International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 4 Issue 2, Feb.-2015, pp: (73-78), Impact Factor: 1.252, Available online at: www.erpublications.com

Experimental investigation of Wind flow characteristics at RGPV Site

Vijay Sahu[1], Anurag Gour[2], Savita Vyas[3], Dr. Mukesh Pandey[4]
School of Energy & Environment Management, RGPV, Bhopal (M.P.), India

Abstract: The main objective of the study was to investigate spatial characteristics of the wind speed and direction in complex terrain that are relevant to wind energy assessment and development, as well as to wind energy system operation, management, and grid integration. Wind data from one tall Wind Mast system located in RGPV Bhopal in M.P. state situated in India operated from September 2013 to November 2013, used in the analysis. Wind speed, direction pressure and temperature at 20 and 40 meters were collected from The wind observation station, which is situated in ENERGY PARK,RGPV at the co-ordinates of E 077° 21.668' longitude and N 023° 18.720' latitude stand a mast. The average wind speed for 20 and 40 m were found to be 3.1 m/s and 2.0 m/s respectively.

Keywords: **Wind Rose, Wind energy, Renewable Energy, Wind MAST.**

Introduction

Wind is an abundant energy resource ultimately powered by the sun. it is estimated that approximately 3% of the sun's thermal energy is transformed into wind energy. wind power is replenished daily by the sun, due to the uneven heating of the earth's surface. Furthermore, the wind is accelerated by major land forms, so that entire regions may be very windy while others are relatively calm. recent studies show that current wind technology operating only in class 3 wind locations is capable of producing approximately 72 terawatts of electricity. This is forty times the amount of electrical power annually consumed worldwide and this clean power source is just beginning to be tapped on a large scale.[1]

The measured maximum speed and direction of the wind represent important data for the design, construction and exploitation of any structure with a dominant wind load. in order to optimize wind energy conversion systems and maximize the energy extraction, annual, monthly, daily, hourly, and even by-minute frequency distributions of wind data are required[2]. According to the recommendations of the Indian norms the main wind parameter used in computation of wind action upon structures is the referent wind speed vref defined as a maximum 10-minute average speed at 40m and 20 m level above the ground.

The paper presents the measurements of wind characteristics of local winds at the RGPV site at Bhopal. The investigations were carried out at an antenna column 40 m high, at three levels/heights - 20 and 40 m above the ground Three Months. The measurements included wind directions and speeds.

Wind MAST

In this study NRG Symphonie Wind MAST system is used. In this system there are 8 Channels Use for calculating the wind speed, wind direction, wind temperature and wind pressure. This system is calculating 10 minutes Averages of all these parameters. This system is consisting of Data logger. Its provides reading in the form of NRG Raw Data File (.RWD) which can be open using the NRG Symphonie Data Retriever software programs.[3]

Wind Rose

A wind rose is a graphic tool used by meteorologists to give a succinct view of how wind speed and direction are typically distributed at a particular location.[4]

Site and data description

The measurement of the wind direction and speed measure from the Wind Data which is taken by the Wind Mast system at the RGPV Bhopal. The wind observation station, which is situated in ENERGY PARK,RGPV at the co-ordinates of E 077° 21.668' longitude and N 023° 18.720' latitude stand a mast, on which is fixed equipment erected to measure the wind speed and wind direction at the height of 20 m and 40 m. And also a data logger (NRG Symphonie Plus 3Data logger) for

storing the wind speed and the information about directions, thermometer, barometer, and cables and terminals to provide the connection.

The Data were carried out on an antenna column 40 m high at Two levels: 20 m and 40 m. above the ground. The measurement data presented in the paper include for each level and for each 10-minute interval the following parameters: average wind velocities, the dominant wind direction and the highest second values of the wind speed with the respective direction and the standard deviation of the wind speed for the period from 01 September 2013 to 30 November 2013.

