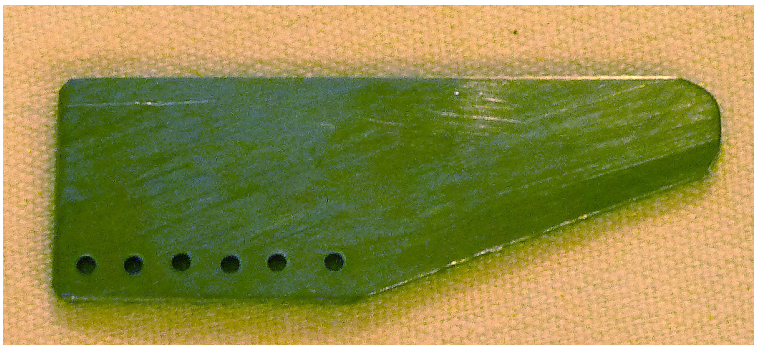
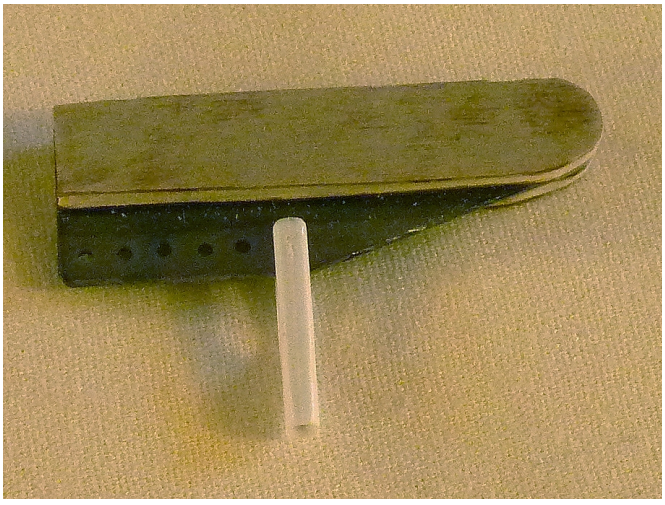
Cirrus/Sirius all flying tailplane suspension

The Sirius is a renewal of a forty year old set of Graupner Cirrus wings and tailplanes with a new fuselage. The only complication was the all-flying tailplanes. This meant I had to find a way of mounting and pivotting them. I decided to install micro servos in the tail for the tailplanes and the rudder.

The bellcrank is the key component. I made it from 1 mm titanium and it weighs 3.4 g. It carries, in 3 mm tubes, the two 2 mm piano wires that plug into the tailplane halves. The holes for the 3 mm brass tubes were drilled when the side cheeks were glued on. The row of 1.5 mm holes is for the clevis on the end of the servo connection. This pushes it from below. I like titanium as it is only twice the density of aluminium but immensely tough and hard enough never to wear. It is about the same as mild steel for cutting and filing though drilling is slightly more difficult due to its springiness and poor conductivity causing heating. Apart from tiny holes, a bench drill press is required but these are cheap now.



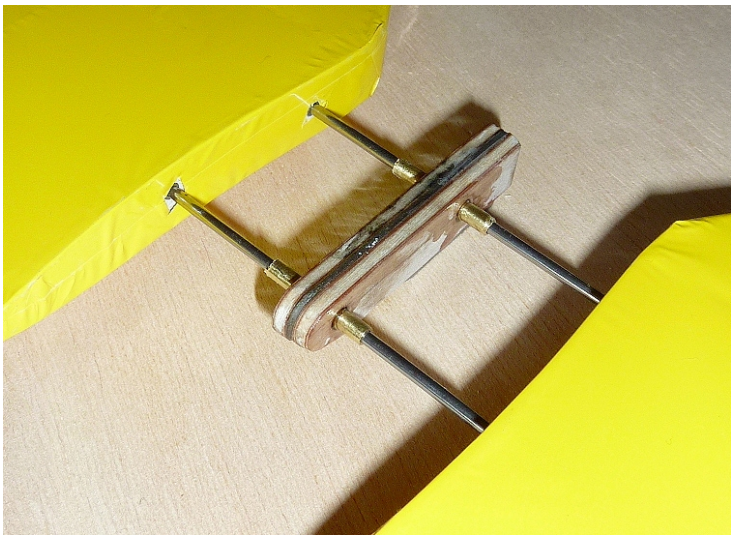
I then laminated some strips for cheeks for the bellcrank and to form a box in which to mount it. I used 1 mm ply on each side of some 2 and 3 mm balsa. This is the bellcrank with the thinner cheeks fitted. The cheeks were sanded, as were the inside surfaces of the box, so they rub smoothly. The rubbing area will give extra stability.



