

4.0 Add Wind Blades

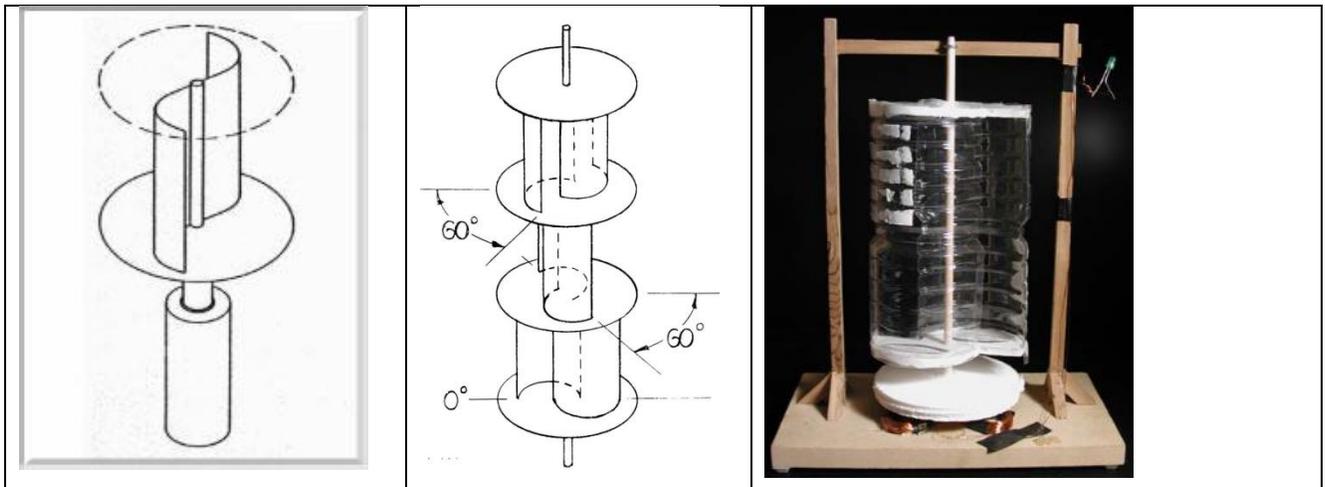
This part of the project will require the teams get creative about how your turbine will capture wind energy, convert it to mechanical energy and turn the generator shaft for electrical energy. This will require an effective application of the engineering design process, Think-it, Design-it, Build-it, Test-it, Fix-it. Given the semester time frame, team meetings at school and out of school are going to be required.

Things you will have consider:

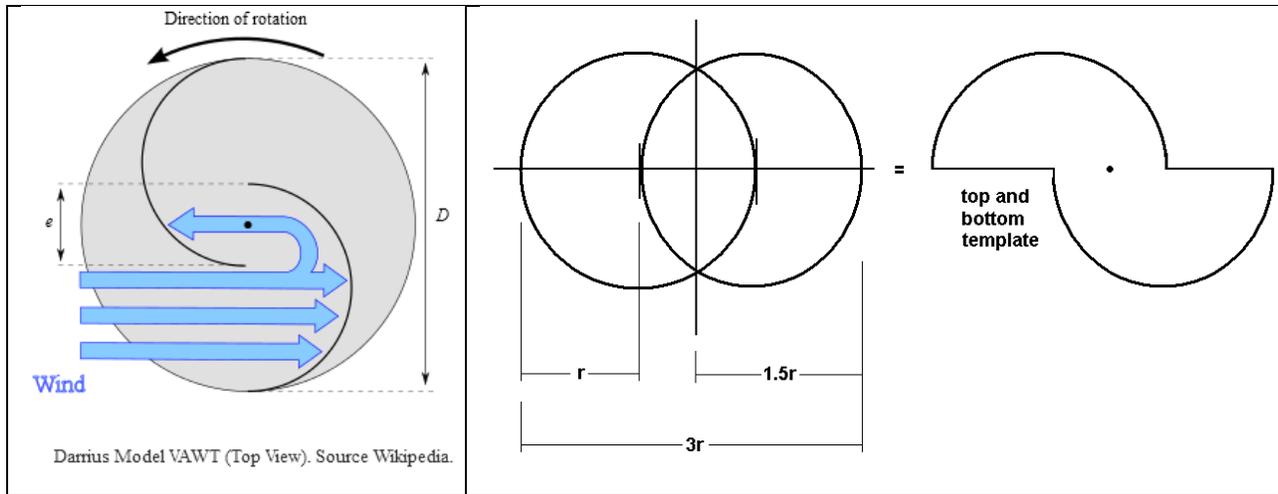
The first wind blade implementation will not be your final one. You will be given an opportunity to learn from your first design and design, build and test a second one.

We recommend that the first blade design be a Savonius type design. This paper will give you an introduction to this design but your team will have to do some additional research, discussion and decision making. The outcome will be its construction and integration with the turbine unit you have already built and tested. (see references or Google)

