Mio Amigo
now called Amico
(Italian)

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Peter Scott © 2021
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Whilst ferkling in my loft I came across a pair of wings and a tailplane from a Graupner Amigo that I flew decades ago at Ivinghoe. Though they are warped they are in good condition structurally and have only a few minor holes in the doped tissue from hangar rash. I wanted a lightweight glider to slope soar on the dunes and cliffs around Norfolk where I live. All I needed was a fuselage, fin and rudder.

Hyperflight does an excellent range of glider components at https://www.hyperflight.co.uk/ including glass fibre fuselage fronts and carbon fibre booms. I bought the Sapphire fuselage and an 850 mm long tapered tail boom. I got the version with the nose cone removed and a motor mounting plate fitted. A motor will be very useful if the model gets blown out over the sea or an ill-trained dog looks like wanting to attack it on landing. The price, including VAT and delivery, was £65.81. Hyperflight is very quick at delivering so I got the items next day. It was very well packed. I think this could be a perfect fuselage for a number of different styles and sizes of glider.

I have a reduced-size Amigo plan printed on an A4 sheet. The scale is 1 : 4.12. The fuselage cross-section is huge, reflecting the size of the radio gear of the day. Incidentally for about £15 you can buy a CD with 750 glider plans on theclassicarchives on eBay. You can print them out full size in A4 sections or have them printed professionally.

Wings

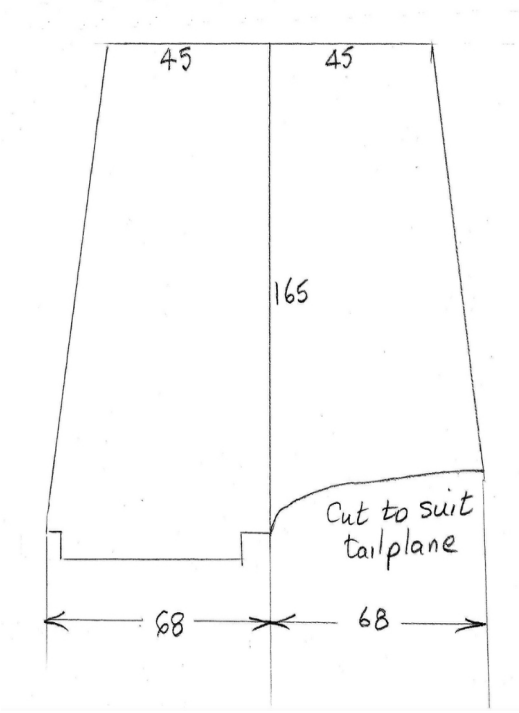
unobtainable so I bought some packaging tissue on eBay for £1.95 for five 500 x 375 mm sheets. I will only be using it for patching so hopefully it will be strong enough. The colour match is pretty good. I did think about stripping off all the tissue and recovering with film. However this would weigh more and would take almost as long as building new wings. There is a possibility that the light structure might buckle when the film is shrunk. I applied a new coat of cellulose dope on the whole wing to improve elasticity. I had to fit ply strips on the top root surfaces to spread the load from the four wing bolts. This won't be an aerobatic model so the loads should be low.

Tailplane

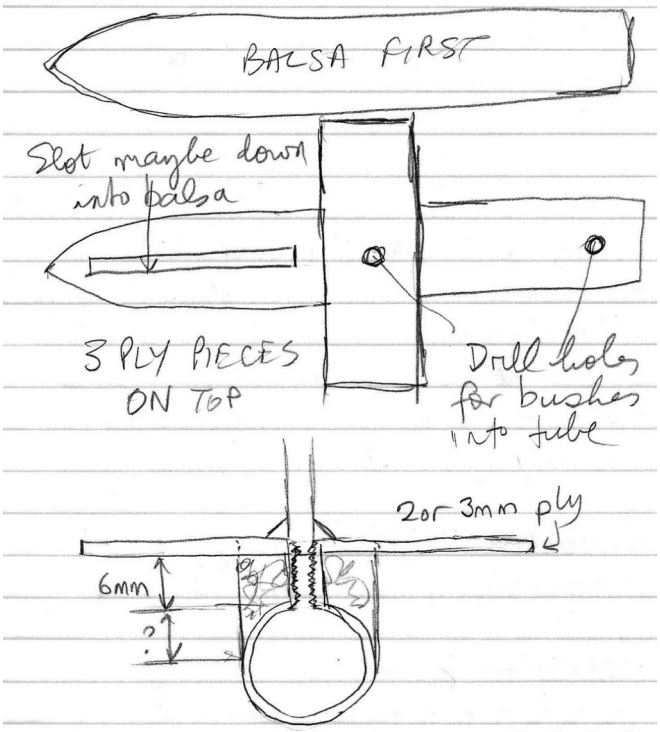
This also has a few tears but is otherwise sound. I repaired it as the wing. I made a mount for the tailplane and fin that is glued on to the rear of the boom – see below. It lifts the tailplane about 6 mm above the top of the boom so the elevator horn will line up better with the snake. The tailplane will be held on by two screws so it can be removed for boxing. The original horn was off centre. I filled in the central cutout and fitted a new horn centrally. I can adjust the tailplane incidence with tapered packing if necessary.

