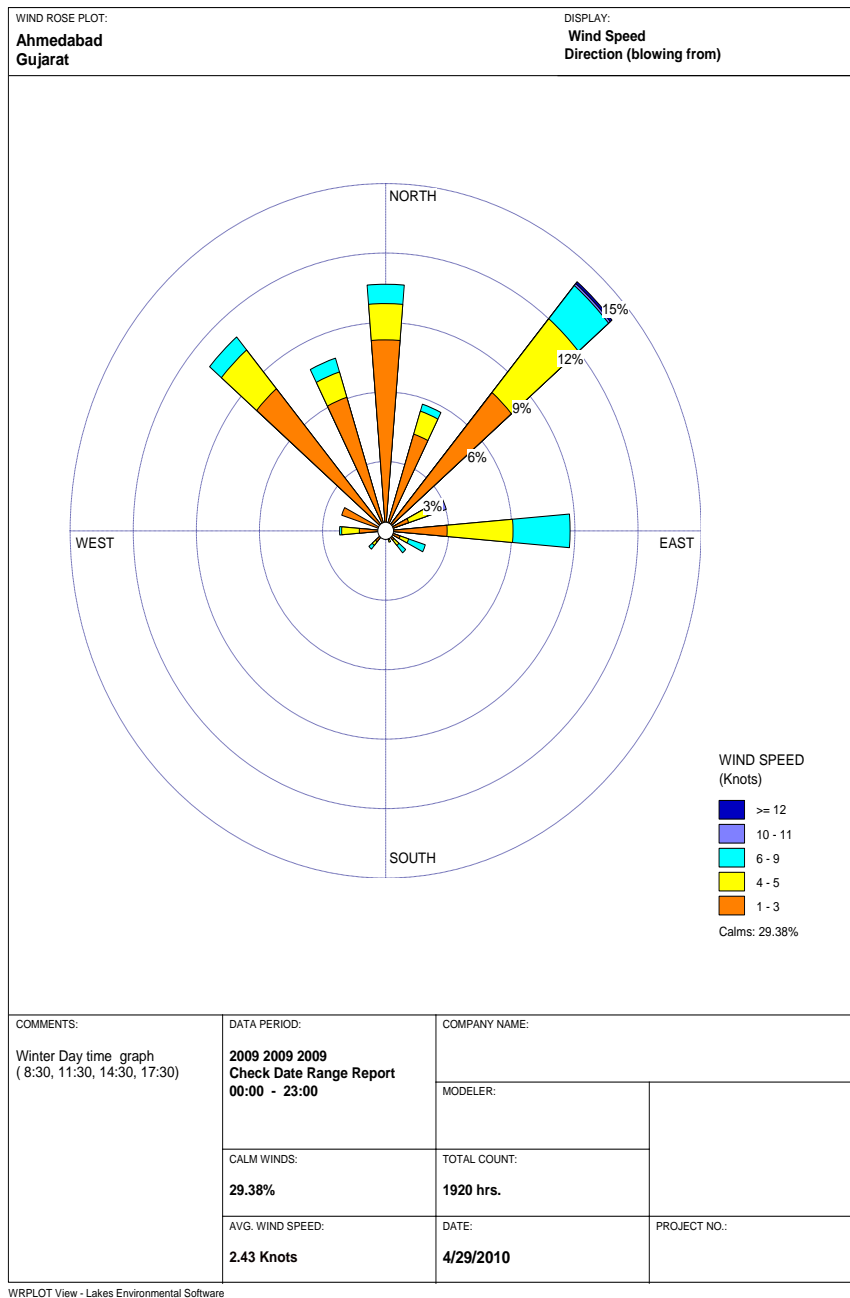
The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 29.38%



**Figure 7 winter wind rose**

Figure 8 depicts Winter day time wind rose which tends to indicate predominant wind direction as NE along with predominant North-Easterly wind sector followed by NW.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 29.38%



**Figure 8 winter day time wind rose**

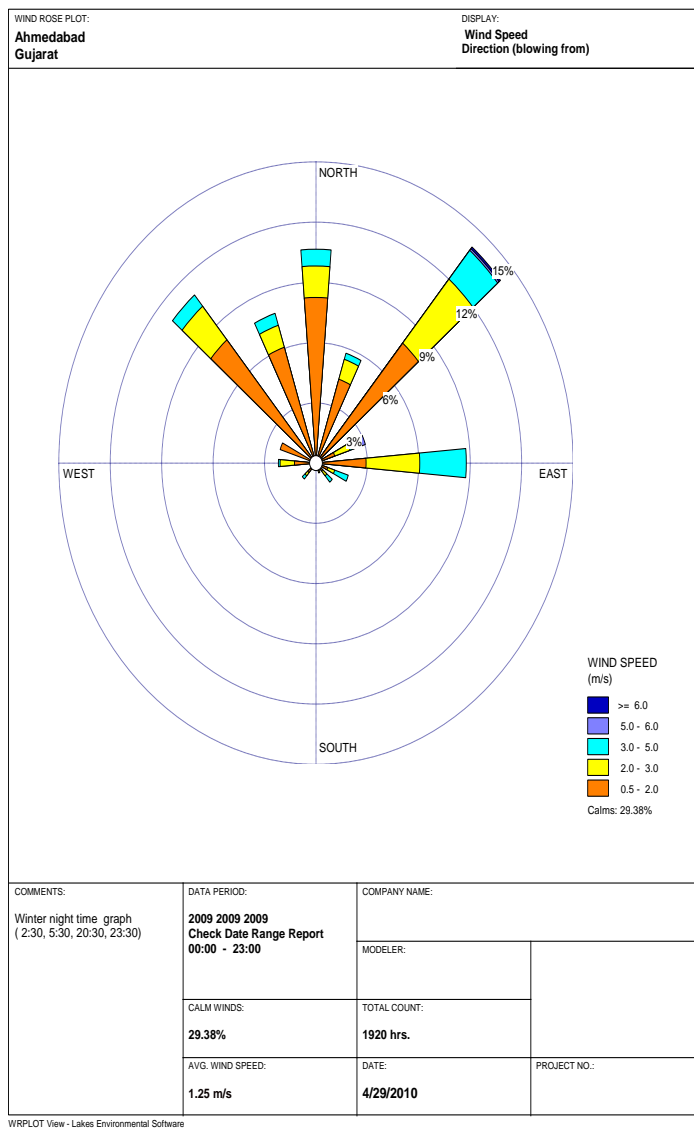
Figure 9 depicts Winter night time wind rose which tends to indicate predominant wind direction as NE along with predominant North Easterly wind sector followed by NW.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 29.38%

It would thus be evident that there is no marked difference between day and night time wind roses and reasonably match with the average winter wind rose.

However, there has been a marked difference between summer and winter wind roses in as much as that in summer the predominant wind direction was SW where as during winter season it was NE, just the opposite. Similarly, the calm conditions during winter season are quite significant (29.38%) as compared to summer season (11.17%)

