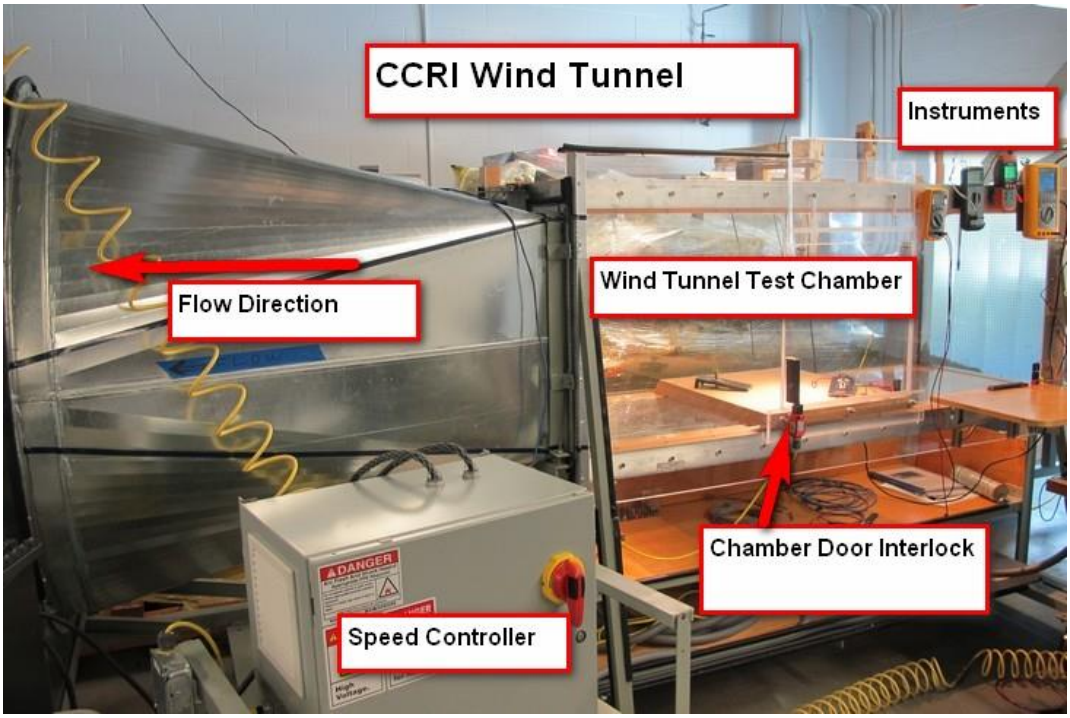
Introduction

The CCRI wind tunnel designed and built by Professor Michael Rinaldi will be used to test your wind turbines. The wind turbine under test will be placed in the test chamber of the wind tunnel and test instruments connected. Varying wind speed and load resistors the characteristics of the wind turbine will be measured.

After all data is collected the data will be analyzed using the Excel spreadsheet template.

