Waterwheel Project

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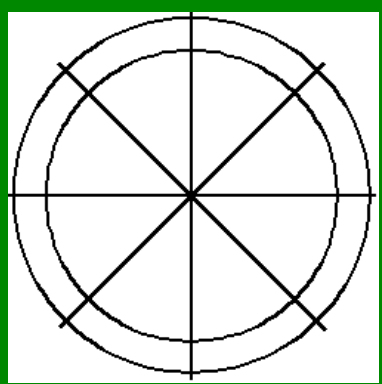
STEP 1

We will start out by cutting the side pieces. I call these pieces "segments". I am making them out of clear 1" x 8" cedar.

First the Layout:



The first thing you need to decide is how big you want to make the wheel, mine is 5' 6" in diameter and is made up of eight segments. I knew that the segments would be 7 1/2" high because I wanted to use 1"x 8" cedar. I used the computer to lay it out and printed a full size pattern of one of the segments.

The layout and cutting of these segments is VERY critical. Any variation in the angles will really show up when you try to mate them.

NOTE: Cut enough segments for BOTH sides of the waterwheel.

Cut the angles first. I can't say it enough that you need to be very accurate with the angles of these cuts.

I used the paper template I made from my computer layout to draw the radius on top of each segment. Next you'll cut the to radius. You can use a band saw,saber saw or cut them by hand.

Once all the pieces are cut, lay them out and make sure that they fit well together and there are no large gaps between segments. If there is a gap you can go back and re-cut them but make very tiny adjustments.

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STEP 2

We now need to route and dado some slots for the bottom of the waterwheel. The bottom will be made out of 1" cedar also so the slots will need to be a little bigger than 3/4".

The waterwheel bottom is put together like a wine barrel so you need to cut slots for the boards to go into. Here is what I'm talking about.

You want to set up the router with a fence so that you can follow the curve of the segment. Set the router to 1/4" depth using a straight cutter. Set the fence so that the notch will come close to the bottom of the segment on the end. I had to reset the fence and make a second pass because my router blade was only a half inch. The slot needs to be a little bigger than the thickness of the boards so they will fit on a curve.

Once you've cut the slot you need to dado the notches where the 2x4 spokes and the 3/4" paddles will go. The spokes will fit half on one segment and half on the other so you will dado a 1 3/4" slot, 1/4" deep, completely across the segment.

Next you will dado the paddle slots. These need to be 3/4" wide, 1/4" deep and cut only through the routed slot, not all the way through the segment. These paddle slots should be spaced evenly with one paddle butted up against a spoke and the other halfway in between. I kept the same angle for the paddles all the way around so they matched the spokes.

Here is a side view of the finished part. I realize they are a little complicated but they are the key to the whole project.

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STEP 3

The Bottom Boards:

The waterwheel bottom is put together like a wine barrel so you need to cut those boards. You will also dado the edges so that they will mesh with one another. Here is what I'm talking about.

We are going to cut out the bottom boards that are really simple. I want to make my 5 1/2 foot diameter waterwheel about 12 inches wide so I cut them 11 inches long and 2 3/4 inches wide.

I set up my dado to cut half the thickness of the board and wide enough to cut a 1/4 in notch along the edge. You can see in the picture how the notch is cut on opposite sides of the board so that they will interlace with one

another.

That's all there is to it now just repeat it another 72 times. It took 73 pieces to go around my waterwheel.

Now would be a good time to place an order for the steel center hub. My hub is made out of 1/8 inch CRS. I had it fabricated by our friends at Rusty Cat Creations in Seattle, rcreate@aol.com. They did a really nice job on this and they do really nice metal yard sculptures. He used an NC plasma jet cutter and did a very accurate job. You should be able to find someone in your area to do the same.

My center hub is 18 inches in diameter. The center hole is 1 inch to accommodate the 1 inch steel rod the whole thing will ride on. I had the boltholes cut square for 1/2 inch carriage bolts. The hole pattern is at the same angles as the segments. The outer holes are 1 inch in from the outside edge and three inches apart. Here's what the finished plate looks like.