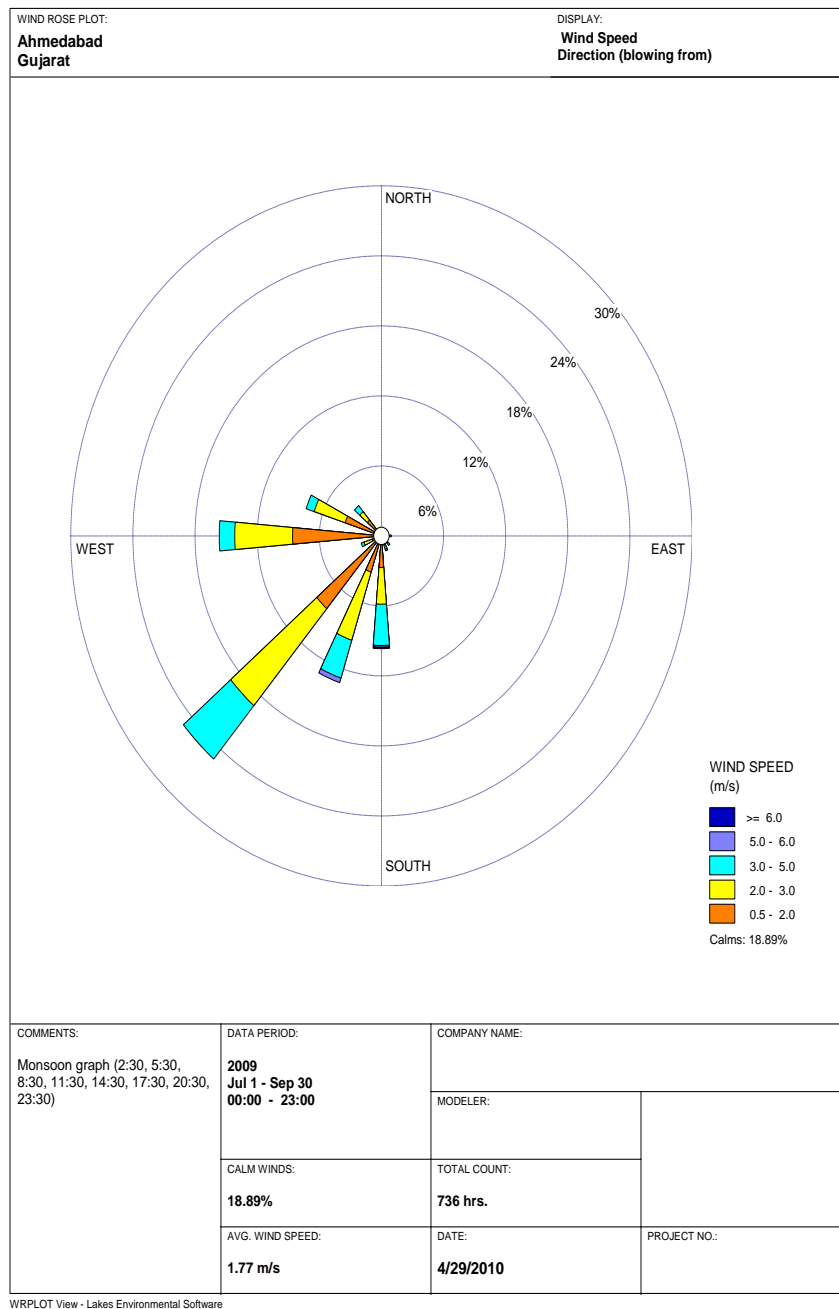




**Figure 9 winter night time wind rose**

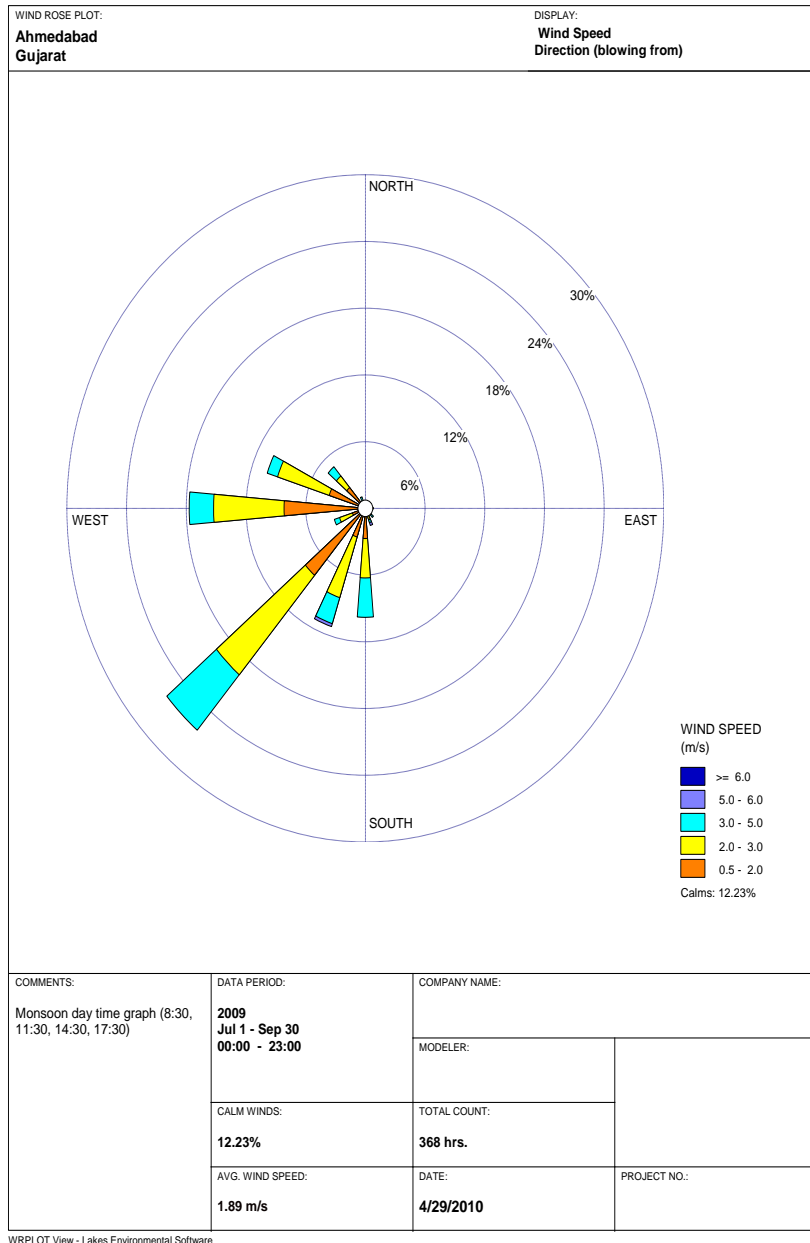
Figure 10 depicts Monsoon wind rose which tends to indicate majority of predominant wind direction as SW along with predominant south westerly wind sector followed by NW.

The pre-dominant wind speed is in the range of 2.0 to 3.0 m/s followed by wind range of 0.5 to 2.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 18.89%



**Figure 10 Monsoon wind rose**

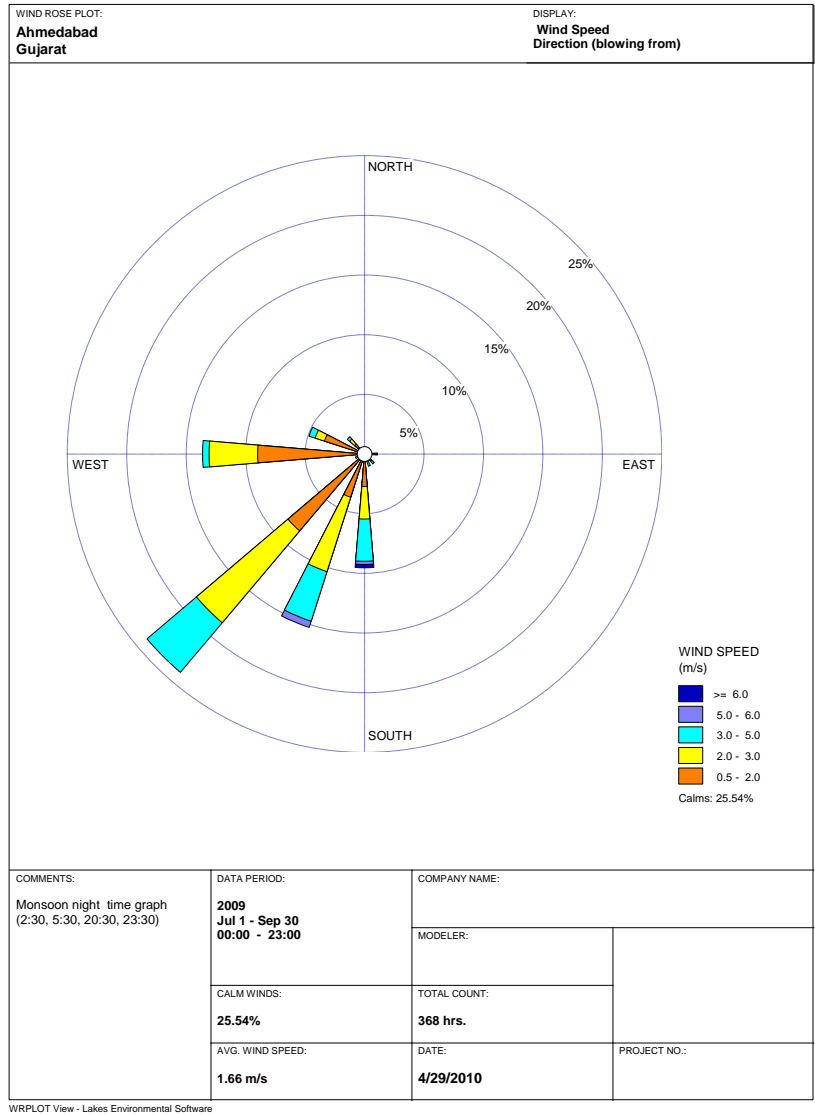
Figure 11 depicts Monsoon day time wind rose which tends to indicate majority of predominant wind direction as SW along with predominant south-westerly wind sector followed by NW. The pre-dominant wind speed is in the range of 2.0 to 3.0 m/s followed by wind range of 0.5 to 2.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 18.89%



**Figure 11 Monsoon day time wind rose**

Figure 12 depicts Monsoon night time wind rose which tends to indicate majority of predominant wind direction as SW along with predominant south-westerly wind sector followed by NW.