Methods

Three Months (01 September 2013 to 30 November 2013) monthly mean wind data from ENERGY PARK, RGPV at the co-ordinates of E 077° 21.668' longitude and N 023° 18.720' latitude were sourced from NRG Symphonie Data Retriever . daily readings over the period considered were used and subjected to various statistical operations. The data were recorded continuously using a cup generator anemometer at a height of 20 and 40m. gives the whole data spread across the period considered.

Results: The average wind speed at 40 and 20 m were found to be 3.1 m/s and 2.0 m/s respectively. The predominate wind direction at 40 and 20 m were found to be same i.e. S (139.5 degrees). The average air temperature and pressure were found to be 25° and 949.2 mb respectively.

Table-1: Average Data table of 3 months

Month	CH1 AVG(m/s)	CH2 Avg(m/s)	CH3 Avg(m/s)	CH7 Avg(Deg)	CH8 Avg(Deg)	CH9 Avg(C)	CH10 Avg(mb)
September	**3.3**	**3.5**	**2.4**	**170.9**	**173.4**	**27.6**	**946.1**
October	**3.1**	**3.3**	**2.1**	**137.8**	**140.4**	**25.8**	**949.1**
November	**3.1**	**3.2**	**1.7**	**105.7**	**104.7**	**21.6**	**952.5**
AVERAGE	**3.1**	**3.3**	**2.0**	**138.13**	**139.5**	**25**	**949.2**

Table-2: All Channel and Sensor Descriptions

Sensor Description:	Anemo 1	Anemo 2	Anemo 3	Vane 1	Vane 2	Temp	Pressure
Logger CH. Number:	Channel 1	Channel 2	Channel 3	Channel 7	Channel 8	Channel 9	Channel 10
Instrument Type:	NRG 40C Anemo	NRG 40C Anemo	NRG 40C Anemo	200 P WindVane	200 P Wind Vane	NRG 110 S	BP 20
Monitoring Height:	40 m	40 m	20 m	38 m	20 m	6 m	3 m
Slope (m/s/Hz):	0.767 m/s Per Hz	0.770 m/s Per Hz	0.768 m/s Per Hz	0.351	0.351	0.136	0.4255
Readings	3.1 m/s	3.3 m/s	2.0 m/s	138.13 deg	139.5 deg	25 C	949.2 mb
Orientation of booms	South	North	South	North	North		