Detail sketch of fin and rudder

As this will be the only steering surface the rudder will have to be quite large. I copied the size and shape of the original fin and rudder and made them from lowish density B grain 5 mm balsa, sanded to cross-section and sealed with EzeKote. I painted them black with acrylic to match the boom, then sealed them with acrylic varnish. The fin is permanently fixed to the boom. I think a little extra weight at the rear will not matter. The snake exits the boom slightly left of top in front of the fin.



Detail sketch of fin and tailplane mount

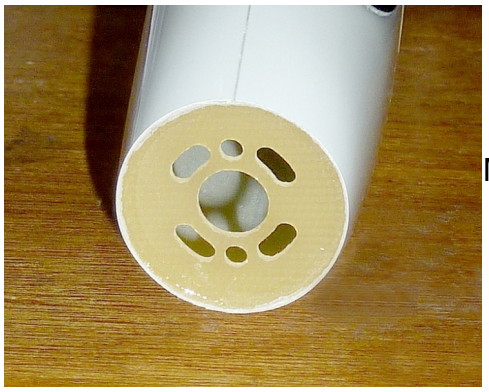


Fuselage

The fibre glass fuselage front is light so I wondered whether I needed to strengthen it inside with epoxy and fibre glass cloth with a few strip of carbon fibre tow. However I had to be careful not to add too much weight with the epoxy. So I decided that the cross pieces on which to mount servos, battery etc would add strength so left it at that. The fuselage

front and boom were superbly finished. There were four holes fitted with M4 bushes ready to be used for wing retaining bolts. Excellent value for money.

I shortened the boom with a Dremel cutting disk. Dust mask on of course.



Motor mounting plate 30 mm diameter

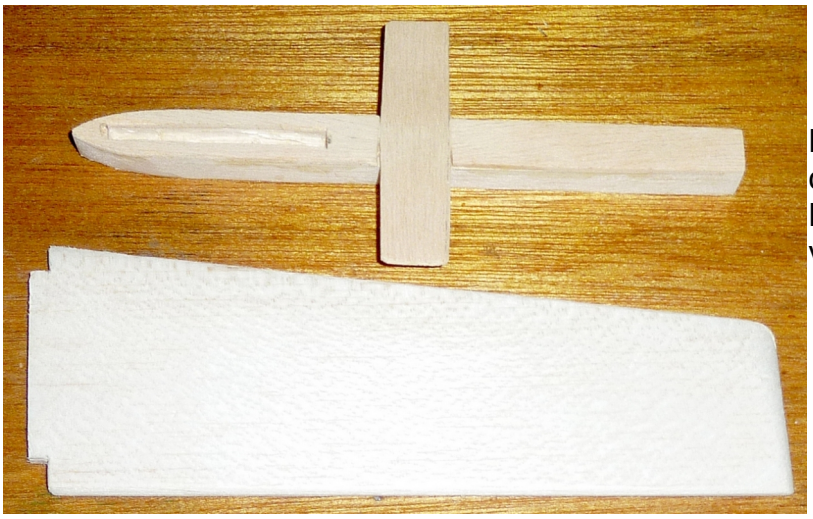
Snake fixing

I debated only fixing the snakes at the rear end of the boom. In the end I decided that, to avoid play, both ends should be fixed and made a balsa bulkhead to push into the fuselage on which to glue the snakes. I screwed a self-tapper into the middle of the bulkhead, which made it easier to manipulate using a pair of narrow pliers.

