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Wheel Building with basic power tools

Building large wheels for a robot that are lighter weight than the rubber/ steel hub surplus stuff. Tools required are a circular saw, a jig saw, at least 3 clamps, a heat gun, a hacksaw and a drill/driver. Materials required are 3/4 inch plywood, 3/8 inch plywood, and 1/8 inch hardboard. Also required are 1 1/8 inch drywall screws and adhesive.

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Laying out the wheel

Start with deciding what diameter wheel you want to build. In this build, I went with a 10 inch diameter wheel, with a 5 inch wide "tire". In this step it is crucial to have as close to a perfect right angle to start with as possible. It's a major part of your layout to have it.
I used a scrap of 3/4 inch plywood that I had laying in the shed for the wheel itself. I also used 3/8 inch ply to make the braces to support the tire. I will go into those more on the next step.

Layout slots for bracing

Here is how I laid out the slots for bracing. They are 3/8 inch wide, by 1/4 of the radius deep, in this case 1.25 inches. Measure and cut them as accurately as possible, because they will be glued in, and they are a major part of what keeps your wheel true and square.

Cutting out the wheel

Here is the wheel cut completely out:

Take your time cutting the wheel out, because everything must be as square as possible. If you need to do any sanding, now is the time to do it, but don't paint or seal it yet. This is also the time to drill any holes, cut slots, etc. to lighten up the wheel. Just don't cut into the hub area, and leave at least an 1 1/4 inch rim around the outside undisturbed, because of the screws used to mount the tire to the wheel.

laying out and cutting the bracing

The braces can be as plain or fancy as you want them. The depth of the braces from the rim to the hub is half of the radius, which in this case is 2 1/2 inches. Just one rule though: When you lay out the braces, leave at least an inch on the inside. You will need this for clamping later!

Glue in the braces

Check the fit of your braces in the wheel slots. They should all be flush with the edge of the wheel.

Glue in each brace and secure them till they dry. I use just a piece of rope or strapping. Basically whatever I have lying around. You can even do it with heavy twine. Just wrap around the outside to keep them from falling out. I usually use liquid nails for projects like this because of it's gap-filling qualities.

adding the tire

Okay, after you have let this dry overnight, you have something that looks like a paddlewheel. Trust me, it's supposed to look like this! Here is where it starts to get tricky. On a work surface you can make a mess of, clamp one board to the surface about 2 inches back from the diameter of the wheel at a right angle to the side edge.
Then take your other clamp and fasten it to the front edge about 2 feet from the side edge that you clamped the board to. The back board you just clamped on is to push your wheel against while you screw the wheel together, and the clamp on the front is to "park" your hardboard against while you are heating and securing. Here I've already started attaching the tire to the wheel.

Heating the hardboard for the curve

Take your time, wear gloves and use plenty of adhesive! Here is how I do it: Heat the whole piece of hardboard from top to bottom about an inch behind your last screw, and about 3 inches in front of it. If you are turning the wheel against the backstop at the same time, you can feel the hardboard start to "give" a little bit as you turn. WORK SLOWLY! Expect the first layer to take about an hour to an hour and a half. You want to heat the hardboard up till it is just short of scorching. This takes practice to learn.

Heat screw and glue. Take your time!

Finishing the first layer

Here is the first layer finished. Notice the gap, and the way the ends have turned up. Don't worry. this is normal! You have to do a second layer to correct this. The next layer is a lot easier!

Starting the second layer

Okay, hopefully you noticed that I started the first layer with the leading edge on a brace. You are going to work in the opposite direction this time, using the middle between two braces as your start. This is to give you a good clamping surface for both the start and finish. (Remember that inch I told you to leave on the back of the wheel? This is why!) When you clamp the scrap board on the starting edge, leave the first 2 inches unglued. This will need to lift a little bit when you are finishing the wheel.

Finishing the second layer

Okay, this strip I cut purposely long so that I knew I could fit the end exactly. After you have brought the end around to the overlap. tranfer a line from the end of the underneath piece to the top piece. Cut this very carefully by hand. I use a sharp razor knife and a speed square to just keep cutting a layer at a time till it falls off. After you get through this, it will still be too tight. One piece will be slightly over the top. Using a hacksaw blade cut flush next to the top piece to the bottom piece. Don't cut through the first layer! The thickness of the sawblade will give you a perfect butt-up on the top layer. Glue these two pieces down and clamp overnight. Ta-da! You are done!