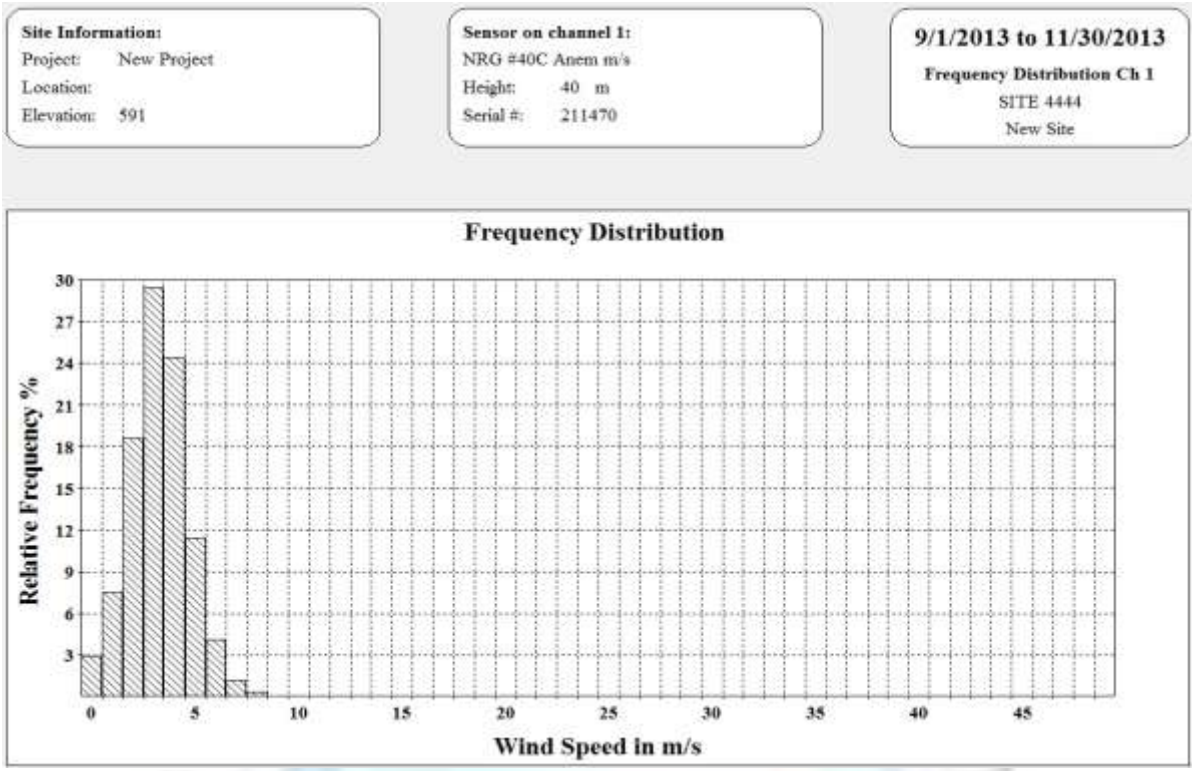

Fig. 1: Frequency Distribution of wind speed at height of 40 m (Chennel 1)

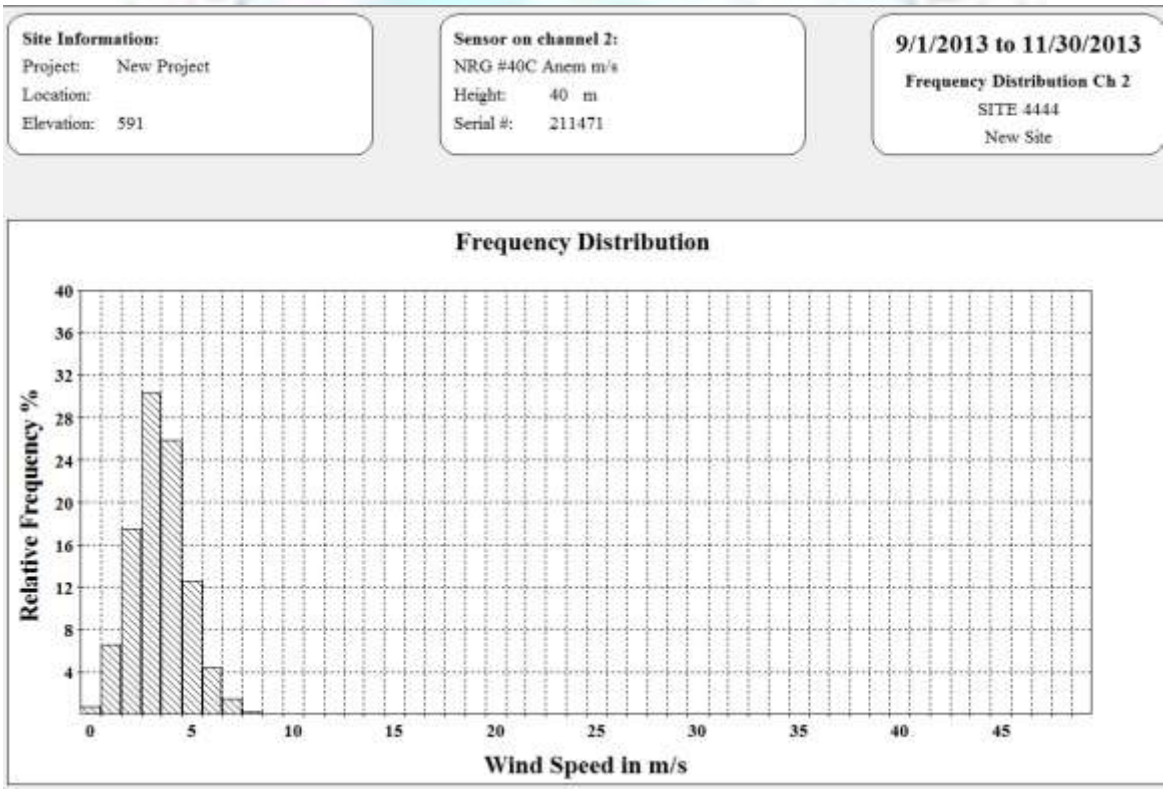

Fig. 2: Frequency Distribution of wind speed at height of 40 m(Chennel 2)