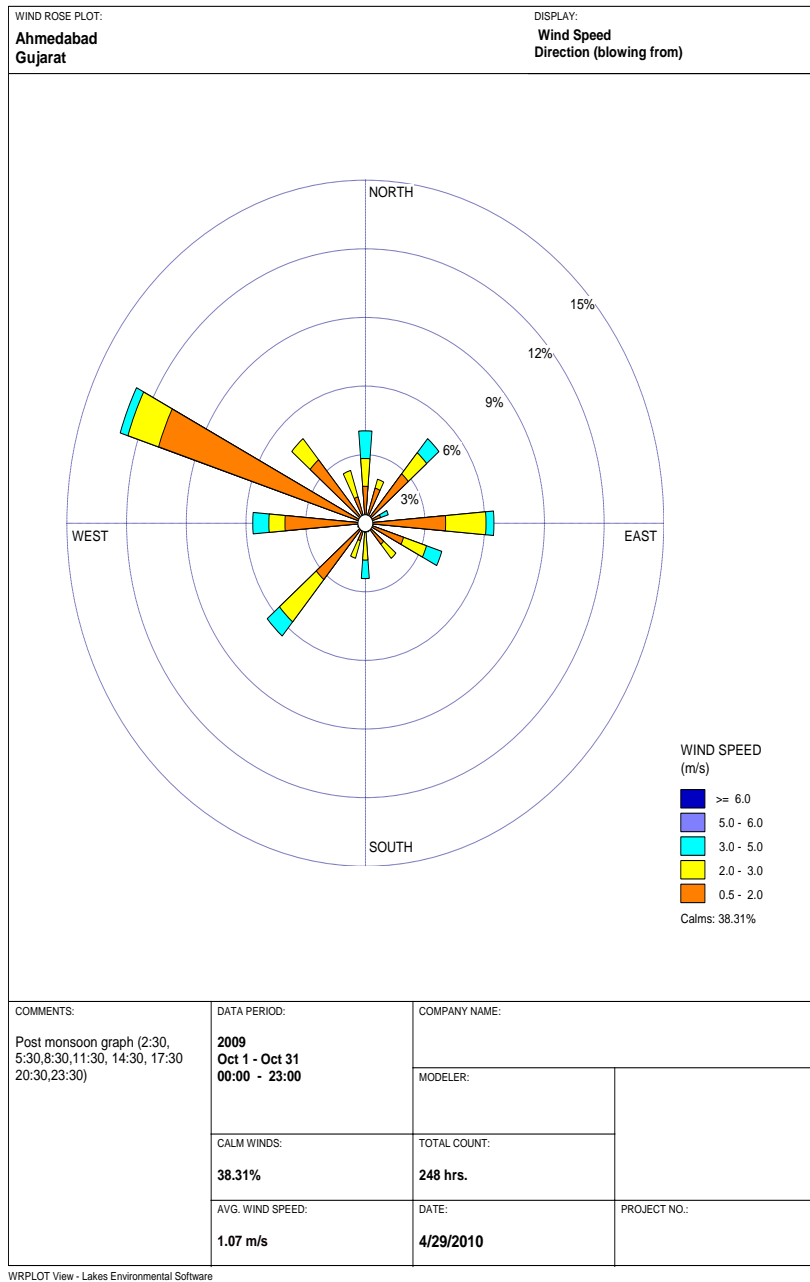
The pre-dominant wind speed is in the range of 2.0 to 3.0 m/s followed by wind range of 0.5 to 2.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is 18.89%



**Figure 12 Monsoon night time wind rose**

Figure 13 depicts Post monsoon average wind rose which tends to indicate predominant wind direction as NW along with predominant north-westerly wind sector followed by NE, SW & SE.

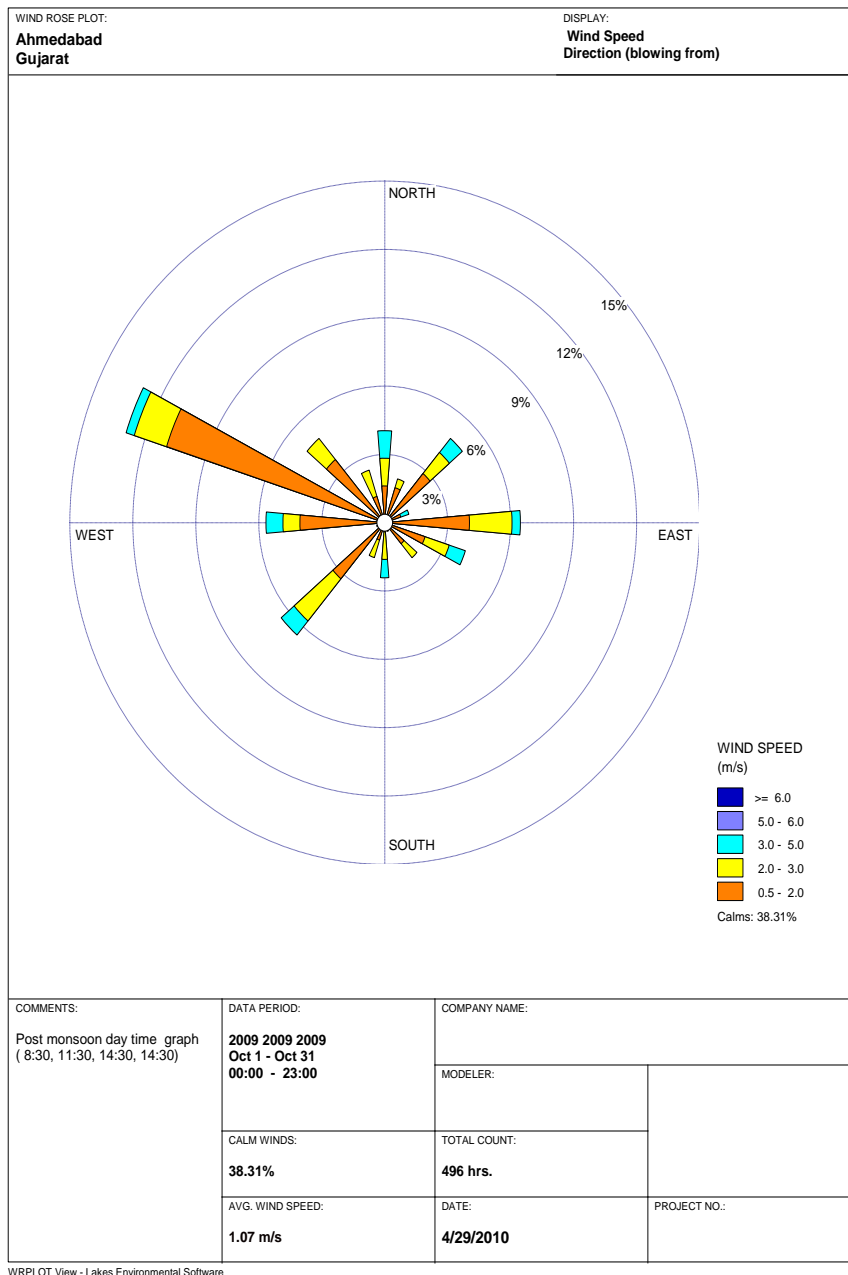
The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds are quite significant of the order of 38.31%



**Figure 13 Post monsoon wind rose**

Figure 14 depicts Post monsoon day time wind rose which tends to indicate predominant wind direction as NW along with predominant north westerly wind sector followed by NE, SW & SE.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds are also significant with 38.31%

