SCALE MATTERS: ARTCILE 4

SOPWITH PUP 1/3 Scale
Working tail skid and scale flying control surface fittings.

By John Armarego

4rd Article featuring the Sopwith Pup 1/**3** working tail skid and scale flying control surface fittings.

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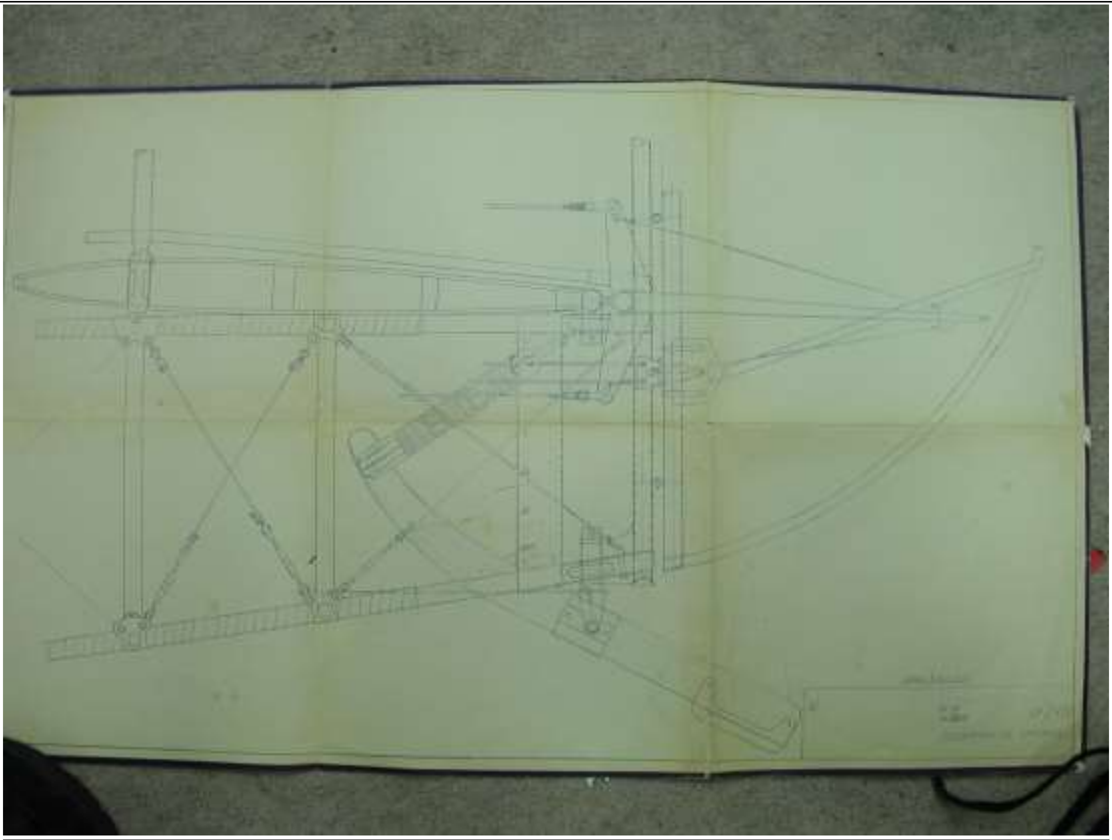
Insert Photo 1 here
1/3 Scale Sopwith Pup being towed by a fully functional Caterpillar Sixty Tractor.

Scale Matters article 4, uncovers and explains the techniques I have developed to construct the working tail skid and scale flying control surface fittings on my 1/3 scale Sopwith Pup. This aircraft was presented in my introductory article in a previous edition of Airborne.

Tail Skid

Having a working tail skid not only adds to the scale realism, but also helps protect the aircraft from the stresses of hard landings or rough field surfaces. It also helps protect the aircraft when being transported. I always transport my aircrafts by having them rest on their undercarriages; the aircrafts should be designed to take relatively substantial loads in this direction without damage. If this is not the case, then the aircraft will probably not stand up to normal landing situations. Sitting in a trailer and traveling all the way from Canberra to Melbourne was a good test of any undercarriage system, it also tests your other packing techniques.

The starting point for the building of the tail skid for my Sopwith Pup was to study a copy of the original drawing of the tail skid assembly for the full sized aircraft. The Sopwith detailed assembly drawing was to 1/2 scale so I reduced the size to 1/3 scale. I decided what I was going to copy, and what I had to modify while still representing the original design.
Seeing a ½ scale drawing of the tail skid highlights how small this full size aircraft really is.
Interesting features of the Sopwith Pup tail skid is the bungee cord used for the spring action, the tail skid is also steerable, and the "blade' fits vertically which digs in to the ground and provides a lot of stability on the ground. The blade also produces a lot of drag on the ground which assists with slowing the aircraft down once the tail is dropped.



