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INVESTIGATION OF WIND PAR AMETERS AT AN AKURE STATION

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ABSTRACT

The role of wind cannot be overemphasized. It has been used for centuries in electric power generation and its role has been identified in many disease epidemics. We aim to investigate the wind direction and speed pattern at the surface (ground level) for four months in a year. Data for this research was obtained from the Wireless weather station installed on the 220 m Nigeria Television Authority (NTA) TV tower station located at Iju, Akure, South-West Nigeria (longitude 5'11'24?E(5.19'E) and latitude of 7'15'00?N (7.25'N)). The months of January and February (representing wet season) while the months of June and September (representing dry season) in 2009 were chosen for analysis. A simple angular histogram is obtained by wrapping a linear histogram round a circle, however it is more common to display angular data with each group as a sector, which is termed a wind rose. Wind speed and directions for the dry months under consideration show noticeable pattern while the wet months do not show any pattern.

Keywords: wind direction, wind speed, feather plots, polar plots

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1.0 INTRODUCTION

Wind speed is a common factor in the design of structures and buildings. Numerous studies has been conducted on the effect of wind speed on buildings and structures (Kumar and Swani, 2010;) disease (Pedersena and Morall, 2009, Limpert, 2008), modeling wind direction(Hirata et al, 2008) and investigating wind speed or direction(Hirata et al 2004; Hussin *et al*, 2006) . It is important to investigate the wind pattern (speed and direction) in a place before the construction of certain structures. Wind direction and wind speed are also important for monitoring and predicting weather patterns and global climate. The construction of wind farms to harness energy from the wind should not be done without recourse to detailed wind speed and direction pattern in the proposed location for maximum output from the proposed farm. Large wind turbine (>4MW) cannot be turned into the wind like smaller wind turbines so they must be constructed to work in the direction of the prevailing wind direction in the location.

In the light of recent advocacy for alternative energy, there is a great need to investigate not only the wind potential but direction of the wind to build an optimum wind turbine. Furthermore, the study area is hilly, as such investigating wind direction will reveal wind directions that can affect structures such as buildings and communication masts.

2.0 MATERIALS AND METHODS

The experimental data were collected using Integrated Sensor Suite, ISS (Davis 6162 wireless vantage Pro) at the weather station situated at Iju, Akure, Ondo state Nigeria. The equipment is an automatic weather station which has the capacity to measure the following parameters: **barometric pressure, temperature, humidity, rainfall, wind speed, and wind direction.** The study area is being characterized as coastal due to the high rainfall and low temperature. Due to the deluge of data, the study was restricted to four months in the year 2009. The months of January and February were chosen as representatives of dry months while June and September were chosen as representative of wet months.

The collected data were analyzed using excel software package while the graphical representation of the wind direction and speed pattern was plotted using Matlab software package. The wind directions were converted from the raw cardinal points to angles in radians. To show the information about the distributions of wind

speeds, and the frequency of the varying wind directions, one may draw a so-called **wind rose** on the basis of meteorological observations of wind speeds and wind directions. A look at the wind rose is extremely useful for sitting wind turbines. If a large share of the energy in the wind comes from a particular direction, then you will want to have as few obstacles as possible, and as smooth a terrain as possible in that direction, when you place wind turbines in the landscape (Soren Krohn , 2002)

3.0 RESULTS

The results for wind speed and direction for the month on January, 2009 as seen on a rose plot are shown in figures 1 – 4, February 2009 (figures 5 – 8), June 2009 (Figures 9 – 12) and September 2009 (Figures 13 – 16)

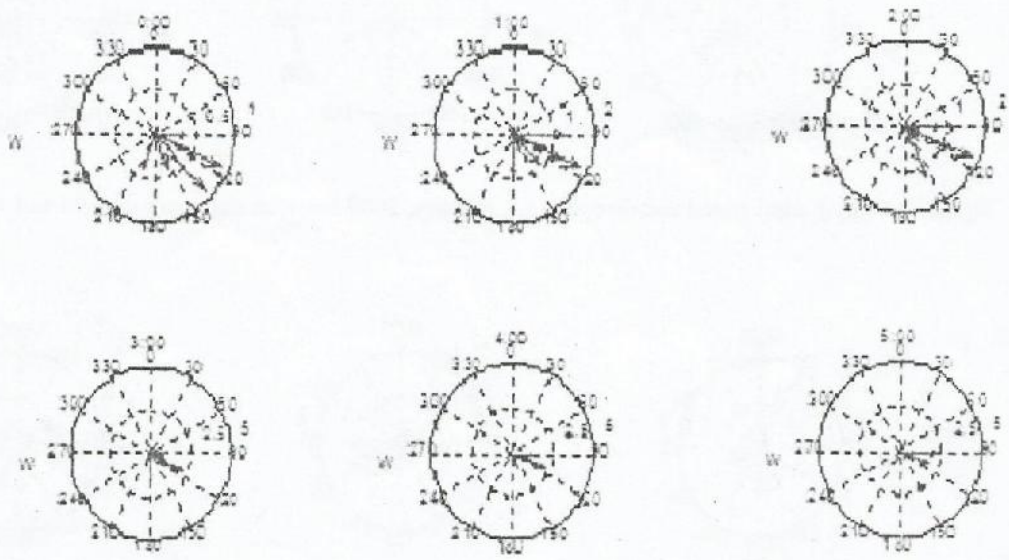

Figure 1: Plot of wind speed and direction for January, 2009 between the hours of 0:00 and 5:00