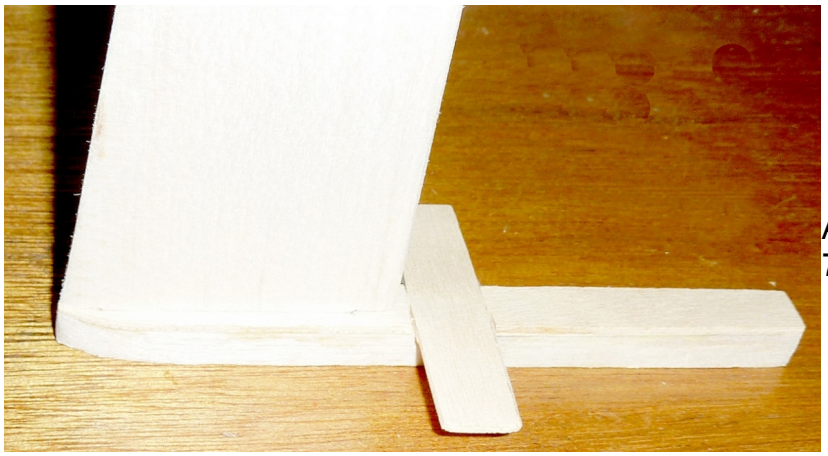
I loose assembled the front and boom with the snake outers in place so I work out how to feed them in when assembling. Feeding the rudder snake into the mount gave me a moment's concern, then I realised I could push the snake core down from the front and use it to steer the snake into place from the rear.

Snake bulkhead

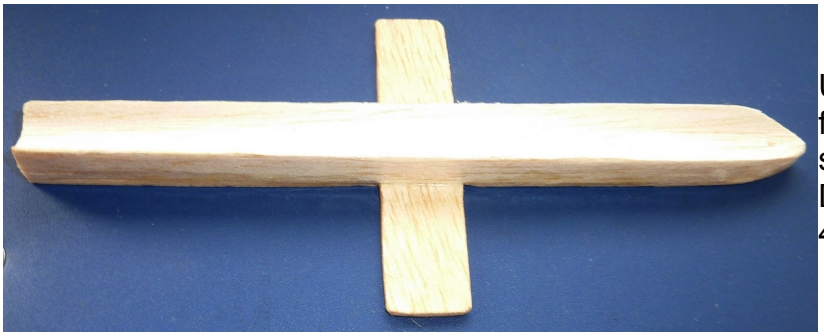
Tail assembly



Here are the tail support components sealed with EzeKote ready for painting and varnishing.