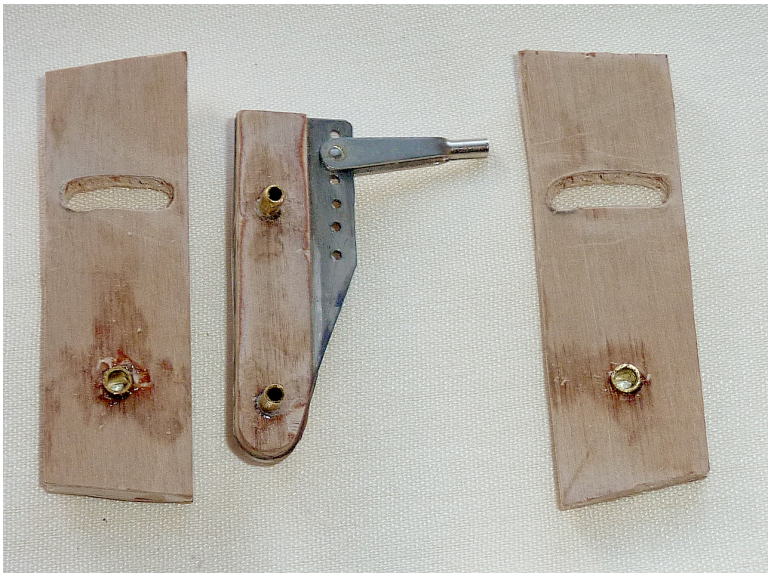
To form the bearings I used two sizes of brass tube. The smaller is 2 mm bore for the tailplane mounting piano wires. This has an outside diameter of 3 mm which is a perfect running fit in 4 mm outside diameter tube. These were glued into the box to form bearings for the bellcrank to pivot. 2 mm is a little small for the wires but this was the size in the original tailplanes. I imagine it was to keep the aft weight down. If I was building new ones I would use larger carbon fibre tubes.

The drilling and assembly order needed careful planning.

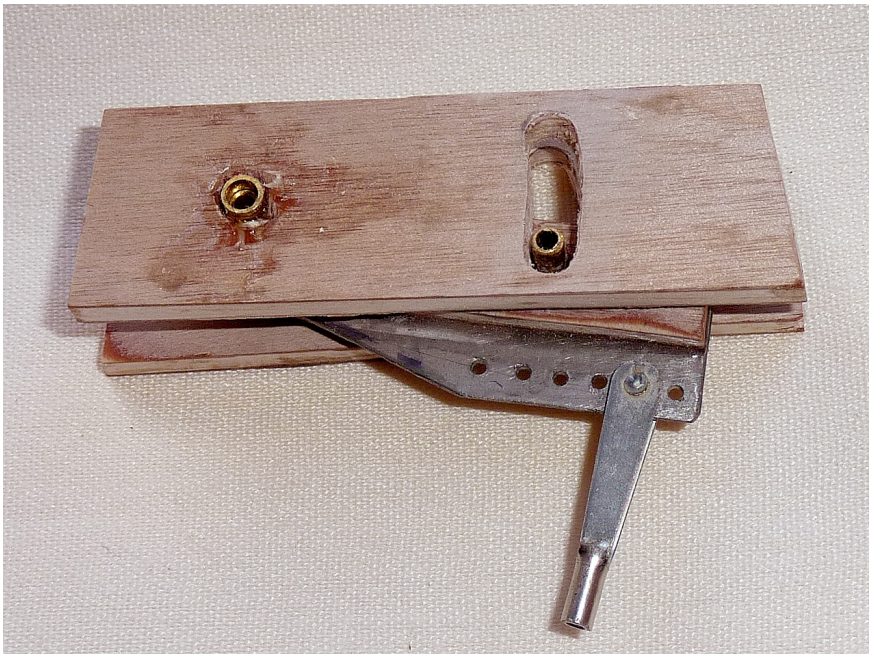
1 Mark and drill the positions of both bellcrank holes using 3 mm twist drill in a drill press.
2 Connect a servo with a tester. Put the bellcrank on 3 mm drill as pivot.
3 Find the servo horn and bellcrank holes to give ±15º on full servo deflection.
4 Make sure the chosen bellcrank hole suits the metal clevis. Open up if necessary.
5 Cut two pieces of 2 mm piano wire of the correct length for tailplanes.
6 Glue 3 mm tubes in front and rear bellcrank holes with these wires in and the tailplanes connected.
7 Measure the distance from the rear of the fin leading edge to the front bellcrank hole.
8 Drill front holes in box sides using 4 mm holesaw using this dimension.
9 Glue in 4 mm brass bushes with 3 mm tube in place to line them up exactly.
10 Cut the rear arcs in the box sides using 5 mm holesaw and a 3 mm drill in the front holes as pivot.
11 Smooth bellcrank sides and relevant sides of box sides.
12 Cut front and rear box spacers out of laminate to give slight clearance.
13 Test clearance under pressure from clamps.
14 Assemble box around bellcrank.