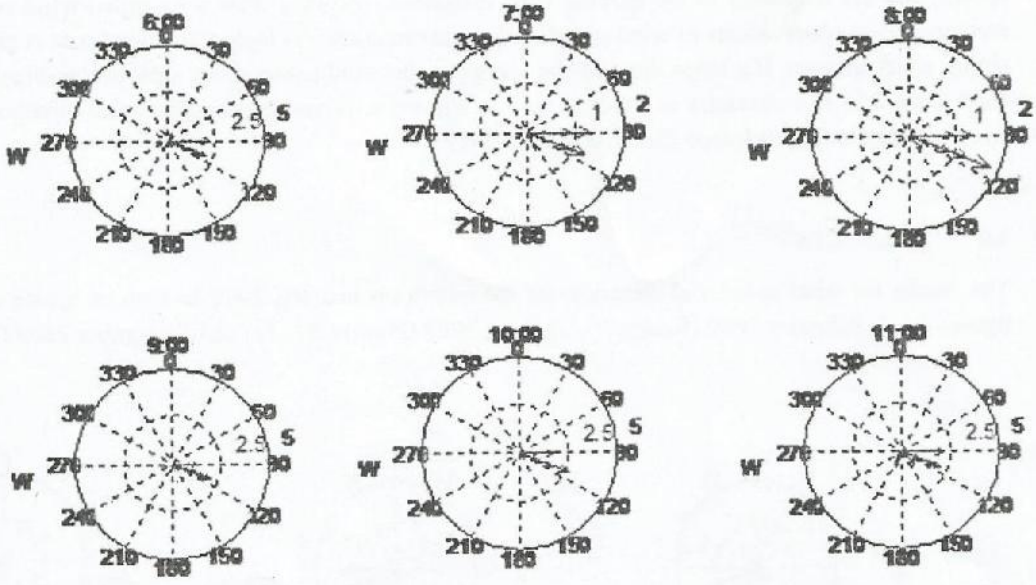

Figure 2: Plot of wind speed and direction for January, 2009 between the hours of 6:00 and 11:00

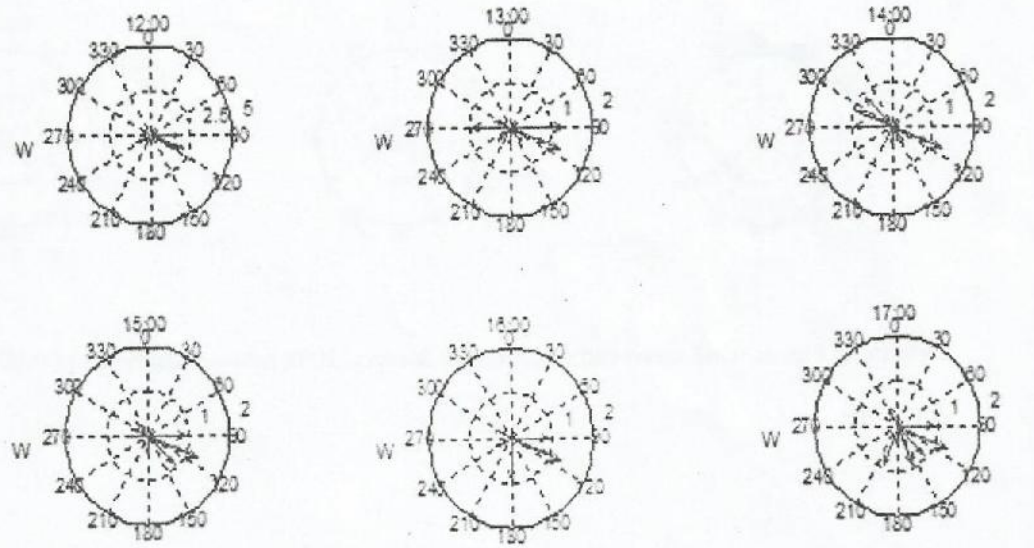

Figure 3: Plot of wind speed and direction for January, 2009 between the hours of 12:00 and 17:00

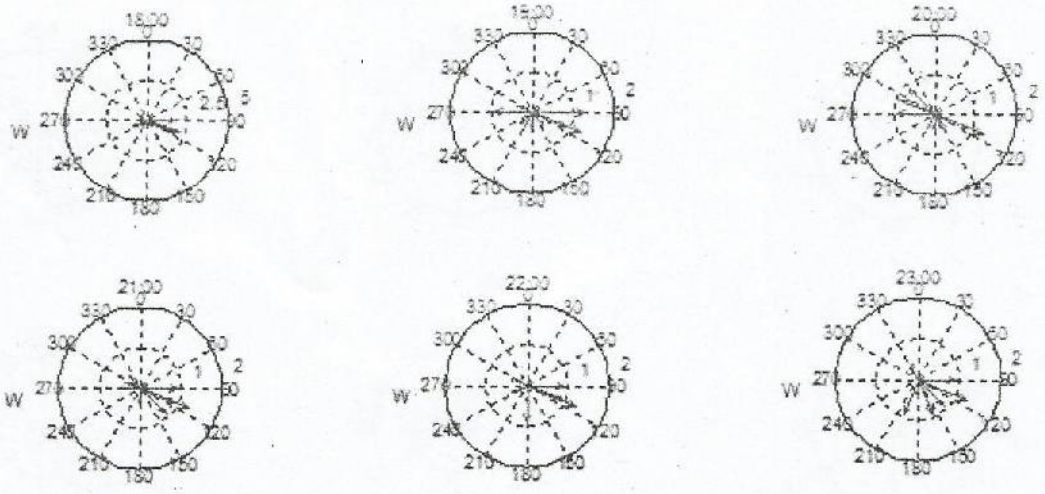

Figure 4: Plot of wind speed and direction for January, 2009 between the hours of 18:00 and 23:00

