Building a Home-Scale Vertical Axis Wind Turbine

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OBJECTIVES

- Build a vertical axis wind turbine (VAWT) to provide power for lighting a small home
- Experiment with different materials and designs to maximize power production and minimize generator cut-in speeds
- Select commonplace materials, tools and methods so that VAWT can be constructed by those with limited resources and experience

Two Design Types

- 3-Level Savonius Rotor (S-Rotor)

- Universal Axis Helical Turbine (UAHT) *(covered separately)*

Two S-Rotor Designs

1) Plastic/Steel

2) Steel/Wood

Materials-Plastic/Steel Rotor

- Rotor
  - One 16-ga. galv. sheet metal (4'x4') (end caps)
  - Three 5-gallon plastic water bottles (vanes)
  - Two ¾" floor flanges
  - One 3" long ¾" nipple
  - Two ¼" set screws
  - One ¾" diam. X 3' long steel keyed shaft and key
  - Two ¾" flanged, sealed bearings
  - Adhesive ("Liquid Nails")
  - Screws, nuts and washers (flanges and bearings)

Materials-Plastic/Steel Rotor (cont.)

- Framework
  - One 2’x4’ sheet 3/4” pressure-treated plywood
  - 25’ of stranded galv. steel wire
  - 12’ of slot angle steel
  - 1 1/2” galv. lag screws (slot angle)
  - 1” hose clamp
  - Shaft key

Tools Needed

- Required
  - Wood and metal saws
  - Drill and sharp metal bits (3/4” hole-saw metal bit)
  - Hammer, pliers, wire cutters
  - Wrench for lag screws
  - Phillips-head screwdriver and Allen key wrench for set screws
  - Tap (for threading nipple for set screws)
  - Measuring tape, 3’ length of string, nail, pencil or pen
  - Utility knife and electrical tape
  - Safety equipment (safety glasses, ear plugs, leather gloves)
  - Carpenter’s square
- Optional
  - Caulking gun
  - 3’ long bar clamps
  - Thread cutting oil
  - Pop rivet gun

Needed Skills and Tips

Skills

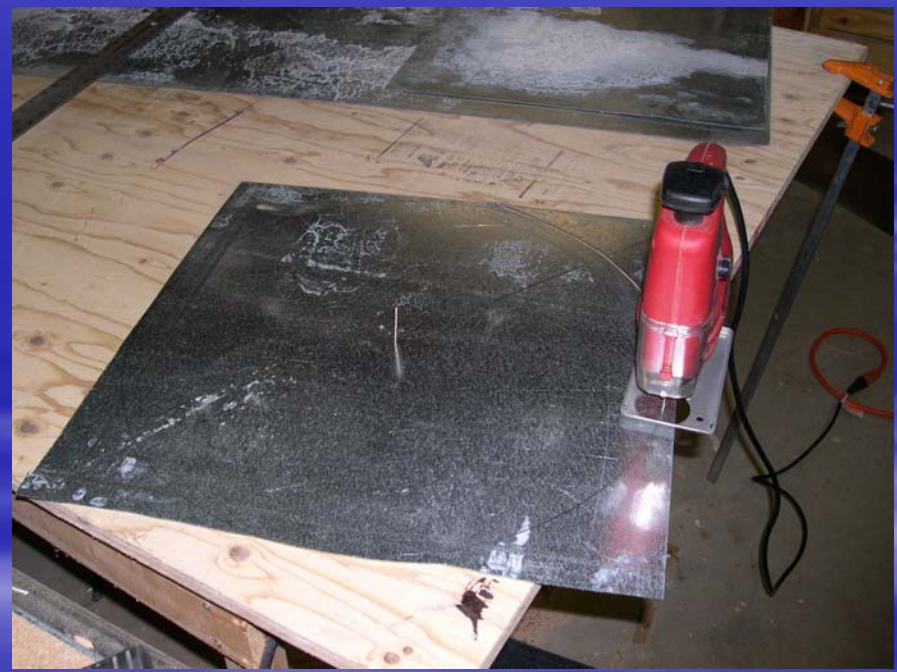
- General construction experience
- Specific experience with cutting, drilling and sanding wood and sheet metal

Tips to Ensure a Smooth-Rotating Turbine

- Measure and cut the rotor vanes precisely
- End caps must be parallel to each other and perpendicular to shaft, check the following…
  - Vane heights are the same
  - End caps are perpendicular to shaft
  - End caps are parallel to each other

Rotor Instructions: Plastic/Steel-Rotor

1) End Caps - Cut four 18” diam. discs from galv. sheet using string and pen to scribe circles. Drill a ¾” hole in center of each disc. Drill holes and attach 2 floor flanges over ¾” holes in centers of 2 discs. Cut ¾” nipple in half and tap holes for set screws in each nipple. Thread nipples into flanges and install set screws.

