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NPRE475
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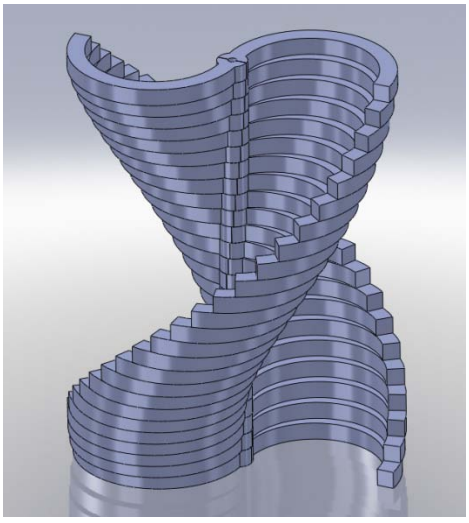
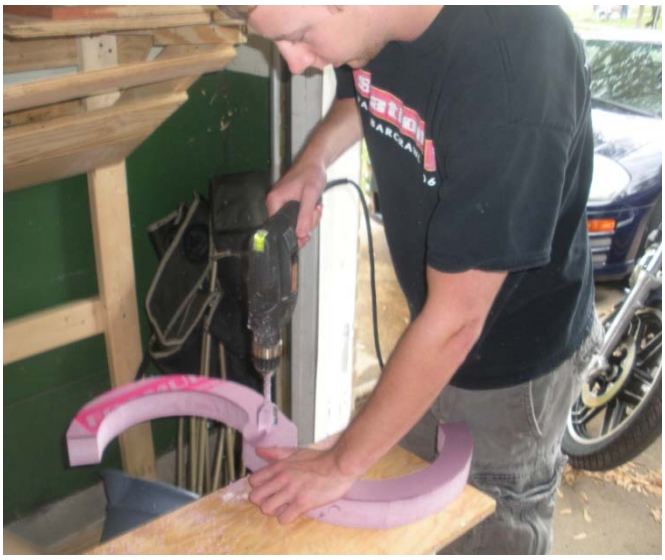
Helical Savonius Turbine

We started out with a simple design on paper and then moved on to SolidWorks to further visualize how we could construct a helical turbine without the use of a mould. Basically, many "S" shapes would have to be constructed and then mounted through a center shaft.



We used 2 4'x10' sheets of 2" insulating polystyrene as the building block. Using a jigsaw, we cut the shapes pretty easily, with about 26 of them in 5 hours. Also, we got to test the durability of the foam since it was raining. In the end, the foam was a bit heavier, but did not seem to be damaged.

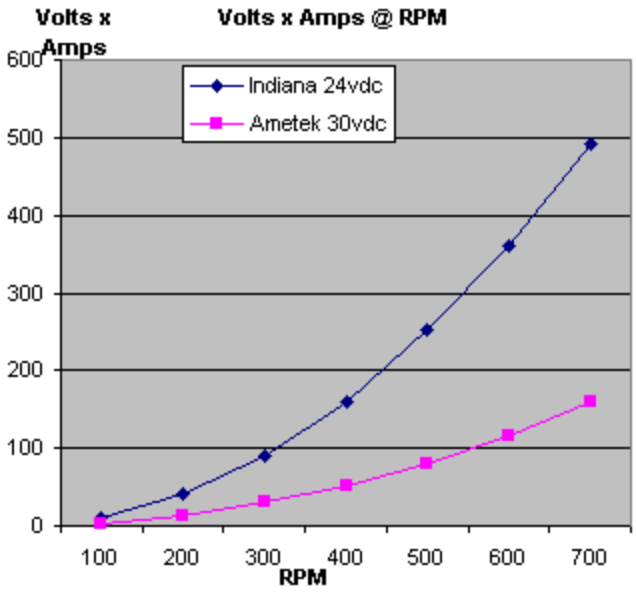


The centers were then bored at 1 3/8" to fit over the pipe we bought. The 1" pipe meant it had an inside diameter of 1", while the outside was a nominal 1.315 inches, which presented a problem further down the line.

Pretty soon, we had something that resembled a helix, so we started building a base box and drilling for the bearings. Two flange bearings were used, with four bolt holes and an inside diameter of 1 3/8".

Generator

We went with a permanent magnet DC motor as our generator. The motor we chose was an Indiana General 24V. The graph provided by the eBay seller claimed it produced 3.28 amps at 12.24 volts at 200 rpm, which we considered a goal for our turbine. The graph also compares the power to another type of motor, Ametek 30V. We tested the motor and it put out similar results as described.



Problems:

One problem we ran into was to couple the 1" pipe to a 5/8" motor shaft. The pipe actually has an outside diameter of 1.315 inches, while the inside is 1" diameter. We were nearing over-budget for the project, so a professional Love-Joy coupling was not used, although it is noted that one company quoted us at about 70 dollars for that coupling of a 1 3/8" to a 5/8" flexible coupling.

Instead, we went with the cheap alternative of cutting two different sized holes into a block of wood, and holding them tight to the motor shaft with the screws. The larger hole was just glued to the shaft. This isn't the most desirable setup, but it was all we could think of with the little time and money for ordering parts.

The odd sized shaft caused numerous problems in bearing fitting and friction in the turbine. However, we did notice that it would start spinning a bit while we working on it and tried to remain optimistic. The Gorilla Glue leaked from all of the S shaped pieces into the bearings, which made the whole design unable to rotate. The next group should implement a metal support and new bearings on the top and bottom to use the existing motor and foam structure to produce power.

Conclusion:

Overall, the project was a somewhat success in that we demonstrated a way to produce the helical shape without a mould. Also, the turbine spun with light wind while we were working on it before the glue rendered the bearings worthless, so we know that it could produce power in a windy environment. The main expenditures for the project were the foam, pipe, and motor at about 300 dollars. Both bearings and the wood only cost about 40 dollars, giving the project a grand total of 340 dollars. The next class could easily make this project work, as the helical foam should produce plenty of power in

turbulent wind conditions on a windy today. Simply new bearings and support would make a nice project.

Recommendations for Improvements

There are many ways this project could be improved, or remade completely:

1**. Use a metal Frame instead of a wooden box.** The spacing of new bearings at the top and the bottom of the pipe would provide better support and less friction for the entire setup. Use 1 3/8” bearings unless you can find a bearing for a 1” pipe (1.315” o.d.).

2. Use a pipe that has a standard outside diameter. The pipe we used is 1.315" o.d., which makes it very difficult to fit in bearings and drill holes for. In many cases, glue had to be used as a filler. There is a lot of friction in this setup because of uncentered shafts which causes a low cut-in speed.

3. Use the entire setup as a mould for fiberglass blade construction. The S shaped pieces were the best way we could think of to build the helix without a mould, but no that this is constructed, it can be used as a mould itself. Sheets of fiberglass cloth could be pinned along the curves. Then, many layers of resin should be used until the cloth becomes rigid and glassy. These fiberglass pieces can be screwed to a plastic pipe, and would make a elegant, smooth, and lightweight design.

4. Use a coupling. The wooden block that is currently installed is unacceptable, a coupling should be used such as the Love-Joy flexible coupling type.

5. Research Bearings. Using the flange bearings puts too much downward stress on the bearing. Instead, a thrust bearing should be used to reduce friction of the downward force. These bearings might be more expensive, however.