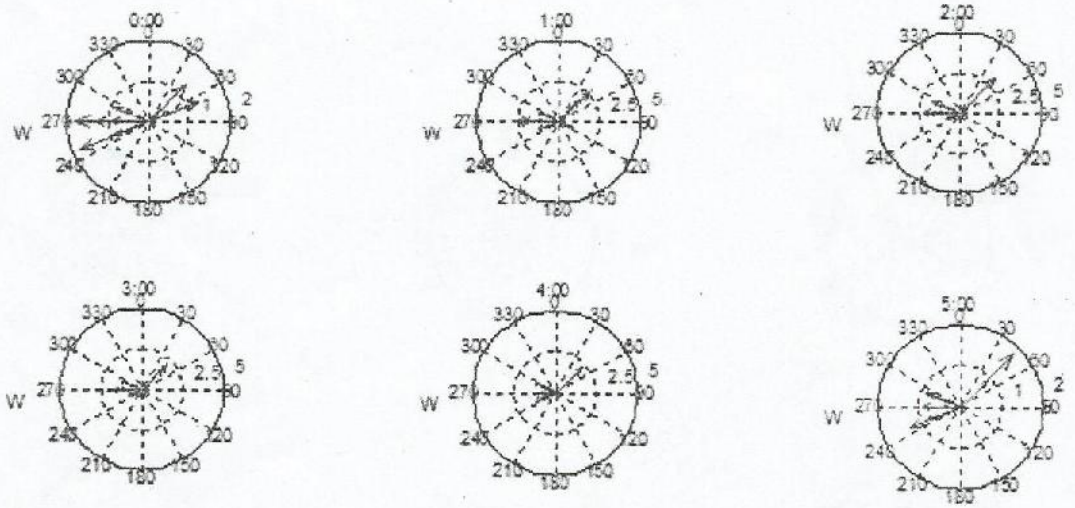

Figure 5: Plot of wind speed and direction for February, 2009 between the hours of 0:00 and 5:00

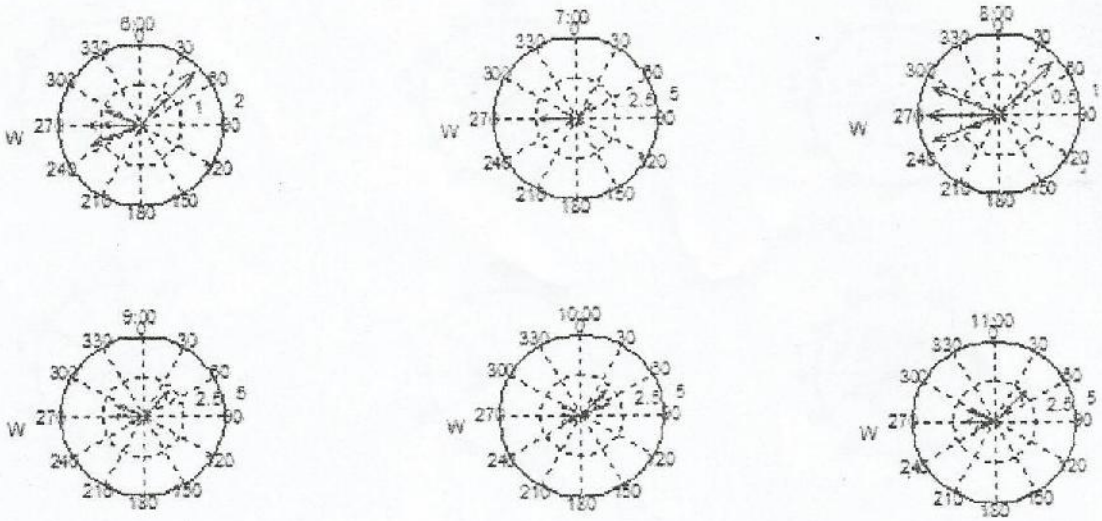

Figure 6: Plot of wind speed and direction for February, 2009 between the hours of 6:00 and 11:00