And assembled
7.43 g

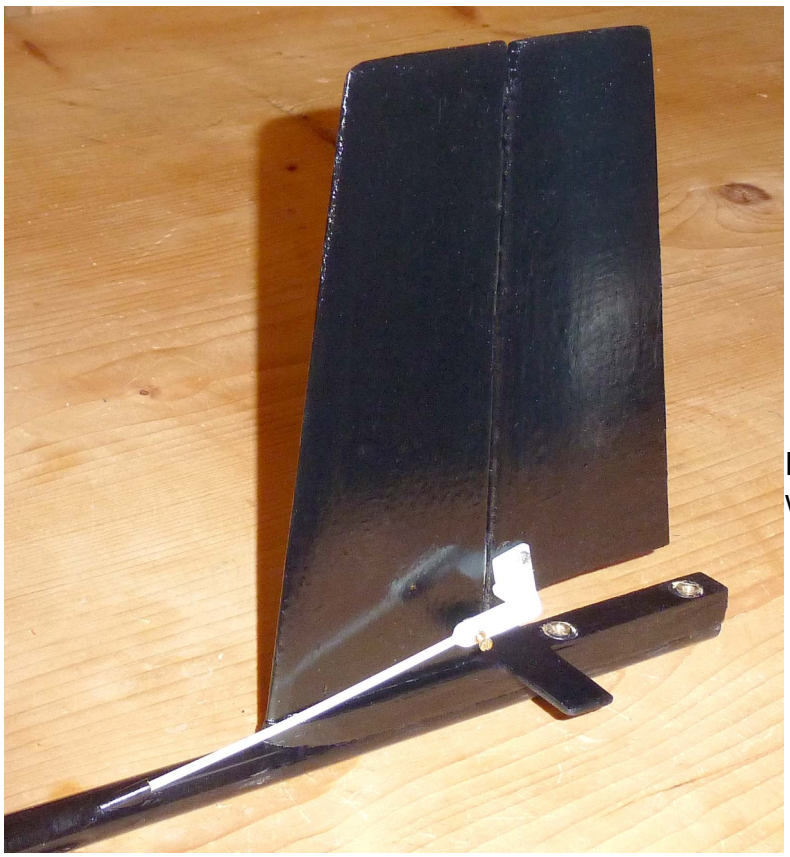


Underside of support shaped to fit boom using a cylindrical sanding attachment in my Dremel.
4.2 g

Rudder snake

The SLEC snake that operates the rudder emerges from the tail boom about 40 mm in front of the fin and slightly off centre to the left. It took a while to work out how to make the slot for it. I practised on the piece cut off the boom. After some messy mistakes I found that the best tools were two burrs in my Dremel runnning at fairly slow speed – 15 krpm. I used the ball burr first from the side, pressing down with the boom positioned with the required hole on top. When I had ground a small dent and hole I opened it up into a slot using the pointed burr. Dust mask on of course. The snake tube will be epoxied in place but not yet. Leave the snake long and only trim and glue after the fuselage parts are glued together. This makes routing the snake much easier when assembling the fuselage.

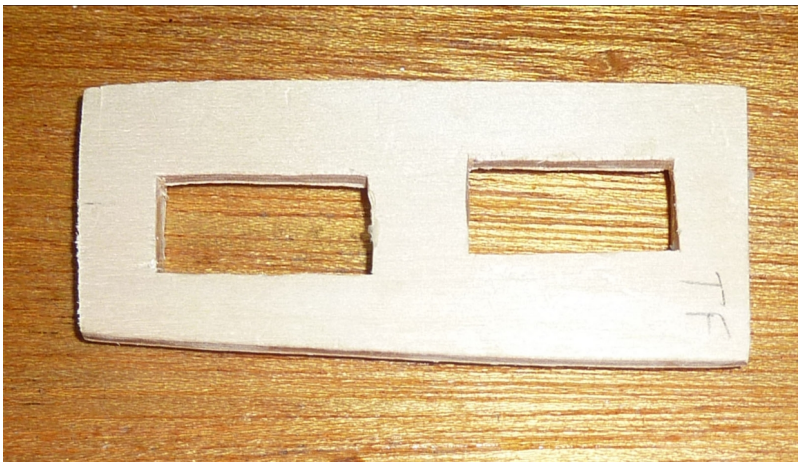
Here you see the result before gluing the snake and painting the assembly. You can also see the M3 bushes glued into counterbored holes ready for the tailplane screws. I can easily change to a different tailplane or to remove the existing one for travel boxing.



Here is the finished rear setup. I wish I could buy black snake cores.

Servos and servo mount

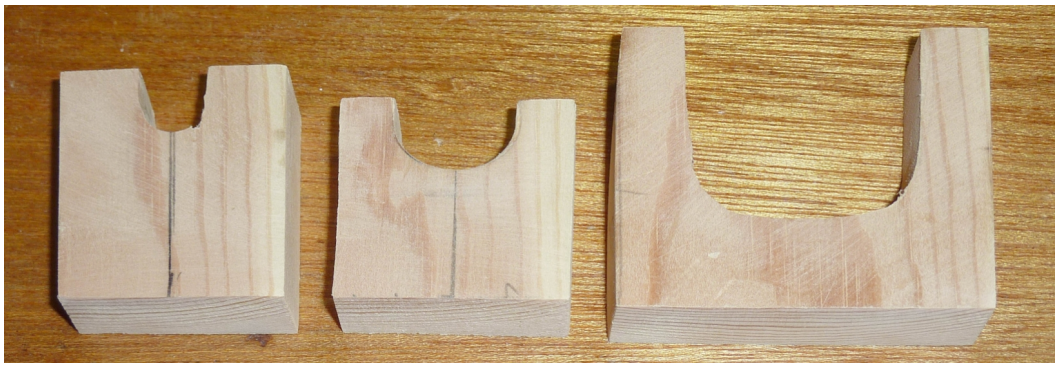
The fuselage is too narrow for the servos to be side by side. I therefore put them end to end but offset a little to give room for a full-size servo arm, as shown in the photograph. I used 2 mm birch ply and screwed it on to spruce bearers glued to the fuselage sides. I added extra pieces of 2 mm ply under the screw holes. I cut out the holes using a fine percing saw. The piece is roughly 80 x 35 mm.