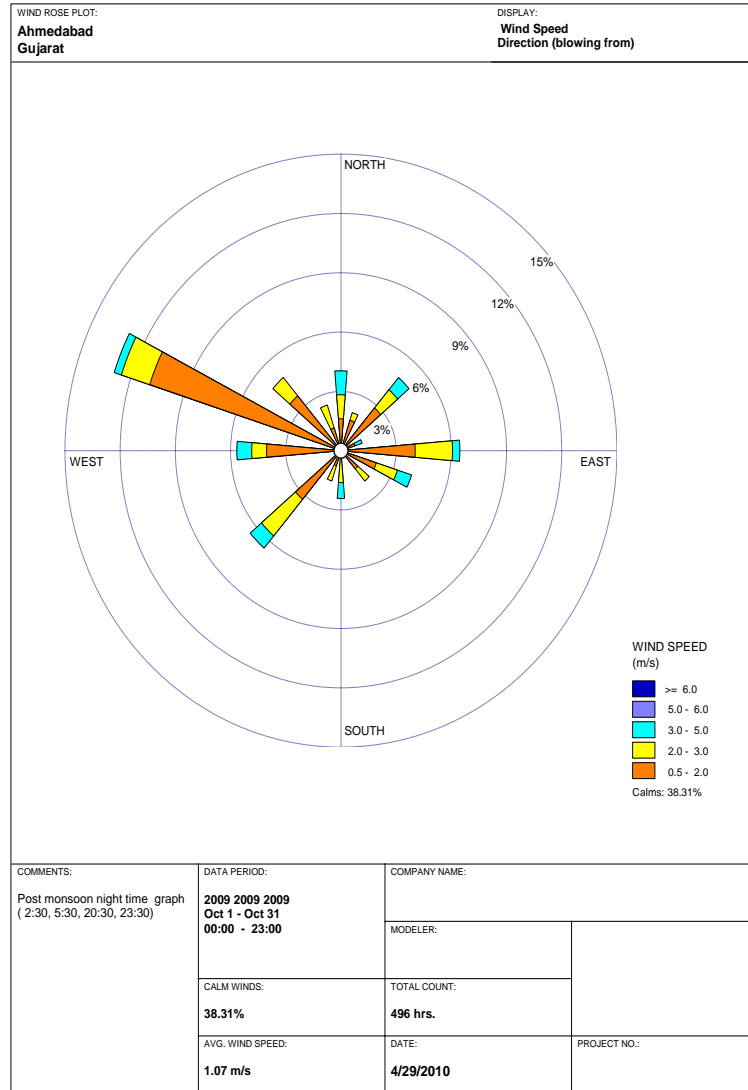


**Figure 14 Post monsoon day time wind rose**

Figure 15 depicts Post monsoon day time wind rose which tends to indicate predominant wind direction as NW along with predominant north-westerly wind sector followed by NE, SW & SE.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 38.31%

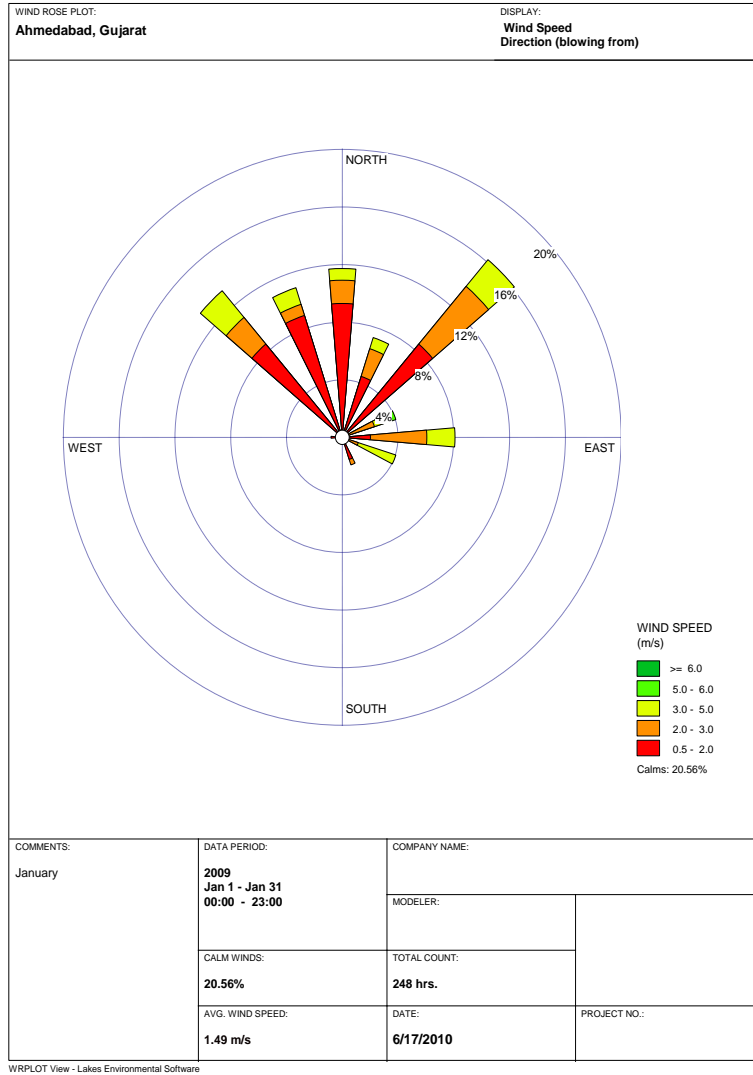
It would thus be evident that the predominant wind direction in summer and monsoon season remains same as SW where as during winter it is NE and post monsoon NW. The predominant wind speed remains in the range of 0.5 to 2 m/s in all seasons except for monsoon which accounts for 2 to 3 m/s. The calm conditions are maximum (38.31%) in post monsoon season, followed by 29.38% in winter, 18.89% in monsoon and 11.17% in summer.



**Figure 15 Post monsoon night time wind rose**

Figure 16 depicts January average windrose which tends to indicate predominant wind direction as NE along with predominant north easterly wind sector followed by NW & SE.

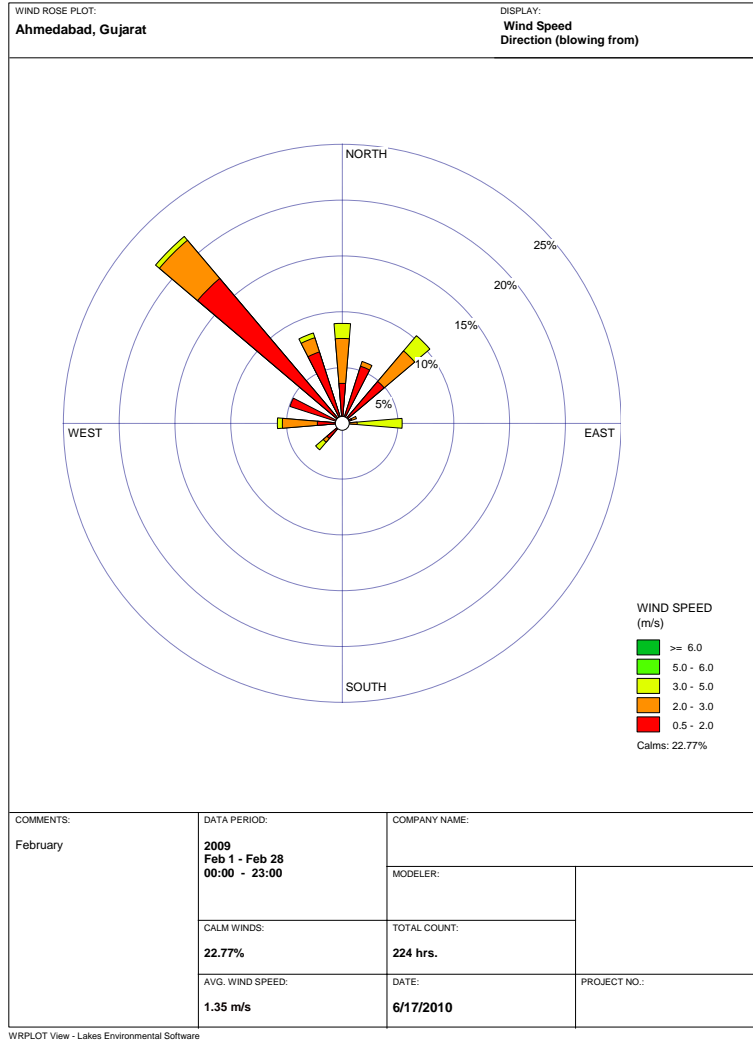
The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 20.56%