Savonius Wind Turbine

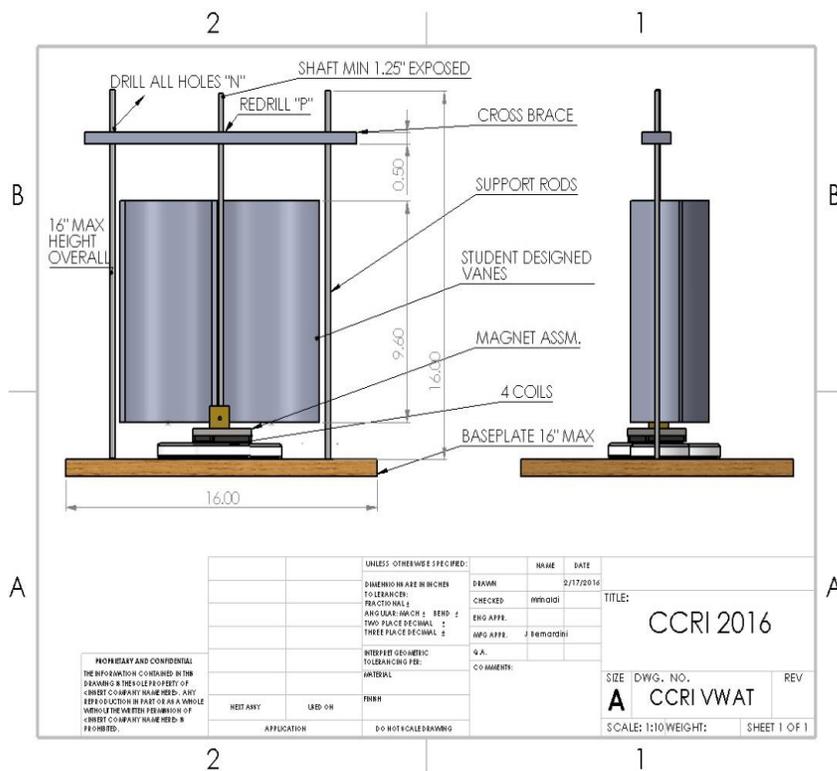


Principle of Operation

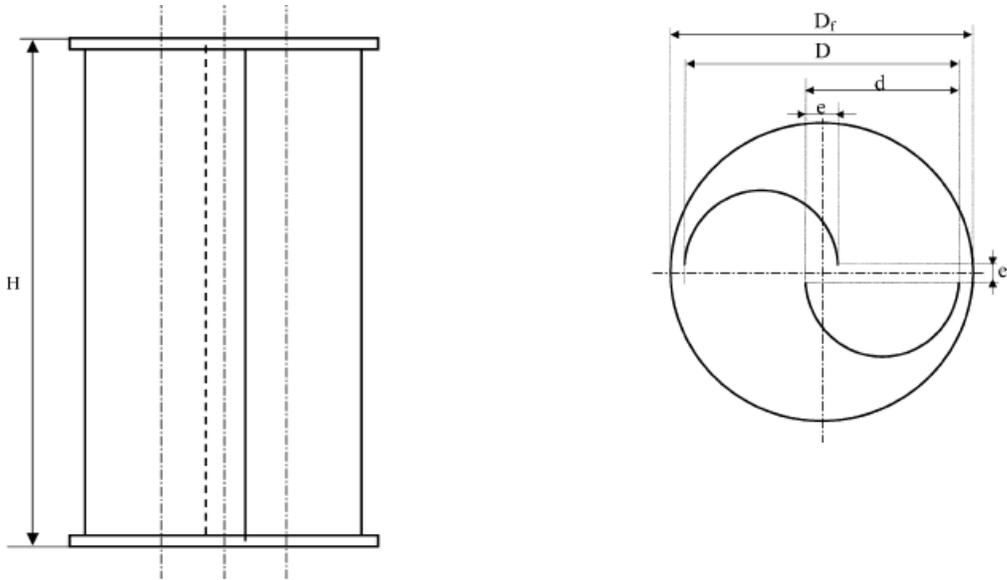


A starting place for the design is the amount of overlap of the two semicircles. From the figure below a starting place is $0.5r$; where “ r ” is the radius of the blade structure. This is not necessarily the optimum dimensions. The research for VAWT suggests other ratios that will be presented below.

Starting with the requirement that the overall wind turbine cannot be any higher than 16 inches the drawing below shows that the height of wind blade is approximately 11.75 inches.



To optimize VAWT performance, research has considered the ratios of height (H) to overall diameter (D) and the “cup” overlap (e) to the “cup” diameter (d).



| | | |
|--|--|--|
| Parameter | $\alpha = \frac{H}{D}$ Height to Diameter | $\beta = \frac{e}{d}$ Overlap Ratio |
| Research Literature Ratio range | 2.0 – 4.0 | 0.0 - 0.3 |
| CCRI Prototype VAWT Overall Dimensions | | |
| | H | D |
| Maximum Dimension | 11.75" | 9.5" |
| Suggested Dimension | 11.0" | 5.5" |

| | H | D | d | β | e |
|-----------|-------|-------|-------|---------|--------------------|
| Example-1 | 11.0" | 5.85" | 3.25" | 0.20 | 3.25 x 0.2 = 0.65" |
| Example-2 | 11.0" | 5.25" | 3.0" | 0.25 | 3.0 x 0.25 = 0.75" |
| Example-3 | 11.0" | 5.10" | 3.0" | 0.30 | 3.0 x 0.3 = 0.90" |

You are free deviate from the literature recommendations. However, if the research is correct it will adversely affect the aerodynamic performance of the turbine. This will show up in the wind tunnel testing

The material for the blades or “cups” can be anything that can be fabricated in the two week time frame the course requires. This can be paper, plastic or aluminum sheets, plastic bottles or large beer cans. The structure should be reasonably stiff and straight and attachable to the rotating shaft

The next problem you have to consider is how you are going to couple the wind blade to the turbine shaft. This will insure that the blade turning will turn the turbine shaft and generate electrical power. You want to be able to remove the wind blade from the shaft to possibly experiment with the blade design. A set screw adjustment would be a simple solution. You might come up with another solution.

With the wind blades attached to the shaft you are ready to test the wind turbine in the wind tunnel.