

# Wooden Windmill



I am Bob Johnston, a carpenter in Cloudcroft N.M., USA. A friend of mine is starting a subdivision and he wanted to know if I could build them a windmill. I have built some windmill towers but never had built a complete windmill out of wood.

I was born on a ranch in McAlister NM. My dad was a carpenter-cowboy for the Luther Hudson ranch. He built many windmill towers. He only had an 8th grade education and could hardly read and write, but he could build add, subtract and multiply numbers like nobody I have ever seen. He taught me a lot about carpentry.

He knew very little about angles. He used rise per foot for every angle he used when he was building something. Carpenters in those days didn't know what a calculator was. They used a framing square for everything. He taught me the pitch (angle) for windmill tower posts was  $1\frac{3}{4}$ " rise per foot ( $8\frac{1}{4}^\circ$ ). I went and looked at an Aermoter windmill wheel and found out the blades

were  $22\frac{1}{2}^\circ$ . I measured the angle of the frame (tower) on several windmills and they were nearly all within one degree of  $8\frac{1}{4}^\circ$ .

This was the information I needed to get started.  $8\frac{1}{4}^\circ$  and  $22\frac{1}{2}^\circ$ .



I got started by getting a picture of a 24' Aermoter mill and tower, 8' diameter fan wheel. I then scaled it and divided all the measurements in half to build a 12' tall windmill ( $\frac{1}{2}$  scale). The blades came out to 22" long, 7" at the wide end and  $3\frac{1}{2}$ " at the narrow end.

As shown in the above picture, I ripped out the  $\frac{1}{2}$ " plywood blades (grain parallel to the length for strength). I rounded the corners, sanded the edges and filled all of the voids in the plywood blades. I had to keep in mind all the way through this project that this little windmill was going to have to withstand the same horizontal loads as its big brother. The wheel was going to want to turn and the tail was going to want to line up with the wind. I decided to build the wheel first so I could seal and paint it and have it ready to assemble to the tower.

I started by determining the area of the blades that I needed to cut out for the dado. I did this by cutting a  $\frac{3}{4}$ "x $\frac{3}{4}$ " piece of wood and making a  $22\frac{1}{2}^\circ$  bevel on one end, then I aligned it on the end of a blade, and just extended the parallel lines of the 1x1 and marked the outside lines (outside extension lines of the piece of wood) where that the dado would be centered on the end of the blade as shown below.



I then took some 2x4's and made a mortise guide with a end cut at  $22\frac{1}{2}^\circ$  for the table saw. I then nailed on a guide for the table slot and assembled it so that the 2x4 was perpendicular with the blade.



I then did a test run and determined where the outside to outside dado would be and

marked this on the clamp block that I glued to the mortise guide. I put increment marks on the clamp block so I could clamp the blade for each pass.



Now I was ready to make the mortises in the blade. I would have to run the blade through the saw 7 times to get this.  $\frac{3}{4}$ "x1" angled mortise, but this is a lot safer than using a  $\frac{3}{4}$ x8" dado and trying to do it in one pass.



After I got all the blade dados finished I carefully sanded and inspected each one to assure myself I hadn't got on the wrong side of the line on some of them. With the blades ready to assemble I took a piece of  $\frac{3}{4}$ " plywood and drew out the 9" inside diameter and 13" outside

diameter circle to attach the blades to. I needed the 26" diameter stabilizer ring for the blades so I cut this out at the same time.



I sanded and filled the voids on the rings and then attached the blades. I calculated the circumference of the 13" ring ( $13 \times 3.14 \div 11 \text{ blades}$ ) = 3.71" and marked the 13" ring for each of the 11 blades. To change the .71 to 16th's you simply multiply  $.71 \times 16$  and gives you  $11.36 / 16$ ". So I marked them  $3 \frac{3}{4}$ ", and it came out within a  $\frac{1}{4}$ ".



I used exterior panel adhesive on all connections. I then calculated the 11 marks for the outside plywood ring, marked the increments and attach the 26" ring to the wheel. I used 1" finish

staples and adhesive on all joints. This is the 48" fan wheel.



Next step was to caulk all of the blade joints with adhesive so it could not get any moisture into the joint.



I used exterior panel adhesive to assure I had water drainage on each joint. I framed and built a inside 7" circle out of oak and attached it to the center of the wheel with oak braces and built the 36" post and attached a 8" piece at 90° on one end to go to the wheel.



I mitered the two 4x4's together and attached the post to the 7" oak circle with 3" screws. I used a 1x2 brace from the post to the 13" ring.

I cut out the tail and frame for the tail and attached them to the wheel.



I stapled two braces from two blades to the tail as the tail is going to catch a lot of wind. This tail is going to be like a small airplane wing 12' in the air and in this area we have many 60 mile an hour winds in the spring.



I sprayed on three coats of exterior spar varnish and checked all joints to make sure they were caulked.



I painted the wheel assembly with exterior silver paint, let it dry and then applied two more coats of varnish.

After this I was ready to frame the tower. I cut the 4x4 post 8'8" long and attached the 4 angle irons to attach the wheel post. I used 3" lag bolts to attach the angle irons. I pre-bored with a 1/4" bit and then screwed the lag bolts in.



After I got the two frames built I laid them out and stapled and nailed on the other 1x4 braces. I clamped in a temporary 4x4 inside the 4x4's while I framed the tower.



I scaled the platform and built it and attached it to the tower. I built the entire tower with rough sawmill white pine. It was stand dried. I was careful, when I selected the wood, not to get any green wood. Green wood will not accept a sealer or glue very well until it dries.



With the four angle irons coming out of the platform I inserted the post and wheel, centered it, and with the tower plumb (the center of the tower on top was plumb with the center of the four post on the bottom) I plumbed the post both ways with a small level and attached it to the platform with 4" screws and attached the four angle irons to the wheel post with 3" lags. I sealed the tower with varnish. I

dug 4 post holes 24" deep and built 12"x12"x4" forms to set on top of the ground and poured concrete into these and used ¼"x1" perforated straps to tie the windmill down with. I had to saw off a couple of post to get the tower center plumb. I used the center of the post and the center of the 4x4 post and plumbed it with a transit level.



At first glance of this project it would appear to be a complicated project, but as you can see it is just a matter of using some everyday carpentry procedures to build a decorative windmill.

I have written a book about these procedures and many others, "50 years as a carpenter". The book has over 200 procedures every carpenter and contractor should know. It is available on my website:

<http://carpenterbooks.com>

Bob Johnston, carpenter