**Figure 16 January wind rose**

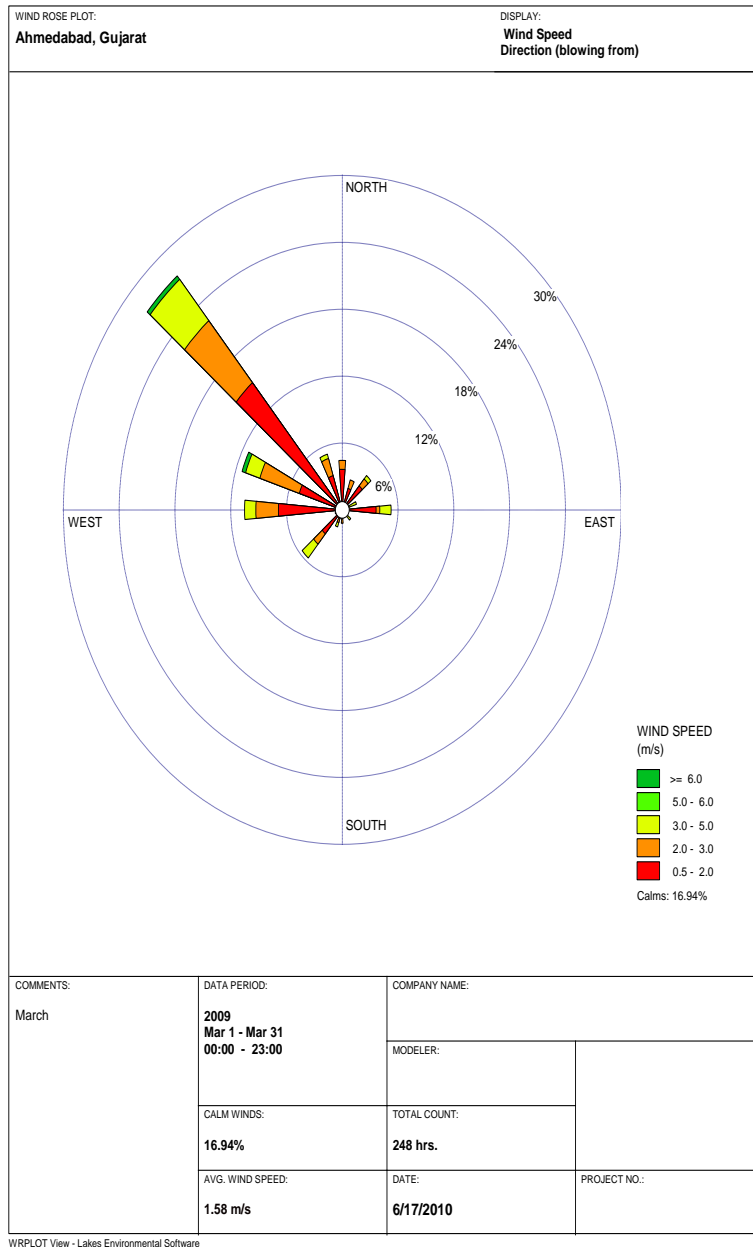
Figure 17 depicts February wind rose which tends to indicate predominant wind direction as NW along with predominant north westerly wind sector followed by NE and very few % wind goes to SW direction. The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 22.77%





**Figure 17 February wind rose**

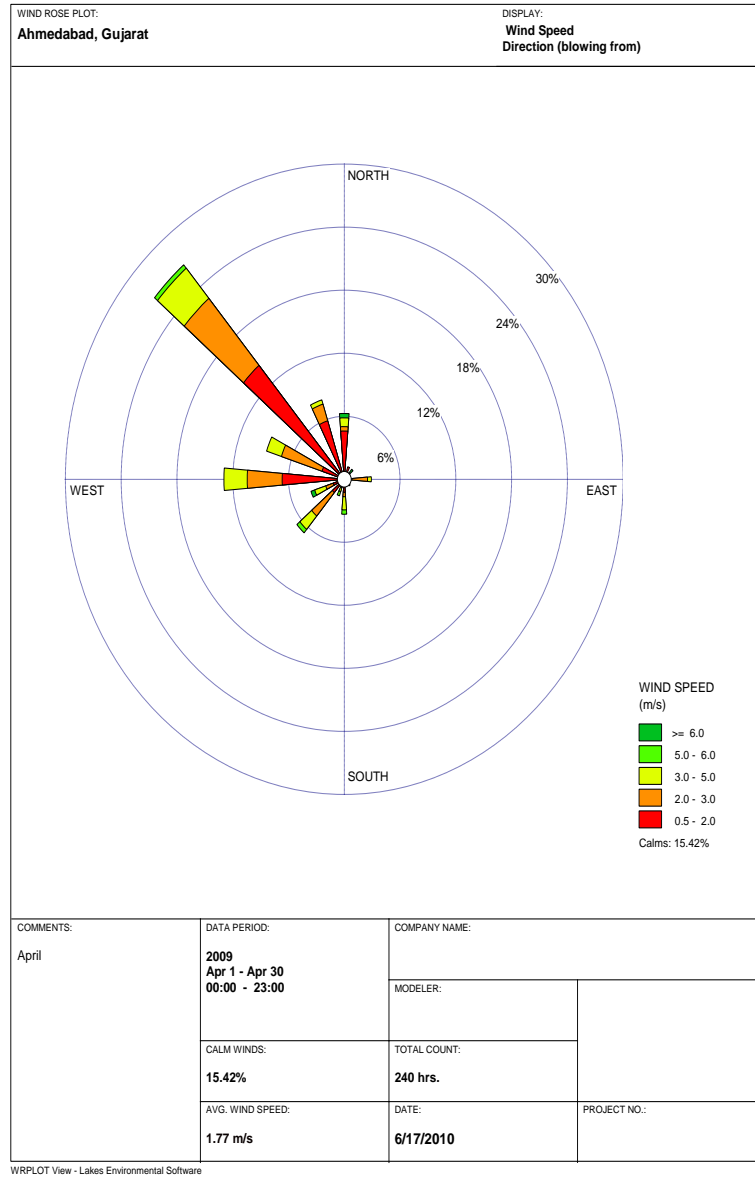
Figure 18 depicts March average windrose which tends to indicate predominant wind direction as NW along with predominant north westerly wind sector followed by NE and very few % wind goes to SW direction . Majority of wind goes to NW direction. The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 16.94%



**Figure 18 March wind rose**

Figure 19 depicts April average windrose which tends to indicate predominant wind direction as NW along with predominant north westerly wind sector followed by SW. Majority of wind goes to NW direction.

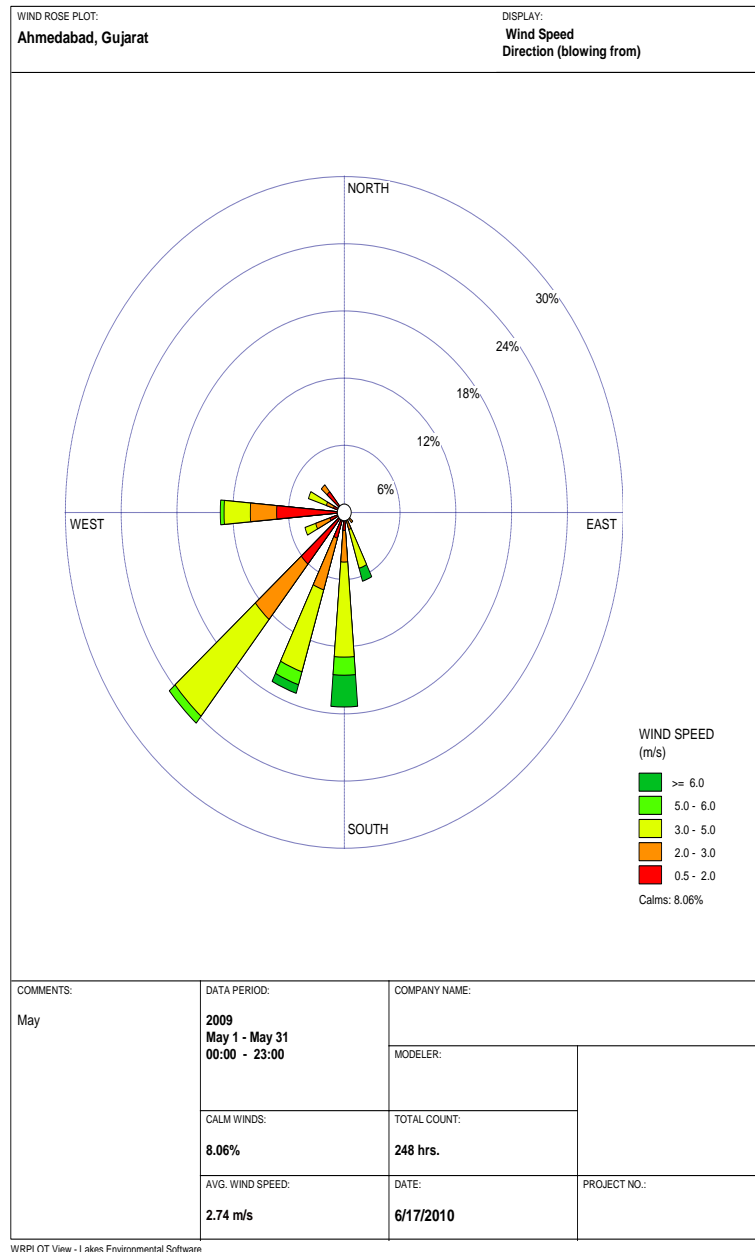
The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 15.42%