Insert Photo 2 here
Original Sopwith Pup tail assembly drawing

Main skid beam
The first part that I made was the main skid beam itself. I scanned the tail skid assembly drawing and then scaled it so that when it was printed out it was the correct size for my aircraft. This was then used as a template to cut the required tail skid

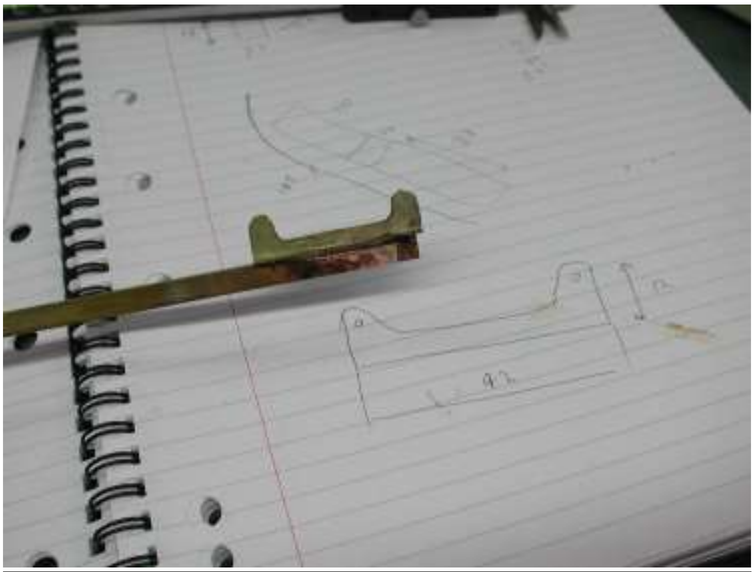
beam from good quality plywood using a jigsaw following the original shape. The main skid beam was then sanded and stained.

Tail skid Blade

The tail skid blade dimensions were scaled from the copy of the original drawing. The parts for the blade were made by filing, folding and silver-soldering pieces of K&S brass sheet. I silver-soldered parts like this using a 5 % silver 2.5 mm brazing rod. Universal silver brazing flux and the good old BernzOmatic MAP gas Torch are readily available from Bunnings or industrial suppliers like BOC.

Insert Photo 3 here

Items used for Silver soldering the brass parts for the tail skid.



Insert Photo 4 here

Tail skid Blade construction

Insert Photo 5 here
Drilling the tail skid blade mounting holes.

Tail Skid Horn and pivot point

The tail skid horn was drawn using a CAD package and then I machined the horn using my CNC mill. This process allowed me to also machine some lightning holes into the horn. I made a few extra just to be sure (see insert 7). This part could have also been made by filing and drilling some brass plate. The pivot point was made by hand as it was much simpler. The two parts were then silver-soldered together.
The centre section mounted to the tail skid beam is also constructed in the same way. The brass parts are bent into shape using a vice and a hammer,   brass and or steel stock of different sizes can be used to act as forms. Patience and practice is all that is needed, a Hare& Forbe Hafco 3- IN-1 /305 small bench Pressbrake, Guillotine & roller unit can also come in very handy.

Insert Photo 6 here
Hare& Forbe Hafco 3- IN-1 /305

It is usually very important with WW1 aircraft to keep the tail as light as possible. The original radial engines were a heavy part so the aircrafts were designed with a very short nose moment. Any weight in the tail usually needs about 5 times the weight in the nose to balance it out.

The brass parts were painted using TAMIYA gloss black X-1 and then glued into position using brass insert pins. The online shop of the last working nail factory in France is a good source for small fittings, they have been manufacturing nails since 1888 and can make 2800 different nails http://www.clous.eu/en/home/.

Insert Photo 7 a,7 b here
Tail skid horn and Pivot Point completed.

Insert Photo 8 here
Tail Skid Horns,   CNC manufactured, a few spares just in case.

Insert Photo 9 here
Test mounting the Tail skid brass parts.

Tail Skid additional bits.
The top mount in the fuselage for the bungee cord is a brass picture frame hanger from Bunnings.
The bungee cord comes from BCF (Boating-Camping-Fishing) and is called Roper Shock cord; they have a range of different sizes. I also use this shock cord on many working WW1 undercarriage suspensions which will be presented in another article.
The shock cord is doubled up as many times as is required to get the necessary tension.