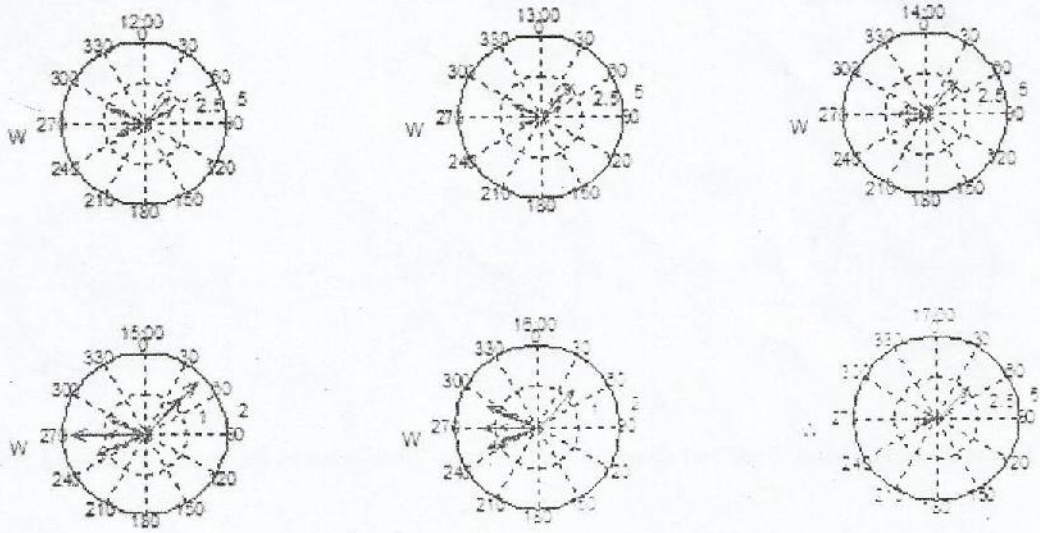

Figure 7: Plot of wind speed and direction for February, 2009 between the hours of 12:00 and 17:00

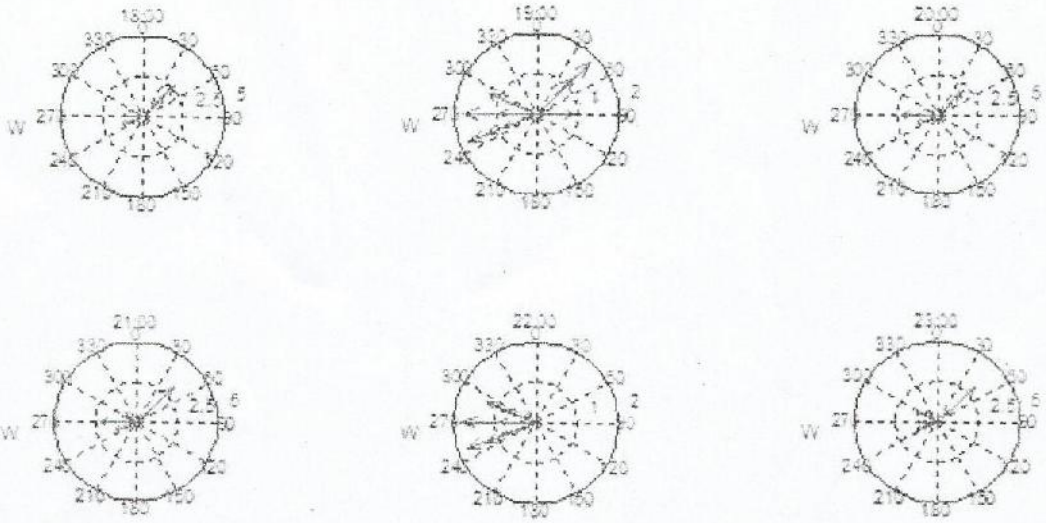

Figure 8: Plot of wind speed and direction for February, 2009 between the hours of 18:00 and 23:00

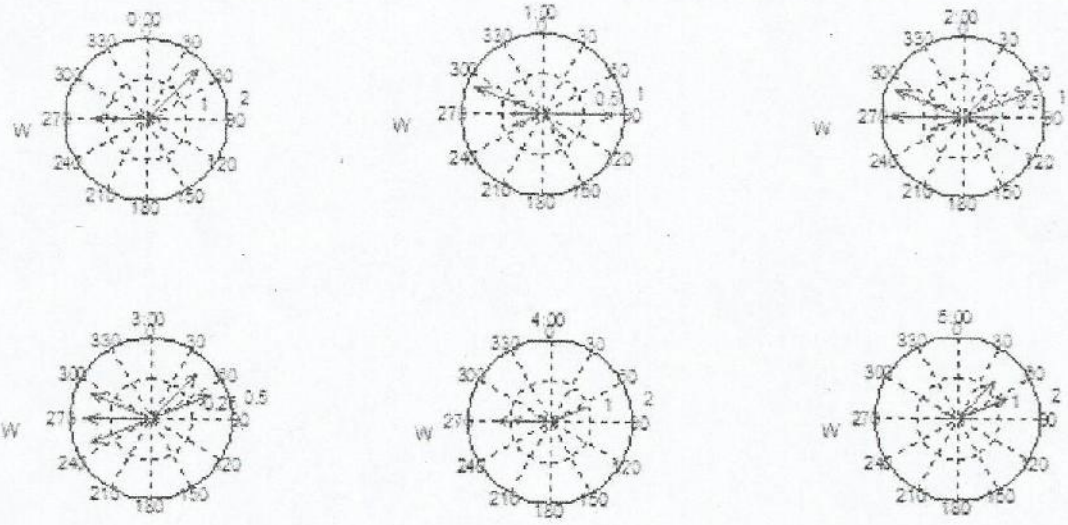

Figure 9: Plot of wind speed and direction for June 2009 between the hours of 0:00 and 5:00