**Figure 19 April wind rose**

Figure 20 depicts May average windrose which tends to indicate predominant wind direction as SW along with predominant south westerly wind sector followed by SE. Majority of wind goes to SW direction.

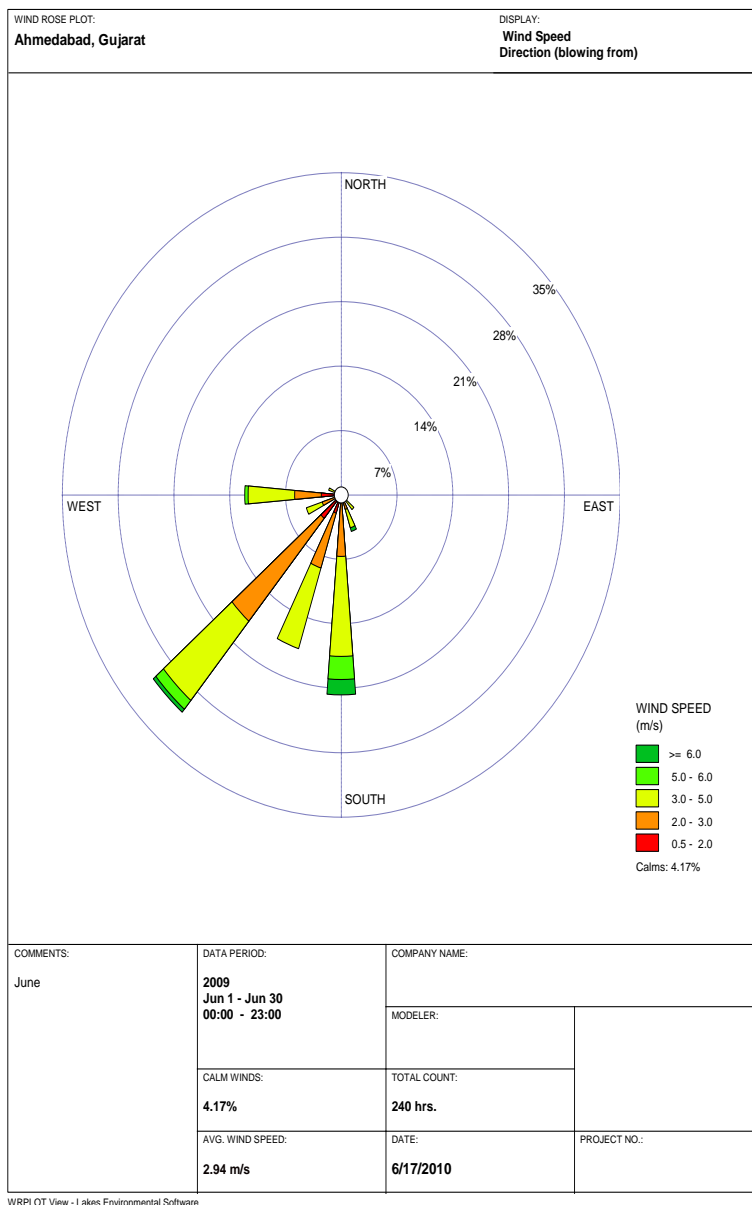
The pre-dominant wind speed is in the range of 3.0 to 5.0 m/s followed by wind range of 2.0 to 3.0 m/s & 0.5 to 2.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 8.05%



**Figure 20 May wind rose**

Figure 21 depicts June average wind rose which tends to indicate predominant wind direction is SW. In June maximum wind goes to SW direction..

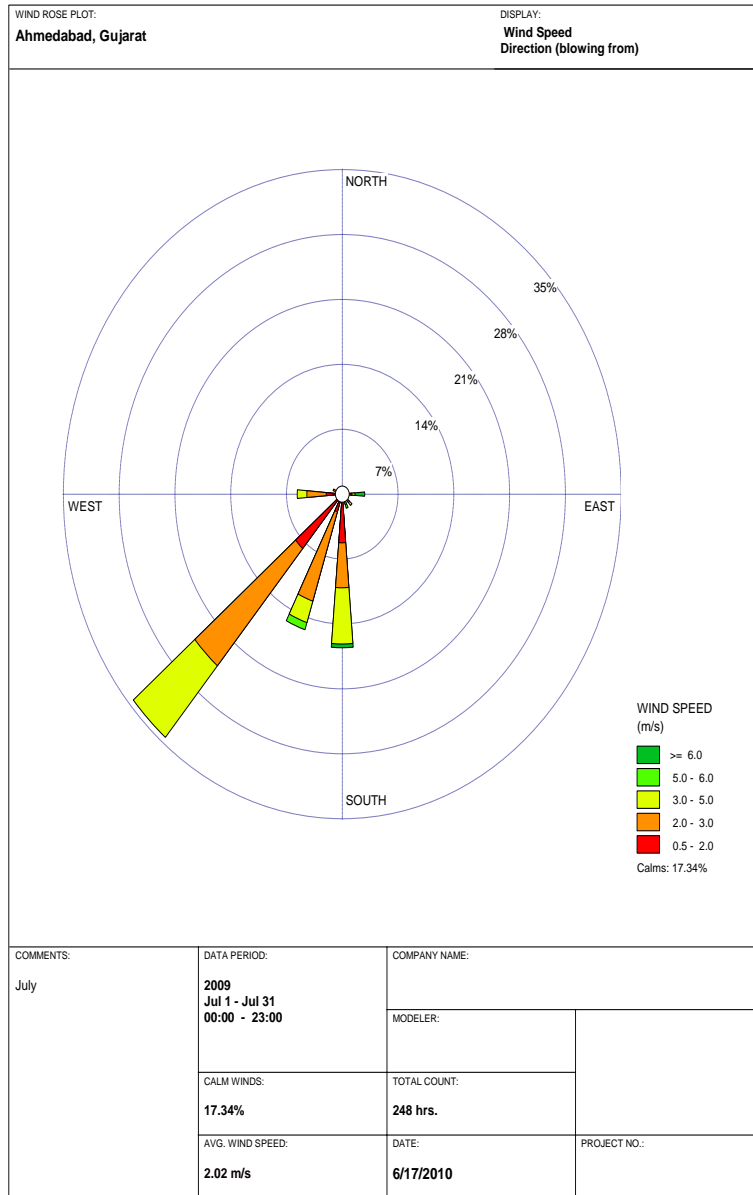
The pre-dominant wind speed is in the range of 3.0 to 5.0 m/s followed by wind range of 2.0 to 3.0 m/s & 0.5 to 2.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 4.17%



**Figure 21 June wind rose**

Figure 22 depicts July average windrose which tends to indicate predominant wind direction is SW. In July majority of wind goes to SW direction.