The hardware required for the hub is 32 each:

- 1/2"-13 X 2 1/2" Zinc Carriage Bolt
- 1/2" Zinc Lock Washer
- 1/2" X 2" O.D. Zinc Fender Washer
- 1/2"-13 Zinc Hex Full Nut

I also picked up enough 1/4" threaded rod to make 16 pieces long enough to hold both wheel halves together. Also 32 each 1/4" nuts, fender washers and lock washers.
That ought to keep you busy for the week, in between shopping, wrapping, gift making, partying and everything else you have to do.

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STEP 4

The Spokes:

I made my spokes out of treated 2x4's but you can make them out of any good, straight 2x4 material. I chose treated lumber to help prevent warping once this whole thing gets out in the weather.

Since the diameter of your waterwheel may be different than mine you need to cut the 2x4's to fit your wheel. I cut mine to XX inches, to fit my 5 1/2 foot diameter, which included about a half inch extra that I will remove later. Cut 16 pieces, 8 per side.

Now you have to figure the angle that the center of the 2x4's will be cut to so that they will fit on the hub. This was a tricky part for me and I ended up cutting them a couple of times to get them just right. Here's a picture of how they will all fit together when complete.

I used the miter on my table saw but that's probably not the safest way to go. If you do, be really careful.

Now drill two bolt holes in each spoke to fit the holes in your hub.

Next we countersink the holes to accommodate the square portion of the bolt that will stick through the hub.

Now that we know exactly where the spokes will mount you need to cut them to length. I made them so that they sat about a 1/4" inside the outer circumference of the wheel.

The final step in making the spokes is to dado a grove for the bottom boards to fit in. I made mine a 1/4" deep.

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STEP 5

Assemble The Spokes:

This is where I discovered that I hadn't cut the points on my spokes just right and had to go back and trim them up a little. I hope you don't have that same problem.

The assembly of the spokes to the hub is relatively simple. You just put the bolts through the hub and 2x4 with the countersink in the 2x4 toward the steel plate. This is so that there is a place for the square shoulder of the carriage bolt to go. I use a large flat washer, split lock washer and nut in each hole.

DO NOT tighten the nuts yet, just make them finger tight. The spokes need to be loose so you can make some fine adjustments. I laid it out flat on the floor and with a tape measure, measured from spoke to spoke to get them as evenly spaced as possible.

Once I had the spokes aligned exactly I tightened the nuts up a little but not tight yet. Next I laid out my side pieces to check the final fit. I had to tap a couple spokes with a hammer to move them ever so slightly.

Once I got every piece exactly where I wanted it I torqued the nuts down and then repeated the process for the other side.