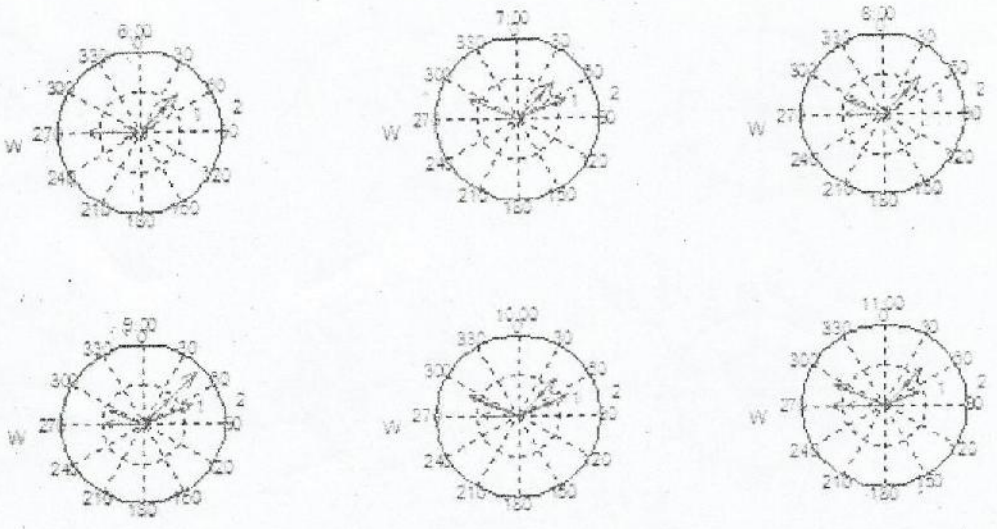

Figure 10: Plot of wind speed and direction for June 2009 between the hours of 6:00 and 11:00

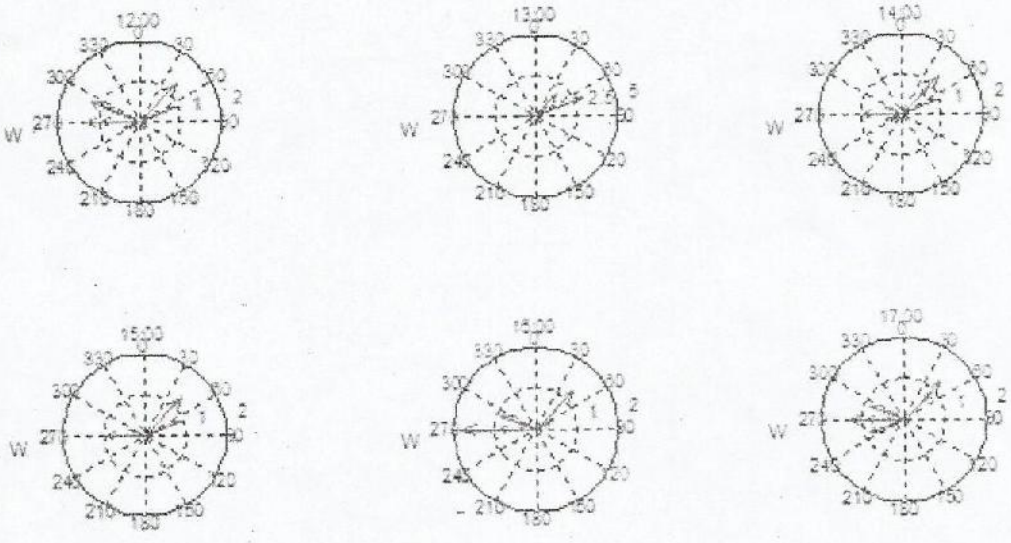

Figure 11: Plot of wind speed and direction for June 2009 between the hours of 12:00 and 17:00

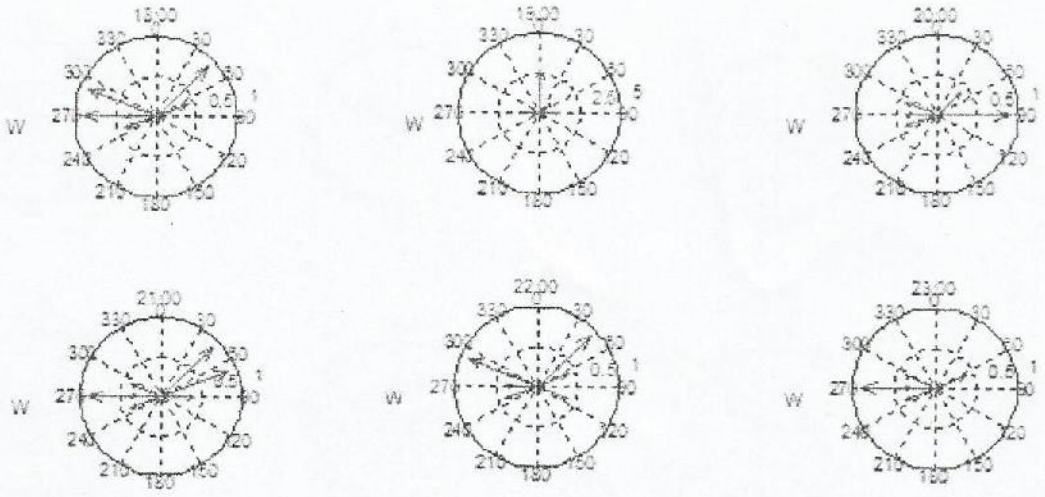

Figure 12: Plot of wind speed and direction for June 2009 between the hours of 18:00 and 23:00