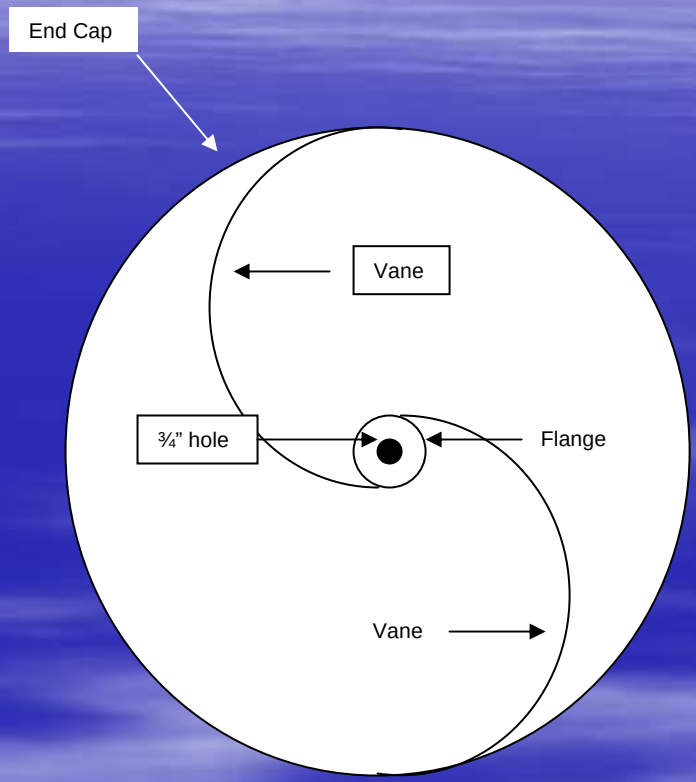


Rotor Instructions (cont.)

2) Vanes – Wearing gloves, use utility knife to cut tops and bottoms off water bottles, leaving 10” long straight sections in middle of bottles. Cut each straight section in half so that two U-shaped sections are produced. There should be 6 vanes when cutting is complete.

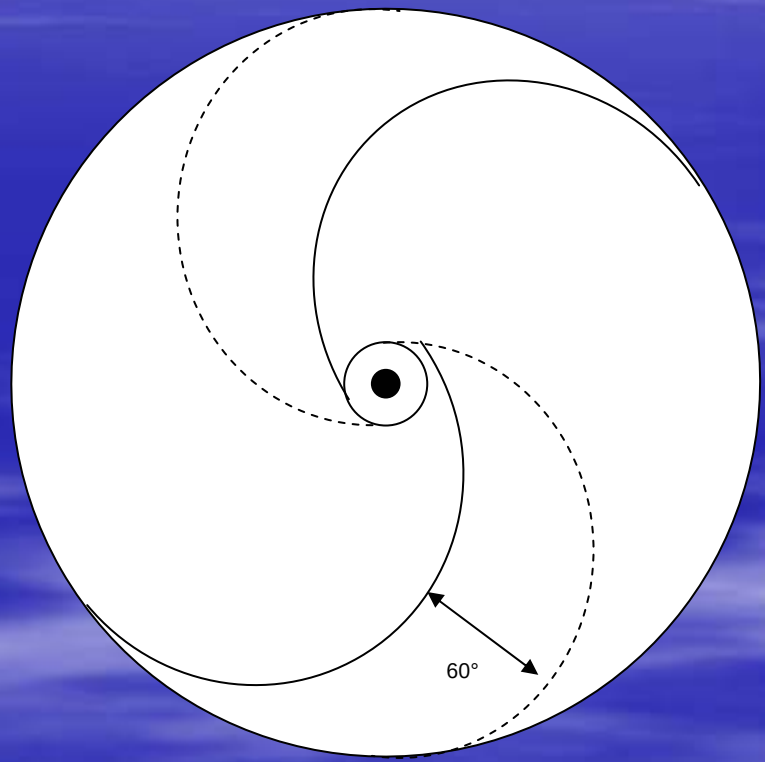
Rotor Instructions (cont.)

3) Assembly- Slide the four end caps onto ¾” steel shaft making sure that the two flanged-end caps are on either end of the shaft (flanges facing in). Leave a 9” or 10” space between end caps. Tighten set screws. Starting on 1st level, slide 2 vanes in between two end caps so they form an S-shape, as viewed from above (see picture).



Building Instructions (cont.)