Site Information:

Project: New Project

Location:

Elevation: 591

Sensor Information:

1 NRG #40C Anem m/s
2 NRG #40C Anem m/s
3 NRG #40C Anem m/s
4 No SCM Installed
5 No SCM Installed
6 No SCM Installed
7 NRG 200P Vane deg
8 NRG 200P Vane deg
9 NRG 110S Temp C
10 NRG BP20 Baro mb
11 No SCM Installed
12 iPack Voltmeter
13 NRG #40C Anem m/s
14 NRG #40C Anem m/s
15 NRG #40C Anem m/s

9/1/2013 to 11/30/2013

Summary Report

SITE 4444

New Site

Channel	1	2	3				7	8	9	10		12	13	14	15
Height	40 m	40 m	20 m	-----	-----	-----	38 m	20 m	6 m	3 m	-----	m	0	0	0
Units	m/s	m/s	m/s	----	----	----	deg	deg	C	mb	-----	Volt	m/s	m/s	m/s
Intervals with Valid Data	13104	13104	13104				13104	13104	13104	13104		13104	13104	13104	13104
Average Filtered Data	3.2	3.34	2.03				56.5	54.7	24.98	949.23		13.51	0.4	0.4	0.4
Average for All Data	3.2	3.34	2.03				56.5	54.7	24.98	949.23		13.51	0.4	0.4	0.4
Min Interval Average	0.3	0.4	0.4						10.8	937.8		13.2	0.4	0.4	0.4
Date of Min Interval	9/9/2013	9/9/2013	9/1/2013						11/16/2013	9/21/2013		9/7/2013	9/1/2013	9/1/2013	9/1/2013
Time of Min Interval	12:00:00 AM	12:00:00 AM	7:20:00 PM						5:50:00 AM	2:50:00 AM		6:40:00 AM	12:00:00 AM	12:00:00 AM	12:00:00 AM
Max Interval Average	10.6	10.6	7.8						35.4	960		14.2	0.4	0.4	0.4
Date of Max Interval	9/20/2013	9/20/2013	9/20/2013						9/14/2013	11/4/2013		11/16/2013	9/1/2013	9/1/2013	9/1/2013
Time of Max Interval	2:50:00 PM	2:50:00 PM	2:50:00 PM						2:10:00 PM	10:10:00 AM		8:30:00 AM	12:00:00 AM	12:00:00 AM	12:00:00 AM
Average Interval SD	0.67	0.65	0.68				10.55	17.15	0.1	0.14		0	0	0	0
Min Sample	0.3	0.4	0.4						10.8	938		13.1	0.4	0.4	0.4
Date of Min Sample	9/1/2013	9/1/2013	9/1/2013						11/16/2013	9/20/2013		11/19/2013	9/1/2013	9/1/2013	9/1/2013
Time of Min Sample	2:50:00 PM	10:40:00 PM	12:00:00 AM						5:40:00 AM	3:00:00 PM		8:00:00 AM	12:00:00 AM	12:00:00 AM	12:00:00 AM
Max Sample	15.6	16.3	15						35.9	960.6		14.6	0.4	0.4	0.4
Date of Max Sample	9/20/2013	9/20/2013	9/20/2013						9/14/2013	11/4/2013		11/19/2013	9/1/2013	9/1/2013	9/1/2013
Time of Max Sample	2:40:00 PM	2:40:00 PM	2:40:00 PM						2:10:00 PM	10:20:00 AM		8:30:00 AM	12:00:00 AM	12:00:00 AM	12:00:00 AM
Average Interval TI	0.24	0.22	0.37										0	0	0
Wind Speed Direction							ENE	ENE							