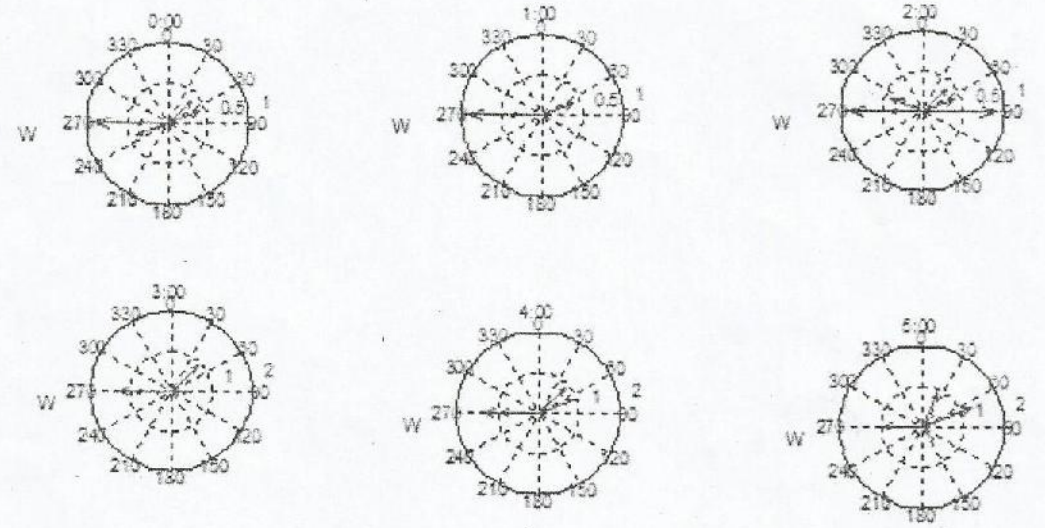

Figure 13: Plot of wind speed and direction for September 2009 between the hours of 0:00 and 5:00

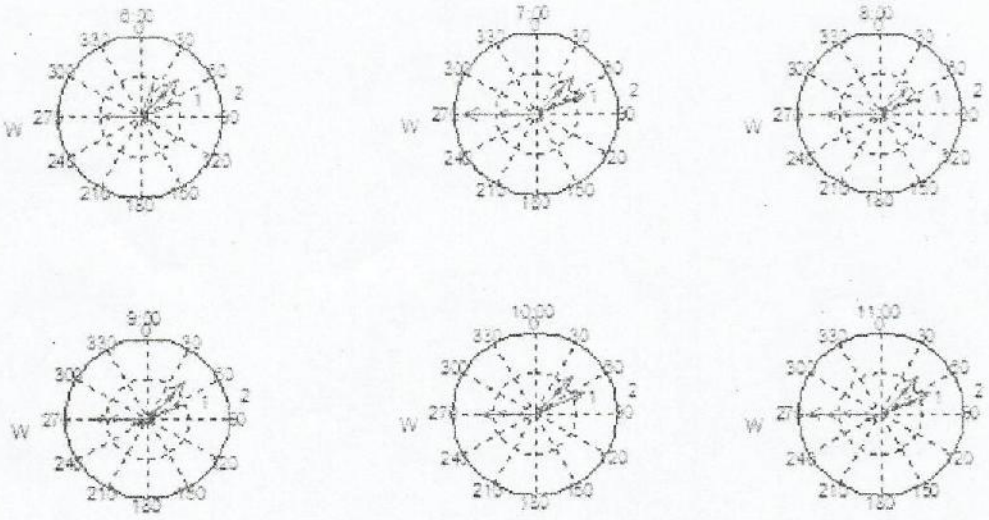

Figure 14: Plot of wind speed and direction for September 2009 between the hours of 6:00 and 11:00

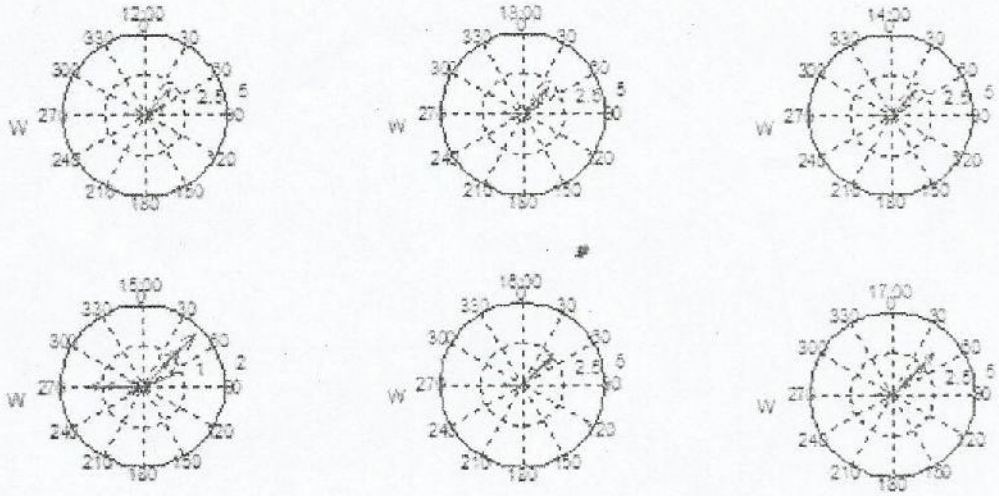

Figure 15: Plot of wind speed and direction for September 2009 between the hours of 12:00 and 17:00