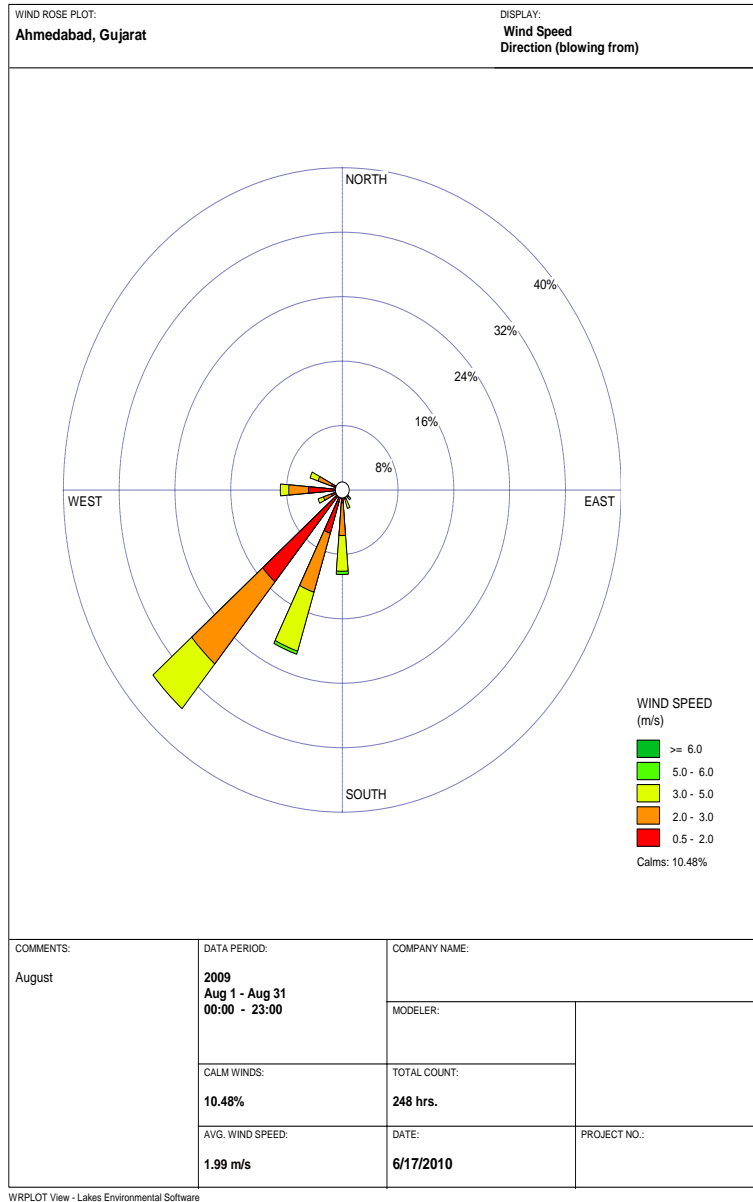
The pre-dominant wind speed is in the range of 2.0 to 3.0 m/s followed by wind range of 0.5 to 2.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 17.34%



**Figure 22 July wind rose**

Figure 23 depicts August average wind rose which tends to indicate predominant wind direction as SW along with predominant south westerly wind sector followed by NW. Majority of wind goes to SW direction and very few percent wind goes to NW direction.

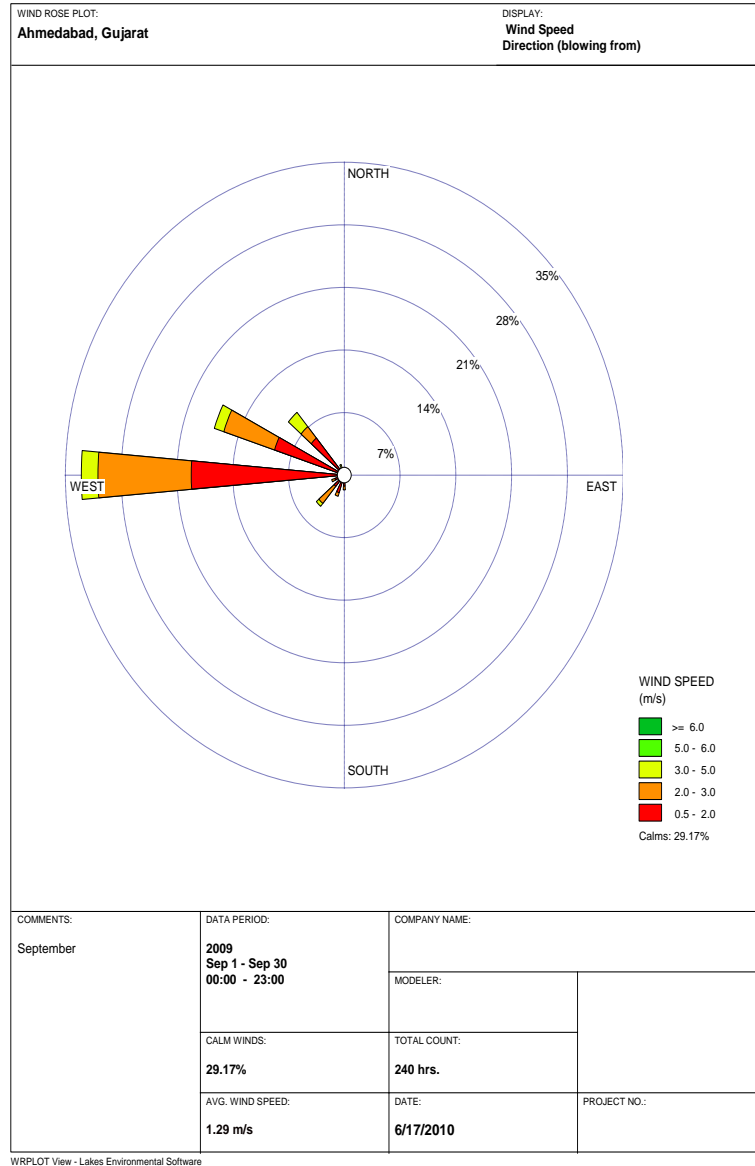
The pre-dominant wind speed is in the range of 2.0 to 3.0 m/s followed by wind range of 0.5 to 2.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 10.48%



**Figure 23 August wind rose**

Figure 24 depicts September average windrose which tends to indicate predominant wind direction as W along with predominant westerly wind sector followed by NW. Majority of wind goes to west direction.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 29.17%

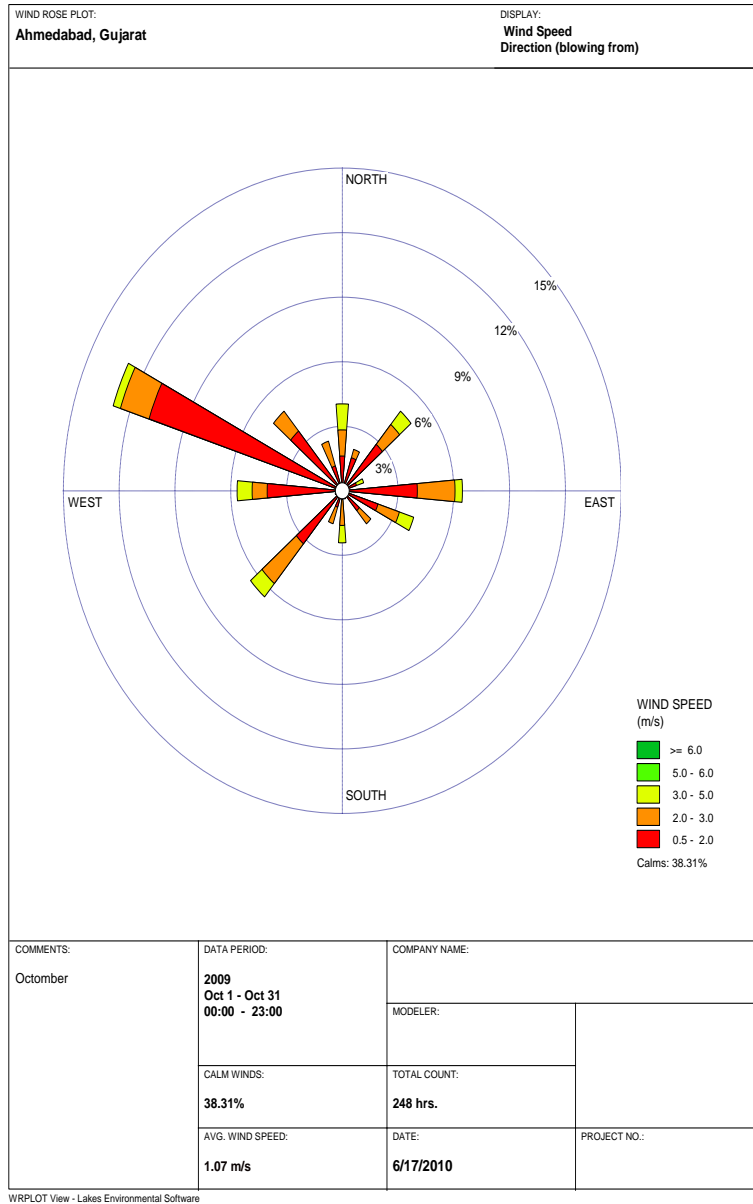


**Figure 24 September wind rose**

Figure 25 depicts October average windrose which tends to indicate predominant wind direction as NW along with predominant north westerly wind sector followed by NE, SW & SE.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 38.31%