Fig. 3: Summry report of wind mast system

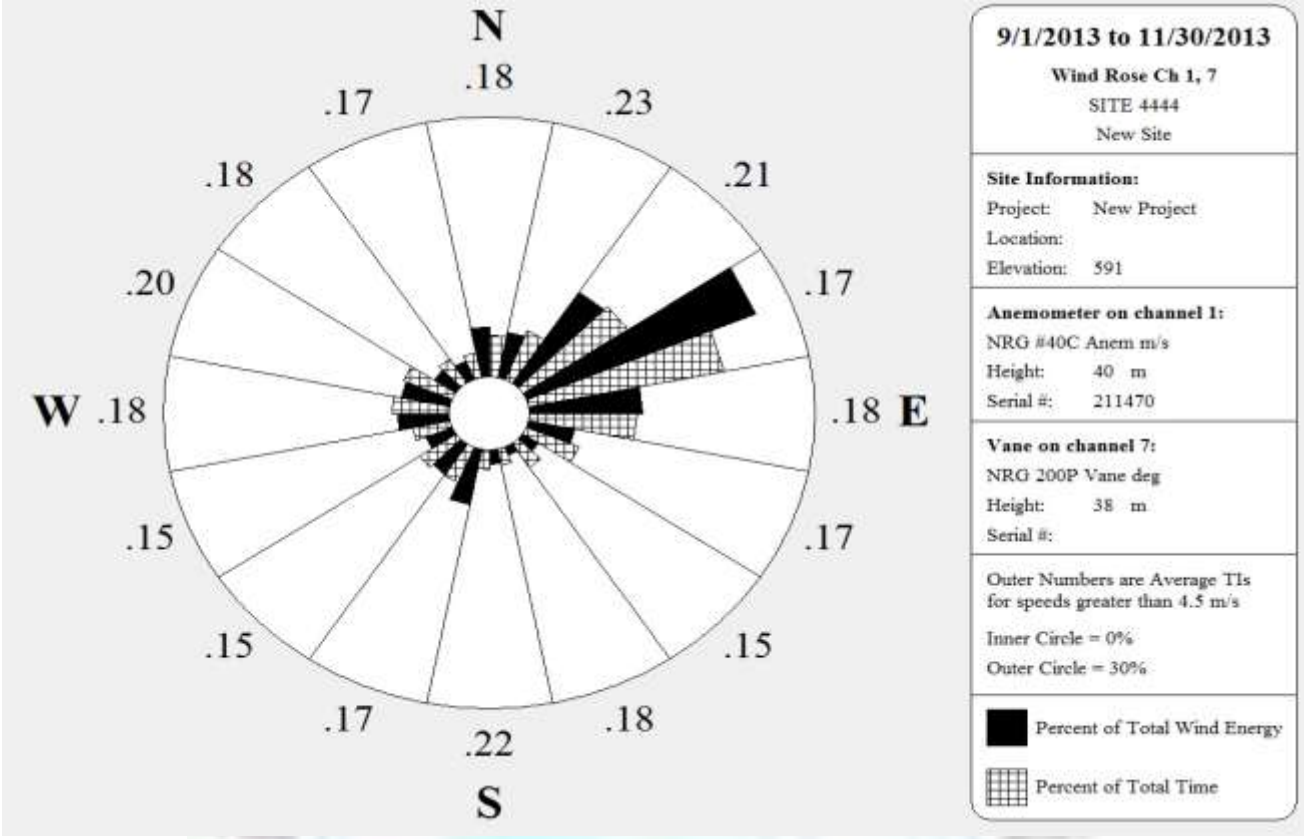

Fig. 4: Wind Rose of wind speed at hieght 40 m v/s wind vane at hieght 38 m(Chennel 1 v/s Chennel 7)