Bellcrank with tubes step 6

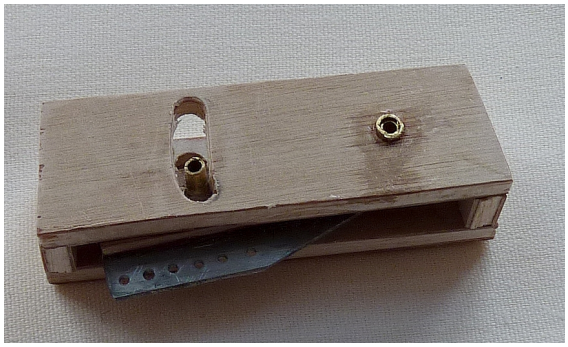


Box parts



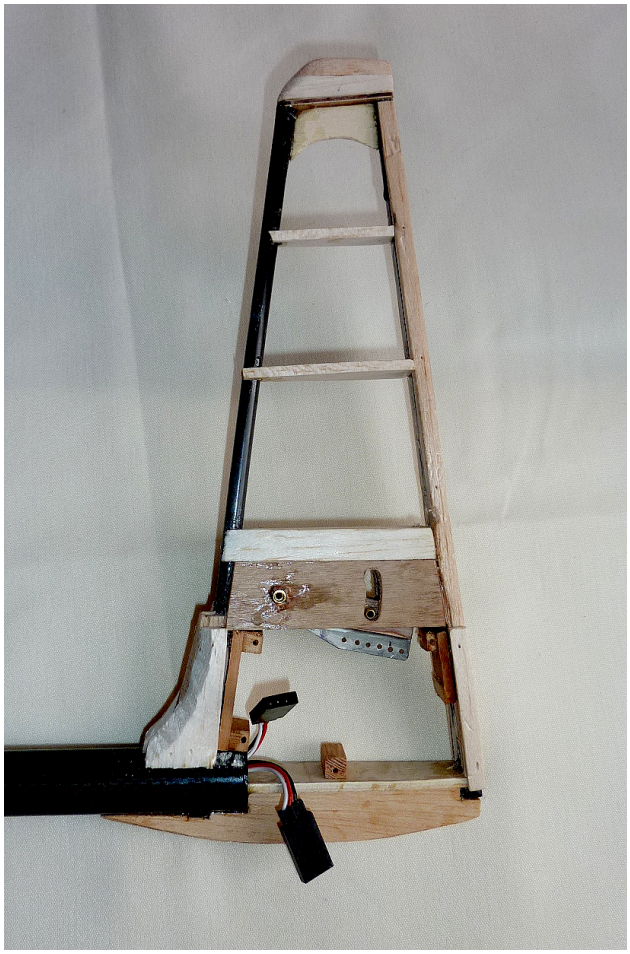
Box - loose assembled

Box complete.



Weight without clevis 11.9 g.