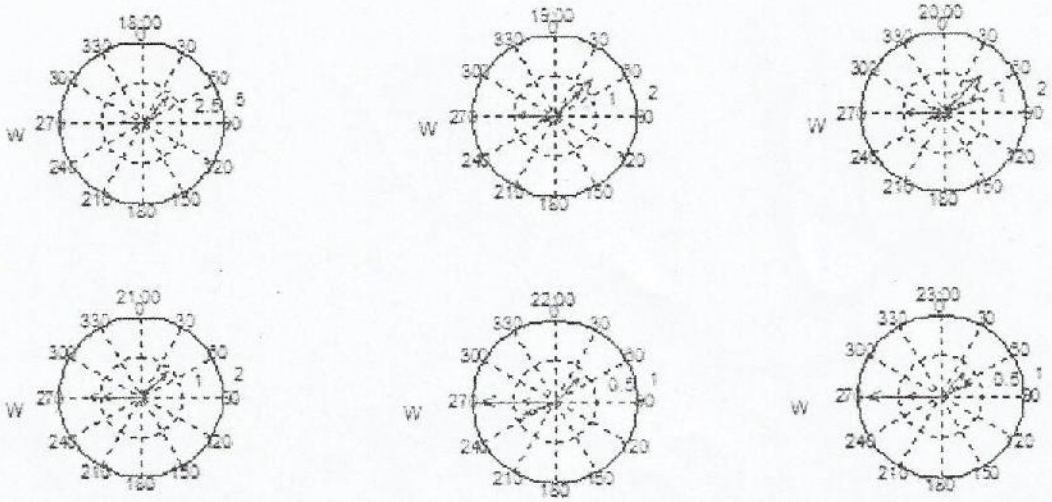

Figure 16: Plot of wind speed and direction for September 2009 between the hours of 18:00 and 23:00

The monthly data was also plotted on a rose plot and shown in Figure 17 (January), Figures 18 (February), Figure 19 (June) and Figure 20 (September).

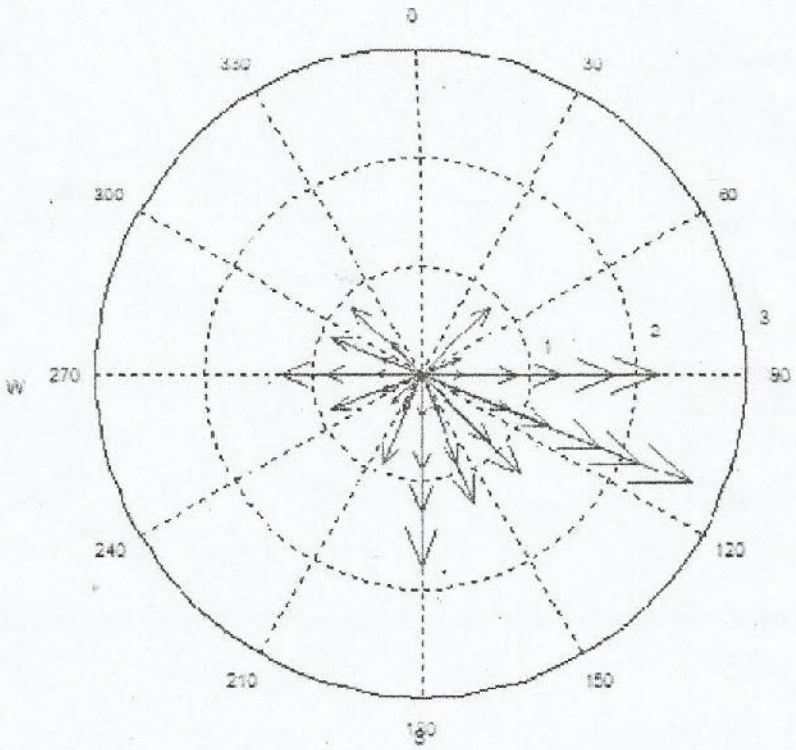

Figure 17: Rose plot for the wind direction and speed over the study area for the month of January, 2009.

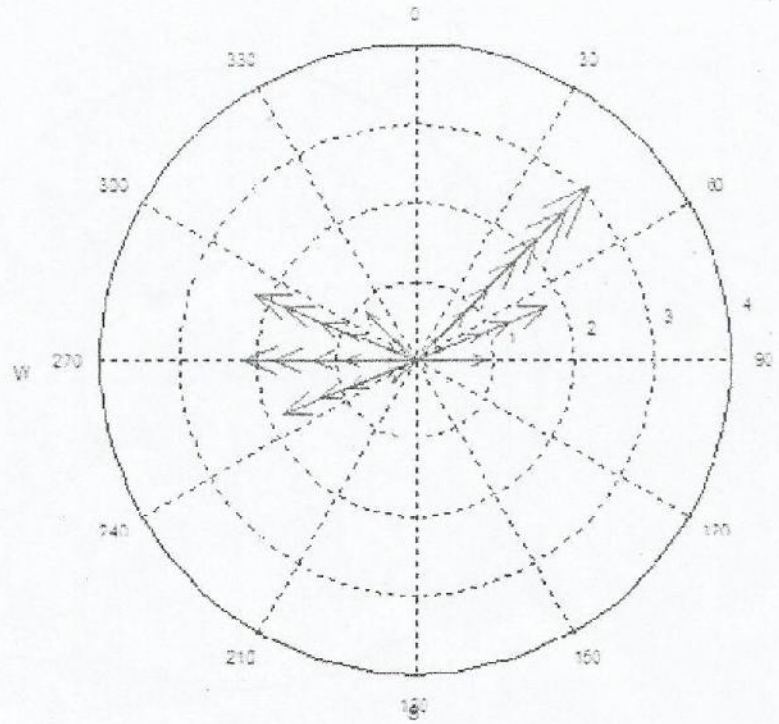

Figure 18: Rose plot for the wind direction and speed over the study area for the month of February, 2009.