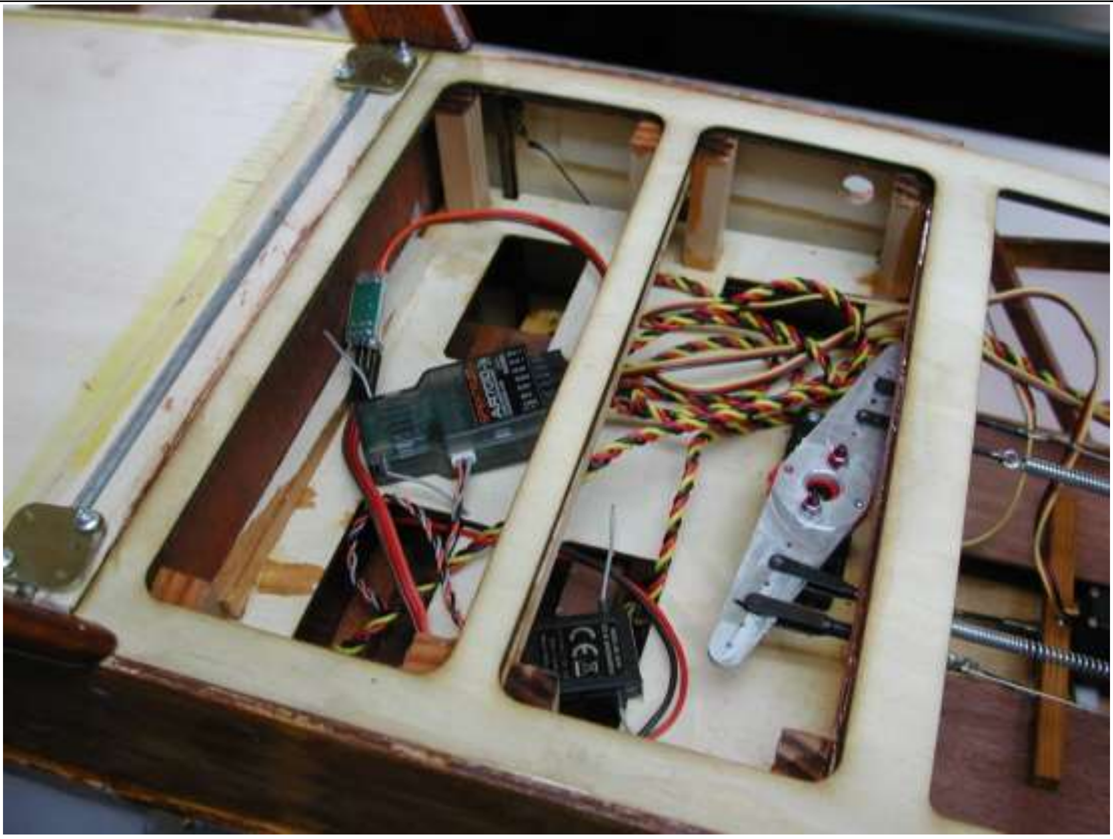
The two ends of the cord bundle are secured by winding heavy duty twine many times around the ends of the bundle and then gluing and fixing the twin with super glue (see inset 10).

Insert Photo 10 here
Tail skid mounted with bungee cord to test the tension and spring action.