Fuselage jig

I usually make a jig for round-section fuselages to ensure that all is perfectly aligned. The motor thrust lines must be right, and angles of attack must be correct.

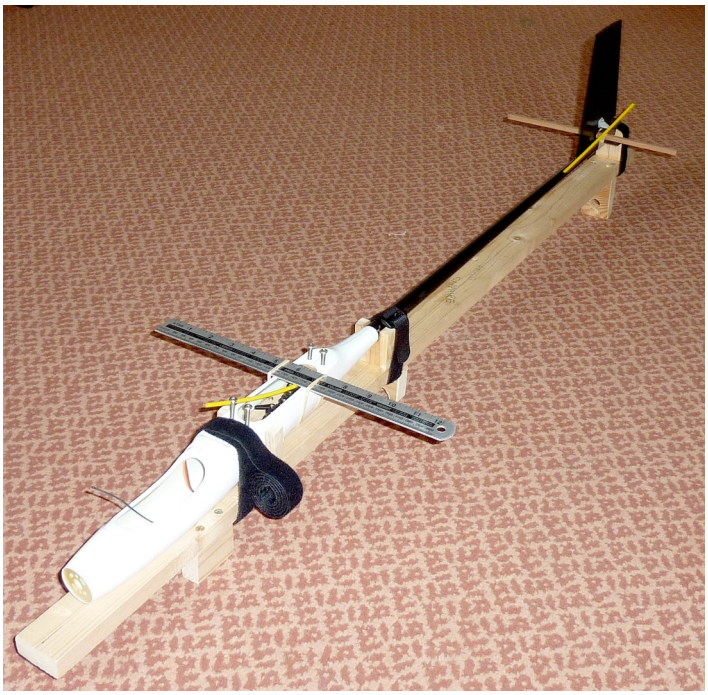
In this case I cut supports from some 15 mm pine and glued and screwed them to a 20 x 40 mm pine base. I used 8 and 20 mm diamond hole saws for the round holes and a jigsaw for the rest of the cutting. The left-hand two in the picture are for the ends of the boom and were sized so that the top of the boom was exactly horizontal to make angle of attack measurement easier. The front part of the fuselage was not a tight fit inside the boom so I sanded the support for the front section to give about 2.5º of wing incidence. Here are the jig supports:



Here is the finished jig. It is on the back of one for another model. I can of course use it for any further Sapphire fuselages I might buy.

Final assembly of front and boom was a bit tricky. I rubber banded some wood and a ruler across the tailplane and wing supports so I could turn the boom to line up the two flying surfaces.

Here is the fuselage in the jig whilst the epoxy hardened. It is held tightly in place by velcro battery straps. Surplus wet epoxy was removed in the usual way with meths. I had intended to put cling film over the middle jig upright in case of epoxy being in the wrong place but I forgot.



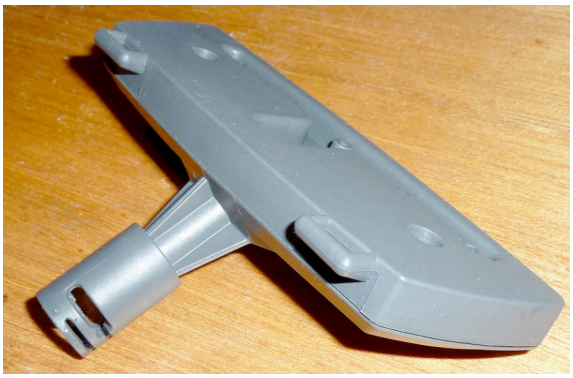
And here is the finished article after removal from the jig. Fortunately the join didn't stick to the jig despite the lack of cling film. Good stuff – meths.

Then the snakes were trimmed and glued into place. I pushed a piece of balsa in the rear of the boom to fix down the the elevator snake.