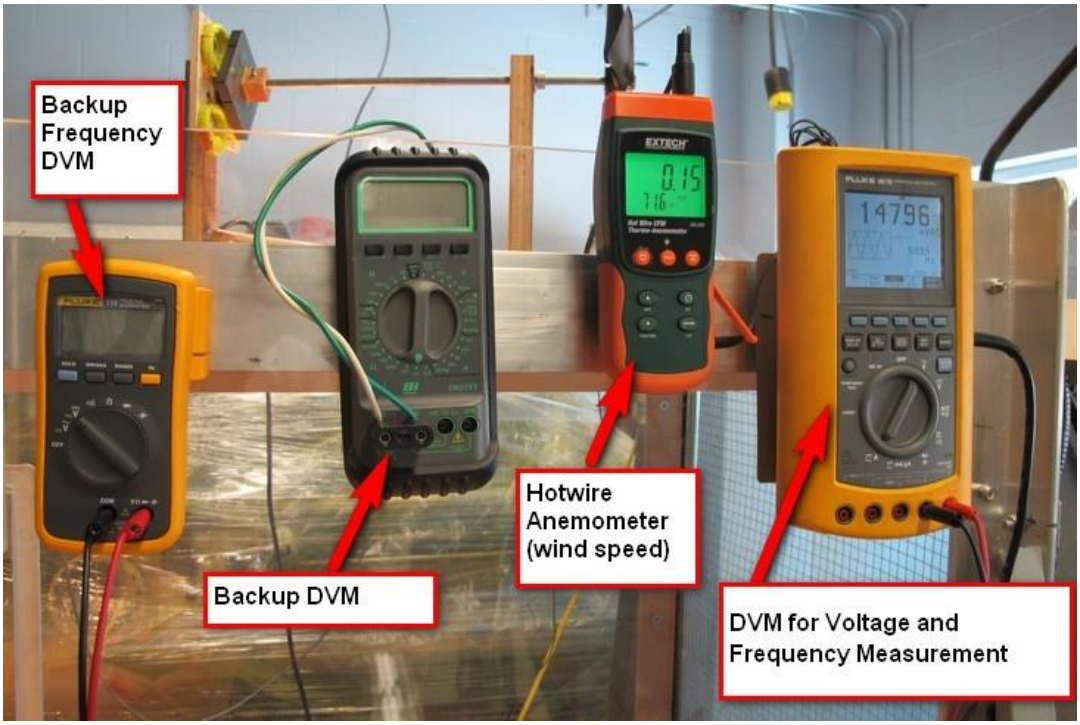
Wind Tunnel



Wind Tunnel Instruments

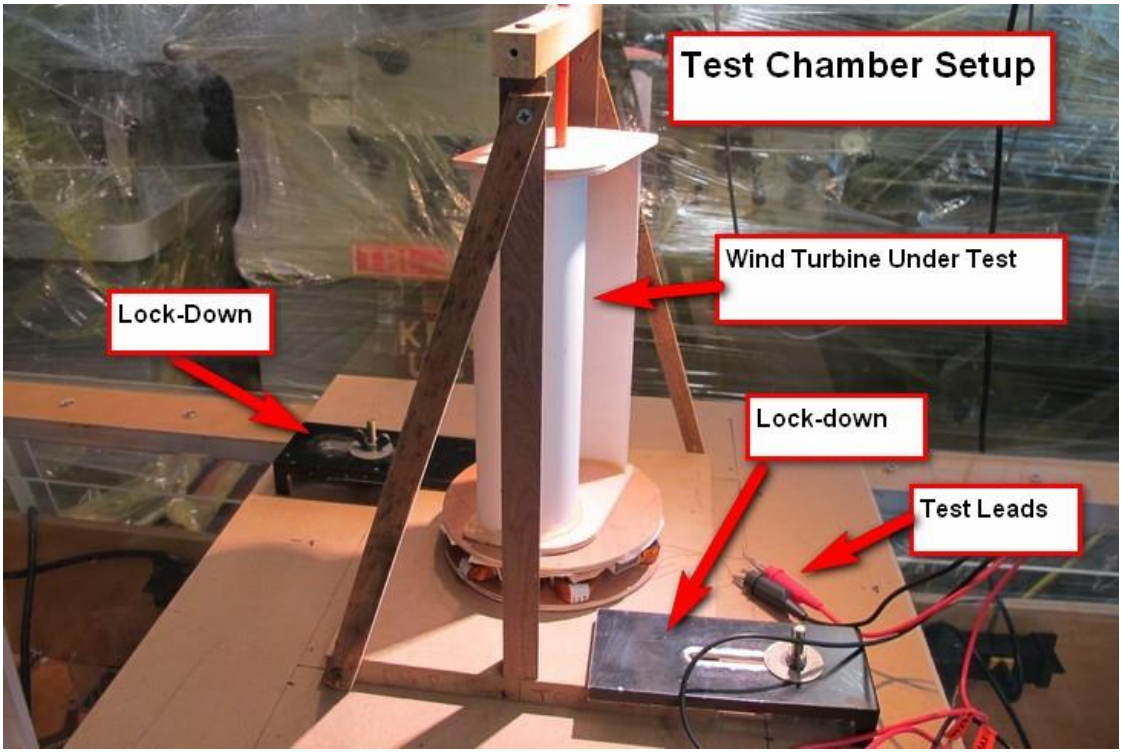
The test instruments used in the wind turbine testing include and anemometer to wind speed and a digital Voltmeter (DVM) to measure generator voltage and generator voltage frequency. The other shown DVM's are for backup and future testing. The DVM can also be used to measure the coil resistance (R_G). This should not be performed while the turbine running, generating voltage.

The tunnel itself is a test instrument that will allow varying the wind speed from one to thirty mph (13.6 meters/sec, mps). Most testing will be limited to a maximum of 15 mph to insure the integrity of the turbine.



Wind Turbine Test Setup

1. Turn on the wind tunnel power strip under the test chamber.
2. Unlock the test chamber door and remove the door.
3. Place the turbine under test in the chamber and secure with the lockdown clamps.
4. Connect the test leads to the turbine output leads.
5. Go to the ohmmeter range of the DVM and measure the coil resistance, R_G = _____ .
6. Change the VDM to the Volts –ac range.



7. Replace the test chamber door and secure.
8. At the wind tunnel control panel turn the speed control to the extreme counter clock wise position.
9. At the wind tunnel control panel, press “Stop” then press “Run”. You should hear a high pitch sound indicating the wind tunnel motor is receiving power.
10. Turning the speed in a clockwise direction slowly increase the speed to 9 mph.
11. Record the no-load voltage and frequency.
12. Connect the 4700 ohm resistor across the DVM leads (and the wind turbine leads and record voltage and frequency
13. Repeat the measurements successively connecting the 27, 15, 10, 5 and 1 ohm resistors, waiting approximately ten seconds before recording data.
14. Repeat steps 10-13 for wind speeds of 11, 13, and 15 mph.
15. Place all data in your engineering journal. All team members must have the data.

16. Create an Excel spreadsheet following the supplied template and analyze the wind turbine data using your turbines physical dimensions and coil resistance..
17. Using a scatter plot, graph the Power coefficient (C_T) vs. Tip-to-speed (TSR) ratio for each wind speed run.
18. Your graphs should allow you to fill in the following table:

Wind Speed -mph	C_{T-} maximum	TSR at maximum C_T
9		
11		
13		
15		

Excel Template

Wind Turbine - Wind Tunnel Data and Calculatio Fall 2016

VAWT-Under test Team ____

	Measured				Calculated						
Wind Velocity Target	Wind Velocity Actual	Load Resistor	Load Voltage	Generator Frequency	Rev./min	Actual Wind Velocity	Wind Power	Generator Power	Rotor Tip Speed	Tip to Speed Ratio	(Electrical) Power Coefficient
(mph)	(mph)	(ohms)	(v-rms)	(Hz)	(rpm)	mps	(watts)	(watts)	(m/s)	(ratio)	(ratio)
v	v	R_L	V_L	F	rpm	v	P_W	P_E	ω	λ	C_P
9		no-load									
		4700									
		27									
		15									
		10									
		5									
		1									
11		no-load									
		4700									
		27									
		15									
		10									
		5									
		1									
13		no-load									
		4700									
		27									
		15									
		10									
		5									
		1									
15		no-load									
		4700									
		27									
		15									
		10									
		5									
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