Insert Photo 11

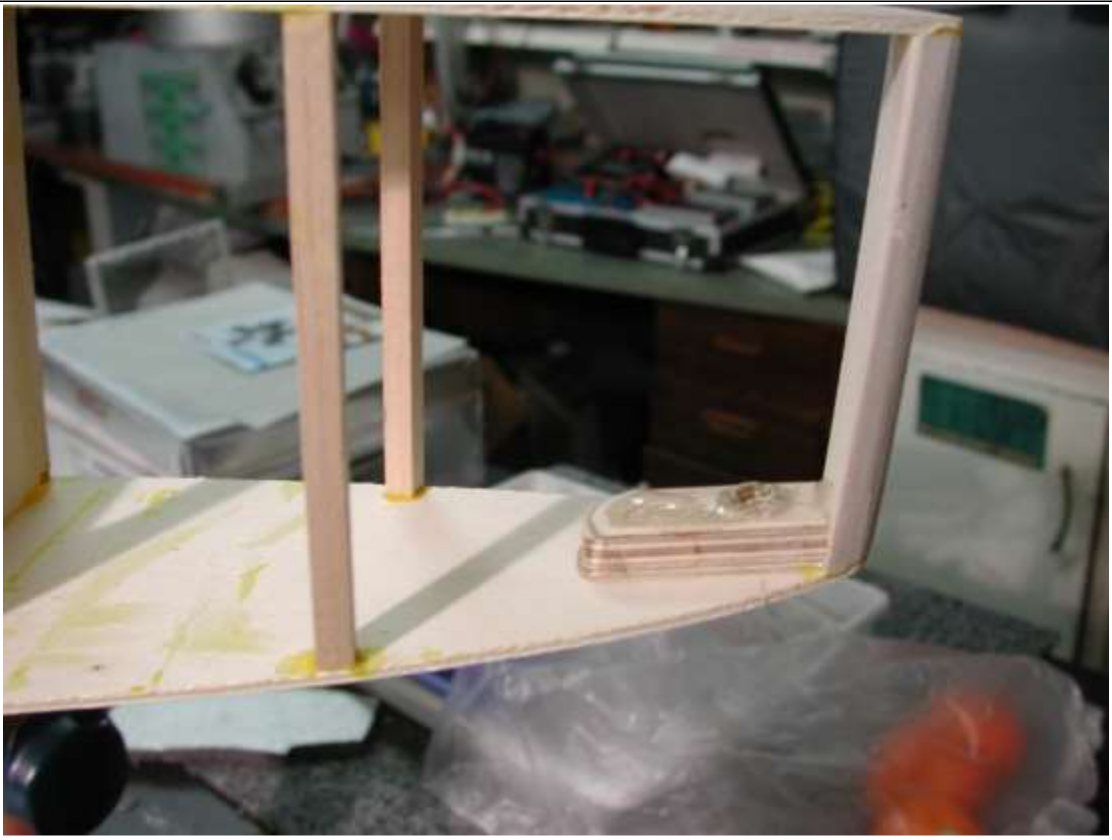
Completed tail Skid assembly

Two shackles are attached to the tail skid horn and the pull-pull cable is attached to these shackles. The pup-pull cable is then run back down the fuselage to the rubber servo horn. (see insert 14). The pull-pull cables are not directly attached to the rudder servo horn, they are connected to two springs one on each side and then connected to the rudder servo horn. This prevents any shock that the tail skid is subjected to, causing any form of damage to the rudder servo gears (see insert 12).



Insert Photo 12 here

Rudder servo control horn showing springs used to connect the Tail skid pull-pull cable control wires.



Insert Photo 13 here

Tail skid fuselage mounting. Note brass threaded insert for the pivot bolt

Insert Photo 14 here

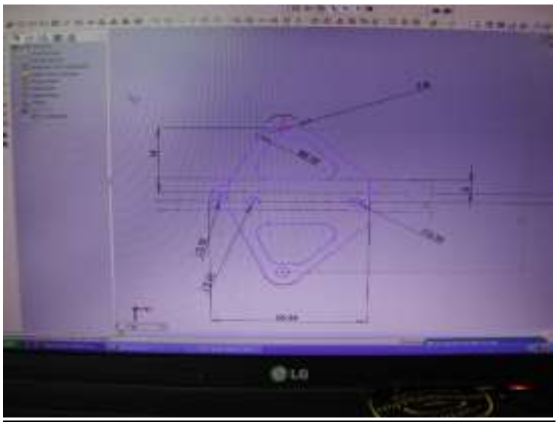
Tail skid shackles and pup-pull cable. Also note the additional plywood sheet on the underside of the fuselage, there is a layer of carbon fibre between the fuselage and this sheet for added strength and stiffness.

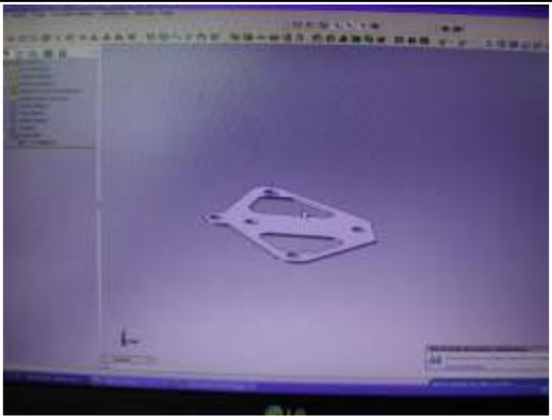
Fuselage Tail Skid mounting.
The Tail skid assembly is attached to the fuselage through a threaded brass insert that is fixed to a plywood block (See insert 13). This whole area is strengthened by laminating carbon fibre between the bottom of the fuselage and an additional plywood sheet, this can be seen in insert 14 along with the Pull-Pull cables. The cut-out in the underside of the fuselage has to be sufficiently large to allow for the required steering movement of the tail skid.