Getting rid of the wing and tailplane warps

I remembered that in the distant past I removed the warps from tissue and dope wings with a jet of steam. You can't do that with an electric kettle as it doesn't have a narrow spout and the kettle switches off. So for £25 I bought a Hoover steam jet cleaner like this:

This is the attachment I used to steam the wings. You have to have an assistant to hold the trigger down on the steamer and the attachment in the air.



The cleaner is useful for other jobs such as cleaning tiles and cookers, though the manual is one of the worst I have ever seen. No, it is the worst.

Dimensions from the plan

From the plan the scale is 1 : 4.12

	Plan dim	Full size
Old fuselage		
Overall length	270	1115
LE to nose	60	247
LE to rear end	210	865
Wing root chord		196

New fuselage

Dims to non-cut nose end assumed to be +30 mm
Overall length to increase by 21 mm for extra chord

Overall length with uncut boom	1330	
Boom length	880	
LE to boom join	250	
LE to nose	195	
Wing chord space	175	
Required LE to end	941	(1136 - 195)
Required boom length	691	(941 - 250)

Aerofoil

NACA 4409

Data for original model

Wingspan	2000 mm
Wing area	37.5 dm²
Wing area loading	21.5 g/dm²
Original flying weight	810 g

Data for new model

Before and after repair and doping

	Before	After
Left wing	120	131
Right wing	114	121
Tailplane	38	41

Fuselage front		60 g as supplied
Tail boom		17 g as supplied
Final fuselage weight		260 g complete with motor, ESC, Rx and servos

ESC	FrSky Neuron 40S	31 g	
Receiver	FrSky RX8R	15 g	
Servos	TowerPro MG90S	13 g	(x2)
Motor	Turnigy 2832	77 g	Aerodrive
Folding prop & 30 mm spinner		26 g	
Battery		69 or 87 g	
Wing joiner		14 g	
Spinner and prop		24 g	

New flying weight (exc battery):

Estimated	620 g
Actual	591 g

Radio and motor

I wanted to keep the weight down as much as I could. However I decided to use a FrSky RX8R receiver for flexibility rather than a micro one. I fitted a FrSky Neuron 40S ESC. It is very small and light but gives a full range of telemetry data. Tower Pro MG90S servos are light and have more than enough pull for the small control surfaces. I used SLEC (https://www.slecuk.com) snakes for push rods, contained inside the fuselage.

The available battery space was 70 x 24 mm by 40 mm high. The most obvious choice was a 1000 mAh 3S battery, which I already had for another model. When flying purely on soaring lift either of these will give me hours of flight time. If I need to use the motor it will hopefully only be for a few tens of seconds. I might use Turnigy nanotech 3S 1000 mAh 72 x 35 x 18.1 mm 87 g. Alternatively I might try a nano-tech 1300 mAh 3S which is 72 x 23 x 35 mm 119 g or Zippy compact 1300 3S 73 x 35 x 24 mm 111 g. One other possibility is some old but perfect 1300 3S Turnigy Graphene 78 x 33 x 26 mm 127 g. They slip in perfectly though a thinner battery might enable me to put the ESC next to the battery and so bring weight forward.

The only components I installed permanently at first were the motor and the servos. I put the servos as far back as I could. I suspected that the model would be nose heavy due to the motor, battery and ESC so wanted as much room as possible to move the battery aft if needed. The centre of gravity shown on the plan is quite a long way back, over half way in fact. The distance from the leading edge will have to be 104 mm. This is only to be expected with a soarer with a lifting tailplane.

Propellor

Prop will be 9 x 5, 9 x 6 or 10 x 5. I will select it using the telemetry data from the Neuron ESC.

Balancing up

The centre of gravity is roughly at half chord. When I found the CoG with everything in roughly the right places, including a 1 Ah 3S battery, the model was tail heavy. This was surprise as there was metal upfront and the boom and tail fittings were light as you saw from earlier. The most obvious solution was a heavier battery if there was room. However that would mean moving the ESC back so might not achieve much. I might be forced to add lead possibly in a well-attached canopy. I will also switch to plastic tailplane bolts.

Future

New wings: The Amigo wings have no ailerons. I might build a new pair of wings with ailerons and no dihedral and a semi-symmetrical aerofoil for days when the wind is stronger. I will need a new tailplane as well.

Plan

This will probably not be to 1 : 4.12 scale when printed, so scale using overall fuselage length of 1115 mm.