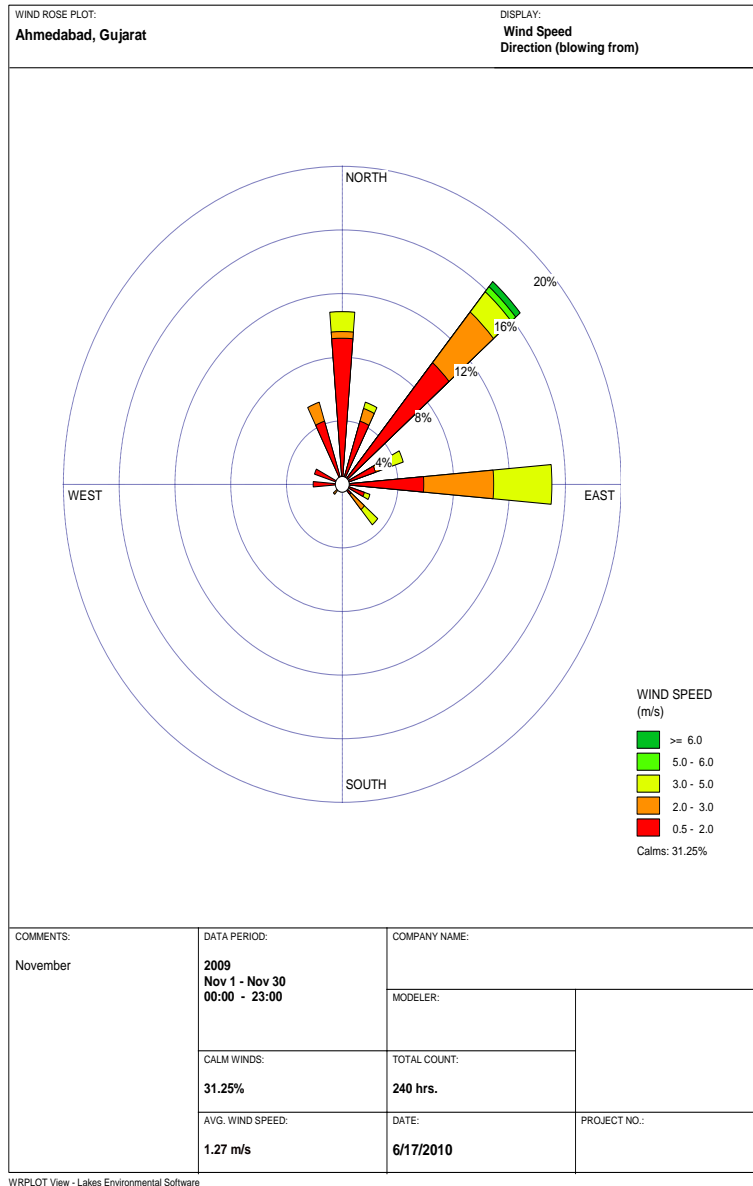




**Figure 25 October wind rose**

Figure 26 depicts November average windrose which tends to indicate predominant wind direction as NE along with predominant North Easterly wind sector followed by NW and SE.

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 31.25%



**Figure 26 November wind rose**

Figure 27 depicts December average windrose which tends to indicate predominant wind direction as NE along with predominant North Easterly wind sector followed by NW .

The pre-dominant wind speed is in the range of 0.5 to 2.0 m/s followed by wind range of 2.0 to 3.0 m/s & 3.0 to 5.0 m/s and > 6 m/s. Majority of the winds have been observed below 5 m/s. The % of calm winds is also significant with 42.31 %

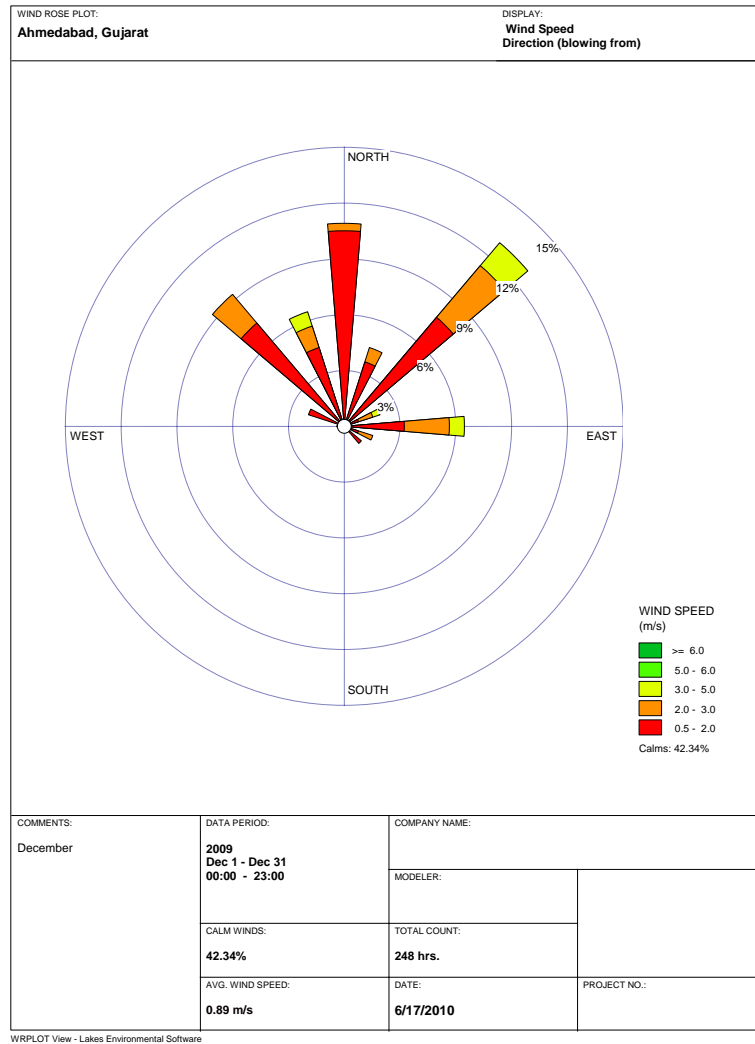


Figure 27 December wind rose

The above figures 16 to 27 are the monthly wind roses, starting from January till December. The table below indicates predominant wind direction, wind speed range and calm conditions during these months.

Table: 1 Monthly wind speed, predominant wind speed range and calm condition in %

Months	Predominant wind direction	Predominant wind speed range (m/s)	Clam condition, %
January	NE	0.5 - 2	20.56
February	NW	0.5 - 2	22.77
March	NW	0.5 - 2	16.94
April	NW	0.5 - 2	15.42
May	SW	3 - 5	8.05
June	SW	3 - 5	4.17
July	SW	2 - 3	17.34
August	SW	2 - 3	10.48
September	W	0.5 - 2	29.17
October	NW	0.5 - 2	38.31
November	NE	0.5 - 2	31.25
December	NE	0.5 - 2	42.31

**Conclusion:**

The table above would tend to show that the predominant wind directions changes monthly but having regard to seasonal months. For example, winter month (Nov. - Jan.) indicate NE as predominant wind directions, whereas, Feb - April shows NW, May – August SW as predominant wind directions. The months August and September appears to be peculiar months which shows W and NW respectively as predominant wind direction.

Similarly, predominant wind speed range is 0.5 - 2 m/s during months September to April ( 8 months ) but 3 - 5 m/s shows in the months May and June, possibly due to summer months and turbulence created during these months. For July and Aug. months, the wind speed is predominant in the range of 2 - 3 m/s.

The clam conditions are maximum during the months December to the extent of 42.31 % followed by 38.31% in the months of October, 31.25 % in November and 29.17 % in the month of September. It tends to show that winter months have maximum calm condition as composed to other months. The reasons for this may be attributed partly on account of stable atmosphere and partly due to least incoming solar radiations, less turbulence, temperature inversion conditions etc. The minimum calm conditions observed during May and June months of the order of 8.05 % and 4.17 % respectively. This may be due to summer months, significant turbulence occurs and outgoing solar radiation are maximum with their wind speeds.