Beginner’s Guide to Constructing a Helicopter

This step-by-step guide was written by Jeff Anderson to aid those attempting their first helicopter. It provides a process for building the rotors of a simple co-axial helicopter. The dimensions given are a good starting point, but are not ideal and will need to be altered to suit your individual helicopter.

The conventional solution is a dual rotor copter; both rotors mounted coaxially and counter rotating. One is attached firmly to the motor stick; the other rotates free on a wire shaft. In flight, **both** turn in opposite direction as one end of the motor torques on the 'free' rotor, and the other end torques on the 'fixed' rotor attached to the motor shaft.

Let’s start with the 'fixed' rotor.

1. Start with the axis of the rotor which is the motor stick itself. It should be about 12 inches long and weigh about 1.5 gm.

2. Select two spar sticks for the rotor. These are long straight stiff pieces of wood. Just fewer than 40 cm long, probably 1/16 by 1/16 and weighing 0.3 to 0.4 gm. These pieces are key, select them carefully.

3. Now, glue the first spar to the rotor, around 2 inches down from what will be the top of the motor stick. Glue it so it is centered on the motor stick, opposite side from the rubber band. Make sure it is square to the motor stick. A jig is handy here. Don't try to do this free hand due to the risk of inaccuracy.

4. Now, measure up the motor stick, say 1 1/4 inches. The second spar is going to be attached here, again centered on the spar. But, this spar must be rotated around the axis so the tips of the spars are separated about 4 inches when looking down along the length of the motor stick. Trigonometry calculations come out as about 28 degrees of angular rotation. And that's clockwise looking from the top of the stick, by convention. It only matters because the free rotor you build next must rotate the opposite way. As long as it is winded correctly, either can work.

5. Now, to attach the spar at an angle with a good glue joint, you'll need to sand a shallow angled notch into the motor stick on the same side as the first spar at the marked location. The angle is again 28 degrees in the direction you want. Glue the second spar into this notch, again square to the motor stick, but angled to the first spar when looking from the top. A jig of some kind is handy.

6. The next step is to put some ribs between the spars to define a twisted surface to put tissue or Mylar covering on. Measure and mark along each spar 5, 10, and 15 cm from the motor stick. Using light balsa cut and fit a rib between the spars at each of these locations and at the spar tips. Make sure you don't cause the spars to bend. These ribs can be straight or have a slight curve like a wing. This is finicky hand work, cut, fit and reject if not perfect. Once you are sure the rib is right, glue it in place. Of course, a jig is handy, be creative.

7. Now, cover the rotor from the 5cm rib out to the tip. The inner 5cm theoretically adds thrust, but as a practical matter, most of the work is done at the tip and the inner area just adds drag and weight. Covering is just like covering a Wright Stuff wing, except the surface is curved in three dimensions. It can be done in one piece, but treating each section on its own might work better.

8. Voila! You have a rotor.

The 'free' rotor is almost the same except for the axis. For the free rotor, the axis is the shaft (think prop shaft wire on a Wright Stuff plane). The spars are selected the same and are just as critical here. You glue them to a very long prop shaft (rubber hook at one end, locking hook at the other). Same spacing, same rotation difference, but in the **opposite** direction as the fixed rotor. It’s a little tough gluing to the wire securely, so it may be easier to cut two 1/16 square spacers about 1 ¼ inches long to slab alongside the wire and glue between the two spars. Also, the locking hook must be glued to the top spar very securely. Everything else is the same.

Note that the dimensions given are approximated. They should result in a relatively decent helicopter if the overall weight is kept to 4.0g **maximum**. The ideal is for individuals to determine themselves. But don't be too surprised if the best thrust is found to be with the lower rotor at a slightly higher pitch than the upper. And maybe a three or four bladed rotor is better. Only testing will tell.