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STEP 6

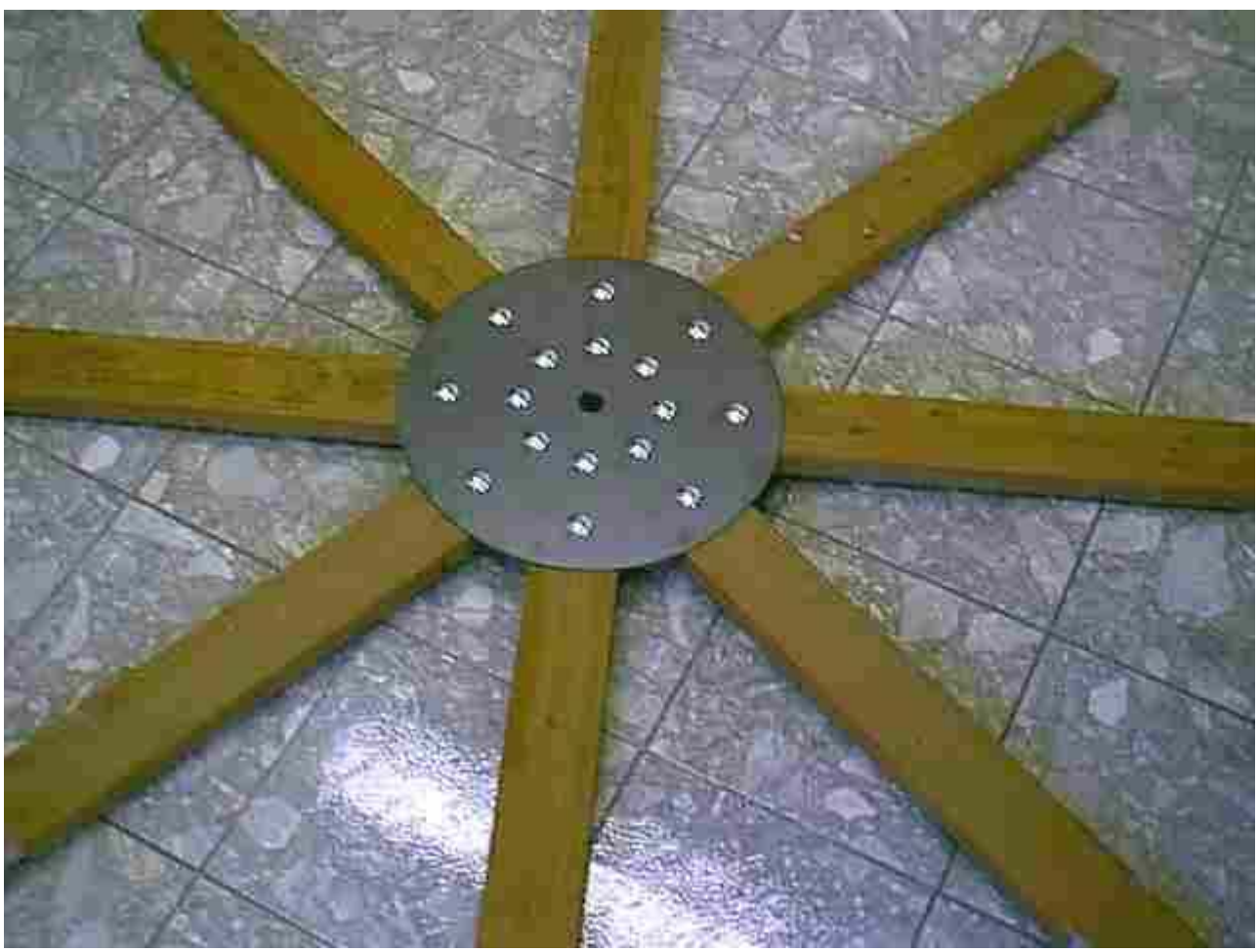
This week Step 6 - Assembling The Sides:

The first thing we need to do is drill some holes for the screws that will hold the sides on.

We are going to drill two holes in each end of each segment. To do this I made a simple paper template to mark each end of each piece. These screws will be going into the spokes so I marked them in the middle of the cutout and evenly spaced.

Drill the holes for the size of screws you'll be using and countersink them so the screws will be flush. I used 2", #6, flathead, exterior screws. Be sure and keep the matching segments together because each side is a mirror image and the segments need to match.

Lay the hub assembly down with the outside up.



Lay the sides in place all around the wheel and get them as even as possible. I had to go around quite a few times to get it just perfect.

Go around and install all the screws. I hope you have a power driver because this could get really old really fast by hand. Now repeat the process for the other side.

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STEP 7

This week Step 7 - Finishing the Bottom Pieces:

This gets to be a little tedious and unfortunately I don't have many pictures of this step so I hope explaining it OK.

Lay one side of the wheel down with the groves facing up.

Start placing the bottom boards in the slot that goes around the wheel overlapping each one.