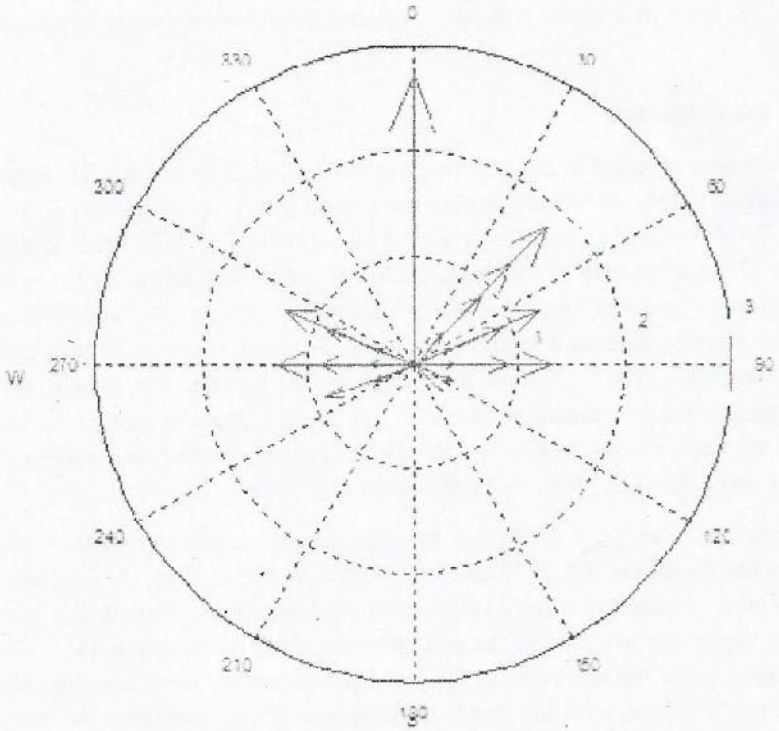

Figure 19: Rose plot for the wind direction and speed over the study area for the month of June, 2009.

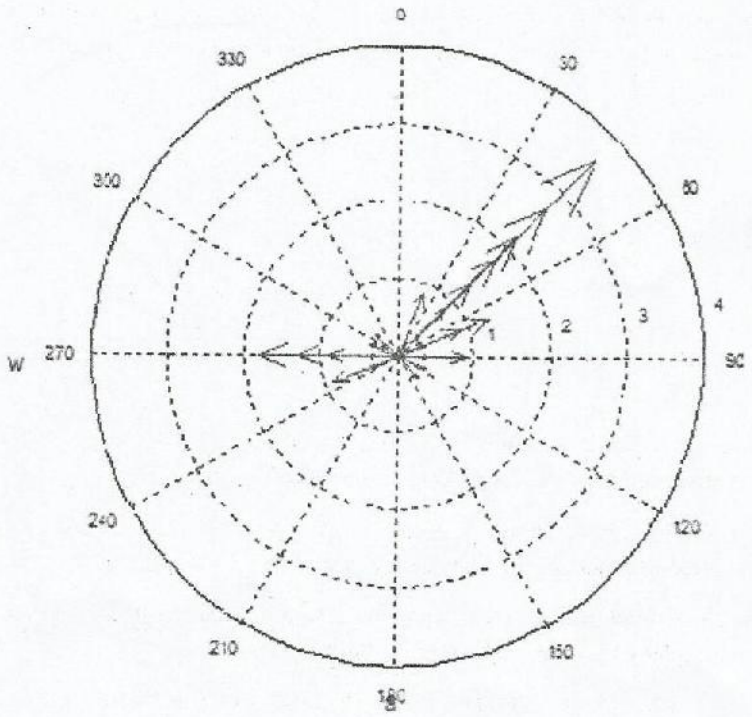

Figure 20: Rose plot for the wind direction and speed over the study area for the month of September, 2009.

4.0 DISCUSSION

From the results obtained in the previous section, we can infer that wind direction and speed over the study area do not follow a specific pattern during the period under investigation. For all the hours in the month of January, 2009 the wind strength is greatest in the direction of 117° while wind speed was predominantly in the direction 45° in the month of February, 2009. The month of June, 2009 also show predominant wind speed in the direction 45° and 270° (for some hours, especially between 1800 and 2300hours) for certain hours of the day but the wind speed changes direction frequently, such that, it cannot be reasonably concluded that the directions are predominant. The month of September, 2009 follows the pattern of June, 2009, with wind speed predominant in the directions 45° and 270°. An optimal angle of ~240° was obtained by Goh et al (2006) for a coastal area while the range 210° – 240° shows high wind speed while mean directions of 212° and 287° were found for two regions of Malaysia by Hussin et al (2006).

Considering the total wind speed and direction for the month of January, 2009, wind directions were pointed mostly in the directions 90°, 117° and 180° with 117° dominating. In February, the predominant direction was 45° with other contending directions between 240° and 300°. June shows predominant direction along 0° and 45° while September has most of the wind flowing along the direction 45°. The random wind directions during rainy months might be attributed to the influence of coastal wind bringing rain-clouds. The dry months have steady wind directions, probably due to the influence of dry winds from the North during harmattan.

5.0 CONCLUSION

Consequently, we propose that buildings and structures that are sensitive to wind should not be constructed in the direction of prevailing winds for wet and dry months. Also, health practitioners should warn the public (especially population in the path of the prevailing wind) to be cautious of wind-borne infectious diseases. Finally, this research reveals directions suitable for positioning of wind turbines for maximum efficiency A good location of the blades of any wind turbine constructed in the study area should be in the direction 45° and

270° , as this has been seen to be the predominant wind directions.. We suggest that other methods such as nonlinear modeling be used in the area to better understand the wind dynamics and develop prediction models.

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