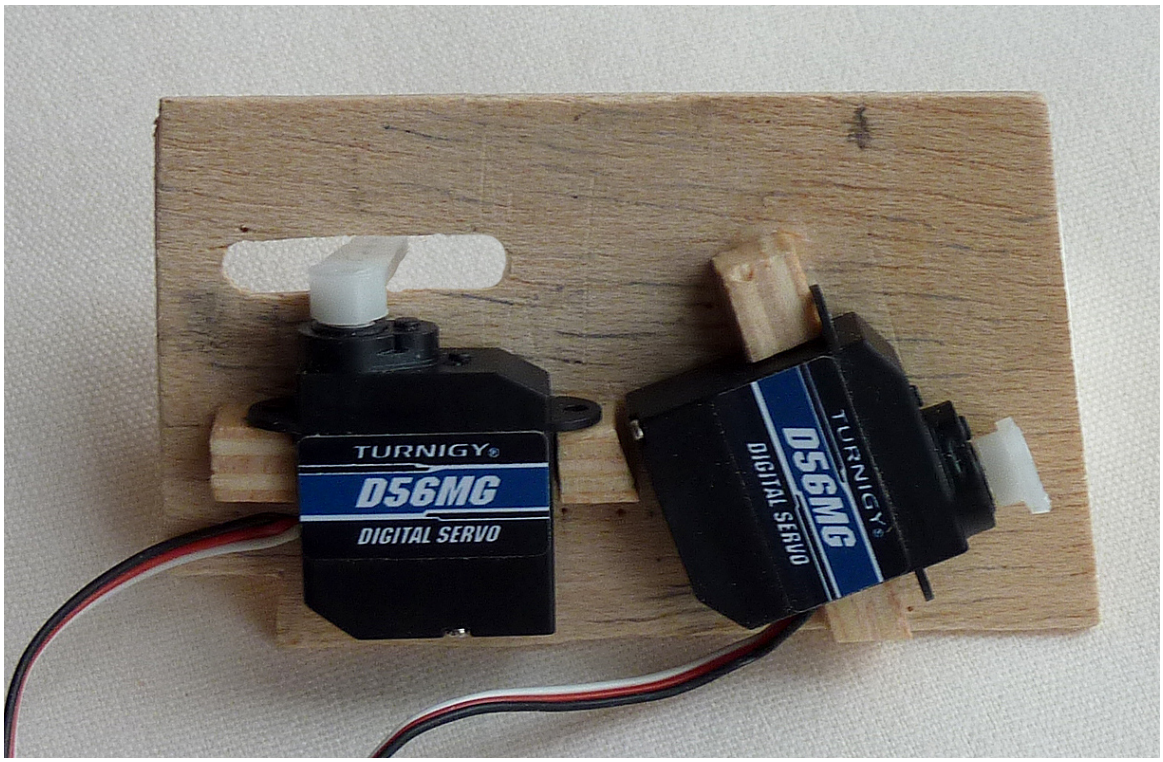
Box installed in fin with tailplanes

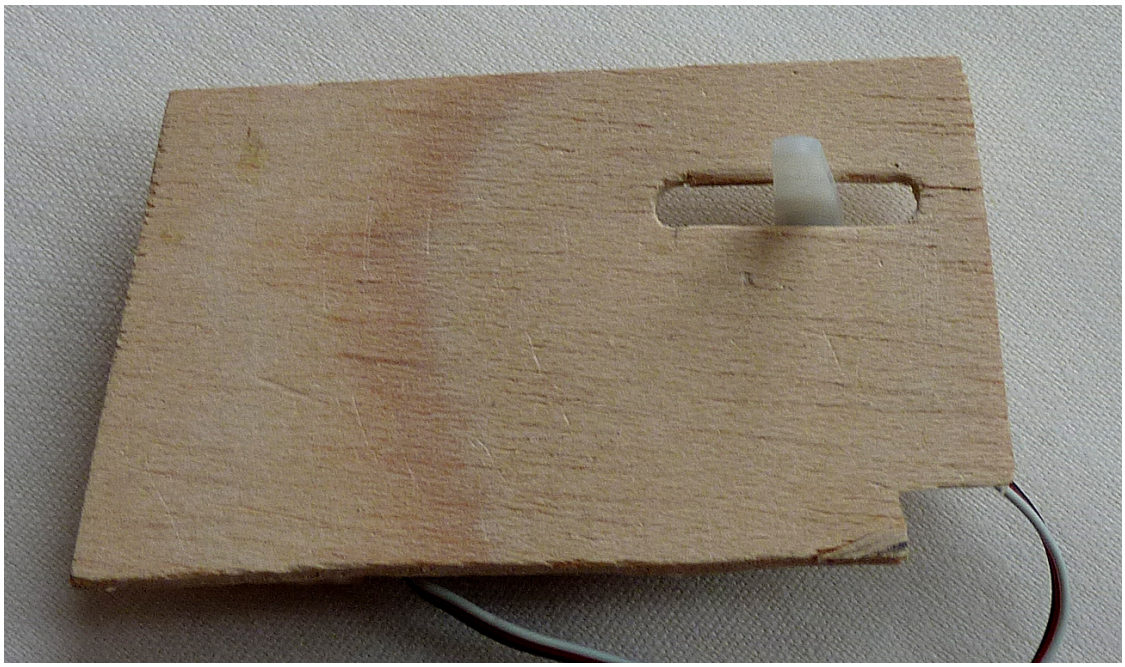


The screw bosses have been added

The two servos go into a box under the bellcrank box. Here is one side – the mounting plate. The servos are metal geared and quite powerful for their size. They are fixed with the normal screws and a dab of rubbery glue. The deflection needed for the tailplanes will be small - probably less than 10º. Airspeeds will not be high so more important is the ability of the servo to hold the tailplanes steady, and the metal gears and short, carefully

drilled, connections should be more than good enough. After filling and sanding, the two sides are now covered with black Hobby King film.





Last edit 17 May 2017