



CALIFORNIA STATE SCIENCE FAIR 2014 PROJECT SUMMARY

Name(s) Jacob D. Loewen	Project Number S0318
Project Title Battle of the Windmills	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The project tested the difference in rotation speeds between the modern three blade wing shaped windmill design and the older eight blade flat windmill design. The author hypothesized that the eight bladed flat windmill design would rotate faster in a wind tunnel at 15 knots.</p> <p>Methods/Materials Two windmills were built out of cardstock: one with three smooth, wing shaped blades and one with eight flat, tilted blades. Both windmills had a portion colored red to aid in observation. A base was made out of PVC pipe to support one windmill at a time for testing. Both windmills were tested in a wind tunnel. Each windmill was tested each at 0 and 45 degrees using the Slo-Pro and Ubersense Slow Motion iPhone applications to see how many times the red section rotated around in 2 seconds.</p> <p>Results The three bladed design averaged 10.25 revolutions per second (RPS) when at 0 degrees relative to the wind. This design rotated at an average of 9.55 RPS at 45 degrees. The eight bladed design rotated at an average of 15.4 RPS at 0 degrees, and rotated at an average of 25.55 RPS at 45 degrees. At a 0 degree angle to the relative wind, the eight bladed windmill showed a 50.2% increase in speed over the three bladed windmill. At a 45 degree angle to the wind, the eight bladed windmill showed a 168% increase of speed over the three bladed windmill.</p> <p>Conclusions/Discussion The data showed that the hypothesis was correct. The eight bladed windmill design rotated faster at 15 knots than the three bladed design. The rotation speeds, however, were entirely different than expected. The windmills moved at a much faster speed than originally thought. The three bladed windmill moved at about 10 revolutions per second at 0 degrees to the relative wind. At 45 degrees, it moved one rotation slightly slower; however, the eight bladed windmill moved much faster than expected. At 45 degrees to the relative wind, the eight bladed windmill moved nearly twice as fast as it did at 0 degrees. This data was additional proof that the hypothesis was correct. This author concluded that due to greater surface area of the eight bladed design, more wind could be converted into energy to produce faster rotation speeds. For this reason the eight bladed flat windmills could be more effective than the modern three bladed ones.</p>	
Summary Statement This project compares and measures the most effective windmill design at 0 and 45 degree angles to the wind..	
Help Received The wind tunnel I used for testing was built by my father.	