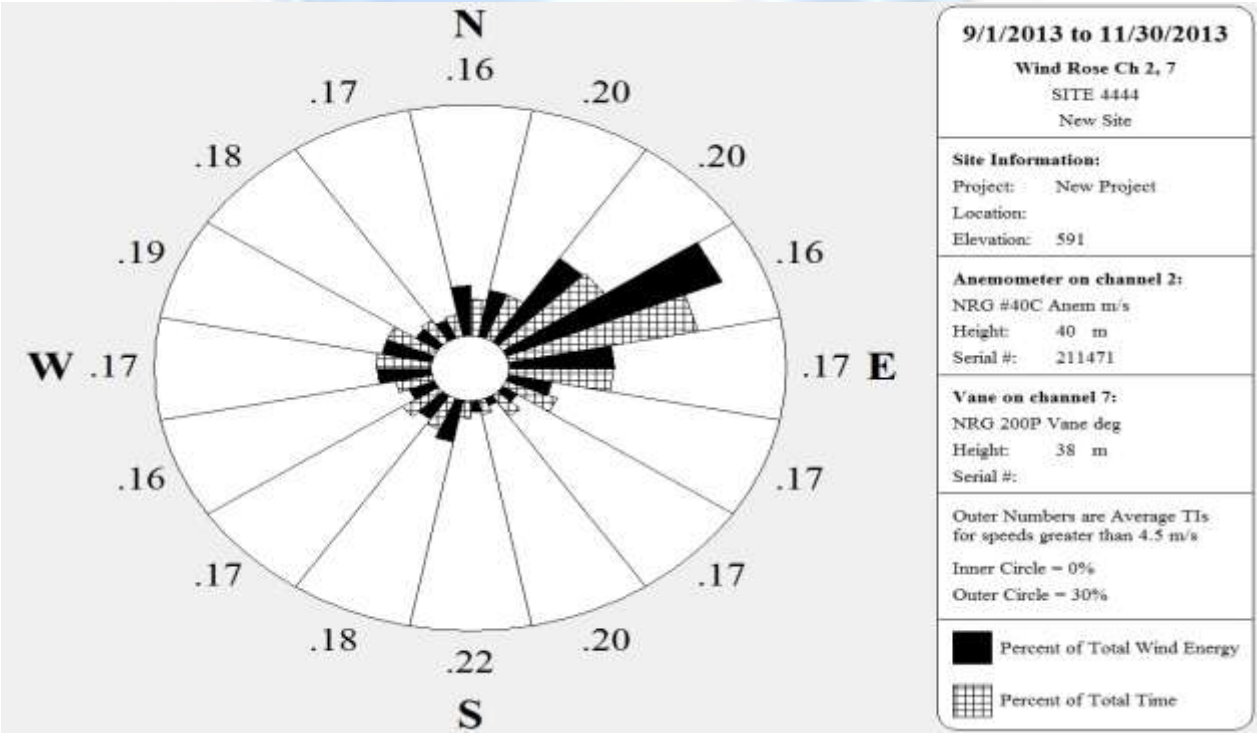

Fig. 5 Wind Rose of wind speed at hieght 40 m v/s wind vane at hieght 38 m(Chennel 2 v/s Chennel 7