As you go around the wheel you will come to the 2x4 spokes. This is where it gets tricky. At each spoke you will need to custom cut each bottom piece to fit around the spoke. You also need to cut the opposite end in a mirror image so when we mount the other wheel side it will fit.

This gets to be pretty tedious but take your time. This is the step that will make it all fit together in the end.

Again I'm sorry I don't have any more pictures of this step but I think you get what I mean. If you don't just drop me a line and I'll help you through it.

Wow, what fun!

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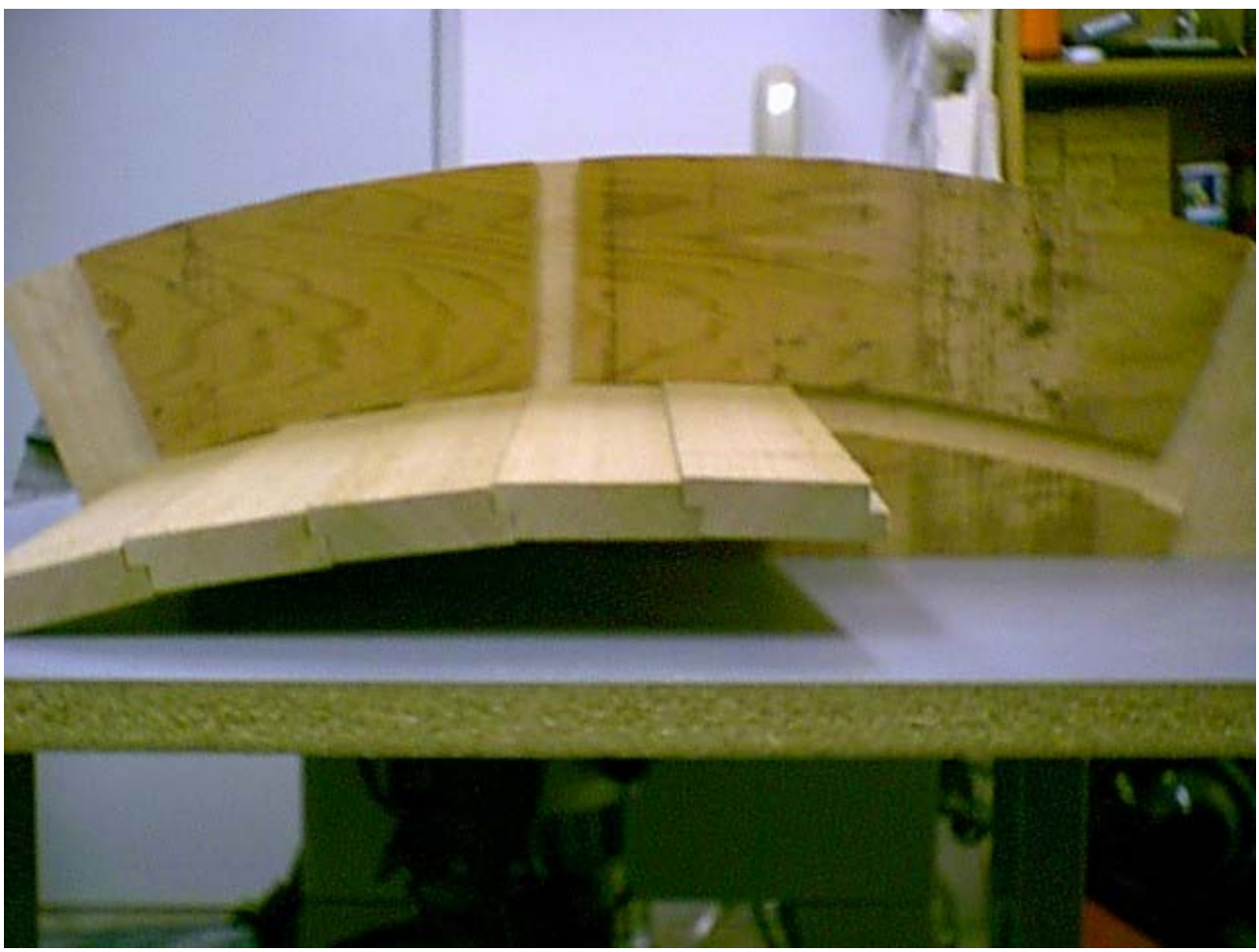
STEP 8

This week Step 8 - Final Assembly:

This is where the whole thing comes together. I was pretty nervous at this point but if everything is cut right it goes together fairly well.