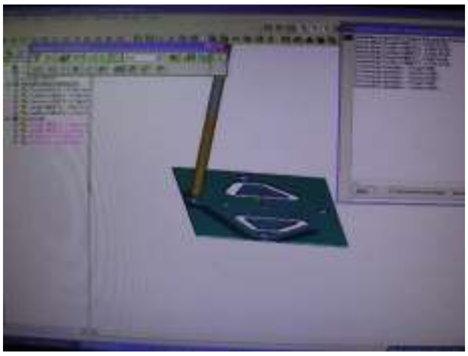
Aileron control Pulleys.

Mounting Brackets
One of the distinguishing features of the Sopwith Pup wings is the aileron control pulley inspection window (There are four inspection windows). I have replicated these in 1/3 scale and made the pulleys move when the ailerons are deflected to add to the scale realism.

Using the drawings of the Sopwith Pup aileron pulley mounting brackets I re-drew the brackets using the computer aided design package (CAD) and then machined the brackets out of thin brass sheet using a converted Hercus CNC mill. (See insert 15). Once machined the brackets were bent up to form the correct shape to hold the pulleys.







Insert Photo 15 a,b,c,d,e,f here
Aileron Pulley bracket drawn using CAD, machining of part simulated and then the part machined out of brass, (four of required).

Pulleys
The aileron pulleys were machined up on a small Micro Lathe out of aluminium to the required scale dimensions. A brass tube insert was used as the bearing surface.
The pulleys have grooves machined into them to hold the aileron cable in place and to stop the cable from jumping off the pulley.

Insert Photo 16 ,a, b here
Aileron Pulleys machined using Micro Lathe

Aileron control Windows.
I drew up a 3D model of a two part die using the CAD package to use to form the window surround parts. This two part die was printed on the 3D plastic printer in ABS plastic. Using soft 0.2mm aluminium sheet (Bunnings Consolidated Alloys 230 x 0.3mm x 10 m Weatherflash role) the plastic die was used in a vice to press the soft aluminium sheet to form the aileron pulley window surrounds. I used a little soap to help the die press and form the surround without sticking. This technique worked very well, I am going to use this process to form the louvers on my 1/3 scale Fokker D7. This Weatherflash that is made for roof flashing is very soft aluminium sheet and can be easily formed. Complex shapes can be easily made and then strengthened by inlaying glass or carbon cloth on the inside surface. The 10 meter role costs $22.00 and that will make many parts.
The formed aluminium window surround is cut and trimmed using a good pair of small scissors.

Insert Photo 17 ,a, b here
3D printed die used to form the Aluminium aileron window surrounds

Aileron cables.
The location for the pulleys is first stained to give the correct appearance when viewed through the completed inspection window.
The Aileron pulleys and the brackets are mounted in the correct location in the wings. Braided fishing tracer is used to simulate the aileron cable. The aileron cable is mounted at one end to a spring that is fixed to an adjacent ½ rib, and the other end is threaded around the pulley and then connected to the scale aileron horn. When the aileron is deflected by the servo on the bottom wing, the scale horn pulls the cable against the spring which makes the pulley rotate in either direction.
The aluminium window surround is mounted to the front ribs using small brass pins and glue. The clear window is cut out of shirt box clear acetate and glued in place using canopy glue (Pacer Formula ‘560’ Canopy glue) The window is then masked before spray painting the wing and roundels.

Insert Photo 18

Aileron Pulley mounted in the wing. Note the cable attached to the spring at one end and attached to the aileron horn at the other. One per wing ½ top and bottom.

Insert Photo 19

Aileron Pulley mounted in the wing with aluminium pressed surround fitted. Note the small brass pins.

Insert Photo 20
Aileron inspection window completed.

Aileron control horn
The aileron control horns were cut out of plywood to the correct contour and three thicknesses where glued together before sanding to get the streamlined shape. The control horns are then stained before fitting the shackles and turn buckles to fix the control horn to the braided fishing line. The shackles and turnbuckles are obtained from modellingtimbers.co.uk as specified in the previous scale matters article.

Insert Photo 20 a,b

Aileron scale control horn. Note secondary attachment point at the rear of the aileron.

Elevator Control Horn

The elevator control horns are drawn to scale using CAD and then CNC machined out of brass stock. The horns are then filed to match the stream lined shape of the original horn. The secondary elevator cable is connected to the elevator horn using turnbuckles and shackles and then terminated at the rear secondary attachment point. The secondary attachment point is made from plywood and runs through to the bottom surface of the elevator and is attached in the same way as the top control lines. (See insert 21)

Insert Photo 21
Aileron scale control horn with secondary attachment point.

Scale Covering

In the next instalment of Scale Matter, I will be explaining my techniques, and the materials I use to cover the model aircraft with fabric to scale and in a realistic way.

Until then happy building and plenty of flying.