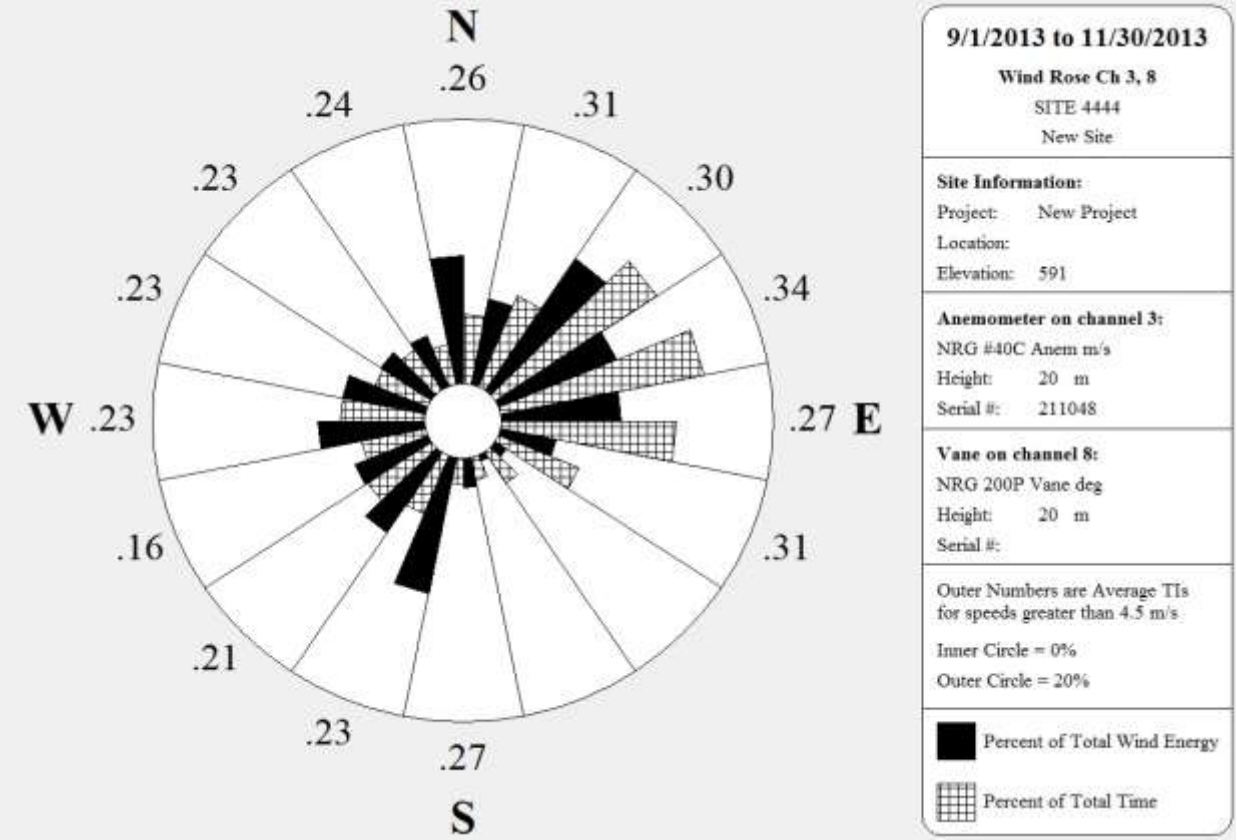

Fig. 6: Wind Rose of wind speed at hieght 20 m v/s wind vane at hieght 20 m(Chennel 3 v/s Chennel 8)

Conclusion

The Study of the characteristics of winds were find out at the RGPV Bhopal location in order to find out the monthly wind speed at two heights and Wind direction . The Study showed that the average wind speed for 20 and 40 m were found 2.06 m/s and 3.25 m/s respectively. The wind direction found were (139 degrees) from both 20m and 40m heights. And the maximum wind speed found to be 3.5 m/s in the month of September and minimum 3.1 m/s in the month of November it was shown that for the wind speed at an height of 40 m the wind profile can be approximated for a particular dominant direction.

References

[1]. ChinchillaWindVAWT_2011-01-0
Wind Power Technologies: A Need for Research and Development in Improving VAWT's Airfoil Characteristics, By Dr. Rigoberto Chinchilla, Dr. Samuel Guccione, & Mr. Joseph Tillman
[2]. Volume 2013 (2013),ArticleID 739162,12pages Available at: http://dx.doi.org/10.1155/2013/739162
[3]. Research Article Statistical and Spectral Analysis of Wind Characteristics Relevant to Wind Energy Assessment Using Tower Measurements in Complex Terrain Radian Belu and Darko Koracin
[4]. http://www.nrgsystems.com/AllProducts/ SensorsandTurbineControl/StandardSensors.aspx
[5]. http://en.wikipedia.org/wiki/Wind_rose