Lay one side of the wheel down with the groves facing up. Install the 1/4" threaded rods into the spokes with a large flat washer and nut as shown below.

Place the bottom boards in the slot that goes around the wheel overlapping each one. Actually these should be in place from the last step.



Take the opposite side of the wheel and carefully place it onto the threaded rods to help line things up. Start pushing the bottom boards that are sticking up into the slot around the top wheel. Line up the spokes as close as possible by looking through them to the other side.

This gets to be pretty tedious but take your time. I had to go around several times jiggling and shaking things quite a lot.

Once the boards are seated put a large flat washer and nut on the top side and tighten them up a little bit. I waited until I had the wheel standing up to really tighten things down.

Now stand the wheel up and evenly tighten the nuts on the threaded shafts.

You should now have something that is starting to look a lot like a waterwheel. We are getting close to the final steps so hang in there.

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STEP 9

This week Step 9 - Paddles:

In order to make the wheel go around we need to make some cups to catch the water. This is pretty easy by just adding some paddles to the wheel.

Using 1" x (what ever you have) cedar cut rectangular pieces to fit in the groves that were cut early on in this project. They should be pretty obvious since they are the ones with nothing in them. They should be pretty snug since you don't want the water to go around them.

Put the paddles in the slots and screw them down with two screws from the bottom. When you are all done it should look something like this,

That should complete your waterwheel construction. Next we need to figure how to install it and make it work.

If by any chance you have tried to make your own waterwheel I would love to hear from you and see some pictures. If you are working on one and run into trouble or have questions just drop me a line and I'll try to help.

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STEP 10

This week Step 10 - Installation:

All that's left to do is install the wheel, build a little sluice, turn on the water, sit back and enjoy.
Since I'm tying this into my storage shed I will only need one stand. I made mine from a 6X6 landscape timber. I mounted crisscross 2X12's for the base.

I used four really long lag bolts and washers to mount the timber to the base. I added a piece of 2X4 and 2X12 to each end of the base to make it level.

Next I put the base into my pond and made it plumb using rocks and sand.

Next I took the steel shaft mounted one end into a Pillow Bearing, sat it on the support, squared it up and with a level marked the hole location on my shed. I drilled a hole through the shed and mounted a 4X4 between the studs on the inside. Remember to use the pillow bearing on the inside to set the height of the 4X4.

I marked the shaft while I had it in place so I would know where to weld the wheel. I put the shaft through the wheel hub and welded it in place.

Next I built a little ramp to help move the wheel into place and just rolled it up. Put the shaft through the wall and mounted a Pillow Bearing on each end.

I ran lag bolts through both Pillow Bearings and that was that.

Next I built a sluice which was nothing more than a cedar 1X10 with 3" sides. I used silicone sealer to help hold the sides on and keep them from leaking. I made a couple of simple brackets to mount it to the shed.

To power the waterwheel I installed a small water pump in the pond. I mounted a "T" on the pump with a hose out the top and a gate valve off the side. I use the gate valve to control the water flow. I bonded the hose into a hole in the side of the sluice and turned it on.

I've discovered that it really doesn't take much water to turn the wheel around. I have it throttled way down and rotates about right. Here is a finished picture of it in this weeks snow.

If by any chance you have tried to make your own waterwheel I would love to hear from you and see some pictures. If you are working on one and run into trouble or have questions just drop me a line and I'll try to help.