3) Assembly (cont.) – Apply a ¼” seam of adhesive along both inside and outside edges of vanes where they meet the end caps and let dry. Repeat process 2nd level, except install 2nd level vanes rotated 60° from 1st level vanes (see picture). Repeat process for 3rd level, rotating another 60°. Clamping between levels assures a good glued joint. Rotor is done.



Frame Building Guidelines

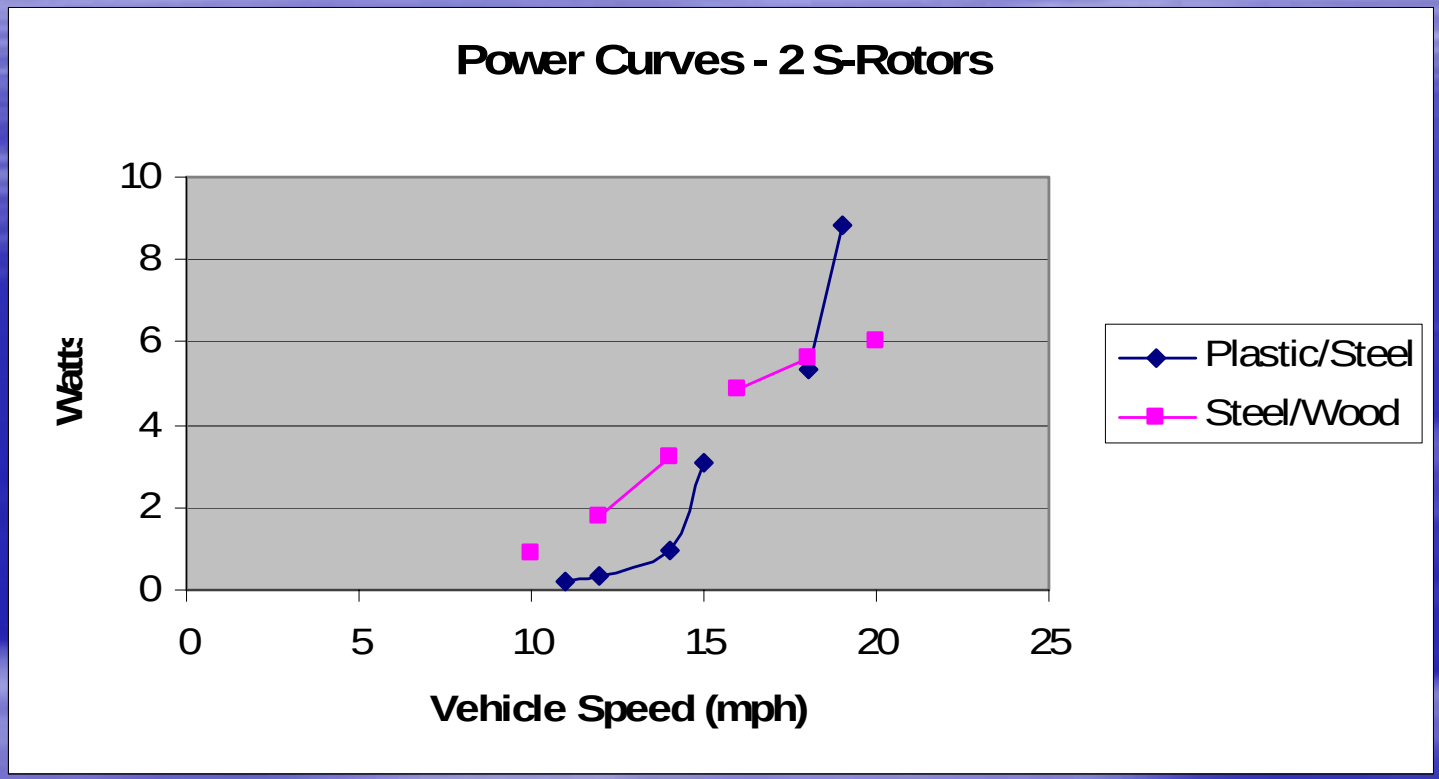
Goal – Build a frame that will do the following:

- Securely hold rotor and bearing assembly
- Hold generator assembly
- Handle high speed rotor rotations
- Not prevent wind from entering rotor
- Be not too heavy

Frame Guidelines

- Top and bottom are ¾” plywood, 24” square
- Drill 2” holes through plywood centers
- Attach bearings to plywood with bolts
- Corner rails are slot angle (36” lengths)
- Attach rails to plywood with lag screws
- Construct small box to attach generator
- Align generator shaft and rotor shaft

Performance Curves & Video



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Conclusions and Costs

- Material costs for either Plastic/Steel or Steel/Wood Rotor range from $150 to $250 U.S. Dollars
- Materials and tools are readily available
- Power ranges from 1 to 10 watts depending on wind speed
- Wind speeds between 10 to 20 mph needed